(Also referred to as FORM PTO-1465)

REQUEST FOR *EX PARTE* REEXAMINATION TRANSMITTAL FORM

Address to:
Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.:

Date:

1. ☐ This is a request for *ex parte* reexamination pursuant to 37 CFR 1.510 of patent number _________________ issued ________________________. The request is made by:
   ☐ patent owner. ☐ third party requester.

2. ☐ The name and address of the person requesting reexamination is:
   ____
   ____
   ____

3. Requester claims ☐ small entity (37 CFR 1.27) or ☐ micro entity status (37 CFR 1.29) – only a patent owner requester can claim micro entity status.

4. ☐ a. A check in the amount of $____________ is enclosed to cover the reexamination fee, 37 CFR 1.20(c)(1);
   ☐ b. The Director is hereby authorized to charge the fee as set forth in 37 CFR 1.20(c)(1) to Deposit Account No. ________________________;
   ☐ c. Payment by credit card. Form PTO-2038 is attached; **or**
   ☐ d. Payment made via EFS-Web.

5. ☐ Any refund should be made by ☐ check or ☐ credit to Deposit Account No.__________________. 37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.

6. ☐ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4).

7. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
   ☐ Landscape Table on CD

8. ☐ Nucleotide and/or Amino Acid Sequence Submission
   If applicable, items a. – c. are required.
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM (2 copies) or CD-R (2 copies); **or**
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

9. ☐ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.

10. ☐ Reexamination of claim(s) ____is requested.

11. ☐ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.

12. ☐ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is included.

13. ☐ The attached detailed request includes at least the following items:

a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1).

b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR 1.510(b)(2).

14. ☐ A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e).

15. ☐ a. It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).
The name and address of the party served and the date of service are:

____

____

Date of Service: ______________________________; **or**

☐ b. A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner **is attached**. See MPEP § 2220.

16. Correspondence Address: Direct all communication about the reexamination to:

☐ The address associated with Customer Number: [ ]

OR

☐ Firm or Individual Name ______________________________

Address

City	State	Zip
Country		
Telephone	Email	

17. ☐ The patent is currently the subject of the following concurrent proceeding(s):

☐ a. Copending reissue Application No. ______________________

☐ b. Copending reexamination Control No. ______________________

☐ c. Copending Interference No. ______________________

☐ d. Copending litigation styled:

____

____

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

______________________________ Authorized Signature

______________ Date

______________________________ Typed/Printed Name

______________ Registration No.

☐ For Patent Owner Requester

☐ For Third Party Requester

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

<u>CONTINUATION SHEET OF PAGE 2 OF FORM PTO/SB/57</u>

17d. Copending litigation styled:

VELOCITY PATENT LLC v. AUDI OF AMERICA, INC., Case No. 1:13-cv-08418-JBG (N.D. Ill.)

VELOCITY PATENT LLC v. MERCEDES-BENZ USA, LLC, Case No. 1:13-cv-08413-JWD (N.D. Ill.)

VELOCITY PATENT LLC v. BMW OF NORTH AMERICA, LLC, Case No. 1:13-cv-08416-JWD (N.D. Ill.)

VELOCITY PATENT LLC v. CHRYSLER GROUP LLC, Case No. 1:13-cv-08419-JWD (N.D. Ill.)

VELOCITY PATENT LLC v. JAGUAR LAND ROVER NORTH AMERICA, LLC, Case No. 1:13-cv-08421-JWD (N.D. Ill.)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent of	:	Harvey Slepian, et al.
Patent No.	:	5,954,781
Issued	:	Sep. 21, 1999
Title	:	METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION
Application Serial No.	:	08/813,270
Filed	:	Mar. 10, 1997
Requester	:	Volkswagen Group of America, Inc.

VIA EFS-WEB
Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

I hereby certify that this correspondence is being electronically transmitted to the United States Patent and Trademark Office via the Office electronic filing system on **May 22, 2014**.
Signature: /Helen Tam/
Helen Tam

REQUEST FOR *EX PARTE* REEXAMINATION
OF U.S. PATENT NO. 5,954,781 PURSUANT TO 37 C.F.R. § 1.510

SIR:

Volkswagen Group of America, Inc. ("Requester" or "VWGoA"), through its undersigned counsel, hereby respectfully requests *ex parte* reexamination of U.S. Patent No. 5,954,781 pursuant to 35 U.S.C. § 302 and the provisions of 37 C.F.R. § 1.510.

TABLE OF CONTENTS

EXHIBITS

Exhibit 1	U.S. Patent No. 5,954,781, entitled "Method and Apparatus for Optimizing Vehicle Operation," issued Sept. 21, 1999, to Harvey Slepian, et al.
Exhibit 2	"First Amended Complaint for Patent Infringement" filed on January 30, 2014 in *VELOCITY PATENT LLC v. AUDI OF AMERICA, INC.*, Case No. 1:13-cv-08418-JBG (N.D. Ill.)
Exhibit 3	U.S. Patent No. 4,901,701, issued on February 20, 1990 to Chasteen
Exhibit 4	U.S. Patent No. 4,631,515, issued on December 23, 1986 to Blee et al.
Exhibit 5	U.S. Patent No. 5,708,584, filed on September 8, 1995, issued on January 13, 1998 to Doi et al.
Exhibit 6	Velocity Patent LLC's Initial Infringement Contentions Pursuant to Local Patent Rule 2.2 to Audi
Exhibit 7	Velocity Patent LLC's Initial Infringement Contentions Pursuant to Local Patent Rule 2.2 to Mercedes-Benz
Exhibit 8	Velocity Patent LLC's Initial Infringement Contentions Pursuant to Local Patent Rule 2.2 to Chrysler
Exhibit 9	Velocity Patent LLC's Initial Infringement Contentions Pursuant to Local Patent Rule 2.2 to Jaguar Land Rover
Exhibit 10	Listing of Prior Art Patents and Printed Publications that Raise Substantial New Questions of Patentability Affecting the Claims of U.S. Patent No. 5,954,781
Exhibit 11	"Automotive Electronics Handbook," published in 1995, by Ronald Jurgen
Exhibit 12	U.S. Patent No. 5,477,452, issued on December 19, 2995 to Milunas et al.
Exhibit 13	U.S. Patent No. 4,559,599, issued on December 17, 1985 to Habu et al.
Exhibit 14	German Patent Application Publication No. 29 26 070, and its corresponding English Translation, published on January 15, 1981
Exhibit 15	U.S. Patent No. 5,357,438, issued on October 18, 1994 to Davidian
Exhibit 16	U.S. Patent No. 4,061,055, issued on December 6, 1977 to Iizuka et al.
Exhibit 17	U.S. Patent No. 5,121,324, issued on June 9, 1992 to Rini et al.
Exhibit 18	U.S. Patent No. 3,925,753, issued on December 9, 1975 to Auman et al.

Exhibit 19	International Patent Application No. WO 96/02853, published on February 1, 1996 to Tonkin
Exhibit 20	Certificate of Service

I. IDENTIFICATION PURSUANT TO 37 C.F.R. § 1.510(b)(2)

Ex parte reexamination of claims 1, 2, 4, 5, 7, 8, 10, 12, 13, 15, and 17–32 of U.S. Patent No. 5,954,781 ("the '781 patent") is requested.

II. COPY OF '781 PATENT PURSUANT TO 37 C.F.R. § 1.510(b)(4)

Pursuant to 37 C.F.R. § 1.510(b)(4), annexed hereto as Exhibit 1 is a copy of the entire '781 patent including the front face, drawings, specification and claims (in double column format) for which *ex parte* reexamination is requested.

To the best of Requester's knowledge, as of the date of this request, no disclaimer, certificate of correction, or reexamination certificate has been issued in connection with the '781 patent.

III. PROCEEDINGS RELATED TO '781 PATENT

Although Requester is not obligated to inform the Office of proceedings related to the '781 patent, the Office is hereby informed of the following proceedings, which are pending as of the date of this Request, that relate to the '781 patent:

> *VELOCITY PATENT LLC v. AUDI OF AMERICA, INC.*, Case No. 1:13-cv-08418-JBG (N.D. Ill.) – First Amended Complaint Filed on January 30, 2014 ("the *VELOCITY-AUDI* case," copy annexed hereto as Exhibit 2) naming as defendants Audi of America, Inc. and Audi of America, LLC. Audi of America, Inc. is a d/b/a of Volkswagen Group of America, Inc., which is a wholly owned subsidiary of Volkswagen AG, a publicly-held German corporation.
>
> *VELOCITY PATENT LLC v. MERCEDES-BENZ USA, LLC, et al.*, Case No. 1:13-cv-08413-JWD (N.D. Ill.) – Complaint Filed on November 21, 2013 ("the *VELOCITY-MERCEDES-BENZ* case").
>
> *VELOCITY PATENT LLC v. BMW OF NORTH AMERICA, LLC, et al.*, Case No. 1:13-cv-08416-JWD (N.D. Ill.) – Complaint Filed on November 21, 2013 ("the *VELOCITY-BMW* case").
>
> *VELOCITY PATENT LLC v. CHRYSLER GROUP LLC,* Case No. 1:13-cv-08419-JWD (N.D. Ill.) – Complaint Filed on November 21, 2013 ("the *VELOCITY-CHRYSLER* case").
>
> *VELOCITY PATENT LLC v. JAGUAR LAND ROVER NORTH AMERICA, LLC,* Case No. 1:13-cv-08421-JWD (N.D. Ill.) – Complaint Filed on November 21, 2013 ("the *VELOCITY-JAGUAR* case".)

IV. THE ’781 PATENT AND ITS PROSECUTION

A. The ’781 Patent

The ’781 patent is titled “Method and Apparatus for Optimizing Vehicle Operation” and was issued on September 21, 1999 from U.S. Application Serial No. 08/873,270 (“the ’270 application”), filed on March 10, 1997.

The ’781 patent is generally related to an “[a]pparatus for optimizing operation of an engine-driven vehicle.” Abstract. In describing the background and prior art, the ’781 patent states that “[i]t has long been recognized that the improper operation of a vehicle may have many adverse effects.” Col. 1, lines 12–13. For example, according to the ’781 patent, “the fuel efficiency of a vehicle may vary dramatically based upon how the vehicle is operated.” Col. 1, lines 13–15. The ’781 patent refers specifically to, for example, operating a vehicle at excessive speeds, excessive RPMs, and excessive manifold pressures as leading to reduced fuel economy and increased operating costs. Col. 1, lines 15–18. The increased operating costs may be considerable, especially for the owner or operator of a fleet of vehicles. Against this background, the ’781 patent describes a processor subsystem to determine when to issue notifications as to recommended changes in vehicle operation that, when executed by the driver, will optimize vehicle operation.

According to the specification, the system “both notifies the driver of recommended corrections in vehicle operation and, under certain conditions, automatically initiates selected corrective action.” Col. 1, lines 7–10. The ’781 patent states that “it would be desirable to provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will enhance the efficient operation thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely.” Col. 1, line 66–col. 2, line 6.

The ’781 patent describes three types of circuits for issuing notifications that indicate operating inefficiencies: a shift notification circuit; a fuel overinjection notification circuit; and a vehicle proximity alarm circuit. The shift notification circuit issues a notification that the engine of the vehicle is being operated at an excessive speed, i.e., the shift notification circuit operates as an upshift notification circuit, and/or issues a notification that the engine of the vehicle is being operated at an insufficient speed, i.e., the shift notification circuit operates as a downshift notification circuit. The fuel overinjection notification circuit issues a notification that excessive fuel is being supplied to the engine of the vehicle, and the vehicle proximity alarm circuit issues an alarm when the vehicle is too close to an object.

According to the ’781 patent, a series of sensors, including a road speed sensor 18, an RPM sensor 20, a manifold pressure sensor 22, a throttle sensor 24, a windshield wiper sensor 30, and a brake sensor 32, are coupled to a processor subsystem 12 and are periodically polled by the processor subsystem to determine their respective states or levels. Col. 5, line 65–col. 6, line 4. The system 10 includes a memory subsystem 14, which is used to hold information to be utilized by the processor subsystem 12 to determine whether to take corrective actions and/or issue notifications. Col. 6, lines 43–46. Figure 1 of the ’781 patent is reproduced below:

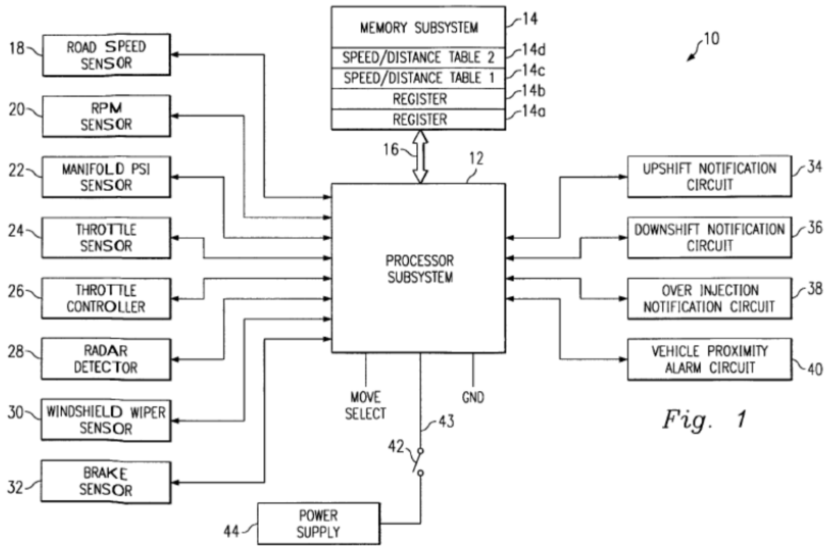

Fig. 1

For example, the processor subsystem 12 determines that the vehicle is being operated unsafely if the speed of the vehicle is such that the stopping distance for the vehicle is greater than the distance separating the vehicle from an object, e.g., a second vehicle, in its path. Col. 9, lines 4–8. As another example, the processor subsystem 12 will notify the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced if the processor subsystem 12 determines that too much fuel is being provided to the engine, which is determined based on the vehicle’s road speed, throttle position, and manifold pressure. Col. 12, lines 5–14. As a further example, the processor subsystem 12 will issue an audible alert to notify the driver that, in order to optimize vehicle operation, an upshift should be performed, based on the vehicle’s engine speed reaching a particular RPM set point. Col. 11, line 45–col. 12, line 4.

Thus, according to the ’781 patent, a system is provided for optimizing vehicle operation that combines operator notifications of recommended corrections in vehicle operation with automatic modification of vehicle operation under certain circumstances. Col.

13, lines 36–40. In addition, the driver is advised of certain actions that will enable the vehicle to be operated with greater fuel efficiency. Col. 13, lines 40–44.

B. Prosecution of the '781 Patent

As described in more detail below, during prosecution of the '781 patent, the Examiner concluded that upshift notification circuits, downshift notification circuits, and processors that determine when to activation upshift and downshift notification circuits were not taught by the cited prior art.

Claims 1 to 6 and 17 to 25 were allowed because they were amended to include, for example, an upshift notification circuit and a processor that determines when to activate the upshift notification circuit. Therefore, the questions whether substantial new questions of patentability are raised and whether claims 1 to 6 and 17 to 25 are obvious in view of the prior art are reduced to these limitations relating to the upshift notification circuit.[1]

Claims 7 to 12, 26, and 27 were allowed because they were, in effect,[2] amended to include, for example, a downshift notification circuit and a processor that determines when to activate the downshift notification circuit. Therefore, the questions whether substantial new questions of patentability are raised and whether claims 7 to 12, 26, and 27 are obvious in view of the prior art are reduced to these limitations relating to the downshift notification circuit.

Claims 13 to 16 were allowed based on the fact that they include an upshift notification circuit, a downshift notification circuit, and a processor that determines when to activate the upshift and downshift notification circuits. Therefore, the questions whether substantial new questions of patentability are raised and whether claims 13 to 16 are obvious in view of the prior art are reduced to these limitations relating to the upshift and downshift notification circuits.

Regarding claims 28 to 30, which were added during prosecution, the applicant argued that these claims were allowable over the cited prior art based on the fact that they

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1 *Graham v. John Deere Co.* 383 U.S. 1 (1966) ("Here, the patentee obtained his patent only by accepting the limitations imposed by the Examiner. The claims were carefully drafted to reflect these limitations and Cook Chemical is not now free to assert a broader view of Scoggin's invention. The subject matter as a whole reduces, then, to the distinguishing features clearly incorporated into the claims. We now turn to those features.").

2 *See*, *e.g.*, *Honeywell Int'l v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1144 (Fed. Cir. 2004) ("[Dependent c]laims 4, 8, and 19 were rewritten into independent form, and the original independent claims were cancelled, effectively adding the inlet guide vane limitations [of dependent claims 4, 8 and 19] to the claimed invention.").

claim a fuel overinjection notification circuit and a processor subsystem that determines whether to activate the fuel overinjection notification circuit based on data received from a road speed sensor, a throttle position sensor, and a manifold pressure sensor. Therefore, the questions whether substantial new questions of patentability are raised and whether claims 28 to 30 are obvious in view of the prior art are reduced to these limitations relating to the fuel overinjection notification circuit.

Regarding claims 31 and 32, which were added during prosecution, the applicants argued that these claims were allowable over the prior art based on the fact that they claim a processor subsystem that determines whether to activate a vehicle proximity alarm circuit based on separation distance data received from a radar detector, vehicle speed data received from a road speed sensor, and a vehicle stopping distance table stored in a memory subsystem. Therefore, the questions whether substantial new questions of patentability are raised and whether claims 31 and 32 are obvious in view of the prior art are reduced to these limitations relating to the vehicle proximity alarm circuit.

The ’270 application was filed on March 10, 1997 with 32 claims, of which application claims 1, 14, 18, and 27 were the only independent claims. Among these independent claims, application claim 1 included a fuel overinjection circuit, application claim 14 included a fuel overinjection circuit, an upshift notification circuit, and a downshift notification circuit, application claim 18 included a vehicle proximity alarm, and application claim 27 included a fuel overinjection circuit and a vehicle proximity alarm.

In the only Office Action, dated August 6, 1998, application claims 1, 2 and 4 to 6 were rejected as obvious in view of U.S. Patent No. 4,901,701 to Chasteen (copy attached as Exhibit 3), application claim 3 was rejected as obvious in view of the combination of Chasteen and U.S. Patent No. 4,631,515 to Blee et al. (copy attached as Exhibit 4), and application claims 7, 18 to 24, 27, and 28 were rejected as obvious in view of the combination of Chasteen and U.S. Patent No. 5,708,584 to Doi et al. (copy attached as Exhibit 5).

In the Office Action, the Examiner stated that application claims 8 to 13, 25, 26, and 29 to 32 included allowable subject matter. Specifically, the Examiner stated that application claims 8, 25, and 29 included allowable subject matter on the basis that “the prior art fails to disclose an upshift notification circuit coupled to the processor subsystem, the upshift notification circuit issuing a notification that the engine of the vehicle is being operated at an excessive engine speed and the processor determines when to activate the upshift notification circuit.” Similarly, the Examiner stated that application claims 11, 26, and 31 included allowable subject matter on the basis that "the prior art fails to disclose a downshift notification circuit coupled to the processor subsystem, the downshift notification circuit issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed and the processor determines when to activate the downshift notification circuit." In addition, application claims 14 to 17, which included both an upshift notification circuit and a downshift notification circuit, were allowed on the basis that:

> the prior art fails to disclose an upshift notification circuit coupled to the processor subsystem, the upshift notification circuit issuing a notification that the engine of the vehicle is being operated at an excessive engine speed and the processor determines when to activate the upshift notification circuit and a downshift notification circuit coupled to the processor subsystem, the downshift notification circuit issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed and the processor determines when to activate the downshift notification circuit.

In response to this Office Action, the applicant submitted an Amendment on February 8, 1999. Application claim 1 was amended as follows, to add the limitations of claims 4 and 8, including the upshift notification circuit of claim 8:

> 1. Apparatus for optimizing operation of a vehicle, comprising:
>
> a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, <u>an engine speed sensor,</u> a manifold pressure sensor and a throttle position sensor;
>
> a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;
>
> a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;
>
> a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;
>
> <u>an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification</u>

that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.

Dependent application claim 11, which included a downshift notification circuit, was rewritten into independent form as follows:

11. Apparatus for optimizing operation of a vehicle, [according to claim 4 and further] comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.

Application claim 18 was amended as follows, to add the limitations of dependent claims 23 to 25, including the upshift notification circuit of claim 25:

18. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed stopping distance table, a manifold pressure set point, an RPM set point, a [and] present level[s] for each one of said at least one sensor and a prior level for each one of said at least one sensor;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

a fuel overinjection circuit coupled to said processor subsystem, said fuel overinjection circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.

Application claim 27 was amended as follows, to add the limitations of dependent claim 29, including the upshift notification circuit of claim 29:

27. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

Dependent application claim 31, which included a downshift notification circuit, was rewritten into independent form as follows:

31. Apparatus for optimizing operation of a vehicle, [according to claim 27 and further] comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

In addition to the foregoing claim amendments, the applicants added new application claims 33 to 38, which are discussed in further detail below.

Regarding the claim amendments, the applicant did not present any substantive arguments against the rejection of claims 1–2, 5, 6, 18 to 24, 27, and 28. Rather, the applicant acknowledged that the claims were merely reformulated to place into allowable form the claims that were indicated to include allowable subject matter.

Regarding the newly presented claims, application claims 34 and 37 were the only independent claims, and these claims as presented in the February 8, 1999 Amendment are reproduced below:

34. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.

37. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem.

In the accompanying Remarks, the applicant asserted that application claim 34 is patentable over the prior art by stating:

> With respect to Chasteen, the Applicants first note the [sic] Chasteen discloses a system where, in response to certain detected conditions, a CPU issues control commands which modify the operation of an engine. In contrast, Applicants' system merely issues notifications of the determination of a fuel overinjection condition. No corrective action is taken by the system. Applicants' system is superior in that it enables the vehicle to be operated outside of the preferred operating conditions when the vehicle operator deems it necessary. For example, it may be necessary to operate the vehicle in a fuel overinjection mode when performing emergency actions such as rapid accelerations to avoid collisions.
>
> The Applicants further note that, in rejection prior Claim 1 as unpatentable over Chasteen, the Examiner acknowledged that Chasteen "fails to specifically disclose a road speed sensor" and asserted that "it would have been obvious . . . to have a road speed sensor in the system since the speed sensor would help to monitor the operation of the vehicle." Again, the Applicants respectfully disagree. Specifically, as presented in new Claims 34-36, Applicants' claimed apparatus for optimizing operation of a vehicle includes a fuel overinjection notification circuit and a processor subsystem which determines when to activate the fuel overinjection notification circuit. The processor makes that determination based upon data received from specifically recited sensors, <u>including the road speed sensor</u>. Thus, not only does Chasteen fail to teach an apparatus for optimizing vehicle operation which includes a road speed sensor, Chasteen is equally deficient in teaching a processor configured to determine a fuel overinjection condition by analyzing, in combination, road speed, throttle position and manifold pressure level. As Chasteen lacks both a specific sensor and a processor configured to determine a fuel overinjection condition from data collected from that specific sensor in combination with other sensors, the Applicants respectfully submit that Chasteen cannot teach or suggest the apparatus defined by new Claims 34-36.

February 8, 1999 Amendment, at 10–11 (emphasis in original).

In other words, according to the applicant, application claim 34 is allowable because the prior art does not disclose a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor.

Additionally, the applicant asserted that application claim 37 is patentable over the prior art by stating:

> The Applicants respectfully submit that new Claims 37-38, as presented herein, are neither taught nor suggested by the proposed combination of Chasteen and Doi et al. The Examiner properly cited Doi et al. as disclosing a vehicle running mode detection system equipped with a radar detector and an alarm circuit. The Applicants respectfully note, however, that the system disclosed in Doi et al. determines alert conditions relative to the proximity between a vehicle and a forward object based upon changes in the distance separating the vehicle and the forward object. In contrast, Applicants' apparatus for optimizing vehicle operation set forth in Claim 37 includes a processor subsystem configured to activate a vehicle proximity alarm circuit based upon road speed (as determined by a road speed sensor), separation (as determined by a radar detector) and a vehicle speed/stopping distance table stored in a memory subsystem.

Id. at 11–12.

In other words, according to the applicant, application claim 37 is allowable because the prior art does not disclose a vehicle proximity alarm that is activated based upon three parameters: (1) road speed, as determined by a road speed sensor; (2) separation, as determined by a radar detector; and (3) a vehicle speed/stopping distance table stored in a memory subsystem. The applicant did acknowledge, however, that a vehicle proximity alarm that is activated based on separation is disclosed in the prior art: "The Applicants respectfully note, however, that the system disclosed in Doi et al. determines alert conditions relative to the proximity between a vehicle and a forward object based upon changes in the distance separating the vehicle and the forward object."

Thereafter, the Examiner issued a Notice of Allowance, which includes a lengthy statement by the Examiner of the reasons for allowance. Although no specific claims are discussed in the Examiner's statement of reasons for allowance, particular claim language is discussed such the reason that each independent was allowed is apparent.

For example, the Notice of Allowance states that

> The prior art fails to disclose an apparatus for optimizing operation of a vehicle and comprising an upshift notification circuit coupled to the processor subsystem, the upshift notification circuit issuing a notification that the engine of the vehicle is being operated at an excessive speed and the processor determines when to activate the upshift notification circuit; and a downshift notification circuit coupled to the processor subsystem, the downshift notification circuit issuing

> a notification that the engine of the vehicle is being operated at an insufficient engine speed and the processor determines when to activate the downshift notification circuit.

The Notice of Allowance further states that:

> Nor does the prior art discloses [sic] a fuel overinjection notification circuit coupled to the processor subsystem, wherein the fuel overinjection notification circuit issuing a notification that excess fuel is being supplied to the engine of the vehicle and the processor subsystem determining whether to activate the fuel overinjection notification circuit based upon data received from the road speed sensor, the throttle position sensor and the manifold sensor.

Additionally, the Notice of Allowance states:

> Nor does the prior art discloses [sic] that the processor subsystem determines whether to activate the vehicle proximity alarm circuit based upon separation distance data received from the radar detector, vehicle speed/stopping distance table stored in the memory subsystem.

V. PATENT OWNER'S INFRINGEMENT CONTENTIONS IN LITIGATIONS INVOLVING THE '781 PATENT

As stated above, the '781 patent is the subject of related litigations, including the *VELOCITY-AUDI* case, the *VELOCITY-MERCEDES-BENZ* case the *VELOCITY-BMW* case, the *VELOCITY-CHRYSLER* case, and the *VELOCITY-JAGUAR* case. Attached as Exhibits 6 to 9 are copies of "Velocity Patent LLC's Initial Infringement Contentions Pursuant to Local Patent Rule 2.2," served by the Patent Owner in the *VELOCITY-AUDI* case, the *VELOCITY-MERCEDES-BENZ* case, the *VELOCITY-CHRYSLER* case, and the *VELOCITY-JAGUAR* case, respectively. In these Initial Infringement Contentions, the Patent Owner has asserted (1) that cylinder-on-demand systems, fuel economy messages, and speed warning systems, for example, are functionalities that infringe fuel overinjection notification circuits, (2) that efficiency programs, gearshift indicators that show current and recommended gears, dynamic steering systems, transmission overheating indicators, and gear selection levers in automatic transmissions, for example, are functionalities that infringe upshift and downshift notification circuits; and (3) that adaptive cruise control systems, braking guard systems, and side assist systems, for example, are functionalities that infringe vehicle proximity alarm circuits.[3]

VI. CITATIONS OF PRIOR ART PATENTS AND PRINTED PUBLICATIONS THAT RAISE SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

Substantial new questions of patentability of claims 1, 2, 4, 5, 7, 8, 10, 12, 13, 15, and 17 to 32 of the ’781 patent are raised by the following prior art patents and printed publications. Annexed hereto as Exhibit 10 is a listing of, *inter alia*, the prior art patents and printed publications that raise substantial questions of patentability. Each of the prior art patent and printed publications cited herein constitutes prior art against the ’781 patent under 35 U.S.C. § 102(b).

A. Automotive Electronics Handbook, by Ronald Jurgen (“Jurgen”), published in 1995.

B. U.S. Patent No. 5,477,452 (“Saturn ’452”), issued on December 19, 1995.

C. U.S. Patent No. 4,559,599 (“Toyota ’599”), issued on December 17, 1985.

D. German Patent Application Publication No. 29 26 070 (“Volkswagen ’070”), published on January 15, 1981.

E. U.S. Patent No. 5,357,438 (“Davidian”), issued on October 18, 1994.

F. U.S. Patent No. 4,061,055 (“Nissan ’055”), issued on December 6, 1977.

G. U.S. Patent No. 5,121,324 (“Mack ’324”), issued on June 9, 1992.

H. U.S. Patent No. 3,925,753 (“GM ’753”), issued on December 9, 1975.

I. PCT Publication No. WO 96/02853 (“Tonkin”), published on February 1, 1996.

A copy of every prior art patent and printed publication relied upon or referred to herein is submitted herewith as required by 37 C.F.R. § 1.510(b)(3), as follows:

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[3] Nothing in the present Request should be considered to constitute an agreement, admission, or concession by VWGoA that the claims of the ’781 patent cover the systems or vehicles described in the Patent Owner’s Initial Infringement Contentions.

A. A copy of Jurgen is annexed hereto as Exhibit 11.

B. A copy of Saturn ’452 is annexed hereto as Exhibit 12.

C. A copy of Toyota ’599 is annexed hereto as Exhibit 13.

D. A copy of Volkswagen ’070 is annexed hereto as Exhibit 14.

E. A copy of Davidian is annexed hereto as Exhibit 15.

F. A copy of Nissan ’055 is annexed hereto as Exhibit 16.

G. A copy of Mack ’324 is annexed hereto as Exhibit 17.

H. A copy of GM ’753 is annexed hereto as Exhibit 18.

I. A copy of Tonkin is annexed hereto as Exhibit 19.

VII. STATEMENTS IDENTIFYING EACH SUBSTANTIAL NEW QUESTION OF PATENTABILITY PURSUANT TO 37 C.F.R. § 1.510(b)(1)

1. Claim 1 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Saturn ’452

2. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Toyota ’599

3. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Volkswagen ’070

4. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, and Davidian

5. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, and Davidian

6. Claims 17–21 and 23 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, and Davidian

7. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Nissan ’055

8. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Mack ’324

9. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and GM ’753

10. Claim 31 is Anticipated Under 35 U.S.C. § 102(b) by Davidian

11. Claims 31 and 32 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Tonkin and Doi et al.

12. Claims 2, 4, and 5 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, and Chasteen

13. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, and Chasteen

14. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, and Chasteen

15. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, Davidian, and Tonkin

16. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin

17. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, Davidian, and Tonkin

18. Claims 24 and 25 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, Davidian and Chasteen

19. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, Davidian and Chasteen

20. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian and Chasteen

21. Claim 32 is Obvious Under 35 U.S.C. § 103(a) in in View of the combination of Davidian and Tonkin

DETAILED EXPLANATIONS PURSUANT TO 37 C.F.R. § 1.510(b)(2)

The following statements are made, pursuant to 37 C.F.R. § 1.510(b)(2), pointing out each substantial new question of patentability based on the prior art patents and printed publications cited above, in accordance with the “broadest reasonable interpretation” standard as set forth in M.P.E.P. § 2258(I)(G).[4]

As set forth in detail below, the foregoing prior art patents and printed publications would have been considered important by a reasonable Examiner in deciding whether to allow claims 1, 2, 4, 5, 7, 8, 10, 12, 13, 15, and 17 to 32 of the ’781 patent. Therefore, these prior art patents and printed publications raise substantial new questions of patentability.

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4 “During reexamination, claims are given their broadest reasonable interpretation consistent with the specification and limitations in the specification are not read into the claims.”

Pursuant to 37 C.F.R. § 1.510(b)(2), a detailed explanation of the pertinence and manner of applying the cited prior art patents and printed publications to every claim for which reexamination is requested is set forth below with reference to the appended charts.

The following detailed explanation is informed by the prosecution history, as set forth above. To briefly summarize, the Examiner in the original prosecution concluded that the prior art failed to teach or suggest upshift or downshift notification circuits for claims 1, 2, 4, 5, 7, 8, 10, 12, 13, 15, and 17 to 27. Because the prosecution history focused on the upshift and/or downshift notification circuits, and because the prior art discussed herein discloses these circuits, substantial new questions of patentability affecting claims 1, 7, 13, 17, 23, 26 are raised by the prior art discussed herein.

With respect to claims 28 to 30, the applicant in the original prosecution emphasized that the prior art failed to teach a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor. Because the prosecution history focused on a fuel overinjection notification circuit activated based on these three sensors, and because the prior art disclosed herein discloses a fuel overinjection notification circuit activated based on these three sensors, substantial new questions of patentability affecting claims 28 to 30 are raised by the prior art discussed herein.

With respect to claims 31 and 32, the applicant in the original prosecution emphasized that the prior art failed to teach a vehicle proximity alarm that is activated based upon three parameters: (1) road speed, as determined by a road speed sensor; (2) separation, as determined by a radar detector; and (3) a vehicle speed/stopping distance table stored in a memory subsystem. Because the prosecution history focused on a vehicle proximity alarm that is activated based on these three parameters, and because the prior art disclosed herein discloses a vehicle proximity alarm activated based on these three parameters, substantial new questions of patentability affecting claims 31 and 32 are raised by the prior art discussed herein.

1. Claim 1 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Saturn ’452

Claim 1 is obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and Saturn ’452. Neither Jurgen nor Saturn ’452 was cited by the Examiner or the applicants during prosecution of the ’781 patent. Therefore, the question of whether claim 1 is obvious in view of the combination of Jurgen and Saturn ’452 was not previously considered. The combination of Jurgen and Saturn ’452 is closer to the subject matter of claim 1 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen and Saturn ’452 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claim 1 was allowable over the prior art cited during prosecution on the basis that the prior art does not teach an upshift notification circuit, wherein the processor determines, based upon data received from sensors, when to activate said upshift notification circuit.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). “During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to.” (Page 22.6). Indeed, Jurgen illustrates these hardware parts:

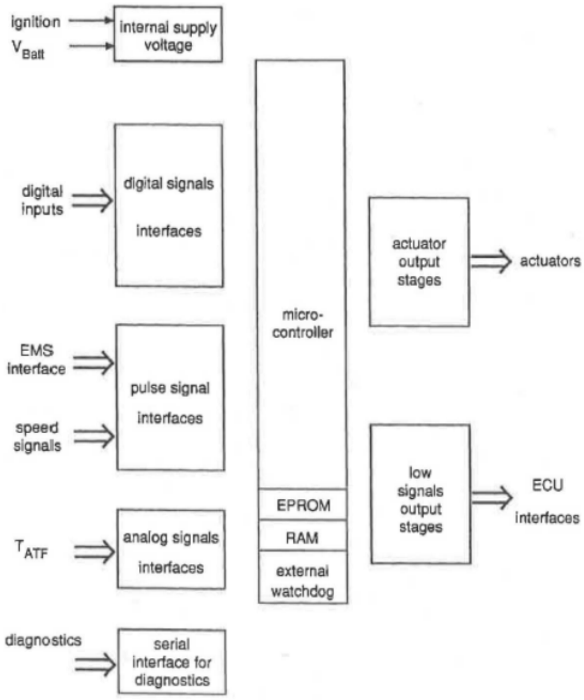


FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches “a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM")). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen also teaches that the transmission can be controlled by calculating the necessary shift points based upon throttle position, the accelerator pedal position (e.g., throttle position), and the vehicle speed. (Page 13.9). "The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application." *Id.* The TCU (transmission control unit) stores shift maps that provide notifications to the transmission regarding whether and when to shift. (Page 13.14). Jurgen, therefore, teaches "an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Saturn '452 teaches a "means for indicating to the operator a point in operation for upshifting to the next higher gear." Abstract. The processor subsystem taught by Saturn '452 receives sensor inputs that sense manifold pressure, engine speed, and throttle position. Col. 2, lines 42 to 44; col. 7, lines 13 to 21. Therefore, Saturn '452 teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor," except for the claimed road speed sensor, which is taught by Jurgen.

Figure 1 of Saturn '452 is illustrative:

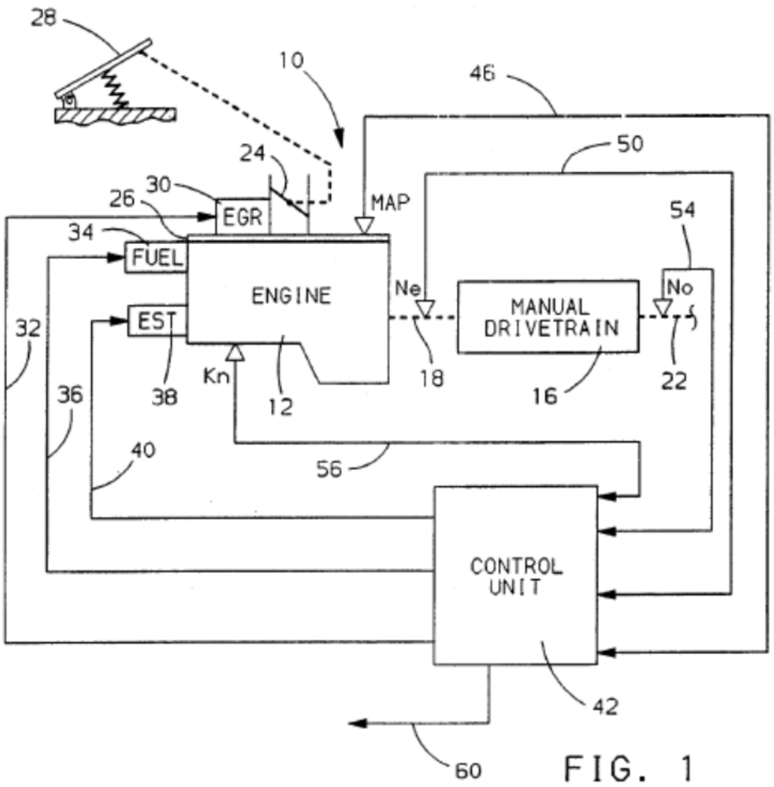


FIG. 1

Figure 1 of Saturn '452 illustrates that the control unit 42 is connected to the sensor inputs, and outputs a signal on line 60 that may drive a lamp "for indicating the state of the upshift indicator light." Col. 2, lines 42 to 55; col. 3, lines 60 to 65. Additionally, Saturn '452 teaches that the control unit includes a memory (col. 2, lines 52 to 55), and that a "predetermined maximum allowable engine speed threshold K1" is used by the system. Col. 6, lines 55 to 60. Therefore, Saturn '452 discloses "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors," except for the claimed manifold pressure set point and present and prior levels for each one of the sensors, which are taught by Jurgen (*see* Jurgen at 12.9, 13.5).

Saturn '452 teaches an upshift notification circuit connected to the control unit, which indicates "via line 60 the state of an upshift indicator light or equivalent visual display." Col. 2, lines 42 to 55. Therefore, Saturn '452 teaches "an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed" and "said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift notification circuit."

A person of ordinary skill in the art, at the time the alleged invention of claim 1 of the '781 patent was made, would have found it obvious to combine the teachings of Jurgen and Saturn '452, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged invention of claim 1 of the '781 patent was made would have been further motivated to combine the teachings of Jurgen and Saturn '452 to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to provide a "means for indicating to the operator a point in operation for upshifting to the next higher gear" (Saturn '452, Abstract), and to provide "an improved method of determining shift points and indicating the same to a vehicle operator in order to maximize real driving fuel economy" (Saturn '452, col. 1, lines 44 to 47). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and Saturn '452 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and the teachings of Saturn '452, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to

> them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and Saturn '452 teaches the limitations that the Examiner concluded were absent from the prior art cited during prosecution of the '781 patent, *i.e.*, an upshift notification circuit activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claim 1 is raised by the combination of Jurgen and Saturn '452.

As set forth in the appended charts, the combination of Jurgen and Saturn '452 teaches all of the limitations of claim 1 of the '781 patent and therefore renders obvious claim 1 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claim 1 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and Saturn '452.

2. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Toyota '599

Claims 1, 7, and 13 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and Toyota '599. Neither Jurgen nor Toyota '599 was cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 1, 7, and 13 are obvious in view of the combination of Jurgen and Toyota '599 was not previously considered. The combination of Jurgen and Toyota '599 is closer to the subject matter of claims 1, 7, and 13 of the '781 patent than any prior art that was relied upon during prosecution of the '781 patent. The combination of Jurgen and Toyota '599 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the '781 patent.

As more fully explained above, the Examiner concluded that claims 1, 7, and 13 were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen illustrated a diagram of these hardware parts:

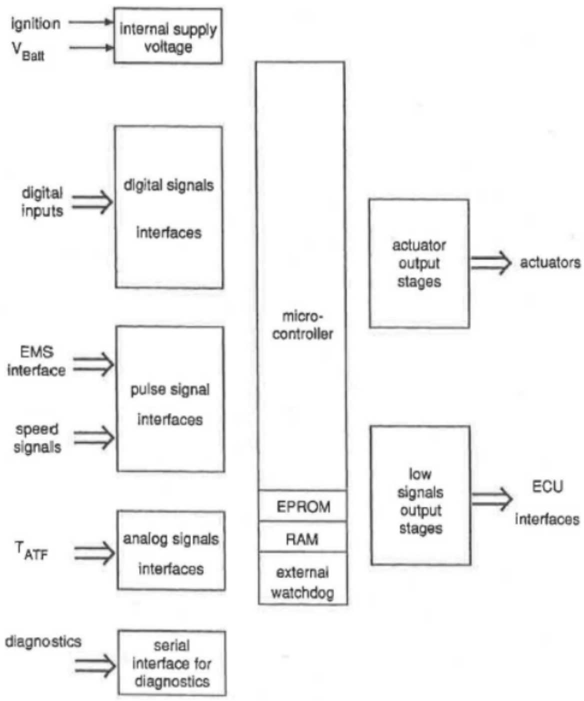


FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

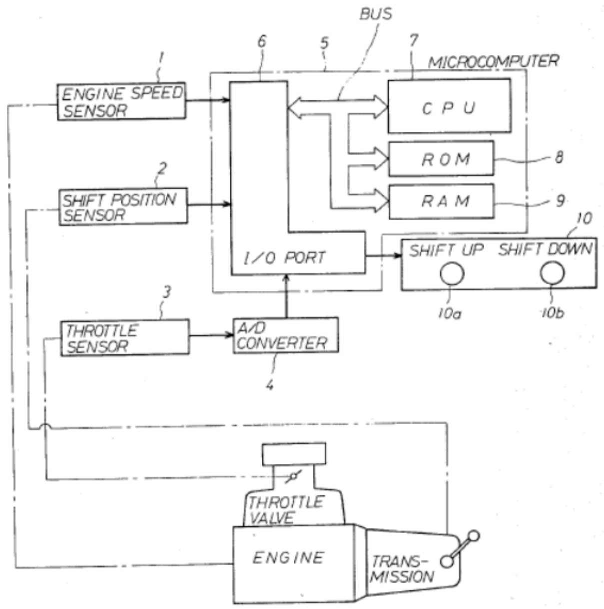
Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM"). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen also teaches that the transmission can be controlled by calculating the necessary shift points based upon throttle position, the accelerator pedal position (e.g., throttle position), and the vehicle speed. (Page 13.9). "The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application." *Id.* The TCU (transmission control unit) stores shift maps that provide notifications to the transmission regarding whether and when to shift. (Page 13.14). Jurgen, therefore, teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Toyota '599 discloses a "shift indication apparatus" coupled to a plurality of sensors. An overview of this system is illustrated in Figure 1:



The sensor inputs to the microcomputer include an engine speed sensor 1 and a throttle sensor 3, which are both "connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5." Col. 2, lines 43 to 48; col. 2, lines 52 to 59. Therefore, Toyota '599 teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor," except for the claimed manifold pressure sensor and road speed sensor, which is taught by Jurgen. *See*, *e.g.*, Jurgen, pages 2.5, 2.7, and 7.6. Toyota '599 also teaches "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Additionally, Toyota '599 teaches that a memory can be used to store a torque data map and an RPM set point. Col. 3, lines 7 to 20 and lines 44 to 61. For example, the engine speed "is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21." Col. 3, lines 44 to 61. The actual RPM exceeding this RPM set point is necessary to begin the main routine. Therefore, Toyota '599 teaches "a memory subsystem, coupled to said processor subsystem" and that said memory subsystem stores an "RPM set point."

Toyota '599 teaches that indicator lamps that tell the driver to shift up or shift down are lit by the microcomputer in order to tell the driver when to shift to improve fuel economy. "Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP_{+1} is preferable." Col. 5, line 63 to col. 6, line 2. "However, only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated, thus indicating the necessity of the speed change operation." E.g. col. 7, lines 29 to 38. Therefore, Toyota '599 teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed" and "said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift[/downshift] notification circuit."

A person of ordinary skill in the art, at the time the alleged inventions of claims 1, 7, and 13 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen and Toyota '599, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 1, 7, and 13 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen and Toyota '599 to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), and to "obtain preferable shift positions relating to optimum fuel consumption rate in accordance with . . . data detected" (Toyota '599, Abstract). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and Toyota '599 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and the teachings of Toyota ’599, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
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> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and Toyota ’599 teaches the limitations that the Examiner concluded were absent from the prior art cited during prosecution of the ’781 patent, *i.e.*, upshift and downshift notification circuits activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claims 1, 7, and 13 is raised by the combination of Jurgen and Toyota ’599.

As set forth in the appended charts, the combination of Jurgen and Toyota ’599 teaches all of the limitations of claims 1, 7, and 13 of the ’781 patent and therefore renders obvious claims 1, 7, and 13 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 1, 7, and 13 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and Toyota ’599.

3. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Volkswagen ’070

Claims 1, 7, and 13 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and Volkswagen ’070. Neither Jurgen nor Volkswagen ’070 was cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 1, 7, and 13 are obvious in view of the combination of Jurgen and Volkswagen ’070 was not previously considered. The combination of Jurgen and Volkswagen ’070 is closer to the subject matter of claims 1, 7, and 13 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen and Volkswagen ’070 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 1, 7, and 13 were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). “During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to.” (Page 22.6). Indeed, Jurgen illustrates a diagram of these hardware parts:

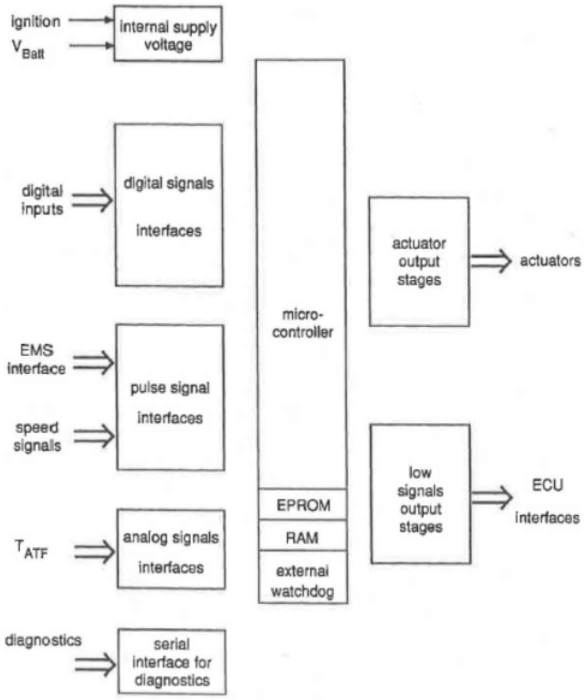


FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM"). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a

maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Volkswagen '070 acknowledges that automobile instrument panels that display fuel economy are in the prior art. For example, Volkswagen '070 describes at page 9:

> It is useful in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***induction manifold vacuum*** as a measure of the fuel consumption. . . . In this case it us useful to integrate the signal transmitters denoted by 4 and 5 in Figure 2 into the instrument of the fuel consumption display, as sketched in Figure 3. During standard driving operation, pointer 30 of the fuel consumption display sweeps scale 31, while it is hidden behind cover 32 during an idling operation or at full-load accelerations. Incorporated in the scale is arrow 33, which constitutes part of a signal transmitter requesting upshifting, which therefore corresponds to signal transmitter 4 in Figure 2.

(emphasis added)

Thus, by describing a fuel consumption display that indicates full-load acceleration, Volkswagen '070 teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen teaches that the transmission can be controlled by calculating the necessary shift points based upon throttle position, the accelerator pedal position (e.g., throttle position), and the vehicle speed. (Page 13.9). "The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application." *Id.* The TCU (transmission control unit) stores shift maps that provide notifications to the transmission regarding whether and when to shift. (Page 13.14). Jurgen, therefore, teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Volkswagen '070 discloses a device "that assists the operator of [an] internal combustion engine equipped with a conventional transmission." Page 5. The device receives an engine speed signal "with the aid of known sensor systems" and uses it to activate an "engine-speed dependent change-over switch 6." Page 7. Volkswagen '070 describes two operating ranges, I and II, and the change-over switch 6 indicates that an upshift or downshift is necessary when the limits of those ranges (*e.g.*, the RPM set point) is reached. Pages 6–8. For example, Figure 2 of Volkswagen '070 illustrates the change-over switch, which receives the engine speed signal and determines when to activate the upshift and downshift notification lamps 4 and 6:

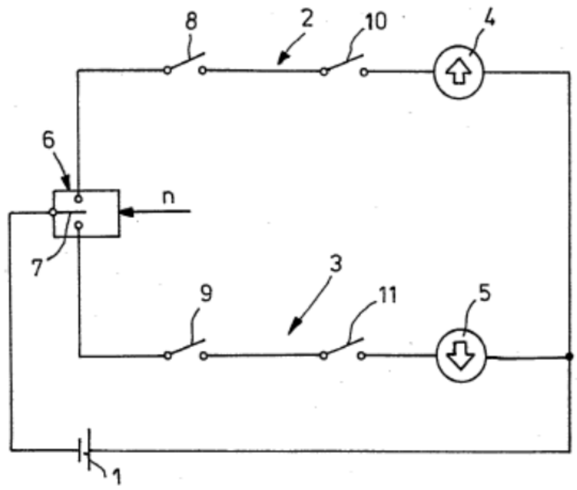


Fig.2

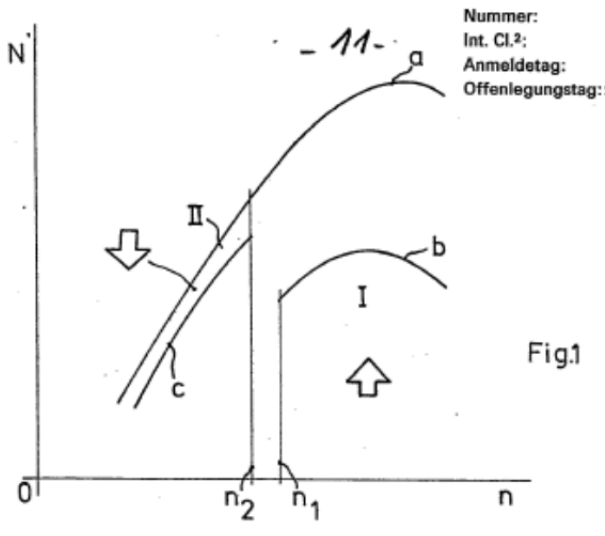
Volkswagen '070 also teaches that engine operating efficiency is based on throttle valve angle, induction manifold vacuum, and engine speed. For example, at page 6, Volkswagen '070 describes:

> As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed values*** n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between 40 to 70% of the maximum engine speed.

Volkswagen ’070 also describes at page 8 that the “engine speed signal is obtained with the aid of known sensor systems.”

Therefore, Volkswagen ’070 teaches “a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor,” except for the claimed road speed sensor, which is taught by Jurgen. *See*, *e.g.*, Jurgen, pages 2.5, 2.7, 7.6, and 12.8. Volkswagen ’070 also teaches “a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom.”

Although Volkswagen ’070 does not explicitly refer to the use of memory, it does disclose operating ranges I and II which are bounded by RPM set points, which trigger the shift notifications. For example, Figure 1 discloses these operating ranges, and includes limits N1 and N2 which are engine speeds at which the shifts are indicated (Pages 6–8):



It would have been obvious to one having ordinary skill in the art to use a known memory device, such as the memory devices described by Jurgen at pages 11.24 to 11.31,[5] to store these set points. Therefore, the combination of Jurgen and Volkswagen ’070 renders obvious an “RPM set point.”

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[5] *See*, *e.g.*, pages 11.25 (“On-chip microcontroller memory consists of some mix of five basic types: random access memory (RAM), read-only memory (ROM), erasable ROM (EPROM), electrically erasable ROM (EPROM), and flash memory. RAM is typically utilized for run-time variable storage and SFRs. The various types of ROM are generally used for code storage and fixed data tables.”) and 11.29 (“Off-chip memory offers the most flexibility to the system designer. . . . Off-chip memory is flexible because the user can implement various memory devices in the configuration of his choice. Most microcontrollers on the market today offer a wide variety of control pins and timing modes to allow the system designer flexibility when interfacing to a wide range of external memory systems.”).

Volkswagen ’070 also teaches both upshift and downshift notification circuits, as upward and downward pointing arrows. When the engine is being operated at an excessive speed, an upshift notification circuit is activated. When the engine is being operated at an insufficient speed, the downshift notification circuit is activated. “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” Pages 6–7; “When the operating point lies in operating range II, ***the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1***.” Page 7. Volkswagen ’070 also teaches that the change-over switch 6 pivots either upwardly or downwardly based upon the engine speed in order to drive the upshift or downshift indicator lights. Pages 7–8. Therefore, Volkswagen ’070 teaches “an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed” and “said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift[/downshift] notification circuit.”

A person of ordinary skill in the art, at the time the alleged inventions of claims 1, 7, and 13 of the ’781 patent were made, would have found it obvious to combine the teachings of Jurgen and Volkswagen ’070, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 1, 7, and 13 of the ’781 patent were made would have been further motivated to combine the teachings of Jurgen and Volkswagen ’070, to “provide optimal driveability for all operating conditions” (Jurgen, Page 12.1), to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), and to “provid[e] a device that assists the operator of the internal combustion engine equipped with a conventional transmission . . . for example, in setting an operating point of the engine that is advantageous in terms of fuel consumption" (Volkswagen '070, Page 5). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and Volkswagen '070 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and the teachings of Volkswagen '070, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
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Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and Volkswagen '070 teaches the limitations that the Examiner concluded were absent from the prior art cited during prosecution of the '781 patent, *i.e.*, upshift and downshift notification circuits activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claims 1, 7, and 13 is raised by the combination of Jurgen and Volkswagen '070.

As set forth in the appended charts, the combination of Jurgen and Volkswagen ’070 teaches all of the limitations of claims 1, 7, and 13 of the ’781 patent and therefore renders obvious claims 1, 7, and 13 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 1, 7, and 13 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and Volkswagen ’070.

4. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, and Davidian

Claims 17–23 and 26 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Toyota ’599, and Davidian. Jurgen, Toyota ’599, and Davidian were not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 17–23 and 26 are obvious in view of the combination of Jurgen, Toyota ’599, and Davidian was not previously considered. The combination of Jurgen, Toyota ’599, and Davidian is closer to the subject matter of claims 17–23 and 26 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Toyota ’599, and Davidian provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner determined that claims 17–23 and 26 were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). “During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to.” (Page 22.6). Indeed, Jurgen illustrates a diagram of these hardware parts:

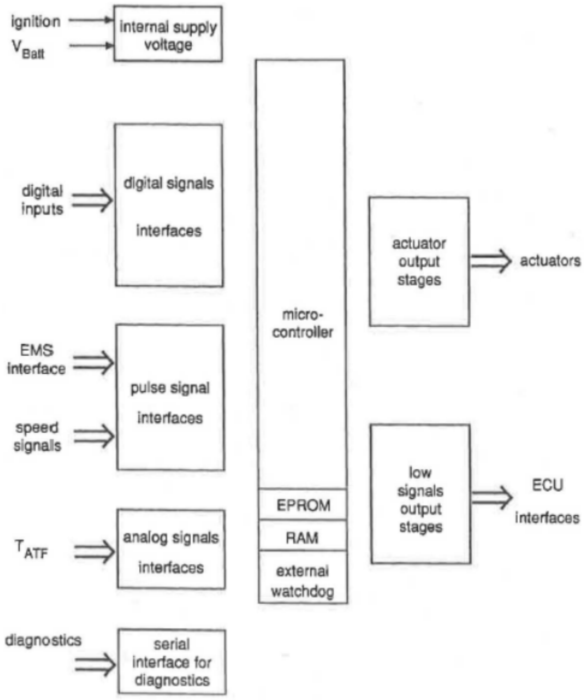

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM"). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a

maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

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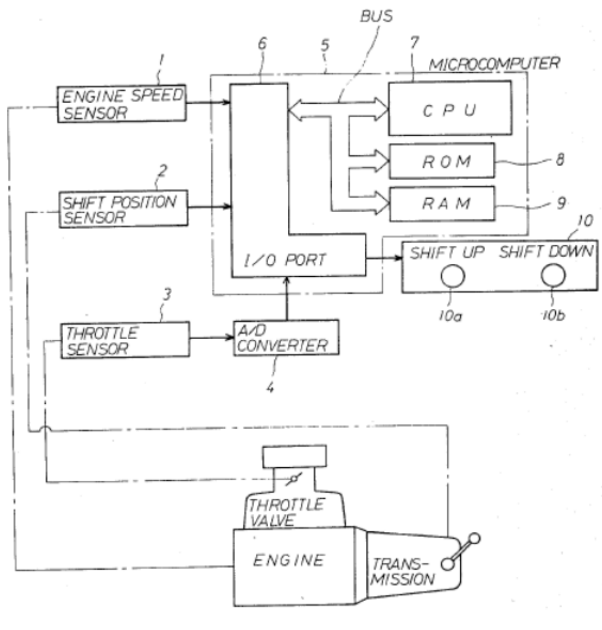
Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Toyota '599 discloses a "shift indication apparatus" coupled to a plurality of sensors. An overview of this system is illustrated in Figure 1:



The sensor inputs to the microcomputer include an engine speed sensor 1 and a throttle sensor 3, which are both "connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5." Col. 2, lines 43 to 48; col. 2, lines 52 to 59. Therefore, Toyota '599 discloses "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor," except for the claimed manifold pressure sensor and road speed sensor, which is taught by Jurgen. *See*, *e.g.*, Jurgen, pages 2.5, 2.7, and 7.6. Toyota '599 also teaches "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Additionally, Toyota '599 teaches that a memory can be used to store a torque data map and an RPM set point. Col. 3, lines 7 to 20 and lines 44 to 61. For example, the engine speed "is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21." Col. 3, lines 44 to 61. The actual RPM exceeding this RPM set point is necessary to begin the main routine. Therefore, Toyota '599 teaches "a memory subsystem, coupled to said processor subsystem" and that said memory subsystem stores an "RPM set point."

Toyota '599 teaches that indicator lamps that tell the driver to shift up or shift down are lit by the microcomputer in order to tell the driver when to shift to improve fuel economy. "Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP_{+1} is preferable." Col. 5, line 63 to col. 6, line 2. "However, only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated, thus indicating the necessity of the speed change operation." E.g. col. 7, lines 29 to 38. Therefore, Toyota '599 teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed" and "said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift[/downshift] notification circuit."

Davidian discloses an anti-collision system that includes "a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle." Col. 4, lines 52 to 66. This front space sensor includes "a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 . . . for measuring the distance of the vehicle from objects in front of . . . the vehicle." Col. 10, lines 17 to 26. The front space sensor in Davidian continuously transmits pulses (including, in one example, RF pulses) and measures "the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object." Col. 10, lines 38 to 50. Therefore, Davidian teaches "a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle."

Davidian also teaches a processor subsystem, disclosed as microcomputer 4, which is illustrated in FIGS. 6a and 6b. It is coupled to the radar detector (front vehicle space sensor 8) and the vehicle speed sensor 12:

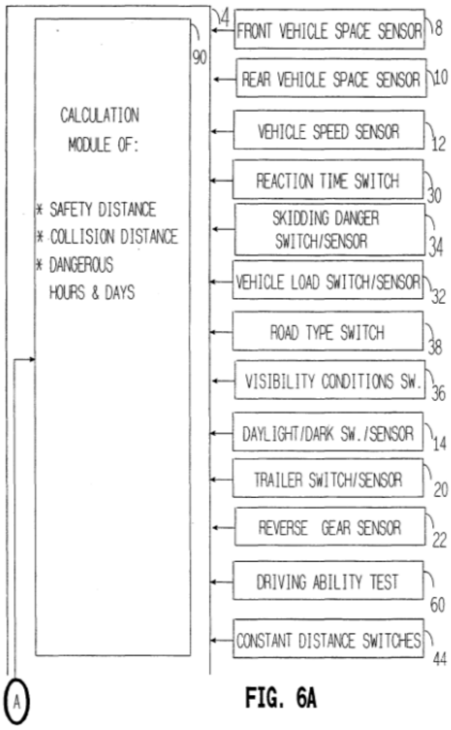


FIG. 6A

"The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above." Col. 8, lines 29 to 43. Therefore, Davidian teaches "a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom."

Davidian teaches a memory subsystem that stores a vehicle speed/stopping distance table. "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" Col. 9, lines 20 to 27. This memory subsystem is a part of the microcomputer 4, as illustrated in FIG. 6A. Davidian also teaches the storing of present and prior levels of each sensor in memory. For example, Davidian's "Black Box Module" 94 stores the "time, ***speed***, and ***relative distance*** between the vehicle and object" each time a collision alarm is activated. Col. 15, lines 22 to 26. Therefore, Davidian teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table" and the memory subsystem storing "a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor."

Davidian teaches a vehicle proximity alarm circuit, which activates a collision alarm when a calculated "Collision Distance" is close to a calculated "Stopping Distance." "A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated." Col. 12, line 59 to col. 13, line 11. The collision alarm, may be an audio alarm or a visual alarm. Col. 9, lines 52 to 56. The determination whether to activate the collision alarm is made by the calculation module 90, which is part of the microcomputer 4. *See* col. 12, line 27 ("Operation of the Calculation Module 90"). Therefore, Davidian teaches "a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object."

Davidian also teaches that the processor subsystem determines when to activate the proximity alarm. The radar input, the vehicle speed input, and the vehicle speed/stopping distance tables are all located in the calculation module 90, which it uses to calculate stopping distance and collision distance. Col. 12, line 59 to col. 13, line 11. Therefore, Davidian teaches "said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem."

Davidian also teaches the use of a rain sensor connected to module 90 to detect the presence of rain. Claim 18 requires the use of a windshield wiper sensor in order to detect if rain is present. In rejecting claim 18, the Examiner stated that "Chasteen discloses a plurality of sensors for controlling the operation of the fuel injection wherein it would have been obvious to use a windshield wiper sensor in order to provide a complete performance operation of the vehicle." August 6, 1998 Office Action, at 5. This rejection was not challenged by the applicant, and the claim was allowed due to the addition of the upshift notification circuit to claim 17. The Examiner's statement that a windshield wiper sensor would be an obvious modification to Chasteen carries equal weight in view of the rain sensor taught in Davidian.

Davidian also teaches that it would be beneficial in certain situations to take automatic control of the vehicle. Col. 2, lines 67 to col. 3, line 2. While Claim 19 requires a throttle controller that selectively reduces the throttle based upon inputs from various sensors, the disclosure in Davidian regarding the automatic application of the brakes achieves the same result — slowing the vehicle down.[6]

Jurgen teaches the use of a brake sensor as claimed in Claim 20. For example, Jurgen teaches that "[p]ressure sensors are used to monitor brake fluid pressure" and that "[b]rake pedal position and brake fluid pressure information are also required for control." Jurgen, pages 7.21 to 22. Therefore, the combination of Jurgen, Toyota '599, and Davidian teaches "at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated."

Davidian also teaches the use of a "black box" to record vehicle events. Claim 21 requires a "means for counting a total number of vehicle proximity alarms determined by said processor subsystem." Davidian teaches the use of four different counters, which are stored in the black box each time a front or rear proximity alarm is activated. Col. 11, lines 60 to 68; col. 14, lines 8 to 12. Davidian does not teach "means for selectively reducing said throttle based upon said total number of vehicle proximity alarms." However, Davidian does teach that automated activation of a brake system is used to slow the vehicle down. Indeed, the Examiner stated that "it has been discussed that Doi et al. disclose an alarm therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to count a total number of alarms associated with the system." August 6, 1998 Office Action, at 6. Davidian teaches counting the number of vehicle proximity alarms, and also teaches the automatic control of a vehicle. Therefore, Davidian renders obvious claim 21.

A person of ordinary skill in the art, at the time the alleged inventions of claims 17–23 and 26 of the '781 patent were made, would have found it obvious to combine the teachings

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[6] Additionally, Jurgen teaches that an electronic throttle controller was known in the art.

of Jurgen, Toyota '599, and Davidian, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 17–23 and 26 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Toyota '599, and Davidian, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to "obtain preferable shift positions relating to optimum fuel consumption rate in accordance with . . . data detected" (Toyota '599, Abstract), and to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Toyota '599, and Davidian are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Toyota '599, and Davidian, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen, Toyota ’599, and Davidian teaches the limitations that the Examiner concluded were as absent from the prior art cited during prosecution of the ’781 patent, *i.e.*, upshift and downshift notification circuits activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claims 17–23 and 26 is raised by the combination of Jurgen, Toyota ’599, and Davidian.

As set forth in the appended charts, the combination of Jurgen, Toyota ’599, and Davidian teaches all of the limitations of claims 17–23 and 26 of the ’781 patent and therefore renders obvious claims 17–23 and 26 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 17–23 and 26 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Toyota ’599, and Davidian.

5. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, and Davidian

Claims 17–23 and 26 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Volkswagen ’070, and Davidian. Jurgen, Volkswagen ’070, and Davidian were not cited by the Examiner or the applicants during prosecution of the ’781 patent. Therefore, the question of whether claims 17–23 and 26 are obvious in view of the combination of Jurgen, Volkswagen ’070, and Davidian was not previously considered. The combination of Jurgen, Volkswagen ’070, and Davidian is closer to the subject matter of claims 17–23 and 26 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen, Volkswagen ’070, and Davidian provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 17–23 and 26 were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen illustrates a diagram of these hardware parts:

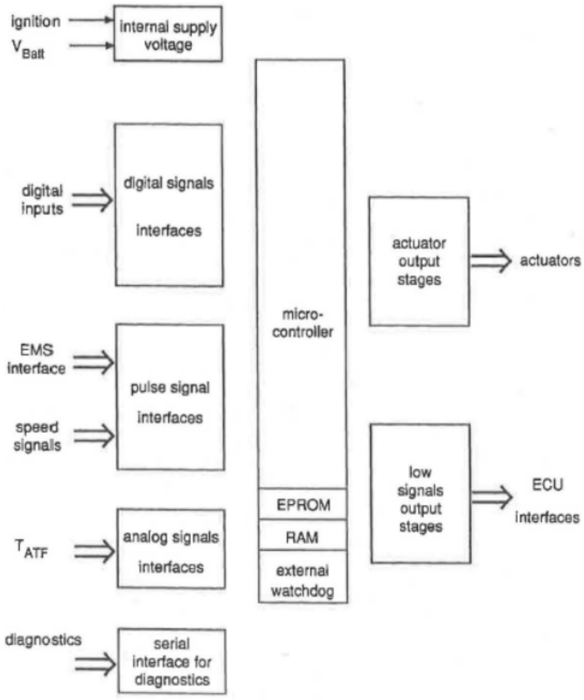


FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM"). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen also teaches that the transmission can be controlled by calculating the necessary shift points based upon throttle position, the accelerator pedal position (e.g., throttle position), and the vehicle speed. (Page 13.9). "The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application." *Id.* The TCU (transmission control unit) stores shift maps that provide notifications to the transmission regarding whether and when to shift. (Page 13.14). Jurgen, therefore, teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Volkswagen '070 discloses a device "that assists the operator of [an] internal combustion engine equipped with a conventional transmission." Page 5. The device receives an engine speed signal "with the aid of known sensor systems" and uses it to activate an "engine-speed dependent change-over switch 6." Page 7. Volkswagen '070 describes two operating ranges, I and II, and the change-over switch 6 indicates that an upshift or downshift is necessary when the limits of those ranges (*e.g.*, the RPM set point) is reached. Pages 6–8.

For example, Figure 2 of Volkswagen ’070 illustrates the change-over switch, which receives the engine speed signal and determines when to activate the upshift and downshift notification lamps 4 and 6:

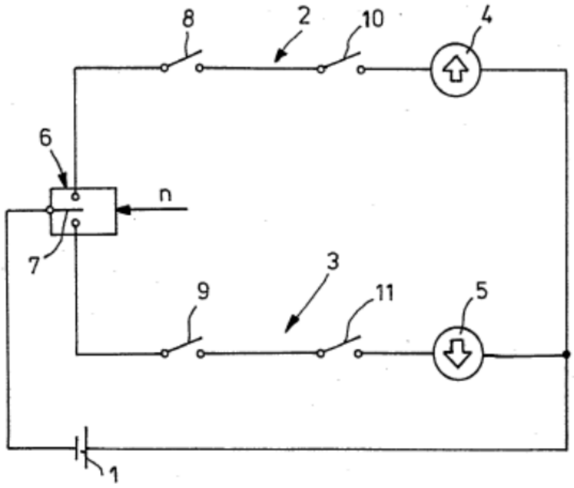


Fig.2

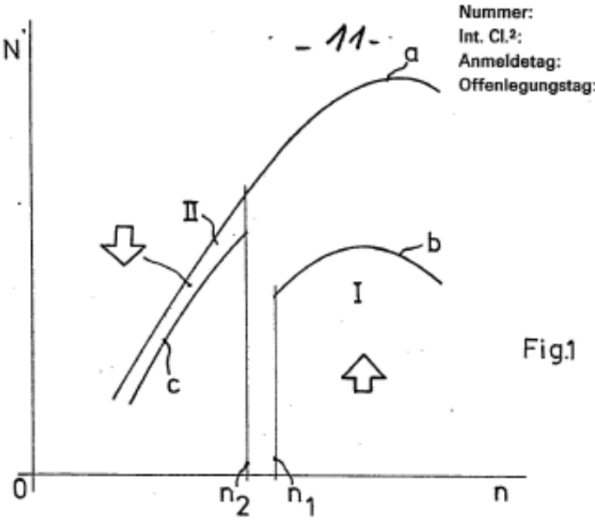
Volkswagen ’070 also teaches that engine operating efficiency is based on throttle valve angle, induction manifold vacuum, and engine speed. For example, at page 6, Volkswagen ’070 describes:

> As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed values*** n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between 40 to 70% of the maximum engine speed.

Volkswagen ’070 also describes at page 8 that the “engine speed signal is obtained with the aid of known sensor systems.”

Therefore, Volkswagen ’070 teaches “a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor,” except for the claimed road speed sensor, which is taught by Jurgen. *See*, *e.g.*, Jurgen, pages 2.5, 2.7, 7.6, and 12.8. Volkswagen ’070 also teaches “a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom.”

Although Volkswagen '070 does not explicitly refer the use of memory, it does disclose operating ranges I and II which are bounded by RPM set points, which trigger the shift notifications. For example, Figure 1 illustrates these operating ranges, and includes limits N1 and N2 which are engine speeds at which the shifts are indicated (Pages 6–8):



It would have been obvious to one having ordinary skill in the art to use a known memory device, such as the memory devices described by Jurgen at pages 11.24 to 11.31,[7] to store these set points. Therefore, the combination of Jurgen, Volkswagen '070, and Davidian renders obvious an "RPM set point."

Volkswagen '070 also teaches both upshift and downshift notification circuits, as upward and downward pointing arrows. When the engine is being operated at an excessive speed, an upshift notification circuit is activated. When the engine is being operated at an insufficient speed, the downshift notification circuit is activated. "Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the***

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[7] *See*, *e.g.*, pages 11.25 ("On-chip microcontroller memory consists of some mix of five basic types: random access memory (RAM), read-only memory (ROM), erasable ROM (EPROM), electrically erasable ROM (EPROM), and flash memory. RAM is typically utilized for run-time variable storage and SFRs. The various types of ROM are generally used for code storage and fixed data tables.") and 11.29 ("Off-chip memory offers the most flexibility to the system designer. . . . Off-chip memory is flexible because the user can implement various memory devices in the configuration of his choice. Most microcontrollers on the market today offer a wide variety of control pins and timing modes to allow the system designer flexibility when interfacing to a wide range of external memory systems.").

upward pointing arrow within operating range I." Pages 6–7; "When the operating point lies in operating range II, ***the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1***." Page 7. Volkswagen '070 also teaches that the change-over switch 6 pivots either upwardly or downwardly based upon the engine speed in order to drive the upshift or downshift indicator lights. Pages 7-8. Therefore, Volkswagen '070 teaches "an upshift[/downshift] notification circuit coupled to said processor subsystem, said upshift[/downshift] notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive[/insufficient] speed" and "said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift[/downshift] notification circuit."

Davidian discloses an anti-collision system that includes "a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle." Col. 4, lines 52 to 66. This front space sensor includes "a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 . . . for measuring the distance of the vehicle from objects in front of . . . the vehicle." Col. 10, lines 17 to 26. The front space sensor taught by Davidian continuously transmits pulses (including, in one example, RF pulses) and measures "the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object." Col. 10, lines 38 to 50. Therefore, Davidian teaches "a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle."

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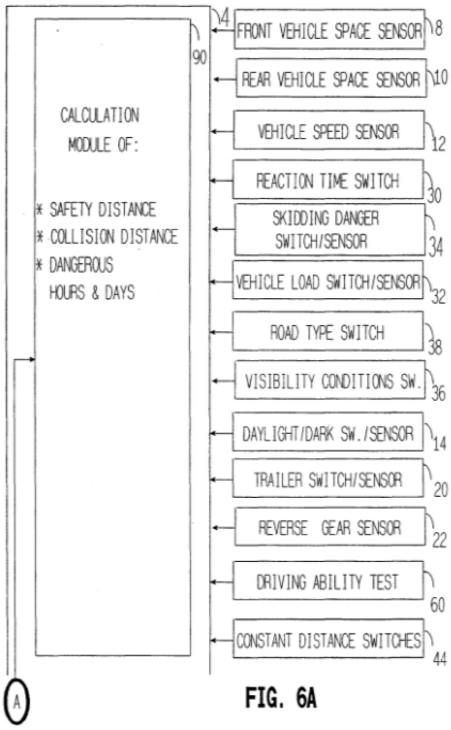

FIG. 6A

"The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above." Col. 8, lines 29 to 43. Therefore, Davidian teaches "a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom."

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A person of ordinary skill in the art, at the time the alleged inventions of claims 17–23 and 26 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Volkswagen '070, and Davidian, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 17–23 and 26 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Volkswagen '070, and Davidian, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel

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[8] Additionally, Jurgen teaches that an electronic throttle controller was known in the art.

consumption (Jurgen, Page 12.4), to "provid[e] a device that assists the operator of the internal combustion engine equipped with a conventional transmission . . . for example, in setting an operating point of the engine that is advantageous in terms of fuel consumption" (Volkswagen '070, Page 5), and to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Volkswagen '070, and Davidian are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Volkswagen '070, and Davidian, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen, Volkswagen '070, and Davidian teaches the limitations that the Examiner concluded were absent from the prior art cited during prosecution of the ’781 patent, *i.e.*, upshift and downshift notification circuits activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claims 17–23 and 26 is raised by the combination of Jurgen, Volkswagen ’070, and Davidian.

As set forth in the appended charts, the combination of Jurgen, Volkswagen ’070, and Davidian teaches all of the limitations of claims 17–23 and 26 of the ’781 patent and therefore renders obvious claims 17–23 and 26 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 17–23 and 26 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Volkswagen ’070, and Davidian.

6. Claims 17–21 and 23 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, and Davidian

Claims 17–21 and 23 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Saturn ’452, and Davidian. Jurgen, Saturn ’452, and Davidian were not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 17–21 and 23 are obvious in view of the combination of Jurgen, Saturn ’452, and Davidian was not previously considered. The combination of Jurgen, Saturn ’452, and Davidian is closer to the subject matter of claims 17–21 and 23 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen, Saturn ’452, and Davidian provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 17 and 23 were allowable over the prior art cited during prosecution on the basis that the prior art does not teach an upshift notification circuit, wherein the processor determines, based upon data received from sensors, when to activate said upshift notification circuit.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). “During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to.” (Page 22.6). Indeed, Jurgen illustrates these hardware parts:

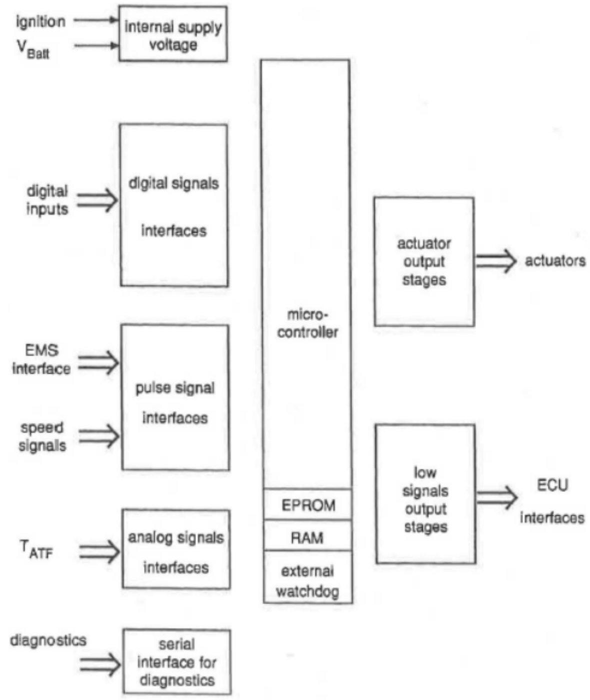

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen also discloses that a memory subsystem can be used in connection with the processor subsystem in order to store programs and data. (Page 13.5). It is disclosed that the memory can store data tables including a manifold pressure set point and an RPM set point for use by the system. (Pages 13.5 ("The memory devices for program and data are usually EPROMs"), 12.9 ("The engine load information is provided by the manifold pressure sensor . . . . The engine control unit contains data tables for combinations of load and RPM"). Additionally, present and prior levels of each sensor are stored in the memory for diagnostic use, which preserves sensor outputs for later use. (Pages 14.2, 22.2 to 22.3). Jurgen, therefore, teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a

maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen also teaches that the transmission can be controlled by calculating the necessary shift points based upon throttle position, the accelerator pedal position (e.g., throttle position), and the vehicle speed. (Page 13.9). "The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application." *Id.* The TCU (transmission control unit) stores shift maps that provide notifications to the transmission regarding whether and when to shift. (Page 13.14). Jurgen, therefore, teaches "an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Saturn '452 teaches a "means for indicating to the operator a point in operation for upshifting to the next higher gear." Abstract. The processor subsystem taught by Saturn '452 receives sensor inputs that sense manifold pressure, engine speed, and throttle position. Col. 2, lines 42 to 44; col. 7, lines 13 to 21. Therefore, Saturn '452 teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor," except for the claimed road speed sensor, which is taught by Jurgen.

Figure 1 of Saturn '452 is illustrative:

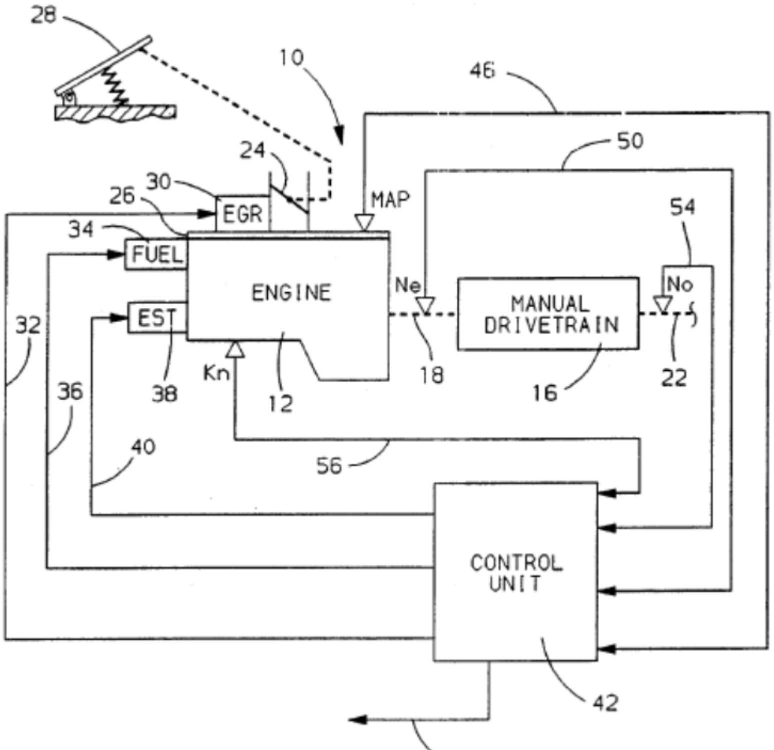

FIG. 1

Figure 1 of Saturn '452 teaches that the control unit 42 is connected to the sensor inputs, and outputs a signal on line 60 that may drive a lamp "for indicating the state of the upshift indicator light." Col. 2, lines 42 to 55; col. 3, lines 60 to 65. Additionally, Saturn '452 teaches that the control unit includes a memory (col. 2, lines 52 to 55), and that a "predetermined maximum allowable engine speed threshold K1" is used by the system. Col. 6, lines 55 to 60. Therefore, Saturn '452 discloses "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors," except for the claimed manifold pressure set point and present and prior levels for each one of the sensors, which are taught in Jurgen (*see* Jurgen at 12.9, 13.5).

Saturn '452 teaches an upshift notification circuit connected to the control unit, which indicates "via line 60 the state of an upshift indicator light or equivalent visual display." Col. 2, lines 42 to 55. Therefore, Saturn '452 teaches "an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed" and "said processor subsystem determining, based upon data received from said plurality of sensors, . . . when to activate said upshift notification circuit."

Davidian discloses an anti-collision system that includes "a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle." Col. 4, lines 52 to 66. This front space sensor includes "a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 . . . for measuring the distance of the vehicle from objects in front of . . . the vehicle." Col. 10, lines 17 to 26. The front space sensor in Davidian continuously transmits pulses (including, in one example, RF pulses) and measures "the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object." Col. 10, lines 38 to 50. Therefore, Davidian teaches "a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle."

Davidian also teaches a processor subsystem, disclosed as microcomputer 4, which is illustrated in FIGS. 6a and 6b. It is coupled to the radar detector (front vehicle space sensor 8) and the vehicle speed sensor 12:

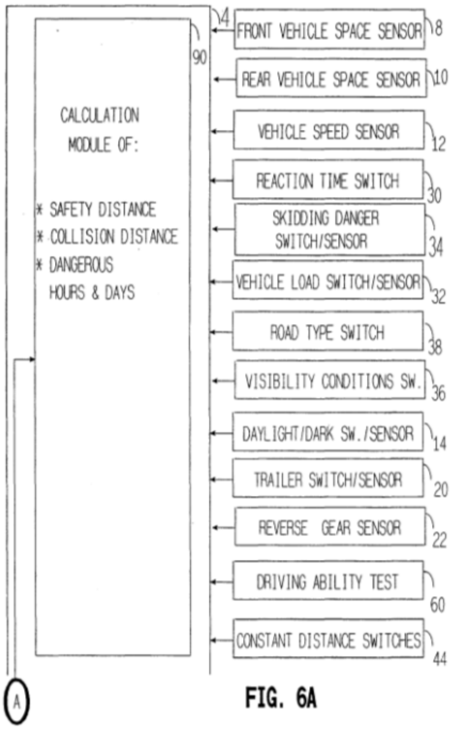

FIG. 6A

"The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above." Col. 8, lines 29 to 43. Therefore, Davidian teaches "a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom."

Davidian teaches a memory subsystem that stores a vehicle speed/stopping distance table. "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" Col. 9, lines 20 to 27. This memory subsystem is a part of the microcomputer 4, as illustrated in FIG. 6A. Davidian also teaches the storing of present and prior levels of each sensor in memory. For example, Davidian's "Black Box Module" 94 stores the "time, ***speed***, and ***relative distance*** between the vehicle and object" each time a collision alarm is activated. Col. 15, lines 22 to 26. Therefore, Davidian teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table" and the memory subsystem storing "a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor."

Davidian teaches a vehicle proximity alarm circuit, which activates a collision alarm when a calculated "Collision Distance" is close to a calculated "Stopping Distance." "A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated." Col. 12, line 59 to col. 13, line 11. The collision alarm, may be an audio alarm or a visual alarm. Col. 9, lines 52 to 56. The determination whether to activate the collision alarm is made by the calculation module 90, which is part of the microcomputer 4. *See* col. 12, line 27 ("Operation of the Calculation Module 90"). Therefore, Davidian teaches "a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object."

Davidian also teaches that the processor subsystem determines when to activate the proximity alarm. The radar input, the vehicle speed input, and the vehicle speed/stopping distance tables are all located in the calculation module 90, which it uses to calculate stopping distance and collision distance. Col. 12, line 59 to col. 13, line 11. Therefore, Davidian teaches "said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem."

Davidian also teaches the use of a rain sensor connected to module 90 to detect the presence of rain. Claim 18 requires the use of a windshield wiper sensor in order to detect if rain is present. In rejecting claim 18, the Examiner stated that "Chasteen discloses a plurality of sensors for controlling the operation of the fuel injection wherein it would have been obvious to use a windshield wiper sensor in order to provide a complete performance operation of the vehicle." August 6, 1998 Office Action, at 5. This rejection was not challenged by the applicant, and the claim was allowed due to the addition of the upshift notification circuit to claim 17. The Examiner's statement that a windshield wiper sensor would be an obvious modification to Chasteen carries equal weight in view of the rain sensor taught in Davidian.

Davidian also teaches that it would be beneficial in certain situations to take automatic control of the vehicle. Col. 2, lines 67 to col. 3, line 2. While Claim 19 requires a throttle controller that selectively reduces the throttle based upon inputs from various sensors, the disclosure in Davidian regarding the automatic application of the brakes achieves the same result – slowing the vehicle down.[9]

Jurgen teaches the use of a brake sensor as claimed in Claim 20. For example, Jurgen teaches that "[p]ressure sensors are used to monitor brake fluid pressure" and that "[b]rake pedal position and brake fluid pressure information are also required for control." Jurgen, pages 7.21 to 22. Therefore, the combination of Jurgen, Saturn '452, and Davidian teaches "at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated."

Davidian also teaches the use of a "black box" to record vehicle events. Claim 21 requires a "means for counting a total number of vehicle proximity alarms determined by said processor subsystem." Davidian teaches the use of four different counters, which are stored in the black box each time a front or rear proximity alarm is activated. Col. 11, lines 60 to 68; col. 14, lines 8 to 12. Davidian does not teach "means for selectively reducing said throttle based upon said total number of vehicle proximity alarms." However, Davidian does teach that automated activation of a brake system is used to slow the vehicle down. Indeed, the Examiner stated that "it has been discussed that Doi et al. disclose an alarm therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to count a total number of alarms associated with the system." August 6, 1998 Office Action, at

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[9] Additionally, Jurgen teaches that an electronic throttle controller was known in the art.

6. Davidian teaches counting the number of vehicle proximity alarms, and also teaches the automatic control of a vehicle. Therefore, Davidian renders obvious claim 21.

A person of ordinary skill in the art, at the time the alleged inventions of claims 17–21 and 23 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Saturn '452, and Davidian, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 17–21 and 23 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Saturn '452, and Davidian, to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to provide a "means for indicating to the operator a point in operation for upshifting to the next higher gear" (Saturn '452, Abstract), to provide "an improved method of determining shift points and indicating the same to a vehicle operator in order to maximize real driving fuel economy" (Saturn '452, col. 1, lines 44 to 47), and to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Saturn '452, and Davidian are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Saturn '452, and Davidian, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .

> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen, Saturn '452, and Davidian teaches the limitations that the Examiner concluded were absent from the prior art cited during prosecution of the '781 patent, *i.e.*, an upshift notification circuit activated by a processor in response to sensor inputs. Accordingly, a substantial new question of patentability affecting claims 17–21 and 23 is raised by the combination of Jurgen, Saturn '452, and Davidian.

As set forth in the appended charts, the combination of Jurgen, Saturn '452, and Davidian teaches all of the limitations of claims 17–21 and 23 of the '781 patent and therefore renders obvious claims 17–21 and 23 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claims 17–21 and 23 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Saturn '452, and Davidian.

7. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Nissan '055

Claims 28–30 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and Nissan '055. Neither Jurgen nor Nissan '055 was cited by the Examiner or the applicants during prosecution of the '781 patent. Therefore, the question of whether claims 28–30 are obvious in view of the combination of Jurgen and Nissan '055 was not previously considered. The combination of Jurgen and Nissan '055 is closer to the subject matter of claims 28–30 of the '781 patent than any prior art that was relied upon during prosecution of the '781 patent, and the combination of Jurgen and Nissan '055 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the '781 patent.

As more fully explained above, the applicants asserted that claim 28 was allowable over the prior art because the prior art does not disclose a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen illustrates these hardware parts:

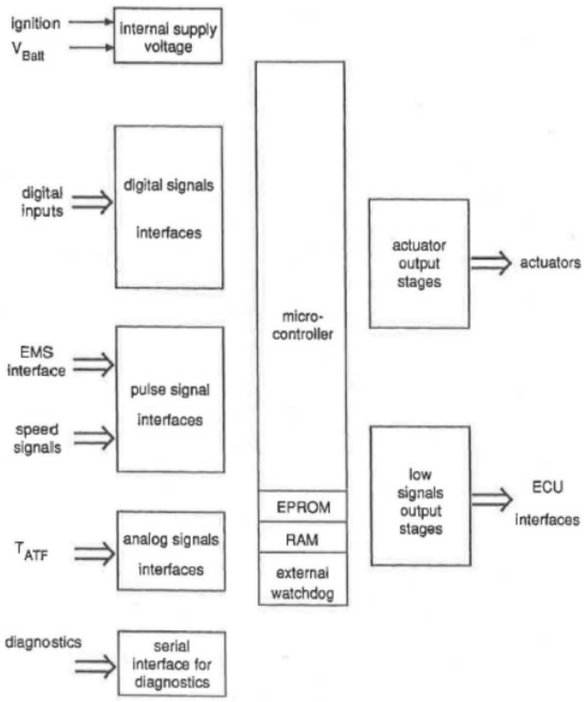


FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

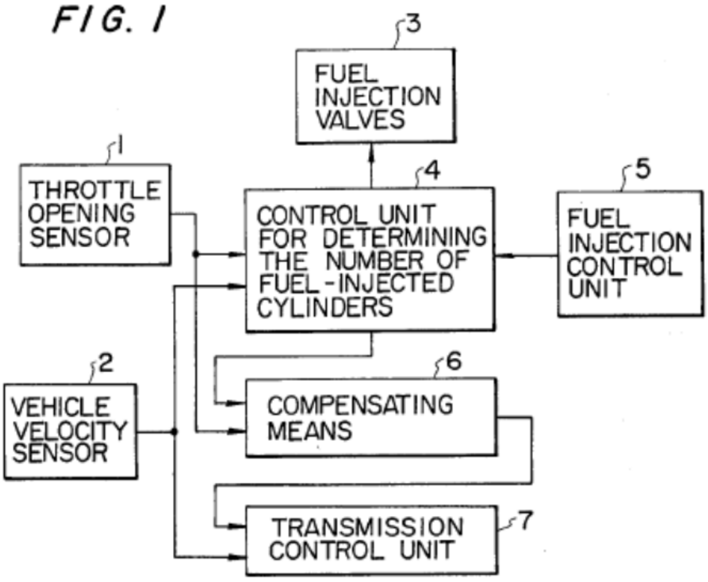
Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU disclosed in Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine

RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Nissan '055 discloses a control system that "controls the number of fuel injected cylinders" in order to increase fuel economy. Abstract. Figure 1 of Nissan '055 discloses that a throttle opening sensor and vehicle velocity sensor are inputs to the system:

FIG. 1



Nissan '055 teaches that "when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders." Col. 2, lines 59 to 66. Therefore, Nissan '055 teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle." Although Nissan '055 does not refer to the use of a manifold pressure sensor, manifold pressure sensors are taught by Jurgen. Therefore, the combination of Jurgen and Nissan '055 teaches "said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor."

Claims 29 and 30 require the fuel overinjection notification circuit to be activated when certain conditions measured by the claimed sensors are either increasing or decreasing. For example, claim 29 requires the fuel overinjection notification circuit to be activated when it is determined that (1) road speed is increasing; (2) throttle position is increasing; and (3) the manifold pressure exceeds a manifold pressure set point. In the remarks that were presented with these claims, the Applicant stated as follows:

> Specifically, as presented in new Claims 34-36, Applicants' claimed apparatus for optimizing operation of a vehicle includes a fuel overinjection notification circuit and a processor subsystem which determines when to activate the fuel overinjection notification circuit. The processor makes that determination based upon data received from specifically recited sensors, <u>including the road speed sensor.</u>

February 16, 1999 Amendment, page 11 (emphasis in original).

In allowing these claims, the Examiner stated that the prior art does not disclose that the processor subsystem determines "whether to activate the fuel overinjection notification circuit based upon data received from the road speed sensor, the throttle position sensor and the manifold sensor." April 22, 1999 Notice of Allowability, at 3. The combination of Jurgen and Nissan '055 teaches the use of road speed, throttle position, and manifold pressure sensors, and also teaches that a fuel overinjection notification circuit can be activated based upon input from these sensors. *See* Jurgen, page 12.22; Nissan '055, col. 2, lines 59 to 66.

A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen and Nissan '055, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen and Nissan '055, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), and to "increas[e] fuel economy" (Nissan '055, Abstract). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and Nissan '055 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and Nissan '055, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and Nissan '055 teaches the limitations that the applicants asserted were absent from the prior art cited during prosecution of the '781 patent, *i.e.*, a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor. Accordingly, a substantial new question of patentability affecting claim 28 is raised by the combination of Jurgen and Nissan '055.

As set forth in the appended charts, the combination of Jurgen and Nissan ’055 teaches all of the limitations of claims 28–30 of the ’781 patent and therefore renders obvious claims 28–30 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 28–30 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and Nissan ’055.

8. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Mack ’324

Claims 28–30 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and Mack ’324. Neither Jurgen nor Mack ’324 was cited by the Examiner or the applicants during prosecution of the ’781 patent. Therefore, the question of whether claims 28–30 are obvious in view of the combination of Jurgen and Mack ’324 was not previously considered. The combination of Jurgen and Mack ’324 is closer to the subject matter of claims 28–30 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen and Mack ’324 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Applicant asserted that claim 28 was allowable over the prior art on the basis that the prior art does not disclose a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). “During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to.” (Page 22.6). Indeed, Jurgen illustrates these hardware parts:

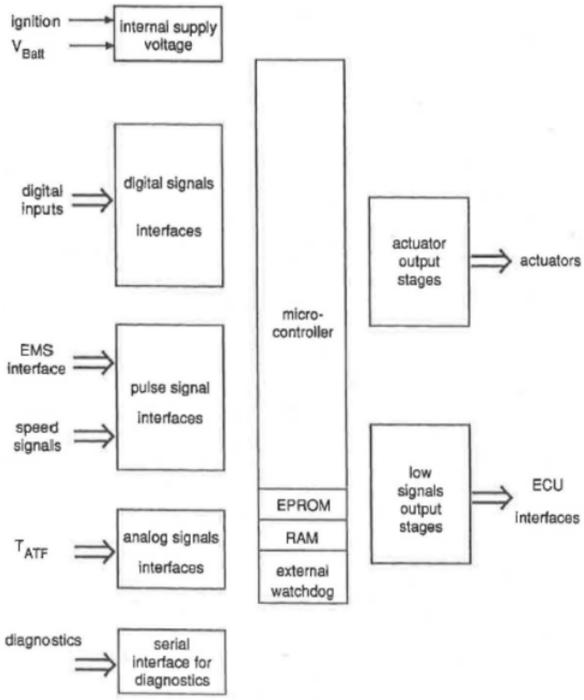


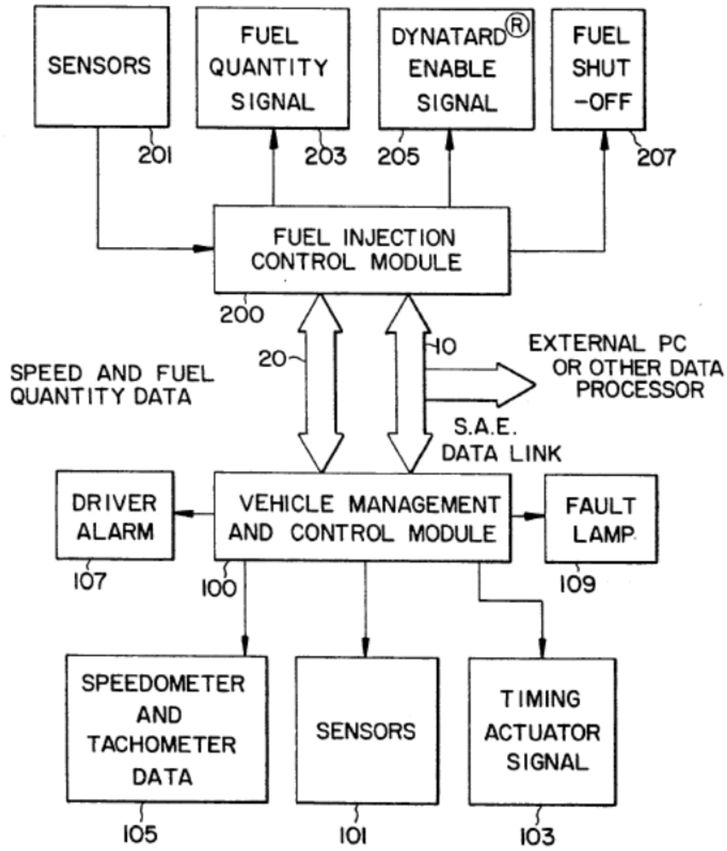
FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

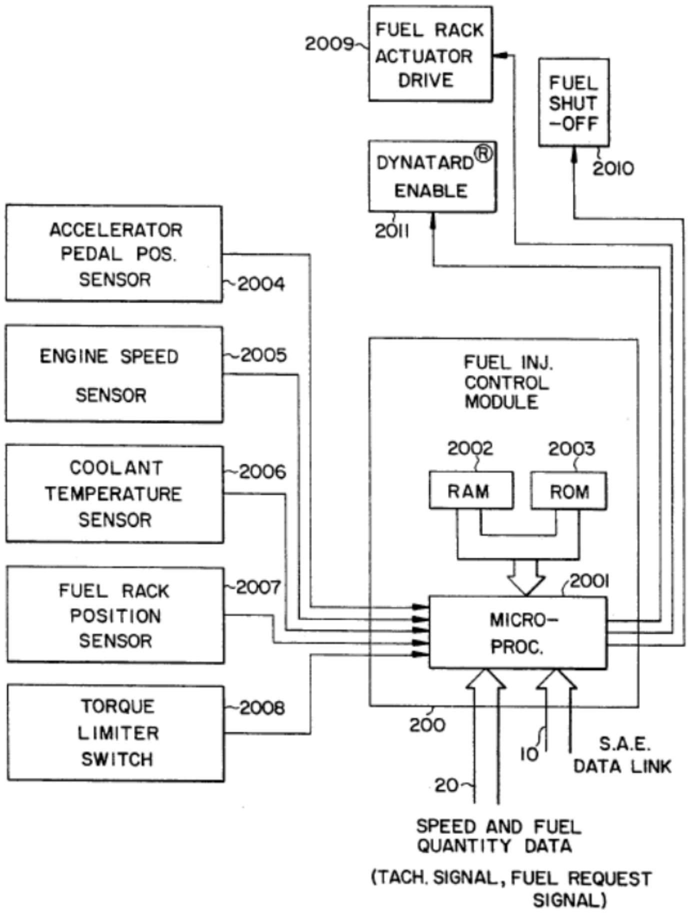
Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

Mack '324 discloses an engine and vehicle management and control system. Abstract. Figure 1 of Mack '324 illustrates an overview of the system:



The fuel injection control module 200 in Mack '324 contains a microprocessor 2001, and receives inputs from sensors 201 and outputs a fuel quantity signal 203 and a fuel shut-off enable signal 207. Col. 2, lines 33 to 27. Figure 3 illustrates the details of the fuel injection control module:



Inputs to the fuel injection control module include sensor inputs from "an accelerator pedal position sensor 2005, an engine speed sensor 2005, a coolant temperature sensor 2006, a fuel rack position sensor 2007, and a torque limiter switch 2008." Col. 3, lines 57 to 61. Mack '324 teaches a fuel overinjection notification signal that stops fuel being injected to the engine when certain overspeed conditions are met. Col. 6, lines 24 to 53. The fuel request signal is sent by the fuel injection control module, to which the sensors are input. Therefore, Mack '324 teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle." Although Mack '324 does not refer to the use of a manifold pressure sensor, manifold pressure sensors are taught by Jurgen. Therefore, the combination of Jurgen and Mack '324 teaches "said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor."

Claims 29 and 30 require the fuel overinjection notification circuit to be activated when certain conditions measured by the claimed sensors are either increasing or decreasing. For example, claim 29 requires the fuel overinjection notification circuit to be activated when it is determined that (1) road speed is increasing; (2) throttle position is increasing; and (3) the manifold pressure exceeds a manifold pressure set point. In the remarks that were presented with these claims, the Applicant stated as follows:

> Specifically, as presented in new Claims 34-36, Applicants' claimed apparatus for optimizing operation of a vehicle includes a fuel overinjection notification circuit and a processor subsystem which determines when to activate the fuel overinjection notification circuit. The processor makes that determination based upon data received from specifically recited sensors, <u>including the road speed sensor.</u>

February 16, 1999 Amendment, page 11 (emphasis in original).

In allowing these claims, the Examiner stated that the prior art does not disclose that the processor subsystem determines "whether to activate the fuel overinjection notification circuit based upon data received from the road speed sensor, the throttle position sensor and the manifold sensor." April 22, 1999 Notice of Allowability, at 3. The combination of Jurgen and Mack '324 teaches the use of road speed, throttle position, and manifold pressure sensors, and also teaches that a fuel overinjection notification circuit can be activated based upon input from these sensors. *See* Jurgen, page 12.22; Mack '324, col. 6, lines 24 to 53.

A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen and Mack '324, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen and Mack '324, to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), and to provide for "optimization in terms of fuel economy" (Mack '324, col. 1, line 24). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and Mack '324 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and Mack ’324, Jurgen describes at page xvii

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and Mack ’324 teaches the limitations that the applicants asserted were absent from the prior art cited during prosecution of the ’781 patent, *i.e.*, a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor. Accordingly, a substantial new question of patentability affecting claims 28–30 is raised by the combination of Jurgen and Mack ’324.

As set forth in the appended charts, the combination of Jurgen and Mack ’324 teaches all of the limitations of claims 28–30 of the ’781 patent and therefore renders obvious claims 28–30 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 28–30 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and Mack ’324.

9. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and GM ’753

Claims 28–30 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen and GM ’753. Neither Jurgen nor GM ’753 was cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 28–30 are obvious in view of the combination of Jurgen and GM ’753 was not previously considered. The combination of Jurgen and GM ’753 is closer to the subject matter of claims 28–30 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen and GM ’753 provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the applicants asserted that claim 28 was allowable over the prior art on the basis that the prior art does not disclose a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), and throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen illustrates these hardware parts:

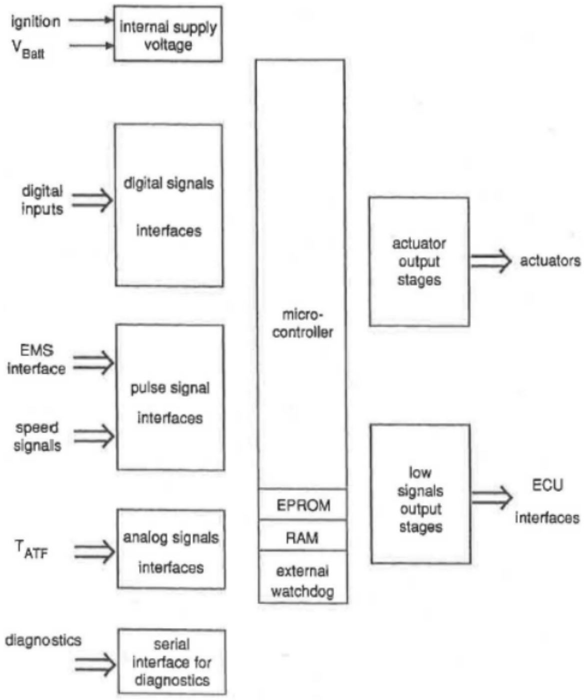


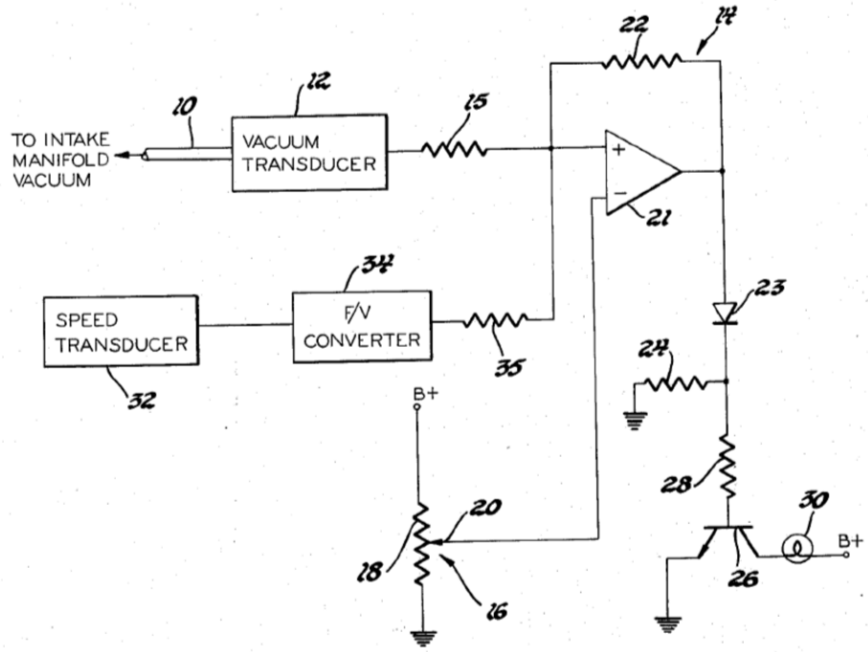
FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor" and "a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom."

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Jurgen, therefore, teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle."

Jurgen teaches "said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift/downshift notification circuit." For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition or shift the engine.

GM '753 discloses "a warning system for providing an indication when the fuel consumption of a throttle controlled vehicle having an internal combustion engine with an intake manifold exceeds pre-established levels." Abstract. Figure 1 of GM '753 provides an overview of the system, which includes a manifold pressure sensor and a vehicle speed sensor:



The vacuum transducer 12 of GM '753 "is effective to generate a voltage having a magnitude which progressively changes with a progressively increased manifold intake level." Col. 1, lines 38 to 55. The speed transducer "generates a series of voltage pulses having a frequency progressively increasing with increasing vehicle speed." Col. 2, lines 34 to 51. These inputs are fed to an analog circuit acting as a processor, which is used to send current to a lamp when a level "determined to represent excessive fuel consumption" is reached. Col. 2, lines 52 to 58. "When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, ***the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed***." Col. 3, lines 20 to 27. Therefore, GM '753 teaches "a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle." Although GM '753 does not refer to the use of a throttle position sensor, throttle position sensors are taught by Jurgen. Therefore, the combination of

Jurgen and GM ’753 teaches “said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.”

Claims 29 and 30 require the fuel overinjection notification circuit to be activated when certain conditions measured by the claimed sensors are either increasing or decreasing. For example, claim 29 requires the fuel overinjection notification circuit to be activated when it is determined that (1) road speed is increasing; (2) throttle position is increasing; and (3) the manifold pressure exceeds a manifold pressure set point. In the remarks that were presented with these claims, the Applicant stated as follows:

> Specifically, as presented in new Claims 34-36, Applicants’ claimed apparatus for optimizing operation of a vehicle includes a fuel overinjection notification circuit and a processor subsystem which determines when to activate the fuel overinjection notification circuit. The processor makes that determination based upon data received from specifically recited sensors, <u>including the road speed sensor.</u>

February 16, 1999 Amendment, page 11 (emphasis in original).

In allowing these claims, the Examiner stated that the prior art does not disclose that the processor subsystem determines “whether to activate the fuel overinjection notification circuit based upon data received from the road speed sensor, the throttle position sensor and the manifold sensor.” April 22, 1999 Notice of Allowability, at 3. The combination of Jurgen and GM ’753 teaches the use of road speed, throttle position, and manifold pressure sensors, and also teaches that a fuel overinjection notification circuit can be activated based upon input from these sensors. *See* Jurgen, page 12.22; GM ’753, col. 3, lines 20 to 27.

A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the ’781 patent were made, would have found it obvious to combine the teachings of Jurgen and GM ’753, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 28–30 of the ’781 patent were made would have been further motivated to combine the teachings of Jurgen and GM ’753, to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), and to “provide[e] an indication when the fuel consumption of a . . . vehicle . . . exceeds pre-established levels" (GM '753, Abstract). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen and GM '753 are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen and GM '753, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Jurgen and GM '753 teaches the limitations that the applicants asserted were absent from the prior art during prosecution of the '781 patent, *i.e.*, a fuel overinjection notification circuit that is activated based on three sensors: a road speed sensor, a throttle position sensor, and a manifold pressure sensor. Accordingly, a substantial new question of patentability affecting claims 28–30 is raised by the combination of Jurgen and GM '753.

As set forth in the appended charts, the combination of Jurgen and GM '753 teaches all of the limitations of claims 28–30 of the '781 patent and therefore renders obvious claims

28–30 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 28–30 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen and GM ’753.

10. Claim 31 is Anticipated Under 35 U.S.C. § 102(b) by Davidian

Claim 31 is anticipated under 35 U.S.C. § 102(b) by Davidian. Davidian was not cited by the Examiner or the applicants during prosecution of the ’781 patent, and Davidian is closer to the subject matter of claim 31 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. Davidian provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

Davidian discloses an anti-collision system that includes “a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle.” Col. 4, lines 52 to 66. This front space sensor includes “a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 . . . for measuring the distance of the vehicle from objects in front of . . . the vehicle.” Col. 10, lines 17 to 26. The front space sensor in Davidian continuously transmits pulses (including, in one example, RF pulses) and measures “the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.” Col. 10, lines 38 to 50. Therefore, Davidian teaches “a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle.”

Davidian also teaches the use of sensors, including “a speed sensor 12 which may sense the speed of the vehicle in any known manner.” Col. 4, lines 60 to 66. Therefore, Davidian teaches “at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor.”

Davidian also teaches a processor subsystem, disclosed as microcomputer 4, which is illustrated in FIGS. 6a and 6b. It is coupled to the radar detector (front vehicle space sensor 8) and the vehicle speed sensor 12:

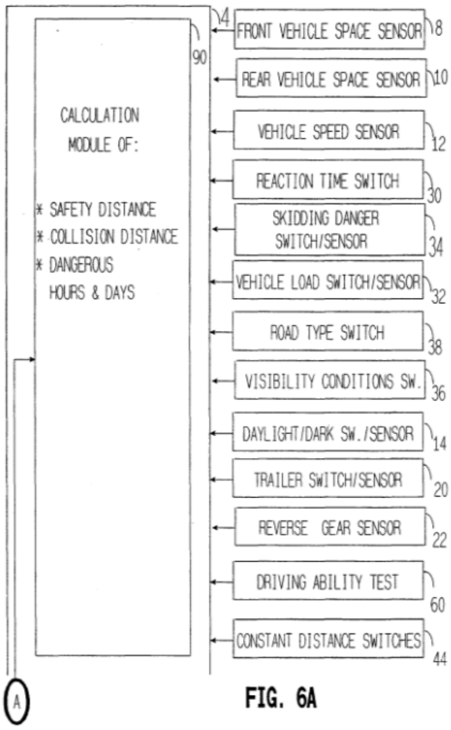


FIG. 6A

"The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above." Col. 8, lines 29 to 43. Therefore, Davidian teaches "a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom."

Davidian teaches a memory subsystem that stores a vehicle speed/stopping distance table. "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" Col. 9, lines 20 to 27. This memory subsystem is a part of the microcomputer 4, as illustrated in FIG. 6A. Therefore, Davidian teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table."

Davidian teaches a vehicle proximity alarm circuit, which activates a collision alarm when a calculated "Collision Distance" is close to a calculated "Stopping Distance." "A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated." Col. 12, line 59 to col. 13, line

11. The collision alarm, may be an audio alarm or a visual alarm. Col. 9, lines 52 to 56. The determination whether to activate the collision alarm is made by the calculation module 90, which is part of the microcomputer 4. *See* col. 12, line 27 ("Operation of the Calculation Module 90"). Therefore, Davidian teaches "a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object."

Davidian also teaches that the processor subsystem determines when to activate the proximity alarm based on (1) separation distance data (received from the front vehicle space sensor 8); (2) vehicle speed data (received form vehicle speed sensor 12); and (3) the vehicle speed/stopping distance table stored in memory. The radar input, the vehicle speed input, and the vehicle speed/stopping distance tables are all located in the calculation module 90, which it uses to calculate stopping distance and collision distance. Therefore, Davidian teaches "said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem."

Thus, Davidian teaches the limitations that the applicants asserted were absent from the prior art during prosecution of the '781 patent, *i.e.*, a vehicle proximity alarm that is activated based upon three parameters: (1) road speed, as determined by a road speed sensor; (2) separation, as determined by a radar detector; and (3) a vehicle speed/stopping distance table stored in a memory subsystem. Accordingly, a substantial new question of patentability affecting claim 31 is raised by Davidian.

As set forth in the appended charts, Davidian teaches all of the limitations of claim 31 of the '781 patent and therefore anticipates claim 31 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claim 31 of the '781 patent under 35 U.S.C. § 102(b) as anticipated by Davidian.

11. Claims 31 and 32 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Tonkin and Doi et al.

Claims 31 and 32 are obvious under 35 U.S.C. § 103(a) in view of the combination of Tonkin and Doi et al. Although Doi et al. was cited by the Examiner during prosecution of the '781 patent, Tonkin was not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 31 and 32 are obvious in view of the combination of Tonkin and Doi et al. was not previously considered. The combination of Tonkin and Doi et al. is closer to the subject matter of claims 31 and 32 of the '781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Tonkin and Doi et al. provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the applicants asserted that claim 31 was allowable over the prior art on the basis that the prior art does not disclose a vehicle proximity alarm that is activated based upon three parameters: (1) road speed, as determined by a road speed sensor; (2) separation, as determined by a radar detector; and (3) a vehicle speed/stopping distance table stored in a memory subsystem. The applicants admitted, however, that a vehicle proximity alarm that is activated based on separation is disclosed in the prior art: “The Applicants respectfully note, however, that the system disclosed in Doi et al. determines alert conditions relative to the proximity between a vehicle and a forward object based upon changes in the distance separating the vehicle and the forward object.”

Tonkin discloses a system that calculates a safety envelope and displays a visible warning when a rear-facing vehicle is getting too near. Abstract. Tonkin discloses the use of a radar sensor in order to determine “distance of separation and/or a relative velocity of a trailing vehicle.” Page 1, lines 23 to 29. *See also* page 5, lines 4 to 9, “The sensor means for sensing the distance and velocity of the trailing vehicle may comprise a radar system.” Therefore, Tonkin discloses “a radar detector.”

Tonkin also teaches the use of sensors, including a velocity sensing means comprising “a conventional speed sensing device fitted to the vehicle’s transmission train.” Page 5, lines 17 to 19. Therefore, Tonkin teaches “at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor.”

Tonkin also teaches the use of a processor coupled to the sensor. Page 1, lines 32 to 34 (“wherein the controller is operable to process the received velocity signal and data signals to determine the existence of an unsafe condition”). Therefore, Tonkin discloses “a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom.”

Tonkin teaches the use of a memory subsystem that stores parameters in a lookup table, including a vehicle speed/stopping distance table. For example, Tonkin teaches that predetermined driving parameters “may for example be stored in a look up table.” Page 3, lines 25 to 32. Additionally, the control system that activates the vehicle proximity alarm relies in part on “known safe stopping distances such as those published by the Minister of Transport, in which a vehicle will stop when the brakes are applied.” Page 16, lines 2 to 21. Finally, Tonkin teaches that a look-up table or database could be provided for unsafe closing speeds, which could be varied according to the velocity of the subject vehicle." Page 17, lines 7 to 25. Therefore, Tonkin teaches "a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table."

Tonkin also teaches a vehicle proximity alarm circuit. "***The system may comprise means for warning*** that the subject vehicle is stationary. ***The system can further comprise means for providing warning*** of different levels of deceleration of the subject vehicle. ***The warning means can comprise an orange light display for the relative speed and/or relative separation conditions and a red light display for the vehicle stationary and/or levels of deceleration conditions***. The relative separation and/or relative speed warning may be overridden by the level of deceleration warning." Page 2, line 29 to page 3, line 3. The control system in Tonkin warns the driver behind the vehicle equipped with the device that the driver is getting too close. Therefore, Tonkin teaches "a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object."

Tonkin teaches that the processor subsystem determines when to activate the proximity alarm circuit based upon (1) separation distance data received from said radar detector; (2) vehicle speed data received from said road speed sensor; and (3) the vehicle speed/stopping distance table. For example, the radar system is "operable to sense a distance of separation and/or a relative velocity of a trailing vehicle." Page 1, lines 32 to 34. The processor subsystem "is operable to process the received velocity signal and data signals to determine the existence of an unsafe condition." The velocity signal used by the processing means is the vehicle velocity signal determined from the vehicle speed sensor. Page 5, lines 17 to 19. The data signals include the separation data (determined from the radar), and the determination regarding whether to activate the alarm is made, in part, using the safe stopping distances provided in the look-up table. Page 17, lines 7 to 25. Therefore, Tonkin teaches "said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem."

Although Tonkin does not refer to the radar detector determining a distance separating a vehicle having an engine and an object *in front* of the vehicle, Doi et al., which was cited by the Examiner during prosecution of the '781 patent, discloses a radar detector that "emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object." Col. 2, lines 59 to 62. Therefore, Doi et al. teaches "a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle."

Tonkin teaches that "information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain." Page 18, lines 9 to 13. Additionally, Tonkin teaches that "safe stopping distances can be adjusted for prevailing weather conditions." Page 18, lines 16 to 19. Therefore, Tonkin discloses the adjustment of the vehicle speed/stopping distance tables based upon weather information determined from a windshield wiper sensor as claimed in claim 32.

A person of ordinary skill in the art, at the time the alleged invention of claims 31 and 32 of the '781 patent was made, would have found it obvious to combine the teachings of Tonkin and Doi et al., and, in addition, would have been motivated to do so, for example, to "provide safety information for example to drivers of following vehicles" (Tonkin, page 1, lines 4-5) and to "detect the relative speed of a vehicle to a forward object (e.g., a forward vehicle) at high efficiency" (Doi et al., col. 1, lines 34 to 36). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will enhance the efficient operation thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Tonkin and Doi et al. are concerned with, for example, vehicle safety.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Thus, the combination of Tonkin and Doi et al. teaches the limitations that the applicants asserted were absent from the prior art during prosecution of the '781 patent, *i.e.*, disclose a vehicle proximity alarm that is activated based upon three parameters: (1) road speed, as determined by a road speed sensor; (2) separation, as determined by a radar detector; and (3) a vehicle speed/stopping distance table stored in a memory subsystem.

Accordingly, a substantial new question of patentability affecting claims 31 and 32 is raised by the combination of Tonkin and Doi et al.

As set forth in the appended charts, the combination of Tonkin and Doi et al. teaches all of the limitations of claims 31 and 32 of the '781 patent and therefore renders obvious claims 31 and 32 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claims 31 and 32 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Tonkin and Doi et al.

12. Claims 2, 4, and 5 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn '452, and Chasteen

Claims 2, 4, and 5 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Saturn '452, and Chasteen. Although Chasteen was cited by the Examiner during prosecution of the '781 patent, neither Jurgen nor Saturn '452 was cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claims 2, 4, and 5 are obvious in view of the combination of Jurgen, Saturn '452, and Chasteen was not previously considered. The combination of Jurgen, Saturn '452, and Chasteen is closer to the subject matter of claims 2, 4, and 5 of the '781 patent than any prior art that was relied upon during prosecution of the '781 patent. The combination of Jurgen, Saturn '452, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the '781 patent.

As more fully explained above, the Examiner concluded that claim 1, from which claims 2, 4, and 5 depend, was allowable over the prior art cited during prosecution on the basis that the prior art does not teach an upshift notification circuit, wherein the processor determines, based upon data received from sensors, when to activate said upshift notification circuit, and there is no indication in the prosecution history that any of dependent claims 2, 4, and 5 were allowable over the cited prior art for any reason other than their dependency from claim 1. As also more fully explained above, the combination of Jurgen and Saturn '452 raises a substantial new question of patentability affecting claim 1 and renders obvious claim 1 under 35 U.S.C. § 103(a).

During prosecution of the '781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 2, 4, and

5 obvious in view of the teachings of Chasteen.[10] For example, in rejecting claims 2 and 4 as obvious in view of Chasteen, the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provide s control command to the engine to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

In the amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claims 2 and 4 and did not present any arguments against the Examiner's findings. Instead, and as indicated above, the applicants amended claim 1, from which claims 2, 4 , and 5 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

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[10] To render a claim obvious, "[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations." M.P.E.P. § 2141

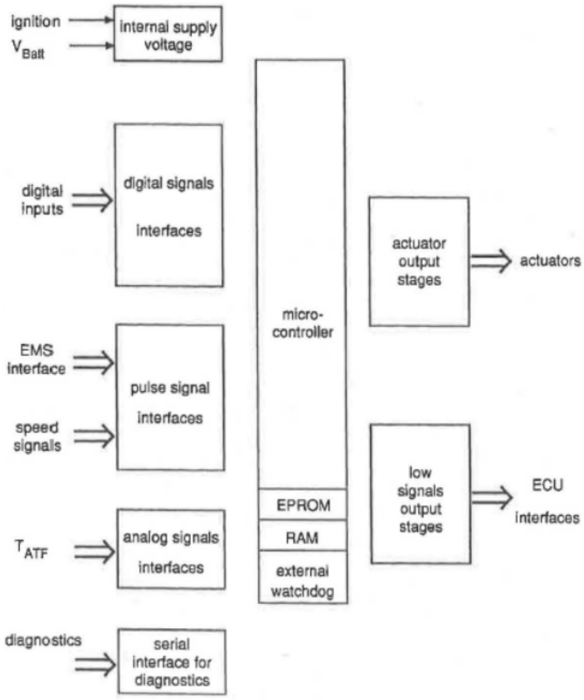

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 2, 4, and 5.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Because Saturn '452 discloses an upshift notification circuit triggered by a processor in response to sensors (*see* col. 2, lines 42 to 55), the Examiner's statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift notification circuit in view of Saturn '452.

A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, and 5 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Saturn '452, and Chasteen, and, in addition, would have been motivated to do so.

Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, and 5 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Saturn '452, and Chasteen, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to provide a "means for indicating to the operator a point in operation for upshifting to the next higher gear" (Saturn '452, Abstract), to provide "an improved method of determining shift points and indicating the same to a vehicle operator in order to maximize real driving fuel economy" (Saturn '452, col. 1, lines 44 to 47), and to indicate the "optimum fuel requirements for the engine" (Chasteen, col. 2, lines 48 to 54). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Saturn '452, and Chasteen are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Saturn '452, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Saturn ’452, and Chasteen teaches all of the limitations of claims 2, 4, and 5 of the ’781 patent and therefore renders obvious claims 2, 4, and 5 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 2, 4, and 5 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Saturn ’452, and Chasteen.

13. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, and Chasteen

Claims 2, 4, 5, 8, 10, 12, and 15 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Toyota ’599, and Chasteen. While Chasteen was cited by the Examiner during prosecution, neither Jurgen nor Toyota ’599 was cited by the Examiner or the applicants during prosecution. Thus, the question of whether claims 2, 4, 5, 8, 10, 12, and 15 are obvious in view of the combination of Jurgen, Toyota ’599, and Chasteen was not previously considered. The combination of Jurgen, Toyota ’599, and Chasteen is closer to the subject matter of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Toyota ’599, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 1, 7, and 13, from which claims 2, 4, 5, 8, 10, 12, and 15 depend, were allowable over the prior art cited during prosecution solely on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits, and there is no indication in the prosecution history that any of dependent claims 2, 4, 5, 8, 10, 12, and 15 were considered allowable over the cited prior art for any reason other than their dependency from claim 1, 7, or 13.

As set forth in more detail above, the combination of Jurgen and Toyota ’599 raises a substantial new question of patentability affecting claims 1, 7, and 13 and renders unpatentable claims 1, 7, and 13 under 35 U.S.C. § 103(a).

During prosecution of the ’781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 2, 4, 5, 8, 10, 12, and 15 obvious in view of the teachings of Chasteen.[11] For example, in rejecting claims 2, 4, and 8 as obvious in view of Chasteen, the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

In the Amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claims 2, 4, or 8 and did not present any arguments against the Examiner’s findings. Instead, and as indicate above, the applicants amended claim 1, from which claims 2, 4, and 5 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art. Similarly, the applicants rewrote claim 7, from which claims 8, 10, 12 depend, into independent form, in effect adding the downshift notification circuit limitations that the Examiner found missing from the prior art.[12] As for claim 15, which depends from claim 13, the Examiner allowed claim 13, and dependent claim 15, because claim 13 include the upshift and downshift notification circuit limitations that the Examiner found missing from the prior art.

Jurgen teaches an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also teaches that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21), and acceleration, *i.e.*, change in speed, (pages 7.8 to 7.18), and that the use of

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[11] To render a claim obvious, “[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations.” M.P.E.P. § 2141.

[12] *See*, *e.g.*, *Honeywell Int’l v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1144 (Fed. Cir. 2004) (“[Dependent c]laims 4, 8, and 19 were rewritten into independent form, and the original independent claims were cancelled, effectively adding the inlet guide vane limitations [of dependent claims 4, 8 and 19] to the claimed invention.”).

processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6) "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

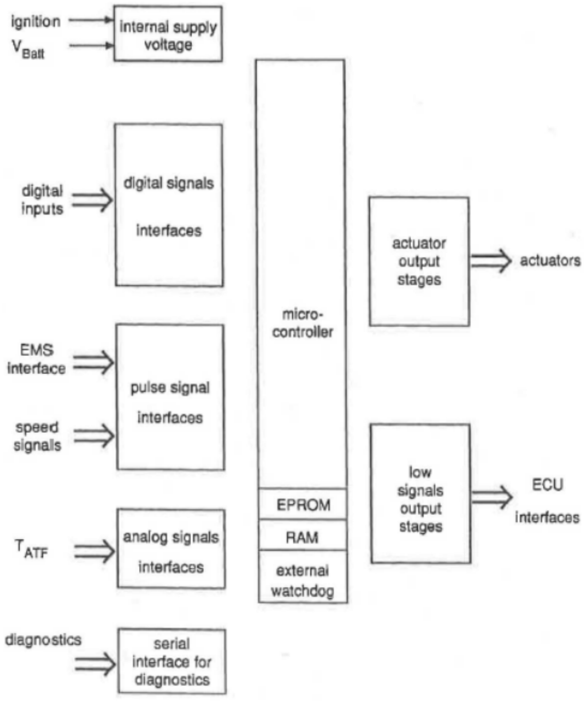

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 2, 4, 5, 8, 10, 12, and 15.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Based upon the Examiner's findings during the original prosecution, it would have been obvious to one of ordinary skill in the art to enable the fuel overinjection notification circuit based upon sensor inputs. For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Claims 5, 10, and 15 require that the upshift and/or downshift notification circuits are activated based upon the same types of sensor inputs. For example, claim 5 requires that "said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point." These claims were indicated as allowable because "the prior art fails to disclose an upshift notification circuit coupled to the processor subsystem, the upshift notification circuit issuing a notification that the engine of the vehicle is being operated at an excessive engine speed and the processor determines when to activate the upshift notification circuit and a downshift notification circuit coupled to the processor subsystem, the downshift notification circuit issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed and the processor determines when to activate the downshift notification circuit."[13] Because Toyota '599 discloses both upshift and downshift notification circuits triggered by a processor in response to sensors (*see* col. 5, line 63 to col. 6, line 2), the Examiner's statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift/downshift notification circuits in view of Toyota '599.

A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, 5, 8, 10, 12, and 15 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Toyota '599, and Chasteen, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, 5, 8, 10, 12, and 15 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Toyota '599, and Chasteen, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to "obtain preferable shift positions relating to optimum fuel consumption rate in accordance with . . . data detected" (Toyota

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[13] Claim 15 was explicitly allowed for the quoted reason. Claims 5 and 10 were objected to as being dependent on a rejected base claim, and were allowed when the upshift/downshift notification circuit limitations were added to the independent claims.

’599, Abstract), and to indicate the “optimum fuel requirements for the engine” (Chasteen, col. 2, lines 48 to 54). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Toyota ’599, and Chasteen are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Toyota ’599, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Toyota ’599, and Chasteen teaches all of the limitations of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent and therefore renders obvious claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Toyota ’599, and Chasteen.

14. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, and Chasteen

Claims 2, 4, 5, 8, 10, 12, and 15 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Volkswagen ’070, and Chasteen. Although Chasteen was cited during prosecution of the ’781 patent, neither Jurgen nor Volkswagen ’070 was cited by the Examiner or the applicants during prosecution. Thus, the question of whether claims 2, 4, 5, 8, 10, 12, and 15 are obvious in view of the combination of Jurgen, Volkswagen ’070, and Chasteen was not previously considered. The combination of Jurgen, Volkswagen ’070, and Chasteen is closer to the subject matter of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Volkswagen ’070, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 1, 7, and 13, from which claims 2, 4, 5, 8, 10, 12, and 15 depend, were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits, and there is no indication in the prosecution history that any of dependent claims 2, 4, 5, 8, 10, 12, and 15 were considered allowable over the prior art for any reason other than their dependency from claim 1, 7, or 13.

As set forth in more detail above, the combination of Jurgen and Volkswagen ’070 raises a substantial new question of patentability affecting claims 1, 7, and 13 and renders obvious claims 1, 7, and 13 under 35 U.S.C. § 103(a).

During prosecution of the ’781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 2, 4, 5, 8, 10, 12, and 15 obvious in view of the teachings of Chasteen.[14] For example, in rejecting claims 2, 4, and 8 as obvious in view of Chasteen, the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the

[14] To render a claim obvious, "[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations." M.P.E.P. § 2141.

> engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

In the Amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claims 2, 4, or 8 and did not present any arguments against the Examiner's findings. Instead, and as indicate above, the applicants amended claim 1, from which claims 2, 4, and 5 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art. Similarly, the applicants rewrote claim 7, from which claims 8, 10, 12 depend, into independent form, in effect adding the downshift notification circuit limitations that the Examiner found missing from the prior art.[15] As for claim 15, which depends from claim 13, the Examiner allowed claim 13, and dependent claim 15, because claim 13 include the upshift and downshift notification circuit limitations that the Examiner found missing from the prior art.

Jurgen teaches an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also teaches that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21), and acceleration, *i.e.*, change in speed, (pages 7.8 to 7.18), and that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

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[15] *See*, *e.g.*, *Honeywell Int'l v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1144 (Fed. Cir. 2004) ("[Dependent c]laims 4, 8, and 19 were rewritten into independent form, and the original independent claims were cancelled, effectively adding the inlet guide vane limitations [of dependent claims 4, 8 and 19] to the claimed invention.").

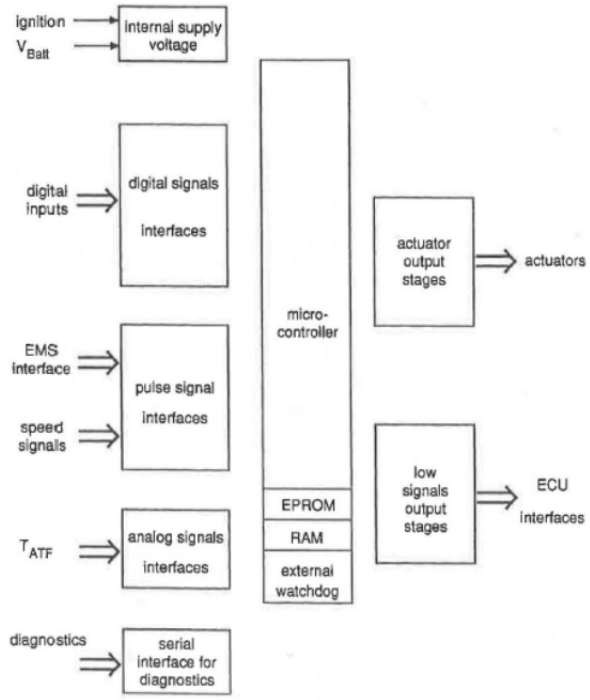

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 2, 4, 5, 8, 10, 12, and 15.

Volkswagen '070 acknowledges that automobile instrument panels that display fuel economy are in the prior art. For example, Volkswagen '070 describes at page 9:

> It is useful in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***induction manifold vacuum*** as a measure of the fuel consumption. . . . In this case it us useful to integrate the signal transmitters denoted by 4 and 5 in Figure 2 into the instrument of the fuel consumption display, as sketched in Figure 3. During standard driving operation, pointer 30 of the fuel consumption display sweeps scale 31, while it is hidden behind cover 32 during an idling operation or at full-load accelerations. Incorporated in the scale is arrow 33, which constitutes part of a signal transmitter requesting upshifting, which therefore corresponds to signal transmitter 4 in Figure 2.

(emphasis added)

Thus, by describing a fuel consumption display that indicates full-load acceleration, Volkswagen '070 teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," "means for determining when throttle position for said vehicle is increasing[/decreasing]," and the processor activating the fuel overinjection circuit based upon measurements from these sensors as claimed in claims 2, 4, 5, 8, 10, 12, and 15.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Based upon the Examiner's findings during the original prosecution, it would have been obvious to one of ordinary skill in the art to enable the fuel overinjection notification circuit based upon sensor inputs. For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Claims 5, 10, and 15 require that the upshift and/or downshift notification circuits are activated based upon the same types of sensor inputs. For example, claim 5 requires that "said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point." These claims were indicated as allowable because "the prior art fails to disclose an upshift notification circuit coupled to the processor subsystem, the upshift notification circuit issuing a notification that the engine of the vehicle is being operated at an excessive engine speed and the processor determines when to activate the upshift notification circuit and a downshift notification circuit coupled to the processor subsystem, the downshift notification circuit issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed and the processor determines when to activate the downshift notification circuit."[16] Because Volkswagen '070 discloses both upshift and downshift notification circuits triggered by a processor in response to sensors (*see* pages 6–8), the Examiner's statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift/downshift notification circuits in view of Volkswagen '070.

[16] Claim 15 was explicitly allowed for the quoted reason. Claims 5 and 10 were objected to as being dependent on a rejected base claim, and were allowed when the upshift/downshift notification circuit limitations were added to the independent claims.

A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent were made, would have found it obvious to combine the teachings of Jurgen, Volkswagen ’070, and Chasteen, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 2, 4, 5, 8, 10, 12, and 15 of the ’781 patent were made would have been further motivated to combine the teachings of Jurgen, Volkswagen ’070, and Chasteen, to “provide optimal driveability for all operating conditions” (Jurgen, Page 12.1), , to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to “provid[e] a device that assists the operator of the internal combustion engine equipped with a conventional transmission . . . for example, in setting an operating point of the engine that is advantageous in terms of fuel consumption” (Volkswagen ’070, page 5)and to indicate the “optimum fuel requirements for the engine” (Chasteen, col. 2, lines 48 to 54). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Volkswagen ’070, and Chasteen are concerned with, for example, improving fuel efficiency.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Volkswagen ’070, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-

> cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Volkswagen '070, and Chasteen teaches all of the limitations of claims 2, 4, 5, 8, 10, 12, and 15 of the '781 patent and therefore renders obvious claims 2, 4, 5, 8, 10, 12, and 15 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claims 2, 4, 5, 8, 10, 12, and 15 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Volkswagen '070, and Chasteen.

15. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota '599, Davidian, and Tonkin

Claim 18 is obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Toyota '599, Davidian, and Tonkin. Jurgen, Toyota '599, Davidian, and Tonkin were not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claim 18 is obvious in view of the combination of Jurgen, Toyota '599, Davidian, and Tonkin was not previously considered. The combination of Jurgen, Toyota '599, Davidian, and Tonkin is closer to the subject matter of claim 18 of the '781 patent than any prior art that was relied upon during prosecution of the '781 patent, and the combination of Jurgen, Toyota '599, Davidian, and Tonkin provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the '781 patent.

Claim 18 depends from claim 17, and adds the limitations of a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated and that the memory subsystem stores a second vehicle speed/stopping distance table.

As set forth in more detail above, the combination of Jurgen, Toyota ’599, and Davidian raises a substantial new question of patentability affecting claim 17 and renders obvious claim 17.

Tonkin teaches that “information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain.” Page 18, lines 9 to 13. Additionally, Tonkin teaches that “safe stopping distances can be adjusted for prevailing weather conditions.” Page 18, lines 16 to 19. Therefore, Tonkin discloses the adjustment of the vehicle speed/stopping distance tables based upon weather information determined from a windshield wiper sensor.

A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made, would have found it obvious to combine the teachings of Jurgen, Toyota ’599, Davidian, and Tonkin, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made would have been further motivated to combine the teachings of Jurgen, Toyota ’599, Davidian, and Tonkin, to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to “obtain preferable shift positions relating to optimum fuel consumption rate in accordance with . . . data detected” (Toyota ’599, Abstract), to provide an “anti-collision system for vehicles” that “computes[] the danger-of-collision distance to the object” (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to “provide safety information for example to drivers of following vehicles” (Tonkin, page 1, lines 4-5). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Toyota ’599, Davidian, and Tonkin are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Toyota ’599, Davidian, and Tonkin, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Regarding the second vehicle speed/stopping distance table, claim 18 merely recites that the memory subsystem stores a second vehicle speed/stopping distance table, and neither claim 18 nor claim 17, from which claim 18 depends, otherwise mentions the second vehicle speed/stopping distance table. Therefore, the second vehicle speed/stopping distance table is a mere duplication of parts, which has not patentable significance since no new or unexpected result is produced thereby. *See*, M.P.E.P. § 2144.04(VI)(B).

As set forth in the appended charts, the combination of Jurgen, Toyota ’599, Davidian, and Tonkin teaches all of the limitations of claim 18 of the ’781 patent and therefore renders obvious claim 18 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claim 18 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Toyota ’599, Davidian, and Tonkin.

16. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin

Claim 18 is obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin. Jurgen, Volkswagen ’070, Davidian, and Tonkin were not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claim 18 is obvious in view of the combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin was not previously considered. The combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin is closer to the subject matter of claim 18 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

Claim 18 depends from claim 17, and adds the limitations of a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated and that the memory subsystem stores a second vehicle speed/stopping distance table.

As set forth in more detail above, the combination of Jurgen, Volkswagen ’070, and Davidian raises a substantial new question of patentability affecting claim 17 and renders obvious claim 17.

Tonkin teaches that “information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain.” Page 18, lines 9 to 13. Additionally, Tonkin teaches that “safe stopping distances can be adjusted for prevailing weather conditions.” Page 18, lines 16 to 19. Therefore, Tonkin discloses the adjustment of the vehicle speed/stopping distance tables based upon weather information determined from a windshield wiper sensor.

A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made, would have found it obvious to combine the teachings of Jurgen, Volkswagen ’070, Davidian, and Tonkin, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made would have been further motivated to combine the teachings of Jurgen, Volkswagen ’070, Davidian, and Tonkin, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to "provid[e] a device that assists the operator of the internal combustion engine equipped with a conventional transmission . . . for example, in setting an operating point of the engine that is advantageous in terms of fuel consumption" (Volkswagen '070, Page 5), to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to "provide safety information for example to drivers of following vehicles" (Tonkin, page 1, lines 4-5). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Volkswagen '070, Davidian, and Tonkin are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Volkswagen '070, Davidian, and Tonkin, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
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> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either

the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Regarding the second vehicle speed/stopping distance table, claim 18 merely recites that the memory subsystem stores a second vehicle speed/stopping distance table, and neither claim 18 nor claim 17, from which claim 18 depends, otherwise mentions the second vehicle speed/stopping distance table. Therefore, the second vehicle speed/stopping distance table is a mere duplication of parts, which has not patentable significance since no new or unexpected result is produced thereby. *See*, M.P.E.P. § 2144.04(VI)(B).

As set forth in the appended charts, the combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin teaches all of the limitations of claim 18 of the ’781 patent and therefore renders obvious claim 18 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claim 18 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin.

17. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, Davidian, and Tonkin

Claim 18 is obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Saturn ’452, Davidian, and Tonkin. Jurgen, Saturn ’452, Davidian, and Tonkin were not cited by the Examiner or the applicants during prosecution. Therefore, the question of whether claim 18 is obvious in view of the combination of Jurgen, Saturn ’452, Davidian, and Tonkin was not previously considered. The combination of Jurgen, Saturn ’452, Davidian, and Tonkin is closer to the subject matter of claim 18 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Jurgen, Saturn ’452, Davidian, and Tonkin provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

Claim 18 depends from claim 17, and adds the limitations of a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated and that the memory subsystem stores a second vehicle speed/stopping distance table.

As set forth in more detail above, the combination of Jurgen, Saturn ’452, and Davidian raises a substantial new question of patentability affecting claim 17 and renders obvious claim 17.

Tonkin teaches that “information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain.” Page 18, lines 9 to 13. Additionally, Tonkin teaches that “safe stopping distances can be adjusted for prevailing weather conditions.”

Page 18, lines 16 to 19. Therefore, Tonkin discloses the adjustment of the vehicle speed/stopping distance tables based upon weather information determined from a windshield wiper sensor.

A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made, would have found it obvious to combine the teachings of Jurgen, Saturn ’452, Davidian, and Tonkin, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged invention of claim 18 of the ’781 patent was made would have been further motivated to combine the teachings of Jurgen, Saturn ’452, Davidian, and Tonkin, to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to provide a “means for indicating to the operator a point in operation for upshifting to the next higher gear” (Saturn ’452, Abstract), to provide “an improved method of determining shift points and indicating the same to a vehicle operator in order to maximize real driving fuel economy” (Saturn ’452, col. 1, lines 44 to 47). to provide an “anti-collision system for vehicles” that “computes[] the danger-of-collision distance to the object” (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to “provide safety information for example to drivers of following vehicles” (Tonkin, page 1, lines 4-5). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Saturn ’452, Davidian, and Tonkin are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Saturn ’452, Davidian, and Tonkin, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately

> in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

Regarding the second vehicle speed/stopping distance table, claim 18 merely recites that the memory subsystem stores a second vehicle speed/stopping distance table, and neither claim 18 nor claim 17, from which claim 18 depends, otherwise mentions the second vehicle speed/stopping distance table. Therefore, the second vehicle speed/stopping distance table is a mere duplication of parts, which has not patentable significance since no new or unexpected result is produced thereby. *See*, M.P.E.P. § 2144.04(VI)(B).

As set forth in the appended charts, the combination of Jurgen, Saturn '452, Davidian, and Tonkin teaches all of the limitations of claim 18 of the '781 patent and therefore renders obvious claim 18 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claim 18 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Saturn '452, Davidian, and Tonkin.

18. Claims 24 and 25 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn '452, Davidian and Chasteen

Claims 24 and 25 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Saturn '452, Davidian, and Chasteen. Although Chasteen was cited by the Examiner during prosecution of the '781 patent, Jurgen, Saturn '452, and Davidian were not cited by the Examiner or the applicants during prosecution. Thus, the question of whether claims 24 and 25 are obvious in view of the combination of Jurgen, Saturn '452, Davidian and Chasteen was not previously considered. The combination of Jurgen, Saturn '452, Davidian, and

Chasteen is closer to the subject matter of claims 24 and 25 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Saturn ’452, Davidian, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claim 23, from which claims 24 and 25 depend, was allowable over the prior art cited during prosecution on the basis that the prior art does not teach an upshift notification circuit, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits, and there is no indication in the prosecution history that either claim 24 or claim 25 was considered allowable over the cited prior art for any reason other than their dependency from claim 23.

As set forth in more detail above, the combination of Jurgen, Saturn ’452, and Davidian raises a substantial new question of patentability affecting claim 23 and renders obvious claim 23 under 35 U.S.C. § 103(a).

During prosecution of the ’781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 24 and 25 obvious in view of the teachings of Chasteen.[17] For example, in rejecting claim 24 as obvious in view of the combination of Chasteen and Doi et al., the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

In the Amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claim 24 or 25 and did not present any arguments against the Examiner’s findings. Instead, and as indicate above, the applicants amended claim 23, from which claims 24 and 25 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art.

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[17] To render a claim obvious, “[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations.” M.P.E.P. § 2141.

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

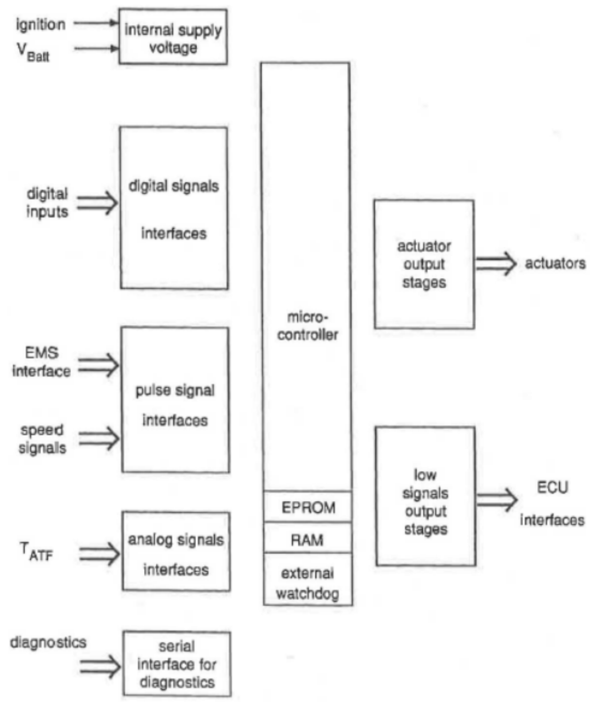

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 24, 25, and 27.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Based upon the Examiner's statements during the original prosecution, it would have been obvious to one of ordinary skill in the art to enable the fuel overinjection notification circuit based upon sensor inputs. For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Claim 25 describes that the upshift notification circuit is activated based upon the same types of sensor inputs. For example, claim 25 requires that "said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point." Because Saturn '452 discloses an upshift notification circuit triggered by a processor in response to sensors (*see* col. 2, lines 42 to 55) the Examiner's statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift notification circuit in view of Saturn '452.

A person of ordinary skill in the art, at the time the alleged inventions of claims 24 and 25 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Saturn '452, Davidian, and Chasteen, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 24 and 25 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Saturn '452, Davidian, and Chasteen, to "provide optimal driveability for all operating conditions" (Jurgen, Page 12.1), to "provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to provide a "means for indicating to the operator a point in operation for upshifting to the next higher gear" (Saturn '452, Abstract), to provide "an improved method of determining shift points and indicating the same to a vehicle operator in order to maximize real driving fuel economy" (Saturn '452, col. 1, lines 44 to 47), to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to indicate the "optimum fuel requirements for the engine" (Chasteen, col. 2, lines 48 to 54). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Jurgen, Saturn '452, Davidian, and Chasteen are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Saturn '452, Davidian, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
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> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Saturn '452, Davidian, and Chasteen teaches all of the limitations of claims 24 and 25 of the '781 patent and therefore renders obvious claims 24 and 25 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claims 24 and 25 of the '781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Saturn '452, Davidian, and Chasteen.

19. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota '599, Davidian and Chasteen

Claims 24, 25, and 27 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Toyota '599, Davidian and Chasteen. Although Chasteen was cited by the Examiner during prosecution of the ’781 patent, Jurgen, Toyota ’599, and Davidian were not cited by the Examiner or the applicants during prosecution. Thus, the question of whether claims 24, 25, and 27 are obvious in view of the combination of Jurgen, Toyota ’599, Davidian and Chasteen was not previously considered. The combination of Jurgen, Toyota ’599, Davidian, and Chasteen is closer to the subject matter of claims 24, 25, and 27 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Toyota ’599, Davidian, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 23 and 26, from which claims 24, 25, and 27 depend, were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits, and there is no indication in the prosecution history that any of dependent claims 24, 25, and 27 were considered allowable over the cited prior art for any reason other than their dependency from claim 23 or 26.

As set forth in more detail above, the combination of Jurgen, Toyota ’599, and Davidian raises a substantial new question of patentability affecting claims 23 and 26 and renders obvious claims 23 and 26 under 35 U.S.C. § 103(a).

During prosecution of the ’781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 24, 25, and 27 obvious in view of the teachings of Chasteen.[18] For example, in rejecting claim 24 as obvious in view of the combination of Chasteen and Doi et al., the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

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[18] To render a claim obvious, “[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations.” M.P.E.P. § 2141.

In the Amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claim 24, 25, or 27 and did not present any arguments against the Examiner's findings. Instead, and as indicate above, the applicants amended claim 23, from which claims 24 and 25 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art, and rewrote claim 26, from which, claim 27 depends, in effect adding the downshift notification circuit limitations that the Examiner found missing from the prior art.[19]

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

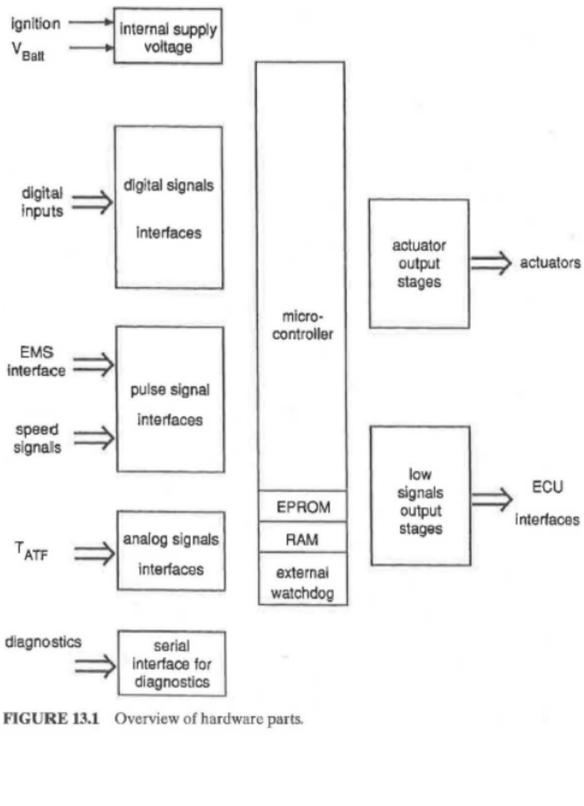

FIGURE 13.1 Overview of hardware parts.

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[19] *See*, *e.g.*, *Honeywell Int'l v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1144 (Fed. Cir. 2004) ("[Dependent c]laims 4, 8, and 19 were rewritten into independent form, and the original independent claims were cancelled, effectively adding the inlet guide vane limitations [of dependent claims 4, 8 and 19] to the claimed invention.").

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 24, 25, and 27.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Based upon the Examiner's statements during the original prosecution, it would have been obvious to one of ordinary skill in the art to enable the fuel overinjection notification circuit based upon sensor inputs. For example, the combination of the ECU, which monitors all of the vehicle's sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Claims 25 and 27 require that the upshift and/or downshift notification circuits are activated based upon the same types of sensor inputs. For example, claim 25 requires that "said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point." Because Toyota '599 discloses both upshift and downshift notification circuits triggered by a processor in response to sensors (*see* col. 5, line 63 to col. 6, line 2), the Examiner's statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift/downshift notification circuits in view of Toyota '599.

A person of ordinary skill in the art, at the time the alleged inventions of claims 24, 25, and 27 of the '781 patent were made, would have found it obvious to combine the teachings of Jurgen, Toyota '599, Davidian, and Chasteen, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: "The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur." (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 24, 25, and 27 of the '781 patent were made would have been further motivated to combine the teachings of Jurgen, Toyota ’599, Davidian, and Chasteen, to “provide optimal driveability for all operating conditions” (Jurgen, Page 12.1), to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to “obtain preferable shift positions relating to optimum fuel consumption rate in accordance with [] data detected” (Toyota ’599, Abstract), to provide an “anti-collision system for vehicles” that “computes[] the danger-of-collision distance to the object” (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to indicate the “optimum fuel requirements for the engine” (Chasteen, col. 2, lines 48 to 54). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Toyota ’599, Davidian, and Chasteen are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Toyota ’599, Davidian, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either

the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Toyota ’599, Davidian, and Chasteen teaches all of the limitations of claims 24, 25, and 27 of the ’781 patent and therefore renders obvious claims 24, 25, and 27 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 24, 25, and 27 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Toyota ’599, Davidian, and Chasteen.

20. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian and Chasteen

Claims 24, 25, and 27 are obvious under 35 U.S.C. § 103(a) in view of the combination of Jurgen, Volkswagen ’070, Davidian and Chasteen. Although Chasteen was cited by the Examiner during prosecution of the ’781 patent, Jurgen, Volkswagen ’070, and Davidian were not cited by the Examiner or the applicants during prosecution. Thus, the question of whether claims 24, 25, and 27 are obvious in view of the combination of Jurgen, Volkswagen ’070, Davidian and Chasteen was not previously considered. The combination of Jurgen, Volkswagen ’070, Davidian, and Chasteen is closer to the subject matter of claims 24, 25, and 27 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent. The combination of Jurgen, Volkswagen ’070, Davidian, and Chasteen provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

As more fully explained above, the Examiner concluded that claims 23 and 26, from which claims 24, 25, and 27 depend, were allowable over the prior art cited during prosecution on the basis that the prior art does not teach upshift and/or downshift notification circuits, wherein the processor determines, based upon data received from sensors, when to activate said upshift and/or downshift notification circuits, and there is no indication in the prosecution history that any of dependent claims 24, 25, and 27 were considered allowable over the cited prior art for any reason other than their dependency from claim 23 or 26.

As set forth in more detail above, the combination of Jurgen, Volkswagen ’070, and Davidian raises a substantial new question of patentability affecting claims 23 and 26 and renders obvious claims 23 and 26 under 35 U.S.C. § 103(a).

During prosecution of the ’781 patent, the Examiner determined that a person of ordinary skill in the art would have found the added limitations of dependent claims 24, 25, and 27 obvious in view of the teachings of Chasteen.[20] For example, in rejecting claim 24 as obvious in view of the combination of Chasteen and Doi et al., the Examiner found that:

> Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare [sic] manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.

In the Amendment filed by the applicants in response to the Office Action containing the foregoing findings, the applicants did not amend claim 24, 25, or 27 and did not present any arguments against the Examiner's findings. Instead, and as indicate above, the applicants amended claim 23, from which claims 24 and 25 depend, to include the upshift notification circuit limitations that the Examiner found missing from the prior art, and rewrote claim 26, from which, claim 27 depends, in effect adding the downshift notification circuit limitations that the Examiner found missing from the prior art.[21]

Jurgen discloses an electronic engine control system that receives sensor inputs, evaluates them, and determines the necessary outputs to provide for optimal driveability. (Jurgen, page 12.1). Jurgen also discloses that these sensors monitor engine speed (page 7.6), road speed (pages 7.8, 14.3), manifold pressure (pages 2.5, 2.7), throttle position (page 12.21). Jurgen also teaches that the use of processor subsystems to receive inputs from these sensors was known. (Pages 12.1, 13.6, 22.6). "During the entire operating time of the vehicle, the ECUs are constantly supervising the sensors they are connected to." (Page 22.6). Indeed, Jurgen discloses a diagram of these hardware parts:

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[20] To render a claim obvious, "[t]he prior art reference (or references when combined) need not teach or suggest all of the claim limitations." M.P.E.P. § 2141.

[21] *See*, *e.g.*, *Honeywell Int'l v. Hamilton Sundstrand Corp.*, 370 F.3d 1131, 1144 (Fed. Cir. 2004) ("[Dependent c]laims 4, 8, and 19 were rewritten into independent form, and the original independent claims were cancelled, effectively adding the inlet guide vane limitations [of dependent claims 4, 8 and 19] to the claimed invention.").

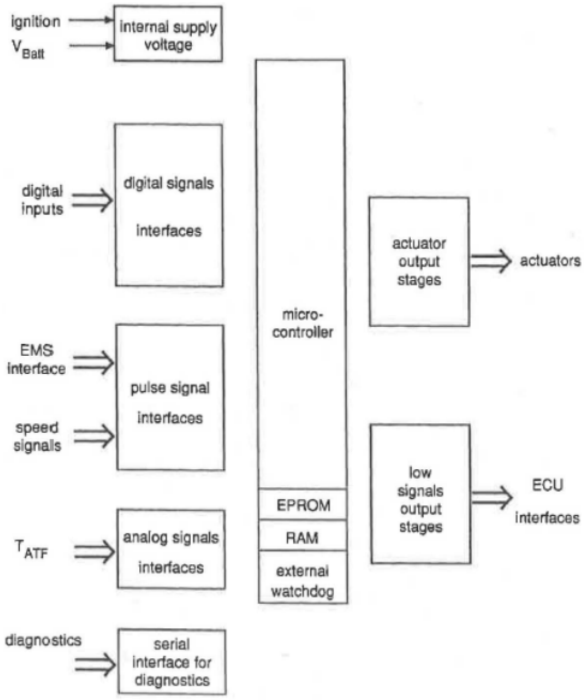

FIGURE 13.1 Overview of hardware parts.

Jurgen, therefore, teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing]," and "means for determining when throttle position for said vehicle is increasing[/decreasing]" as claimed in claims 24, 25, and 27.

Volkswagen '070 acknowledges that automobile instrument panels that display fuel economy are in the prior art. For example, Volkswagen '070 describes at page 9:

> It is useful in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***induction manifold vacuum*** as a measure of the fuel consumption. . . . In this case it us useful to integrate the signal transmitters denoted by 4 and 5 in Figure 2 into the instrument of the fuel consumption display, as sketched in Figure 3. During standard driving operation, pointer 30 of the fuel consumption display sweeps scale 31, while it is hidden behind cover 32 during an idling operation or at full-load accelerations. Incorporated in the scale is arrow 33, which constitutes part of a signal transmitter requesting upshifting, which therefore corresponds to signal transmitter 4 in Figure 2.

(emphasis added)

Thus, by describing a fuel consumption display that indicates full-load acceleration, Volkswagen '070 teaches "means for determining when road speed for said vehicle is increasing[/decreasing]," means for determining when throttle position for said vehicle is increasing[/decreasing],” “means for determining when throttle position for said vehicle is increasing[/decreasing],” and the processor activating the fuel overinjection circuit based upon measurements from these sensors as claimed in claims 2, 4, 5, 8, 10, 12, and 15.

Jurgen teaches a fuel overinjection notification circuit, which issues a notification that excessive fuel is being supplied to the engine of the vehicle. For example, the ECU taught by Jurgen can shut off fuel in certain situations by evaluating the throttle position, engine RPM, and vehicle speed. (Page 12.4). Additionally, the ECU can shut off fuel injectors when a maximum speed is achieved (page 12.14). The ECU provides the fuel overinjection notification to the fuel injectors when a fuel cutoff state is reached. Based upon the Examiner’s statements during the original prosecution, it would have been obvious to one of ordinary skill in the art to enable the fuel overinjection notification circuit based upon sensor inputs. For example, the combination of the ECU, which monitors all of the vehicle’s sensors (see above) and the TCU, which stores the shift maps, can send notification circuits to the fuel injectors and/or the transmission in order to alleviate a fuel overinjection condition.

Claims 25 and 27 require that the upshift and/or downshift notification circuits are activated based upon the same types of sensor inputs. For example, claim 25 requires that “said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.” Because Volkswagen ’070 discloses both upshift and downshift notification circuits triggered by a processor in response to sensors (*see* pages 6–8), the Examiner’s statements that the fuel overinjection circuit triggered based upon sensor inputs would have been obvious in view of Chasteen also apply to the upshift/downshift notification circuits in view of Volkswagen ’070.

A person of ordinary skill in the art, at the time the alleged inventions of claims 24, 25, and 27 of the ’781 patent were made, would have found it obvious to combine the teachings of Jurgen, Volkswagen ’070, Davidian, and Chasteen, and, in addition, would have been motivated to do so. Indeed, Jurgen, for example, expressly describes one such motivation: “The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, provide optimal driveability for all operating conditions, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.” (Jurgen, Page 12.1). A person of ordinary skill in the art, at the time the alleged inventions of claims 24, 25, and 27 of the ’781 patent were made would have been further motivated to combine the teachings of

Jurgen, Volkswagen ’070, Davidian, and Chasteen, to “provide optimal driveability for all operating conditions” (Jurgen, Page 12.1), to “provide[] the fuel metering and ignition timing precision to minimize fuel consumption (Jurgen, Page 12.4), to “provid[e] a device that assists the operator of the internal combustion engine equipped with a conventional transmission . . . for example, in setting an operating point of the engine that is advantageous in terms of fuel consumption” (Volkswagen ’070, Page 5), to provide an “anti-collision system for vehicles” that “computes[] the danger-of-collision distance to the object” (Davidian, Col. 1, line 7 and col. 2, lines 3 to 4), and to indicate the “optimum fuel requirements for the engine” (Chasteen, col. 2, lines 48 to 54). The ’781 patent states that its object is to “provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will ***enhance the efficient operation*** thereof with the ability to automatically take corrective action ***if the vehicle is being operated unsafely***.” Col. 1, line 66 to col. 2, line 5. Thus, like the ’781 patent, Jurgen, Volkswagen ’070, Davidian, and Chasteen are concerned with, for example, improving fuel efficiency and safety.

Furthermore, as additional evidence that a person of ordinary skill in the art would be motivated to combine the teachings of Jurgen, Volkswagen ’070, Davidian, and Chasteen, Jurgen describes at page xvii:

> Automotive electronics as we know it today encompasses a wide variety of devices and systems. Key to them all, and those yet to come, is the ability to sense and measure accurately automotive parameters. Equally important at the output is the ability to initiate control actions accurately in response to commands. In other words, sensors and actuators are the heart of any automotive electronics application. . . .
>
> The importance of sensors and actuators cannot be overemphasized. The future growth of automotive electronics is arguably more dependent on sufficiently accurate and low-cost sensors and actuators than on computers, controls, displays, and other technologies.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either

the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Jurgen, Volkswagen ’070, Davidian, and Chasteen teaches all of the limitations of claims 24, 25, and 27 of the ’781 patent and therefore renders obvious claims 24, 25, and 27 of the ’781 patent. Therefore, VWGoA proposes a ground of rejection of claims 24, 25, and 27 of the ’781 patent under 35 U.S.C. § 103(a) as obvious in view of the combination of Jurgen, Volkswagen ’070, Davidian, and Chasteen.

21. Claim 32 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Davidian and Tonkin

Claim 32 is obvious under 35 U.S.C. § 103(a) in view of the combination of Davidian, Chasteen, and Tonkin. Neither Davidian nor Tonkin was cited by the Examiner or the applicants during prosecution of the ’781 patent. Therefore, the question of whether claim 32 is obvious in view of the combination of Davidian and Tonkin was not previously considered. The combination of Davidian and Tonkin is closer to the subject matter of claim 32 of the ’781 patent than any prior art that was relied upon during prosecution of the ’781 patent, and the combination of Davidian and Tonkin provides new, non-cumulative technical teachings that were not otherwise provided in any prior art that was relied upon during prosecution of the ’781 patent.

Claim 32 depends from claim 31. As set forth in more detail above, Davidian raises a substantial new question of patentability affecting claim 31 and anticipates claim 31 under 35 U.S.C. § 102(b).

Claim 32 adds the limitations of a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated and that the memory subsystem further stores a second vehicle speed/stopping distance table. During prosecution of the ’781 patent, the applicants stated that “the windshield wiper sensor [of claim 32] is not used to inform the operator as to whether the windshield wipers are on or off.” Rather, according to the applicants, “the sensor is used by the processor subsystem to classify road conditions as either ‘dry’ or ‘wet’.” Davidian describes that the automatic sensors of the vehicle include a rain sensor 16 (col. 4, line 67 to col. 5, line 2), and Tonkin describes that safe stopping distances can be adjusted for prevailing weather conditions, and that information regarding the weather may be obtained by the warning system controller ascertaining if the windscreen wipers are in use or have been in use recently due to rain (col. 18, lines 9 to 16). Thus, the combination of Davidian and Tonkin teaches a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated, as described in claim 32.

Regarding the memory subsystem storing a second vehicle speed/stopping distance table, Tonkin describes that "safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather." Page 18, lines 16 to 19. Thus, Tonkin teaches a memory subsystem storing a second vehicle speed/stopping distance table, as described in claim 32.

Claim 32 additionally recites that:

> if said windshield wiper sensor indicates that said windshield wiper is deactivated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based on data received from said radar detector, said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem;

and

> if said windshield wiper sensor indicates that said windshield wiper is activated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based on data received from said radar detector, said road speed sensor and said second vehicle speed/stopping distance table stored in said memory subsystem.

According to the applicants, "[i]f the road is dry, the processor subsystem uses a first vehicle speed/stopping distance table to determine if an object is too closed to the vehicle" and "[i] the road is wet, however, the processor subsystem uses a second vehicle speed/stopping distance table to determine if the object is too close to the vehicle." Referring, for example, to page 18, lines 19 to 26, Tonkin teaches the same control strategy:

> [A] two level warning system can be provided wherein, a first waning, e.g. turn on all lamps 13, when a trailing vehicle 18 encroaches within the safe stopping distance of the subject vehicle 16 for poor weather conditions, and a second warning e.g. flash all or some lamps 13, if the trailing vehicle encroaches within the safe stopping distance for good conditions.

A person of ordinary skill in the art, at the time the alleged inventions of claim 18 of the '781 patent was made, would have found it obvious to combine the teachings of Davidian Chasteen, and Tonkin and, in addition, would have been motivated to do so, for example, to provide an "anti-collision system for vehicles" that "computes[] the danger-of-collision distance to the object" (Davidian, Col. 1, line 7 and col. 2, lines 3-4) and to "provide safety information for example to drivers of following vehicles" (Tonkin, page 1, lines 4-5). The '781 patent states that its object is to "provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will enhance the efficient operation thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely." Col. 1, line 66 to col. 2, line 5. Thus, like the '781 patent, Tonkin and Doi et al. are concerned with, for example, vehicle safety.

Moreover, the combination of these teachings is merely (a) the combination of prior art elements according to known methods to yield predictable results; (b) the simple substitution of known elements for one another to obtain predictable results; (c) the use of known techniques to improve similar devices in the same way; (d) the application of known techniques to known devices ready for improvement to yield predictable results; (e) obvious to try; and (f) known to work in one field of endeavor prompting variations for use in either the same field or a different one based on design incentives or other market forces since the variations are predictable to one of ordinary skill in the art.

As set forth in the appended charts, the combination of Davidian and Tonkin teaches all of the limitations of claim 32 of the '781 patent and therefore renders obvious claim 32 of the '781 patent. Therefore, VWGoA proposes a ground of rejection of claim 32 of the '781 patent under 35 U.S.C. § 103(a) as obvious by the combination of Davidian and Tonkin.

VIII. VWGoA's PROPOSED GROUNDS OF REJECTION

In view of all of the foregoing, and the annexed claim charts, VWGoA respectfully proposes the following grounds of rejection:

1. Claim 1 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Saturn '452

2. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Toyota '599

3. Claims 1, 7, and 13 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Volkswagen '070

4. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota '599, and Davidian

5. Claims 17–23 and 26 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen '070, and Davidian

6. Claims 17–21 and 23 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn '452, and Davidian

7. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Nissan ’055

8. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and Mack ’324

9. Claims 28–30 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen and GM ’753

10. Claim 31 is Anticipated Under 35 U.S.C. § 102(b) by Davidian

11. Claims 31 and 32 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Tonkin and Doi et al.

12. Claims 2, 4, and 5 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, and Chasteen

13. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, and Chasteen

14. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, and Chasteen

15. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, Davidian, and Tonkin

16. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin

17. Claim 18 is Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, Davidian, and Tonkin

18. Claims 24 and 25 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Saturn ’452, Davidian and Chasteen

19. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Toyota ’599, Davidian and Chasteen

20. Claims 24, 25, and 27 are Obvious Under 35 U.S.C. § 103(a) in View of the Combination of Jurgen, Volkswagen ’070, Davidian and Chasteen

21. Claim 32 is Obvious Under 35 U.S.C. § 103(a) in in View of the combination of Davidian and Tonkin

IX. <u>FEE PURSUANT TO 37 C.F.R. § 1.510(a)</u>

The fee under 37 C.F.R. § 1.510(a) for requesting *ex parte* reexamination is being paid by credit card. The Director is authorized to charge any additional fees that may be required in connection with this paper or these proceedings on behalf of Requester, Volkswagen Group of America, Inc., to the deposit account of Kenyon & Kenyon LLP, Deposit Account ***11-0600***.

X. <u>CERTIFICATION PURSUANT TO 37 C.F.R. § 1.510(b)(5)</u>

According to 37 C.F.R. § 1.510(b)(5), a request for *ex parte* reexamination must include a certification that a copy of the request filed by a person other than the patent owner has been served in its entirety on the patent owner at the address as provided for in 37 C.F.R. § 1.33(c).

According to the Office's PAIR system, the correspondence address for the '781 patent is: Michael S. Bush, Haynes & Boone LLP, 3100 Nationsbank Plaza, 901 Main Street, Dallas, TX 75202-3789. Accordingly, a copy of this Request is being served in its entirety at the foregoing correspondence address as provided for in 37 C.F.R. § 1.33(c), in accordance with 37 C.F.R. § 1.510(b)(5). A certificate of service is annexed hereto as Exhibit 10, which sets forth that, pursuant to 37 C.F.R. § 1. 1.510(b)(5), a copy of this Request is being served in its entirety on "the patent owner at the address as provided for in [37 C.F.R.] § 1.33(c)" at the following address: 3100 Nationsbank Plaza, 901 Main Street, Dallas, TX 75202-3789**.**

XI. <u>CERTIFICATION PURSUANT TO 37 C.F.R. § 1.510(b)(6)</u>

Requester Volkswagen Group of America, Inc. hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit the filing of the *ex parte* reexamination request.

XII. CONCLUSION

For all of the reasons set forth above, reexamination of claims 1, 2, 4, 5, 7, 8, 10, 12, 13, 15, and 17–32 of the ’781 patent is requested.

Respectfully submitted,

Date: May 22, 2014

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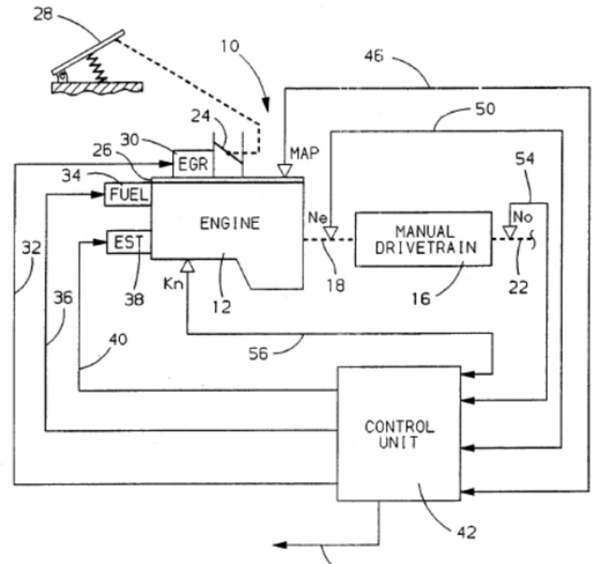
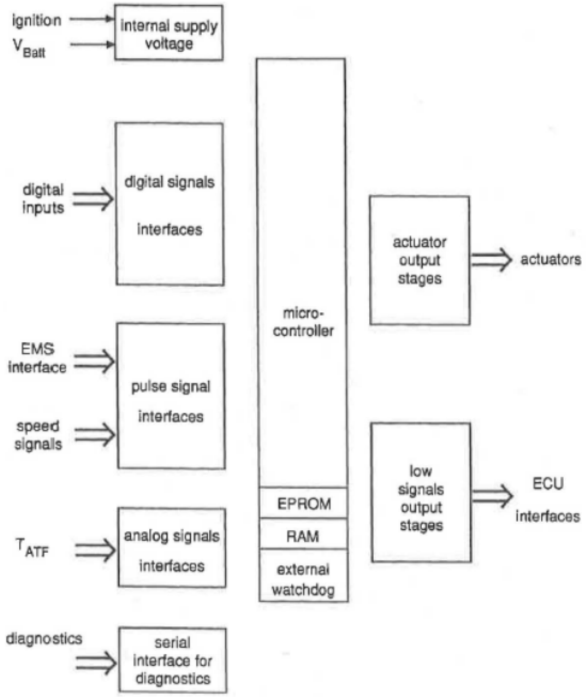
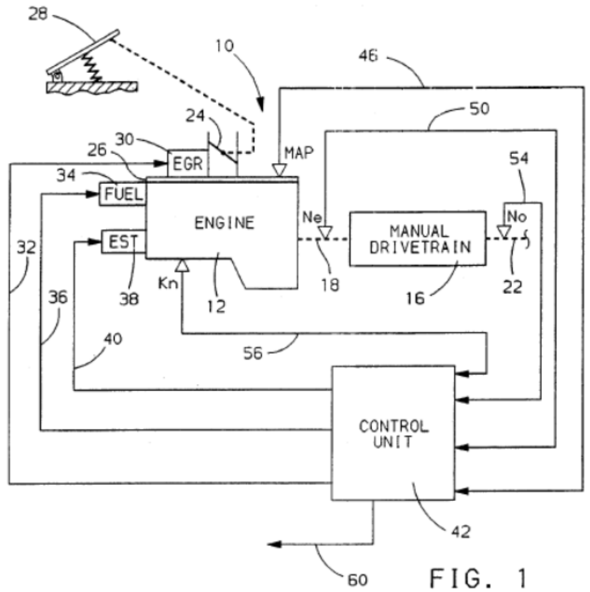
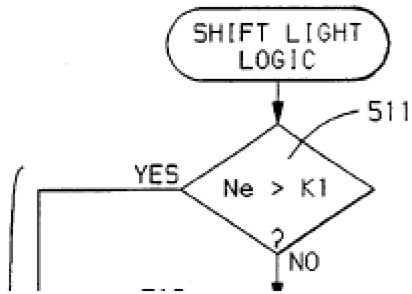
Appendix

1. <u>Claim 1 is Obvious in View of the Combination of Jurgen and Saturn ’452</u>

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)
1. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., Abstract, “***A motor vehicle has a manual transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear.”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***”	E.g., col. 1, lines 31 to 33, “Conventional shift indicator calibration typically involves setting ***manifold pressure*** (MAP) thresholds at a variety of speeds.” E.g., col. 2, lines 13 to 18, “Referring to FIG. 1, the reference numeral 10 generally designates a motor vehicle drivetrain comprising a spark ignition ***internal combustion engine (engine)*** 12, engine output shaft 10 and the combination of conventional manual clutch, gearbox and final drive assembly (manual drivetrain) 16.” E.g., col. 2, lines 42 to 44, “Control unit 42 receives inputs required by the present embodiment including ***manifold absolute pressure (MAP)***, on line 46, ***engine speed (Ne)*** on line 50 and output speed (No) on line 54.” E.g., col. 7, lines 13 to 21, “Throttle position “%T” is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle.

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)
	E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552.” E.g., FIG. 1:  FIG. 1
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:	E.g., col. 2, lines 42 to 46, “***Control unit 42 receives inputs*** required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42.” E.g., col. 2, lines 52 to 55, “***Control unit 42 may be mechanized with a conventional state of the art microcomputer controller*** including a central processing unit, memory and input-output devices.” E.g., FIG. 1:

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)
	 **FIGURE 13.1** Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	 FIG. 1
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda	E.g., col. 2, lines 52 to 55, “Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, ***memory*** and input-output devices.” E.g., col. 6, lines 55 to 60, “First, ***engine speed Ne is checked at block 511 to determine if it exceeds a predetermined maximum allowable engine speed threshold K1***. If the threshold is exceeded then an upshift is required regardless of the value of UTR and control is therefore passed via line 560 to block 542 where the shift

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)
	closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).”	light flag is set to one (SL FLAG=1). If the threshold at block 511 is not exceeded, decision block 512 is encountered.” E.g., FIG. 5: 
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle***	

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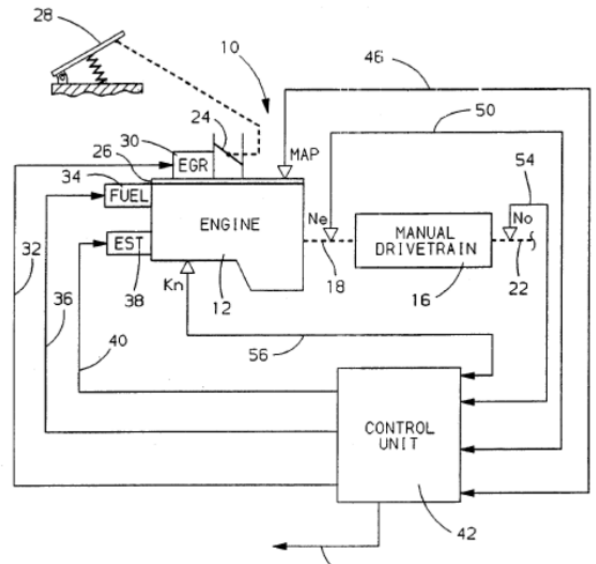
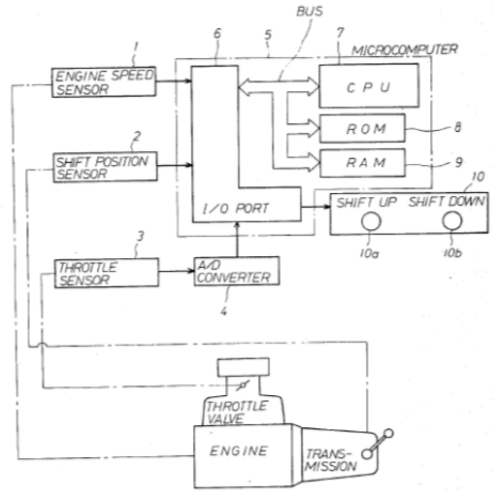
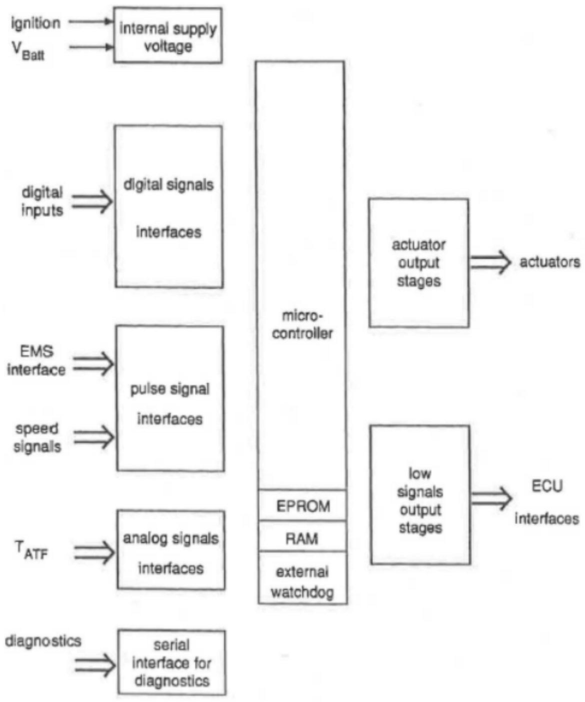
	position, engine RPM, and vehicle speed. "	
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)." E.g., page 13.14, "In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power."	E.g., Abstract, "***A motor vehicle has a manual transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear." E.g., col. 1, lines 10 to 13, "Shift indicators are commonly used on manual transmission vehicles ***to assist non-expert drivers in determining when it is appropriate to shift the transmission to a higher gear*** in order to maximize driving fuel economy." E.g., col. 2, lines 42 to 55, "Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices." E.g., col. 3, lines 60 to 65, "Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example."
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.*** "	E.g., col. 2, lines 42 to 55, "Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit***

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)
activate said upshift notification circuit.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices.” E.g., col. 3, lines 60 to 65, “Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example.” E.g., FIG. 1:  FIG. 1

2. Claims 1, 7, and 13 are Obvious in View of the Combination of Jurgen and Toyota '599

Limitation of '781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)
1. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***"
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***"	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 43 to 48, "***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., col. 2, lines 52 to 59, "Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)
	E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 37 to 42, “***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing unit (CPU) 7***, a read only memory (ROM) 8, and a random access

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)
	E.g., Figure 13.1:  **FIGURE 13.1** Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and ***the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5*** through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, ***the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5*** through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***”

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)
	replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is	E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:

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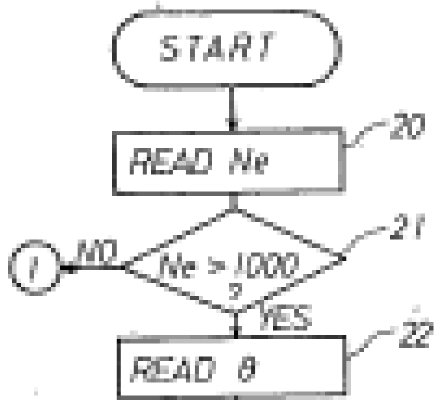
	plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque***	

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)
	and to assist in engine braking. The fuel is then shut off. During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 5, line 63 to col. 6, line 2, “Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, ***a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position*** ***SP_{+1} is preferable.***” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate*** ***B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated,*** thus indicating the necessity of the speed change operation.”
said processor subsystem determining, based upon data received from said plurality of	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access***

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sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.	***determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	***memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9." E.g., col. 2, lines 59 to 63, "***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***" E.g., col. 5, line 63 to col. 6, line 2, "***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position*** SP_{+1} ***is preferable.***"

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7. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., Abstract, “***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after

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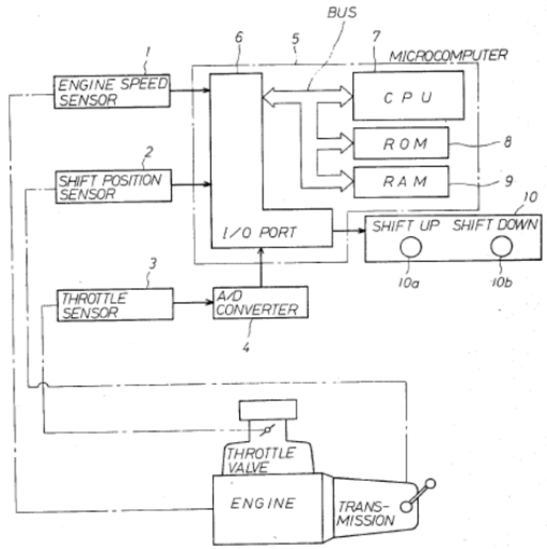
	input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	converting from the analog signals into the digital signals.” E.g., FIG. 1: 
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 37 to 42, “***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing unit (CPU) 7***, a read only memory (ROM) 8, and a random access

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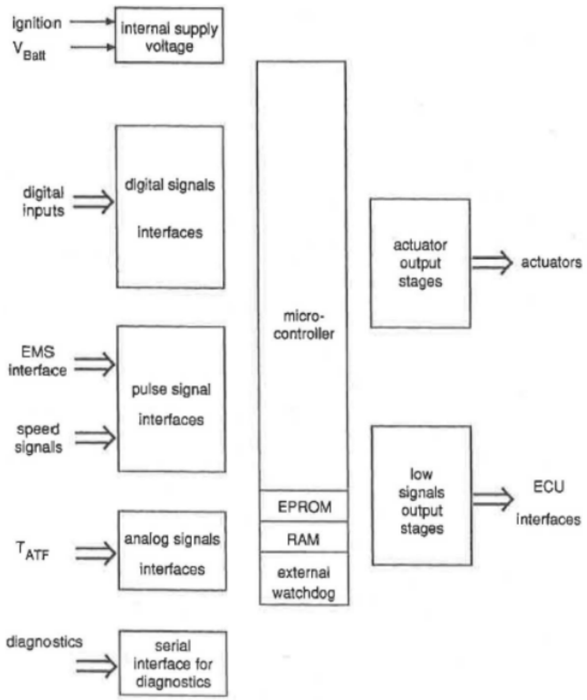
	E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and ***the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5*** through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, ***the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5*** through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***”

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	replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is	E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:

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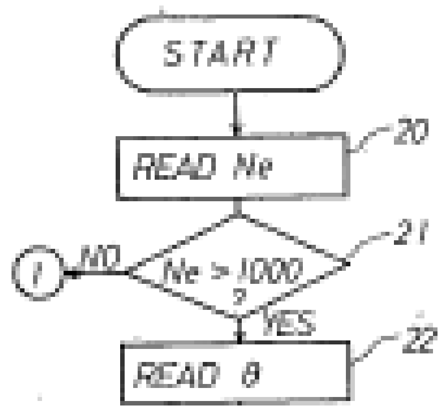
	plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque***	

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	and to assist in engine braking. The fuel is then shut off. During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 7, lines 10 to 17, “***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable.” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate*** B_e***, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation.”
said processor subsystem determining, based upon data received from said plurality of	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access***

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sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.	***determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position*** SP_{+1} ***is preferable.***”

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13. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***"
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 43 to 48, "***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., col. 2, lines 52 to 59, "Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after

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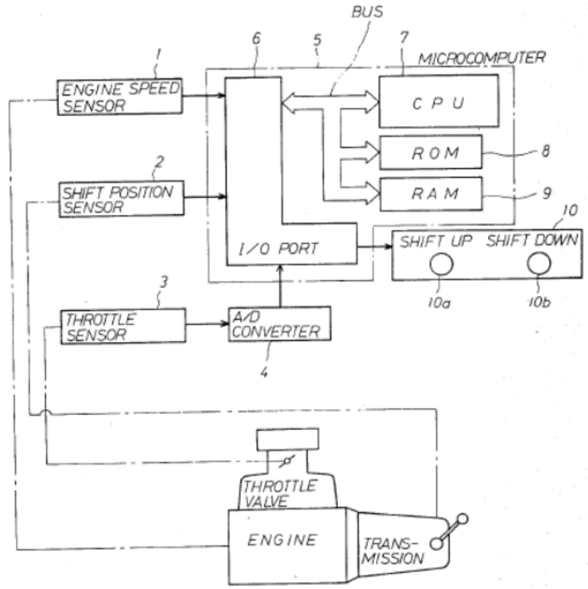
	input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models." E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	converting from the analog signals into the digital signals." E.g., FIG. 1: 
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 37 to 42, "***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing***

<table>
<tr><th>Limitation of ’781 Patent Claim 13</th><th>Automotive Electronics Handbook (Jurgen)</th><th>U.S. Patent No. 4,559,599 (Toyota ’599)</th></tr>
<tr><td></td><td>components and monitoring and safety circuits (Fig. 13.1).”

E.g., Figure 13.1:

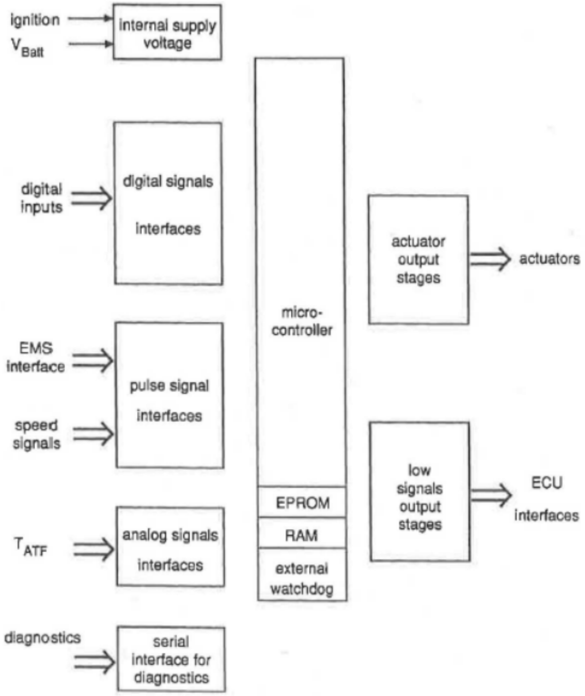


FIGURE 13.1 Overview of hardware parts.

E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the microcontroller calculates the vehicle speed from the speed sensor’s signal to within 1/32 m/h.”</td><td>unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.”

E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.”

E.g., col. 2, lines 52 to 59, “Similarly, the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”</td></tr>
<tr><td>a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an engine speed set point and present and prior levels for each one of said</td><td>E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . The memory devices for program and data are usually EPROMS. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications,</td><td>E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.”</td></tr>
</table>

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plurality of sensors;	battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control	E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:

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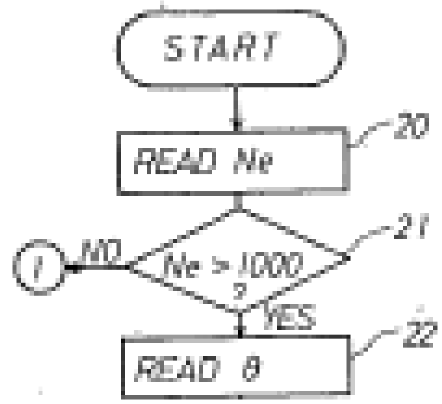
	units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque***	

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	and to assist in engine braking. The fuel is then shut off. During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in torque."	
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)." E.g., page 13.14, "In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power."	E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 5, line 63 to col. 6, line 2, "Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, ***a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.***" E.g. col. 7, lines 29 to 38, "However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated,*** thus indicating the necessity of the speed change operation."
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and	E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.***

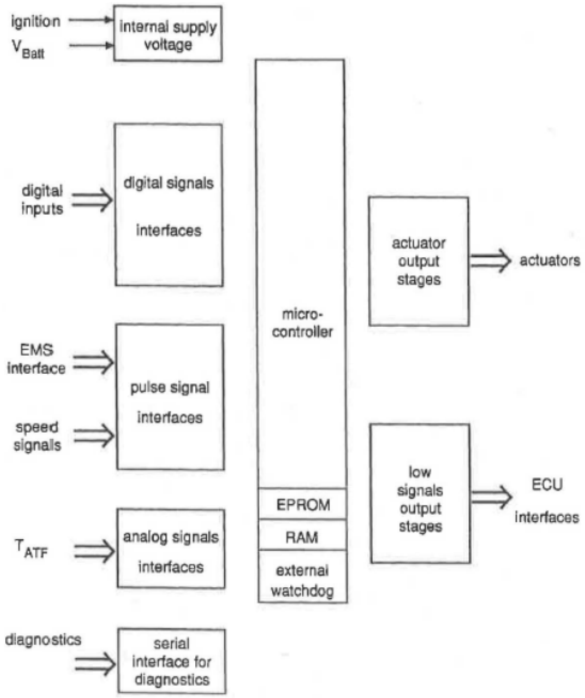
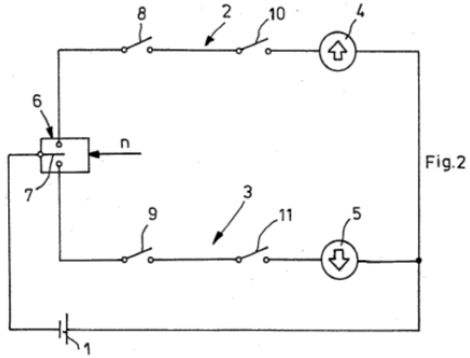
Limitation of ’781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)
issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;	diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 7, lines 10 to 17, “***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable.” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation.”
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit, said upshift notification circuit, and said downshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps,	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating***

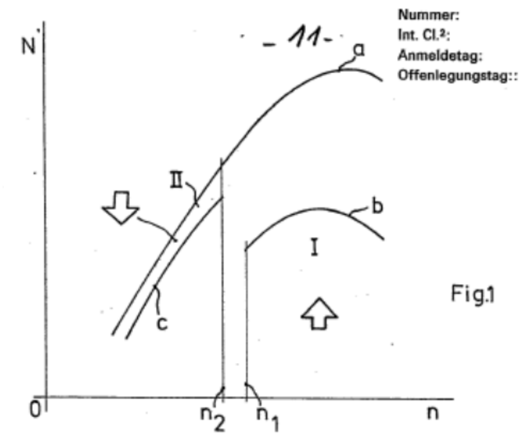
Limitation of '781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)
	which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	***to the drive that the speed change from current shift position to the one step shifting up position*** SP_{+1} ***is preferable.***"

3. Claims 1, 7, and 13 are Obvious in View of the Combination of Jurgen and Volkswagen ’070

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
1. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., page 5 (English translation), “The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations.”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	absolute pressure (MAP) sensors.” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	consumption.”
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:	E.g., pages 7 to 8 (English translation), “***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 2:

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way that by shift

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is	operations, it is possible to achieve operating points in the output/engine speed diagram that are more favorable in terms of fuel consumption.” E.g., page 8 (English translation), “***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1.” E.g., Figure 1: 

Limitation of ’781 Patent Claim 1	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”

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	feel when entering the fuel cutoff mode, due to the change in torque.”	
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1:

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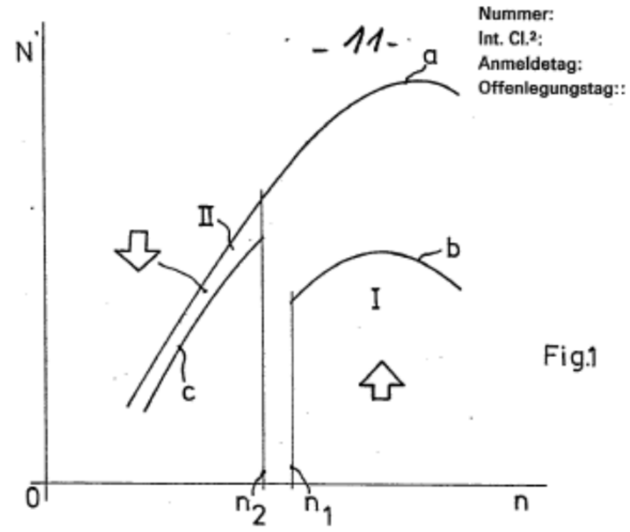
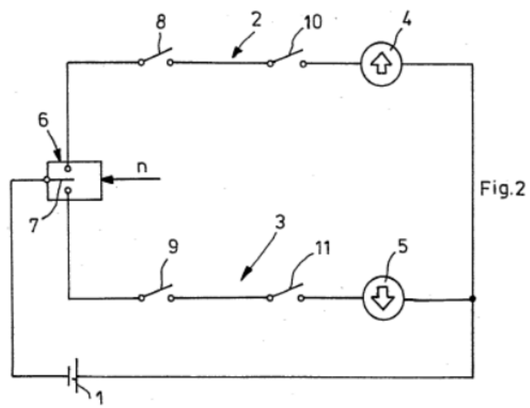
		 E.g., Figure 2: 
said processor subsystem determining, based upon data received from said plurality of	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU***	E.g., pages 6 to 7 (English translation), "Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after

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sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.	***determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., page 7 (English translation), "***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***" E.g., page 9 (English translation), "It is useful if in addition to this device, ***a display of the route-specific fuel consumption*** is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."

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7. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., page 5 (English translation), “The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations.”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”

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	E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:	E.g., pages 7 to 8 (English translation), “***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 2:

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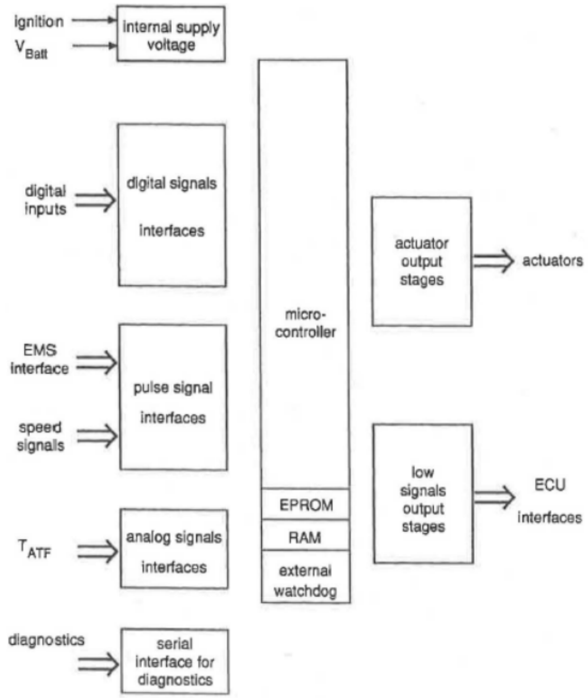
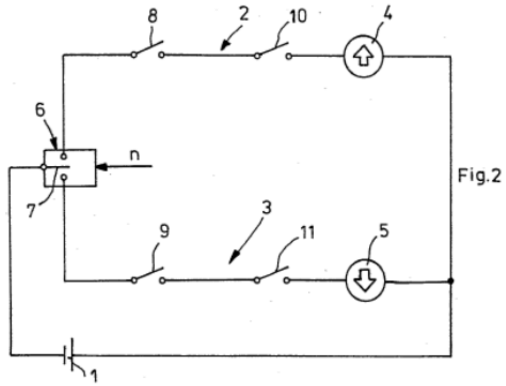
	 **FIGURE 13.1** Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way that by shift operations, it is possible to achieve

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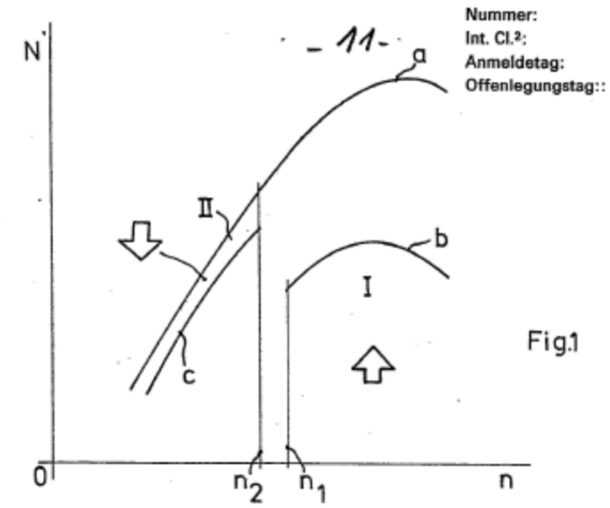
	E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which	operating points in the output/engine speed diagram that are more favorable in terms of fuel consumption.” E.g., page 8 (English translation), “***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1.” E.g., Figure 1:  Fig.1

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	is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”

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	amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1:

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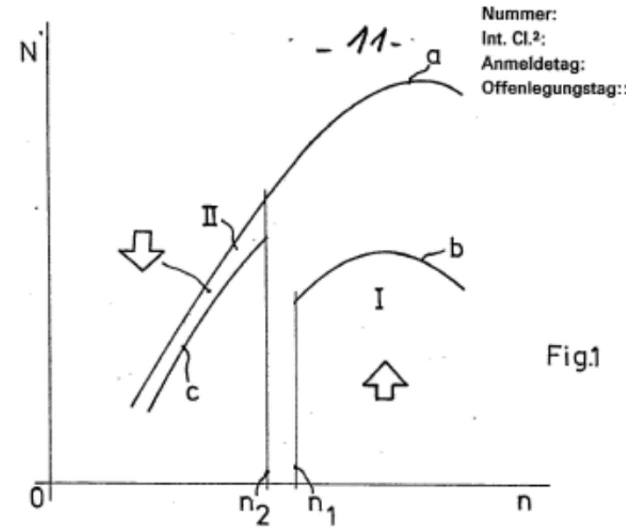
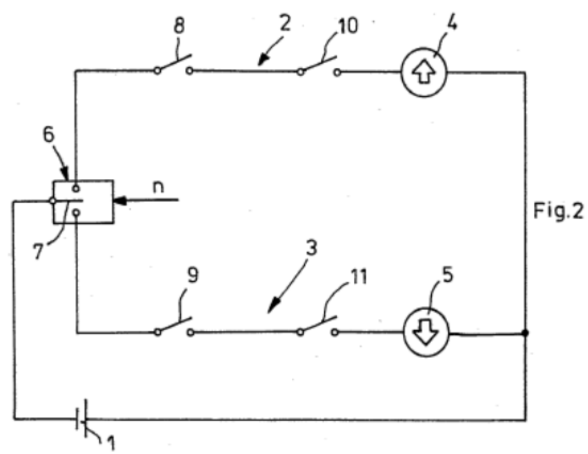
		 E.g., Figure 2: 
said processor subsystem	E.g., page 12.4, “During coasting and braking, fuel consumption	E.g., pages 6 to 7 (English translation), “Looking initially at operating

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determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.	can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., page 7 (English translation), “***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***” E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption*** is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”

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13. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., page 5 (English translation), “The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations.”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”

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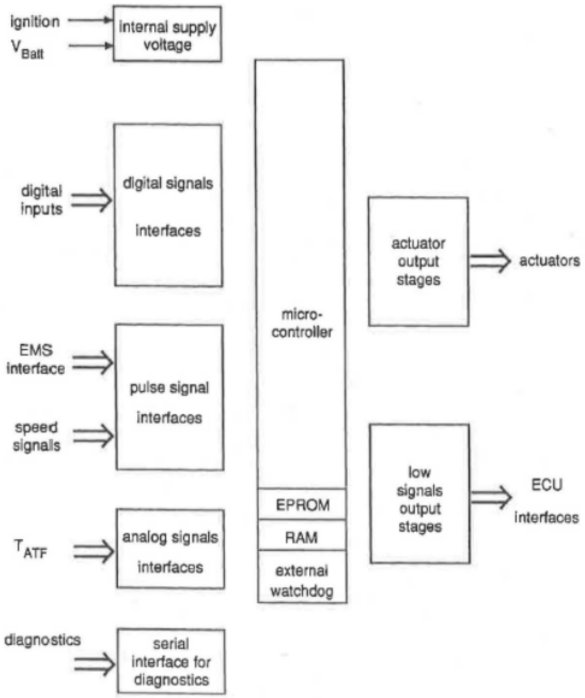
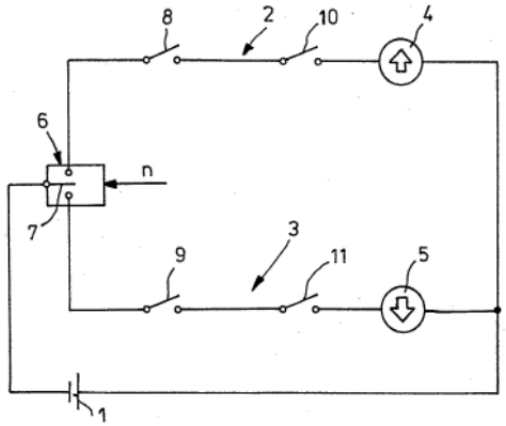
	E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:	E.g., pages 7 to 8 (English translation), “***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 2:

Limitation of ’781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	 Fig.2
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an engine speed set point and present and prior levels for each one of said plurality of sensors;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way that by shift operations, it is possible to achieve operating points in the

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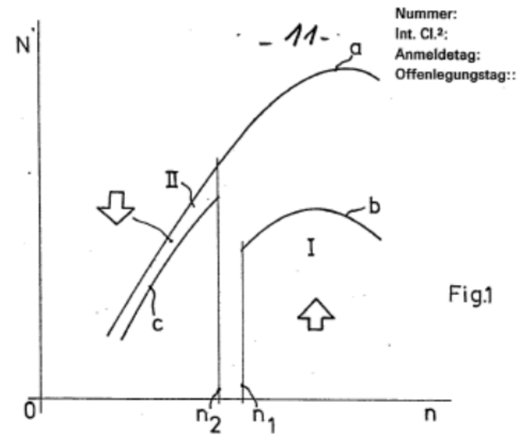
	E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding	output/engine speed diagram that are more favorable in terms of fuel consumption.” E.g., page 8 (English translation), “***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1.” E.g., Figure 1:  Fig.1

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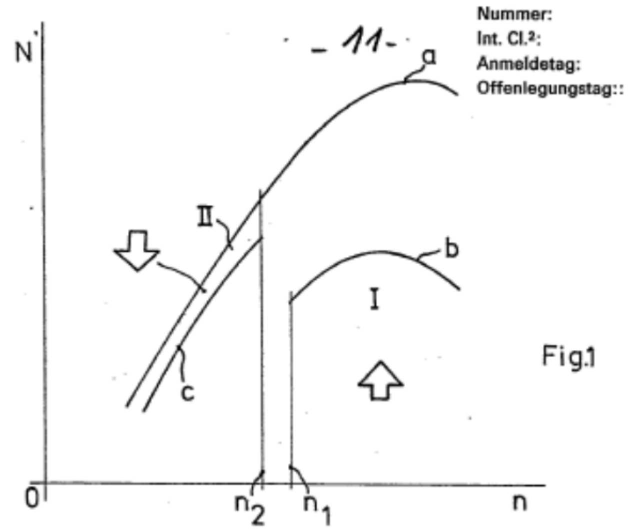
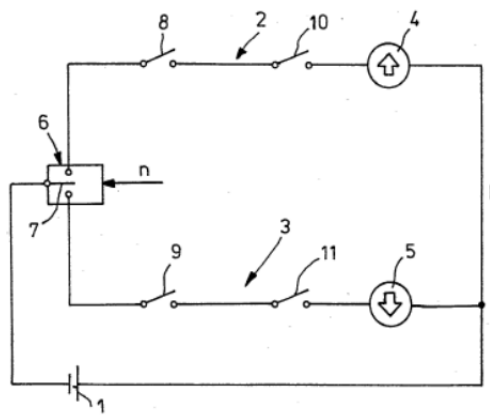
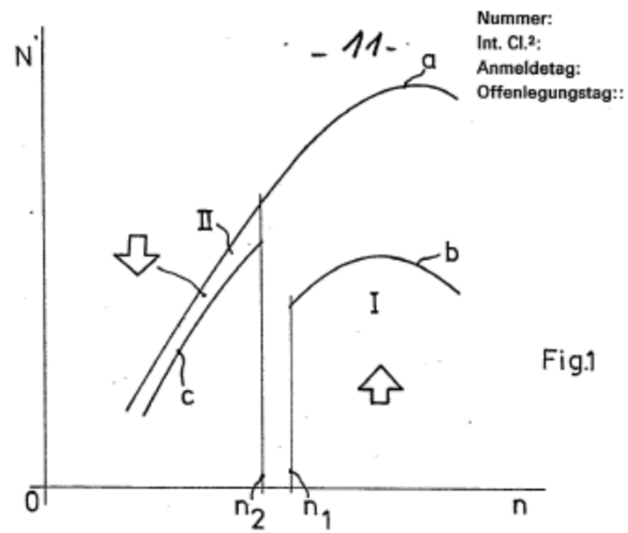
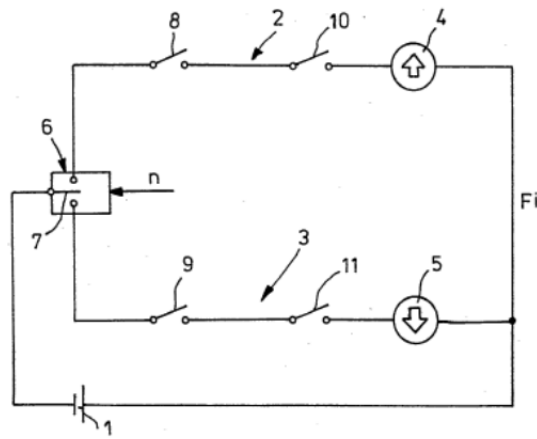
	adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***" E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 12.17, "***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in	E.g., page 9 (English translation), "It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption."

Limitation of '781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)
	torque."	
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)." E.g., page 13.14, "In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power."	E.g., pages 6 to 7 (English translation), "Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:

Limitation of '781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)
		 Fig.1 E.g., Figure 2:  Fig.2
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and	E.g., pages 6 to 7 (English translation), "Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after***

Limitation of ’781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;	diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	***upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1: 

Limitation of ’781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
		E.g., Figure 2:  Fig.2
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit, said upshift notification circuit, and said downshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,***	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.”

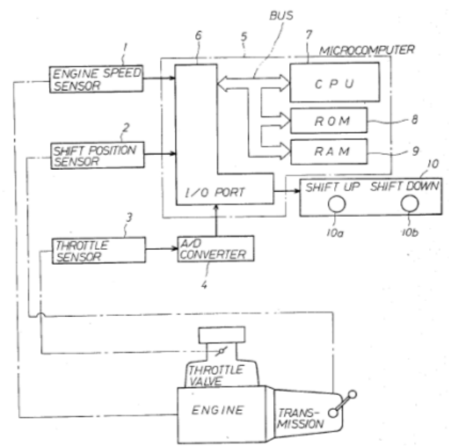
Limitation of ’781 Patent Claim 13	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)
	on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., page 7 (English translation), “***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***” E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption*** is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”

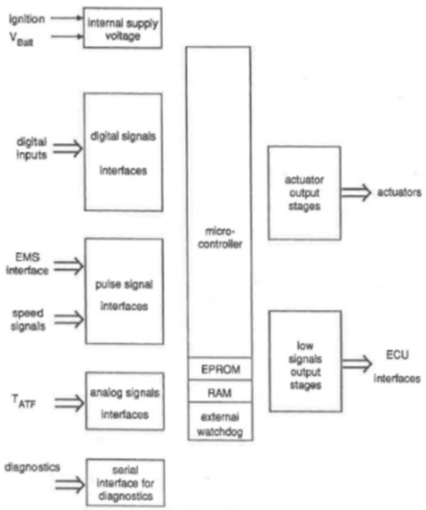
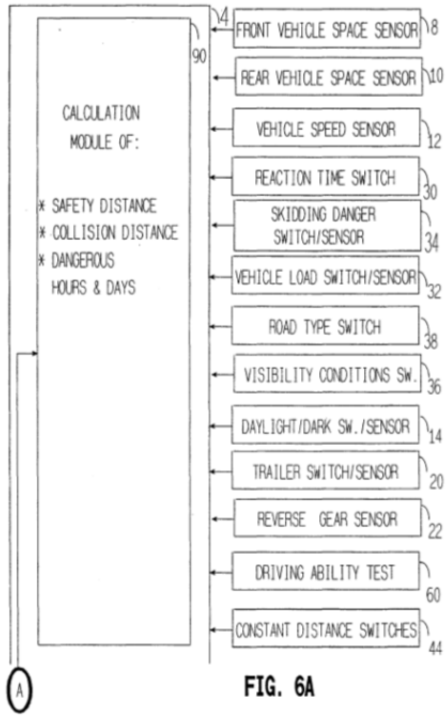
4. <u>Claims 17–23 and 26 are Obvious in View of the Combination of Jurgen, Toyota '599, and Davidian</u>

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
17. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***"	E.g., col. 1, lines 1 to 2, "The present invention relates to ***an anti-collision system for vehicles.***"
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 4, lines 52 to 66, "***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g.,

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
			an acceleration sensor, or by calculations based on the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
at least one sensor coupled to said vehicle for monitoring	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for***	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
operation thereof, said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;	control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models." E.g., page 12.18, "To control the idle speed, the	***detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 43 to 48, "***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., col. 2, lines 52 to 59, "Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals." E.g., FIG. 1:	vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc."

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
	ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”		
a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 37 to 42, “***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing unit (CPU) 7***, a read	E.g., col. 8, lines 29 to 43, “***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm.” E.g., col. 8, lines 58 to 60, “Thus, module 90 receives inputs from the front space sensor 8, the

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
	E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	only memory (ROM) 8, and a random access memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and ***the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5*** through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, ***the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5*** through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”	rear space sensor 10, and the vehicle speed sensor 12.” E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.*** ”	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor;	and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic	E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the	pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162.

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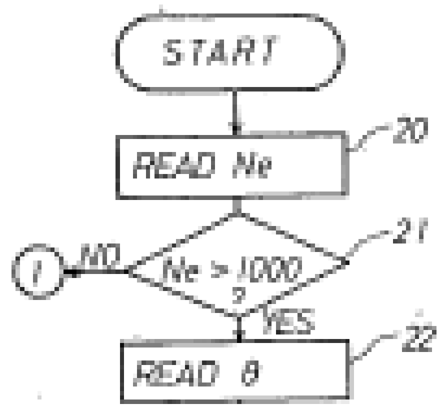
	control unit will revert back to the original production values that are written in ROM (read-only memory)." E.g., page 14.2, "Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals." E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	operation returns to the step 20." E.g., Figure 4: 	Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164."
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	E.g., page 7.6, "[W]heel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications. Linear speed sensing can be used to measure the ground speed. This measurement also has the possibly of use in ABS, ASR, and inertial navigation. ***Similar types of sensors can be used in crash avoidance, proximity, and obstacle detection applications.***"		E.g., col. 3, lines 59 to 66, "The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision." E.g., col. 4, lines 14 to 16, "In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined***

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	E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		***to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25." E.g., col. 6, lines 25 to 29, "Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***." E.g., col. 6, lines 41 to 46, "Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48." E.g., col. 8, lines 37 to 48, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ..." E.g., Figs. 3 and 6B (ref. no. 46C)
a fuel overinjection circuit coupled to said processor subsystem, said fuel overinjection circuit issuing a notification that excessive fuel is	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and***		

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
being supplied to said engine of said vehicle;	***fuel consumption.***" E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 12.17, "***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in torque."		
an upshift	E.g., page 13.7 to 13.9, "***The basic functions of***	E.g., col. 2, line 64 to col. 3, line 3, "***The***	

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	***the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	***indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 5, line 63 to col. 6, line 2, “Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, ***a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position*** SP_{+1} ***is preferable.***” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate*** B_e***, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated,*** thus indicating the necessity of the speed change operation.”	
said processor subsystem determining, based upon data received from said radar detector,	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position,***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable***

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.	***engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9." E.g., col. 2, lines 59 to 63, "***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***" E.g., col. 5, line 63 to col. 6, line 2, "***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP*** $_{+1}$ ***is preferable.***"	***it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ..." E.g., col. 12, line 59 to col 13, line 11, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***" E.g., col. 13, lines 17 to 22, "***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as

Limitation of ’781 Patent Claim 17	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 4,559,599 (Toyota ’599)**	**U.S. Patent No. 5,357,438 (Davidian)**
			indicated by block 164.”

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, "The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22." E.g., col. 8, lines 58 to 63, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18."
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the***

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
			reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”

Limitation of ’781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
19. Apparatus for optimizing operation of a vehicle according to claim 17 and further comprising:	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.
a throttle controller for controlling a throttle of said engine of said vehicle; and	E.g., page 14.4, “When the error signal has been computed, ***an output signal to the servo actuators is generated to increase, hold, or decrease the throttle position***. . . . Throttle positioning is traditionally either a vacuum type servo or motor.”		E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.”
said processor subsystem selectively reducing said throttle based upon data received from said radar detector, said at least one sensor and said memory subsystem.			E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.” E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The

Limitation of ’781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
			reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 20	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
20. Apparatus for optimizing operation of a vehicle according to claim 19 wherein	See claim 19 claim chart, at page A-71.	See claim 19 claim chart, at page A-71.	See claim 19 claim chart, at page A-71.
said at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated.	E.g., pages 7.21 to 22, “In antilock brake systems, speed sensors are attached to all wheels to determine wheel rotation speed and slip differential between wheels . . . ***Brake pedal position and brake fluid pressure information are also required for control.***”		E.g., col. 6, lines 25 to 34, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and whether or not there is a collision danger (region 46c). A similar display, shown at 48 and having regions 48a, 48b and 48c, is provided with respect to the rear of the vehicle equipped with the system, whether a rear collision danger exists, and ***the status of the rear brake light.***” E.g., col. 8, lines 37 to 57, “The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: . . . a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel, ***the brake light actuator 26 and (e.g., in the case of a train) the vehicle brakes automatically***; a black box module 94, which controls the information recorded into and read out of the black box 28; and a driving ability test module 95, involved in the driving ability test 60 in the control panel of FIG. 2, or 80 in the control panel of FIG. 5. The operation of each of these modules (except the clock 91) is described more particularly below with reference to the flow charts of FIGS. 9-14.”

Limitation of ’781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
21. Apparatus for optimizing operation of a vehicle according to claim 19 wherein said processor subsystem further comprises:	See claim 19 claim chart, at page A-71.	See claim 19 claim chart, at page A-71.	See claim 19 claim chart, at page A-71.
means for counting a total number of vehicle proximity alarms determined by said processor subsystem;			E.g., col. 11, lines 7 to 11, “ALSF Alarm stopping front counter; ALSR Alarm stopping rear counter; ALCF Alarm collision front counter; ALCR Alarm collision rear counter.” E.g., col. 11, lines 60 to 68, “The ALSF and ALSR counters, the ALCF and ALCR counters, and the ALFA and ALRA accumulators in the above table, and referred to in the flow charts below, would be provided in the black box 28 which records all the incidents in which the safety alarm and collision alarm were actuated, including the time, vehicle speed and vehicle distance for each alarm incident.” E.g., col. 14, lines 8 to 12, “Whenever the measured distance is equal to or less than the stopping distance (block 225), the system increments the alarm stopping front counter (block 228), records the time, distance and speed in the black box, and also actuates the safety alarm (block 229).”
means for selectively reducing said throttle based upon said total number of vehicle proximity alarms.			E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.” E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters***

Limitation of ’781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
			briefly described above and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 22	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
22. Apparatus for optimizing operation of a vehicle according to claim 17 and further comprising:	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation,	E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 5, line 63 to col. 6, line 2, “Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, ***a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position*** SP_{+1} ***is preferable.***” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate*** B_e***, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated,*** thus	

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	where the shift points are placed at points of highest engine output power.”	indicating the necessity of the speed change operation.”	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said downshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.***” E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform***	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***”

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	point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed)."	***shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 7, lines 10 to 17, "***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable." E.g. col. 7, lines 29 to 38, "However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation."	E.g., col. 13, lines 17 to 22, "***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164."

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23. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***"	E.g., col. 1, lines 1 to 2, "The present invention relates to ***an anti-collision system for vehicles.***"
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 4, lines 52 to 66, "***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on

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			the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
a plurality of sensors coupled to a vehicle having an engine, said	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer.	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing***	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system

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plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;	Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position***	***pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1:	independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”

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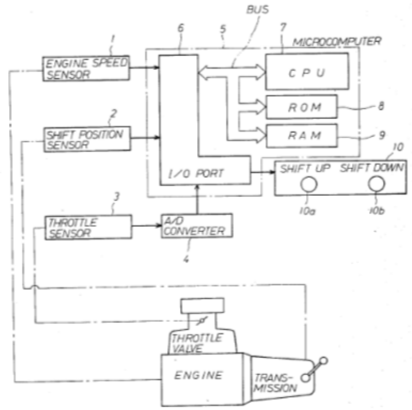
	sensor, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."		
a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)." E.g., Figure 13.1:	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 37 to 42, "***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing unit (CPU) 7***, a read only memory (ROM) 8, and a random access	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor

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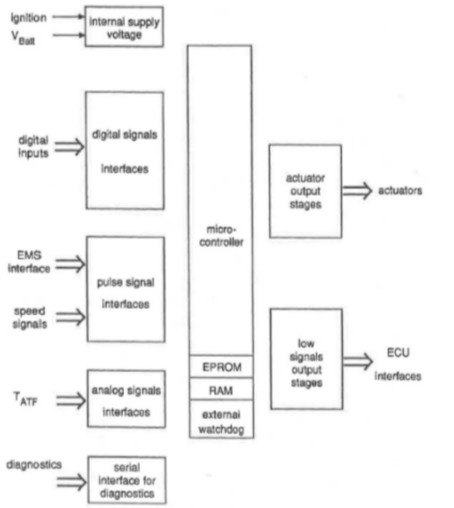
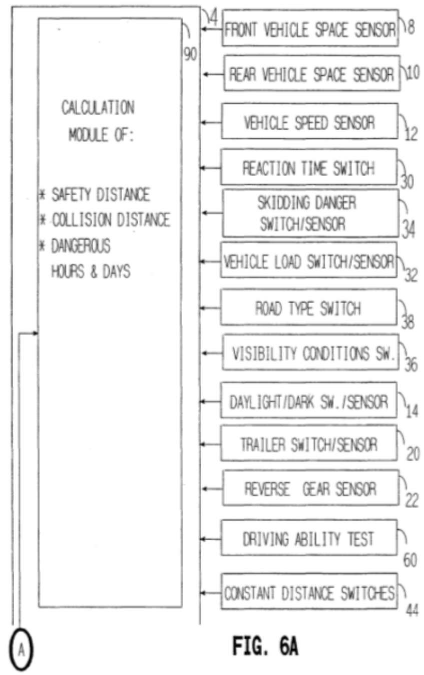
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and ***the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5*** through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, ***the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5*** through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”	12.” E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2***	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***”

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distance table, a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).”	***has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:	E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the

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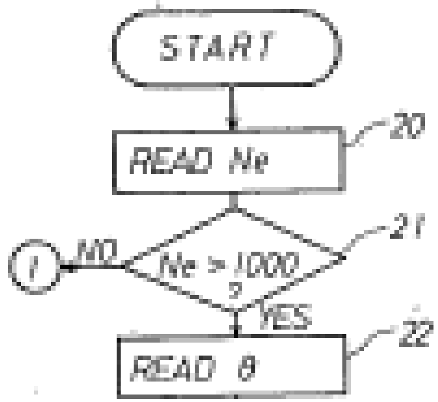
	E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff***		

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	can occur by evaluating the throttle position, engine RPM, and vehicle speed." E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 12.17, "***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in torque."		
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the	E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the	

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notification that said engine of said vehicle is being operated at an excessive engine speed;	unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 5, line 63 to col. 6, line 2, “Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, ***a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.***” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated,*** thus indicating the necessity of the speed change operation.”	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel***	

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)
circuit;	***are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP_{+1} is preferable.***”	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;			E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and***

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			a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor, e.g., 1.25." E.g., col. 6, lines 25 to 29, "Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***." E.g., col. 6, lines 41 to 46, "Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48." E.g., col. 8, lines 37 to 48, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ..." E.g., Figs. 3 and 6B (ref. no. 46C)
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when			E.g., col. 8, lines 37 to 43, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ..."

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to activate said vehicle proximity alarm circuit.			E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

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26. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., Abstract, “***A shift indication apparatus*** having an engine rotation sensor, a throttle valve sensor, and a shift position sensor, a microcomputer having a ROM and RAM for storing data corresponding to the engine speed, throttle valve openings, and the shift positions therein, and an indicator for indicating preferable shift positions to be performed by a driver in which a torque data map and a fuel consumption rate data map have stored in the ROM for calculating various torque and fuel consumption rates ***so as to obtain preferable shift positions relating to optimum fuel consumption rate in accordance with said data detected. With this construction, it becomes possible for a driver to run his car in accordance with the indications of the shift operation on the indicator so as to enable the economical running of the car to be realized.***”	E.g., col. 1, lines 1 to 2, “The present invention relates to ***an anti-collision system for vehicles.***”
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		E.g., col. 4, lines 52 to 66, “***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”

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			E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
a plurality of sensors coupled to a vehicle having an engine, said plurality of	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the***	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration

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sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;	brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models." E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and	***engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 43 to 48, "***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., col. 2, lines 52 to 59, "Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals." E.g., FIG. 1:	sensor, or by calculations based on the Doppler effect, etc."

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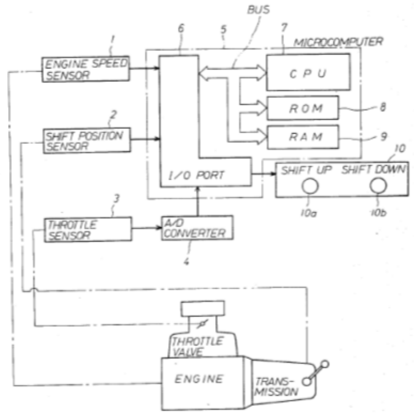
	vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."		
a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)." E.g., Figure 13.1:	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer, an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, ***a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors,*** and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 37 to 42, "***The microcomputer 5*** further comprises an input/output port (I/O port) 6, ***a central processing unit (CPU) 7***, a read only memory (ROM) 8, and a random access	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor

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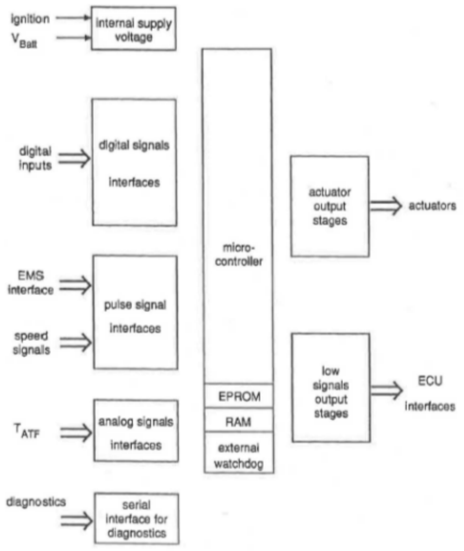
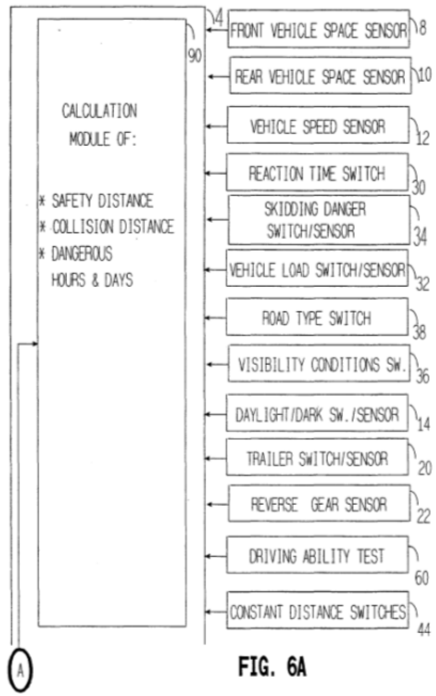
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	memory (RAM) 9. In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 43 to 48, “The engine speed sensor 1 is mounted in a distributor (not shown) and ***the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5*** through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., col. 2, lines 52 to 59, “Similarly, ***the output of the throttle sensor 3 is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5*** through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”	12.” E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map***	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be***

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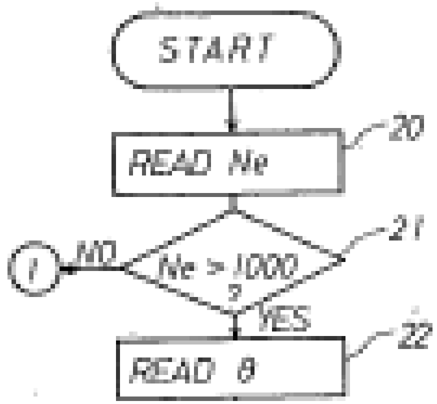
speed/stopping distance table, a manifold pressure set point, RPM set point, and present and prior levels for each one of said plurality of sensors;	supplied RAMs. These are increasingly being replaced by EEPROMs." E.g., page 12.9, "A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory)."	***indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated." E.g., col. 3, lines 44 to 61, "***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20."	***changed periodically if necessary.***" E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an

Limitation of '781 Patent Claim 26	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
	E.g., page 14.2, "Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals." E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	E.g., Figure 4: 	object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164."
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***" E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can***		

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	occur by evaluating the throttle position, engine RPM, and vehicle speed.” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
a downshift notification circuit coupled to said processor subsystem, said downshift notification	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit	E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the	

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circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;	memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)." E.g., page 13.14, "In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power."	indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 7, lines 10 to 17, "***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable." E.g. col. 7, lines 29 to 38, "However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation."	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors***	E.g., col. 2, lines 37 to 42, "***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9." E.g., col. 2, lines 59 to 63, "***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel***	

Limitation of '781 Patent Claim 26	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)
notification circuit;	***are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., pages 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	***consumption rate in accordance with various parameters calculated.***" E.g., col. 5, line 63 to col. 6, line 2, "***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP_{+1} is preferable.***" E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 7, lines 10 to 17, "***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable."	

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		E.g. col. 7, lines 29 to 38, "However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation."	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	E.g., page 7.6, "[W]heel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications. Linear speed sensing can be used to measure the ground speed. This measurement also has the possibly of use in ABS, ASR, and inertial navigation. ***Similar types of sensors can be used in crash avoidance, proximity, and obstacle detection applications.***" E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 3, lines 59 to 66, "The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision." E.g., col. 4, lines 14 to 16, "In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25." E.g., col. 6, lines 25 to 29, "Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***." E.g., col. 6, lines 41 to 46, "Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the***

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			visually-indicated alarms of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.			E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert***

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			the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

5. Claims 17–23 and 26 are Obvious in View of the Combination of Jurgen, Volkswagen '070, and Davidian

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)
17. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., page 5 (English translation), "The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations."	E.g., col. 1, lines 1 to 2, "The present invention relates to ***an anti-collision system for vehicles.***"
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 4, lines 52 to 66, "***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
			the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
at least one sensor coupled to said vehicle for monitoring operation thereof,	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer.	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system

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said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;	Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models." E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position***	output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed." E.g., page 8 (English translation), "***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here." E.g., page 9 (English translation), "It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."	independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc."

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	sensor, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."		
a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)." E.g., Figure 13.1:	E.g., pages 7 to 8 (English translation), "***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 2:	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12." E.g., Figure 6A:

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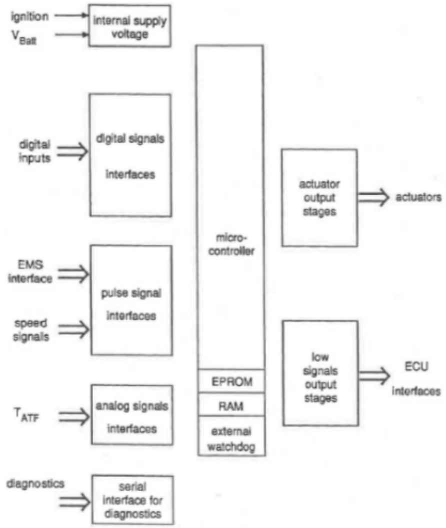
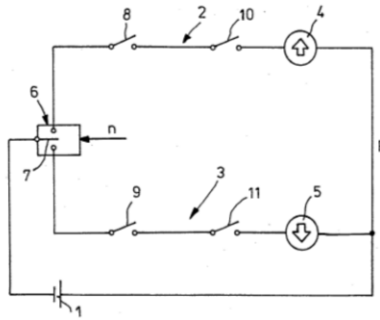
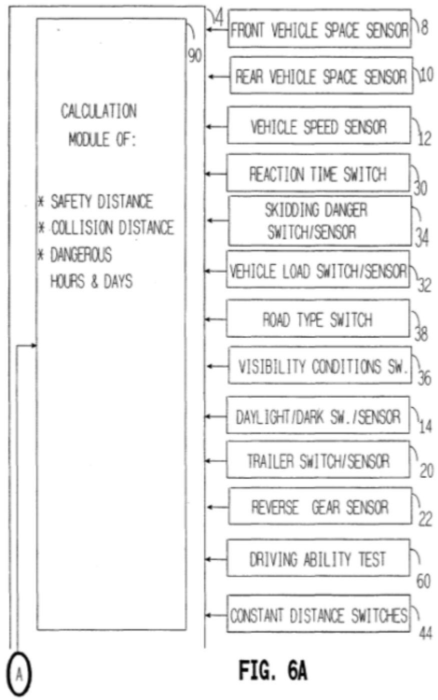
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	 Fig.2	 FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way that by shift operations, it is possible to achieve operating points in the	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system

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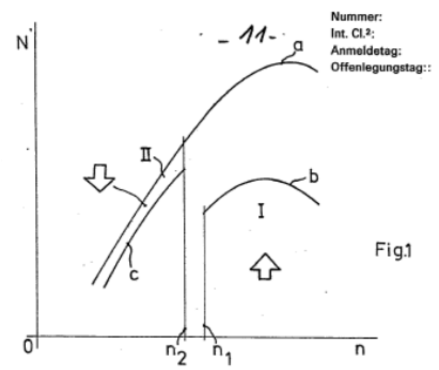
set point, a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor;	E.g., page 12.9, "A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory)." E.g., page 14.2, "Other safety-related items	output/engine speed diagram that are more favorable in terms of fuel consumption." E.g., page 8 (English translation), "***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1." E.g., Figure 1:  Fig.1	then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates

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	include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		according to the deceleration alarm module 93, as indicated by block 164.”
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	E.g., page 7.6, “[W]heel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications. Linear speed sensing can be used to measure the ground speed. This measurement also has the possibly of use in ABS, ASR, and inertial navigation. ***Similar types of sensors can be used in crash avoidance, proximity, and obstacle detection applications.***” E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25.”

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			E.g., col. 6, lines 25 to 29, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***.” E.g., col. 6, lines 41 to 46, “Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
a fuel overinjection circuit coupled to said processor subsystem, said fuel overinjection circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	

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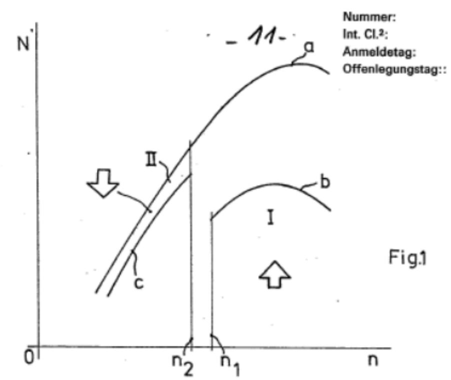
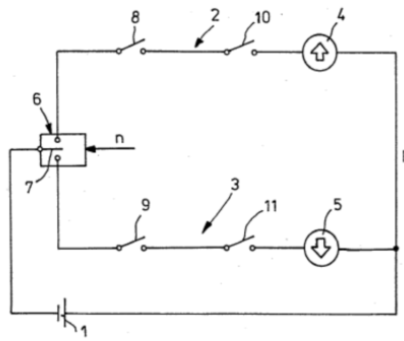
	decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
an upshift notification circuit coupled to said processor subsystem, said upshift	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating	

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)
notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)." E.g., page 13.14, "In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power."	range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:  E.g., Figure 2:	

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
		 Fig.2	
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed*** n_1 ***(see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed*** n_2***, it pivots in the***	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger,

Limitation of ’781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
	uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., page 7 (English translation), “***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***” E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption*** is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, “The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22.” E.g., col. 8, lines 58 to 63, “Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18.”
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the***

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
			reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”

Limitation of ’781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
19. Apparatus for optimizing operation of a vehicle according to claim 17 and further comprising:	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.
a throttle controller for controlling a throttle of said engine of said vehicle; and	E.g., page 14.4, “When the error signal has been computed, ***an output signal to the servo actuators is generated to increase, hold, or decrease the throttle position***. . . . Throttle positioning is traditionally either a vacuum type servo or motor.”	E.g., page 7 (English translation), “The position of the operating point of the engine is in operation range II close to full load, i.e., to the left of engine speed n_2 in Figure 1, first of all has the basic disadvantage that the desired higher output is not obtained despite the fact that the ***accelerator pedal*** or the ***output control element is in the full throttle position***.”	E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.”
said processor subsystem selectively reducing said throttle based upon data received from said radar detector, said at least one sensor and said memory subsystem.			E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.” E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated

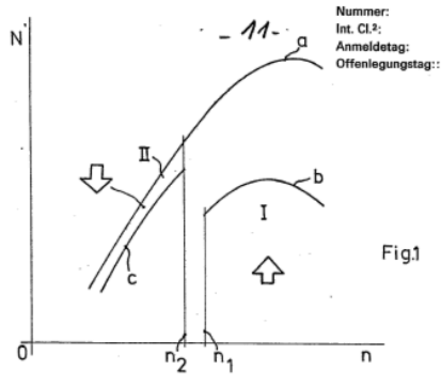
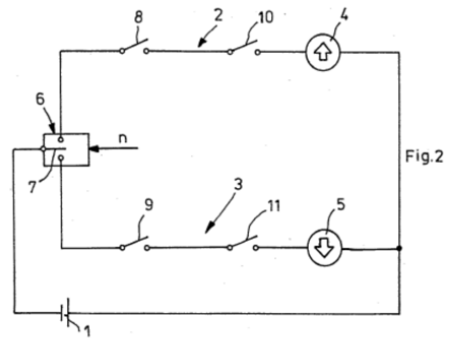
Limitation of ’781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
			example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 20	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
20. Apparatus for optimizing operation of a vehicle according to claim 19 wherein	See claim 19 claim chart, at page A-118.	See claim 19 claim chart, at page A-118.	See claim 19 claim chart, at page A-118.
said at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated.	E.g., pages 7.21 to 22, “In antilock brake systems, speed sensors are attached to all wheels to determine wheel rotation speed and slip differential between wheels . . . ***Brake pedal position and brake fluid pressure information are also required for control.***”		E.g., col. 6, lines 25 to 34, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and whether or not there is a collision danger (region 46c). A similar display, shown at 48 and having regions 48a, 48b and 48c, is provided with respect to the rear of the vehicle equipped with the system, whether a rear collision danger exists, and ***the status of the rear brake light.***” E.g., col. 8, lines 37 to 57, “The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: . . . a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel, ***the brake light actuator 26 and (e.g., in the case of a train) the vehicle brakes automatically***; a black box module 94, which controls the information recorded into and read out of the black box 28; and a driving ability test module 95, involved in the driving ability test 60 in the control panel of FIG. 2, or 80 in the control panel of FIG. 5. The operation of each of these modules (except the clock 91) is described more particularly below with reference to the flow charts of FIGS. 9-14.”

Limitation of '781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)
21. Apparatus for optimizing operation of a vehicle according to claim 19 wherein said processor subsystem further comprises:	See claim 19 claim chart, at page A-118.	See claim 19 claim chart, at page A-118.	See claim 19 claim chart, at page A-118.
means for counting a total number of vehicle proximity alarms determined by said processor subsystem;			E.g., col. 11, lines 7 to 11, "ALSF Alarm stopping front counter; ALSR Alarm stopping rear counter; ALCF Alarm collision front counter; ALCR Alarm collision rear counter." E.g., col. 11, lines 60 to 68, "The ALSF and ALSR counters, the ALCF and ALCR counters, and the ALFA and ALRA accumulators in the above table, and referred to in the flow charts below, would be provided in the black box 28 which records all the incidents in which the safety alarm and collision alarm were actuated, including the time, vehicle speed and vehicle distance for each alarm incident." E.g., col. 14, lines 8 to 12, "Whenever the measured distance is equal to or less than the stopping distance (block 225), the system increments the alarm stopping front counter (block 228), records the time, distance and speed in the black box, and also actuates the safety alarm (block 229)."
means for selectively reducing said throttle based upon said total number of vehicle proximity alarms.			E.g., col. 2, line 67 to col. 3, line 2, "According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated." E.g., col. 8, lines 37 to 43, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters***

Limitation of ’781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
			briefly described above and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 22	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
22. Apparatus for optimizing operation of a vehicle according to claim 17 and further comprising:	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation,	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1:	

Limitation of ’781 Patent Claim 22	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
	where the shift points are placed at points of highest engine output power.”	 E.g., Figure 2: 	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said downshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a***	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system

Limitation of ’781 Patent Claim 22	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
	engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., page 7 (English translation), “***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***”	then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
23. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., page 5 (English translation), “The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations.”	E.g., col. 1, lines 1 to 2, “The present invention relates to ***an anti-collision system for vehicles.***”
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		E.g., col. 4, lines 52 to 66, “***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”

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			E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler

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collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;	higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models." E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM,	engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed." E.g., page 8 (English translation), "***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here." E.g., page 9 (English translation), "It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."	effect, etc."

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	and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”		
a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:	E.g., pages 7 to 8 (English translation), “***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 2:	E.g., col. 8, lines 29 to 43, “***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm.” E.g., col. 8, lines 58 to 60, “Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12.” E.g., Figure 6A:

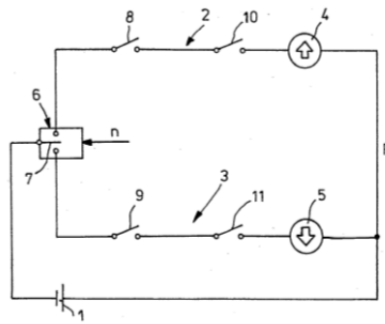
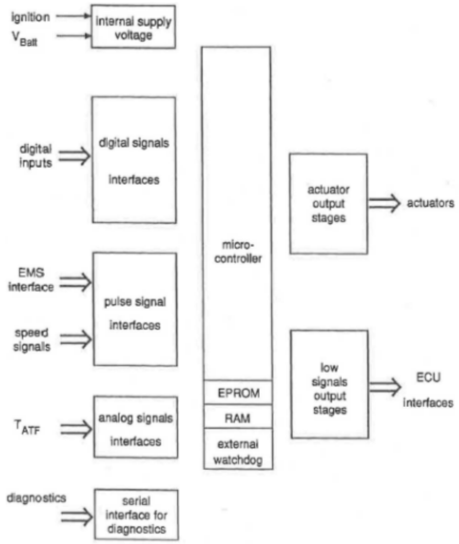
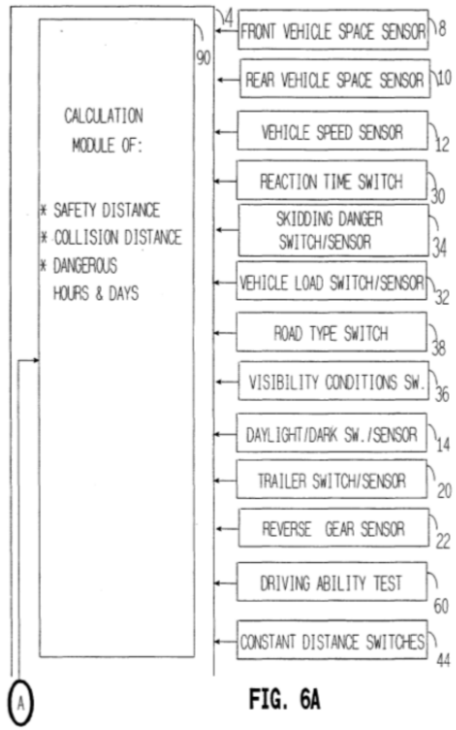


Fig.2

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
	 FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”		 FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way that by shift operations,	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***”

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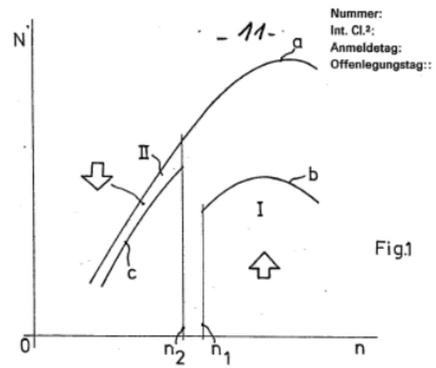
manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).”	it is possible to achieve operating points in the output/engine speed diagram that are more favorable in terms of fuel consumption.” E.g., page 8 (English translation), “***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1.” E.g., Figure 1:  	E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and

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	E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position,***	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	

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	engine RPM, and vehicle speed.” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the***	

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<tr><th>Limitation of ’781 Patent Claim 23</th><th>Automotive Electronics Handbook (Jurgen)</th><th>German Patent Application Publication No. 29 26 070 (Volkswagen ’070)</th><th>U.S. Patent No. 5,357,438 (Davidian)</th></tr>
<tr><td>said engine of said vehicle is being operated at an excessive engine speed;</td><td>a wide range. The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”

E.g., page 13.14, “In addition to these functions, different shift maps can be implemented into the data field of the TCU [Transmission Control Unit]. For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”</td><td>driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.”

E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.”

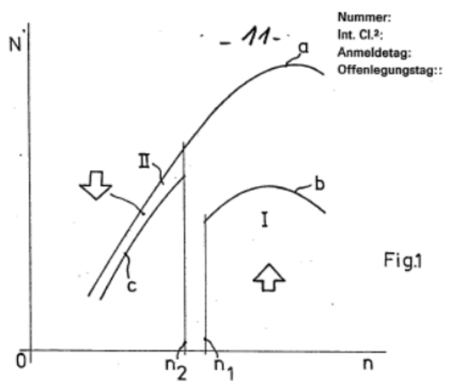
E.g., Figure 1:


Fig.1

E.g., Figure 2:</td><td></td></tr>
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		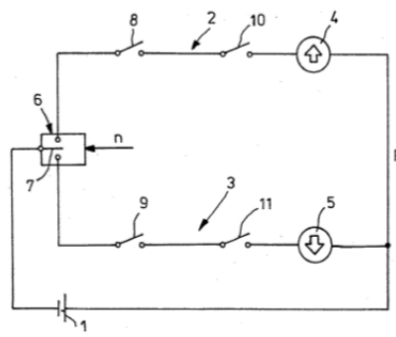 Fig.2	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit;	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center***	

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	unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., page 7 (English translation), “***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***” E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption*** is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;			E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25.”

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			E.g., col. 6, lines 25 to 29, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***.” E.g., col. 6, lines 41 to 46, “Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.			E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
			factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

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26. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., page 5 (English translation), “The present invention is based on the objective of providing ***a device that assists the operator of the internal combustion engine equipped with a conventional transmission***, i.e., the driver of a motor vehicle, for example, in setting an operating point of the engine that is advantageous in terms of consumption, by way of gear shift operations.”	E.g., col. 1, lines 1 to 2, “The present invention relates to ***an anti-collision system for vehicles.***”
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		E.g., col. 4, lines 52 to 66, “***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by

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			calculations based on the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
a plurality of sensors coupled to a vehicle having	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring

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an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;	transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future	setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”

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	models." E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."		
a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)."	E.g., pages 7 to 8 (English translation), "***The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded*** and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 2:	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed

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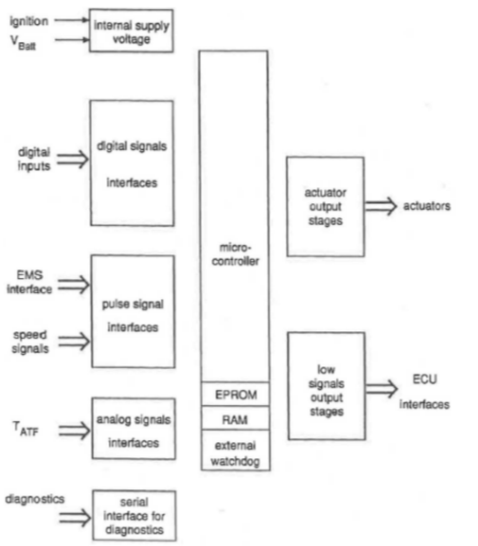
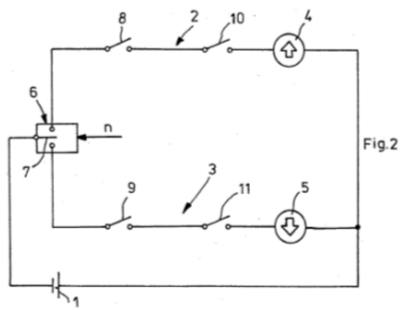
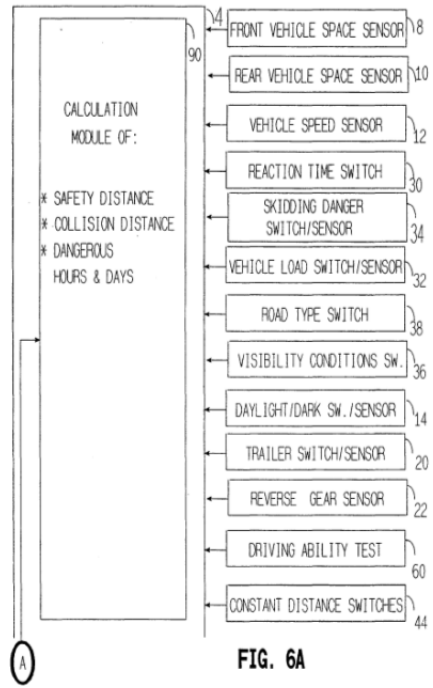
	E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	 Fig.2	sensor 12.” E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, ***output N of the engine has been plotted across engine speed n***.” E.g., page 6 (English translation), “***The numerical values of the limits of the two operating ranges I and II are of course dependent on the individual situation.*** In general, it can be said that these two operating ranges lie in such a way	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only***

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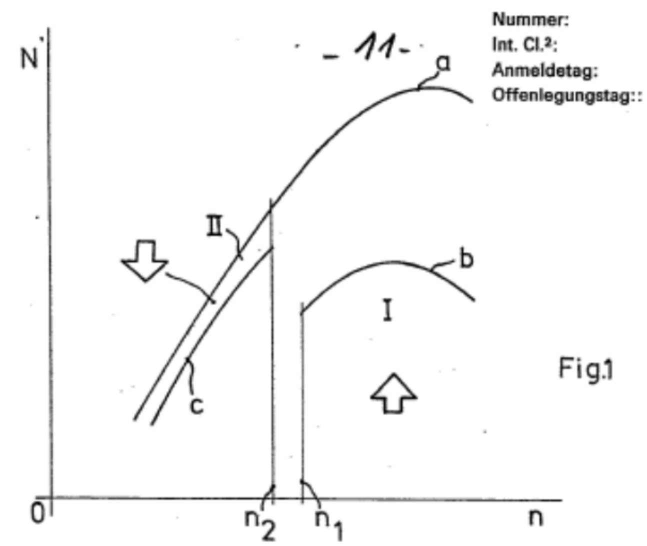
a first vehicle speed/stopping distance table, a manifold pressure set point, RPM set point, and present and prior levels for each one of said plurality of sensors;	diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit***	that by shift operations, it is possible to achieve operating points in the output/engine speed diagram that are more favorable in terms of fuel consumption.” E.g., page 8 (English translation), “***Furthermore, to define the two operating ranges I and II, load-dependent switches 8 and 9 are provided in control circuits 2 and 3*** in Figure 2, the first of which is closed only below the line denoted by b in Figure 1, and switch 9 is closed only above the line denoted by c in Figure 1.” E.g., Figure 1: 	***memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD,

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	even after the engine is shut off. Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a fuel overinjection notification circuit coupled to said processor subsystem,	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition,***	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	

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said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	***the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel		

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	cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output	E.g., page 7 (English translation), “When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., FIG. 1:	

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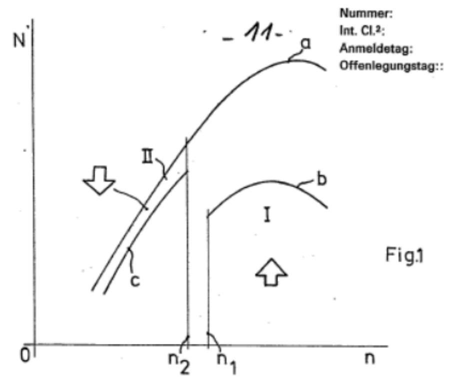
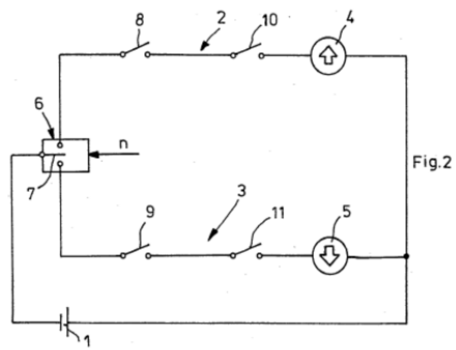
	power.”	 E.g., FIG. 2: 	
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear, at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within***	

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fuel overinjection circuit and when to activate said downshift notification circuit;	E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., pages 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	***operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., page 7 (English translation), "***When the operating point lies in operating range II, the device according to the present invention generates a signal that asks the driver to downshift, which is indicated by the downward pointing arrow at operating range II in Figure 1.***" E.g., page 9 (English translation), "It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption."	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle	E.g., page 7.6, "[W]heel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment		E.g., col. 3, lines 59 to 66, "The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision

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proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	applications. Linear speed sensing can be used to measure the ground speed. This measurement also has the possibly of use in ABS, ASR, and inertial navigation. ***Similar types of sensors can be used in crash avoidance, proximity, and obstacle detection applications.***” E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25.” E.g., col. 6, lines 25 to 29, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***.” E.g., col. 6, lines 41 to 46, “Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
said processor			E.g., col. 8, lines 37 to 43, “The ***microcomputer***

Limitation of ’781 Patent Claim 26	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.			***4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***”

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			E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

6. Claims 17–21 and 23 are Obvious in View of the Combination of Jurgen, Saturn '452, and Davidian

Limitation of '781 Patent Claim 17	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)
17. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "***A motor vehicle has a manual transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear."	E.g., col. 1, lines 1 to 2, "The present invention relates to ***an anti-collision system for vehicles.***"
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 4, lines 52 to 66, "***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent

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			of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
at least one sensor coupled to said vehicle	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This	E.g., col. 1, lines 31 to 33, “Conventional shift indicator calibration typically involves setting ***manifold pressure*** (MAP) thresholds at a variety of	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known***

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for monitoring operation thereof, said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;	information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models."	speeds." E.g., col. 2, lines 13 to 18, "Referring to FIG. 1, the reference numeral 10 generally designates a motor vehicle drivetrain comprising a spark ignition ***internal combustion engine (engine)*** 12, engine output shaft 10 and the combination of conventional manual clutch, gearbox and final drive assembly (manual drivetrain) 16." E.g., col. 2, lines 42 to 44, "Control unit 42 receives inputs required by the present embodiment including ***manifold absolute pressure (MAP)***, on line 46, ***engine speed (Ne)*** on line 50 and output speed (No) on line 54." E.g., col. 7, lines 13 to 21, "Throttle position "%T" is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle. ***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552." E.g., FIG. 1:	***manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc."

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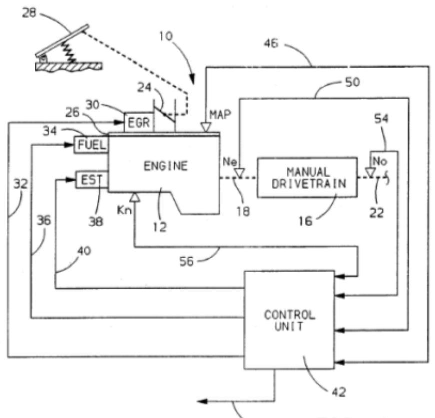
	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	 FIG. 1	
a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and	E.g., col. 2, lines 42 to 46, "***Control unit 42 receives inputs*** required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42." E.g., col. 2, lines 52 to 55, "***Control unit 42 may be mechanized with a conventional state of the art microcomputer controller*** including a central processing unit, memory and input-output devices." E.g., FIG. 1:	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90

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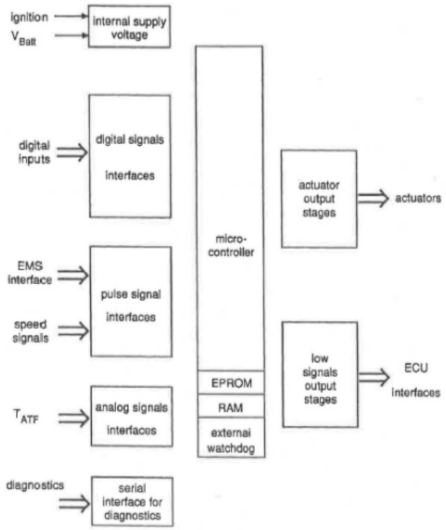
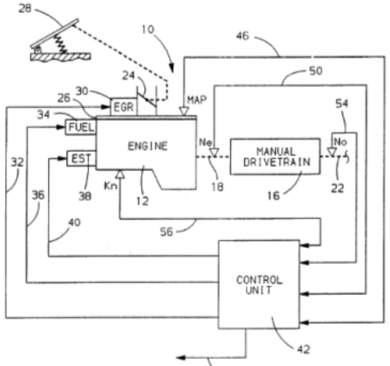
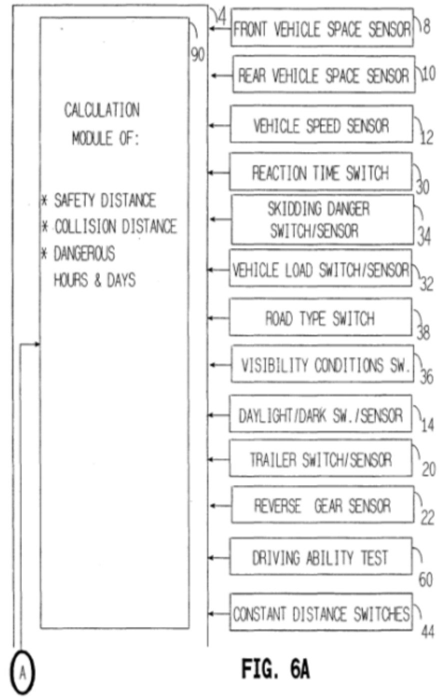
	safety circuits (Fig. 13.1)." E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, "The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor's signal*** to within 1/32 m/h."	 FIG. 1	receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12." E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem	E.g., page 13.5, "The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for	E.g., col. 2, lines 52 to 55, "Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, ***memory*** and input-output devices." E.g., col. 6, lines 55 to 60, "First, ***engine speed Ne is checked at block 511 to determine if it exceeds a***	E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires

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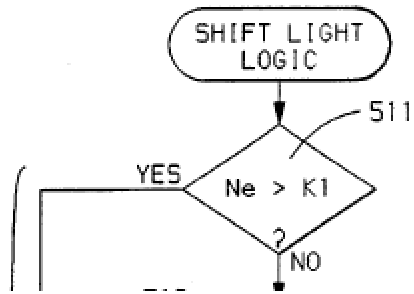
storing a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor;	diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the	***predetermined maximum allowable engine speed threshold K1***. If the threshold is exceeded then an upshift is required regardless of the value of UTR and control is therefore passed via line 560 to block 542 where the shift light flag is set to one (SL FLAG=1). If the threshold at block 511 is not exceeded, decision block 512 is encountered.” E.g., FIG. 5:  	pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle,

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	electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said	E.g., page 7.6, “[W]heel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications. Linear speed sensing can be used to measure the ground speed. This measurement also has the possibly of use in ABS, ASR, and inertial navigation. ***Similar types of sensors can be***		E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.”

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object;	***used in crash avoidance, proximity, and obstacle detection applications.***" E.g., page 7.23, "Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***."		E.g., col. 4, lines 14 to 16, "In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25." E.g., col. 6, lines 25 to 29, "Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***." E.g., col. 6, lines 41 to 46, "Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48." E.g., col. 8, lines 37 to 48, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ..." E.g., Figs. 3 and 6B (ref. no. 46C)
a fuel overinjection circuit coupled to said processor subsystem, said	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to		

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fuel overinjection circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount		

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	of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	E.g., Abstract, “***A motor vehicle has a manual transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear.” E.g., col. 1, lines 10 to 13, “Shift indicators are commonly used on manual transmission vehicles ***to assist non-expert drivers in determining when it is appropriate to shift the transmission to a higher gear*** in order to maximize driving fuel economy.” E.g., col. 2, lines 42 to 55, “Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices.”	

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		E.g., col. 3, lines 60 to 65, “Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example.”	
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the***	E.g., col. 2, lines 42 to 55, “Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices.” E.g., col. 3, lines 60 to 65, “Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example.” E.g., FIG. 1:	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision***

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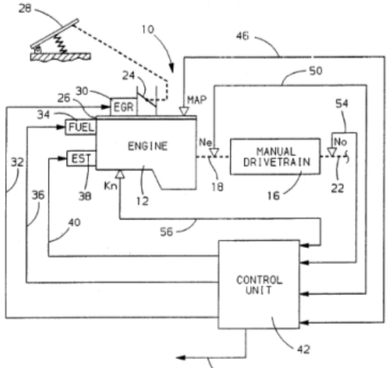
	lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”	 FIG. 1	***distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

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18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, “The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22.” E.g., col. 8, lines 58 to 63, “Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18.”
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***” E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the***

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			reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”

Limitation of ’781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
19. Apparatus for optimizing operation of a vehicle according to claim 17 and further comprising:	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.
a throttle controller for controlling a throttle of said engine of said vehicle; and	E.g., page 14.4, “When the error signal has been computed, ***an output signal to the servo actuators is generated to increase, hold, or decrease the throttle position***. . . . Throttle positioning is traditionally either a vacuum type servo or motor.”		E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.”
said processor subsystem selectively reducing said throttle based upon data received from said radar detector, said at least one sensor and said memory subsystem.			E.g., col. 2, line 67 to col. 3, line 2, “According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated.” E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The

Limitation of '781 Patent Claim 19	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)
			reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***" E.g., col. 13, lines 17 to 22, "***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164."

Limitation of ’781 Patent Claim 20	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)
20. Apparatus for optimizing operation of a vehicle according to claim 19 wherein	See claim 19 claim chart, at page A-167.	See claim 19 claim chart, at page A-167.	See claim 19 claim chart, at page A-167.
said at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated.	E.g., pages 7.21 to 22, “In antilock brake systems, speed sensors are attached to all wheels to determine wheel rotation speed and slip differential between wheels . . . ***Brake pedal position and brake fluid pressure information are also required for control.***”		E.g., col. 6, lines 25 to 34, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and whether or not there is a collision danger (region 46c). A similar display, shown at 48 and having regions 48a, 48b and 48c, is provided with respect to the rear of the vehicle equipped with the system, whether a rear collision danger exists, and ***the status of the rear brake light.***” E.g., col. 8, lines 37 to 57, “The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: . . . a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel, ***the brake light actuator 26 and (e.g., in the case of a train) the vehicle brakes automatically***; a black box module 94, which controls the information recorded into and read out of the black box 28; and a driving ability test module 95, involved in the driving ability test 60 in the control panel of FIG. 2, or 80 in the control panel of FIG. 5. The operation of each of these modules (except the clock 91) is described more particularly below with reference to the flow charts of FIGS. 9-14.”

Limitation of '781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)
21. Apparatus for optimizing operation of a vehicle according to claim 19 wherein said processor subsystem further comprises:	See claim 19 claim chart, at page A-167.	See claim 19 claim chart, at page A-167.	See claim 19 claim chart, at page A-167.
means for counting a total number of vehicle proximity alarms determined by said processor subsystem;			E.g., col. 11, lines 7 to 11, "ALSF Alarm stopping front counter; ALSR Alarm stopping rear counter; ALCF Alarm collision front counter; ALCR Alarm collision rear counter." E.g., col. 11, lines 60 to 68, "The ALSF and ALSR counters, the ALCF and ALCR counters, and the ALFA and ALRA accumulators in the above table, and referred to in the flow charts below, would be provided in the black box 28 which records all the incidents in which the safety alarm and collision alarm were actuated, including the time, vehicle speed and vehicle distance for each alarm incident." E.g., col. 14, lines 8 to 12, "Whenever the measured distance is equal to or less than the stopping distance (block 225), the system increments the alarm stopping front counter (block 228), records the time, distance and speed in the black box, and also actuates the safety alarm (block 229)."
means for selectively reducing said throttle based upon said total number of vehicle proximity alarms.			E.g., col. 2, line 67 to col. 3, line 2, "According to a further feature, the system includes an actuator for actuating a mechanical system of the vehicle, e.g., ***the brakes of a train***, or steering of an aircraft, at the time the collision alarm is actuated." E.g., col. 8, lines 37 to 43, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ..."

Limitation of ’781 Patent Claim 21	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
			E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
23. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., Abstract, “***A motor vehicle has a manual transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear.”	E.g., col. 1, lines 1 to 2, “The present invention relates to ***an anti-collision system for vehicles.***”
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 7.23, “Ultrasonics, infrared, laser, and ***microwaves (radar) can be used in the detection of objects behind vehicles and in the blind areas***.”		E.g., col. 4, lines 52 to 66, “***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
			calculations based on the Doppler effect, etc.” E.g., col. 10, lines 17 to 26, “FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***” E.g., col. 10, lines 38 to 50, “As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***”
a plurality of sensors coupled to a vehicle having an engine, said	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a	E.g., col. 1, lines 31 to 33, “Conventional shift indicator calibration typically involves setting ***manifold pressure*** (MAP) thresholds at a variety of speeds.”	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position***	E.g., col. 2, lines 13 to 18, “Referring to FIG. 1, the reference numeral 10 generally designates a motor vehicle drivetrain comprising a spark ignition ***internal combustion engine (engine)*** 12, engine output shaft 10 and the combination of conventional manual clutch, gearbox and final drive assembly (manual drivetrain) 16.” E.g., col. 2, lines 42 to 44, “Control unit 42 receives inputs required by the present embodiment including ***manifold absolute pressure (MAP)***, on line 46, ***engine speed (Ne)*** on line 50 and output speed (No) on line 54.” E.g., col. 7, lines 13 to 21, “Throttle position “%T” is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle. ***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552.” E.g., FIG. 1:	system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”

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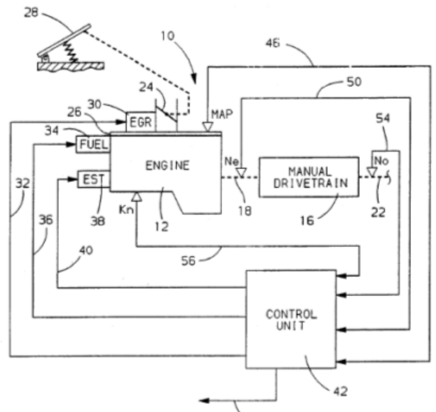
	sensor, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	 FIG. 1	
a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	E.g., col. 2, lines 42 to 46, “***Control unit 42 receives inputs*** required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42.” E.g., col. 2, lines 52 to 55, “***Control unit 42 may be mechanized with a conventional state of the art microcomputer controller*** including a central processing unit, memory and input-output devices.” E.g., FIG. 1:	E.g., col. 8, lines 29 to 43, “***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm.” E.g., col. 8, lines 58 to 60, “Thus, module 90

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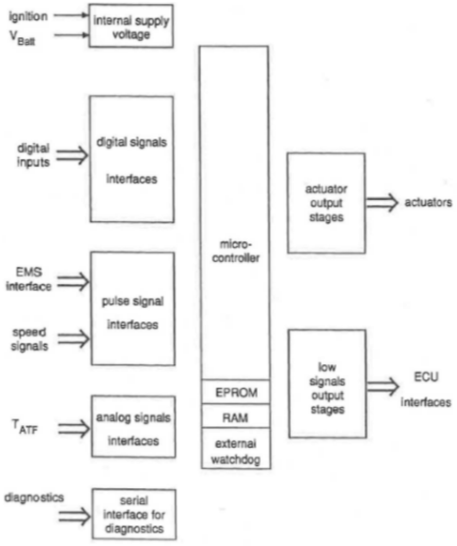
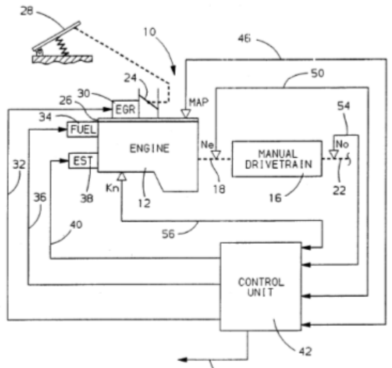
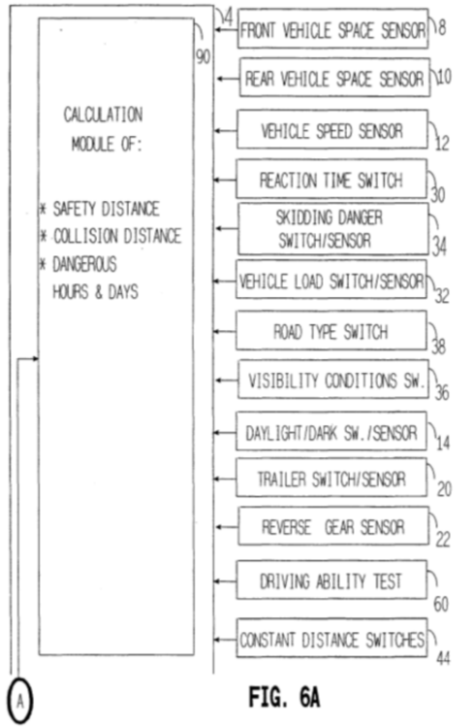
	E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	 FIG. 1	receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12.” E.g., Figure 6A:  FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to	E.g., col. 2, lines 52 to 55, “Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, ***memory*** and input-output devices.” E.g., col. 6, lines 55 to 60, “First, ***engine speed Ne is***	E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road

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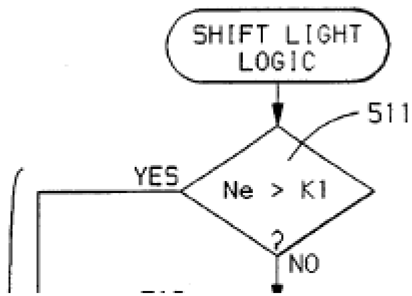
subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs." E.g., page 12.9, "A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the***	***checked at block 511 to determine if it exceeds a predetermined maximum allowable engine speed threshold K1***. If the threshold is exceeded then an upshift is required regardless of the value of UTR and control is therefore passed via line 560 to block 542 where the shift light flag is set to one (SL FLAG=1). If the threshold at block 511 is not exceeded, decision block 512 is encountered." E.g., FIG. 5: 	type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor***. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle,

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	engine is shut off. Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”		these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***”		

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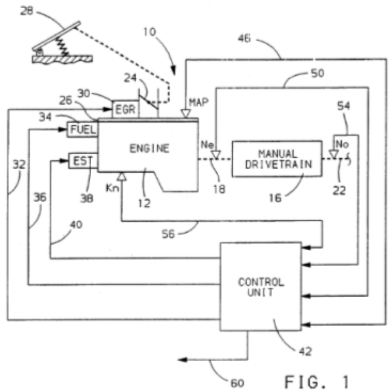
circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”		
an upshift	E.g., page 13.7 to 13.9, “***The basic functions of***	E.g., Abstract, “***A motor vehicle has a manual***	

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;	***the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made, on the one hand, by the highest admissible engine speed for each application*** and, on the other hand, by the lowest engine speed that is practical for driving comfort and noise emission. ***The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).” E.g., page 13.14, “In addition to these functions, ***different shift maps can be implemented into the data field of the TCU [Transmission Control Unit].*** For example, it is possible to have one shift map for low fuel consumption, which has shift points in the range of the best efficiency of the engine, and additionally to have another map for power operation, where the shift points are placed at points of highest engine output power.”	***transmission and means for indicating to the operator a point in operation for upshifting to the next higher gear*** from the present gear. ***A method of determining the shift point*** is provided based upon actual operating parameters of the motor vehicle effecting current wheel torque and predicted wheel torque in the next higher gear.” E.g., col. 1, lines 10 to 13, “Shift indicators are commonly used on manual transmission vehicles ***to assist non-expert drivers in determining when it is appropriate to shift the transmission to a higher gear*** in order to maximize driving fuel economy.” E.g., col. 2, lines 42 to 55, “Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices.” E.g., col. 3, lines 60 to 65, “Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example.”	

Limitation of '781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)
said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit;	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	E.g., col. 2, lines 42 to 55, "Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices." E.g., col. 3, lines 60 to 65, "Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example." E.g., FIG. 1:	

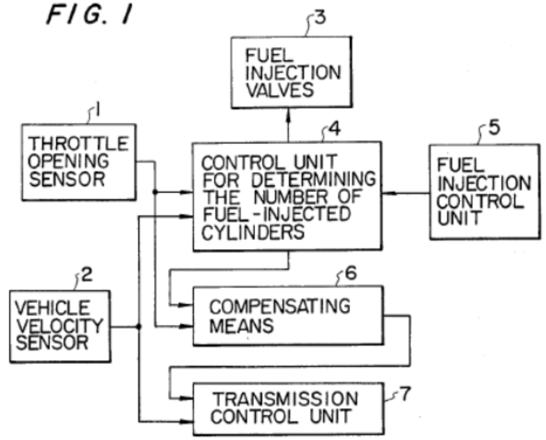
Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
		 FIG. 1	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;			E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25.” E.g., col. 6, lines 25 to 29, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front

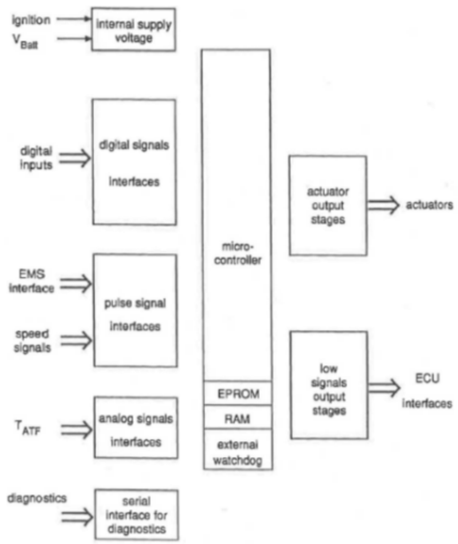
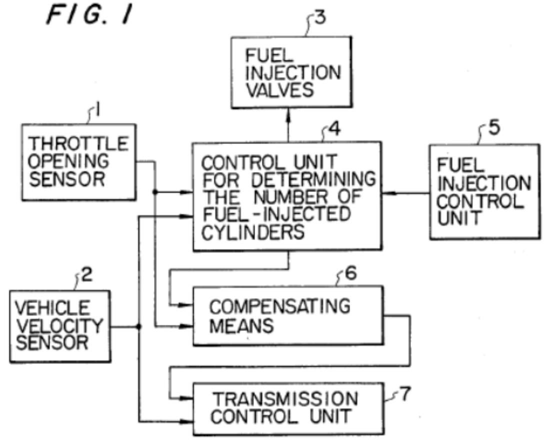
Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
			vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***.” E.g., col. 6, lines 41 to 46, “Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated alarms*** of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.			E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and

Limitation of ’781 Patent Claim 23	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)
			the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

7. Claims 28–30 are Obvious in View of the Combination of Jurgen and Nissan '055

Limitation of '781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan '055)
28. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "A control system which controls the number of fuel injected cylinders is used with an electronic type of automatic transmission system and includes compensating means or an engine operating parameter changing unit for changing a parameter fed to the transmission system to properly operate the same, thus increasing fuel economy or reducing fuel consumption."
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the	E.g., col. 2, lines 51 to 54, "The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a vehicle velocity sensor 2." E.g., FIG. 1:

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	FIG. 1  *See also* Col. 1, lines 63 to 64.
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and	E.g., col. 2, lines 47 to 49, “The control unit 4 determines the number of cylinders to which fuel is injected, and controls fuel injection through a plurality of fuel injection valves 3 which are respectively positioned on the cylinders.” E.g., col. 2, lines 51 to 54, “The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a vehicle velocity sensor 2.” E.g., FIG. 1:

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	FIG. 1 
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel	E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders.”

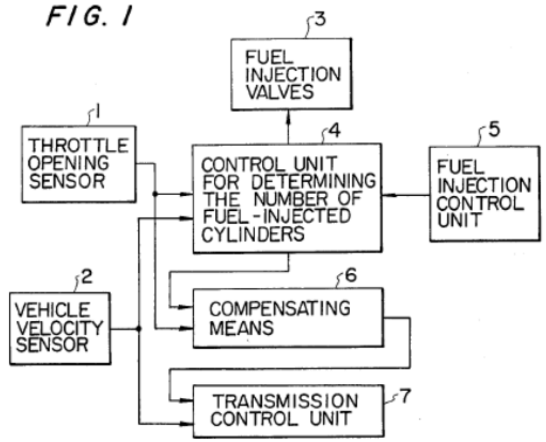
Limitation of '781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan '055)
	consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 12.17, "***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in torque."	
said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel	E.g., col. 2, lines 47 to 49, "The control unit 4 determines the number of cylinders to which fuel is injected, and controls fuel injection through a plurality of fuel injection valves 3 which are respectively positioned on the cylinders." E.g., col. 2, lines 51 to 54, "The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a vehicle velocity sensor 2."

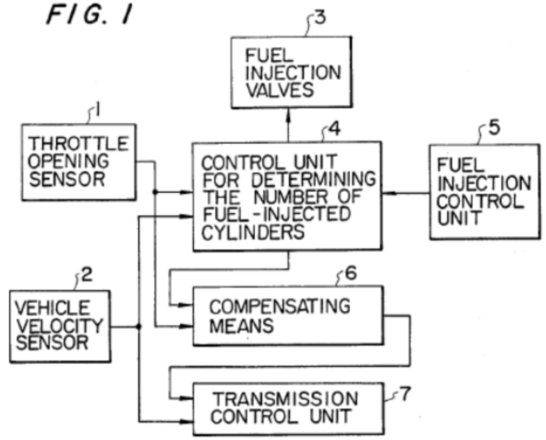
Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders.”

Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
29. Apparatus according to claim 28 and further comprising:	See claim 28 claim chart, at page A-185.	See claim 28 claim chart, at page A-185.
a memory subsystem, coupled to said processor subsystem, said memory subsystem maintaining a manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted	E.g., col. 2, lines 47 to 49, “The control unit 4 determines the number of cylinders to which fuel is injected, and controls fuel injection through a plurality of fuel injection valves 3 which are respectively positioned on the cylinders.” E.g., col. 2, lines 51 to 54, “The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a vehicle velocity sensor 2.” E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders.”

Limitation of '781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan '055)
	(i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory)." E.g., page 14.2, "Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals." E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***" E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***"	E.g., col. 2, lines 59 to 66, "With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders."

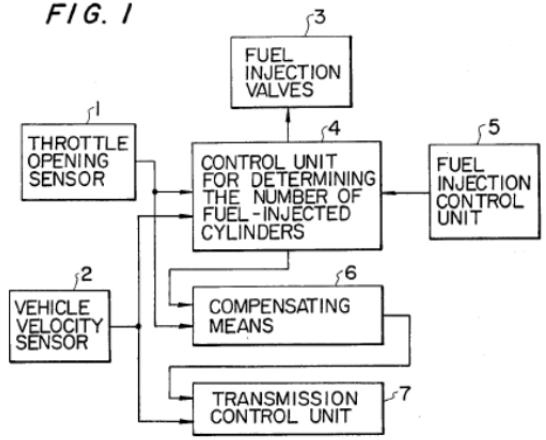
Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	
(1) based upon data received from said road speed sensor, road speed of said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as	E.g., col. 2, lines 51 to 54, “The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a ***vehicle velocity sensor 2***.” E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders.” E.g., FIG. 1:

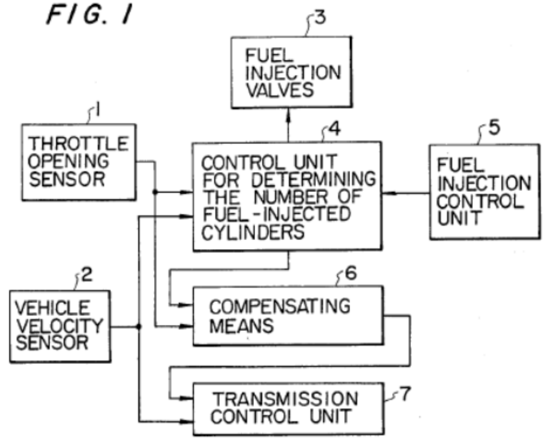
Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	FIG. 1  *See also* Col. 1, lines 63 to 64.
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing; and	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 51 to 54, “The determination of the number of the cylinders to which fuel is injected is performed based on signals from a ***throttle opening sensor 1*** and a vehicle velocity sensor 2.” E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders.” E.g., FIG. 1:

Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
		F/G. 1  *See also* Col. 1, lines 63 to 64.
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle exceeds said manifold pressure set point.	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	

Limitation of ’781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
30. Apparatus according to claim 28, wherein:	See claim 28 claim chart, at page A-185.	See claim 28 claim chart, at page A-185.
said plurality of sensors coupled to said vehicle further include an engine speed sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for	E.g., col. 2, lines 47 to 49, “The control unit 4 determines the number of cylinders to which fuel is injected, and controls fuel injection through a plurality of fuel injection valves 3 which are respectively positioned on the cylinders.” E.g., col. 2, lines 51 to 54, “The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a vehicle velocity sensor 2.” E.g., col. 2, lines 59 to 66, “With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and

Limitation of '781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan '055)
	vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	stops injection of fuel to specified one or more cylinders."
(1) based upon data received from said road speed sensor, road speed of said vehicle is decreasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."	E.g., col. 2, lines 51 to 54, "The determination of the number of the cylinders to which fuel is injected is performed based on signals from a throttle opening sensor 1 and a ***vehicle velocity sensor 2***." E.g., col. 2, lines 59 to 66, "With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders." E.g., FIG. 1:

Limitation of '781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan '055)
		FIG. 1  *See also* Col. 1, lines 63 to 64.
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	E.g., col. 2, lines 51 to 54, "The determination of the number of the cylinders to which fuel is injected is performed based on signals from a ***throttle opening sensor 1*** and a vehicle velocity sensor 2." E.g., col. 2, lines 59 to 66, "With this arrangement, when the signal from the vehicle velocity sensor 2 exceeds a predetermined level and at the same time the signal from the throttle opening sensor 1 falls below another predetermined level, the control unit 4 determines the number of cylinders to which fuel is actually injected based on the two signals applied and stops injection of fuel to specified one or more cylinders." E.g., FIG. 1:

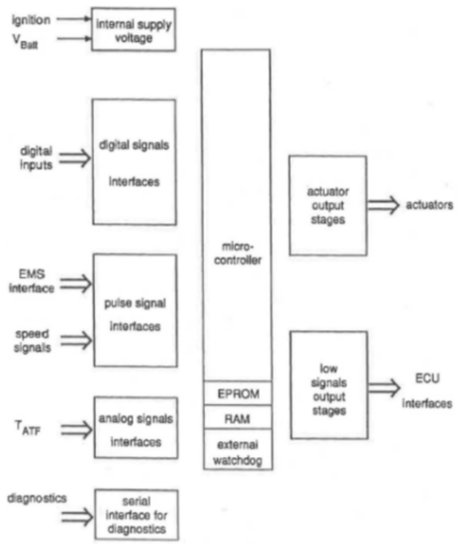
Limitation of ’781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
		FIG. 1  *See also* Col. 1, lines 63 to 64.
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	
(4) based upon data received from said engine speed sensor, engine speed for said vehicle is decreasing.	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the	

Limitation of ’781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,061,055 (Nissan ’055)
	automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	

8. Claims 28–30 are Obvious in View of the Combination of Jurgen and Mack '324

Limitation of '781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack '324)
28. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, "The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur."	E.g., Abstract, "An electronic integrated engine and vehicle management and control system includes an electronic vehicle control module and a fuel injection control module, in communication with each other, which together control the total vehicle and engine operation functions of a heavy duty vehicle. A novel fuel injection timing device is utilized with the control module to allow precise and sophisticated control of engine timing based on a number of engine and vehicle operating parameters as determined by the control modules. Functions such as engine speed control, vehicle road speed control, engine protection shutdown, fuel economy, braking control and diagnostics are performed by the system."
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio." E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the	E.g., col. 3, lines 57 to 61, "The control module 200 reads input signals from an accelerator pedal position sensor 2004, an engine speed sensor 2005, a coolant temperature sensor 2006, a fuel rack position sensor 2007, and a torque limiter switch 2008." E.g., col. 5, lines 23 to 41, "The control module 100 monitors vehicle road speed and engine speed in conjunction with information from various switches indicating application of brakes, clutch, and switches mounted on the instrument panel, to maintain vehicle operation within specified limits. These limits, such as minimum and maximum engine speeds and maximum vehicle road speed can be programmed into the control module memory via the SAE serial data communication link from an external computer such as a PC, which can be interfaced with the control module through a serial port connector attached to the data communication link 10. If the control module determines that any modifications are needed to maintain vehicle and engine operation within the prescribed limits, the fuel quantity

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack ’324)
	Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	required to maintain the desired operating parameters is calculated and its value is transmitted as a fuel request signal 111 to the fuel injection control module, with a confirming signal being sent via the SAE data communication link 10.” E.g., FIGS. 1, 2
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and	E.g., col. 2, line 45 to col. 3, line 11, “The vehicle management and control module 100 is composed of a microprocessor 1001, a random access memory 1005, and an EPROM 1003, and an EEPROM 1004. The inputs to the microprocessor 1001 comprise a number of pulse width modulated (PWM) inputs 1007, a plurality of digital data inputs 1009, and a plurality of analog inputs 1011. The pulse inputs include a pulse signal from an mph sensor which is mounted near the vehicle's transmission output shaft so as to provide an electrical pulse each time one of the teeth of a tone wheel mounted on the transmission output shaft passes the tip of the sensor. The frequency of the mph sensor output pulses is proportional to the rotational velocity of the transmission output shaft. The road speed of the vehicle can thus be calculated by factoring the number of teeth on the tone wheel, the gear ratio between the transmission output

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack ’324)
	monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	shaft and the vehicle axle shaft, and the rolling circumference of the drive axle tires. These data values can be programmed into the module memory for each specific type of vehicle in which the system is installed. The timing event sensor is mounted proximate the fuel injection pump camshaft of the vehicle engine and generates a pulse when the fuel injection pump camshaft attains an angular position corresponding to port closure or beginning of fuel injection for a predetermined plunger of the injection pump. The engine position sensor is mounted proximate the engine crankshaft and generates a pulse when the crankshaft attains an angular position related to top dead center (TDC) of the corresponding piston of the cylinder to which the plunger is coupled, on its power stroke. The data line 20 is a pulse width modulation signal line which communicates engine speed and fuel quantity data to the microprocessor 1001 from the fuel injection control module 200.” E.g., FIGS. 1, 2
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a vehicle road speed above the preset road speed limit, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack ’324)
	consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. To eliminate such an occurrence, the control module detects a ratio of engine speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear.”
said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a vehicle road speed above the preset road speed limit, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase

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	cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. To eliminate such an occurrence, the control module detects a ratio of engine speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear.” E.g., FIG. 2

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29. Apparatus according to claim 28 and further comprising:	See claim 28 claim chart, at page A-200.	See claim 28 claim chart, at page A-200.
a memory subsystem, coupled to said processor subsystem, said memory subsystem maintaining a manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted (i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory).” E.g., page 14.2, “Other safety-related items include ***program code to***	E.g., col. 2, line 45 to col. 3, line 11, “The vehicle management and control module 100 is composed of a microprocessor 1001, a random access memory 1005, and an EPROM 1003, and an EEPROM 1004. The inputs to the microprocessor 1001 comprise a number of pulse width modulated (PWM) inputs 1007, a plurality of digital data inputs 1009, and a plurality of analog inputs 1011. The pulse inputs include a pulse signal from an mph sensor which is mounted near the vehicle's transmission output shaft so as to provide an electrical pulse each time one of the teeth of a tone wheel mounted on the transmission output shaft passes the tip of the sensor. The frequency of the mph sensor output pulses is proportional to the rotational velocity of the transmission output shaft. The road speed of the vehicle can thus be calculated by factoring the number of teeth on the tone wheel, the gear ratio between the transmission output shaft and the vehicle axle shaft, and the rolling circumference of the drive axle tires. These data values can be programmed into the module memory for each specific type of vehicle in which the system is installed. The timing event sensor is mounted proximate the fuel injection pump camshaft of the vehicle engine and generates a pulse when the fuel injection pump camshaft attains an angular position corresponding to port closure or beginning of fuel injection for a predetermined plunger of the injection pump. The engine position sensor is mounted proximate the engine crankshaft and generates a pulse when the crankshaft attains an angular position related to top dead center (TDC) of the corresponding piston of the cylinder to which the plunger is coupled, on its power stroke. The data line 20 is a pulse width modulation signal line which communicates engine speed and fuel quantity data to the microprocessor 1001 from the fuel injection control module 200.”

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	detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics. Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals.” E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	E.g., FIGS. 1, 2
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a vehicle road speed above the preset road speed limit, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. To eliminate such an occurrence, the control module detects a ratio of engine speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine

Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack ’324)
	remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear.”
(1) based upon data received from said road speed sensor, road speed of said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a ***vehicle road speed above the preset road speed limit***, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. To eliminate such an occurrence, the control module detects a ratio of engine speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear.”

Limitation of '781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack '324)
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing; and	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle exceeds said manifold pressure set point.	E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models."	

Limitation of '781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,121,324 (Mack '324)
30. Apparatus according to claim 28, wherein:	See claim 28 claim chart, at page A-200.	See claim 28 claim chart, at page A-200.
said plurality of sensors coupled to said vehicle further include an engine speed sensor;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."	E.g., col. 3, lines 57 to 61, "The control module 200 reads input signals from an accelerator pedal position sensor 2004, ***an engine speed sensor 2005***, a coolant temperature sensor 2006, a fuel rack position sensor 2007, and a torque limiter switch 2008." E.g., col. 5, lines 23 to 41, "***The control module 100 monitors vehicle*** road speed and ***engine speed*** in conjunction with information from various switches indicating application of brakes, clutch, and switches mounted on the instrument panel, to maintain vehicle operation within specified limits. These limits, such as minimum and maximum engine speeds and maximum vehicle road speed can be programmed into the control module memory via the SAE serial data communication link from an external computer such as a PC, which can be interfaced with the control module through a serial port connector attached to the data communication link 10. If the control module determines that any modifications are needed to maintain vehicle and engine operation within the prescribed limits, the fuel quantity required to maintain the desired operating parameters is calculated and its value is transmitted as a fuel request signal 111 to the fuel injection control module, with a confirming signal being sent via the SAE data communication link 10." E.g., FIGS. 1, 2
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and	

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	vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	
(1) based upon data received from said road speed sensor, road speed of said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a ***vehicle road speed above the preset road speed limit***, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. To eliminate such an occurrence, the control module detects a ratio of engine

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	well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear.”
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	

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(4) based upon data received from said engine speed sensor, engine speed for said vehicle is decreasing.	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	E.g., col. 6, lines 24 to 53, “In the case where the control module detects a vehicle road speed above the preset road speed limit, the module generates a fuel request signal which causes the fuel injection control module to stop fueling the engine to insure that the vehicle operator would not be able to exceed the stored limit. It is possible, however, for a loaded vehicle to exceed the stored road speed limit while going down hill. In such a case, the control module would transmit a fuel quantity request signal of zero to disable any additional increase in vehicle speed. If the vehicle transmission should jump out of gear and into neutral at such time, the operator will not be able to fuel the engine to increase engine speed sufficiently to place the transmission back into gear. ***To eliminate such an occurrence, the control module detects a ratio of engine speed to vehicle road speed and compares this calculated ratio with a prestored minimum engine speed to road speed ratio***. FIG. 8 is a flow chart explaining this operation. The minimum stored ratio is determined based on the minimum possible engine rotational speed at the road speed limit. As long as the actual vehicle speed is above the stored road speed limit and the transmission is in gear, the engine speed-to-vehicle speed ratio will be above the stored minimum. However, if the engine speed-to-vehicle speed ratio is below such minimum, the transmission must be out of gear. Upon the occurrence of such a condition, ***the road speed limiting function will be disabled for a specified period of time to allow the operator to rev up the engine and place the transmission back into gear***.”

9. Claims 28–30 are Obvious in View of the Combination of Jurgen and GM ’753

Limitation of ’781 Patent Claim 28	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 3,925,753 (GM ’753)
28. Apparatus for optimizing operation of a vehicle, comprising:	E.g., page 12.1, “The electronic engine control system consists of sensing devices which continuously measure the operating conditions of the engine, ***an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices***, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs. The motive for using an electronic engine control system is to provide the needed accuracy and adaptability in order to minimize exhaust emissions and fuel consumption, ***provide optimal driveability for all operating conditions***, minimize evaporative emissions, and provide system diagnosis when malfunctions occur.”	E.g., Abstract, “A warning system for providing an indication when the fuel consumption of a throttle controlled vehicle having an internal combustion engine with an intake manifold exceeds pre-established levels.”
a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.” E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the	E.g., col. 1, lines 38 to 55, “Referring to the drawing, there is illustrated a warning device for providing an indication of excessive fuel consumption by a vehicle powered by a throttle controlled internal combustion engine having an intake manifold. A conduit pneumatically couples the intake manifold vacuum to a vacuum transducer 12. The vacuum transducer 12 is effective to generate a voltage having a magnitude which progressively changes with a progressively increased intake manifold vacuum level. In the preferred embodiment, the magnitude of the voltage generated by the vacuum transducer 12 progressively decreases with an increasing intake manifold vacuum level. The voltage generated by the vacuum transducer 12 is coupled to the positive input of a summing switch 14 through a resistor 15. The resulting current supplied by the vacuum transducer 12, hereinafter referred to as the vacuum signal, progressively decreases with increasing intake manifold vacuum level.” E.g., col. 2, lines 34 to 51, “To provide a manifold

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	Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.” E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	vacuum trigger level which increases with increasing vehicle speed, a speed transducer 32 is provided which generates a series of voltage pulses having a frequency progressively increasing with increasing vehicle speed. The speed transducer 32 may take the form of a slotted disc rotated by a vehicle wheel adjacent a magnetic pickup whose output is a series of voltage pulses having the frequency related to vehicle speed. These voltage pulses are supplied to a frequency-to-voltage converter 34 whose output is a voltage having a magnitude progressively increasing with increasing vehicle speed. The output of the frequency-to.-voltage converter 34 is coupled to the positive input of the summing switch 14 through a resistor 35. The resulting current supplied by the frequency-to voltage converter 34, hereinafter referred to as the speed signal, has a magnitude progressively increasing with increasing vehicle speed.” E.g., FIG. 1
a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and	E.g., FIG. 1 E.g., col. 2, lines 52 to 58, “By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32.”

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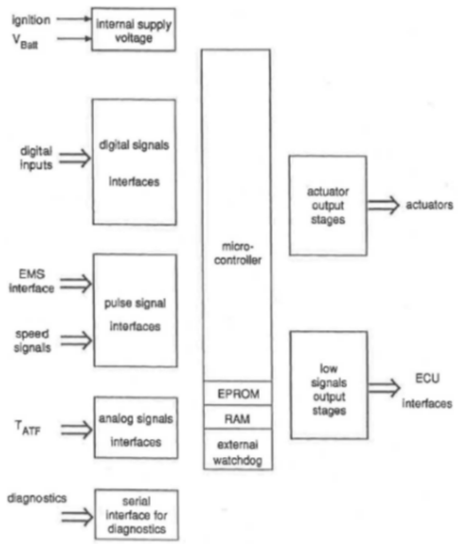
	monitoring and safety circuits (Fig. 13.1).” E.g., Figure 13.1:  FIGURE 13.1 Overview of hardware parts. E.g., page 14.3, “The speed sensor is one of the most critical parts in the system, because the ***microcontroller calculates the vehicle speed from the speed sensor’s signal*** to within 1/32 m/h.”	
a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	E.g., page 12.22, “During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***” E.g., page 12.4, “During coasting and braking, fuel	E.g., col. 2, lines 10 to 15, “The lamp 30 may be located at the vehicle instrument panel or any other location where it is readily observable by the vehicle operator. Alternatively, the lamp 30 may be replaced with a buzzer to provide an audible indication.” E.g., col. 2, lines 52 to 58, “By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum

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	consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 12.17, “***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a ‘bump’ feel when entering the fuel cutoff mode, due to the change in torque.”	signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32.” E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.”
said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel	E.g., col. 2, lines 52 to 58, “By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32.” E.g., col. 2, lines 59 to 64, “By combining the speed

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	cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., pages 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	signal in proper sense with the reference signal, the manifold vacuum level at which the output of the summing switch 14 swings positive to effect energization of the lamp 30, herein referred to as the manifold vacuum trigger level, may be increased as a function of vehicle speed." E.g., col. 3, lines 20 to 27, "When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed."

Limitation of ’781 Patent Claim 29	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 3,925,753 (GM ’753)
29. Apparatus according to claim 28 and further comprising:	See claim 28 claim chart, at page A-213.	See claim 28 claim chart, at page A-213.
a memory subsystem, coupled to said processor subsystem, said memory subsystem maintaining a manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . [T]he electronic control unit has a feature for adapting changes in the fuel required for the load/RPM points. ***At each load/RPM point, the lambda sensor continuously provides information that allows the system to adjust the fuel to the commanded A/F ratio. The corrected information is stored in RAM (random access memory) so that the next time the engine reaches that operating point (load/RPM), the anticipatory value will require less correction. These values remain stored in the electronic control unit even after the engine is shut off.*** Only if power to the electronic control unit is disrupted	E.g., FIG. 1 E.g., col. 2, lines 52 to 58, “By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32.” E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.”

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	(i.e., due to a dead battery), will the correction be lost. In that case, the electronic control unit will revert back to the original production values that are written in ROM (read-only memory)." E.g., page 14.2, "Other safety-related items include ***program code to detect abnormal operating conditions and preserving into memory the data points associated with the abnormal condition for later diagnostics.*** Abnormal conditions, for example, could be an intermittent vehicle speed sensor, or erratic driver switch signals." E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.22, "During an acceleration transition, the ECU adds a correction factor (an increase) to the commanded injector pulse width. The sudden increase in air results in a lean mixture which must be corrected swiftly to obtain good transitional response. ***During a deceleration transition, the fuel can be shut off by simply not providing a pulse width signal to the injector to minimize exhaust emissions and fuel consumption.***" E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***"	E.g., col. 2, lines 52 to 58, "By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32." E.g., col. 2, lines 59 to 64, "By combining the speed signal in proper sense with the reference signal, the manifold vacuum level at which the output of the summing switch 14 swings positive to effect energization of the lamp 30, herein referred to as the manifold vacuum trigger level, may be increased as a function of vehicle speed."

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	E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes." E.g., page 12.17, "***During transition to fuel cutoff, the ignition timing is retarded from its current setting to reduce engine torque and to assist in engine braking. The fuel is then shut off.*** During the transition, the throttle bypass valve or the main throttle valve may remain open for a short period to allow fresh air to oxidize the remaining unburned HC and CO to further reduce exhaust emissions. During development of the fuel cutoff strategy, the advantage of reduced emission effects and catalyst temperature control must be balanced against driveability requirements. The use of fuel cutoff may change the perceived amount of engine braking felt by the driver. In addition, care must be taken to avoid a 'bump' feel when entering the fuel cutoff mode, due to the change in torque."	E.g., col. 3, lines 20 to 27, "When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed."
(1) based upon data received from said road speed sensor, road speed of said vehicle is increasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as	E.g., col. 2, lines 34 to 51, "***To provide a manifold vacuum trigger level which increases with increasing vehicle speed, a speed transducer 32 is provided which generates a series of voltage pulses having a frequency progressively increasing with increasing vehicle speed***. The speed transducer 32 may take the form of a slotted disc rotated by a vehicle wheel adjacent a magnetic pickup whose output is a series of voltage pulses having the frequency related to vehicle speed. These voltage pulses are supplied to a frequency-to-voltage converter 34 whose output is a voltage having a magnitude progressively increasing with increasing vehicle speed. The output of the frequency-to.-voltage converter 34 is coupled to the positive input of the summing switch 14 through a resistor 35. The resulting current supplied by the frequency-to-voltage converter 34, hereinafter

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	well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	referred to as the speed signal, has a magnitude progressively increasing with increasing vehicle speed.” E.g., FIG. 1
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing; and	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle exceeds said manifold pressure set point.	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.” E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.”

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30. Apparatus according to claim 28, wherein:	See claim 28 claim chart, at page A-213.	See claim 28 claim chart, at page A-213.
said plurality of sensors coupled to said vehicle further include an engine speed sensor;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	
said processor subsystem activating said fuel overinjection notification circuit upon determining that:	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., pages 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps	E.g., col. 2, lines 52 to 58, “By conventional circuit design techniques, the magnitude of the speed signal may be made to equal the difference between the magnitude of the reference signal and the magnitude of the vacuum signal when the manifold vacuum is at the level determined to represent excessive fuel consumption at the instantaneous speed represented by the output of the speed transducer 32.” E.g., col. 2, lines 59 to 64, “By combining the speed signal in proper sense with the reference signal, the manifold vacuum level at which the output of the summing switch 14 swings positive to effect energization of the lamp 30, herein referred to as the manifold vacuum trigger level, may be increased as a function of vehicle speed.” E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum

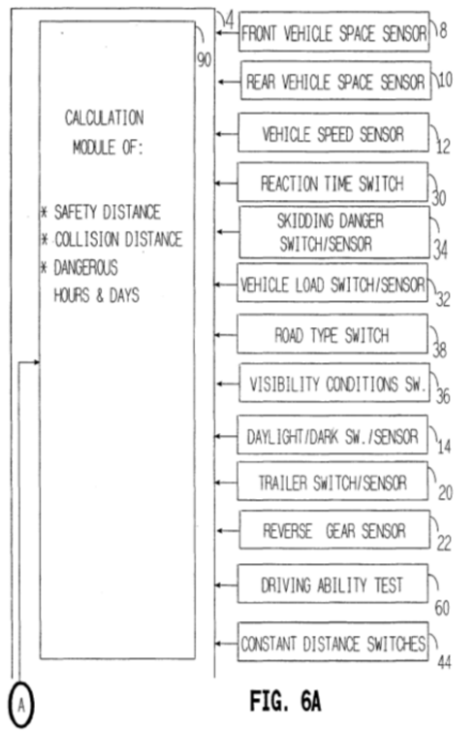
Limitation of '781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 3,925,753 (GM '753)
	are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed."
(1) based upon data received from said road speed sensor, road speed of said vehicle is decreasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."	E.g., col. 2, lines 34 to 51, "***To provide a manifold vacuum trigger level which increases with increasing vehicle speed, a speed transducer 32 is provided which generates a series of voltage pulses having a frequency progressively increasing with increasing vehicle speed***. The speed transducer 32 may take the form of a slotted disc rotated by a vehicle wheel adjacent a magnetic pickup whose output is a series of voltage pulses having the frequency related to vehicle speed. These voltage pulses are supplied to a frequency-to-voltage converter 34 whose output is a voltage having a magnitude progressively increasing with increasing vehicle speed. The output of the frequency-to.-voltage converter 34 is coupled to the positive input of the summing switch 14 through a resistor 35. The resulting current supplied by the frequency-to-voltage converter 34, hereinafter referred to as the speed signal, has a magnitude progressively increasing with increasing vehicle speed." E.g., FIG. 1
(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	

Limitation of ’781 Patent Claim 30	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 3,925,753 (GM ’753)
(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.” E.g., col. 3, lines 20 to 27, “When the vehicle is operated in a manner such that the manifold vacuum decreases below the manifold vacuum trigger level established at the instantaneous vehicle speed, the output of the summing switch 14 swings positive to effect energization of the lamp 30 to provide an indication of fuel consumption in excess of the predetermined amount at that speed.”
(4) based upon data received from said engine speed sensor, engine speed for said vehicle is decreasing.	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	

10. <u>Claim 31 is Anticipated by Davidian</u>

Limitation of '781 Patent Claim 31	U.S. Patent No. 5,357,438 (Davidian)
31. Apparatus for optimizing operation of a vehicle, comprising:	E.g., col. 1, lines 1 to 2, "The present invention relates to ***an anti-collision system for vehicles.***"
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., col. 4, lines 52 to 66, "***Vehicle 2 further includes a front space sensor 8 for sensing the space in front of the vehicle, such as the presence of another vehicle, a corresponding rear space sensor 10, and a pair of side sensors 11.*** All the space sensors are in the form of pulse (e.g., ultrasonic) transmitters and receivers, for determining the distance of the vehicle from an object, e.g., another vehicle, at front or rear. Space sensors may also be provided at the sides of the vehicle. Vehicle 2 is further equipped with a speed sensor 12 which may sense the speed of the vehicle in any known manner, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc." E.g., col. 10, lines 17 to 26, "FIG. 7 is a circuit diagram of the microcomputer 4 and the other components of the electrical system. The microprocessor is indicated by block 100, its power supply by block 102, and its watchdog circuit by block 104. ***It includes a transmitter 106 and a receiver 108 for transmitting and receiving the pulses (e.g., RF, ultrasound, laser, IR, etc.) in the front space sensor 8 and the rear space sensor 10 for measuring the distance of the vehicle from objects in front of, and to the rear, of the vehicle, respectively.***" E.g., col. 10, lines 38 to 50, "As indicated earlier, the distance of the vehicle from an object is determined by the front space sensor 8 with respect to objects in front of the vehicle, and by the rear space sensor 10 with respect to objects at the rear of the vehicle. Each of these space sensors may be of known construction, including a transmitter as indicated at 106 in FIG. 7, and a receiver as indicated at 108. ***Thus, pulses are continuously transmitted by each transmitter, and the echoes from the objects in front of or to the rear of the vehicle are received by the respective receiver. The computer then measures the round-trip time from the pulse transmission to the echo reception in order to determine the distance of the vehicle from the object.***"
at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor;	E.g., col. 4, lines 60 to 66, "Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect,

Limitation of '781 Patent Claim 31	U.S. Patent No. 5,357,438 (Davidian)
	etc."
a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;	E.g., col. 8, lines 29 to 43, "***FIGS. 6a, 6b, are a block diagram illustrating the microcomputer 4 and its inputs and outputs described earlier which enable it to continuously monitor the operation of the vehicl***e and to actuate first a Safety alarm, and then a Collision alarm whenever the vehicle may enter a danger-of-collision situation according to the various preset parameters and automatic parameters introduced into the computer. ***The microcomputer 4 as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, which receives data concerning the various parameters briefly described above*** and as will be described more particularly below to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm." E.g., col. 8, lines 58 to 60, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12." E.g., Figure 6A:

Limitation of '781 Patent Claim 31	U.S. Patent No. 5,357,438 (Davidian)
	 FIG. 6A
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table;	E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as***

Limitation of ’781 Patent Claim 31	U.S. Patent No. 5,357,438 (Davidian)
	supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.*** The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	E.g., col. 3, lines 59 to 66, “The anti-collision system illustrated in FIGS. 1-14 is particularly useful for motor vehicles (passengers cars, buses, trucks) in order to ***actuate an alarm when the vehicle is travelling at a distance behind another vehicle or in front of another***, which is equal to or less than a danger-of-collision distance computed by a computer such that if the front vehicle stops suddenly there is a danger of a rear-end collision.” E.g., col. 4, lines 14 to 16, “In the system described below***, there are two alarms: a Collision alarm, which is actuated when the vehicle is determined to be within the danger-of-collision distance; and a Safety alarm, which is actuated before the Collision alarm, at a distance greater than the danger-of-collision distance by a predetermined safety factor***, e.g., 1.25.” E.g., col. 6, lines 25 to 29, “Control panel 6 further includes a front distance display 46, in which are displayed the distance to the front vehicle (in region 46a), in which direction (by arrow 46b), and ***whether or not there is a collision danger (region 46c)***.” E.g., col. 6, lines 41 to 46, “Control panel 6 further includes a speaker 54 for producing an ***audio alarm in the event of a collision danger, in addition to the visually-indicated***

Limitation of ’781 Patent Claim 31	U.S. Patent No. 5,357,438 (Davidian)
	alarms of sections 46c and 48c of the displays 46 and 48.” E.g., col. 8, lines 37 to 48, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: ... ***a deceleration alarm module 93, which controls the Safety alarm and Collision alarm on the control panel***, ...” E.g., Figs. 3 and 6B (ref. no. 46C)
said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem.	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***” E.g., col. 13, lines 17 to 22, “***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164.”

11. <u>Claims 31 and 32 are Obvious in View of the Combination of Tonkin and Doi et al.</u>

Limitation of '781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
31. Apparatus for optimizing operation of a vehicle, comprising:	E.g., Abstract, "The system comprising a controller fitted to a subject vehicle (16) and sensor means (20) operable to sense a distance of separation and relative velocity of a trailing vehicle (18). Also input to the controller is a velocity signal derived from a velocity sensing means (97) determining the ground speed of the subject vehicle using a doppler radar system. The controller calculates a safety envelope and activates a visible warning device attached to the rear of the subject vehicle if the trailing vehicle penetrates the safety envelope. An enhanced safety envelope determined by adverse road conditions is also established, any incursion into the enhanced envelope resulting generally in the visible warning being at a less prominent level. If however the closing speed of the trailing vehicle exceeds a predetermined threshold, penetration of the enhanced envelope results immediately in the full warning being displayed with full prominence to the driver of the trailing vehicle. The system has application to improving the safety of road vehicles."	E.g., Abstract, "In a vehicle running mode detecting system, a relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object is calculated on the basis of a time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed."
a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;	E.g., page 1, lines 23 to 29, "According to one aspect of the invention there is provided a safety system for vehicles comprising a controller fitted in use to a subject vehicle, <u>**sensor means fitted to the subject vehicle in use and operable to sense a distance of separation and/or a relative velocity of a trailing vehicle**</u> and operable to input data signals representative thereof to the controller." E.g., page 5, lines 4 to 9, ***"The sensor means for sensing the distance and velocity of the trailing vehicle may comprise a radar system*** transmitting and receiving radar pulses, from which received pulses information is derived sufficient to determine both the proximity and relative speed of the trailing vehicle."	E.g., col. 2, lines 58 to 62, "The ***radar head unit*** 3 emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object." E.g., col. 2, line 66 to col. 3, line 7, "As shown in FIG. 2, ***signals from the radar head unit 3 and the vehicle speed sensor 5 which detects the running speed of the vehicle 1 are input into the control unit 4*** and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6. ***When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the vehicle control device 8 automatically causes brakes 8a***

Limitation of ’781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	E.g., FIG. 2A	***of the vehicle 1 to operate to decelerate vehicle 1***.” E.g., FIG. 3.
at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor;	E.g., page 5, lines 17 to 19, “The velocity sensing means may comprise a ***conventional speed sensing device*** fitted to the vehicle’s transmission train and may for example include a hall effect sensor.”	E.g., col. 2, lines 58 to 62, “The ***radar head unit 3*** emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object.” E.g., col. 2, line 66 to col. 3, line 7, “As shown in FIG. 2, signals from the radar head unit 3 and the ***vehicle speed sensor 5 which detects the running speed of the vehicle 1*** are input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6. When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the vehicle control device 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate vehicle 1.” E.g., FIG. 3.
a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;	E.g., page 1, lines 32 to 34, “ . . . ***wherein the controller is operable to process the received velocity signal and data signals*** to determine the existence of an unsafe condition.” E.g., page 3, lines 5 to 10, “The system in a preferred embodiment has a radar device having two receiver antenna which device ***operably communicates with a controller which is able thereby to determine the direction of motion of the vehicle***, and warning means which is automatically actuated by the controller to provide a warning when the vehicle moves.”	E.g., col. 2, lines 58 to 62, “The radar head unit 3 emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object.” E.g., col. 2, line 66 to col. 3, line 7, “As shown in FIG. 2, signals from the radar head unit 3 and the vehicle speed sensor 5 which detects the running speed of the vehicle 1 are ***input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4*** and shown by the headup display 6. When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the vehicle control

Limitation of '781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
		device 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate vehicle 1." E.g., FIG. 3.
a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table;	E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions***. These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope." E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit." E.g., page 17, lines 7 to 25, "Thus a warning system has been described using a ground speed sensor for a subject	

Limitation of '781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16."	
a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;	E.g., page 2, line 29 to Page 3, line 3, "***The system may comprise means for warning*** that the subject vehicle is stationary. ***The system can further comprise means for providing warning*** of different levels of deceleration of the subject vehicle. ***The warning means can comprise an orange light display for the relative speed and/or relative separation conditions and a red light display for the vehicle stationary and/or levels of deceleration conditions***. The relative separation and/or relative speed warning may be overridden by the level of deceleration warning." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. These parameters may for example be stored in a look up table allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety	E.g., col. 2, lines 58 to 62, "The radar head unit 3 emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, ***thereby measuring the distance from the vehicle 1 to the forward object***." E.g., col. 2, line 66 to col. 3, line 7, "As shown in FIG. 2, signals from the radar head unit 3 and the vehicle speed sensor 5 which detects the running speed of the vehicle 1 are input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6. ***When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the vehicle control device 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate vehicle 1***." E.g., FIG. 3.

Limitation of ’781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	envelope.” E.g., page 16, lines 2 to 21, “***The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16*** for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example, there are known safe stopping distances such as those published by the Minister of Transport, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. ***Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit***.” E.g., page 17, lines 7 to 25, “***Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20***. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a	

Limitation of '781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	similar manner to the safe stopping distance, or safety envelope distance. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16."	
said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem.	E.g., page 2, line 29 to Page 3, line 3, "The system may comprise means for warning that the subject vehicle is stationary. The system can further comprise means for providing warning of different levels of deceleration of the subject vehicle. The warning means can comprise an orange light display for the relative speed and/or relative separation conditions and a red light display for the vehicle stationary and/or levels of deceleration conditions. The relative separation and/or relative speed warning may be overridden by the level of deceleration warning." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions***. These parameters may for example be stored in a look up table allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope."*** E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published***	E.g., col. 2, lines 58 to 62, "The radar head unit 3 emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object." E.g., col. 2, line 66 to col. 3, line 7, "As shown in FIG. 2, ***signals from the radar head unit 3 and the vehicle speed sensor 5 which detects the running speed of the vehicle 1 are input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6.*** When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the ***vehicle control device*** 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate vehicle 1." E.g., FIG. 3.

Limitation of ’781 Patent Claim 31	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	by the Minister of Transport, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication ***with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit.***” E.g., page 17, lines 7 to 25, “***Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20***. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”	

Limitation of ’781 Patent Claim 32	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
32. Apparatus for optimizing operation of a vehicle according to claim 31 wherein:	See claim 31 claim chart, at page A-230.	See claim 31 claim chart, at page A-230.
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and	E.g., page 18, lines 9 to 13, “The information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain (and not used with a water spray to clean the windscreen).”	
said memory subsystem further storing a second vehicle speed/stopping distance table;	E.g., page 3, lines 25 to 32, “The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope.” E.g., page 16, lines 2 to 21, “The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope	

Limitation of ’781 Patent Claim 32	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit.” E.g., page 17, lines 7 to 25, “Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”	
if said windshield wiper sensor indicates that said windshield wiper is deactivated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem;	E.g., page 2, line 29 to Page 3, line 3, “The system may comprise means for warning that the subject vehicle is stationary. The system can further comprise means for providing warning of different levels of deceleration of the subject vehicle. The warning means can comprise an orange light display for the relative speed and/or relative separation conditions and a red light display for the vehicle stationary and/or levels of deceleration conditions. The relative separation and/or relative speed warning may be overridden by the level of deceleration warning.” E.g., page 3, lines 25 to 32, “The size of the enhanced safe distance and enlarged safety envelope will generally	E.g., col. 2, lines 58 to 62, “The radar head unit 3 emits a pulse laser beam (as a radar wave) forward of the vehicle 1 from the source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle 1 to the forward object.” E.g., col. 2, line 66 to col. 3, line 7, “As shown in FIG. 2, ***signals from the radar head unit 3 and the vehicle speed sensor 5 which detects the running speed of the vehicle 1 are input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6.*** When it is determined that the forward object is an

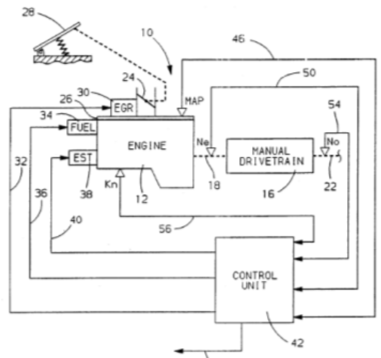
Limitation of '781 Patent Claim 32	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These parameters may for example be stored in a look up table allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope."*** E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport, in which a vehicle will stop when the brakes are applied***. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication ***with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit.***" E.g., page 17, lines 7 to 25, "***Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20***. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined	obstruction for the vehicle 1 to clear, the alarm 7 operates and the ***vehicle control device*** 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate vehicle 1." E.g., FIG. 3.

Limitation of ’781 Patent Claim 32	PCT Publication No. WO 96/02853 (Tonkin)	U.S. Patent No. 5,708,584 (Doi et al.)
	values could be used to trigger warning displays if the closing speed is too great. For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”	
if said windshield wiper sensor indicates that said windshield wiper is activated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said second vehicle speed/stopping distance table stored in said memory subsystem.	E.g., page 18, lines 16 to 19, “Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather.”	

12. Claims 2, 4, and 5 are Obvious in View of the Combination of Jurgen, Saturn '452, and Chasteen

Limitation of '781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 4,901,701 (Chasteen)
2. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-3.	See claim 1 claim chart, at page A-3.	E.g., col. 1, lines 9 to 13, "The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions." E.g., col. 2, lines 2 to 17, "Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors' need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art."
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and		

Limitation of '781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 4,901,701 (Chasteen)
	performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		
means for determining when throttle position for said vehicle is increasing; and	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	E.g., col. 7, lines 13 to 21, "Throttle position "%T" is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle. ***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552." E.g., FIG. 1:	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***." E.g., FIG. 1

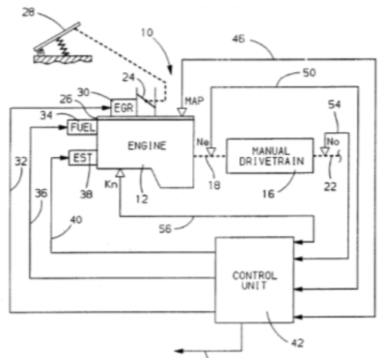
Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
		 FIG. 1	
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”		

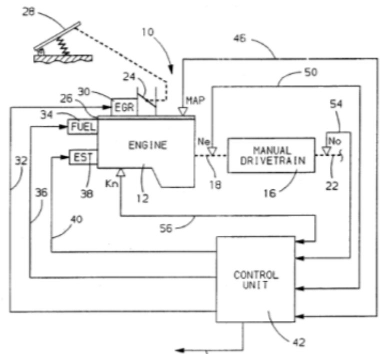
Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
			discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
4. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-3.	See claim 1 claim chart, at page A-3.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers,		

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
	antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 7, lines 13 to 21, “Throttle position “%T” is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle. ***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552.” E.g., FIG. 1:	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

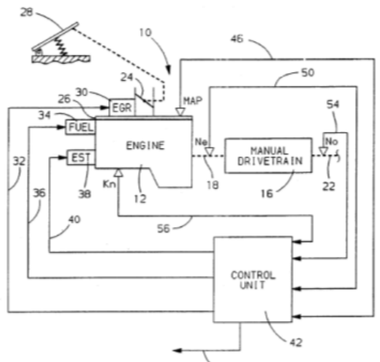
Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
		 FIG. 1	
means for determining when manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”		
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the	E.g., col. 2, lines 42 to 44, “Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, ***engine speed (Ne)*** on line 50 and output speed (No) on line 54.” E.g., col. 6, lines 55 to 60, “First, ***engine speed***	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.”

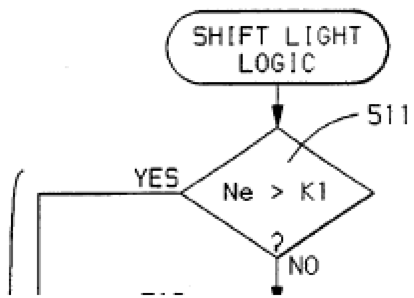
Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
	automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	***Ne is checked at block 511 to determine if it exceeds a predetermined maximum allowable engine speed threshold K1***. If the threshold is exceeded then an upshift is required regardless of the value of UTR and control is therefore passed via line 560 to block 542 where the shift light flag is set to one (SL FLAG=1). If the threshold at block 511 is not exceeded, decision block 512 is encountered.” E.g., FIG. 1:  FIG. 1	E.g., FIG. 1
said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors

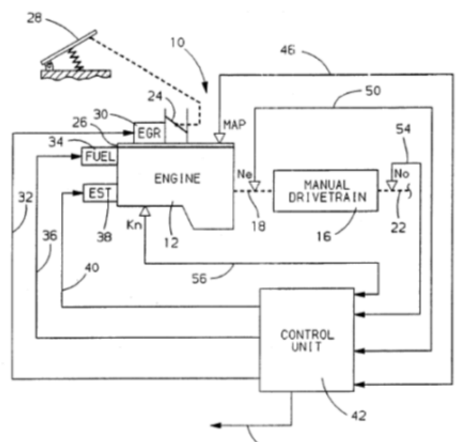
Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
	established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”		described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
5. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-3.	See claim 1 claim chart, at page A-3.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower		

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
	emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 7, lines 13 to 21, “Throttle position “%T” is checked at block 515 against a closed position threshold K3. Closed throttle is indicative of vehicle coast, a state of operation wherein the engine is not imparting torque to the drive wheels and thus does not necessitate an upshift. Closed throttle may also be indicative of the operator purposefully using the drivetrain to decelerate the vehicle. ***Therefore, where a closed throttle is detected***, control bypasses the upshift threshold steps 530 and proceeds with execution of block 552.” E.g., FIG. 1:	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of '781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 4,901,701 (Chasteen)
		 FIG. 1	
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety		

Limitation of '781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 4,901,701 (Chasteen)
	circuits (Fig. 13.1)."		
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	E.g., col. 2, lines 52 to 55, "Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, ***memory*** and input-output devices." E.g., col. 6, lines 55 to 60, "First, ***engine speed Ne is checked at block 511 to determine if it exceeds a predetermined maximum allowable engine speed threshold K1***. If the threshold is exceeded then an upshift is required regardless of the value of UTR and control is therefore passed via line 560 to block 542 where the shift light flag is set to one (SL FLAG=1). If the threshold at block 511 is not exceeded, decision block 512 is encountered." E.g., FIG. 5: 	E.g., col. 11, lines 22 to 33, "***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***."
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point	E.g., col. 2, lines 42 to 55, "Control unit 42 receives inputs required by the present embodiment including manifold absolute pressure (MAP), on line 46, engine speed (Ne) on line 50 and output speed (No) on line 54. Knock sensing means Kn are also shown providing signal input via line 56 to control unit 42. ***Control unit 42 indicates via line 60 the state of an upshift indicator light or equivalent visual display***	E.g., col. 9, lines 1 to 8, "The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure

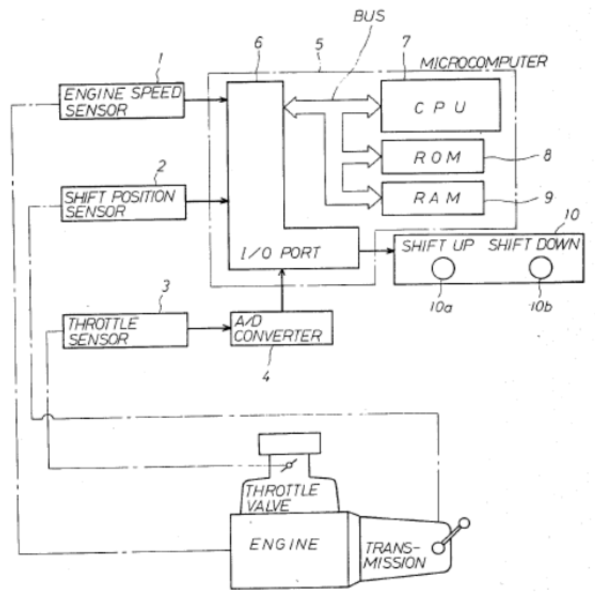
Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***such as is found in conventional instrumentation in a motor vehicle. Line 60 may provide a logic signal to an instrument cluster for further processing or may drive a lamp directly via a power driver in control unit 42***. Control unit 42 may be mechanized with a conventional state of the art microcomputer controller including a central processing unit, memory and input-output devices.” E.g., col. 3, lines 60 to 65, “Finally, ***control unit 42 outputs a signal online [sic] 60 as shown in FIG. 1 for indicating the state of the upshift indicator light*** as well as various other output signals for instrument cluster displays such as vehicle speedometer, oil pressure and coolant temperature for example.” E.g., FIG. 1:  FIG. 1	sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 4,901,701 (Chasteen)
			the engine.”

13. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious in View of the Combination of Jurgen, Toyota ’599, and Chasteen

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
2. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-9.	See claim 1 claim chart, at page A-9.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency		

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing; and	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

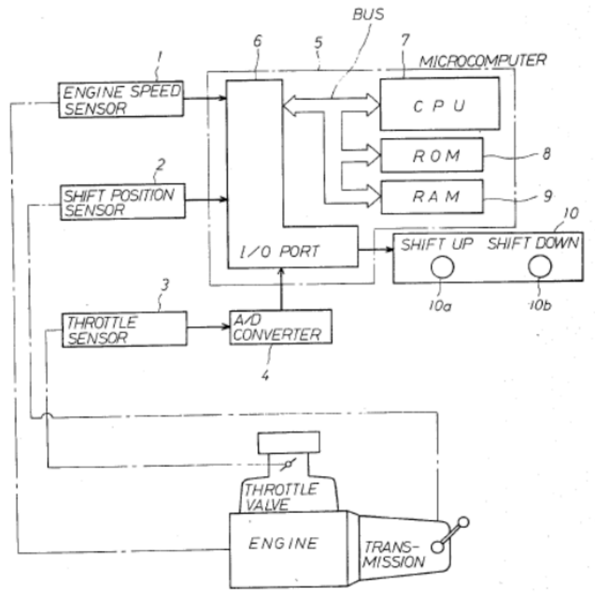
Limitation of '781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
		to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals." E.g., FIG. 1: 	
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs."	E.g., col. 2, lines 37 to 42, "The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***" E.g., col. 3, lines 7 to 20, "***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel***	

Limitation of '781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
	E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)."	***consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated."	
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes."		E.g., col. 9, lines 1 to 8, "The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., col. 9, lines 48 to 55, "The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114." E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is

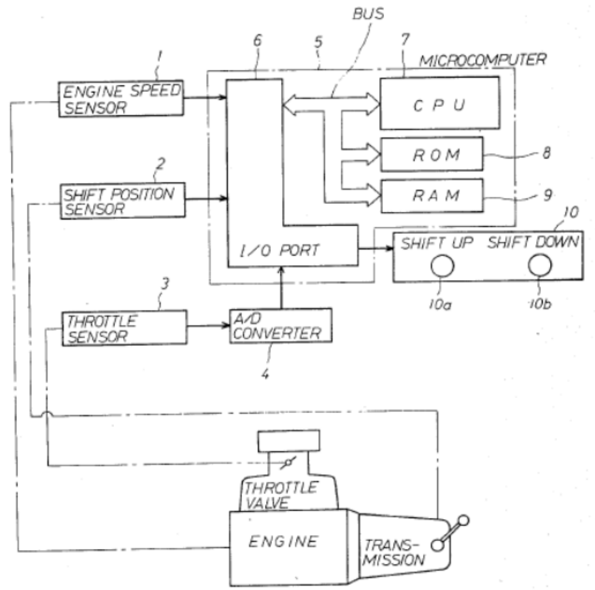
Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
			greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
4. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-9.	See claim 1 claim chart, at page A-9.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower		

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		converting from the analog signals into the digital signals.” E.g., FIG. 1:  	
means for determining when manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air		

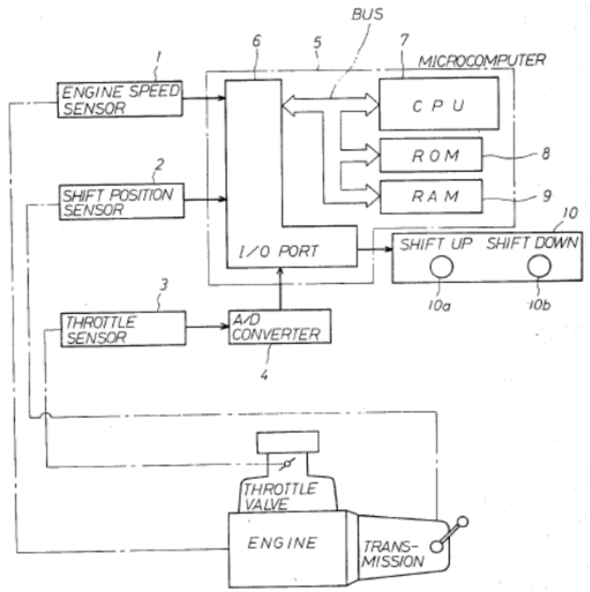
Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”		
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., FIG. 1:	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
			
said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	below the threshold, fuel injection resumes.”		pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

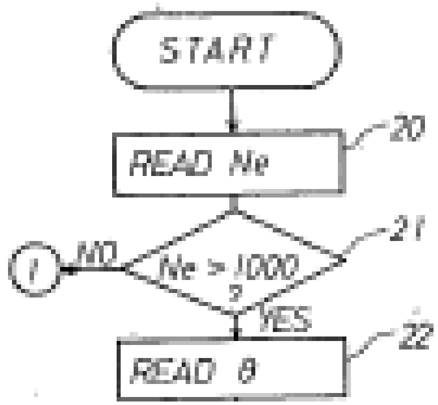
Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
5. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-9.	See claim 1 claim chart, at page A-9.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This		

Limitation of '781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
	information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***." E.g., FIG. 1

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	information to the ECU.”	accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 	
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously***		

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”		
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The***	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has***	E.g., col. 11, lines 22 to 33, “***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	shift point limitations are made, on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	***been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:	returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***.”

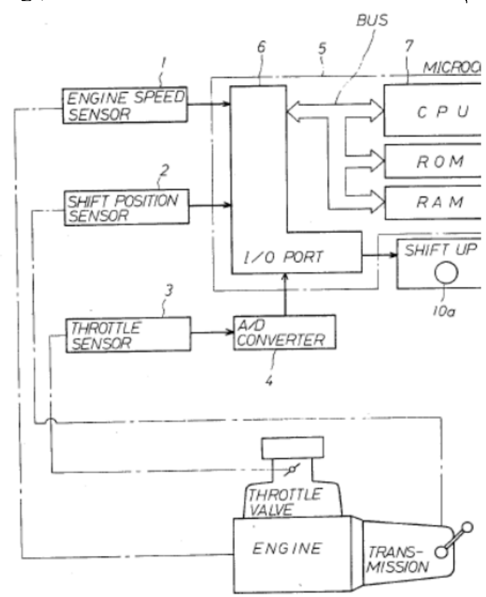
Limitation of '781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
			
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator***	E.g., col. 2, lines 37 to 42, "***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9." E.g., col. 2, lines 59 to 63, "***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***" E.g., col. 5, line 63 to col. 6, line 2, "***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift***	E.g., col. 9, lines 1 to 8, "The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., col. 9, lines 48 to 55, "The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	pedal position, and the vehicle speed (determined by the transmission output speed).”	***position to the one step shifting up position SP*** $_{+1}$ ***is preferable.*** ”	pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel

Limitation of '781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
			injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
8. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-16.	See claim 7 claim chart, at page A-16.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic		

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 	
means for comparing manifold pressure to	E.g., page 12.1, “The electronic engine	E.g., col. 2, lines 37 to 42, “The	

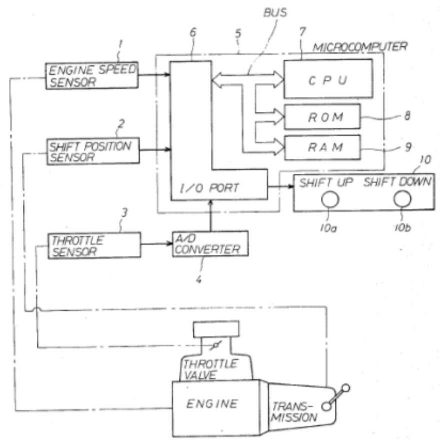
Limitation of '781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
said manifold pressure set point; and	control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)."	microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***" E.g., col. 3, lines 7 to 20, "***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated."	
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***"		E.g., col. 9, lines 1 to 8, "The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”		sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a

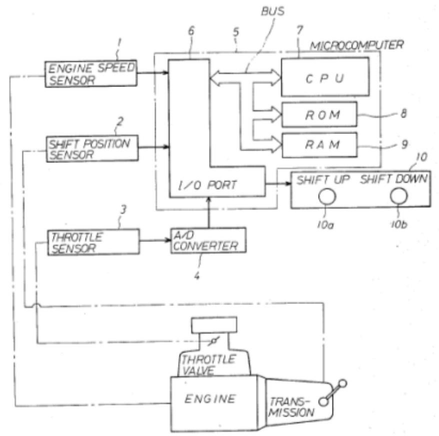
Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
			processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
10. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-16.	See claim 7 claim chart, at page A-16.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a		

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 	
means for determining when manifold pressure for said vehicle is increasing;	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***”		

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”		
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

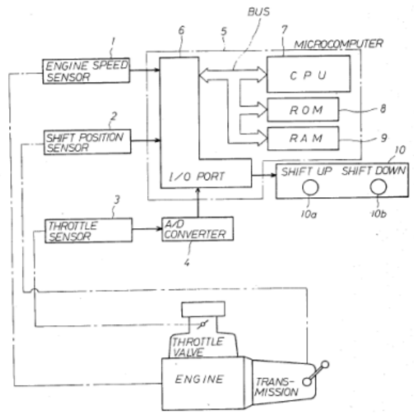
Limitation of '781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
		microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., FIG. 1: 	
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs***	E.g., col. 2, lines 37 to 42, "***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9." E.g., col. 2, lines 59 to 63, "***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***"	E.g., col. 9, lines 1 to 8, "The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., col. 9, lines 48 to 55, "The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain

Limitation of '781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
	of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed)."	E.g., col. 5, line 63 to col. 6, line 2, "***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.***" E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 7, lines 10 to 17, "***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change	the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114." E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., Statement of Examiner, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		operation from the current shift position to the one step shifting down position SP_{-1} is preferable.” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation.”	speed and throttle for adjusting the fuel injector for supplying fuel to the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
12. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-16.	See claim 7 claim chart, at page A-16.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a		

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 	
means for determining when manifold pressure for said vehicle is increasing;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the		

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”		
means for determining when engine speed for said vehicle is decreasing;	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are***		E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

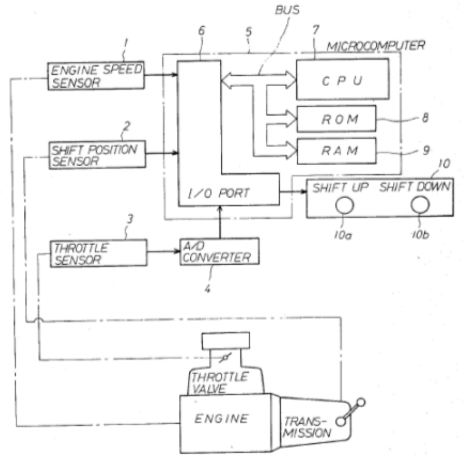
Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	the shift point control, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”		
said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs***	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with***	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”	***various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP*** $_{+1}$ ***is preferable.***” E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 7, lines 10 to 17, “***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus	to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., Statement of Examiner, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would

Limitation of '781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
		indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable." E.g. col. 7, lines 29 to 38, "However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation."	consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

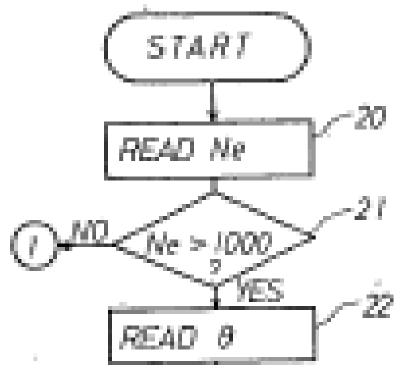
Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
15. Apparatus for optimizing operation of a vehicle according to claim 13 wherein said processor subsystem further comprises:	See claim 13 claim chart, at page A-23.	See claim 13 claim chart, at page A-23.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a		

Limitation of '781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***." E.g., FIG. 1

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1: 	
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an***		E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine

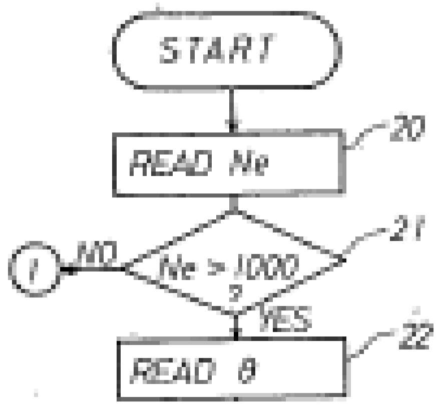
Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”		RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.”
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs***	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in***	E.g., col. 11, lines 22 to 33, “***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.***”

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”	***the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.”	

Limitation of '781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 4,901,701 (Chasteen)
		E.g., Figure 4:  	
means for determining when manifold pressure is increasing;	E.g., page 12.1, "The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer		

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”		
means for determining when engine speed is increasing or decreasing;	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine***	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined timing, e.g. periodical***	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”	***timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21.*** If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:	

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
			
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point; and	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to***	E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
	speed).”	***the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.*** ”	processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus***	E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		indicating to the drive that the speed change from current shift position to the one step shifting up position SP_{+1} ***is preferable.***” E.g., col. 2, line 64 to col. 3, line 3, “***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications.” E.g., col. 7, lines 10 to 17, “***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down indication lamp in the indicator 10 is illuminated,*** thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable.” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate*** B_e, ***the corresponding shift-up lamp or shift-***	control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 4,901,701 (Chasteen)
		down lamp in the indicator 10 is illuminated, thus indicating the necessity of the speed change operation.”	

14. Claims 2, 4, 5, 8, 10, 12, and 15 are Obvious in View of the Combination of Jurgen, Volkswagen ’070, and Chasteen

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
2. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-31.	See claim 1 claim chart, at page A-31.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought		

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing; and	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across	

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation

Limitation of ’781 Patent Claim 2	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	the threshold, fuel injection resumes.”		of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
4. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-31.	See claim 1 claim chart, at page A-31.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic		

Limitation of '781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
	sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed." E.g., page 12.21, "The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU."	E.g., page 6 (English translation), "As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine."	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***." E.g., FIG. 1
means for determining when manifold pressure for said vehicle is increasing; and	E.g., page 2.5, "Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute***	E.g., page 6 (English translation), "As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line	

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	pressure (MAP) sensors.” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.”	E.g., page 6 (English translation), “The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle

Limitation of ’781 Patent Claim 4	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
			position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
5. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	See claim 1 claim chart, at page A-31.	See claim 1 claim chart, at page A-31.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic		

Limitation of ’781 Patent Claim 5	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line	

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	evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the***	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed	E.g., col. 11, lines 22 to 33, “***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***.”

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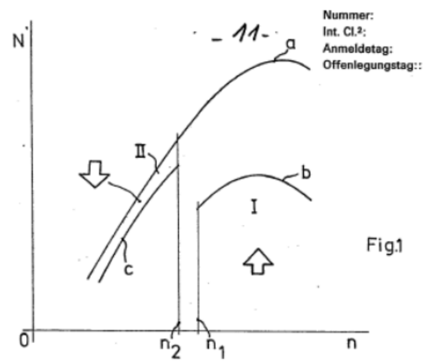
	throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed)."	dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:  E.g., Figure 2:	

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		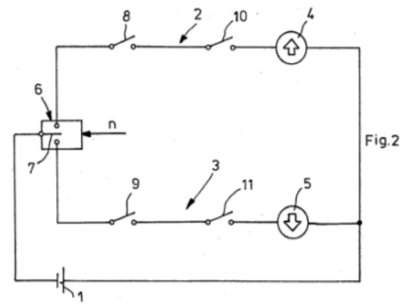	
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than***	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated

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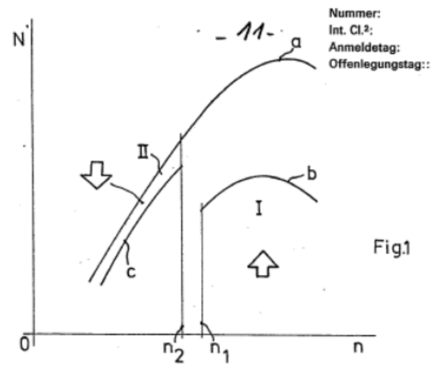
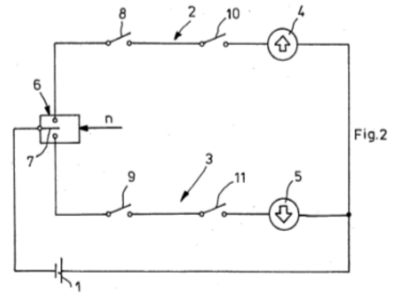
		predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:  E.g., Figure 2: 	at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
8. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-39.	See claim 7 claim chart, at page A-39.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a		

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the	

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain

Limitation of ’781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
			the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the

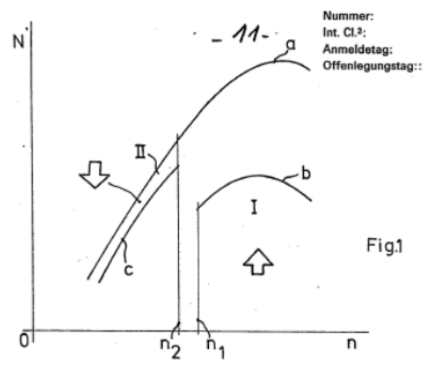
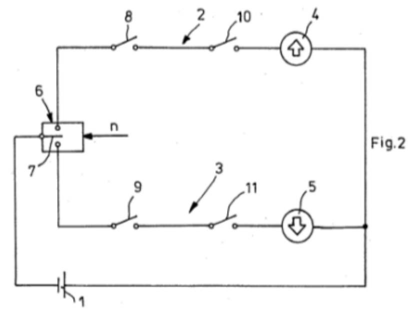
Limitation of '781 Patent Claim 8	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
			speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
10. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-39.	See claim 7 claim chart, at page A-39.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic		

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for determining when manifold pressure for said vehicle is increasing;	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP)***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line	

Limitation of '781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
	sensors." E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models."	that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***." E.g., page 9 (English translation), "It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."	
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications."	E.g., page 6 (English translation), "The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed." E.g., page 8 (English translation), "***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here."	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., FIG. 1

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.”	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle

Limitation of ’781 Patent Claim 10	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
		E.g., Figure 1:  E.g., Figure 2: 	position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
12. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	See claim 7 claim chart, at page A-39.	See claim 7 claim chart, at page A-39.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a		

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for determining when manifold pressure for said vehicle is increasing;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the***	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been	

Limitation of '781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
	operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)."	plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed." E.g., page 9 (English translation), "It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."	
means for determining when engine speed for said vehicle is decreasing;	E.g., page 12.4, "During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***" E.g., page 12.14, "Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be	E.g., page 6 (English translation), "As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., FIG. 1

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	established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.”	
said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”	E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”		sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a

Limitation of ’781 Patent Claim 12	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
			processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
15. Apparatus for optimizing operation of a vehicle according to claim 13 wherein said processor subsystem further comprises:	See claim 13 claim chart, at page A-47.	See claim 13 claim chart, at page A-47.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic		

Limitation of ’781 Patent Claim 15	**Automotive Electronics Handbook (Jurgen)**	**German Patent Application Publication No. 29 26 070 (Volkswagen ’070)**	**U.S. Patent No. 4,901,701 (Chasteen)**
	sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which***	E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se;	E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next

Limitation of '781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
	evaluates the sensor inputs using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs." E.g., page 22.6, "During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***" E.g., page 13.4, "On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1)."	they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."	makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine."
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the***	E.g., pages 6 to 7 (English translation), "Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed	E.g., col. 11, lines 22 to 33, "***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.***"

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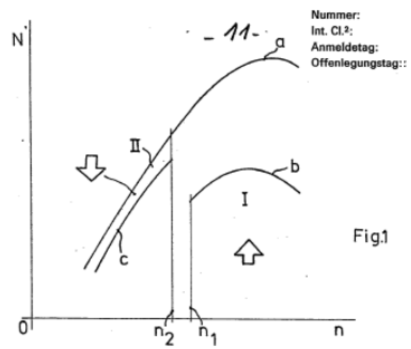
	throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed).”	dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1:  E.g., Figure 2:	

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		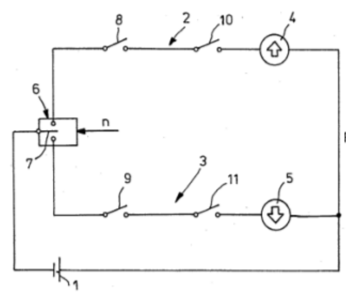 Fig.2	
means for determining when manifold pressure is increasing;	E.g., page 12.1, “The electronic engine control system consists of ***sensing devices which continuously measure the operating conditions of the engine, an electronic control unit (ECU) which evaluates the sensor inputs*** using data tables and calculations and determines the output to the actuating devices, and actuating devices which are commanded by the ECU to perform an action in response to the sensor inputs.” E.g., page 22.6, “During the entire operating time of the vehicle, ***the ECUs are constantly supervising the sensors they are connected to.***” E.g., page 13.4, “On the functional side, the hardware configuration can be divided into power supply, input signal transfer circuits, output stages, and ***microcontroller***, including peripheral components and monitoring and safety circuits (Fig. 13.1).”	E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”	
means for determining when engine speed is increasing or decreasing;	E.g., page 12.4, “During coasting and braking, fuel consumption can be further	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134,

Limitation of ’781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 4,901,701 (Chasteen)
	reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.” E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine. As a measure thereof, in addition to the ***throttle valve angle*** itself, it is also possible to use the ***induction manifold vacuum***. . . . The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.”	an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

Limitation of '781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point; and	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	E.g., pages 6 to 7 (English translation), "Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:	E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

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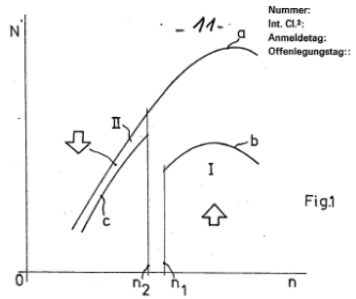
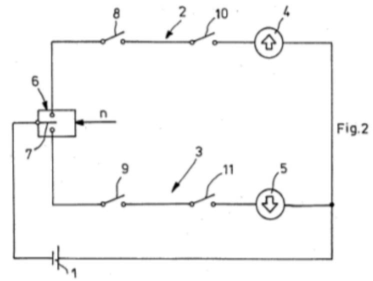
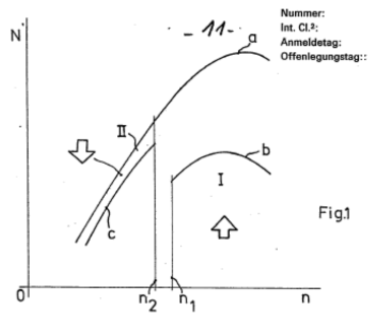
		 E.g., Figure 2: 	
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving***	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***”	E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the

Limitation of '781 Patent Claim 15	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 4,901,701 (Chasteen)
	comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed (determined by the transmission output speed)."	E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:  E.g., Figure 2:	engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

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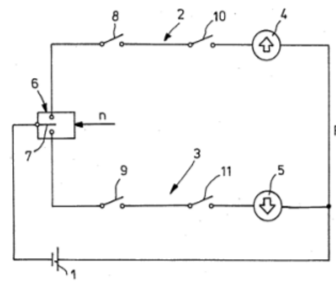
		 Fig.2	

15. Claim 18 is Obvious in View of the Combination of Jurgen, Toyota '599, Davidian, and Tonkin

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.	See claim 17 claim chart, at page A-57.	E.g., Abstract, "The system comprising a controller fitted to a subject vehicle (16) and sensor means (20) operable to sense a distance of separation and relative velocity of a trailing vehicle (18). Also input to the controller is a velocity signal derived from a velocity sensing means (97) determining the ground speed of the subject vehicle using a doppler radar system. The controller calculates a safety envelope and activates a visible warning device attached to the rear of the subject vehicle if the trailing vehicle penetrates the safety envelope. An enhanced safety envelope determined by adverse road conditions is also established, any incursion into the enhanced envelope resulting generally in the visible warning being at a less prominent level. If however the closing speed of the trailing vehicle exceeds a predetermined threshold, penetration of the enhanced envelope results immediately in the full warning being displayed with full prominence to the driver of the trailing vehicle. The system has application to improving the safety of road vehicles."

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, “The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22.” E.g., col. 8, lines 58 to 63, “Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18.”	E.g., page 18, lines 9 to 13, “The information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain (and not used with a water spray to clean the windscreen).”
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, “***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***”	E.g., page 18, lines 16 to 19, “Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather.” E.g., page 3, lines 25 to 32, “The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These***

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			E.g., col. 12, line 59 to col 13, line 22, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance.*** The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the	***parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope.” E.g., page 16, lines 2 to 21, “The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***<u>, there are known safe stopping distances such as those published by the Minister of Transport</u>***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”	the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit.” E.g., page 17, lines 7 to 25, “Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres,

Limitation of ’781 Patent Claim 18	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 4,559,599 (Toyota ’599)**	**U.S. Patent No. 5,357,438 (Davidian)**	**PCT Publication No. WO 96/02853 (Tonkin)**
				if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”

16. Claim 18 is Obvious in View of the Combination of Jurgen, Volkswagen ’070, Davidian, and Tonkin

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.	See claim 17 claim chart, at page A-104.	E.g., Abstract, “The system comprising a controller fitted to a subject vehicle (16) and sensor means (20) operable to sense a distance of separation and relative velocity of a trailing vehicle (18). Also input to the controller is a velocity signal derived from a velocity sensing means (97) determining the ground speed of the subject vehicle using a doppler radar system. The controller calculates a safety envelope and activates a visible warning device attached to the rear of the subject vehicle if the trailing vehicle penetrates the safety envelope. An enhanced safety envelope determined by adverse road conditions is also established, any incursion into the enhanced envelope resulting generally in the visible warning being at a less prominent level. If however the closing speed of the trailing vehicle exceeds a predetermined threshold, penetration of the enhanced envelope results immediately in the full warning being displayed with full prominence to the driver of the trailing vehicle. The system has application to improving the safety of road vehicles.”

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, "The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22." E.g., col. 8, lines 58 to 63, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18."	E.g., page 18, lines 9 to 13, "The information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain (and not used with a water spray to clean the windscreen)."
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***"	E.g., page 18, lines 16 to 19, "Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance.*** The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above,	adverse road conditions. ***These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope." E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164."	and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit." E.g., page 17, lines 7 to 25, "Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety***

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
				envelope distance. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”

17. Claim 18 is Obvious in View of the Combination of Jurgen, Saturn '452, Davidian, and Tonkin

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
18. Apparatus for optimizing operation of a vehicle according to claim 17 wherein:	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.	See claim 17 claim chart, at page A-153.	E.g., Abstract, "The system comprising a controller fitted to a subject vehicle (16) and sensor means (20) operable to sense a distance of separation and relative velocity of a trailing vehicle (18). Also input to the controller is a velocity signal derived from a velocity sensing means (97) determining the ground speed of the subject vehicle using a doppler radar system. The controller calculates a safety envelope and activates a visible warning device attached to the rear of the subject vehicle if the trailing vehicle penetrates the safety envelope. An enhanced safety envelope determined by adverse road conditions is also established, any incursion into the enhanced envelope resulting generally in the visible warning being at a less prominent level. If however the closing speed of the trailing vehicle exceeds a predetermined threshold, penetration of the enhanced envelope results immediately in the full warning being displayed with full prominence to the driver of the trailing vehicle. The system has application to improving the safety of road vehicles."

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and			E.g., col. 4, line 67 to col. 5, line 2, "The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22." E.g., col. 8, lines 58 to 63, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18."	E.g., page 18, lines 9 to 13, "The information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain (and not used with a water spray to clean the windscreen)."
said memory subsystem further storing a second vehicle speed/stopping distance table.			E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in the form of a look-up table,*** for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***"	E.g., page 18, lines 16 to 19, "Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These parameters may for example be***

Limitation of '781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance.*** The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the	***stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope." E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the

Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
			object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”	trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit.” E.g., page 17, lines 7 to 25, “Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing

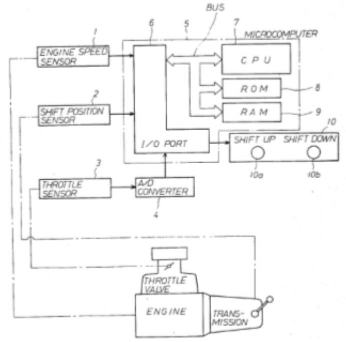
Limitation of ’781 Patent Claim 18	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
				too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”

18. Claims 24 and 25 are Obvious in View of the Combination of Jurgen, Saturn '452, Davidian, and Chasteen

Limitation of '781 Patent Claim 24	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 5,477,452 (Saturn '452)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
24. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-172.	See claim 23 claim chart, at page A-172.	See claim 23 claim chart, at page A-172.	E.g., col. 1, lines 9 to 13, "The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions." E.g., col. 2, lines 2 to 17, "Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors' need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not

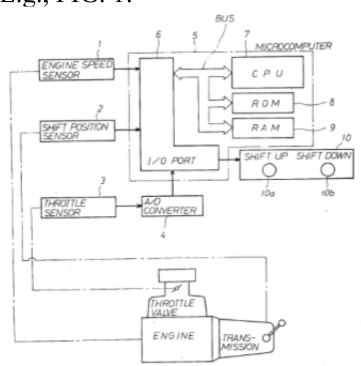
Limitation of '781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				been developed in the prior art."
means for determining when road speed for said vehicle is increasing or decreasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		E.g., col. 4, lines 60 to 66, "Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc."	
means for determining when throttle position for said vehicle	E.g., page 12.18, "To control the idle speed, the ECU uses inputs	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift	E.g., col. 4, lines 60 to 66, "Vehicle 2 is further equipped	E.g., col. 9, lines 3 to 8, "These sensors may include a battery

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
is increasing or decreasing; and.	from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	indication apparatus with a manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.”	with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
		E.g., FIG. 1: 		
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque***		

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	***curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.”		
means for determining when manifold pressure for said vehicle is increasing or decreasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the			

Limitation of '781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn '452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***" E.g., page 2.7, "Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models."			
means for determining when engine speed for said vehicle is increasing or decreasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a		E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., FIG. 1

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	(ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., FIG. 1: 		
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases			E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130

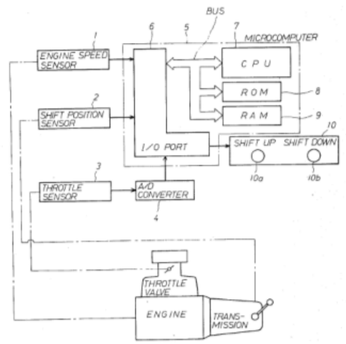
Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
manifold pressure for said vehicle is above said manifold pressure set point or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”			through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 5,477,452 (Saturn ’452)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
25. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-172.	See claim 23 claim chart, at page A-172.	See claim 23 claim chart, at page A-172.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***,	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138,

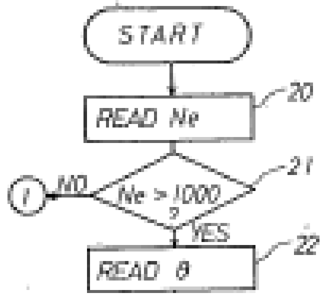
Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1:	for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting***		

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	***and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.”		
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing		E.g., col. 11, lines 22 to 33, “***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the***

Limitation of '781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***" E.g., col. 3, lines 7 to 20, "***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated." E.g., col. 3, lines 44 to 61, "***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined***		***engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. ***If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***."

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
		timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21. If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20.” E.g., Figure 4:		

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation***		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in

Limitation of '781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	transmission output speed)."	***indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.*** "		the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114." E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0

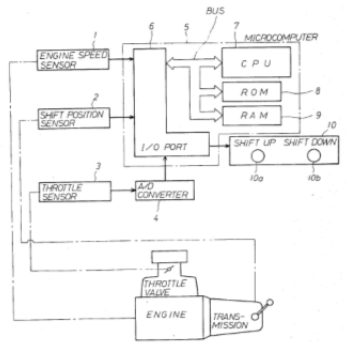
Limitation of ’781 Patent Claim 25	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 4,559,599 (Toyota ’599)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
				(increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

19. Claims 24, 25, and 27 are Obvious in View of the Combination of Jurgen, Toyota ’599, Davidian, and Chasteen

Limitation of ’781 Patent Claim 24	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 4,559,599 (Toyota ’599)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
24. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-79.	See claim 23 claim chart, at page A-79.	See claim 23 claim chart, at page A-79.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not

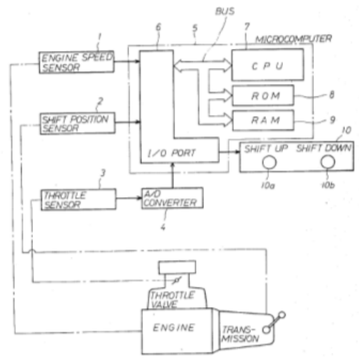
Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				been developed in the prior art.”
means for determining when road speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	
means for determining when throttle position for said vehicle is increasing or decreasing; and.	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position***	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which***	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	sensor, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	manual transmission according to the present invention comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1:	***may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting***		

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	***and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.”		
means for determining when manifold pressure for said vehicle is increasing or decreasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive			

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”			
means for determining when engine speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing		E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 43 to 48, “***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9.” E.g., FIG. 1: 		
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set			E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132.

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
vehicle is above said manifold pressure set point or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***” E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”			These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of ’781 Patent Claim 25	**Automotive Electronics Handbook (Jurgen)**	**U.S. Patent No. 4,559,599 (Toyota ’599)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
25. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-79.	See claim 23 claim chart, at page A-79.	See claim 23 claim chart, at page A-79.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.”

Limitation of '781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, "There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."		E.g., col. 4, lines 60 to 66, "Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc."	
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, "To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power	E.g., col. 2, lines 23 to 36, "Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention comprises	E.g., col. 4, lines 60 to 66, "Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***,	E.g., col. 9, lines 3 to 8, "These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138,

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1:	for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

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		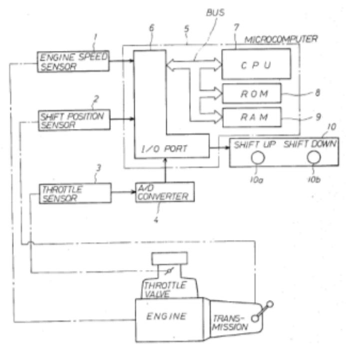		
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to	E.g., col. 2, lines 37 to 42, “The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting***		

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	determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults."	***and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated."		
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, "***The basic functions of the transmission control are the shift point control***, the lockup	E.g., col. 2, lines 37 to 42, "The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing		E.g., col. 11, lines 22 to 33, "***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the***

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	unit (CPU) 7, ***a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ***ROM 8, and RAM 9.***” E.g., col. 3, lines 7 to 20, “***The torque data map indicative of torque curves T as shown in FIG. 2 has been stored in the ROM 8 in advance. The fuel consumption rate data map indicative of equal fuel consumption rate curves B as shown in FIG. 3 has been also stored in the ROM 8 in advance. In FIG. 2, each equal torque curve T was prepared by plotting and connecting equal torque points on the graph with respect to the engine speed vs. throttle valve opening.*** In FIG. 3, each fuel consumption rate curve B was prepared by plotting and connecting equal fuel consumption rate points on a graph obtained in advance by experiment data with respect to the engine speed and the torques thus calculated.” E.g., col. 3, lines 44 to 61, “***In this case, as shown in FIG. 4, the operation of a main routine is started at a predetermined***		***engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. ***If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***.”

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		timing, e.g. periodical timing pulses from a timer (not shown) and the detection of the engine speed N_e from the sensor 1 is carried out and it is stored into the RAM 9 at the step 20. Then, the engine speed N_e is read from the RAM 9 and it is compared with a predetermined number N (=1000 rpm) to determine whether or not the N_e exceeds the value 1000 at the step 21. If the result of the decision is YES, the next step 22 is executed. That is, in the step 22, the reading in of the opening of the throttle valve is performed through the throttle sensor 3 and the A/D converter 4. In the above case, if the result of the decision in step 21 is NO, the main routine is terminated by determining that the shift operation is not necessary and the engine speed N_e is read again at the predetermined timing and now the operation returns to the step 20." E.g., Figure 4:		

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		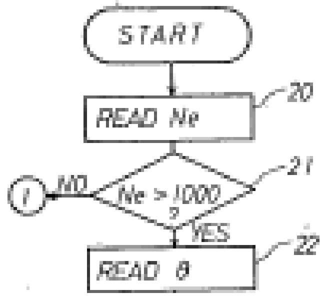		
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation***		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	transmission output speed).”	***indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable.***”		the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0

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				(increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

Limitation of '781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
27. Apparatus for optimizing operation of a vehicle according to claim 26 wherein said processor subsystem further comprises:	See claim 26 claim chart, at page A-91.	See claim 26 claim chart, at page A-91.	See claim 26 claim chart, at page A-91.	E.g., col. 1, lines 9 to 13, "The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions." E.g., col. 2, lines 2 to 17, "Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors' need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art."

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means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering,	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift indication apparatus with a manual transmission according to the present invention	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***,	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138,

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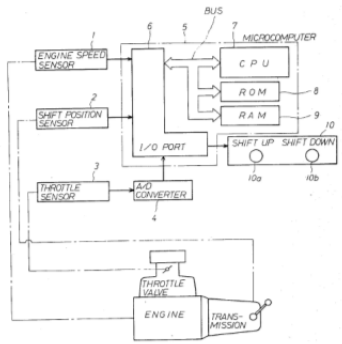
	charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	comprises an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed, a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations.” E.g., col. 2, lines 52 to 59, “Similarly, the output of ***the throttle sensor 3*** is connected through the A/D converter 4 to the input of the I/O port 6 so as to transmit the output signals thereof to the microcomputer 5 through the A/D converter 4 and to store the data corresponding to the throttle value opening into the RAM 9 after converting from the analog signals into the digital signals.” E.g., FIG. 1:	for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1

Limitation of ’781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota ’599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				
means for determining when manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”			
means for determining when engine speed for said vehicle is	E.g., page 7.6, “There are several applications for rotational speed	E.g., col. 2, lines 23 to 36, “Referring to FIG. 1, the shift		E.g., col. 9, lines 3 to 8, “These sensors may include a battery

Limitation of '781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
decreasing;	sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications." E.g., page 7.8, "In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio."	indication apparatus with a manual transmission according to the present invention comprises ***an engine speed sensor 1 for detecting the engine speed and for producing pulse signals of a frequency proportional to the engine speed,*** a shift position sensor 2 for detecting the shift positions of the transmission, ***a throttle sensor 3 for detecting the opening degree of the throttle valve by means of, for instance, a potentiometer,*** an A/D converter 4 for converting analog signals from the throttle valve sensor 3 into digital signals, a microcomputer 5 for performing various calculations in accordance with the different signals from the sensors, and an indicator 10 for indicating the result of the calculations." E.g., col. 2, lines 43 to 48, "***The engine speed sensor 1*** is mounted in a distributor (not shown) and the output of the sensor is connected to the input of the I/O port 6 so as to transmit the output pulses to the microcomputer 5 through the I/O port 6 and to store the data corresponding to the engine speed into the RAM 9." E.g., FIG. 1:		voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., FIG. 1

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		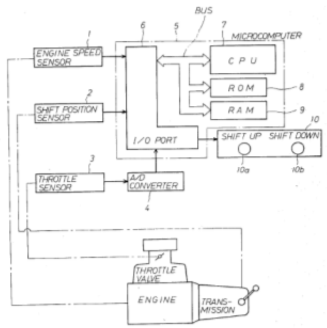		
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., col. 2, lines 37 to 42, “***The microcomputer 5 further comprises an input/output port (I/O port) 6, a central processing unit (CPU) 7, a read only memory (ROM) 8, and a random access memory (RAM) 9.*** In the microcomputer 5, there is provided a bus BUS which communicates the I/O port 6 and the CPU 7, ROM 8, and RAM 9.” E.g., col. 2, lines 59 to 63, “***The input of the indicator 10 is connected to the output of the I/O port 6 so as to indicate each preferable shift position corresponding to the optimum fuel consumption rate in accordance with various parameters calculated.***” E.g., col. 5, line 63 to col. 6, line 2, “***Namely, in this step, the speed change operation***		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion

Limitation of '781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	U.S. Patent No. 4,559,599 (Toyota '599)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
		indicating signal is applied to the indicator or display 10 from the microcomputer 5 through the I/O port 6. As a result, a particular lamp in this case, a shift up indicating lamp in the indicator 10, is illuminated, thus indicating to the drive that the speed change from current shift position to the one step shifting up position SP $_{+1}$ is preferable." E.g., col. 2, line 64 to col. 3, line 3, "***The indicator 10 includes a shift-up indicating lamp 10a and a shift-down indicating lamp 10b.*** ***The indicator 10 may be assembled by light emiting [sic] diodes (LED) so as to perform shift-up and shift-down indications by up and down directed arrow marks.*** Alternatively, the indicator 10 may also be replaced with other voice combining circuit so as to announce the shift operations by voice instead of the indications." E.g., col. 7, lines 10 to 17, "***In this step 42, shift-down display is performed. Namely in this case, the shift down display instruction signal from the microcomputer 5 is applied to the indicator 10 through the I/O port 6 and the shift-down***		immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114." E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU

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		indication lamp in the indicator 10 is illuminated, thus indicating to the driver that speed change operation from the current shift position to the one step shifting down position SP_{-1} is preferable.” E.g. col. 7, lines 29 to 38, “However, ***only when either one of the assumed fuel consumption rates above is better than the current fuel consumption rate B_e, the corresponding shift-up lamp or shift-down lamp in the indicator 10 is illuminated***, thus indicating the necessity of the speed change operation.”		provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

20. <u>Claims 24, 25, and 27 are Obvious in View of the Combination of Jurgen, Volkswagen '070, Davidian, and Chasteen</u>

Limitation of '781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
24. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-126.	See claim 23 claim chart, at page A-126.	See claim 23 claim chart, at page A-126.	E.g., col. 1, lines 9 to 13, "The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions." E.g., col. 2, lines 2 to 17, "Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors' need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in

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				operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	
means for determining when	E.g., page 12.18, “To control the	E.g., page 6 (English	E.g., col. 4, lines 60 to 66,	E.g., col. 9, lines 3 to 8, “These

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
throttle position for said vehicle is increasing or decreasing; and.	idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	“Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point;	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.” E.g., page 12.9, “A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel		

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, “The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by comparing the registered actual value with the internally stored nominal values*** with the help of control units and their self-diagnosis, thus detecting faults.”	consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”		
means for determining when manifold pressure for said	E.g., page 2.5, “Automotive specification and testing	E.g., page 6 (English translation), “As can be seen		

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
vehicle is increasing or decreasing; and	guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”		
means for determining when engine speed for said vehicle is increasing or decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were	E.g., page 6 (English translation), “The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the		E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.”

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”	maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.”		E.g., FIG. 1
said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are	E.g., page 12.4, “During coasting and braking, fuel consumption can be further reduced by shutting off the fuel until the engine speed decreases to slightly higher than the set idle speed. ***The ECU determines when fuel shutoff can occur by evaluating the throttle position, engine RPM, and vehicle speed.***”	E.g., page 9 (English translation), “It is useful if in addition to this device, ***a display of the route-specific fuel consumption is provided in a vehicle***. Such display devices are known per se; they generally utilize the injection manifold vacuum as a measure of fuel consumption.”		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a

Limitation of ’781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
decreasing.	E.g., page 12.14, “Using the inputs of engine RPM and vehicle speed to the electronic control unit, thresholds can be established for limiting these variables with fuel cutoff. ***When the maximum speed is achieved, the fuel injectors are shut off.*** When the speed decreases below the threshold, fuel injection resumes.”			barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the

Limitation of '781 Patent Claim 24	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen '070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine." E.g., August 6, 1998 Office Action, "Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine."

Limitation of ’781 Patent Claim 25	**Automotive Electronics Handbook (Jurgen)**	**German Patent Application Publication No. 29 26 070 (Volkswagen ’070)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
25. Apparatus for optimizing operation of a vehicle according to claim 23 wherein said processor subsystem further comprises:	See claim 23 claim chart, at page A-126.	See claim 23 claim chart, at page A-126.	See claim 23 claim chart, at page A-126.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes

Limitation of ’781 Patent Claim 25	**Automotive Electronics Handbook (Jurgen)**	**German Patent Application Publication No. 29 26 070 (Volkswagen ’070)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
				in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is increasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	

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means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for comparing manifold pressure to said manifold pressure set point; and	E.g., page 13.5, “The calculators inside the control units are usually microcontrollers. . . . ***The memory devices for program and data are usually EPROMS***. Their storage capacity is, in present applications, up to 64 Kbytes. Future applications will necessitate storage sizes up to 128 Kbytes. The failure storages for diagnostics and the storage for adaptive data are in conventional applications, battery voltage-supplied RAMs. These are increasingly being replaced by EEPROMs.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel consumption is provided in a vehicle.		

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	E.g., page 12.9, "A subsystem of the fuel control system is lambda closed-loop control. . . . . [T]he engine control unit uses an anticipatory control strategy that uses engine load and RPM to determine the approximate fuel requirement. ***The engine load information is provided by the manifold pressure sensor for speed density systems and by the air meter for air flow and air mass measurement systems and by the throttle valve position sensor. The engine control unit contains data tables for combinations of load and RPM.*** This allows for rapid response to changes in operating conditions. The lambda sensor still provides the feedback correction for each load/RPM point. . . . . E.g., pages 22.2 to 22.3, "The most important test points of control units and sensors are tied to a diagnostic connector which is plugged into the measuring instrument with a corresponding adapter for the respective vehicle. . . . . ***Modern electronics in vehicles support diagnosis by***	Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption."		

Limitation of ’781 Patent Claim 25	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	comparing the registered actual value with the internally stored nominal values with the help of control units and their self-diagnosis, thus detecting faults.”			
means for comparing engine speed to said RPM set point;	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than***		E.g., col. 11, lines 22 to 33, “***As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0***. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302***. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine***.”

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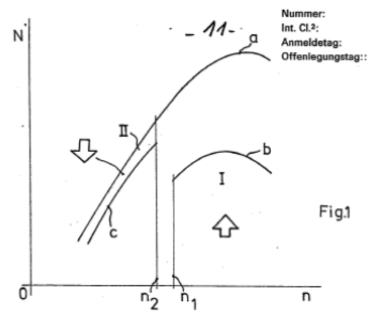
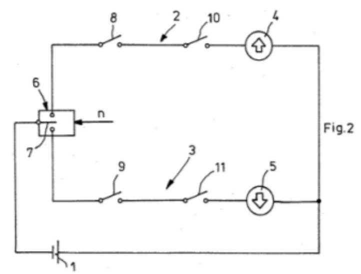
		predefined engine speed n_2, it pivots in the downward direction from a neutral center position, which it therefore assumes when engine speed values between n_1 and n_2 are present.” E.g., Figure 1:  E.g., Figure 2: 		
said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the***		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132.

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vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	functions, and diagnostic functions for vehicle service." E.g., page 13.9, "The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed)."	***next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***" E.g., pages 7 to 8 (English translation), "The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are present." E.g., Figure 1:		These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146." E.g., col. 9, lines 48 to 55, "The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114." E.g., col. 11, lines 22 to 33, "As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined

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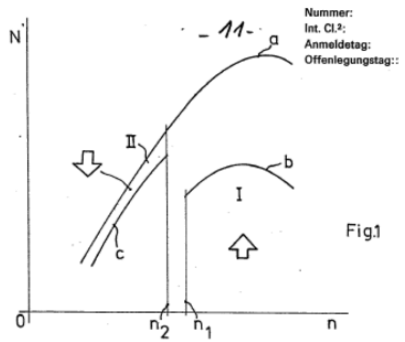
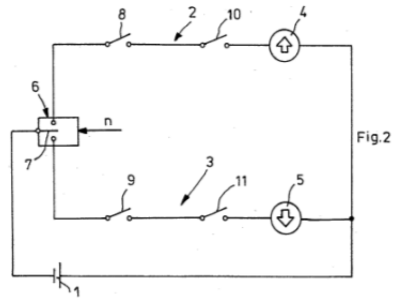
		 E.g., Figure 2: 		amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

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27. Apparatus for optimizing operation of a vehicle according to claim 26 wherein said processor subsystem further comprises:	See claim 26 claim chart, at page A-139.	See claim 26 claim chart, at page A-139.	See claim 26 claim chart, at page A-139.	E.g., col. 1, lines 9 to 13, “The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.” E.g., col. 2, lines 2 to 17, “Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors’ need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to

Limitation of ’781 Patent Claim 27	**Automotive Electronics Handbook (Jurgen)**	**German Patent Application Publication No. 29 26 070 (Volkswagen ’070)**	**U.S. Patent No. 5,357,438 (Davidian)**	**U.S. Patent No. 4,901,701 (Chasteen)**
				extremes in operating conditions has not been developed in the prior art.”
means for determining when road speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. First it is necessary to monitor engine speed. This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, ***wheel speed sensing is required*** for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road and engine speed sensors***, as well as torque data and throttle position are required for the MCU to select the optimum		E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	

Limitation of ’781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
	gear ratio.”			
means for determining when throttle position for said vehicle is increasing;	E.g., page 12.18, “To control the idle speed, the ECU uses inputs from the ***throttle position sensor***, air conditioning, automatic transmission, power steering, charging system, engine RPM, and vehicle speed.” E.g., page 12.21, “The electronic injection unit also houses the ***throttle position sensor*** and, in some cases, an inlet air temperature sensor which provides operating condition information to the ECU.”	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant ***throttle valve angle*** in a carburetor engine.”	E.g., col. 4, lines 60 to 66, “Vehicle 2 is further equipped with ***a speed sensor 12 which may sense the speed of the vehicle in any known manner***, for example using the speed measuring system of the vehicle itself, or a speed measuring system independent of the vehicle, e.g., an acceleration sensor, or by calculations based on the Doppler effect, etc.”	E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and ***a throttle position sensor 146***.” E.g., FIG. 1
means for determining when manifold pressure for said vehicle is increasing; and	E.g., page 2.5, “Automotive specification and testing guidelines have been developed and published by the Society of Automotive Engineers (SAE) specifically for ***manifold absolute pressure (MAP) sensors.***” E.g., page 2.7, “Manifold absolute pressure (MAP) is used as an input to fuel and ignition control in internal combustion engine control systems. ***The speed-density system that uses the MAP sensor*** has been preferred over	E.g., page 6 (English translation), “As can be seen when viewing Figure 1 to begin with, output N of the engine has been plotted across engine speed n. a is the curve of the output at full load, b is a line that represents a constant setting of the output control element, i.e., a line that represents a constant throttle valve angle in a carburetor engine. As a measure thereof, in addition to the throttle valve angle itself, it is also possible to use the ***induction manifold vacuum***.” E.g., page 9 (English translation), “It is useful if in addition to this device, a display of the route-specific fuel		

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	mass air flow (MAF) control because it's less expensive, but stricter emission standards are causing more manufacturers to use mass air flow for future models.”	consumption is provided in a vehicle. Such display devices are known per se; they generally utilize the ***injection manifold vacuum*** as a measure of fuel consumption.”		
means for determining when engine speed for said vehicle is decreasing;	E.g., page 7.6, “There are several applications for rotational speed sensing. ***First it is necessary to monitor engine speed.*** This information is used for transmission control, engine control, cruise control, and possibly for a tachometer. Electronics and electronic sensing in the automobile were brought about by the need for higher efficiency engines, better fuel economy, increased power and performance, and lower emissions. Second, wheel speed sensing is required for use in transmissions, cruise control, speedometers, antilock brake systems (ABS), traction control (ASR), variable ratio power steering assist, four-wheel steering, and possibly in inertial navigation and air bag deployment applications.” E.g., page 7.8, “In electronic transmission applications, ***information from the road***	E.g., page 6 (English translation), “The operating ranges I and II are further delimited by ***engine speed*** values n_1 or n_2, the first of which usually lies between approximately 20 to 50% of the maximum engine speed, and the second usually lies between approximately 40 and 70% of the maximum engine speed.” E.g., page 8 (English translation), “***The engine speed signal is obtained with the aid of known sensor systems***, which therefore need not be described in further detail here.”		E.g., col. 9, lines 3 to 8, “These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, ***an engine speed sensor 140***, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., FIG. 1

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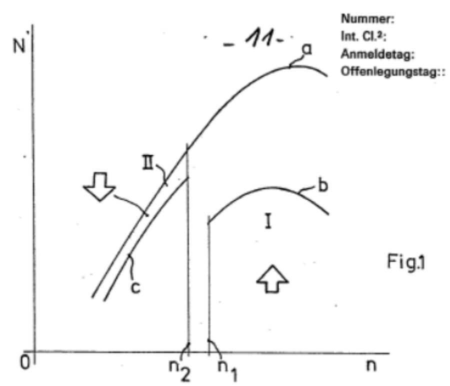
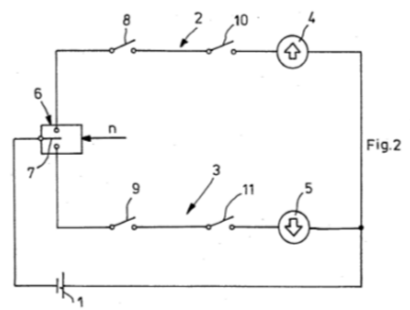
	and engine speed sensors, as well as torque data and throttle position are required for the MCU to select the optimum gear ratio.”			
said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	E.g., page 13.7 to 13.9, “***The basic functions of the transmission control are the shift point control***, the lockup control, engine torque control during shifting, related safety functions, and diagnostic functions for vehicle service.” E.g., page 13.9, “The basic shift point control uses shift maps, which are defined in data in the unit memory. These shift maps are selectable over a wide range. ***The shift point limitations are made,*** on the one hand, by the highest admissible engine speed for each application and, on the other hand, ***by the lowest engine speed that is practical for driving comfort and noise emission. The inputs of the shift point determination are the throttle position, the accelerator pedal position, and the vehicle speed*** (determined by the transmission output speed).”	E.g., pages 6 to 7 (English translation), “Looking initially at operating range I remote from full load, ***the desired output at a lower specific fuel consumption is able to be achieved after upshifting into the next higher gear,*** at an operating point that lies to the left of operating range I in the diagram of Figure 1. ***Accordingly, the device of the present invention generates a signal that asks the operator, i.e., normally the driver, to shift to a higher gear, which is indicated in Figure 1 by the upward pointing arrow within operating range I.***” E.g., pages 7 to 8 (English translation), “The two control circuits 2 and 3 are selectively closed by engine-speed dependent change-over switch 6, to which a signal that corresponds to the individual engine speed n is forwarded and which is developed in such a way that ***at engine speeds that are greater than predefined engine speed n_1 (see Figure 1), its shift lever pivots upwardly in Figure 2, but at engine speeds that are smaller than predefined engine speed n_2, it pivots in the downward direction from a neutral center position,*** which it therefore assumes when engine speed values between n_1 and n_2 are		E.g., col. 9, lines 1 to 8, “The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146.” E.g., col. 9, lines 48 to 55, “The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of

Limitation of ’781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
		present.” E.g., Figure 1:  E.g., Figure 2:  		the pressure regulator 114.” E.g., col. 11, lines 22 to 33, “As indicated at 303 the CPU determines from the reading taken at 302 whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of 302 whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block 304. If throttle position is less than 20°, the CPU decision-making process returns to block 302. If the throttle position is greater than the predetermined amount and RPM = 0, the CPU provides a control command to the engine fuel injector(s) to prime the engine.” E.g., August 6, 1998 Office Action, “Chasteen discloses the sensors as discussed for sensing the signals and a processor and compare manifold pressure for activating the fuel injection. Chasteen discloses the speed (RPM) and throttle position are determined to be greater than 0 (increasing) and the CPU provides a control command to

Limitation of ’781 Patent Claim 27	Automotive Electronics Handbook (Jurgen)	German Patent Application Publication No. 29 26 070 (Volkswagen ’070)	U.S. Patent No. 5,357,438 (Davidian)	U.S. Patent No. 4,901,701 (Chasteen)
				the engine fuel injector to prime the engine (See column 11, lines 22-33) therefore on [sic] would consider increasing and decreasing the speed and throttle for adjusting the fuel injector for supplying fuel to the engine.”

21. Claim 32 is Obvious in View of the Combination of Davidian and Tonkin

Limitation of '781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
32. Apparatus for optimizing operation of a vehicle according to claim 31 wherein:	See claim 31 claim chart, at page A-225.	E.g., Abstract, "The system comprising a controller fitted to a subject vehicle (16) and sensor means (20) operable to sense a distance of separation and relative velocity of a trailing vehicle (18). Also input to the controller is a velocity signal derived from a velocity sensing means (97) determining the ground speed of the subject vehicle using a doppler radar system. The controller calculates a safety envelope and activates a visible warning device attached to the rear of the subject vehicle if the trailing vehicle penetrates the safety envelope. An enhanced safety envelope determined by adverse road conditions is also established, any incursion into the enhanced envelope resulting generally in the visible warning being at a less prominent level. If however the closing speed of the trailing vehicle exceeds a predetermined threshold, penetration of the enhanced envelope results immediately in the full warning being displayed with full prominence to the driver of the trailing vehicle. The system has application to improving the safety of road vehicles."
said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and	E.g., col. 4, line 67 to col. 5, line 2, "The automatic sensors on vehicle 2 further include a daylight sensor 14, ***a rain sensor 16***, a vehicle load sensor 18, a trailer-hitch sensor 20, and a reverse gear sensor 22." E.g., col. 8, lines 58 to 63, "Thus, module 90 receives inputs from the front space sensor 8, the rear space sensor 10, and the vehicle speed sensor 12. ***Module 90 also receives inputs from the sensors in case there is no depressible key, e.g.,*** the daylight sensor 14, the trailer sensor 20, the reverse gear sensor 22, ***the rain sensor 16***, and the vehicle load sensor 18."	E.g., page 18, lines 9 to 13, "The information regarding the weather might be obtained for example by enabling the warning system controller to ascertain if the windscreen wipers are in use or have been in use recently due to rain (and not used with a water spray to clean the windscreen)."
said memory subsystem further storing a second vehicle speed/stopping distance table;	E.g., col. 9, lines 20 to 27, "***Computer module 90 also includes information about the vehicle braking distances as a function of speed. This is preferably in***	E.g., page 18, lines 16 to 19, "Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to

Limitation of '781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
	the form of a look-up table, for example, provided by the manufacturer for predetermined defined conditions concerning road type, skidding danger, vehicle load and tires pressure, and is ***stored in a ROM (read-only memory) of the microcomputer so that it can be changed periodically if necessary.***" E.g., col. 12, line 59 to col 13, line 22, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. ***In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance.*** The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and ***the braking distance is the product of the braking distance (as supplied by the manufacturer),*** road type, ***skidding danger,*** vehicle load and braking factor. The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated. The foregoing calculations of stopping distance SD and collision distance CD with respect to objects at the front of the vehicle are also made with respect to objects at the rear of the vehicle, these calculations being RSD and RCD, respectively, also shown in block 162. Whenever the distance between the vehicle and an object	weather and possibly for different severities of poor weather." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions***. These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope." E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit." E.g., page 17, lines 7 to 25, "Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity

Limitation of ’781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
	to the front of the vehicle or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, the system operates according to the deceleration alarm module 93, as indicated by block 164.”	sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”
if said windshield wiper sensor indicates that said windshield wiper is deactivated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem;	E.g., col. 8, lines 37 to 43, “The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ...” E.g., col. 12, line 59 to col 13, line 11, “The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety***	E.g., page 18, lines 16 to 19, “Thus, safe stopping distances can be adjusted for prevailing weather conditions, again by providing stored values according to weather and possibly for different severities of poor weather.” E.g., page 3, lines 25 to 32, “The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope.” E.g., page 16, lines 2 to 21, “The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18

Limitation of '781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
	factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger. ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***" E.g., col. 13, lines 17 to 22, "***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164."	is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit." E.g., page 17, lines 7 to 25, "Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16."
if said windshield wiper sensor indicates that said windshield wiper is activated, said processor subsystem	E.g., col. 8, lines 37 to 43, "The ***microcomputer 4*** as illustrated in FIGS. 6a, 6b is divided into various	E.g., page 18, lines 16 to 19, "Thus, safe stopping distances can be adjusted for prevailing weather

Limitation of '781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said second vehicle speed/stopping distance table stored in said memory subsystem.	functional modules, as follows: a calculation module 90, ***which receives data concerning the various parameters briefly described above*** and as will be described more particularly below ***to enable it to make the necessary computations for actuating the Safety alarm and the Collision alarm***; ..." E.g., col. 12, line 59 to col 13, line 11, "The system then makes the computations illustrated (as an example) in block 162 to determine the stopping distance SD, which is equal to the reaction distance plus the braking distance multiplied by a stopping factor ST and a safety factor SF. In the illustrated example, the stopping distance is the sum of the reaction distance and the braking distance. The reaction distance is the product of the reaction time, visibility condition, daylight condition, reaction factor and speed; and the braking distance is the product of the braking distance (as supplied by the manufacturer), road type, skidding danger, vehicle load and braking factor. ***The stopping distance (SD) includes further safety factors, and determines when the safety alarm will be actuated to first alert the driver of an approaching collision danger.*** ***A determination is also made of the collision distance CD which is equal to the stopping distance SD divided by the collision safety factor CSF, e.g., 1.25 in the example illustrated above, such that should the distance between the vehicle and the object come within the collision distance CD, the collision alarm is then actuated.***" E.g., col. 13, lines 17 to 22, "***Whenever the distance between the vehicle and an object to the front of the vehicle*** or to the rear of the vehicle comes within the stopping distance SD and the collision distance CD, ***the system operates according to the deceleration alarm module 93***, as indicated by block 164."	conditions, again by providing stored values according to weather and possibly for different severities of poor weather." E.g., page 3, lines 25 to 32, "The size of the enhanced safe distance and enlarged safety envelope will generally be predetermined so as to correspond to typical parameters appropriate for driving under adverse road conditions. ***These parameters may for example be stored in a look up table*** allowing the parameters to be determined from the signals received by the controller together with the parameters defining the normal safety envelope." E.g., page 16, lines 2 to 21, "The control system is designed to activate display 12 to provide a warning signal to a driver of the trailing vehicle when the trailing vehicle 18 when the trailing vehicle is closing too rapidly on the subject vehicle 16 for example, alternately a warning signal is displayed when the trailing vehicle 18 is too close to the subject vehicle 16. Even if they are travelling at the same speed for example***, there are known safe stopping distances such as those published by the Minister of Transport***, in which a vehicle will stop when the brakes are applied. Accordingly, by knowing the velocity of the subject vehicle 16 for example preferably using the radar ground sensing system described herein, which provides therefore a true ground speed, or other means in communication with a microprocessor control system and by using a proximity sensor 20 to determine the separation of the subject vehicle 16 from the trailing vehicle 18 a safety envelope can be created behind the subject vehicle 16. Intrusion in the envelope by the trailing vehicle 18 causes an initial level of lamps 13 in array 12 to be lit." E.g., page 17, lines 7 to 25, "Thus a warning system has been described using a ground speed sensor for a subject vehicle 16 coupled by a microprocessor with a proximity

Limitation of ’781 Patent Claim 32	U.S. Patent No. 5,357,438 (Davidian)	PCT Publication No. WO 96/02853 (Tonkin)
		sensor 20. In a more sophisticate [sic] version, proximity sensor 20 could be a radar device described herein for measuring velocity and could therefore be used to measure the relative velocity of a subject vehicle 16 and trailing vehicle 18. By knowing the closing speed of the trailing vehicle 18 predetermined values could be used to trigger warning displays if the closing speed is too great. ***For example, a look-up table or database could again be provided for unsafe closing speeds. This look-up table might again be varied according to the velocity of the subject vehicle 16 in a similar manner to the safe stopping distance, or safety envelope distance***. Therefore, whilst the safety envelope distance at 30mph is 25 metres, if the trailing vehicle is closing too rapidly, say, a difference in speed of 30mph, then the warning signal could be activated even when the trailing vehicle 18 is 50 metres behind the subject vehicle 16.”

EXHIBIT 1

US005954781A

United States Patent [19]

Slepian et al.

[11] **Patent Number: 5,954,781**

[45] **Date of Patent: Sep. 21, 1999**

[54] **METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION**

[75] Inventors: **Harvey Slepian**, Peoria; **Loran Sutton**, East Peoria, both of Ill.

[73] Assignee: **TAS Distributing Co., Inc.**, Peoria, Ill.

[21] Appl. No.: **08/813,270**

[22] Filed: **Mar. 10, 1997**

[51] **Int. Cl.**[6] **G06F 7/00**

[52] **U.S. Cl.** **701/96**; 701/103; 340/425.5; 340/438

[58] **Field of Search** 701/1, 121, 123, 701/101, 102, 103, 104, 96, 300; 123/478, 480, 351, 481; 340/903, 425.5, 426, 436, 438

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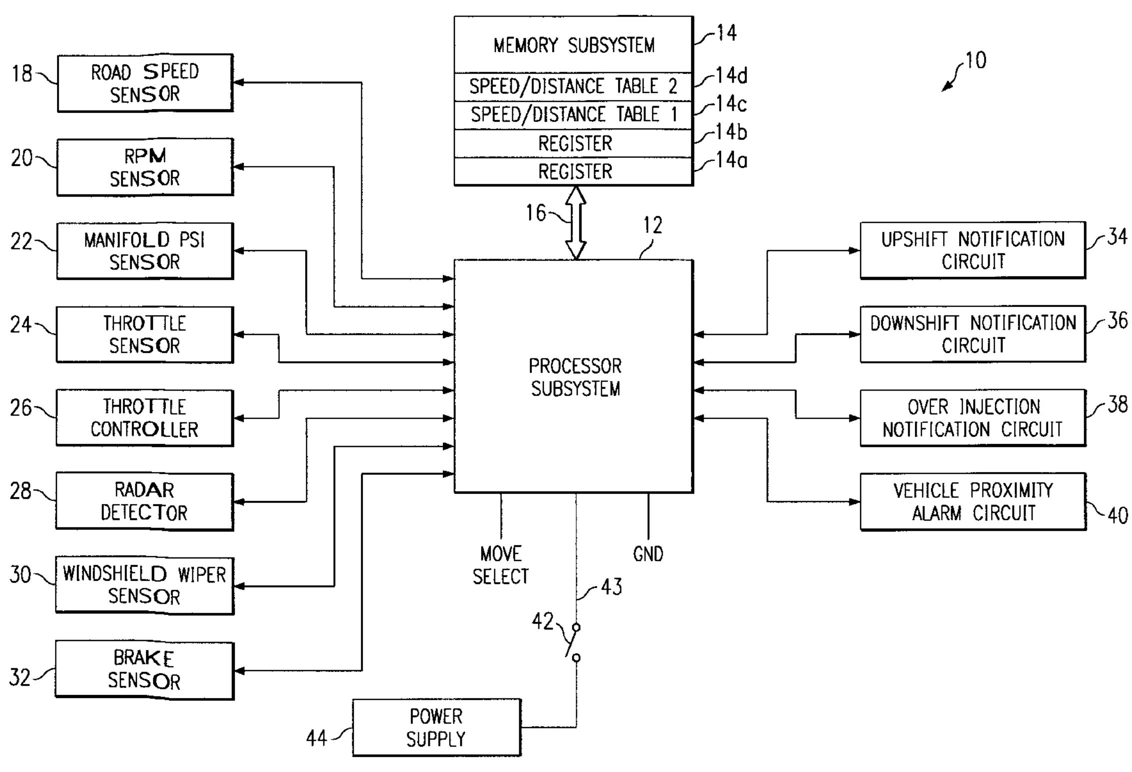
Primary Examiner—William A. Cuchlinski, Jr.
Assistant Examiner—Gertrude Arthur
Attorney, Agent, or Firm—Haynes and Boone, LLP

[57] **ABSTRACT**

Apparatus for optimizing operation of an engine-driven vehicle. The apparatus includes a processor subsystem, a memory subsystem, a road speed sensor, an engine speed sensor, a manifold pressure sensor, a throttle position sensor, a radar detector for determining the distance separating the vehicle from an object in front of it, a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated, a brake sensor for determining whether the brakes of the vehicle have been activated, a fuel over-injection notification circuit for issuing notifications that excessive fuel is being supplied to the engine of the vehicle, an upshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an excessive engine speed, a downshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an insufficient engine speed, a vehicle proximity alarm circuit for issuing an alarm that the vehicle is too close to an object in front of the vehicle and a throttle controller for automatically reducing the amount of fuel supplied to the engine if the vehicle is too close to the object in front of it. Based upon data received from the sensors and data stored in the memory subsystem, the processor determines whether to activate the fuel overinjection notification circuit, the upshift notification circuit, the downshift notification circuit, the vehicle proximity alarm circuit or the throttle controller.

32 Claims, 3 Drawing Sheets



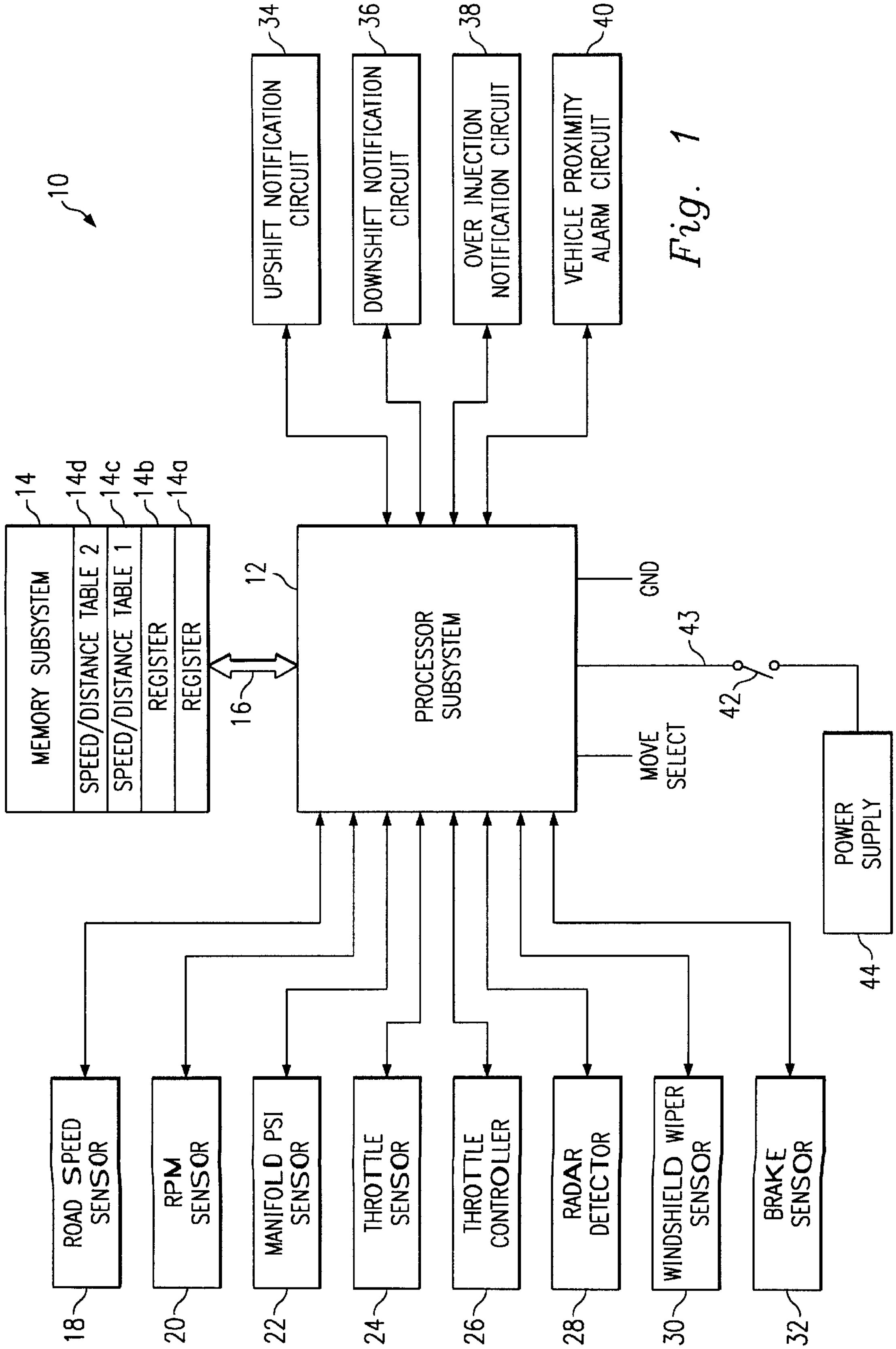

10
UPSHIFT NOTIFICATION CIRCUIT
34
DOWNSHIFT NOTIFICATION CIRCUIT
36
OVER INJECTION NOTIFICATION CIRCUIT
38
VEHICLE PROXIMITY ALARM CIRCUIT
40
MEMORY SUBSYSTEM
14
SPEED/DISTANCE TABLE 2
14d
SPEED/DISTANCE TABLE 1
14c
REGISTER
14b
REGISTER
14a
16
12
PROCESSOR SUBSYSTEM
GND
43
42
MOVE SELECT
POWER SUPPLY
44
ROAD SPEED SENSOR
18
RPM SENSOR
20
MANIFOLD PSI SENSOR
22
THROTTLE SENSOR
24
THROTTLE CONTROLLER
26
RADAR DETECTOR
28
WINDSHIELD WIPER SENSOR
30
BRAKE SENSOR
32

Fig. 1

Fig. 2A

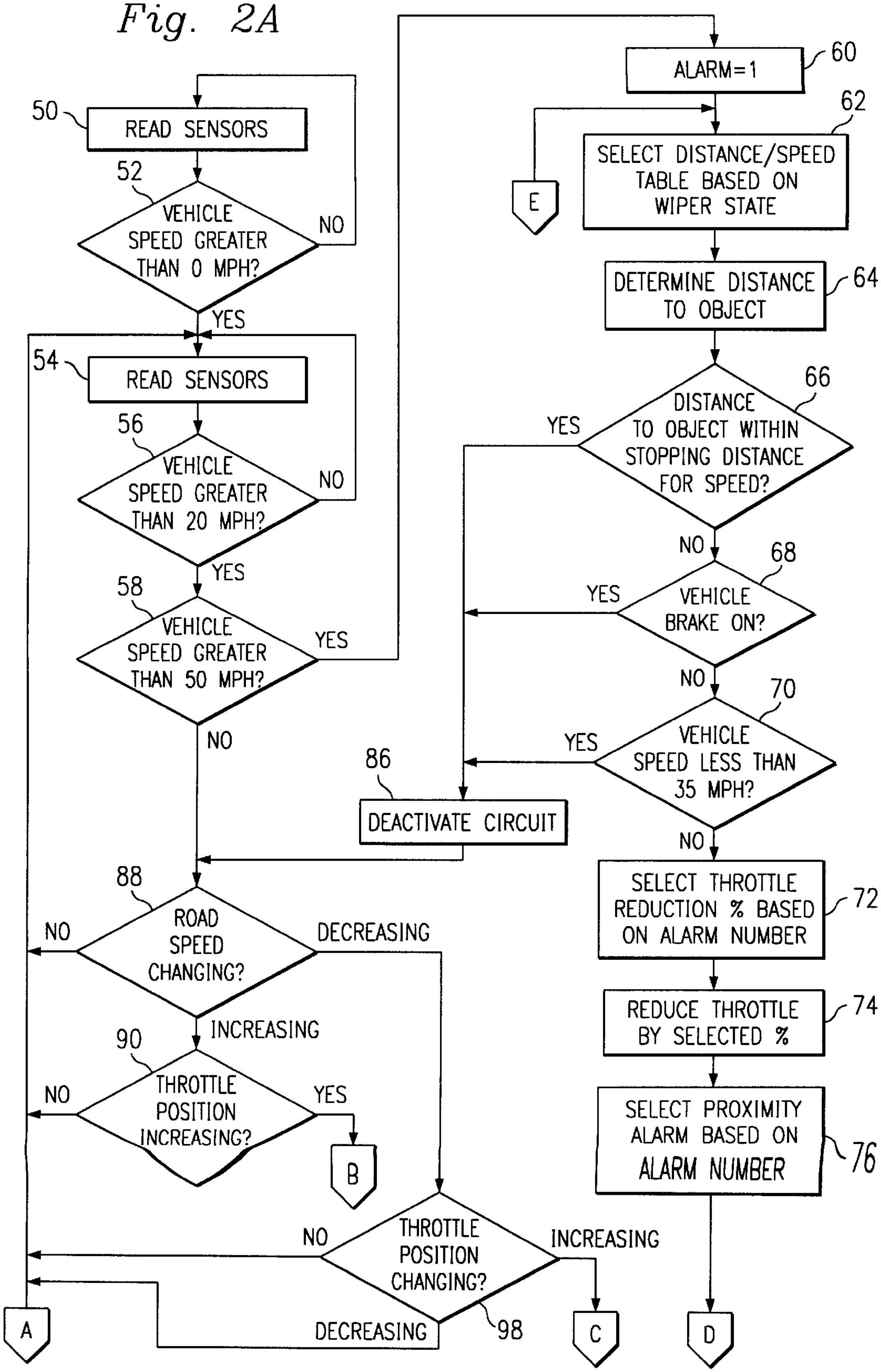
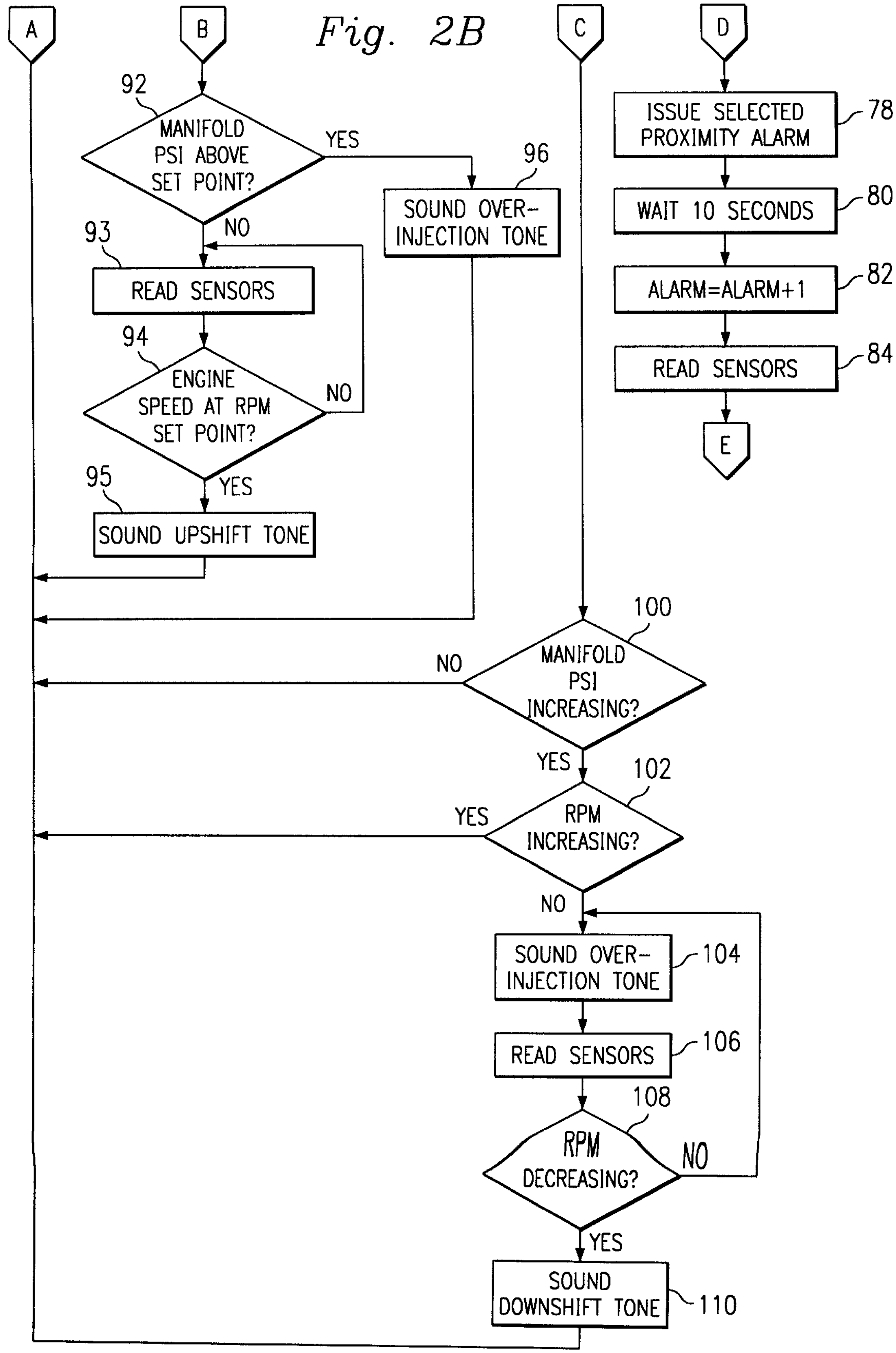

READ SENSORS
50
52
VEHICLE SPEED GREATER THAN 0 MPH?
NO
YES
54
READ SENSORS
56
VEHICLE SPEED GREATER THAN 20 MPH?
NO
YES
58
VEHICLE SPEED GREATER THAN 50 MPH?
YES
NO
ALARM=1
60
62
SELECT DISTANCE/SPEED TABLE BASED ON WIPER STATE
E
DETERMINE DISTANCE TO OBJECT
64
66
DISTANCE TO OBJECT WITHIN STOPPING DISTANCE FOR SPEED?
YES
NO
68
VEHICLE BRAKE ON?
YES
NO
70
VEHICLE SPEED LESS THAN 35 MPH?
YES
NO
86
DEACTIVATE CIRCUIT
SELECT THROTTLE REDUCTION % BASED ON ALARM NUMBER
72
REDUCE THROTTLE BY SELECTED %
74
SELECT PROXIMITY ALARM BASED ON ALARM NUMBER
76
88
ROAD SPEED CHANGING?
NO
DECREASING
INCREASING
90
THROTTLE POSITION INCREASING?
NO
YES
B
THROTTLE POSITION CHANGING?
NO
INCREASING
DECREASING
98
A
C
D

Fig. 2B


A
B
C
D
92
MANIFOLD PSI ABOVE SET POINT?
YES
NO
96
SOUND OVER-INJECTION TONE
93
READ SENSORS
94
ENGINE SPEED AT RPM SET POINT?
NO
95
YES
SOUND UPSHIFT TONE
ISSUE SELECTED PROXIMITY ALARM
78
WAIT 10 SECONDS
80
ALARM=ALARM+1
82
READ SENSORS
84
E
100
MANIFOLD PSI INCREASING?
NO
YES
102
RPM INCREASING?
YES
NO
SOUND OVER-INJECTION TONE
104
READ SENSORS
106
108
RPM DECREASING?
NO
YES
SOUND DOWNSHIFT TONE
110

METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to an apparatus for optimizing vehicle operation and, more particularly, relates to a system which both notifies the driver of recommended corrections in vehicle operation and, under certain conditions, automatically initiates selected corrective action.

2. Description of Related Art

It has long been recognized that the improper operation of a vehicle may have many adverse effects. For example, the fuel efficiency of a vehicle may vary dramatically based upon how the vehicle is operated. More specifically, operating a vehicle at excessive speed, excessive RPM and/or excessive manifold pressure will result in both reduced fuel economy and increased operating costs. The aforementioned increased operating costs can be quite considerable, particularly for an owner or operator of a fleet of vehicles. To correct these types of improper vehicle operations are often surprisingly simple. For example, upshifting the drive gear will typically eliminate an excessive RPM condition. However, even when the solution is quite simple, oftentimes, the driver will be unaware of the need to take corrective action.

A variety of patents have disclosed systems, commonly referred to as "shift prompters", which monitor the operation of a vehicle and advises the operator of the vehicle when to take certain actions. Numerous ones of these devices include sensors which measure engine speed and vehicle speed. See, for example, U.S. Pat. No. 4,492,112 to Igarashi et al., U.S. Pat. No. 4,631,515 to Blee et al. and U.S. Pat. No. 4,701,852 to Ulveland. Certain ones, however, disclose the use of other types of sensors as well. For example, U.S. Pat. No. 4,524,460 to Weber is directed to a driving aid indicator which includes vehicle speed, manifold pressure, throttle position and engine speed sensors. U.S. Pat. No. 4,752,883 to Asakura et al. and U.S. Pat. No. 4,868,756 to Kawanabe et al. are directed to upshift notification devices which include sensors for measuring engine speed, vehicle speed, manifold pressure and cooling water temperature. Finally, U.S. Pat. No. 4,853,673 to Kido et al. discloses a shift indicator system which includes sensors for measuring engine speed and throttle position. Generally, the above-listed patents all provide displays intended to enable the driver to operate the vehicle in a manner leading to uniform performance and maximum fuel economy. However, Blee et al. discloses the use of audible warnings as well as a speed controller to prevent further increases in engine speed if the driver ignores previously issued warnings.

Improper vehicle operation has other adverse effects as well. It is well known that the faster a vehicle travels, the longer it takes to stop. Thus, what may be a safe separation distance between successive vehicles when a vehicle is traveling at 35 mph may be unsafe if that vehicle is traveling at 50 mph. Road conditions also play a role in determining the safe separation distance between vehicles. For example, greater separation distances are generally recommended when roads are wet. As a result, therefore, based on the combination of a vehicle's speed, the distance separating the vehicle from a second vehicle in front of it and road conditions, many vehicles are operated unsafely. To correct this situation, a reduction in operating speed, an increase in vehicle separation or some combination thereof, is required.

It may be readily seen from the foregoing that it would be desirable to provide a system which integrates the ability to

issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will enhance the efficient operation thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely. It is, therefore, the object of the invention to provide such a system.

SUMMARY OF THE INVENTION

In one embodiment, the present invention is directed to an apparatus for optimizing operation of an engine-driven vehicle. The apparatus includes a processor subsystem, a memory subsystem, plural sensors, including road speed, manifold pressure and throttle position sensors, for collectively monitoring operation of the vehicle and a fuel overinjection notification circuit for issuing notifications that excessive fuel is being supplied to the engine of the vehicle. The processor subsystem receives data from the sensors and, from the received data, determines when to activate the fuel overinjection circuit. In one aspect thereof, the processor subsystem determines when road speed for the vehicle is increasing, determines when throttle position for the vehicle is increasing, compares manifold pressure and a manifold pressure set point stored in the memory subsystem and activates the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point.

In further aspects thereof, the sensors may include an engine speed sensor and the processor subsystem may determine when road speed for the vehicle is decreasing, when throttle position for the vehicle is increasing, when manifold pressure for the vehicle is increasing, when engine speed for the vehicle is decreasing and may activate the fuel overinjection notification circuit if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing.

In still further aspects thereof, the apparatus may also include an upshift notification circuit, activated by the processor subsystem based upon data received from the sensors, which issues notifications that the engine of the vehicle is being operated at excessive engine speeds. In this aspect, the processor subsystem determines when road speed for the vehicle is increasing, when throttle position for the vehicle is increasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem, compares engine speed to an RPM set point stored in the memory subsystem and activates the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point.

In still yet further aspects thereof, the apparatus may also include a downshift notification circuit, activated by the processor subsystem based upon data received from the sensors, which issues a notification that the engine of the vehicle is being operated at an insufficient engine speed. The processor subsystem may determine when road speed for the vehicle is decreasing, when throttle position for the vehicle is increasing, when manifold pressure for the vehicle is increasing, when engine speed for the vehicle is decreasing and may activate the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

In still further aspects thereof, the fuel overinjection circuit, the upshift notification circuit or the downshift notification circuit may include a horn for issuing a tone for a preselected time period.

In another embodiment, the present invention is of an apparatus for optimizing operation of a vehicle. The apparatus includes road speed, engine speed, manifold pressure and throttle position sensors, a processor subsystem coupled to each of the sensors to receive data therefrom and a memory subsystem, coupled to the processor subsystem, for storing a manifold pressure set point, an engine speed set point and present and prior levels for each one of the sensors. The apparatus further includes a fuel overinjection notification circuit, an upshift notification circuit and a downshift notification circuit, all of which are coupled to the processor subsystem. The fuel overinjection notification circuit issues notifications that excessive fuel is being supplied to the engine of the vehicle, the upshift notification circuit issues notifications that the engine of the vehicle is being operated at an excessive engine speed and the downshift notification circuit issues notifications that the engine of the vehicle is being operated at an insufficient engine speed. Based upon data received from the sensors, the processor subsystem determines when to activate the fuel overinjection circuit, the upshift notification circuit and the downshift notification circuit. In one aspect thereof, the fuel overinjection circuit includes a first horn for issuing a first tone for a first preselected time period, the upshift notification circuit includes a second horn for issuing a second tone for a second preselected time period and the downshift notification circuit includes a third horn for issuing a third tone for a third preselected time period.

In another aspect thereof, the processor subsystem may determine when road speed for the vehicle is increasing or decreasing, engine speed is increasing or decreasing, throttle position for the vehicle is increasing and manifold pressure is increasing; may compare manifold pressure to the manifold pressure set point and engine speed to the RPM set point; and may activate the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point or if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing, the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point and the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

In another aspect, the present invention is of an apparatus for optimizing operation of a vehicle which includes a radar detector for determining a distance separating a vehicle having an engine and an object in front of the vehicle and at least one sensor for monitoring operation of the vehicle. The apparatus further includes a processor subsystem, a memory subsystem and a vehicle proximity alarm circuit. The processor subsystem is coupled to the radar detector and the at least one sensor to receive data therefrom while the memory subsystem, in which a first vehicle speed/stopping distance table and present levels for each one of the at least one sensor are stored, and the vehicle proximity alarm circuit are coupled to the processor subsystem. Based on data received from the radar detector, the at least one sensor and the contents of the memory subsystem, the processor determines when to instruct the vehicle proximity alarm circuit to issue an alarm that the vehicle is too close to the object.

In one aspect thereof, the at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated and a second vehicle speed/stopping distance table is stored in the memory subsystem. In another aspect thereof, the apparatus further includes a throttle controller for controlling a throttle of the engine of the vehicle. The processor subsystem may selectively reduce the throttle based upon data received from the radar detector, the at least one sensor and the memory subsystem or may also count a total number of vehicle proximity alarms determined by the processor subsystem and selectively reduce the throttle based upon the total number of vehicle proximity alarms, as well. In yet another aspect thereof, the at least one sensor further includes a brake sensor for indicating whether a brake system of the vehicle is activated.

In other aspects thereof, the apparatus may be further provided with a fuel overinjection notification circuit for issuing a notification that excessive fuel is being supplied to the engine of the vehicle, an upshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an excessive engine speed or a downshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed. If a fuel overinjection notification circuit is provided, the apparatus includes a manifold pressure sensor and a throttle position sensor which also provide the processor subsystem with data used, together with a manifold pressure set point and prior levels for the sensors stored in the memory subsystem, to determine when to activate the fuel overinjection circuit. If an upshift notification circuit is provided, the apparatus includes an engine speed sensor which also provides the processor subsystem with data used, together with an RPM set point stored in the memory subsystem, to determine when to activate the upshift notification circuit. Finally, if a downshift notification circuit is provided, the processor subsystem determines when to activate the downshift notification circuit based upon the data received from the plurality of sensors.

In still another embodiment, the present invention is of an apparatus for optimizing operation of a vehicle which includes a radar detector for determining a distance separating the vehicle from an object in front of it, a plurality of sensors, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor, which collectively monitor the operation of the vehicle, a processor subsystem, a memory subsystem, a fuel overinjection notification circuit for issuing notification that excessive fuel is being supplied to the engine of the vehicle and a vehicle proximity alarm circuit for issuing alarms if the vehicle is too close to the object. Based upon data received from the sensors, the processor subsystem determines when to activate the fuel overinjection circuit. Based upon data received from the radar detector, the sensors and the memory subsystem, the processor subsystem also determines when to activate the vehicle proximity alarm circuit.

In one aspect of this embodiment of the invention, the processor subsystem determines when road speed for the vehicle is increasing or decreasing, when throttle position for the vehicle is increasing or decreasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem, determines when manifold pressure for the vehicle is increasing or decreasing and determines when engine speed for the vehicle is increasing or decreasing. In this aspect, the processor subsystem activates the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point or if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing.

In a further aspect thereof, the apparatus may also include an upshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an excessive engine speed, the processor subsystem determining when to activate the upshift notification circuit based upon data received from the sensors. In a related aspect thereof, the processor subsystem determines when road speed for the vehicle is increasing, determines when throttle position for the vehicle is increasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem and compares engine speed to an RPM set point stored in the memory subsystem. In this aspect, the processor subsystem activates the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point.

In still another aspect thereof, the apparatus may also include a downshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed. In this aspect, the processor subsystem determines when to activate the downshift notification circuit based upon data received from the sensors. In a related aspect thereof, the processor subsystem determines when road speed for the vehicle is decreasing, determines when throttle position for the vehicle is increasing, determines when manifold pressure for the vehicle is increasing and determines when engine speed for the vehicle is decreasing. In this aspect, the processor subsystem activates the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood, and its numerous objects, features and advantages will become apparent to those skilled in the art by reference to the accompanying drawing, in which:

FIG. **1** is a block diagram of an apparatus for optimizing vehicle performance constructed in accordance with the teachings of the present invention; and

FIGS. **2**A–B is a flow chart of a method for optimizing vehicle performance in accordance with the teachings of the present invention.

DETAILED DESCRIPTION

Referring first to FIG. **1**, a system **10** for optimizing vehicle performance constructed in accordance with the teachings of the present invention will now be described in greater detail. The system **10** includes a processor subsystem **12**, for example, a microprocessor, and a memory subsystem **14**, for example, the memory subsystem **14** may include a nonvolatile random access memory (or "NVRAM"), coupled together by a bus **16** for bi-directional exchanges of address, data and control signals therebetween. The system **10** is installed in a vehicle (not shown) for which optimized performance and driver assist capabilities are desired. Although it is contemplated that the system **10** is suitable for use with any type vehicle, most commonly, the system **10** shall be installed in a truck.

Also coupled to the processor subsystem **12** are a series of sensors, each of which are periodically polled by the processor subsystem **12**, to determine the respective states or levels thereof. The sensors include a road speed sensor **18**, an RPM sensor **20**, a manifold pressure sensor **22**, a throttle sensor **24**, a windshield wiper sensor **30** and a brake sensor **32**. The sensors are selected to be either state or level sensors, depending on whether the information to be collected thereby is a state, i.e., on/off or a level, for example, 35 mph. The road speed sensor **18** and the RPM sensor **20** are level sensors which respectively provide the processor subsystem **12** with signals which indicate the operating speed and engine speed for the vehicle. The road speed sensor **18** and the RPM sensor **20** may derive such information from any one of a variety of sources. For example, the road speed sensor **18** may be connected to receive the speed input signal transmitted to the vehicle's speedometer while the RPM sensor **20** may be connected to receive the RPM input signal to the vehicle's tachometer.

The manifold pressure sensor **22** is a level sensor which is positioned downstream of the throttle valve in the intake manifold of the vehicle to measure manifold pressure thereat. The throttle sensor **24** is a level sensor, attached to the throttle, which measures the extent to which the throttle is opened. The windshield wiper sensor **30** is a state sensor which determines whether the vehicle's windshield wipers are on or off. In alternate embodiments thereof, the windshield wiper sensor **30** may be electrically coupled to the on/off switch for the windshield wiper or to an output of the windshield wiper motor. Finally, the brake sensor **32** is a state sensor which determines whether the brakes of the vehicle have been engaged. For example, the brake sensor **32** may be electrically coupled to the brake system to detect the activation thereof.

Preferably, the memory subsystem **14** should include first and second registers **14***a* and **14***b*, each having sufficient bits for holding the state/level of each of the sensors **18**, **20**, **22**, **24**, **30** and **32**. The first register **14***a* is used to hold the present state or level of each of the sensors **18**, **20**, **22**, **24**, **30** and **32** while the second register **14***b* is used to hold the prior state or level for each of the sensors **18**, **20**, **22**, **24**, **30** and **32**. Each time the processor subsystem **12** writes the present state or level of the sensors **18**, **20**, **22**, **24**, **30** and **32** to the first register **14***a*, the prior contents of the first register **14***a* is written to the second register **14***b* which, in turn, discards the prior content thereof. The memory subsystem **14** is also used to hold information to be utilized by the processor subsystem **12** to determining whether to take corrective actions and/or issue notifications. Typically, such information is placed in the memory subsystem **14** while the system **10** is being initialized. The information includes one or more speed/distance tables which, when used in a manner which will be more fully described below in combination with data collected by the system **10**, enable the processor subsystem **12** to determine if the vehicle is being operated unsafely and if corrective action is necessary. Speed/stopping distance table. The information also includes two pre-set threshold values—a manifold psi set point and an engine RPM set point. As will also be more fully described below, the processor subsystem **12** uses these threshold values to determine when to issue notifications as to recommended changes in vehicle operation which, when executed by the driver, will optimize vehicle operation. The speed/stopping distance table(s) are based upon National Safety Council guidelines, vary according to the class of the vehicle and provide the relationship between the speed at which a vehicle is travelling and the distance which the vehicle will require to come to a complete stop if travelling at that speed. The manifold psi set point and RPM set point are selected based upon the manufacturer's guidelines for proper operation of the vehicle, vary based upon horsepower and engine size for the vehicle and represent thresholds above which the manifold pressure and engine rotation speed, respectively, for the vehicle should never exceed.

The system **10** also includes a throttle controller **26** capable of opening and/or closing the throttle, a radar detector **28** positioned to determine the distance separating the vehicle and an object in front of the vehicle, for example, a second vehicle travelling in the same direction, a series of circuits **34**, **36**, **38** and **40** for notifying the driver of the vehicle of recommended corrections in vehicle operation and alerting the driver to unsafe operating conditions and a power supply, for example a +12 v battery, for providing power to the energy-demanding components of the system **10**. The circuits **34**, **36**, **38** and **40** include an upshift notification circuit **34** for notifying the driver that an upshift is recommended, a downshift notification circuit **36** for notifying the driver that a downshift is recommended, an overinjection notification circuit **38** for notifying the driver that too much fuel is being supplied to the vehicle and a vehicle proximity alarm circuit **40** for alerting the driver when an object in front of the vehicle is too close. The circuits **34**, **36** and **38** may be configured to provide visual and/or audible notifications, for example, using lights and/or horns. For example, the upshift circuit **34**, the downshift notification circuit **36** and the overinjection notification circuit **38** may each include a horn, or other tone generating device, from which an audible notification may be generated at a selected pitch. Preferably, each of the notification circuits **34**, **36** and **38** may be configured to provide distinct audible notifications, for example, tones at distinct pitches, so that the driver may readily distinguish which of the notification circuits **34**, **36** and **38** have been activated by the processor subsystem **12**. The proximity alarm circuit **40** may include one or more visual and/or audible warning devices such as lights and/or horns. For example, the proximity alarm circuit **40** may include a warning light and a warning horn. If desired, the proximity alarm circuit may also include a display for displaying the speed of the object in the vehicle's path and/or the stopping distance in feet. The proximity alarm circuit **40** may be further equipped to provide audible indications of the speed of the object in the vehicle's path and/or the stopping distance in feed as well as selector circuitry for selecting both the information to be provided as well as the manner in which the information is to be conveyed.

Finally, the processor subsystem **12** is further provided with one or more mode select input lines which enable operator configuration of the operation of the system **10**. For example, as described herein, the corrective operations consist of the combination of an automatic reduction of throttle and audio/visual alerts that the vehicle is being operated unsafely. It is specifically contemplated, however, that the system **10** include a mode select line for switching the system **10** between an "active" mode where both automatic throttle reduction and audio/visual alerts are generated and an "inactive" mode where only audio/visual alerts are generated.

Referring next to FIGS. **2**A–B, a method for optimizing vehicle performance in accordance with the teachings of the present invention will now be described in greater detail. The method commences by powering up the processor subsystem **12**, for example, by closing switch **42**, thereby coupling the processor subsystem **12** to the power source **44** via line **43**. Alternately, the processor subsystem **12** may be connected to the electrical system of the vehicle such that it will automatically power up when the vehicle is started. Of course, any of the other devices which also form part of the system **10** and require power may also be coupled to the line **43**. Appropriate voltage levels for the processor subsystem **12**, as well as any additional power-demanding devices coupled to the power source **44**, would be provided by voltage divider circuitry (not shown).

Once the system **10** is powered up, the method begins at step **50** by the processor subsystem **12** polling the road speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32** to determine their respective levels or states and places the acquired information in the first data register **14***a*. Of course, it should be noted, however, that polling of the sensors by the processor subsystem **12** is but one technique by which the processor subsystem **12** may acquire the requisite information. Alternately, each sensor **20**, **22**, **24**, **30** and **32** may periodically place its level or state in one or more bits of the first data register **14***a*. The processor subsystem **12** would then acquire information by checking the contents of the first data register **14***a* at selected time intervals.

Proceeding to step **52**, the processor subsystem **12** examines the contents of the first data register **14***a* to determine the operating speed of the vehicle. If the processor subsystem **12** determines that the vehicle is stationary, i.e., the operating speed of the vehicle is zero, the processor subsystem **12** will return to step **50** where the road speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32** will be repeatedly polled until an operating speed greater than zero is detected at step **52**. While polling may be conducted at a variety of time intervals, a polling period of one second appears suitable for the uses contemplated herein.

Returning to step **52**, once an operating speed greater than zero is detected by the processor subsystem **12**, the method proceeds to step **54** where the processor subsystem **12** again polls the operating speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32**, to determine their respective levels or states and places the acquired information in the first data register **14***a*. In turn, the contents of the first data register **14***a* is placed in the second data register **14***b*.

Proceeding now to step **56**, from the polled value of the road speed sensor **18**, the processor subsystem **12** determines whether the vehicle is travelling faster than 20 mph. If the operating speed of the vehicle is less than 20 mph, the method returns to step **54** where the sensors **18**, **20**, **22**, **24**, **30** and **32** will be repeatedly polled and the value of the road speed sensor examined until the processor subsystem **12** determines that the vehicle is travelling faster than 20 mph. If, however, the processor subsystem **12** determines that the vehicle is travelling faster than 20 mph, the method proceeds to step **58** where the processor subsystem **12** then determines if the vehicle is travelling faster than 50 mph, again by checking the contents of the first data register **14***a*.

Past this juncture, the method of the present invention will proceed through a series of steps designed to optimize vehicle operation. However, prior to optimizing vehicle operation, the processor subsystem **12** will determine if the vehicle is being operated unsafely. If so, the processor subsystem **12** will initiate corrective operations before commencing vehicle operation optimization. More specifically, if the processor subsystem **12** determines at step **58** that the vehicle is travelling at a speed greater than 50 mph, the processor subsystem **12** will initiate a process by which it will determine whether the vehicle is being operated unsafely.

The processor subsystem **12** determines that the vehicle is being operated unsafely if the speed of the vehicle is such that the stopping distance for the vehicle d is greater than the distance separating the vehicle from an object, for example, a second vehicle, in its path. In order to make this determination, the processor subsystem **12** is provided access to at least one speed/distance table. For example, stored at location **14***c* within the memory subsystem **14** is a first speed/stopping distance table. The speed/stopping distance table contains the relationship between vehicle speed and stopping distance. Thus, for any given speed, the processor subsystem **12** may look-up the stopping distance for that speed. Preferably, the memory subsystem **14** should contain multiple speed/stopping distance tables so that differences in road conditions and/or vehicle class may be taken into account. For example, the speed/stopping distance table stored at location **14***c* may be a speed/stopping distance table for dry roads while a speed/stopping distance table for wet roads may be stored at location **14***d*. If desired, the memory subsystem **14** may also contain additional speed/stopping distance tables for other vehicle classes. If such additional tables were provided, however, the disclosed method would need to be modified to include additional steps in which the operator provides the vehicle's class and the processor subsystem **12** selects the appropriate speed/stopping distance tables for the indicated class of vehicle.

To make the aforementioned determination of unsafe vehicle operation, the method proceeds to step **60** where the processor subsystem **12** sets the value of the expression ALARM to 1. The method then proceeds to step **62** where the processor subsystem **12** examines the state of the wiper sensor **32** and selects a speed/stopping distance table based upon the state of the wiper sensor **32**. If the state of the wiper sensor **32** indicates that the windshield wiper is off, the processor subsystem **12** concludes that the vehicle is being operated in dry conditions and selects the speed/stopping distance table stored at the location **14***c* of the memory subsystem **14**. If, however, the state of the wiper sensor **32** indicates that the windshield wiper is on, the processor subsystem **12** concludes that the vehicle is being operated in wet conditions and selects the speed/stopping distance table stored at the location **14***d* of the memory subsystem **14**. From the selected speed/stopping distance table **14***c* or **14***d*, the processor subsystem **12** then retrieves the stopping distance for the speed at which the vehicle is travelling.

Continuing on to step **64**, the processor subsystem **12** determines the distance of the vehicle to an object in its path, i.e., a second vehicle travelling in front of the vehicle and in the same direction. To do so, the processor subsystem **12** instructs the radar device **28** to determine the distance between the vehicle and the second vehicle in front of it. Upon determining the distance separating the two vehicles, the radar device **28** transmits the determined separation distance to the processor subsystem **12**. At step **66**, the processor subsystem **12** determines if the two vehicles are separated by a safe distance. To do so, the processor subsystem **12** compares the distance separating the two vehicles to the retrieved stopping distance for the vehicle. If the determined distance separating the two vehicles is greater than the retrieved stopping distance for the vehicle, the processor subsystem **12** determines that the vehicle is being operated safely. If, however, the determined distance separating the two vehicles is less than the retrieved stopping distance, the processor subsystem **12** determines that the vehicle is being operated unsafely.

If the processor subsystem **12** determines at step **66** that the vehicle is being operated unsafely, the processor subsystem **12** initiates appropriate corrective action. At step **68**, the processor subsystem **12** determines whether the vehicle brake is on by examining the state of the brake sensor **32**. If the brake is on, the processor subsystem **12** concludes that the driver is taking corrective action and that further corrective action is not necessary. If, however, the processor subsystem **12** determines that the vehicle brake is off, the method proceeds to step **70** where the processor subsystem examines the level of the vehicle speed sensor to determine if the speed of the vehicle is less than 35 mph. If the speed of the vehicle is less than 30 mph, the processor subsystem **12** concludes that no further corrective action will be taken.

If, however, the processor subsystem **12** determines that the speed of the vehicle is greater than 35 mph, the method proceeds to step **72** where the processor subsystem **12** selects a throttle reduction value based upon the value of the expression ALARM. Generally, the severity of the corrective action to be initiated by the processor subsystem **12** is varied depending on the number of times that corrective action has been taken and, more specifically, the severity of the selective corrective action increases with the value of the expression ALARM. For example, in the embodiment of the invention disclosed herein, if ALARM=1, a 25% throttle reduction is selected, if ALARM=2, a 50 throttle reduction is selected and, if ALARM≧3, a 100% throttle reduction is selected. By reducing the throttle, the transport of fuel to the engine is retarded and the vehicle will begin to decelerate.

Continuing on to step **74**, the processor subsystem **12** determines the extent to which the throttle is open using the throttle level provided by the throttle sensor **24** and, using throttle control **26**, reduces the throttle by the selected percentage. At step **76**, the processor subsystem **12** selects an alert mode, again based upon the value of the expression ALARM. As before, the severity of the alert mode may increase with the value of ALARM. For example, when ALARM=1, a warning light may be activated in a flash mode while, when 2≦ALARM≦3, an audible alert which lasts for a first selected time period, for example, two seconds, may be activated in combination with the flashing warning light and when ALARM≧4, an audible alert which lasts for a second, longer, time period, for example, six seconds, may be activated in combination with the flashing light.

Proceeding to step **78**, the processor subsystem **12** issues an alert to the operator of the vehicle in accordance with the selected alert mode. To do so, the processor subsystem **12** activates vehicle proximity alarm circuit **40** in accordance with the selected alert mode. After issuing the alert at step **78**, the method proceeds to step **80** where the processor subsystem **12** waits a selected period before taking any further action. The wait period is intended to provide sufficient time to see if the previously initiated corrective action eliminates the hazardous condition. As disclosed herein, a wait period of 10 seconds is suitable. However, wait periods of various lengths should be equally suitable for the uses contemplated herein.

Upon expiration of the wait period, the value of the expression ALARM is incremented by one at step **82** and, at step **84**, the processor subsystem **12** again polls the operating speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32**, to determine their respective levels or states and places the acquired information in the first data register **14***a*. The method returns to step **64** where the distance between the vehicle and the object in its path is re-determined. The processor subsystem **12** continues to take corrective action until it determines that the vehicle is no longer being operated in a hazardous manner. More specifically, the processor subsystem **12** will conclude that the hazardous condition has been corrected when it either: determines at step **66** that the distance separating the vehicle and the object is within the stopping distance for the vehicle, determines at step **68** that the vehicle brake is on or determines at step **70** that the speed of the vehicle is less than 35 mph. Upon making such a determination, the method proceeds to step **86** where the processor subsystem **12** deactivated the vehicle proximity alarm circuit **40** to turn off the flashing light.

The method of optimizing vehicle operation in accordance with the teachings of the present invention will now be described in greater detail. Returning now to step **58**, if the processor subsystem **12** determines that the vehicle is travelling slower than 50 mph, or if the processor subsystem **12** determines at step **66** that the distance separating the vehicle and the object is within the stopping distance for the vehicle or if the processor subsystem **12** determines at step **68** that the vehicle brake is on or if the processor subsystem **12** determines at step **70** that the speed of the vehicle is less than 35 mph, the method proceeds, after deactivation of the vehicle proximity alarm circuit **40**, to step **88** where the processor subsystem **12** determines if the road speed of the vehicle is changing. To do so, the processor subsystem **12** compares the speed of the vehicle maintained in the first register **14***a* to the speed of the vehicle maintained in the second register **14***b*.

If the vehicle speed maintained in the first register **14***a* is greater than the vehicle speed maintained in the second register **14***b*, the vehicle is accelerating. If so, the method continues to step **90** where the processor subsystem **12** determines if the throttle position is increasing. To do so, the processor subsystem **12** compares the throttle level, i.e., the extent to which the throttled is opened, maintained in the first register **14***a* to the throttle level maintained in the second register **14***b*. If the throttle position has not increased, the processor subsystem **12** determines that, since the vehicle is accelerating but fuel consumption is not increasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the processor subsystem **12** determines at step **90** that the throttle position has increased, the method proceeds to step **92** where the processor subsystem **12** determines if the manifold pressure level maintained in the first register **14***a* has exceeded the manifold pressure set point for the vehicle. If the vehicle's road speed and throttle position are increasing and the manifold pressure for the vehicle is at or below the manifold pressure set point, the processor subsystem **12** proceeds to step **93** where the sensors **18**, **20**, **22**, **24**, **30** and **32** are again polled and on to step **94** where the processor subsystem **12** compares the engine speed level maintained in the first register **14***a* to the RPM set point stored in the memory subsystem **14** to determine if the engine speed has reached the RPM set point. If the engine speed has not reached the RPM set point, the method returns to step **93** where the sensors **18**, **20**, **22**, **24**, **30** and **32** are repeatedly polled until the processor subsystem **12** determines that the engine speed has reached the RPM set point. Once the engine speed has reached the RPM set point, the processor subsystem **12** determines that the vehicle needs to be upshifted and, proceeding to step **95**, the processor subsystem **12** will activate the upshift notification circuit **34** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, an upshift should be performed. The method then returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

Returning to step **92**, if the vehicle's road speed and throttle position are increasing and the manifold pressure for the vehicle is above the manifold pressure set point, the processor subsystem **12** determines that too much fuel is being provided to the engine and proceeding to step **96**, the processor subsystem **12** will activate the overinjection notification circuit **38** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced. The method then returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

Returning to step **88**, if the processor subsystem **12** determines, when comparing the speed of the vehicle maintained in the first register **14***a* to the speed of the vehicle maintained in the second register **14***b*, that the speed of the vehicle is decreasing, the method proceeds to step **98** where the processor subsystem **12** determines if the throttle position is changing. To do so, the processor subsystem **12** compares the throttle level, i.e., the extent to which the throttled is opened, maintained in the first register **14***a* to the throttle level maintained in the second register **14***b*. If the throttle position has either remained constant or decreased, the processor subsystem **12** determines that, since fuel consumption is either constant or reduced, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the processor subsystem **12** determines at step **98** that the throttle position has increased, the method proceeds to step **100** where the processor subsystem **12** determines if the manifold pressure is increasing. To do so, the processor subsystem **12** compares the manifold pressure level maintained in the first register **14***a* to the manifold pressure level maintained in the second register **14***b*. If the manifold pressure level maintained in the first register **14***a* is less than the manifold pressure level maintained in the second register **14***b*, the processor subsystem **12** determines that, since manifold pressure is decreasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the manifold pressure level maintained in the first register **14***a* is greater than the manifold pressure level maintained in the second register **14***b*, the processor subsystem **12** determines that the manifold pressure for the vehicle is increasing and the method proceeds to step **102** where the processor subsystem **12** determines if the engine speed is increasing. To do so, the processor subsystem **12** compares the engine speed level maintained in the first register **14***a* to the engine speed level maintained in the second register **14***b*. If the engine speed level maintained in the first register **14***a* is less than the engine speed level maintained in the second register **14***b*, the processor subsystem **12** determines that, since engine speed is increasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the engine speed level maintained in the first register **14***a* is less than the engine speed level maintained in the second register **14***b*, the processor subsystem **12** determines that, since the manifold pressure is increasing while the engine speed is decreasing, too much fuel is being supplied to the engine. Accordingly, at step **104**, the processor subsystem **12** activates the overinjection notification circuit **38** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced.

Proceeding on to step **106**, the sensors **18**, **20**, **22 24**, **30** and **32** are again polled and, at step **108**, the processor subsystem **12** determines if the engine speed is decreasing, again by comparing the engine speed level maintained in the first and second registers **14**_a_ and **14**_b_. If the engine speed has not decreased, the method returns to step **104** where the processor subsystem **12** again activates the overinjection notification circuit **38** to issue another audible alert notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced. Thus, the driver will be repeatedly notified of the overinjection condition until the processor subsystem **12** determines, at step **108**, that the engine speed is decreasing. The method will then proceed to step **110** where, since the processor subsystem **12** has determined that, since the engine speed is decreasing, the vehicle should be downshifted. Accordingly, at step **110**, the processor subsystem **12** activates the downshift notification circuit **36** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the vehicle should be downshifted. The method then returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**. The method will repeatedly loop through the aforementioned process to continuously determine if the vehicle is being operated unsafely, take appropriate corrective action and to provide notifications to the driver as to how operation of the vehicle may be optimized until the processor subsystem **12** is powered down or the vehicle is turned off.

Thus, there has been described and illustrated herein, an apparatus for optimizing vehicle operation which combines both operator notifications of recommended corrections in vehicle operation with automatic modification of vehicle operation under certain circumstances. By incorporating the disclosed apparatus in a vehicle, not only will certain hazardous operations of the vehicle be prevented but also the driver will be advised of certain actions which will enable the vehicle to be operated with greater fuel efficiency. However, those skilled in the art will recognize that many modifications and variations besides those specifically mentioned herein may be made without departing substantially from the concept of the present invention. Accordingly, it should be clearly understood that the form of the invention described herein is exemplary only and is not intended as a limitation on the scope of the invention.

What is claimed is:

1. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.

2. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing; and

means for comparing manifold pressure to said manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.

3. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said fuel overinjection circuit further comprises a horn for issuing a tone for a preselected time period.

4. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

5. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point; and

means for comparing engine speed to said RPM set point;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.

6. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said upshift notification circuit further comprises a horn for issuing a tone for a preselected time period.

7. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.

8. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing; and

means for comparing manifold pressure to said manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.

9. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said fuel overinjection circuit further comprises a horn for issuing a tone for a preselected time period.

10. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

11. Apparatus for optimizing operation of a vehicle according to claim 10 wherein said downshift notification circuit further comprises a horn for issuing a tone for a preselected time period.

12. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

13. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an engine speed set point and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit, said upshift notification circuit and said downshift notification circuit.

14. Apparatus for optimizing operation of a vehicle according to claim 13 wherein:

said fuel overinjection circuit further comprises a first horn for issuing a first tone for a first preselected time period;

said upshift notification circuit further comprises a second horn for issuing a second tone for a second preselected time period; and

said downshift notification circuit further comprises a third horn for issuing a third tone for a third preselected time period.

15. Apparatus for optimizing vehicle performance according to claim 13 wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing or decreasing

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point;

means for comparing engine speed to said RPM set point;

means for determining when manifold pressure is increasing; and

means for determining when engine speed is increasing or decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point; and

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

16. Apparatus for optimizing operation of a vehicle according to claim **15** wherein:

said fuel overinjection circuit further comprises a first horn for issuing a first tone for a first preselected time period;

said upshift notification circuit further comprises a second horn for issuing a second tone for a second preselected time period; and

said downshift notification circuit further comprises a third horn for issuing a third tone for a third preselected time period.

17. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

a fuel overinjection circuit coupled to said processor subsystem, said fuel overinjection circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.

18. Apparatus for optimizing operation of a vehicle according to claim **17** wherein:

said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and

said memory subsystem further storing a second vehicle speed/stopping distance table.

19. Apparatus for optimizing operation of a vehicle according to claim **17** and further comprising:

a throttle controller for controlling a throttle of said engine of said vehicle; and

said processor subsystem selectively reducing said throttle based upon data received from said radar detector, said at least one sensor and said memory subsystem.

20. Apparatus for optimizing operation of a vehicle according to claim **19** wherein said at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated.

21. Apparatus for optimizing operation of a vehicle according to claim **19** wherein said processor subsystem further comprises:

means for counting a total number of vehicle proximity alarms determined by said processor subsystem;

means for selectively reducing said throttle based upon said total number of vehicle proximity alarms.

22. Apparatus for optimizing operation of a vehicle according to claim **17** and further comprising:

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said downshift notification circuit.

23. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

24. Apparatus for optimizing operation of a vehicle according to claim **23** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing or decreasing;

means for determining when throttle position for said vehicle is increasing or decreasing; and

means for comparing manifold pressure to said manifold pressure set point;

means for determining when manifold pressure for said vehicle is increasing or decreasing; and

means for determining when engine speed for said vehicle is increasing or decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

25. Apparatus for optimizing operation of a vehicle according to claim **23** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point; and

means for comparing engine speed to said RPM set point;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.

26. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

27. Apparatus for optimizing operation of a vehicle according to claim **26** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

28. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.

29. Apparatus according to claim **28** and further comprising:

a memory subsystem, coupled to said processor subsystem, said memory subsystem maintaining a manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit upon determining that:

(1) based upon data received from said road speed sensor, road speed of said vehicle is increasing;

(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing; and

(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle exceeds said manifold pressure set point.

30. Apparatus according to claim **28**, wherein:

said plurality of sensors coupled to said vehicle further include an engine speed sensor;

said processor subsystem activating said fuel overinjection notification circuit upon determining that:

(1) based upon data received from said road speed sensor, road speed of said vehicle is decreasing;

(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing;

(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle is increasing; and

(4) based upon data received from said engine speed sensor, engine speed for said vehicle is decreasing.

31. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem.

32. Apparatus for optimizing operation of a vehicle according to claim **31** wherein:

said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and

said memory subsystem further storing a second vehicle speed/stopping distance table;

if said windshield wiper sensor indicates that said windshield wiper is deactivated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem;

if said windshield wiper sensor indicates that said windshield wiper is activated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said second vehicle speed/stopping distance table stored in said memory subsystem.

* * * * *

EXHIBIT 2

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS

EASTERN DIVISION

VELOCITY PATENT LLC,	)	
Plaintiff,	)	Civil Action No. 1:13-cv-8418
v.	)	
AUDI OF AMERICA, INC. AUDI OF AMERICA, LLC	)	**JURY TRIAL DEMANDED**
Defendants.	)	

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Velocity Patent LLC ("Velocity") for its complaint against Defendants Audi of America, Inc. and Audi of America, LLC (collectively "Audi") hereby demands a jury trial and alleges as follows:

NATURE OF THE ACTION

1. This is a civil action for patent infringement arising under the patent laws of the United States, 35 U.S.C. § 1 *et seq.*

THE PARTIES

2. Plaintiff Velocity is a limited liability corporation organized and existing under the laws of Illinois and having a principal business address at 335 Lloyden Park Lane, Atherton, CA 94027.

3. On information and belief, Defendant Audi of America, Inc. is a corporation organized under the laws of the state of Michigan with an office and principal place of business located at 3800 W. Hamlin Road, Auburn Hills, MI 48326.

4. On information and belief, Defendant Audi of America, LLC is a corporation organized under the laws of the state of Delaware with an office and principal place of business located at 220 Ferdinand Porsche Dr., Herndon, VA 20171.

5. Audi advertises, markets, and distributes automobiles under the Audi brand throughout the United States.

JURISDICTION AND VENUE

6. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

7. This Court has personal jurisdiction over Audi because Audi has committed, and continues to commit, acts of patent infringement in Illinois, including in this judicial district, and otherwise transacts business in the state of Illinois, including in this district.

8. Venue is proper in this District under 28 U.S.C. §§ 1391(b)-(d) and 1400(b) because Audi is subject to personal jurisdiction in this judicial district and has committed, and continues to commit, acts of patent infringement giving rise to the claims alleged herein within this judicial district.

THE PATENT-IN-SUIT

9. On September 21, 1999, U.S. Patent No. 5,954,781 ("the '781 Patent"), entitled "METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION" (Exhibit A), duly and legally issued.

10. Velocity owns all rights, title, and interest in and to the '781 patent and has the right to sue and recover for past, present, and future infringement.

COUNT I - INFRINGEMENT OF THE '781 PATENT

11. Paragraphs 1 through 10 are incorporated by reference as though fully stated herein.

12. Audi manufactures, uses, imports, offers for sale, and sells automobiles that include radar equipment and radar-based safety features, including, for example, automobiles equipped with a Driver Assistance package.

13. Audi also manufactures, uses, imports, offers for sale, and sells automobiles with information displays that provide drivers with information regarding, for example, fuel consumption, efficiency of operation, and safety.

14. Additionally, Audi manufactures, uses, imports, offers for sale, and sells automobiles that include engines with cylinder on demand technology, which allows the engine to switch between a mode in which all of the engine cylinders are active, and a mode in which only a portion of the engine cylinders are active.

15. Furthermore, Audi manufactures, uses, imports, offers for sale, and sells automobiles that include manual gear shifting features, including, for example, automobiles equipped with automatic transmissions and a manual shift program.

16. By manufacturing, using, importing, offering for sale, and selling automobiles equipped with one or more of the features described above, Audi has directly infringed, and continues to infringe, either literally or under the doctrine of equivalents, at least claim 17 of the '781 Patent in violation of 35 U.S.C. § 271.

17. Velocity has been damaged by Audi's infringement of the '781 Patent.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff Velocity prays that this Court:

A. Enter a judgment that Audi has infringed the '781 Patent;

B. Award Velocity damages in an amount sufficient to compensate Velocity for Audi's infringement of the '781 Patent, but not less than a reasonable royalty;

C. Award Velocity prejudgment interest pursuant to 35 U.S.C. § 284; and

D. Grant Velocity such other and further relief as this Court may deem just and proper.

JURY DEMAND

Velocity hereby demands a jury trial on all issues appropriately triable by a jury.

Dated: November 21, 2013

Respectfully submitted,

/s/ James A. Shimota
James A. Shimota

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Counsel for Plaintiff Velocity Patent, LLC

EXHIBIT A

US005954781A

United States Patent [19]

Slepian et al.

[11] Patent Number: 5,954,781

[45] Date of Patent: Sep. 21, 1999

[54] **METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION**

[75] Inventors: **Harvey Slepian**, Peoria; **Loran Sutton**, East Peoria, both of Ill.

[73] Assignee: **TAS Distributing Co., Inc.**, Peoria, Ill.

[21] Appl. No.: **08/813,270**

[22] Filed: **Mar. 10, 1997**

[51] **Int. Cl.**[6] **G06F 7/00**

[52] **U.S. Cl.** **701/96**; 701/103; 340/425.5; 340/438

[58] **Field of Search** 701/1, 121, 123, 701/101, 102, 103, 104, 96, 300; 123/478, 480, 351, 481; 340/903, 425.5, 426, 436, 438

[56] **References Cited**

U.S. PATENT DOCUMENTS

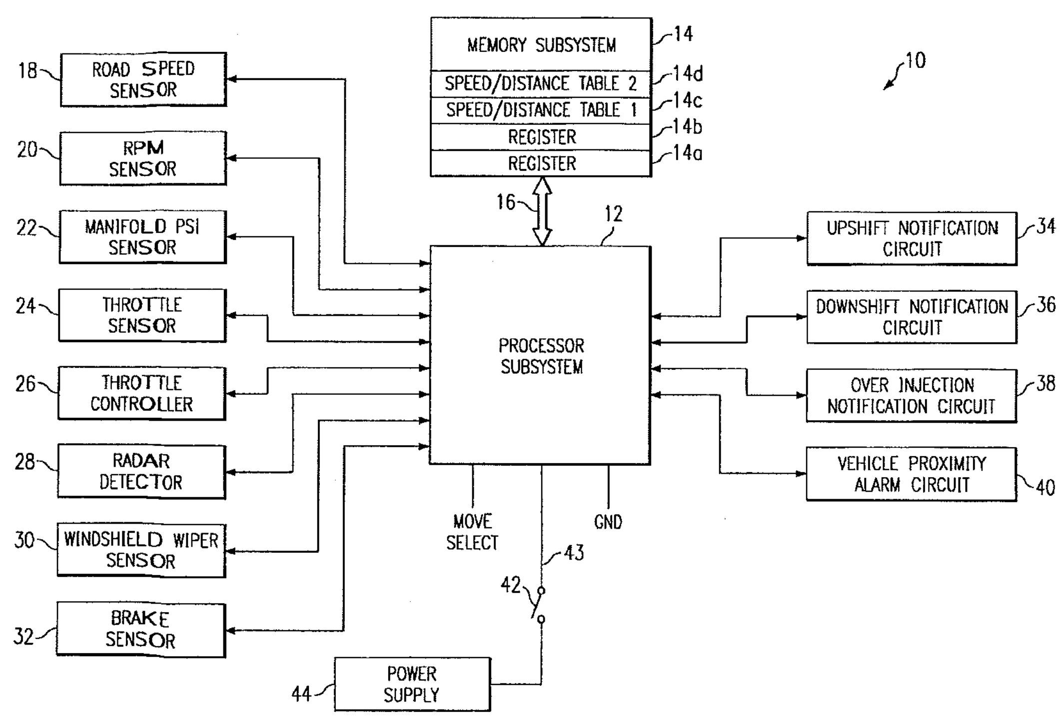
4,492,112	1/1985	Igarashi et al.	73/117.3
4,542,460	9/1985	Weber	364/424
4,631,515	12/1986	Blee et al.	340/62
4,701,852	10/1987	Ulveland	364/424.1
4,752,883	6/1988	Asakura et al.	364/424.1
4,853,673	8/1989	Kido et al.	340/439
4,868,756	9/1989	Kawanabe et al.	364/442
4,901,701	2/1990	Chasteen	123/478
5,420,792	5/1995	Butsuen et al.	701/96
5,708,584	1/1998	Doi et al.	701/96
5,745,870	4/1998	Yamamoto et al.	701/96

Primary Examiner—William A. Cuchlinski, Jr.
Assistant Examiner—Gertrude Arthur
Attorney, Agent, or Firm—Haynes and Boone, LLP

[57] **ABSTRACT**

Apparatus for optimizing operation of an engine-driven vehicle. The apparatus includes a processor subsystem, a memory subsystem, a road speed sensor, an engine speed sensor, a manifold pressure sensor, a throttle position sensor, a radar detector for determining the distance separating the vehicle from an object in front of it, a windshield wiper sensor for indicating whether a windshield wiper of the vehicle is activated, a brake sensor for determining whether the brakes of the vehicle have been activated, a fuel over-injection notification circuit for issuing notifications that excessive fuel is being supplied to the engine of the vehicle, an upshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an excessive engine speed, a downshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an insufficient engine speed, a vehicle proximity alarm circuit for issuing an alarm that the vehicle is too close to an object in front of the vehicle and a throttle controller for automatically reducing the amount of fuel supplied to the engine if the vehicle is too close to the object in front of it. Based upon data received from the sensors and data stored in the memory subsystem, the processor determines whether to activate the fuel overinjection notification circuit, the upshift notification circuit, the downshift notification circuit, the vehicle proximity alarm circuit or the throttle controller.

32 Claims, 3 Drawing Sheets



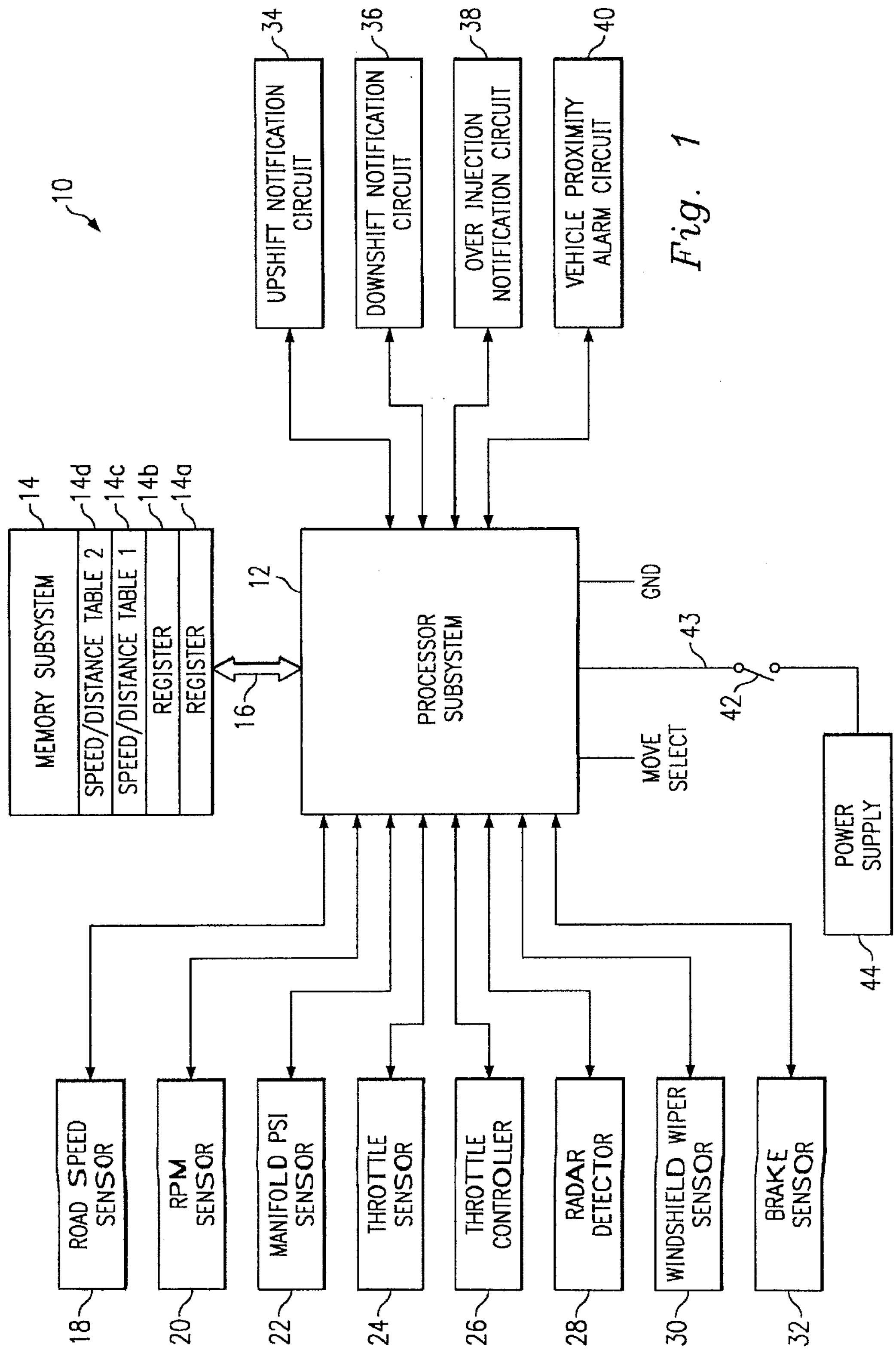
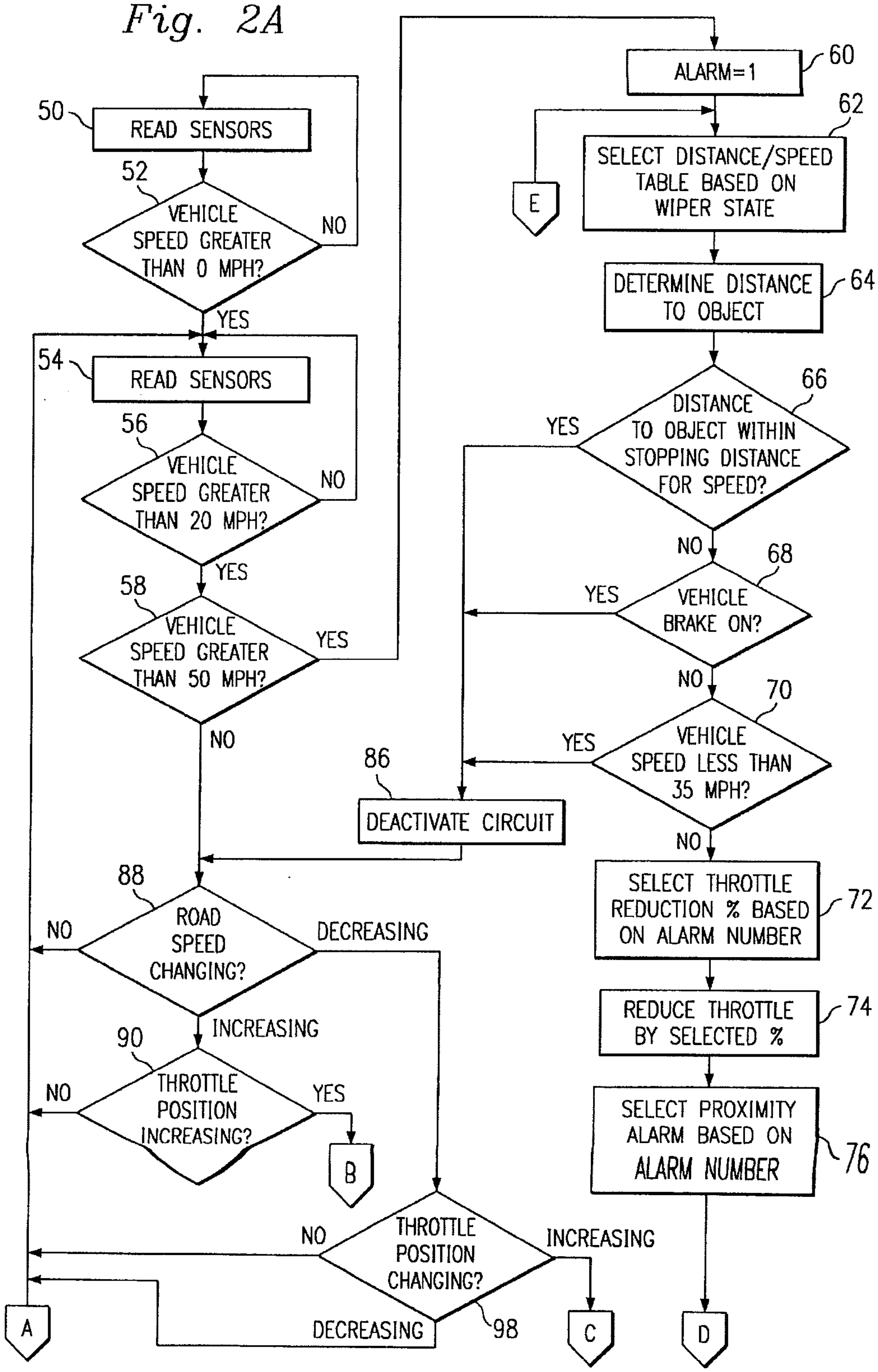

10
UPSHIFT NOTIFICATION CIRCUIT
34
DOWNSHIFT NOTIFICATION CIRCUIT
36
OVER INJECTION NOTIFICATION CIRCUIT
38
VEHICLE PROXIMITY ALARM CIRCUIT
40
MEMORY SUBSYSTEM
14
SPEED/DISTANCE TABLE 2
14d
SPEED/DISTANCE TABLE 1
14c
REGISTER
14b
REGISTER
14a
16
12
PROCESSOR SUBSYSTEM
GND
43
42
MOVE SELECT
POWER SUPPLY
44
ROAD SPEED SENSOR
18
RPM SENSOR
20
MANIFOLD PSI SENSOR
22
THROTTLE SENSOR
24
THROTTLE CONTROLLER
26
RADAR DETECTOR
28
WINDSHIELD WIPER SENSOR
30
BRAKE SENSOR
32

Fig. 1

Fig. 2A



50
READ SENSORS
52
VEHICLE SPEED GREATER THAN 0 MPH?
NO
YES
54
READ SENSORS
56
VEHICLE SPEED GREATER THAN 20 MPH?
NO
YES
58
VEHICLE SPEED GREATER THAN 50 MPH?
YES
NO
60
ALARM=1
62
SELECT DISTANCE/SPEED TABLE BASED ON WIPER STATE
E
64
DETERMINE DISTANCE TO OBJECT
66
DISTANCE TO OBJECT WITHIN STOPPING DISTANCE FOR SPEED?
YES
NO
68
VEHICLE BRAKE ON?
YES
NO
70
VEHICLE SPEED LESS THAN 35 MPH?
YES
NO
86
DEACTIVATE CIRCUIT
72
SELECT THROTTLE REDUCTION % BASED ON ALARM NUMBER
74
REDUCE THROTTLE BY SELECTED %
76
SELECT PROXIMITY ALARM BASED ON ALARM NUMBER
88
ROAD SPEED CHANGING?
NO
DECREASING
INCREASING
90
THROTTLE POSITION INCREASING?
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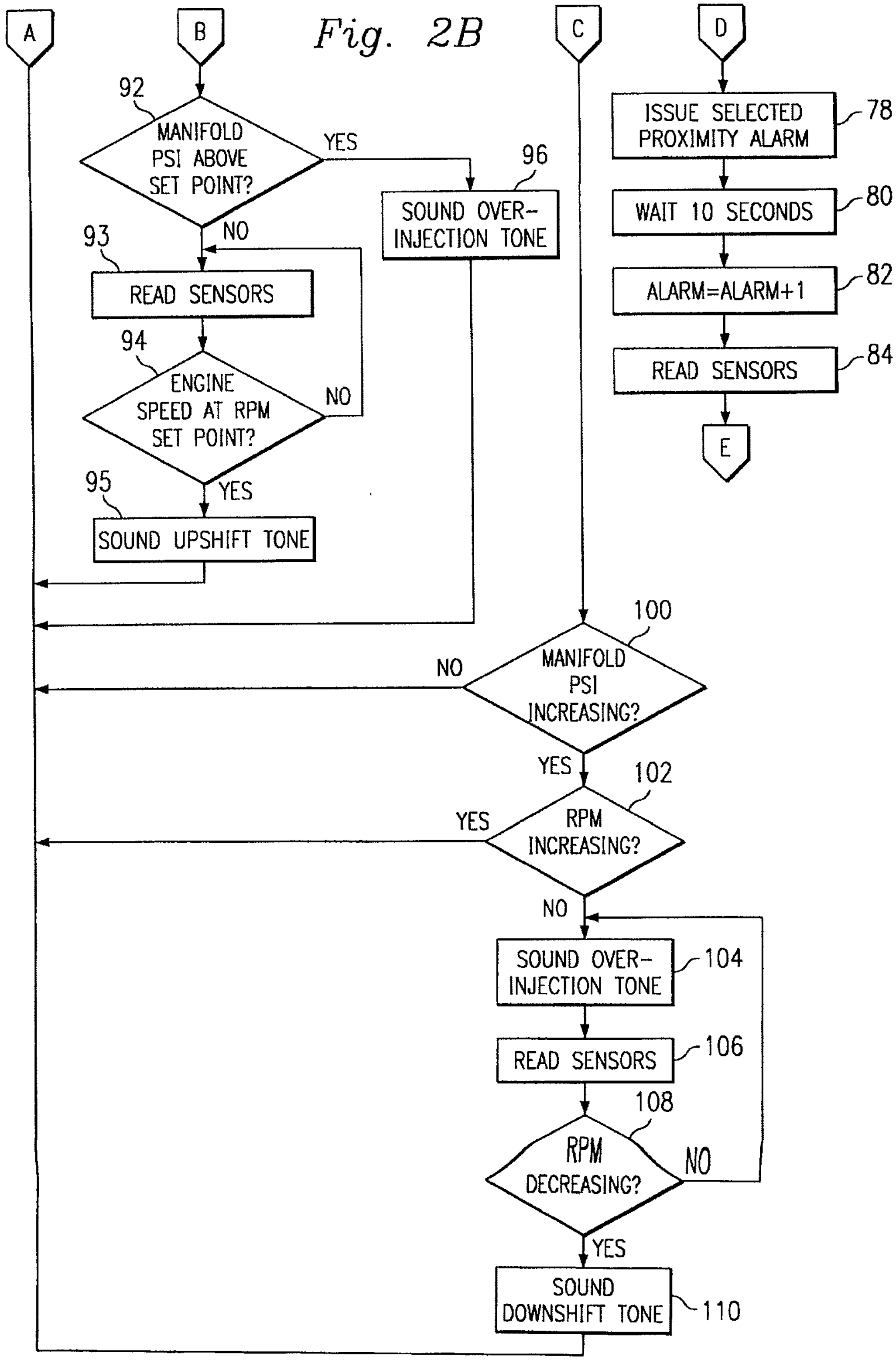
YES
B
THROTTLE POSITION CHANGING?
NO
INCREASING
DECREASING
98
A
C
D

Fig. 2B


A
B
C
D
92
MANIFOLD PSI ABOVE SET POINT?
YES
NO
96
SOUND OVER-INJECTION TONE
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READ SENSORS
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ENGINE SPEED AT RPM SET POINT?
NO
95
YES
SOUND UPSHIFT TONE
ISSUE SELECTED PROXIMITY ALARM
78
WAIT 10 SECONDS
80
ALARM=ALARM+1
82
READ SENSORS
84
E
100
MANIFOLD PSI INCREASING?
NO
YES
102
RPM INCREASING?
YES
NO
SOUND OVER-INJECTION TONE
104
READ SENSORS
106
108
RPM DECREASING?
NO
YES
SOUND DOWNSHIFT TONE
110

METHOD AND APPARATUS FOR OPTIMIZING VEHICLE OPERATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to an apparatus for optimizing vehicle operation and, more particularly, relates to a system which both notifies the driver of recommended corrections in vehicle operation and, under certain conditions, automatically initiates selected corrective action.

2. Description of Related Art

It has long been recognized that the improper operation of a vehicle may have many adverse effects. For example, the fuel efficiency of a vehicle may vary dramatically based upon how the vehicle is operated. More specifically, operating a vehicle at excessive speed, excessive RPM and/or excessive manifold pressure will result in both reduced fuel economy and increased operating costs. The aforementioned increased operating costs can be quite considerable, particularly for an owner or operator of a fleet of vehicles. To correct these types of improper vehicle operations are often surprisingly simple. For example, upshifting the drive gear will typically eliminate an excessive RPM condition. However, even when the solution is quite simple, oftentimes, the driver will be unaware of the need to take corrective action.

A variety of patents have disclosed systems, commonly referred to as "shift prompters", which monitor the operation of a vehicle and advises the operator of the vehicle when to take certain actions. Numerous ones of these devices include sensors which measure engine speed and vehicle speed. See, for example, U.S. Pat. No. 4,492,112 to Igarashi et al., U.S. Pat. No. 4,631,515 to Blee et al. and U.S. Pat. No. 4,701,852 to Ulveland. Certain ones, however, disclose the use of other types of sensors as well. For example, U.S. Pat. No. 4,524,460 to Weber is directed to a driving aid indicator which includes vehicle speed, manifold pressure, throttle position and engine speed sensors. U.S. Pat. No. 4,752,883 to Asakura et al. and U.S. Pat. No. 4,868,756 to Kawanabe et al. are directed to upshift notification devices which include sensors for measuring engine speed, vehicle speed, manifold pressure and cooling water temperature. Finally, U.S. Pat. No. 4,853,673 to Kido et al. discloses a shift indicator system which includes sensors for measuring engine speed and throttle position. Generally, the above-listed patents all provide displays intended to enable the driver to operate the vehicle in a manner leading to uniform performance and maximum fuel economy. However, Blee et al. discloses the use of audible warnings as well as a speed controller to prevent further increases in engine speed if the driver ignores previously issued warnings.

Improper vehicle operation has other adverse effects as well. It is well known that the faster a vehicle travels, the longer it takes to stop. Thus, what may be a safe separation distance between successive vehicles when a vehicle is traveling at 35 mph may be unsafe if that vehicle is traveling at 50 mph. Road conditions also play a role in determining the safe separation distance between vehicles. For example, greater separation distances are generally recommended when roads are wet. As a result, therefore, based on the combination of a vehicle's speed, the distance separating the vehicle from a second vehicle in front of it and road conditions, many vehicles are operated unsafely. To correct this situation, a reduction in operating speed, an increase in vehicle separation or some combination thereof, is required.

It may be readily seen from the foregoing that it would be desirable to provide a system which integrates the ability to issue audible warnings which advise the driver to correct operation of the vehicle in a manner which will enhance the efficient operation thereof with the ability to automatically take corrective action if the vehicle is being operated unsafely. It is, therefore, the object of the invention to provide such a system.

SUMMARY OF THE INVENTION

In one embodiment, the present invention is directed to an apparatus for optimizing operation of an engine-driven vehicle. The apparatus includes a processor subsystem, a memory subsystem, plural sensors, including road speed, manifold pressure and throttle position sensors, for collectively monitoring operation of the vehicle and a fuel over-injection notification circuit for issuing notifications that excessive fuel is being supplied to the engine of the vehicle. The processor subsystem receives data from the sensors and, from the received data, determines when to activate the fuel overinjection circuit. In one aspect thereof, the processor subsystem determines when road speed for the vehicle is increasing, determines when throttle position for the vehicle is increasing, compares manifold pressure and a manifold pressure set point stored in the memory subsystem and activates the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point.

In further aspects thereof, the sensors may include an engine speed sensor and the processor subsystem may determine when road speed for the vehicle is decreasing, when throttle position for the vehicle is increasing, when manifold pressure for the vehicle is increasing, when engine speed for the vehicle is decreasing and may activate the fuel overinjection notification circuit if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing.

In still further aspects thereof, the apparatus may also include an upshift notification circuit, activated by the processor subsystem based upon data received from the sensors, which issues notifications that the engine of the vehicle is being operated at excessive engine speeds. In this aspect, the processor subsystem determines when road speed for the vehicle is increasing, when throttle position for the vehicle is increasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem, compares engine speed to an RPM set point stored in the memory subsystem and activates the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point.

In still yet further aspects thereof, the apparatus may also include a downshift notification circuit, activated by the processor subsystem based upon data received from the sensors, which issues a notification that the engine of the vehicle is being operated at an insufficient engine speed. The processor subsystem may determine when road speed for the vehicle is decreasing, when throttle position for the vehicle is increasing, when manifold pressure for the vehicle is increasing, when engine speed for the vehicle is decreasing and may activate the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

In still further aspects thereof, the fuel overinjection circuit, the upshift notification circuit or the downshift notification circuit may include a horn for issuing a tone for a preselected time period.

In another embodiment, the present invention is of an apparatus for optimizing operation of a vehicle. The apparatus includes road speed, engine speed, manifold pressure and throttle position sensors, a processor subsystem coupled to each of the sensors to receive data therefrom and a memory subsystem, coupled to the processor subsystem, for storing a manifold pressure set point, an engine speed set point and present and prior levels for each one of the sensors. The apparatus further includes a fuel overinjection notification circuit, an upshift notification circuit and a downshift notification circuit, all of which are coupled to the processor subsystem. The fuel overinjection notification circuit issues notifications that excessive fuel is being supplied to the engine of the vehicle, the upshift notification circuit issues notifications that the engine of the vehicle is being operated at an excessive engine speed and the downshift notification circuit issues notifications that the engine of the vehicle is being operated at an insufficient engine speed. Based upon data received from the sensors, the processor subsystem determines when to activate the fuel overinjection circuit, the upshift notification circuit and the downshift notification circuit. In one aspect thereof, the fuel overinjection circuit includes a first horn for issuing a first tone for a first preselected time period, the upshift notification circuit includes a second horn for issuing a second tone for a second preselected time period and the downshift notification circuit includes a third horn for issuing a third tone for a third preselected time period.

In another aspect thereof, the processor subsystem may determine when road speed for the vehicle is increasing or decreasing, engine speed is increasing or decreasing, throttle position for the vehicle is increasing and manifold pressure is increasing; may compare manifold pressure to the manifold pressure set point and engine speed to the RPM set point; and may activate the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point or if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing, the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point and the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

In another aspect, the present invention is of an apparatus for optimizing operation of a vehicle which includes a radar detector for determining a distance separating a vehicle having an engine and an object in front of the vehicle and at least one sensor for monitoring operation of the vehicle. The apparatus further includes a processor subsystem, a memory subsystem and a vehicle proximity alarm circuit. The processor subsystem is coupled to the radar detector and the at least one sensor to receive data therefrom while the memory subsystem, in which a first vehicle speed/stopping distance table and present levels for each one of the at least one sensor are stored, and the vehicle proximity alarm circuit are coupled to the processor subsystem. Based on data received from the radar detector, the at least one sensor and the contents of the memory subsystem, the processor determines when to instruct the vehicle proximity alarm circuit to issue an alarm that the vehicle is too close to the object.

In one aspect thereof, the at least one sensor further includes a windshield wiper sensor for indicating whether a

windshield wiper of the vehicle is activated and a second vehicle speed/stopping distance table is stored in the memory subsystem. In another aspect thereof, the apparatus further includes a throttle controller for controlling a throttle of the engine of the vehicle. The processor subsystem may selectively reduce the throttle based upon data received from the radar detector, the at least one sensor and the memory subsystem or may also count a total number of vehicle proximity alarms determined by the processor subsystem and selectively reduce the throttle based upon the total number of vehicle proximity alarms, as well. In yet another aspect thereof, the at least one sensor further includes a brake sensor for indicating whether a brake system of the vehicle is activated.

In other aspects thereof, the apparatus may be further provided with a fuel overinjection notification circuit for issuing a notification that excessive fuel is being supplied to the engine of the vehicle, an upshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an excessive engine speed or a downshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed. If a fuel overinjection notification circuit is provided, the apparatus includes a manifold pressure sensor and a throttle position sensor which also provide the processor subsystem with data used, together with a manifold pressure set point and prior levels for the sensors stored in the memory subsystem, to determine when to activate the fuel overinjection circuit. If an upshift notification circuit is provided, the apparatus includes an engine speed sensor which also provides the processor subsystem with data used, together with an RPM set point stored in the memory subsystem, to determine when to activate the upshift notification circuit. Finally, if a downshift notification circuit is provided, the processor subsystem determines when to activate the downshift notification circuit based upon the data received from the plurality of sensors.

In still another embodiment, the present invention is of an apparatus for optimizing operation of a vehicle which includes a radar detector for determining a distance separating the vehicle from an object in front of it, a plurality of sensors, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor, which collectively monitor the operation of the vehicle, a processor subsystem, a memory subsystem, a fuel overinjection notification circuit for issuing notification that excessive fuel is being supplied to the engine of the vehicle and a vehicle proximity alarm circuit for issuing alarms if the vehicle is too close to the object. Based upon data received from the sensors, the processor subsystem determines when to activate the fuel overinjection circuit. Based upon data received from the radar detector, the sensors and the memory subsystem, the processor subsystem also determines when to activate the vehicle proximity alarm circuit.

In one aspect of this embodiment of the invention, the processor subsystem determines when road speed for the vehicle is increasing or decreasing, when throttle position for the vehicle is increasing or decreasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem, determines when manifold pressure for the vehicle is increasing or decreasing and determines when engine speed for the vehicle is increasing or decreasing. In this aspect, the processor subsystem activates the fuel overinjection notification circuit if both road speed and throttle position for the vehicle are increasing and manifold pressure for the vehicle is above the manifold pressure set point or if both throttle position and manifold pressure for the vehicle are increasing and road speed and engine speed for the vehicle are decreasing.

In a further aspect thereof, the apparatus may also include an upshift notification circuit for issuing notifications that the engine of the vehicle is being operated at an excessive engine speed, the processor subsystem determining when to activate the upshift notification circuit based upon data received from the sensors. In a related aspect thereof, the processor subsystem determines when road speed for the vehicle is increasing, determines when throttle position for the vehicle is increasing, compares manifold pressure to a manifold pressure set point stored in the memory subsystem and compares engine speed to an RPM set point stored in the memory subsystem. In this aspect, the processor subsystem activates the upshift notification circuit if both road speed and throttle position for the vehicle are increasing, manifold pressure for the vehicle is at or below the manifold pressure set point and engine speed for the vehicle is at or above the RPM set point.

In still another aspect thereof, the apparatus may also include a downshift notification circuit for issuing a notification that the engine of the vehicle is being operated at an insufficient engine speed. In this aspect, the processor subsystem determines when to activate the downshift notification circuit based upon data received from the sensors. In a related aspect thereof, the processor subsystem determines when road speed for the vehicle is decreasing, determines when throttle position for the vehicle is increasing, determines when manifold pressure for the vehicle is increasing and determines when engine speed for the vehicle is decreasing. In this aspect, the processor subsystem activates the downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for the vehicle are increasing.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood, and its numerous objects, features and advantages will become apparent to those skilled in the art by reference to the accompanying drawing, in which:

FIG. 1 is a block diagram of an apparatus for optimizing vehicle performance constructed in accordance with the teachings of the present invention; and

FIGS. 2A–B is a flow chart of a method for optimizing vehicle performance in accordance with the teachings of the present invention.

DETAILED DESCRIPTION

Referring first to FIG. 1, a system 10 for optimizing vehicle performance constructed in accordance with the teachings of the present invention will now be described in greater detail. The system 10 includes a processor subsystem 12, for example, a microprocessor, and a memory subsystem 14, for example, the memory subsystem 14 may include a nonvolatile random access memory (or "NVRAM"), coupled together by a bus 16 for bi-directional exchanges of address, data and control signals therebetween. The system 10 is installed in a vehicle (not shown) for which optimized performance and driver assist capabilities are desired. Although it is contemplated that the system 10 is suitable for use with any type vehicle, most commonly, the system 10 shall be installed in a truck.

Also coupled to the processor subsystem 12 are a series of sensors, each of which are periodically polled by the processor subsystem 12, to determine the respective states or levels thereof. The sensors include a road speed sensor 18, an RPM sensor 20, a manifold pressure sensor 22, a throttle sensor 24, a windshield wiper sensor 30 and a brake sensor 32. The sensors are selected to be either state or level sensors, depending on whether the information to be collected thereby is a state, i.e., on/off or a level, for example, 35 mph. The road speed sensor 18 and the RPM sensor 20 are level sensors which respectively provide the processor subsystem 12 with signals which indicate the operating speed and engine speed for the vehicle. The road speed sensor 18 and the RPM sensor 20 may derive such information from any one of a variety of sources. For example, the road speed sensor 18 may be connected to receive the speed input signal transmitted to the vehicle's speedometer while the RPM sensor 20 may be connected to receive the RPM input signal to the vehicle's tachometer.

The manifold pressure sensor 22 is a level sensor which is positioned downstream of the throttle valve in the intake manifold of the vehicle to measure manifold pressure thereat. The throttle sensor 24 is a level sensor, attached to the throttle, which measures the extent to which the throttle is opened. The windshield wiper sensor 30 is a state sensor which determines whether the vehicle's windshield wipers are on or off. In alternate embodiments thereof, the windshield wiper sensor 30 may be electrically coupled to the on/off switch for the windshield wiper or to an output of the windshield wiper motor. Finally, the brake sensor 32 is a state sensor which determines whether the brakes of the vehicle have been engaged. For example, the brake sensor 32 may be electrically coupled to the brake system to detect the activation thereof.

Preferably, the memory subsystem 14 should include first and second registers 14*a* and 14*b*, each having sufficient bits for holding the state/level of each of the sensors 18, 20, 22, 24, 30 and 32. The first register 14*a* is used to hold the present state or level of each of the sensors 18, 20, 22, 24, 30 and 32 while the second register 14*b* is used to hold the prior state or level for each of the sensors 18, 20, 22, 24, 30 and 32. Each time the processor subsystem 12 writes the present state or level of the sensors 18, 20, 22, 24, 30 and 32 to the first register 14*a*, the prior contents of the first register 14*a* is written to the second register 14*b* which, in turn, discards the prior content thereof. The memory subsystem 14 is also used to hold information to be utilized by the processor subsystem 12 to determining whether to take corrective actions and/or issue notifications. Typically, such information is placed in the memory subsystem 14 while the system 10 is being initialized. The information includes one or more speed/distance tables which, when used in a manner which will be more fully described below in combination with data collected by the system 10, enable the processor subsystem 12 to determine if the vehicle is being operated unsafely and if corrective action is necessary. Speed/stopping distance table. The information also includes two pre-set threshold values—a manifold psi set point and an engine RPM set point. As will also be more fully described below, the processor subsystem 12 uses these threshold values to determine when to issue notifications as to recommended changes in vehicle operation which, when executed by the driver, will optimize vehicle operation. The speed/stopping distance table(s) are based upon National Safety Council guidelines, vary according to the class of the vehicle and provide the relationship between the speed at which a vehicle is travelling and the distance which the vehicle will require to come to a complete stop if travelling at that speed. The manifold psi set point and RPM set point are selected based upon the manufacturer's guidelines for proper operation of the vehicle, vary based upon horsepower and engine size for the vehicle and represent thresholds above which the manifold pressure and engine rotation speed, respectively, for the vehicle should never exceed.

The system **10** also includes a throttle controller **26** capable of opening and/or closing the throttle, a radar detector **28** positioned to determine the distance separating the vehicle and an object in front of the vehicle, for example, a second vehicle travelling in the same direction, a series of circuits **34**, **36**, **38** and **40** for notifying the driver of the vehicle of recommended corrections in vehicle operation and alerting the driver to unsafe operating conditions and a power supply, for example a +12 v battery, for providing power to the energy-demanding components of the system **10**. The circuits **34**, **36**, **38** and **40** include an upshift notification circuit **34** for notifying the driver that an upshift is recommended, a downshift notification circuit **36** for notifying the driver that a downshift is recommended, an overinjection notification circuit **38** for notifying the driver that too much fuel is being supplied to the vehicle and a vehicle proximity alarm circuit **40** for alerting the driver when an object in front of the vehicle is too close. The circuits **34**, **36** and **38** may be configured to provide visual and/or audible notifications, for example, using lights and/or horns. For example, the upshift circuit **34**, the downshift notification circuit **36** and the overinjection notification circuit **38** may each include a horn, or other tone generating device, from which an audible notification may be generated at a selected pitch. Preferably, each of the notification circuits **34**, **36** and **38** may be configured to provide distinct audible notifications, for example, tones at distinct pitches, so that the driver may readily distinguish which of the notification circuits **34**, **36** and **38** have been activated by the processor subsystem **12**. The proximity alarm circuit **40** may include one or more visual and/or audible warning devices such as lights and/or horns. For example, the proximity alarm circuit **40** may include a warning light and a warning horn. If desired, the proximity alarm circuit may also include a display for displaying the speed of the object in the vehicle's path and/or the stopping distance in feet. The proximity alarm circuit **40** may be further equipped to provide audible indications of the speed of the object in the vehicle's path and/or the stopping distance in feed as well as selector circuitry for selecting both the information to be provided as well as the manner in which the information is to be conveyed.

Finally, the processor subsystem **12** is further provided with one or more mode select input lines which enable operator configuration of the operation of the system **10**. For example, as described herein, the corrective operations consist of the combination of an automatic reduction of throttle and audio/visual alerts that the vehicle is being operated unsafely. It is specifically contemplated, however, that the system **10** include a mode select line for switching the system **10** between an "active" mode where both automatic throttle reduction and audio/visual alerts are generated and an "inactive" mode where only audio/visual alerts are generated.

Referring next to FIGS. 2A–B, a method for optimizing vehicle performance in accordance with the teachings of the present invention will now be described in greater detail. The method commences by powering up the processor subsystem **12**, for example, by closing switch **42**, thereby coupling the processor subsystem **12** to the power source **44** via line **43**. Alternately, the processor subsystem **12** may be connected to the electrical system of the vehicle such that it will automatically power up when the vehicle is started. Of course, any of the other devices which also form part of the system **10** and require power may also be coupled to the line **43**. Appropriate voltage levels for the processor subsystem **12**, as well as any additional power-demanding devices coupled to the power source **44**, would be provided by voltage divider circuitry (not shown).

Once the system **10** is powered up, the method begins at step **50** by the processor subsystem **12** polling the road speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32** to determine their respective levels or states and places the acquired information in the first data register **14***a*. Of course, it should be noted, however, that polling of the sensors by the processor subsystem **12** is but one technique by which the processor subsystem **12** may acquire the requisite information. Alternately, each sensor **20**, **22**, **24**, **30** and **32** may periodically place its level or state in one or more bits of the first data register **14***a*. The processor subsystem **12** would then acquire information by checking the contents of the first data register **14***a* at selected time intervals.

Proceeding to step **52**, the processor subsystem **12** examines the contents of the first data register **14***a* to determine the operating speed of the vehicle. If the processor subsystem **12** determines that the vehicle is stationary, i.e., the operating speed of the vehicle is zero, the processor subsystem **12** will return to step **50** where the road speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32** will be repeatedly polled until an operating speed greater than zero is detected at step **52**. While polling may be conducted at a variety of time intervals, a polling period of one second appears suitable for the uses contemplated herein.

Returning to step **52**, once an operating speed greater than zero is detected by the processor subsystem **12**, the method proceeds to step **54** where the processor subsystem **12** again polls the operating speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32**, to determine their respective levels or states and places the acquired information in the first data register **14***a*. In turn, the contents of the first data register **14***a* is placed in the second data register **14***b*.

Proceeding now to step **56**, from the polled value of the road speed sensor **18**, the processor subsystem **12** determines whether the vehicle is travelling faster than 20 mph. If the operating speed of the vehicle is less than 20 mph, the method returns to step **54** where the sensors **18**, **20**, **22**, **24**, **30** and **32** will be repeatedly polled and the value of the road speed sensor examined until the processor subsystem **12** determines that the vehicle is travelling faster than 20 mph. If, however, the processor subsystem **12** determines that the vehicle is travelling faster than 20 mph, the method proceeds to step **58** where the processor subsystem **12** then determines if the vehicle is travelling faster than 50 mph, again by checking the contents of the first data register **14***a*.

Past this juncture, the method of the present invention will proceed through a series of steps designed to optimize vehicle operation. However, prior to optimizing vehicle operation, the processor subsystem **12** will determine if the vehicle is being operated unsafely. If so, the processor subsystem **12** will initiate corrective operations before commencing vehicle operation optimization. More specifically, if the processor subsystem **12** determines at step **58** that the vehicle is travelling at a speed greater than 50 mph, the processor subsystem **12** will initiate a process by which it will determine whether the vehicle is being operated unsafely.

The processor subsystem **12** determines that the vehicle is being operated unsafely if the speed of the vehicle is such that the stopping distance for the vehicle d is greater than the distance separating the vehicle from an object, for example, a second vehicle, in its path. In order to make this determination, the processor subsystem **12** is provided access to at least one speed/distance table. For example, stored at location **14***c* within the memory subsystem **14** is a first speed/stopping distance table. The speed/stopping distance table contains the relationship between vehicle speed and stopping distance. Thus, for any given speed, the processor subsystem **12** may look-up the stopping distance for that speed. Preferably, the memory subsystem **14** should contain multiple speed/stopping distance tables so that differences in road conditions and/or vehicle class may be taken into account. For example, the speed/stopping distance table stored at location **14***c* may be a speed/stopping distance table for dry roads while a speed/stopping distance table for wet roads may be stored at location **14***d*. If desired, the memory subsystem **14** may also contain additional speed/stopping distance tables for other vehicle classes. If such additional tables were provided, however, the disclosed method would need to be modified to include additional steps in which the operator provides the vehicle's class and the processor subsystem **12** selects the appropriate speed/stopping distance tables for the indicated class of vehicle.

To make the aforementioned determination of unsafe vehicle operation, the method proceeds to step **60** where the processor subsystem **12** sets the value of the expression ALARM to 1. The method then proceeds to step **62** where the processor subsystem **12** examines the state of the wiper sensor **32** and selects a speed/stopping distance table based upon the state of the wiper sensor **32**. If the state of the wiper sensor **32** indicates that the windshield wiper is off, the processor subsystem **12** concludes that the vehicle is being operated in dry conditions and selects the speed/stopping distance table stored at the location **14***c* of the memory subsystem **14**. If, however, the state of the wiper sensor **32** indicates that the windshield wiper is on, the processor subsystem **12** concludes that the vehicle is being operated in wet conditions and selects the speed/stopping distance table stored at the location **14***d* of the memory subsystem **14**. From the selected speed/stopping distance table **14***c* or **14***d*, the processor subsystem **12** then retrieves the stopping distance for the speed at which the vehicle is travelling.

Continuing on to step **64**, the processor subsystem **12** determines the distance of the vehicle to an object in its path, i.e., a second vehicle travelling in front of the vehicle and in the same direction. To do so, the processor subsystem **12** instructs the radar device **28** to determine the distance between the vehicle and the second vehicle in front of it. Upon determining the distance separating the two vehicles, the radar device **28** transmits the determined separation distance to the processor subsystem **12**. At step **66**, the processor subsystem **12** determines if the two vehicles are separated by a safe distance. To do so, the processor subsystem **12** compares the distance separating the two vehicles to the retrieved stopping distance for the vehicle. If the determined distance separating the two vehicles is greater than the retrieved stopping distance for the vehicle, the processor subsystem **12** determines that the vehicle is being operated safely. If, however, the determined distance separating the two vehicles is less than the retrieved stopping distance, the processor subsystem **12** determines that the vehicle is being operated unsafely.

If the processor subsystem **12** determines at step **66** that the vehicle is being operated unsafely, the processor subsystem **12** initiates appropriate corrective action. At step **68**, the processor subsystem **12** determines whether the vehicle brake is on by examining the state of the brake sensor **32**. If the brake is on, the processor subsystem **12** concludes that the driver is taking corrective action and that further corrective action is not necessary. If, however, the processor subsystem **12** determines that the vehicle brake is off, the method proceeds to step **70** where the processor subsystem examines the level of the vehicle speed sensor to determine if the speed of the vehicle is less than 35 mph. If the speed of the vehicle is less than 30 mph, the processor subsystem **12** concludes that no further corrective action will be taken.

If, however, the processor subsystem **12** determines that the speed of the vehicle is greater than 35 mph, the method proceeds to step **72** where the processor subsystem **12** selects a throttle reduction value based upon the value of the expression ALARM. Generally, the severity of the corrective action to be initiated by the processor subsystem **12** is varied depending on the number of times that corrective action has been taken and, more specifically, the severity of the selective corrective action increases with the value of the expression ALARM. For example, in the embodiment of the invention disclosed herein, if ALARM=1, a 25% throttle reduction is selected, if ALARM=2, a 50 throttle reduction is selected and, if ALARM≧3, a 100% throttle reduction is selected. By reducing the throttle, the transport of fuel to the engine is retarded and the vehicle will begin to decelerate.

Continuing on to step **74**, the processor subsystem **12** determines the extent to which the throttle is open using the throttle level provided by the throttle sensor **24** and, using throttle control **26**, reduces the throttle by the selected percentage. At step **76**, the processor subsystem **12** selects an alert mode, again based upon the value of the expression ALARM. As before, the severity of the alert mode may increase with the value of ALARM. For example, when ALARM=1, a warning light may be activated in a flash mode while, when 2≦ALARM≦3, an audible alert which lasts for a first selected time period, for example, two seconds, may be activated in combination with the flashing warning light and when ALARM≧4, an audible alert which lasts for a second, longer, time period, for example, six seconds, may be activated in combination with the flashing light.

Proceeding to step **78**, the processor subsystem **12** issues an alert to the operator of the vehicle in accordance with the selected alert mode. To do so, the processor subsystem **12** activates vehicle proximity alarm circuit **40** in accordance with the selected alert mode. After issuing the alert at step **78**, the method proceeds to step **80** where the processor subsystem **12** waits a selected period before taking any further action. The wait period is intended to provide sufficient time to see if the previously initiated corrective action eliminates the hazardous condition. As disclosed herein, a wait period of 10 seconds is suitable. However, wait periods of various lengths should be equally suitable for the uses contemplated herein.

Upon expiration of the wait period, the value of the expression ALARM is incremented by one at step **82** and, at step **84**, the processor subsystem **12** again polls the operating speed sensor **18**, the RPM sensor **20**, the manifold pressure sensor **22**, the throttle sensor **24**, the windshield wiper sensor **30** and the brake sensor **32**, to determine their respective levels or states and places the acquired information in the first data register **14***a*. The method returns to step **64** where the distance between the vehicle and the object in its path is re-determined. The processor subsystem **12** continues to take corrective action until it determines that the vehicle is no longer being operated in a hazardous manner. More specifically, the processor subsystem **12** will conclude that the hazardous condition has been corrected when it either: determines at step **66** that the distance separating the vehicle and the object is within the stopping distance for the vehicle, determines at step **68** that the vehicle brake is on or determines at step **70** that the speed of the vehicle is less than 35 mph. Upon making such a determination, the method proceeds to step **86** where the processor subsystem **12** deactivated the vehicle proximity alarm circuit **40** to turn off the flashing light.

The method of optimizing vehicle operation in accordance with the teachings of the present invention will now be described in greater detail. Returning now to step **58**, if the processor subsystem **12** determines that the vehicle is travelling slower than 50 mph, or if the processor subsystem **12** determines at step **66** that the distance separating the vehicle and the object is within the stopping distance for the vehicle or if the processor subsystem **12** determines at step **68** that the vehicle brake is on or if the processor subsystem **12** determines at step **70** that the speed of the vehicle is less than 35 mph, the method proceeds, after deactivation of the vehicle proximity alarm circuit **40**, to step **88** where the processor subsystem **12** determines if the road speed of the vehicle is changing. To do so, the processor subsystem **12** compares the speed of the vehicle maintained in the first register **14*a*** to the speed of the vehicle maintained in the second register **14*b***.

If the vehicle speed maintained in the first register **14*a*** is greater than the vehicle speed maintained in the second register **14*b***, the vehicle is accelerating. If so, the method continues to step **90** where the processor subsystem **12** determines if the throttle position is increasing. To do so, the processor subsystem **12** compares the throttle level, i.e., the extent to which the throttled is opened, maintained in the first register **14*a*** to the throttle level maintained in the second register **14*b***. If the throttle position has not increased, the processor subsystem **12** determines that, since the vehicle is accelerating but fuel consumption is not increasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the processor subsystem **12** determines at step **90** that the throttle position has increased, the method proceeds to step **92** where the processor subsystem **12** determines if the manifold pressure level maintained in the first register **14*a*** has exceeded the manifold pressure set point for the vehicle. If the vehicle's road speed and throttle position are increasing and the manifold pressure for the vehicle is at or below the manifold pressure set point, the processor subsystem **12** proceeds to step **93** where the sensors **18**, **20**, **22**, **24**, **30** and **32** are again polled and on to step **94** where the processor subsystem **12** compares the engine speed level maintained in the first register **14*a*** to the RPM set point stored in the memory subsystem **14** to determine if the engine speed has reached the RPM set point. If the engine speed has not reached the RPM set point, the method returns to step **93** where the sensors **18**, **20**, **22**, **24**, **30** and **32** are repeatedly polled until the processor subsystem **12** determines that the engine speed has reached the RPM set point. Once the engine speed has reached the RPM set point, the processor subsystem **12** determines that the vehicle needs to be upshifted and, proceeding to step **95**, the processor subsystem **12** will activate the upshift notification circuit **34** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, an upshift should be performed. The method then returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

Returning to step **92**, if the vehicle's road speed and throttle position are increasing and the manifold pressure for the vehicle is above the manifold pressure set point, the processor subsystem **12** determines that too much fuel is being provided to the engine and proceeding to step **96**, the processor subsystem **12** will activate the overinjection notification circuit **38** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced. The method then returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

Returning to step **88**, if the processor subsystem **12** determines, when comparing the speed of the vehicle maintained in the first register **14*a*** to the speed of the vehicle maintained in the second register **14*b***, that the speed of the vehicle is decreasing, the method proceeds to step **98** where the processor subsystem **12** determines if the throttle position is changing. To do so, the processor subsystem **12** compares the throttle level, i.e., the extent to which the throttled is opened, maintained in the first register **14*a*** to the throttle level maintained in the second register **14*b***. If the throttle position has either remained constant or decreased, the processor subsystem **12** determines that, since fuel consumption is either constant or reduced, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the processor subsystem **12** determines at step **98** that the throttle position has increased, the method proceeds to step **100** where the processor subsystem **12** determines if the manifold pressure is increasing. To do so, the processor subsystem **12** compares the manifold pressure level maintained in the first register **14*a*** to the manifold pressure level maintained in the second register **14*b***. If the manifold pressure level maintained in the first register **14*a*** is less than the manifold pressure level maintained in the second register **14*b***, the processor subsystem **12** determines that, since manifold pressure is decreasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the manifold pressure level maintained in the first register **14*a*** is greater than the manifold pressure level maintained in the second register **14*b***, the processor subsystem **12** determines that the manifold pressure for the vehicle is increasing and the method proceeds to step **102** where the processor subsystem **12** determines if the engine speed is increasing. To do so, the processor subsystem **12** compares the engine speed level maintained in the first register **14*a*** to the engine speed level maintained in the second register **14*b***. If the engine speed level maintained in the first register **14*a*** is less than the engine speed level maintained in the second register **14*b***, the processor subsystem **12** determines that, since engine speed is increasing, no modification of vehicle operation is necessary. Accordingly, the method returns to step **54** for a next polling of the sensors **18**, **20**, **22 24**, **30** and **32**.

If, however, the engine speed level maintained in the first register **14*a*** is less than the engine speed level maintained in the second register **14*b***, the processor subsystem **12** determines that, since the manifold pressure is increasing while the engine speed is decreasing, too much fuel is being supplied to the engine. Accordingly, at step **104**, the processor subsystem **12** activates the overinjection notification circuit **38** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced.

Proceeding on to step **106**, the sensors **18, 20, 22 24, 30** and **32** are again polled and, at step **108**, the processor subsystem **12** determines if the engine speed is decreasing, again by comparing the engine speed level maintained in the first and second registers **14***a* and **14***b*. If the engine speed has not decreased, the method returns to step **104** where the processor subsystem **12** again activates the overinjection notification circuit **38** to issue another audible alert notifying the driver that, in order to optimize vehicle operation, the amount of fuel being supplied to the engine should be reduced. Thus, the driver will be repeatedly notified of the overinjection condition until the processor subsystem **12** determines, at step **108**, that the engine speed is decreasing. The method will then proceed to step **110** where, since the processor subsystem **12** has determined that, since the engine speed is decreasing, the vehicle should be downshifted. Accordingly, at step **110**, the processor subsystem **12** activates the downshift notification circuit **36** to issue an audible alert for a selected time period, for example, 6 seconds, thereby notifying the driver that, in order to optimize vehicle operation, the vehicle should be downshifted. The method then returns to step **54** for a next polling of the sensors **18, 20, 22 24, 30** and **32**. The method will repeatedly loop through the aforementioned process to continuously determine if the vehicle is being operated unsafely, take appropriate corrective action and to provide notifications to the driver as to how operation of the vehicle may be optimized until the processor subsystem **12** is powered down or the vehicle is turned off.

Thus, there has been described and illustrated herein, an apparatus for optimizing vehicle operation which combines both operator notifications of recommended corrections in vehicle operation with automatic modification of vehicle operation under certain circumstances. By incorporating the disclosed apparatus in a vehicle, not only will certain hazardous operations of the vehicle be prevented but also the driver will be advised of certain actions which will enable the vehicle to be operated with greater fuel efficiency. However, those skilled in the art will recognize that many modifications and variations besides those specifically mentioned herein may be made without departing substantially from the concept of the present invention. Accordingly, it should be clearly understood that the form of the invention described herein is exemplary only and is not intended as a limitation on the scope of the invention.

What is claimed is:

1. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.

2. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing; and

means for comparing manifold pressure to said manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.

3. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said fuel overinjection circuit further comprises a horn for issuing a tone for a preselected time period.

4. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

5. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point; and

means for comparing engine speed to said RPM set point;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.

6. Apparatus for optimizing operation of a vehicle according to claim **1** wherein said upshift notification circuit further comprises a horn for issuing a tone for a preselected time period.

7. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.

8. Apparatus for optimizing operation of a vehicle according to claim **7** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing; and

means for comparing manifold pressure to said manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.

9. Apparatus for optimizing operation of a vehicle according to claim **7** wherein said fuel overinjection circuit further comprises a horn for issuing a tone for a preselected time period.

10. Apparatus for optimizing operation of a vehicle according to claim **7** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

11. Apparatus for optimizing operation of a vehicle according to claim **10** wherein said downshift notification circuit further comprises a horn for issuing a tone for a preselected time period.

12. Apparatus for optimizing operation of a vehicle according to claim **7** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

13. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an engine speed set point and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit, said upshift notification circuit and said downshift notification circuit.

14. Apparatus for optimizing operation of a vehicle according to claim **13** wherein:

said fuel overinjection circuit further comprises a first horn for issuing a first tone for a first preselected time period;

said upshift notification circuit further comprises a second horn for issuing a second tone for a second preselected time period; and

said downshift notification circuit further comprises a third horn for issuing a third tone for a third preselected time period.

15. Apparatus for optimizing vehicle performance according to claim **13** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing or decreasing

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point;

means for comparing engine speed to said RPM set point;

means for determining when manifold pressure is increasing; and

means for determining when engine speed is increasing or decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point; and

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

16. Apparatus for optimizing operation of a vehicle according to claim **15** wherein:

said fuel overinjection circuit further comprises a first horn for issuing a first tone for a first preselected time period;

said upshift notification circuit further comprises a second horn for issuing a second tone for a second preselected time period; and

said downshift notification circuit further comprises a third horn for issuing a third tone for a third preselected time period.

17. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor, a manifold pressure sensor, a throttle position sensor and an engine speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, a present level for each one of said at least one sensor and a prior level for each one of said at least one sensor;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

a fuel overinjection circuit coupled to said processor subsystem, said fuel overinjection circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit, when to activate said fuel overinjection circuit, and when to activate said upshift notification circuit.

18. Apparatus for optimizing operation of a vehicle according to claim **17** wherein:

said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and

said memory subsystem further storing a second vehicle speed/stopping distance table.

19. Apparatus for optimizing operation of a vehicle according to claim **17** and further comprising:

a throttle controller for controlling a throttle of said engine of said vehicle; and

said processor subsystem selectively reducing said throttle based upon data received from said radar detector, said at least one sensor and said memory subsystem.

20. Apparatus for optimizing operation of a vehicle according to claim **19** wherein said at least one sensor further includes a brake sensor for indicating whether a brake system of said vehicle is activated.

21. Apparatus for optimizing operation of a vehicle according to claim **19** wherein said processor subsystem further comprises:

means for counting a total number of vehicle proximity alarms determined by said processor subsystem;

means for selectively reducing said throttle based upon said total number of vehicle proximity alarms.

22. Apparatus for optimizing operation of a vehicle according to claim **17** and further comprising:

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said downshift notification circuit.

23. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

24. Apparatus for optimizing operation of a vehicle according to claim **23** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing or decreasing;

means for determining when throttle position for said vehicle is increasing or decreasing; and

means for comparing manifold pressure to said manifold pressure set point;

means for determining when manifold pressure for said vehicle is increasing or decreasing; and

means for determining when engine speed for said vehicle is increasing or decreasing;

said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point or if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.

25. Apparatus for optimizing operation of a vehicle according to claim **23** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is increasing;

means for determining when throttle position for said vehicle is increasing;

means for comparing manifold pressure to said manifold pressure set point; and

means for comparing engine speed to said RPM set point;

said processor subsystem activating said upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.

26. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, and engine speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to said radar detector and each one of said plurality of sensors, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a first vehicle speed/stopping distance table, a manifold pressure set point, RPM set point, and present and prior levels for each one of said plurality of sensors;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed;

said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining, based upon data received from said radar detector, said at least one sensor and said memory subsystem, when to activate said vehicle proximity alarm circuit.

27. Apparatus for optimizing operation of a vehicle according to claim **26** wherein said processor subsystem further comprises:

means for determining when road speed for said vehicle is decreasing;

means for determining when throttle position for said vehicle is increasing;

means for determining when manifold pressure for said vehicle is increasing; and

means for determining when engine speed for said vehicle is decreasing;

said processor subsystem activating said downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.

28. Apparatus for optimizing operation of a vehicle, comprising:

a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;

a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;

a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

said processor subsystem determining whether to activate said fuel overinjection notification sensor based upon data received from said road speed sensor, said throttle position sensor and said manifold pressure sensor.

29. Apparatus according to claim **28** and further comprising:

a memory subsystem, coupled to said processor subsystem, said memory subsystem maintaining a manifold pressure set point;

said processor subsystem activating said fuel overinjection notification circuit upon determining that:

(1) based upon data received from said road speed sensor, road speed of said vehicle is increasing;

(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing; and

(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle exceeds said manifold pressure set point.

30. Apparatus according to claim **28**, wherein:

said plurality of sensors coupled to said vehicle further include an engine speed sensor;

said processor subsystem activating said fuel overinjection notification circuit upon determining that:

(1) based upon data received from said road speed sensor, road speed of said vehicle is decreasing;

(2) based upon data received from said throttle position sensor, throttle position for said vehicle is increasing;

(3) based upon data received from said manifold pressure sensor, manifold pressure for said vehicle is increasing; and

(4) based upon data received from said engine speed sensor, engine speed for said vehicle is decreasing.

31. Apparatus for optimizing operation of a vehicle, comprising:

a radar detector, said radar detector determining a distance separating a vehicle having an engine and an object in front of said vehicle;

at least one sensor coupled to said vehicle for monitoring operation thereof, said at least one sensor including a road speed sensor;

a processor subsystem, coupled to said radar detector and said at least one sensor, to receive data therefrom;

a memory subsystem, coupled to said processor subsystem, said memory subsystem storing a first vehicle speed/stopping distance table;

a vehicle proximity alarm circuit coupled to said processor subsystem, said vehicle proximity alarm circuit issuing an alarm that said vehicle is too close to said object;

said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon separation distance data received from said radar detector, vehicle speed data received from said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem.

32. Apparatus for optimizing operation of a vehicle according to claim **31** wherein:

said at least one sensor further includes a windshield wiper sensor for indicating whether a windshield wiper of said vehicle is activated; and

said memory subsystem further storing a second vehicle speed/stopping distance table;

if said windshield wiper sensor indicates that said windshield wiper is deactivated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said first vehicle speed/stopping distance table stored in said memory subsystem;

if said windshield wiper sensor indicates that said windshield wiper is activated, said processor subsystem determining whether to activate said vehicle proximity alarm circuit based upon data received from said radar detector, said road speed sensor and said second vehicle speed/stopping distance table stored in said memory subsystem.

* * * * *

EXHIBIT 3

United States Patent [19]

Chasteen

[11] **Patent Number: 4,901,701**

[45] **Date of Patent: Feb. 20, 1990**

[54] **TWO-CYCLE ENGINE WITH ELECTRONIC FUEL INJECTION**

[75] Inventor: **Ronald E. Chasteen,** Lakeside, Ariz.

[73] Assignee: **Injection Research Specialists, Inc.,** Colorado Springs, Colo.

[21] Appl. No.: **345,081**

[22] Filed: **Apr. 28, 1989**

Related U.S. Application Data

[63] Continuation of Ser. No. 119,626, Nov. 12, 1987, abandoned.

[51] **Int. Cl.**[4] **F02M 7/00;** G05D 23/00

[52] **U.S. Cl.** **123/478;** 364/557; 236/DIG. 8

[58] **Field of Search** .... 123/478, 480, 73 A, 123/65 BA, 383, 502, 440, 492, 489; 364/186, 550, 557, 510, 555.01; 236/DIG. 8

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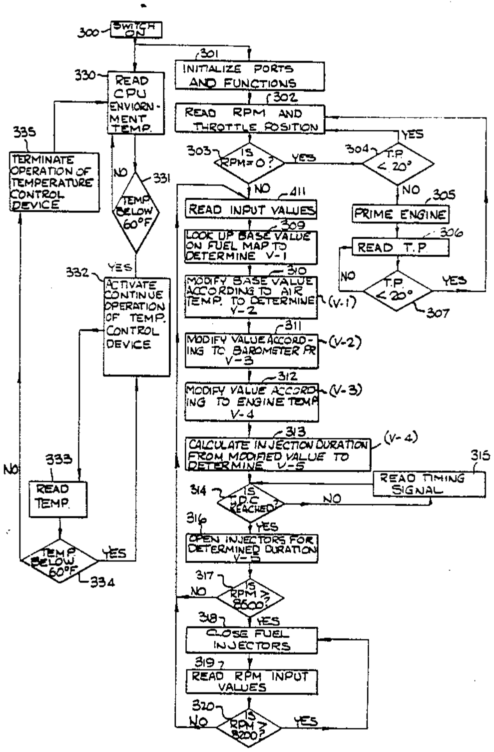
Primary Examiner—Raymond A. Nelli
Attorney, Agent, or Firm—Bruce G. Klaas; William P. O'Meara

[57] **ABSTRACT**

A fuel injection system for a two-stroke cycle engine comprising an air manifold; a throttle valve; a fuel injector; a fuel supply system including a fuel pump; a battery voltage sensor; an air temperature sensor; an engine speed sensor; a timing sensor; a barometric pressure sensor; a throttle position sensor; a first data processor for receiving and processing sensing signals for determining fuel injector duration and timing and fuel pump operating speed; a first data processor temperature sensor for sensing the relative temperature of certain electronic components in the first data processor; a heater operatively associated with the first data processor electronic components for selectively heating the electronic components; and a second data processor operable independently of the first data processor for receiving an electronic component temperature sensing signal and for generating a control signal to the heater responsive thereto for heating the components when the temperature thereof is below a predetermined minimum value.

1 Claim, 5 Drawing Sheets



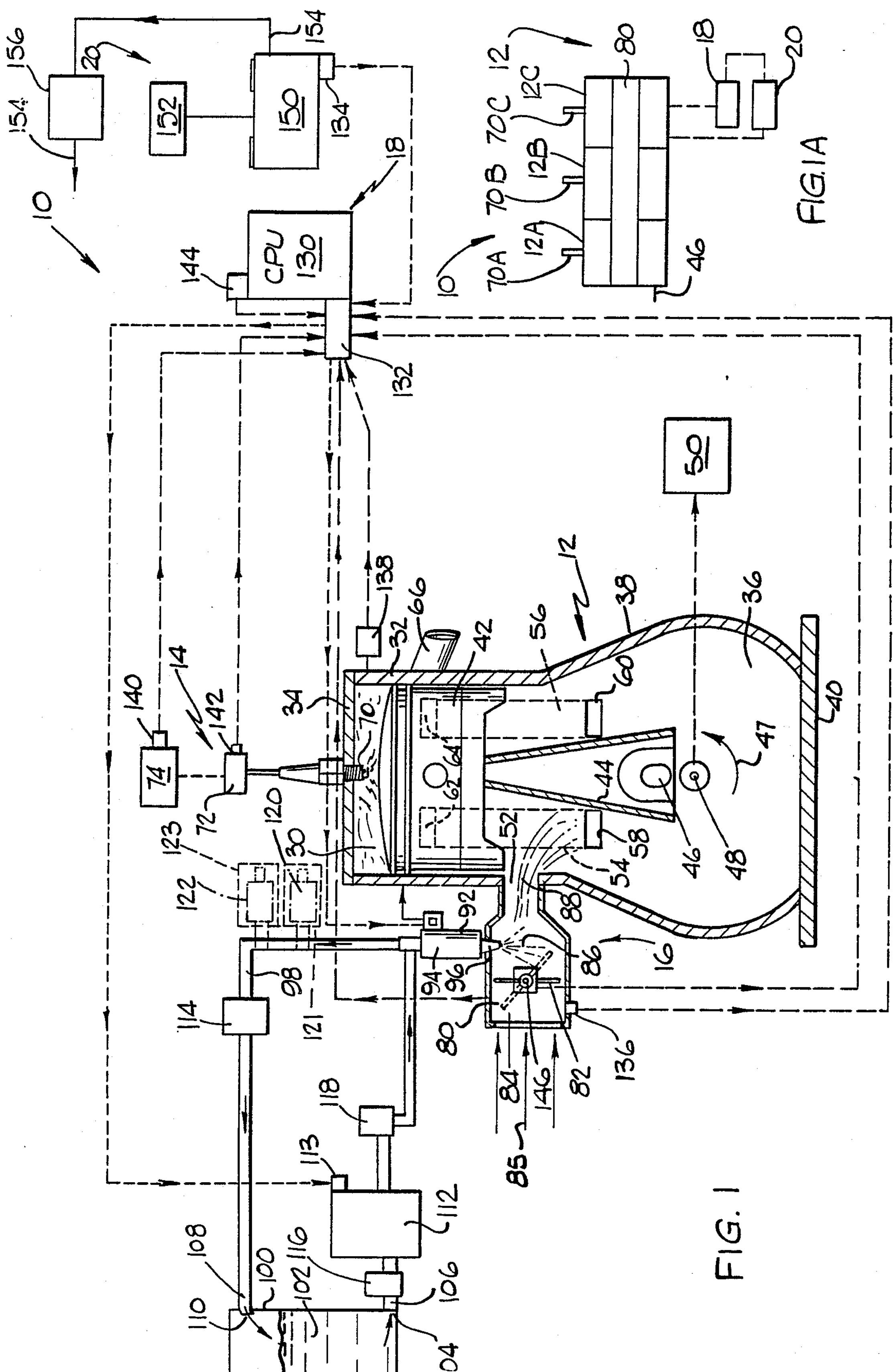
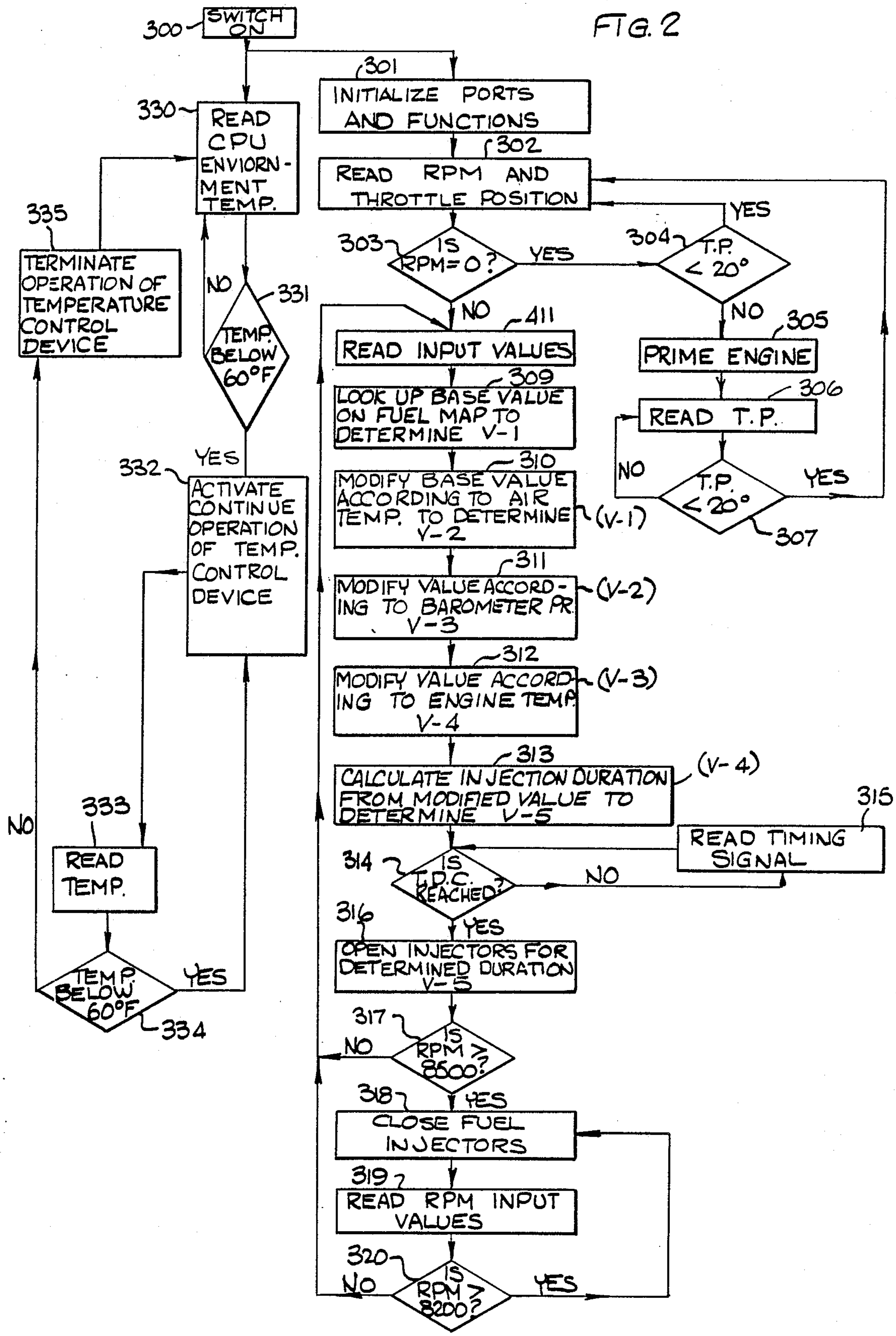


FIG. 1

FIG. 1A

FIG. 2



300 SWITCH ON
301 INITIALIZE PORTS AND FUNCTIONS
302 READ RPM AND THROTTLE POSITION
303 IS RPM=0?
YES
NO
304 T.P. < 20°
YES
NO
305 PRIME ENGINE
306 READ T.P.
307 T.P. < 20°
YES
NO
411 READ INPUT VALUES
309 LOOK UP BASE VALUE ON FUEL MAP TO DETERMINE V-1
310 MODIFY BASE VALUE ACCORDING TO AIR TEMP. TO DETERMINE V-2
(V-1)
311 MODIFY VALUE ACCORDING TO BAROMETER PR. V-3
(V-2)
312 MODIFY VALUE ACCORDING TO ENGINE TEMP. V-4
(V-3)
313 CALCULATE INJECTION DURATION FROM MODIFIED VALUE TO DETERMINE V-5
(V-4)
315 READ TIMING SIGNAL
314 IS T.D.C. REACHED?
NO
YES
316 OPEN INJECTORS FOR DETERMINED DURATION V-5
317 IS RPM > 8500?
NO
YES
318 CLOSE FUEL INJECTORS
319 READ RPM INPUT VALUES
320 IS RPM > 8200?
NO
YES
330 READ CPU ENVIORNMENT TEMP.
331 TEMP. BELOW 60°F
NO
YES
332 ACTIVATE CONTINUE OPERATION OF TEMP. CONTROL DEVICE
335 TERMINATE OPERATION OF TEMPERATURE CONTROL DEVICE
333 READ TEMP.
334 TEMP. BELOW 60°F
YES
NO

FIG. 3

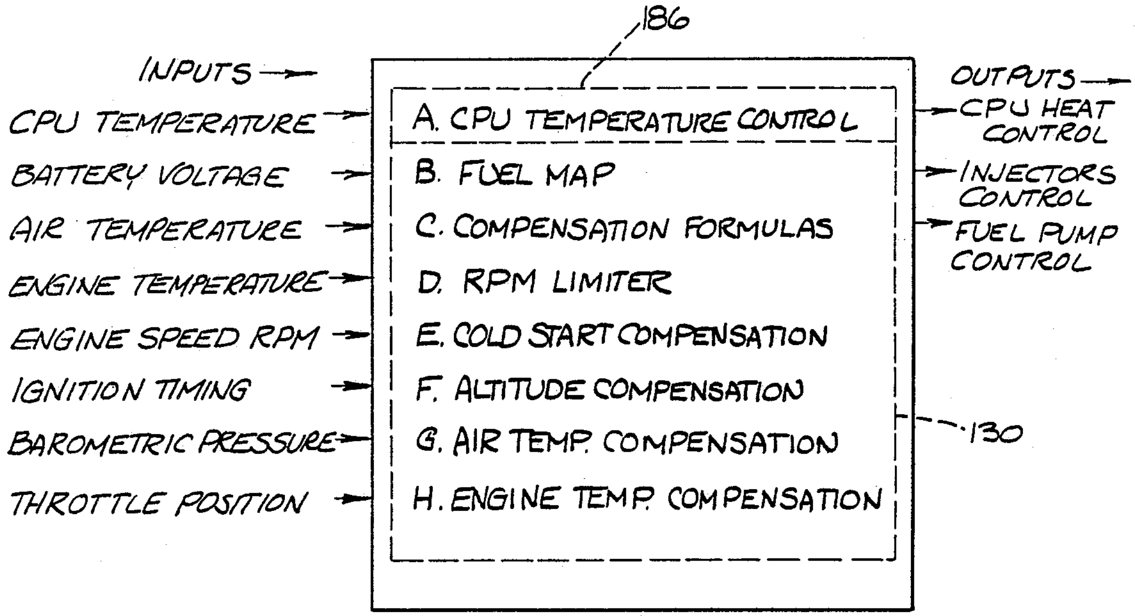
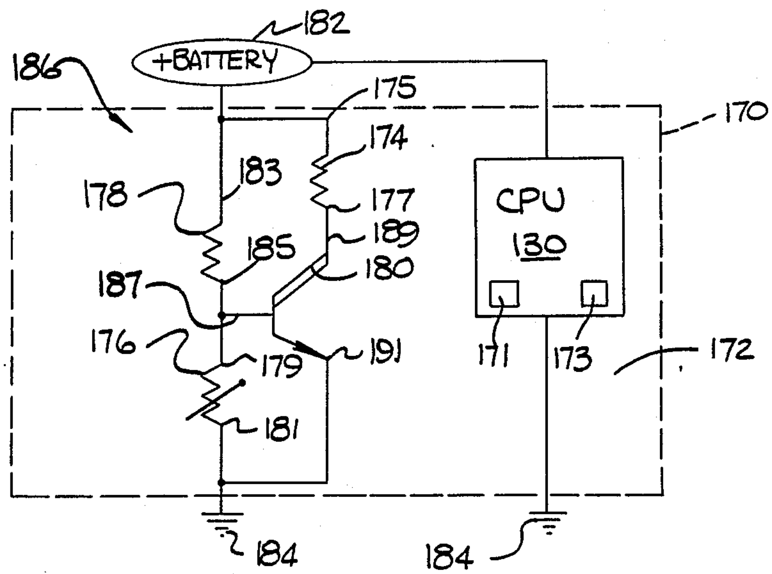

186
INPUTS
CPU TEMPERATURE
BATTERY VOLTAGE
AIR TEMPERATURE
ENGINE TEMPERATURE
ENGINE SPEED RPM
IGNITION TIMING
BAROMETRIC PRESSURE
THROTTLE POSITION
A. CPU TEMPERATURE CONTROL
B. FUEL MAP
C. COMPENSATION FORMULAS
D. RPM LIMITER
E. COLD START COMPENSATION
F. ALTITUDE COMPENSATION
G. AIR TEMP. COMPENSATION
H. ENGINE TEMP. COMPENSATION
OUTPUTS
CPU HEAT CONTROL
INJECTORS CONTROL
FUEL PUMP CONTROL
130

FIG. 4

THROTTLE POSITION NUMBER	0	500	1000	1500	2000	3000	4000	5000	6000	7000	7500	8000	8500	9000	9500	10000
170	0	0	10	10	12	24	94	80	81	96	29	47	66	70	24	39
135	0	0	10	10	12	24	94	80	84	82	78	74	72	60	60	60
115	10	10	10	10	12	24	75	42	52	54	59	71	28	77	64	28
90	10	10	10	10	12	24	50	39	42	42	39	43	47	29	25	29
75	10	10	10	10	12	24	50	29	61	74	64	56	50	40	30	25
61	10	10	10	10	12	24	45	37	54	61	51	42	36	30	20	15
52	10	10	10	10	12	20	24	16	43	58	50	40	32	25	15	10
44	10	10	10	10	12	16	24	14	41	50	40	30	22	15	10	5
37	10	10	10	10	12	15	20	12	30	40	30	20	12	6	3	2
31	10	10	10	10	12	13	15	10	20	30	20	10	2	-	-	-
25	10	10	10	10	12	13	8	4	10	20	10	6	-	-	-	-
20	10	10	10	10	10	10	6	2	6	10	5	2	-	-	-	-
16	7	7	7	6	6	10	2	-	-	-	-	-	-	-	-	-
13	5	5	5	5	4	10	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	6	10	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-

RPM

FIG. 5



+BATTERY
182
186
175
170
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CPU
130
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172
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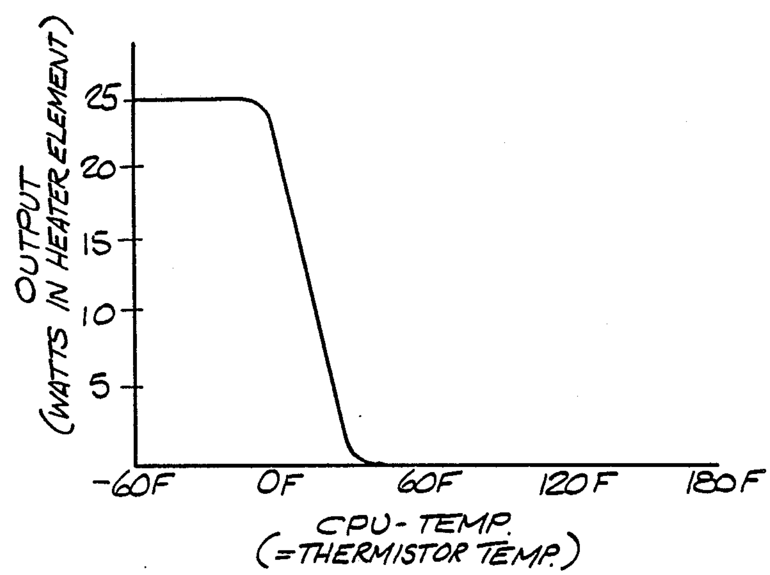
184
184



OUTPUT
(WATTS IN HEATER ELEMENT)
25
20
15
10
5
-60F
0F
60F
120F
180F
CPU-TEMP.
(=THERMISTOR TEMP.)

FIG. 6

TWO-CYCLE ENGINE WITH ELECTRONIC FUEL INJECTION

The present application is a continuation of U.S. patent application Ser. No. 119,626 filed Nov. 12, 1987.

BACKGROUND OF THE INVENTION

The present invention relates generally to two-stroke operating cycle engines and, more particularly, to a two-stroke engine fuel injection system and control system therefor which are adapted for extreme weather conditions.

Two-stroke operating cycle engines (two-cycle engines), although less fuel-efficient than four-stroke operating cycle engines (four-cycle engines), are capable of developing greater horsepower and torque than a comparably-sized four-cycle engine. This feature has led to the use of two-cycle engines in many environments in which operating efficiency is secondary to torque and weight considerations.

Electronically-controlled fuel injection is widely used in four-cycle engines. In electronic fuel injection used in four-cycle engines, sensor readings associated with various engine operating parameters are used to calculate an optimum fuel/air mixture for the engine. Fuel is then injected directly into the engine's cylinders in the proper amount based upon this electronically determined fuel/air mixture. In some four-cycle engine fuel injection systems, the fuel is injected into an air plenum upstream of the cylinder and is subsequently allowed to enter the cylinder with the plenum air through operation of an intake valve. Electronic fuel injection systems have replaced conventional carburetors in many four-cycle engines, especially in the automotive industry. However, fuel injection is not in general use with two-cycle engines and has not heretofore been used with small-displacement two-cycle engines which are used under severe cold weather conditions, for a number of reasons. Small two-cycle engines are used in association with equipment that is relatively inexpensive as compared to automobiles and other machines with which electronic fuel injection has been widely used in the past. In relatively large, expensive machinery, the cost associated with modifying basic engine components to enable internal mounting of various engine parameter sensors may be justified by increased fuel savings and engine performance and may amount to a relatively small portion of the purchase price of such an automobile, etc. In smaller engine environments, the cost of internal engine modification to existing engine assemblies would, in most cases, far outweigh any fuel savings which might be achieved by an electronic fuel injection unit and would represent a substantial increase in the cost of the associated small machine, e.g. snowmobile, dirt bike, etc., powered by the two-cycle engine.

Fuel injection systems without electronic controls have been used on two-cycle engines, but have not been satisfactory on small-displacement, small-mass two-cycle engines. The reason that fuel injection without electronic control has not been used successfully in small two-cycle engines is that such engines lack flywheels and other high-mass rotating components which tend to stabilize engine operation. Dueto this lack of a large rotating mass in such engines, even a short duration mismatch between the rate at which fuel is actually delivered to the engine and the optimum engine fuel rate requirements will cause engine sputter or rapid deceleration and stalling. Small, two-cycle engines are especially subject to malfunction under variable operating conditions such as changes in sea level, with associated barometric changes and changes in ambient air temperature. Many machines such as snowmobiles, snowblowers, dirt bikes, etc., are operated in such widely variable operating conditions. In view of the costs associated with engine modification for sensors' need for electronic control of fuel injectors and in view of the fact that the engine parameters which are critical to control of fuel injectors for two-cycle engines were not, prior to the present invention, understood in the art, a successful electronically-controlled fuel injection system for small, two-cycle engines which are subject to extremes in operating conditions has not been developed in the prior art.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide an electronic fuel injection system for a two-cycle engine which requires no internal modification to the basic engine assembly.

It is another object of the present invention to provide an electronic fuel injection control system which may be readily adapted for use with any conventional two-stroke cycle engine assembly.

It is another object of the present invention to provide a relatively small two-stroke cycle engine with electronic fuel injection which is capable of operation under variable and extreme conditions of air temperature and under widely varying barometric pressure conditions.

It is another object of the present invention to provide a fuel injection system for a two-cycle engine in which fuel injection takes place in an air manifold.

It is another object of the present invention to provide a fuel injection and control system for a two-cycle engine in which all fuel injectors simultaneously inject fuel into portions of an air manifold which are associated with individual cylinder/crankcases.

It is another object of the present invention to provide a control system for a electronic fuel injection system which utilizes relatively inexpensive electronic components and which is not subject to electronic component malfunction associated with low-temperature operation.

It is another object of the present invention to provide an electronic fuel injection system for a two-cycle engine which includes an electronically-stored fuel map indicative of the optimum fuel requirements for the engine under standard operating conditions over variable engine speed conditions and variable throttle conditions.

It is another object of the present invention to provide an electronic fuel injection system which provides a selected set of operating condition sensor inputs which do not require internal engine unit modifications and which provide optimized engine performance.

SUMMARY OF THE INVENTION

The present invention is directed to an electronic fuel injection system for a small two-cycle engine. One aspect of the invention is a temperature control assembly which is operably associated with an electronic central processing unit of the type having electronic components which are subject to malfunction under low temperature conditions. The electronic components of the heating assembly are not subject to malfunction under low temperature conditions and are designed to produce a heating response which is inversely proportional to temperature below a predetermined threshold temperature. The heating assembly is preferably mounted within a relatively small enclosure which also houses the electronic control system central processing unit. The heating assembly senses the temperature within the relatively small enclosure and rapidly heats electronic components within the relatively small enclosure to a predetermined temperature in response to sensing an environmental temperature within the enclosure which is below the predetermined temperature. The heating system may be actuated at the same time the electronic control system is actuated such as by the turning of the ignition switch of an associated machine, such as a snowmobile, etc.

Another feature of the present invention is th provision of an electronically-controlled fuel injection system which has a plurality of sensor inputs which are limited to the sensor inputs which are critical to the operation of a two-cycle engine and which may be mounted externally of a main engine assembly comprising a cylinder crankcase, piston, and crankshaft exclusive of the carburetion/fuel injection system therefor. The electronically-controlled fuel injection system of the present invention may thus be used without modification of existing two-cycle engine assemblies and is controlled by a CPU which may include a programmable memory device such as an EPROM which may be selectively programmed for any particular engine assembly with which the electronic fuel injection system is to be used. Another feature of the invention is the injection of fuel from a fuel injector into a portion of an air manifold which is in direct fluid communication with the crankcase portion of each individual cylinder/-crankcase assembly. This injection of fuel into a manifold upstream of a crankcase provides mixing of a precise amount of fuel and air prior to entry of fuel into the crankcase and also enables all fuel injectors to be opened and closed simultaneously, rather than being timed to the operation of each associated piston.

Thus, the present invention may comprise a control system for controlling the operation of a machine designed to be operated in a relatively broad air temperature, comprising: (a) at least one performance variable sensing means for sensing the present state of a preselected variable associated with machine performance and for generating a performance variable sensing signal indicative of said present state of said preselected performance variable; (b) a first data processing means for receiving and processing said performance variable sensing signal and for generating a control signal based upon the processing of said sensing signal for controlling at least one operating parameter of said machine; said data processing means comprising at least one temperature-sensitive electronic circuit component which is subject to malfunction below a predetermined malfunction temperature which is within said relatively broad operating temperature range of said machine; (c) component environment temperature sensing means for sensing the temperature within the immediate operating environment of said temperature-sensitive electronic circuit component and for generating a temperature signal representative of the sensed temperature; (d) a second data processing means which operates independently of said first data processing means and which is not subject to temperature-related malfunction within said operating temperature range of s id machine for processing said signal from said component environment temperature sensing means and generating a heating control signal responsive thereto when the temperature in said electronic circuit environment is sensed to be below said predetermined malfunction temperature; (e) heating means responsive to said heating control signal for heating said temperature sensitive electronic component environment in response to said control signal; (f) power supply means for providing electric energy for operating said control system; (g) switch means for selectively operably electrically connecting or disconnecting said energy supply means and electrically operated components of said control system.

The present invention may also comprise a fuel injection system for a two-stroke cycle engine of the type comprising at least one cylinder, a crankcase associated with said cylinder, a piston reciprocally mounted in said cylinder and crankcase; a reciprocally openable and closable crankcase inlet for enabling combustible fluid to be drawn into the crankcase, a reciprocally openable and closable transfer port for transferring combustible fluid compressed in said crankcase to said cylinder, an ignition system for igniting compressed combustible fluid in said cylinder, a reciprocally openable and closable exhaust port in said cylinder for enabling exhaust of burned combustible fluid from said cylinder, a crankshaft connected to said piston for transferring mechanical energy from said piston to a drive unit, and an electrical energy supply source including a battery for operating the ignition system and other electrical components, comprising: (a) air manifold means operably associated with said crankcase inlet; (b) throttle valve means operably positioned in said air manifold means for controlling airflow into said crankcase inlet, said throttle valve means dividing said manifold means into an upstream portion positioned remote from said crankcase inlet and a downstream portion positioned contiguously with said crankcase inlet; (c) fuel injection means for injecting a fine spray of fuel into said downstream portion of said manifold means whereby a mixture of air and fuel is provided in said downstream portion of said manifold means which is subsequently drawn into said crankcase through said crankcase inlet; (d) fuel supply means for supplying fuel to said fuel injection means comprising: (i) fuel reservoir means for holding a volume of fuel therein and having a reservoir inlet and a reservoir outlet; (ii) fuel circulation conduit means for transferring fuel from said fuel reservoir to said fuel injection means comprising a first end inlet in fluid communication with said fuel reservoir outlet, a second end outlet in fluid communication with said fuel reservoir inlet and an intermediately positioned fuel injection outlet positioned in fluid communication with said fuel injection means; (iii) fuel pump means operatively associated with circulation conduit means at a position thereon between said conduit means first end inlet and said conduit means fuel injector outlet for pumping fuel through said circulating conduit; (iv) pressure limiting regulator means operatively associated with said circulation conduit means at a position thereon between said conduit means fuel injector outlet and said conduit means second end outlet for preventing pressure in said conduit means from exceeding a predetermined maximum pressure; (e) battery voltage sensing means for sensing battery voltage and for providing a battery voltage sensing signal representative thereof; (f) air temperature sensing means for sensing the temperature of air in said upstream portion of said manifold means and for providing an air temperature signal representative thereof; (g) engine speed sensing means for sensing the speed of revolution of said engine and for providing an engine speed signal representative thereof; (h) timing sensing means for sensing each occurrence of a predetermined cyclically repeating state of said engine and for providing a timing signal indicative thereof; (i) barometric pressure sensing means for sensing atmospheric air pressure and for generating a barometric pressure sensing signal representative thereof; (j) throttle position sensing means for sensing the relative amount of opening of said throttle valve means and for generating a throttle position signal representative thereof; (k) first data processing means for receiving and processing said sensing signals comprising: (i) means for processing said engine speed sensing signal and said throttle position sensing signal and for generating a priming control signal to said fuel injection means for selectively injecting or not injecting fuel into said manifold means based on said engine speed signal and said throttle position signal; (ii) means for receiving and processing said engine speed signal and throttle position signal for determining a base fuel injection value; (iii) means for receiving and processing said air temperature signal and calculating an air temperature modification value of said base fuel injection value; (iv) means for receiving and processing said barometric pressure sensing signal for calculating a barometric pressure modification value of said base fuel injection value; (v) means for receiving and processing said engine temperature signal for calculating an engine temperature modification value of said base fuel injection value; (vi) means for determining a total fuel injection value representative of the total fuel amount which is to be injected by said fuel injection means during a single two-stroke operating cycle of said piston from said base fuel injection value, said air temperature modification value, said barometric pressure modification value, and said engine temperature modification value; (vii) means for determining an injector open duration interval based on said total fuel injection value and a known fuel output rate capacity of said fuel injection means; (viii) means for generating a control signal for opening said injection means for said determined injector duration open interval at a predetermined point in time determined from said timing sensing signal; (ix) means for receiving and processing said engine speed signal for overridingly terminating fuel injection means operation in response to an engine speed sensing signal indicative of a predetermined maximum speed and for restoring fuel injection means operation in response to an engine speed sensing signal indicative of a predetermined restore operation speed lower than said predetermined maximum speed; (x) means for receiving and processing said engine speed sensing signal and for generating a pump control signal in response thereto for maintaining said pump at an optimum operating speed for providing said predetermined maximum operating pressure in said fuel circulation conduit means at said pump; (l) first data processing means temperature sensing means for sensing the relative temperature of certain electronic components in said first data processing means and providing a component temperature sensing signal indicative thereof; (m) heating means operative associated with said first data processing means electronic components for selectively heating said electronic components; (n) second data processing means operable independently of said first data processing means for receiving said electronic component temperature sensing signal and for generating a control signal to said heating means responsive to said component temperature sensing signal for heating said components when the temperature thereof is below a predetermined minimum value.

BRIEF DESCRIPTION OF THE DRAWING

An illustrative and presently preferred embodiment of the invention is shown in the accompanying drawing in which:

FIG. **1** is a schematic illustration of a two-stroke cycle engine with electronically-controlled fuel injection.

FIG. **1A** is a schematic illustration of the engine of FIG. **1** showing additional cylinder portions thereof.

FIG. **2** is a flow chart illustrating operations of the electronic control unit of the present invention including the operation of the central processing unit and also the operation of a central processing unit temperature control assembly.

FIG. **3** is a diagram illustrating sensor inputs and control signal outputs and basic functions performed by an electronic control unit.

FIG. **4** is a typical engine fuel map expressed in rectangular coordinates.

FIG. **5** is a schematic illustration of an electronic control unit for a fuel injection system.

FIG. **6** is a graph of heater output as a function of CPU temperature for a typical CPU temperature control assembly of the type illustrated in FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

A two-stroke engine unit **10** of the present invention is shown schematically in FIG. **1**. In general, the two-stroke cycle engine unit **10** comprises an engine assembly **12**, an ignition assembly **14**, a fuel/air input assembly **16**, an electronic control assembly **18** and an electrical power supply assembly **20**.

ENGINE ASSEMBLY

The engine assembly **12** illustrated in FIG. **1** is of a type which is conventional and well known in the art. The engine assembly comprises a cylinder cavity **30** which is generally referred to in the art simply as a cylinder. The cylinder cavity is defined by a cylindrical sidewall **32** and a circular top wall **34** which is fixedly attached to the sidewall **32**. The engine assembly also comprises a generally pear-shaped crankcase cavity **36** which is generally referred to in the art simply as a crankcase. The crankcase cavity is defined by a crankcase sidewall **38** which is fixedly connected at the upper portion thereof to a lower portion of cylindrical sidewall **32**. The crankcase wall is fixedly connected at a lower portion thereof to a base plate **40**. The cylindrical cavity **30** and crankcase cavity **36** thus provide the upper and lower portions of a continuous total engine cavity. A cylindrical piston **42** is slidingly mounted in cylindrical cavity **30** and is pivotally attached to a connecting rod **44** which is, in turn, pivotally attached to a portion of crankshaft **46** which rotates, as indicated at **47**, about a crankshaft central axis of rotation **48**. The reciprocal motion of piston **42** within cylinder **30** is transferred by connecting rod **44** and crankshaft **46** to a conventional drive assembly **50** of an associated machine such as, for example, a snowmobile **12**.

A fuel/air mixture which is sometimes referred to herein as combustion fluid or combustion material is drawn into the crankcase **36** through a combustion fluid inlet **52** sometimes referred to herein as an intake port **52**. The intake port **52** is positioned at an upper portion of crankcase **36** and is cyclically opened and closed by reciprocation of piston **42**. Transfer passages **54**, **56**, etc., having crankshaft transfer passage openings **58**, **60**, etc., and cylinder transfer port openings **62**, **64**, etc., enable transfer of compressed combustion fluid within the crankcase **36** to the cylinder **30**. The cylinder transfer passage openings **62**, **64**, etc., are cyclically opened and closed through reciprocal motion of piston **42**. A cylinder exhaust gas outlet **66** sometimes referred to herein as exhaust port **66** is provided in the cylinder sidewall **32** to discharge burned combustion fluid from cylinder **30**. Exhaust port **66** is also cyclically opened and closed by reciprocation of piston **42**. The engine assembly may comprise a plurality of cylinder/crankcase/piston assemblies identical to those described above which are operably connected to common crankshaft **46**.

The mechanical operation of the two-cycle engine assembly, in general, is as follows. During upward motion of piston **42**, crankcase intake port **52** is progressively opened and cylinder transfer passage openings **62**, **64** and cylinder exhaust port **66** ar progressively closed causing fuel/air mixture to be drawn into crankcase **3** through port **52** and causing fluid air mixture in cylinder **30** to be retained therein and progressively compressed. When the piston **42** reaches approximately its upward limit of motion or "top dead center" (T.D.C.), sparkplug **70** ignites the fuel/air mixture driving piston **42** downwardly. During the downward movement of the piston, cylinder exhaust port **66** is progressively opened, cylinder transfer port openings **62** and **64** are progressively opened and crankcase inlet **52** is progressively closed causing fuel/air mixture within the crankcase to be compressed and forced through the transfer passages **54**, **56** into cylinder **30**. The inflow of fresh fuel/air mixture into cylinder **30** is physically channeled into the cylinder in a manner to drive out burned exhaust gas within the cylinder out through exhaust port **66**. During the subsequent upward movement of the piston **42**, the abovedescribed cylinder fuel/air compression and crankcase fuel/air intake is again repeated, etc.

Ignition Assembly

Ignition assembly **14** comprises a conventional sparkplug mounted within cylinder **34** for igniting the fuel/air mix therein. Sparkplug **70** is conventionally connected to an ignition coil **72** which is, in turn, conventionally connected to an electrical power supply **20** and conventional timing apparatus **74** which may be conventionally linked to crankshaft **46**. In an engine assembly with a plurality of cylinder/crankcase/piston assemblies, each cylinder is provided with a spark plug.

Fuel Air Input Assembly

Fuel air input assembly **16** includes an air manifold **80** mounted in fluid communication with crankshaft intake port **52**. A throttle valve **82**, which in a preferred embodiment comprises a conventional butterfly valve, divides the air manifold **80** into an upstream portion **84** which is in fluid communication with atmospheric air **8** through conventional air filters, etc. (not shown) and a downstream manifold portion **86** which opens directly into crankcase **36**. In the case of a multiple cylinder engine, there may be a single manifold upstream portion and a plurality of downstream portions, one for each cylinder/crankcase. An electrically operated fuel injector **92** comprising a solenoid valve portion **94** and a gas jet nozzle portion **96** is mounted so as to discharge a gas spray into the downstream manifold portion **86** to produce a fuel/air mixture in the downstream manifold portion which is subsequently drawn into crankcase **36**. The fuel injector may be of a convention commercially available type such as Bosch 280150-007 available from the Robert Bosch Company, or NAPA 217514 available from Echlin, Inc., Branfort, Conn., 06405. The fuel injector **92** is connected at the solenoid valve end thereof to a fuel circulation conduit **98** which is in fluid communication with a fuel reservoir **102** in fuel tank **100**. The fuel circulation conduit comprises a conduit first end **104** connected to a fuel tank outlet **106** and a second end **108** connected to a fuel tank return inlet **110**. An electric fuel pump **112** is provided for pumping fuel, such as gasoline, through the conduit **98**. The electric fuel pump **112** is operably connected in fluid communication with the conduit at a point thereon between the fuel tank outlet **106** and the fuel injector **92**. Conventional speed control circuitry **113** is provided to control the relative pumping speed of the fuel pump in response to a signal from the electronic control assembly **18** as discussed in further detail below. The fuel pump is conventionally connected to the electrical power supply assembly **20** from which it draws its operating energy. A conventional mechanically operated pressure limiting regulator **114** is operatively mounted in the fuel circulation conduit at a point between the fuel injector **92** and the fuel tank return inlet **110**. Pressure regulator **114** prevents the fluid pressure in the circulating conduit from exceeding a predetermined maximum pressure which may be, e.g. 42 psia. A conventional coarse fuel filter **116** may be provided in the circulating conduit between fuel tank outlet **106** and fuel pump **112**. A conventional fine fuel filter **118** may be provided in the circulating conduit between the fuel pump and injector **92**. As shown in phantom in FIG. **1**, the above-described fuel system may be employed to provide fuel to further fuel injectors **120**, **122** which are attached in fluid communication with the circulating conduit between the first fuel injector **92** and the pressure regulator **114**. These fuel injectors **120**, **122** may be mounted in manifold assemblies which may be identical to manifold assembly **16** described above and which are in turn associated with ignition assemblies and cylinder/crankcase piston assemblies **121**, **123** which may be identical to those described above and which may be operably connected to a common electronic control assembly **18** and electrical power supply assembly **20**.

Electronic Control Assembly

Electronic control assembly **18** includes a central processing unit **130** described in further detail below which is operably connected to conventional interface circuitry **132** which may comprise conventional analog to digital (A/D) circuitry for converting analog sensor signal inputs to digital signal inputs and which may further comprise conventional digital to analog (D/A) interface circuitry used to convert digital CPU command signals to analog command signals which are used to control various engine operating components as described below.

The electronic control assembly comprises a number of sensors having sensor outputs which are provided to the CPU 130 through interface circuitry 132. These sensors may include a battery voltage sensor 134, an air temperature sensor 136, an engine temperature sensor 138, an engine speed sensor 140, an ignition timing sensor 142, a barometric pressure sensor 144, and a throttle position sensor 146. The battery voltage sensor may comprise a conventional sensor or current sensing circuit well-known in the art. The air temperature sensor 136 may comprise a T55101 NAPA sensor mounted in the engine manifold. The engine temperature sensor 138 is mounted on the cooling fins of an air-cooled engine or may comprise a TS 4000 NAPA mounted within the engine cooling water jacket of a liquid cooled engine. The engine speed sensor 140 may comprise a conventional electronic encoder mounted on the crankshaft or associate drive linkage. In such an engine speed sensor configuration, an engine speed value is determined by counting the number of encoder pulses occurring within a fixed time interval. This timing interval may be provided by an external clock pulse signal or a CPU internal clock signal. The ignition timing sensor 142 may comprise an electric signal sensor connected directly to the ignition coil 72 for sensing the time of ignition of each cylinder. In such an ignition timing sensor configuration, the CPU is programmed to respond to only one cylinder ignition pulse per engine revolution. Thus, for example, in a three cylinder engine, the CPU would respond to only the first ignition coil pulse in each three pulse set associated with a complete engine revolution. Similarly, the ignition timing sensor signal may be derived directly from encoder signal 140 simply through counting the number of encoder pulses which are associated with a single revolution of the engine and generating a timing pulse after the occurrence of such a predetermined number of encoder pulses.

Barometric pressure sensor 144 may be mounted in any convenient location where it is exposed to the atmosphere such as, for example, on the housing of the CPU 130. The barometric pressure sensor 144 may be any of a number of commercially available sensors such as a Motorola MPX 201. Throttle position 146 senses the relative amount of opening of the throttle butterfly valve 82 and may comprise a conventional potentiometer unit.

The CPU 130 receives and processes the signals from the various sensors described above and generates control signals which are used to control fuel pump speed, to maintain the speed of operation of the fuel pump at a rate which provides a pressure in the circulation conduit portion immediately downstream therefrom which is approximately equal to the preset maximum pressure of the pressure regulator 114. The CPU 130 also generates control signals which actuate the solenoid valve portion 94 of each fuel injector 92 to selectively open and close and injector to provide a proper amount of fuel injection into the manifold as determined by the CPU. The CPU 130 may also provide a number of other control functions a described in further detail below. The CPU 130, in a preferred embodiment of the invention, comprises a conventional microprocessor chip 171, FIG. 5, such as a Motorola 6502 and a conventional memory chip 173, FIG. 5, which may be a PROM or EPROM chip such as, for example, Motorola 2532.

The electronic control assembly may also comprise a CPU temperature control assembly. One embodiment of such a temperature control system is illustrated in FIG. 5 in which CPU 130 is mounted within a relatively small, e.g. 10 cubic inches, CPU protective enclosure box 170 which defines a local CPU environmental enclosure 172. The box 170 may be 2.5 inches×5 inches×0.75 inches. Also positioned within the CPU environment enclosure are a conventional heating coil 174 having terminals 175, 177, which may have a resistance of 50 ohms, and a conventional thermistor 176, which may be, e.g., an NTC 750 ohm thermistor. The heater element and thermistor are connected as shown in an electronic circuit containing a second resistor 178 having terminals 183, 185 and having a resistance of 10,000 ohms, and a Darlington transistor 180 having a gate terminal 187, a collector terminal 189, and an emitter terminal 191, which may be a Motorola 6668 which may have an amplification of 400%. The circuit containing the circuit elements 174, 176, 178, 180 is connected to the positive pole of a battery 182 and a ground (or negative pole of a battery) 184. The battery 182 may also be used to provide power for CPU 130. Battery 182 may be same or different from the battery 150 used to provide energy to the engine ignition system, etc. The voltage drop across 182, 184 may be, e.g., 5 volts. The characteristics of the particular circuit elements 174, 176, 178, 180 may be selected to provide a heating energy response to particular temperature conditions such as indicated in FIG. 6 for rapidly heating the CPU environment 172 to a predetermined maximum threshold value such as 60° F. It will thus be seen that the heating circuit indicated generally at 186 is adapted to maintain the CPU at a temperature which is above a predetermined low temperature, e.g. 60° F., below which certain components of the CPU are subject to a greatly increased probability of malfunction. It will of course be appreciated that this predetermined temperature may be chosen to have a value well above a temperature at which malfunction is probable. A heating circuit such as illustrated at FIG. 5 may be provided relatively inexpensively and thus eliminates the need for expensive CPU chips which are adapted to be operable under low temperature conditions. The heating circuit such as illustrated at FIG. 5 is adapted to be particularly effective under conditions associated with the usage of snowmobiles and other winter operated machines such as snowblowers, etc.

Electric Power Supply

The engine electric power supply 20 may comprise conventional power supply components such as a battery 150 which may be a conventional 12-volt battery and other power generating devices such as alternator or generator which are represented schematically at 152. Power to the electronic control assembly 18, fuel input assembly 16, and other electrically-operated components may be provided through conventional conductors 154 operably connected to a switching assembly 156 which may be a snowmobile ignition switch, etc.

An engine unit comprising multiple cylinder/crankcase/piston assemblies 12A, 12B, 12C in engine assembly 12 and comprising an ignition assembly with multiple spark plugs 70A, 70B, 70 with a common crankshaft 146 and a common electronic control assembly 18 and a common power supply 20 is shown in FIG. 1A.

Having thus described the overall construction and operation of the two-stroke cycle engine unit 10 in general, certain specific features of the electronic control assembly **18** will now be described in greater detail.

Control System Functions

The basic functional steps performed by the control assembly central processing unit **130** is illustrated in FIG. **2**. As illustrated at **300**, the control system becomes operational by switching the system on. In a typical use environment such as when the control system is used in associated with a snowmobile engine, step **300** would be performed by turning the snowmobile ignition switch to the "on" position. As illustrated at **301** switching the system on causes electrical energy to be provided to the CPU which initializes all ports and functions of the CPU. Next, the CPU reads the engine speed and throttle position which are indicated as RPM and T.P., respectively, in block **302**. Next, as indicated in blocks **303–307**, the CPU determines whether or not the engine is to be primed. The sequence of steps **302–307** comprises what will be referred to herein as a "cold start circuit". As indicated at **303**, the CPU determines from the reading taken at **302** whether or not the engine RPM is greater than 0. If engine RPM is greater than 0, the CPU next makes the determination from the throttle position reading of **302** whether or not the throttle position is greater than a predetermined amount, such as 20°, as indicated in block **304**. If throttle position is less than 20°, the CPU decision-making process returns to block **302**. If the throttle position is greater than the predetermined amount and RPM=0, the CPU provides a control command to the engine fuel injector(s) to prime the engine. In a preferred embodiment of the invention, an engine priming pulse of a predetermined fixed duration associated with a predetermined fixed amount of fuel, e.g. 100 milliliters per injector, is sent to each fuel injector in response to a prime engine command from the CPU. After an initial engine priming function indicated at **305** has been performed, the CPU again reads throttle position as indicated at **306**. After reading the throttle position, the CPU again determines whether or not the throttle position is greater than a predetermined amount such as 20°. If the throttle position is greater than 20°, then the CPU again returns to decision step **306** and repeats step **306**, **307** until the throttle position is less than 20°. In a typical operating environment, this would be the equivalent of waiting for an operator to release an opened throttle lever/pedal. Once the throttle position is reduced to below 20°, as indicated at block **307**, the CPU decision-making processing returns to block **302**, causing the cold circuit decision-making process of blocks **302–307** to be repeated until engine RPM is greater than 0. After engine RPM becomes greater than 0, the CPU reads all of the input values from the various sensors, as shown schematically in FIG. **3**.

Next, as indicated at **309**, the CPU determines a base fuel value from a "fuel map" and the engine speed input and the throttle position input. A fuel map is prepared and stored in permanent memory of the CPU based upon the operating characteristics of the particular engine which is being controlled. The fuel map is prepared and stored in permanent CPU memory in an initial production step before the CPU is used to control the engine. A typical fuel map is illustrated in FIG. **3** in which the horizontal axis is indicative of engine RPM value and the vertical axis, as indicated at the right-hand side of the fuel map, is indicative of throttle position. Throttle position may be expressed, for example, in angular degrees of throttle opening or may be expressed in assigned numbers relating, non-linearly, to throttle opening which enables a higher resolution of the fuel map in certain critical regions of an engine power curve. The data array shown in FIG. **3** indicates the optimum base fuel value in milliliters for an engine fuel injector single pulse under predetermined standard operating conditions for any given engine RPM and throttle position. For example, if the engine RPM is **6000** and the throttle position is **25**, the optimum base fuel value as indicated from the fuel map is 20 milliliters under standard operating conditions. It will, of course, be appreciated that the information provided in the fuel map may be stored in various electronic forms such as in algorithm form as well as look-up table form. It will also be appreciated that the resolution of the fuel map may be provided to conform with the resolution of the RP and throttle position sensing signals and with the resolution requirements of the control system.

The base fuel value from the fuel map (FIG. **4**) reading performed in block **309** and indicated as V-**1** is stored in CPU memory and is modified in steps **310–313** based upon the various input values read in block **308**. As indicated at block **310**, the base fuel value is first modified based on the air temperature input. At a predetermined operating temperature, e.g. standard operation conditions of 70° F., no modification is performed. If the temperature is above or below this predetermined value, then the base fuel value is modified accordingly based upon a predetermined algorithm or look-up table which is stored in permanent memory. Algorithms for engine fuel requirement modification based upon ambient air temperature are well-known in the art. The modified base value determined based upon air temperature modification is indicated as V-**2**.

As indicated in block **311**, the modified base value V-**2** is next further modified based upon the barometric pressure reading. This modification may again be performed by use of a conventional algorithm or look-up table stored in permanent memory. The resulting modified fuel value is indicated as V-**3**.

As indicated in block **312**, modified value V-**3** is next further modified based upon engine temperature. The modified value is indicated as V-**4**. This modification may be made either from a stored algorithm or a stored look-up table which is prepared based upon the particular engine temperature operating characteristics of the subject engine.

Next, as indicated in block **313**, the modified fuel value V-**4**, which is indicative of the total corrected (compensated) fuel amount that each injector should inject into the engine during each revolution thereof for optimum performance, is used to determine the duration of injector opening which is required to provide fuel injection in the amount of V-**4** under predetermined fuel injector parameters, e.g. with a known, constant fixed fuel pressure and a known, fixed injector orifice size, etc. This duration is indicated at V-**5** and may be expressed in milliseconds. An alternative to modifying base fuel value is sequential steps as described above in **310–312**; relative correction factors may be simultaneously computed based on the variables indicated in **310–312** and a total correction factor may be derived therefrom and applied to the base fuel value to arrive at a total corrected fuel amount V-**4**.

Next, as illustrated in blocks **314** and **315**, the CPU determines whether a predetermined cyclically reoccurring state (repeating once per engine revolution) of the engine, such as, for example, a top dead center position of a selected one of the pistons, has been reached. Once that cyclically reoccurring engine state has been reached, the CPU provides a control command to the fuel injector(s) causing the fuel injector(s) to be opened for the predetermined length of time V-5 calculated in step **313**. It will be appreciated that for a multiple cylinder engine the injectors may be opened sequentially at a predetermined spacing in time associated with the piston positions in the various cylinders, or all of the injectors may be opened simultaneously. In the preferred embodiment of the invention, all of the injectors are opened simultaneously due to the fact that, with the injection of fuel into the manifold, as opposed to conventional fuel injection into the crankcase, the sequential timing of injectors in unnecessary.

Next, as indicated in block **317**, the engine RPM value from step **308** is compared to a predetermined maximum desired engine RPM such as, for example, 8500 RPM. If the engine speed is less than the predetermined maximum value, then the CPU again returns to operating step **308** and repeats steps **308–317**. If the engine speed is greater than the predetermined value, then, as indicated in block **318**, the CPU provides a control signal which closes the fuel injectors.

Next, as indicated in block **319**, the CPU again reads the RPM input value. If the RPM input value is greater than a predetermined value which may be less than the maximum engine RPM (e.g. 8200 RPM), then the fuel injectors are retained in a closed positioned as indicated in step **318**, and steps **319** and **320** are repeated. If the engine speed is less than 8200 RPM, then the CPU returns to step **308**. Thus, once the engine reaches 8500 RPM, the fuel injectors are closed and remain closed until engine speed drops to 8200 RPM. This total termination of fuel as opposed to conventional speed control methods which simply reduce fuel injection amount or terminate ignition prevents damage to the engine or spark plug fouling associated with such prior art methods.

It will be understood by those with skill in the art that the total corrected (compensated) fuel value may be based on an average derived from several iterations of sensor inputs and total corrected fuel value calculations. It will also be appreciated that the actual fuel adjustments may be made at intervals less frequent than those in which total fuel value calculations are made, e.g. input readings and fuel value calculations may be made 100 times per second and total fuel injection duration may be adjusted 16 times per second.

The CPU **130** may also control pump speed based upon engine RPM. For example, at engine start up when RPM=0, the fuel pump may be actuated by a control signal from CPU **130** to cause it to run at full speed for one second and then stop until RPM is greater than zero. Above RPM=0, the CPU may cause the pump to run at 50% of its rated capacity (drawing one-half its normal maximum current amount) up to a predetermined engine speed, e.g. 3600 RPM. Above this predetermined speed, the CPU may cause the pump to operate at 100% of its rated capacity. Of course, more than two pumping rates may be provided, if desired, based upon a plurality of different engine RPM ranges. Such an arrangement, as well as providing optimum pressure, reduces energy draw on the electrical power supply at start-up and at low RPM.

As further indicated by FIG. **2**, the switching on of the ignition, etc., at step **300** also operates a control circuit which functions independently from the CPU **130** which performs the functions indicated in steps **300–320**. In this independent circuit, as indicated at step **330**, the temperature in the immediate environment of the chip components (e.g. microprocessor, EPROM, etc.) which comprise CPU **130** is initially determined. Next, as indicated at step **331**, if the temperature within the CPU environment is greater than a predetermined temperature, such as, for example, 60° F., then the system returns to step **330** and cycles between **330** and step **331**. When the temperature in the immediate operating environment of the CPU is sensed to be below the predetermined temperature, then the system actuates a temperature control device, such as a heating coil, to elevate the temperature in the environment of the CPU. Next, as indicated at step **333**, the temperature within the operating environment is again read and compared to a predetermined temperature which may be the same or higher than the minimum temperature of step **331**. If the temperature is below this second predetermined temperature, such as, e.g. 60° F., then the temperature control device continues to operate. If the temperature exceeds this second predetermined temperature, then the operation of the temperature control device is terminated and the system again returns to step **330**.

It will be appreciated that these general control functions described in steps **330–335** apply to any system which is designed to maintain the temperature within a particular environment within a predetermined temperature range. Such temperature control could be performed by any number of conventional heating/air conditioning systems. In the presently preferred embodiment, a temperature control system which is not subject to malfunction at lowered temperatures, e.g −b **60**° F., is provided such as illustrated in FIG. **5** and discussed above.

All "Motorola" components indicated herein are commercially available from Motorola, Inc., 8201 E. McDowell Road, Scottsdale, Ariz., 85257-3812. All "NAPA" components indicated herein are commercially available from Echlin, Inc., Branfort, Conn., 06405.

While an illustrative and presently preferred embodiment of the invention has been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

What is claimed is:

1. A fuel injection system for a two-stroke cycle engine of the type comprising at least one cylinder, a crankcase associated with said cylinder, a piston reciprocally mounted in said cylinder and crankcase; a reciprocally openable and closable crankcase inlet for enabling combustible fluid to be drawn into the crankcase, a reciprocally openable and closable transfer port for transferring combustible fluid compressed in said crankcase to said cylinder, an ignition system for igniting compressed combustible fluid in said cylinder, a reciprocally openable and closable exhaust port in said cylinder for enabling exhaust of burned combustible fluid from said cylinder, a crankshaft connected to said piston for transferring mechanical energy from said piston to a drive unit, and an electrical energy supply source including a battery for operating the ignition system and other electrical components, comprising:

(a) fuel injection means for injecting fuel for combustion within said cylinder;

(b) fuel supply means for supplying fuel to said fuel injection means;

(c) battery voltage sensing means for sensing battery voltage and for providing a battery voltage sensing signal representative thereof;

(d) air temperature sensing means for sensing the temperature of ambient air and for providing an air temperature signal representative thereof;

(e) engine speed sensing means for sensing the speed of revolution of said engine and for providing an engine speed signal representative thereof;

(f) timing sensing means for sensing each occurrence of a predetermined cyclically repeating state of said engine and for providing a timing signal indicative thereof;

(g) barometric pressure sensing means for sensing atmospheric air pressure and for generating a barometric pressure sensing signal representative thereof;

(h) throttle position sensing means for sensing the relative amount of opening of said throttle valve means and for generating a throttle position signal representative thereof;

(i) first data processing means for receiving and processing said sensing signals comprising:

(i) means for processing said engine speed sensing signal and said throttle position sensing signal and for generating a priming control signal to said fuel injection means for selectively injecting or not injecting fuel into said manifold means based on said engine speed signal and said throttle position signal;

(ii) means for receiving and processing said engine speed signal and throttle position signal for determining a base fuel injection value;

(iii) means for receiving and processing said air temperature signal and calculating an air temperature modification value of said base fuel injection value;

(iv) means for receiving and processing said barometric pressure sensing signal for calculating a barometric pressure modification value of said base fuel injection value;

(v) means for receiving and processing said engine temperature signal for calculating an engine temperature modification value of said base fuel injection value;

(vi) means for determining a total fuel injection value representative of the total fuel amount which is to be injected by said fuel injection means during a single two-stroke operating cycle of said piston from said base fuel injection value, said air temperature modification value, said barometric pressure modification value, and said engine temperature modification value;

(vii) means for determining an injector open duration interval based on said total fuel injection value and a known fuel output rate capacity of said fuel injection means;

(viii) means for generating a control signal for opening said injection means for said determined injector duration open interval at a predetermined point in time determined from said timing sensing signal;

(ix) means for receiving and processing said engine speed sensing signal for generating a pump control signal in response thereto for maintaining said pump at an optimum operating speed for providing said predetermined maximum operating pressure in said fuel circulation conduit means at said pump.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,901,701

DATED : February 20, 1990

INVENTOR(S) : Ronald E. Chasteen

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 1, Line 65: Delete "Dueto"; insert -- Due to --
Col. 3, Line 18: Delete "th"; insert -- the --
Col. 4, Line 1: Delete "s id"; insert -- said --
Col. 7, Line 66: Delete "8"; insert -- 85 --
Col. 9, Line 58: Delete "and"; insert -- each --
Col. 9, Line 61: Delete "a"; insert -- as --
Col. 12, Line 5: Delete "3"; insert -- 4 --
Col. 12, Line 18: Delete "RP"; insert -- RPM --
Col. 12, Line 23: Delete "308"; insert -- 411 --
Col. 13, Line 22: Delete "308" in both instances; insert -- 411 -- in both instances
Col. 13, Line 33: Delete "308"; insert -- 411 --
Col. 15, Line 23: Delete "said"; insert -- a --
Col. 15, Line 32: Delete "said" insert -- a --
Col. 16, Line 9: Delete "said"; insert -- an --
Col. 16, Line 27: Following "injector" insert -- open --; Following "duration" delete "open"
Col. 16, Line 33: Delete "said"; insert -- a --
Col. 16, Line 34: Delete "said"; insert -- a --
Col. 16, Line 35: Delete "said"; insert -- a --

Signed and Sealed this

Twenty-first Day of April, 1992

Attest:

HARRY F. MANBECK, JR.

Attesting Officer

Commissioner of Patents and Trademarks

EXHIBIT 4

United States Patent [19]

Blee et al.

[11] **Patent Number: 4,631,515**

[45] **Date of Patent: Dec. 23, 1986**

[54] **VEHICLE GEAR SHIFT INDICATOR**

[75] Inventors: **Timothy J. Blee; Norman P. Deane,** both of Rugby, Great Britain

[73] Assignee: **AE PLC,** Warwickshire, England

[21] Appl. No.: **452,083**

[22] Filed: **Dec. 22, 1982**

[30] **Foreign Application Priority Data**

Apr. 22, 1981 [GB] United Kingdom 8112478

[51] **Int. Cl.**[4] **B60Q 1/00**

[52] **U.S. Cl.** .... **340/62;** 340/52 F

[58] **Field of Search** .... 340/62, 52 R, 52 F; 364/424.1, 442; 74/866, 335, DIG. 7

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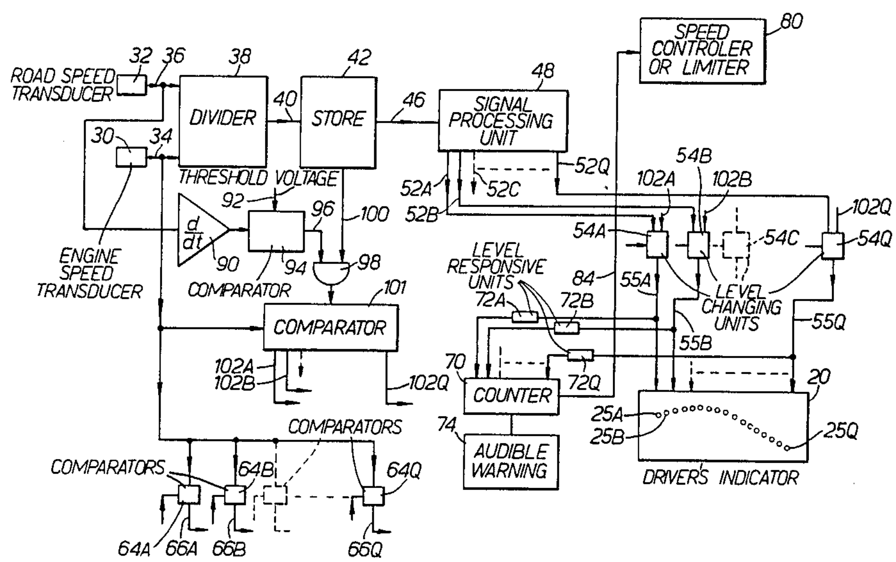
Primary Examiner—John W. Caldwell, Sr.
Assistant Examiner—Tyrone Queen
Attorney, Agent, or Firm—Leydig, Voit & Mayer

[57] **ABSTRACT**

An indicator panel **20** has an array of LED's **25A** to **25Q** to provide an indication to the driver of a road vehicle, particularly a diesel-powered truck, when he should change to the next highest gear during acceleration from rest or low speed. The LED's are lit progressively as the engine speed increases in each gear and, when lit, emit green light if the engine speed is below the optimum change-up speed for that gear. When the engine speed begins to exceed the optimum change-up speed, the next LED illuminated produces red light to the driver. An audible warning may also be produced. If the driver does not change up in response to such warning, further red LED's will show and a more strident audible warning may be given. The change-up speeds to which the system responds are pre-set so as to be the optimum speeds for increased fuel efficiency. The change-up speed corresponding to the lowest gear is relatively low and increases successively for the successively high gears. The system may be associated with engine speed control or limiting means so as positively to prevent further increase in engine speed if the driver ignores the warning. The system may also produce an indication of the optimum engine speeds at which the driver should change down to the next lower gear during vehicle deceleration.

14 Claims, 3 Drawing Figures



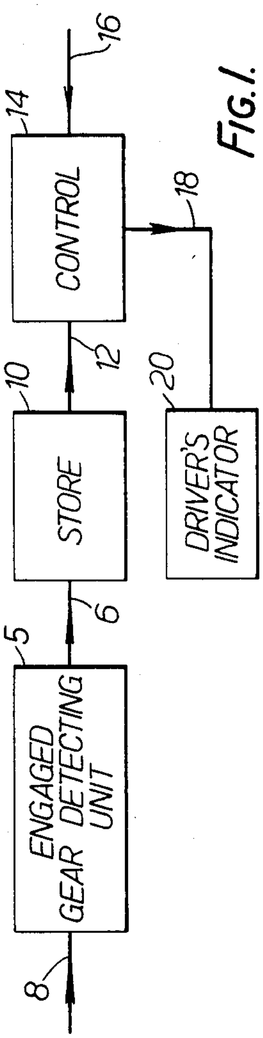

ENGAGED GEAR DETECTING UNIT
STORE
CONTROL
DRIVER'S INDICATOR
8
5
6
10
12
14
16
18
20

FIG. 1.

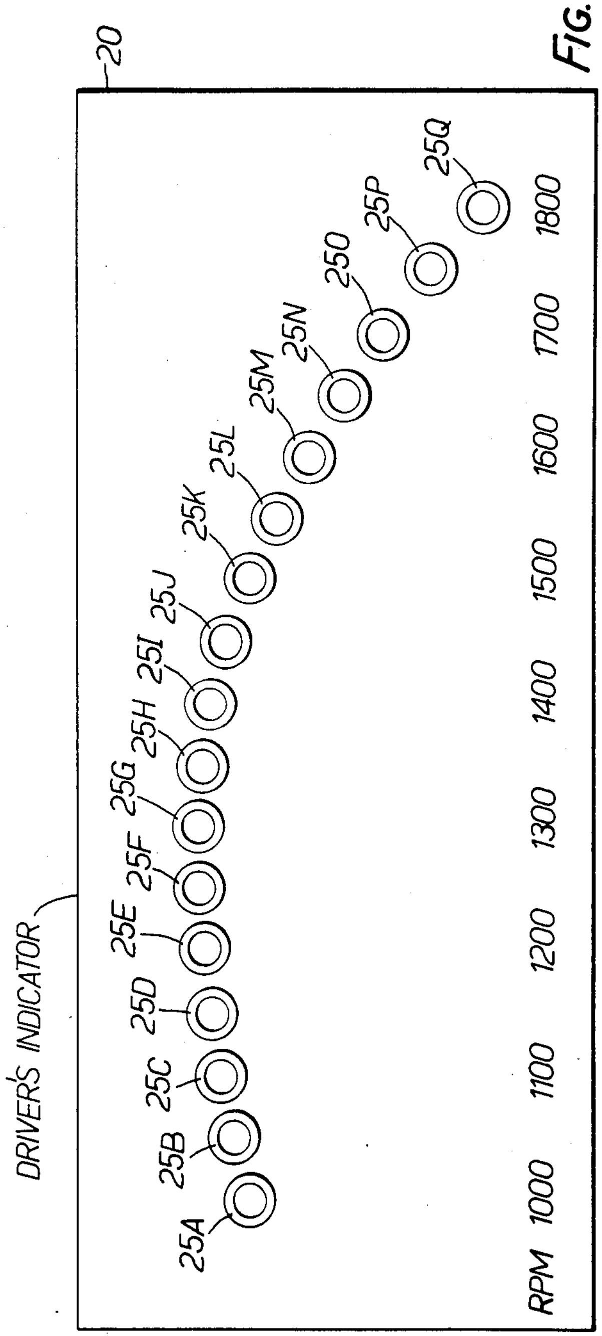

20
DRIVER'S INDICATOR
25A
25B
25C
25D
25E
25F
25G
25H
25I
25J
25K
25L
25M
25N
25O
25P
25Q
RPM
1000
1100
1200
1300
1400
1500
1600
1700
1800

FIG. 2.

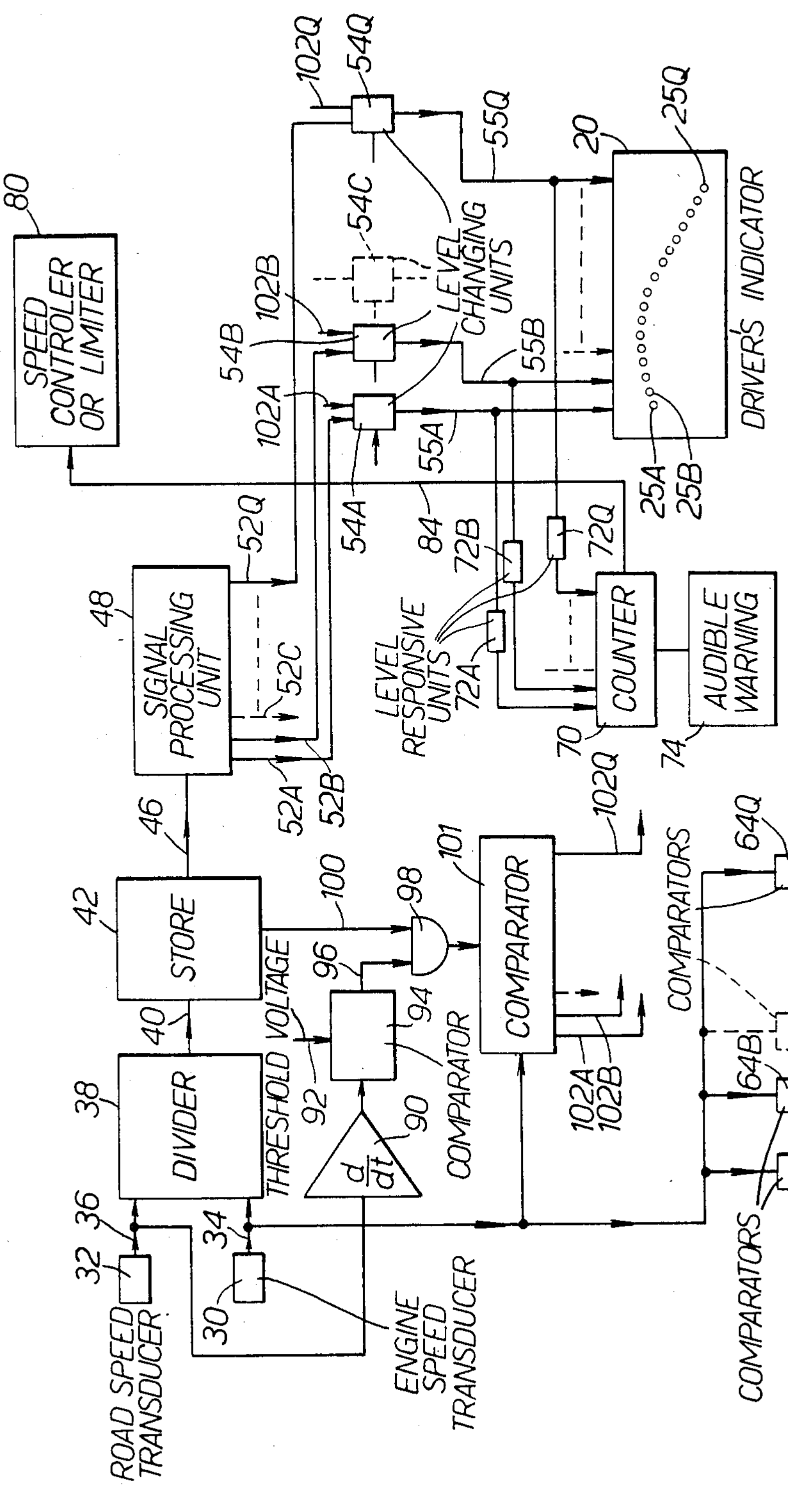

SPEED CONTROLER OR LIMITER
80
SIGNAL PROCESSING UNIT
48
DIVIDER
38
STORE
42
COMPARATOR
101
COUNTER
70
AUDIBLE WARNING
74
DRIVER'S INDICATOR
20
LEVEL CHANGING UNITS
LEVEL RESPONSIVE UNITS
THRESHOLD VOLTAGE
COMPARATOR
COMPARATORS
ROAD SPEED TRANSDUCER
ENGINE SPEED TRANSDUCER
d/dt
30
32
34
36
40
46
52A
52B
52C
52Q
54A
54B
54C
54Q
55A
55B
55Q
25A
25B
25Q
72A
72B
72Q
84
90
92
94
96
98
100
102A
102B
102Q
64A
64B
64Q
66A
66B
66Q

FIG. 3.

VEHICLE GEAR SHIFT INDICATOR

The invention relates to drive aids for vehicles such as, but not restricted to, road vehicles. Embodiments of the invention to be described provide indications facilitating the efficient control of a road vehicle, such as a diesel-engined truck, by its driver.

According to the invention, there is provided an indicating system for use on a mechanically powered vehicle to indicate to the driver thereof when he should change to a higher gear, comprising means responsive to the particular gear engaged at any time to produce a datum signal having a value representing a datum speed dependent on the identity of the gear, and indicating means responsive to the datum signal and to the actual engine speed and operative when the actual engine speed reaches the datum speed to produce an indication to the driver that he should change to the next higher gear, the values of the datum signals being respectively predetermined so that the respective datum speeds at which the said indications are produced are such that respective gear changes at those speeds promote engine efficiency.

According to the invention, there is also provided a system for indicating to the driver of a road vehicle when he should change to a higher gear, comprising gear-indicating means responsive to the identity of the actual gear engaged at any time to produce a gear-indicating signal, means responsive to the gear-indicating signal to generate an electrical datum signal having a predetermined engine-speed-representing value dependent on the identity of that gear and representing a relatively low engine speed for the lowest gear and successively higher engine speeds for the successively higher gears, an array of light sources for positioning in the vehicle where they may be seen by the driver, and light source control means responsive to each datum signal and to a signal representing actual engine speed to energise the light sources successively as the actual engine speed increases and to modify the indication provided to the driver by the energised light sources when the actual engine speed reaches the speed represented by the datum signal.

According to the invention, there is further provided indicating means for identifying the gear ratio which is currently engaged in a transmission system having a plurality of selectable fixed gear ratios, comprising first transducing means operative to produce a first signal which is proportional to the input speed to the transmission system, second transducing means operative to produce a second signal proportional to the output speed of the transmission system, and signal processing means operative to measure the ratio between the first and second signals to indicate the identity of the engaged gear ratio.

An electrical system embodying the invention and for indicating to the drive of a road vehicle when he should make each gear change for best efficiency, will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

FIG. 1 is a block circuit diagram of one form of the system;

FIG. 2 is a front elevation of an indicator panel showing, diagrammatically, the indication provided to the driver; and

FIG. 3 is a more detailed block circuit diagram of the system.

The system to be described is particularly designed for providing an indication to the driver of a diesel-engined truck when he should make each gear change. Large high-power diesel engines, particularly naturally aspirated types, produce maximum torque at relatively low engine rpm, and it is therefore inefficient and wasteful of fuel for the driver to operate the engine at a speed above the peak of the torque/rpm curve when high road speed of the vehicle is not required or possible. Specifically, when starting the truck from rest, it is wasteful of fuel for the driver to run the engine up to a high speed in the lower gears. When starting the truck from rest, the primary requirement in the lower gears is to take the engine speed up to that at which maximum torque is developed. As the truck speed increases, and as each higher gear is engaged in turn, the engine speed immediately prior to each gear change can be successively increased, assuming that the desired final road speed in the highest gear corresponds to an engine speed above the value at which maximum torque is developed.

In other words, for maximum efficiency, when starting the truck from rest, the driver should make each successive gear change at a successively higher engine speed. The system to be described facilitates this.

FIG. 1 shows the system in broad outline.

As shown, the system comprises an engaged gear detecting unit **5**. The purpose of unit **5** is to produce an output signal on a line **6** identifying the particular gear through which the truck engine is driving the road wheels at any particular time (that is, representing the total gear ratio between the truck engine and the road wheels). The unit **5** receives an appropriate input signal on a line **8**. For example, line **8** could be controlled by microswitches responsive to the settings of the driver's gear control lever(s). However, other means for producing the signal on line **8** will be described below.

The gear-indicating signal on line **6** is fed as an input to a data store **10**. Store **10** stores a number of different datum signals, a different one for each of the truck's gears. The value of each datum signal represents the optimum engine speed at which the driver should change from that gear to the next higher gear, that is, "optimum" primarily in the sense of promoting maximum fuel efficiency. Therefore, as explained, the datum signal corresponding to the lowest gear will represent a relatively low engine speed and the datum signals for the higher gears will represent successively higher engine speed values. Store **10** responds to the particular gear indicated by the signal on line **6** by outputting the appropriate datum signal on a line **12** and this is fed into a signal processing unit **14**. Unit **14** also receives a signal representing actual engine speed on a line **16** and produces an output signal on a line **18** which controls a driver's indicating unit **20**. Unit **20** is positioned so as to enable the driver to respond readily to its indication. The unit **20** may provide its indication in any suitable form. For example, it may be a visible indication. Instead, it can be an audible indication. As another example, it could be a combination of visible and audible indications.

The signal processing unit **14** controls the indicating unit **20** so that it provides an indication to the driver when the engine speed of the truck in any particular gear reaches the value at which he should change to the next higher gear.

When he has changed to the next higher gear, the signal processing unit **14** receives the new datum signal on line **12** and is thus able to control the indicating unit **20** so as to provide an indication when the actual engine speed has risen to the (higher) engine speed datum at which he should change up again.

As will be explained in more detail below, the signal processing unit **14** can also be arranged, by means of an appropriate speed control or speed limiting system, to provide a positive limit on the engine speed if the driver should ignore the gear-change-indication provided by the unit **20**.

A particular form which the system FIG. **1** can take will now be described in detail with reference to FIGS. **2** and **3**.

FIG. **2** shows one form which the driver's indicator **20** (see FIG. **1**) may take. It comprises an array of lamps **25A**, **25B** . . . **25Q**. In this example, therefore, there are seventeen lamps and each one corresponds to an engine rpm increment of 50 rpm. The lamps may cover a speed range from 1,000 to 1,800 rpm, say. As the engine speed increases, the lamps are progressively lit, starting with lamp **25A**. Therefore, when the engine speed rises to 1,000 rpm, lamp **25A** becomes lit. An increase in engine speed to 1,050 rpm causes lamp **25B** to be lit, lamp **25A** remaining lit; and so on, until, at an engine speed of 1,800 rpm, all the lamps are lit.

In a manner to be explained in more detail, the colours displayed by the illuminated lamps change so as to indicate to the driver when he should make a gear change.

The lamps **25A** to **25Q** are physically arranged in a curve which approximately matches the shape of the engine torque/engine rpm curve over the speed range (thus showing that peak torque occurs at about 1,300 rpm in this example). They may be light-emitting dioes (LED's).

The system will now be more specifically described with reference to FIG. **3**.

As shown in FIG. **3**, the system is energised by transducers **30** and **32**, transducer **30** providing an electrical output on a line **34** representing engine speed and transducer **32** providing an electrical output on a line **36** representing road speed. The transducers **30** and **32** may be of any suitable type. For example, the engine speed transducer **30** may pick up an electrical signal from the driver's engine rpm indicator, and the road speed transducer may pick up an electrical signal from the vehicle tachograph. However, other arrangements are possible. The electrical outputs on lines **34** and **36** may be in analogue or digital form.

Lines **34** and **36** are fed to a dividing circuit **38** which measures the ratio of their signals. This ratio is solely dependent on the particular gear which is engaged, and the divider **38** compares the measured ratio with each of a number of pre-stored datum values, respectively equal to the ratios corresponding to the gears, and produces an electrical output on a line **40** which indicates which gear is engaged at any particular time.

It will be appreciated that the signal on line **40** could instead be generated by, for example, an electromechanical switch arrangement linked to the gearbox or to the gear selector. However, the arrangement specifically illustrated in FIG. **3** has the advantage of simplicity and absence of moving parts.

However generated, the signal on line **40** is then fed into a store **42**. This may be in any suitable form and stores a series of electrical datum signals respectively corresponding to the different gears of the truck. The datum signal stored in store **42** for first gear has the lowest value, and the values are progressively greater (but not necessarily in linear proportion) for each of the successively higher gears.

Store **42** accesses the appropriate datum signal, that is, the datum signal corresponding to the particular gear engaged (as indicated by the value of the signal on line **40**), and outputs this datum signal on a line **46**. This signal is passed to a processing unit **48**.

The processing unit **48** has a bank of output lines **52A**, **52B** . . . **52Q** (not all of which are shown) and these are respectively connected to level changing units **54A**, **54B** . . . **54Q** (not all of which are shown), and the actual connections are mostly omitted to avoid unduly complicating the diagram.

The outputs of the level changing units **54A**, **54B** . . . **54Q** are connected by respective lines **55A**, **55B** . . . **55Q** to control respective ones of the lamps **25A**, **25B** . . . **25Q** in the driver's display **20**.

The processing unit **48** energises the lines **52A**, **54B** . . . **52Q** according to the value of the signal on line **46**, each line **52A**, **52B** . . . **52Q** having either a HIGH value or a LOW value. When the signal level on line **46** is low, only the earliest one or ones in the sequence of lines **52A** to **52Q** are held at the LOW level and all the remainder are HIGH: for example, with the signal on line **46** at its lowest level (corresponding to first gear), only lines **52A** and **52B**, say, would be at the LOW level, with all the remainder at the HIGH level. For a signal level on line **46** corresponding to second gear, more of the lines in the series **52A** to **52Q** would be at the LOW level, such as lines **52A**, **52B**, **52C** and **52D** for example, with all the remainder at the HIGH level; and so on for all the other possible values of the signal on line **46**. Thus, for a signal level on line **46** corresponding to the highest gear (the truck may have eight or nine gears for example), all the lines **52A** to **52Q** could be at the LOW level.

The engine speed-dependent signal on line **34** is also connected to feed a bank of comparators **64A**, **64B** . . . **64Q** (only some of which are shown). Each comparator has a second input lines which carries a respective threshold signal (the sources of these thresholds not being shown in the Figure). The comparators **64A** to **64Q** are connected through the level changing units **54A** to **54Q** to the LED's by means of respective output lines **66A** to **66Q**.

When the engine speed is low (below 1,000 rpm in this example), none of the lines **66A** to **66Q** is energised. As the engine speed increases to 1,000 rpm and beyond, the lines **66A** to **66Q** successively become energised. The threshold signals applied to the comparators **64A** to **64Q** are set so that line **66A** becomes energised when the engine speed is 1,000 rpm, line **66B** becomes energised when the engine speed reaches 1,050 rpm, line **66C** becomes energised when the engine speed reaches 1,100 rpm and so on, until line **66Q** becomes energised when the engine speed reaches 1,800 rpm (all the earlier-energised lines remaining energised).

As each line **66A** to **66Q** becomes energised, it causes the corresponding LED **25A** to **25Q** to become illuminated. Assuming that the corresponding one of the lines **52A** to **52Q** is at a LOW level, the illuminated LED will emit green light. However, if the corresponding line **52A** to **52Q** is at a HIGH level, then the corresponding level changing unit **54A** to **54Q** will cause the illuminated LED to emit red light instead.

The operation of the system as so far described will now be considered.

If the truck is running at a steady relatively high speed in the highest gear, so that its engine speed is above 1,800 rpm, all the LED's **25A** to **25Q** will be green. If the truck speed now decreases, causing or as a result of a corresponding fall in engine speed, then the LED's will be extinguished one by one as the engine speed falls below 1,800 rpm. Assuming that the truck speed is falling at greater than the threshold rate represented by the signal on line **92**, unit **94** will open gate **98** and the comparator **101** will be fed with the datum signal on line **100** representing the minimum appropriate speed for the current gear (top gear); this might be an engine speed of 1,400 rpm for example. Therefore, when comparator **101** determines that the actual engine speed has fallen to 1,400 rpm, it energises the lines **102A** to **102I**. The resultant signals applied to level changing units **54A** to **54I** cause the corresponding LED's **25A** to **25I** to change from green to red. This therefore provides an indication to the driver that he should change to a lower gear.

If the driver allows the engine speed to fall further without making a gear change, then the falling signal on line **34** will cause the comparators **64A** to **64I** (in this example) to extinguish the LED's one by one.

During such deceleration, the audible warning unit **74** may be disabled.

It will be appreciated that the detailed circuitry shown in FIG. **3** is merely exemplary of the many different possible forms which it can take, and many modifications are possible. For example, but without limitation, the interlinking of the gear change indication system with the speed control system **80** may be omitted, and/or the arrangement of the system so as to provide an indication to the driver when he should change to a lower gear may be omitted.

Although the systems described have been described in relation to trucks and more particularly to trucks powered by diesel engines, they may be applied (with appropriate modification if necessary) to vehicles other than trucks and to vehicles powered by other types of engine, and "vehicle" is not restricted to road vehicles; as examples, it may include rail vehicles and boats.

We claim:

1. An indicating system for use on a mechanically propelled vehicle having a driver-operated engine-driving wheels transmission system using a plurality of separate gears normally operable in an ascending or descending sequence and to indicate to the driver thereof when he should change from the particular one of the gears which is engaged at any time to the next gear in one of the sequences comprising

means responsive to the particular gear engaged to produce an electrical datum signal having a value representing a datum speed dependent on the identity of that gear,

indicating means comprising means operative in response to predetermined control signals to produce respective ones of a series of indications to the driver indicating with successively greater urgency that he should change to the next gear in the said sequence,

means responsive to the actual speed of the engine or of the vehicle to produce an electrical signal representing that speed,

control means responsive to the datum signal and to the electrical signal representing the actual speed and operative when the actual speed reaches the datum speed to produce a first one of the said control signals,

means feeding the first control signal to the indicating means to cause the indicating means to produce the first said indication in the said series,

means responsive to the datum signal and to the electrical signal representing the actual speed and connected to sense whether the driver changes to the said next gear in the sequence in response to the said first indication in the said series and, if he does not, to produce successive further said control signals as the actual speed exceeds the datum speed by a respective predetermined amount or amounts, and

means connected to feed the said further control signals to the indicating means to cause the indicating means to produce in succession the other indications in the said series,

the values of the datum signals being respectively predetermined so that the respective datum signals are such that respective gear changes at those speeds promote engine efficiency, the datum signals having values which are pre-calculated and are independent of the actual operation of the vehicle at any time.

2. A system according to claim **1**, in which the datum speed for the lowest gear represents a relatively low engine speed and the datum speeds for the higher gears represent successively higher engine speeds.

3. A system according to claim **1**, in which each said indication is a visible indication.

4. A system according to claim **1**, in which each said indication is an audible indication.

5. A system according to claim **1**, in combination with a speed control arrangement connected to the vehicle engine and comprising means responsive to an engine speed control signal to positively prevent further increase in engine speed, the system including means responsive to the engine speed exceeding the respective said datum speed for the said particular one of the gears which is engaged at any time to generate a said engine speed control signal, and means feeding the engine speed control signal to the speed control arrangement.

6. A system for indicating to the driver of a road vehicle having a multiple-geared engine-driving wheels transmission system when he should change from a particular one of the gears which is engaged at any time to a higher gear, comprising

gear-indicating means responsive to the identity of the said particular one of the gears to produce an electrical gear-indicating signal indicating the identity of that particular gear,

means connected to receive and to be responsive to the gear-indicating signal to generate a respective one of a plurality of electrical datum signals having respective predetermined engine-speed-representing values dependent on the identity of the said particular one of the gears and representing a relatively low engine speed for the lowest gear of the transmission system and successively higher engine speeds for the successively higher gears thereof,

an array of light sources for positioning in the vehicle where they may be seen by the driver, and

light source control means connected to control the array of light sources and connected to receive and to be responsive to each datum signal and to an electrical signal representing actual engine speed whereby to energise the light sources successively

As the truck moves off from rest in first gear, the engine speed will be below 1,000 rpm and none of the lines **66A** to **66Q** will be energised. Therefore, none of the LED's **25A** to **25Q** will be illuminated. The divider **18** will determine from the ratio of its inputs that first gear is engaged and store **42** will therefore produce the appropriate datum signal output. As explained, this will be at such a value that unit **48** will hold most of its output lines **52A** to **52Q** at the HIGH level with only lines **52A** and **52B** (in this example) being at the LOW level.

As the engine speed increases to 1,000 rpm (with the truck still in first gear), line **66A** becomes energised and LED **25A** becomes lit. Because the corresponding level changing unit **54A** is receiving only a LOW level, line **66A** is energised at a low level and LED **25A** emits green light.

As the engine speed continues to increase, LED **25B** will become illuminated and emit green light (because it is assumed in this example that line **52B** is at a LOW level).

However, line **52C** and all remaining lines up to **52Q** are at a HIGH level. Therefore, when the engine speed reaches 1,100 rpm in this example, LED **25C** becomes illuminated and emits red light, in contrast to LED's **25A** and **25B** which are green.

This provides an indication to the driver that he has reached an engine speed value which, for the particular gear engaged at the present time (first gear), is such that he should change to the next higher gear.

If he does not change gear, the engine speed will continue to rise and LED **25D** will be illuminated and emit red light, and similarly for LED **25E** assuming that he still does not make a gear change.

However, if he does make a gear change, this will be detected by the divider **38** and the store **42** will change the value of the signal on line **46** to a higher value. This causes the processing unit **48** to alter the energisation of the lines **52A** to **52Q** so that, for example, lines **52A**, **52B**, **52C** and **52D** are now all at a LOW level while the remainder (**52E** to **52Q**) are at a HIGH level.

Therefore, LED **25C**, which was previously emitting red light, will now change to green, assuming the engine speed is still at 1,100 rpm (clearly, the engine speed may fall slightly during the actual gear change but will then start to rise again in the higher gear).

When the engine speed has reached the appropriate limit for second gear, 1,250 in this example, LED **25E** becomes illuminated and emits red light. This indicates to the driver that he must make the next gear change.

This process continues for each succeeding gear, so that the display **20** indicates to the driver the appropriate engine speed at which he should make each gear change.

The datum signals in store **42** are pre-selected so that the indicated gear-change speeds increase successively and according to an appropriate curve so as to obtain maximum fuel efficiency from the engine.

As shown, the lines **55A** to **55Q** are also connected to a counting unit **70** through level-responsive units **72A**, **72B** . . . **72Q** only some of which are shown. The level-responsive units are set so that the counter is only affected by the signals on the lines **52A** to **52Q** when they have the higher levels corresponding to emission of red light from the associated LED. The counter **70** counts the number of lines **55A** to **55Q** carrying red-producing levels and operates an audible warning unit **74** accordingly. More specifically, when counter **70** detects one line **55A** to **55Q** carrying a red-indicating level, it causes the audible warning unit **74** to emit an intermittent low-frequency sound warning to the driver, advising him that the gear-change limit has been reached. If the driver does not make a gear change, then, as explained, the next line of the lines **55A** to **55Q** will change to a red-indicating level. This will be detected by the counter **70** which causes the warning unit **74** to increase the frequency of its sound output. A still further increase in engine speed without gear change, producing a third red-indicating level input to counter **70**, causes the unit **74** to emit a continuous sound output.

The truck may also be fitted with a road speed control system indicated diagrammatically by the block **80**. Such a system may take any suitable form, such as, for example, described in our British Pat. Nos. 1386961 and 1493623. Normally such a system **80** operates only when the truck is in the highest gear, so as to limit the truck's road speed to a particular upper speed value (or to control it at that value) and this operation is independent of the gear-change indicating system as so far described. However, the gear-change indicating system described may be linked to the speed control system **80** by means of a line **84** from the counter **70**.

Counter **70** energises line **84** when it determines that at least three of the lines **55A** to **55Q** are carrying red-indicating levels. When the speed control **80** receives the signal on line **84**, it operates (irrespective of the particular gear engaged at that time) to prevent further increase in engine speed. Therefore, if the driver persists in ignoring the gear-change indication given by the display unit **20**, further increase in engine speed will be positively prevented.

As so far described, the operation of the gear-change indicating system is that which occurs when the truck is accelerating. The operation is different if the vehicle is decelerating, as will now be described.

Deceleration of the truck is sensed by a differentiating unit **90** responsive to the road speed signal on line **36**. If the vehicle is decelerating at at least a predetermined rate represented by a threshold on a line **92**, a comparator **94** energises a line **96** to open a gate **98**.

Besides producing the datum signal on line **46**, store **42** produces a second datum signal on a line **100**. In contrast to the datum signals on line **46**, the datum signals on line **100** represent the minimum appropriate engine speed corresponding to each gear. Line **100** is connected through gate **98** to a comparator **101** which also receives the engine speed indicating signal from line **34**. Gate **98** only passes the signal on line **96** to comparator **101** when the truck is decelerating at at least the speed set by the threshold on line **92**. Comparator **101** has output lines **102A** to **102K** and these are connected to third inputs of the level changing units **54A** to **54K**, the actual connections being omitted. When comparator **101** determines that the actual engine speed has fallen to the level represented by the datum signal on line **100**, it energises the corresponding output line **102A** to **102K** and also all the other ones of its output lines which represent lower speed values. Thus, for example, if the signal on line **100** represents a datum speed of 1,400 rpm, comparator **101** will energise its output line **102I** (which is connected to the level changing unit **54I** controlling the LED **25I** representing 1,400 rpm); in addition, it will energise all the lines **102A** to **102H**.

The operation of this part of the system will now be considered in more detail.

as the actual engine speed increases, the light source means including modifying means adapted to modify the indication provided to the driver by the energised light sources and means responsive to each datum signal and to the electrical signal representing actual engine speed to sense the extent by which the actual engine speed exceeds the speed represented by the datum signal and operative to actuate the modifying means to cause the array of light sources to produce a series of indications to the driver indicating with successively greater urgency as the said extent increases that he should change to the said next higher gear.

7. A system according to claim **6**, in which the light source control means modifies the indication provided by the energised light source or sources by changing the colour of the light emitted thereby.

8. A system according to claim **6**, including an audible indicating unit responsive to each datum signal and to the electrical signal representing actual engine speed to produce an audible indication when the actual engine speed exceeds the speed represented by the respective datum signal.

9. A system according to claim **6**, in which the light sources are light-emitting diodes.

10. A system according to claim **6**, in which the array of light sources is physically arranged in a manner corresponding at least approximately to the shape of the torque versus engine speed characteristic of the engine.

11. A system according to claim **1**, applied to a truck or similar heavy road vehicle powered by a diesel engine.

12. A system according to claim **1**, in which the said actual speed is the engine speed.

13. A system according to claim **6** in which the gear-indicating means comprises

- first transducing means operative to produce a first signal which is proportional to the input speed to the transmission system,
- second transducing means operative to produce a second signal which is proportional to the output speed of the transmission system, and
- signal processing means operative to measure the ratio between the first and second signals to indicate the identity of the engaged gear ratio.

14. A system according to claim **13**, in which the first and second signals are electrical signals.

* * * * *

EXHIBIT 5

US005708584A

United States Patent [19]

Doi et al.

[11] **Patent Number: 5,708,584**

[45] **Date of Patent: Jan. 13, 1998**

[54] **VEHICLE RUNNING MODE DETECTING SYSTEM**

[75] Inventors: **Ayumu Doi; Yasunori Yamamoto; Hideki Nishitake; Tomohiko Adachi,** all of Hiroshima-ken, Japan

[73] Assignee: **Mazda Motor Corporation,** Hiroshima, Japan

[21] Appl. No.: **525,218**

[22] Filed: **Sep. 8, 1995**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] **B60T 8/32**

[52] **U.S. Cl.** **364/426.044**; 364/461; 180/169; 180/170; 340/903

[58] **Field of Search** 364/426.041, 426.044, 364/460, 461, 565; 180/167–170, 176–179; 123/350, 352; 342/454, 455; 340/903, 904

[56] **References Cited**

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4,621,705	11/1986	Etoh	180/169
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61-146644	7/1996	Japan .

Primary Examiner—Gary Chin

Attorney, Agent, or Firm—Sixbey, Friedman, Leedom & Ferguson, P.C.; Gerald J. Ferguson, Jr.

[57] **ABSTRACT**

In a vehicle running mode detecting system, a relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object is calculated on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed. Whether the vehicle is running in a constant distance mode where the distance between the vehicle and the forward object is kept substantially constant or in a varying distance mode where the vehicle is accelerating or decelerating relative to the forward object and the distance between the vehicle and the forward object is varying is determined on the basis of the change in the distance between the vehicle and the forward object. The reference time is updated less frequently when the vehicle is running in the constant distance mode than when the vehicle is running in the varying distance mode.

9 Claims, 5 Drawing Sheets

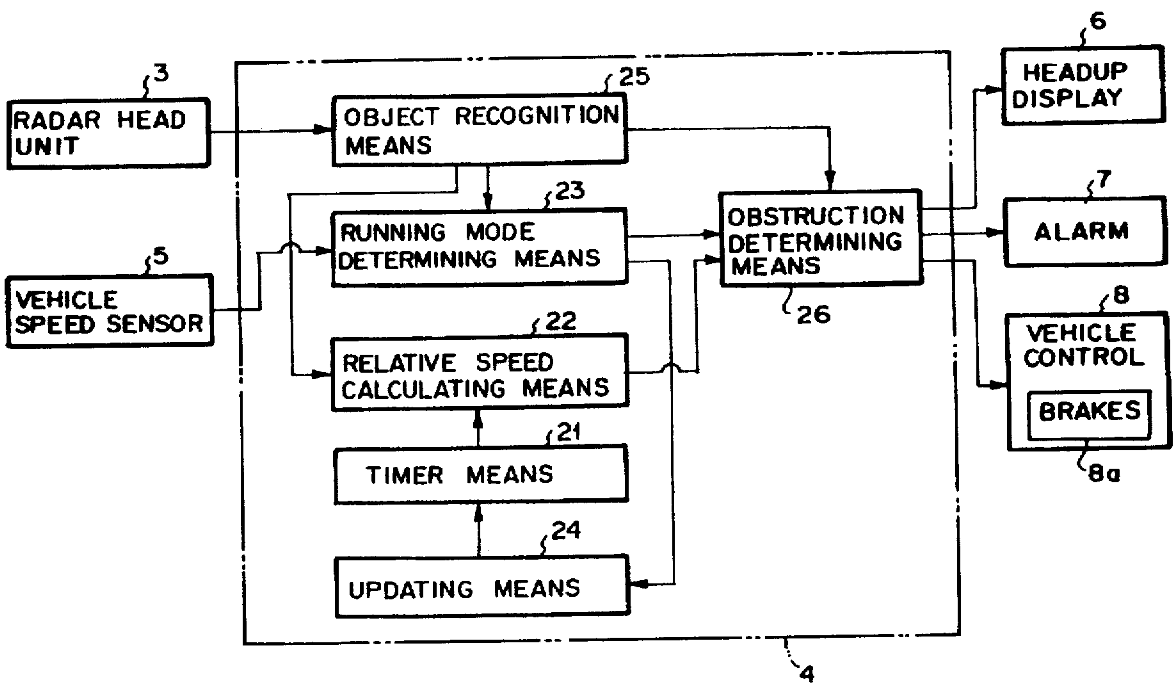


FIG.1

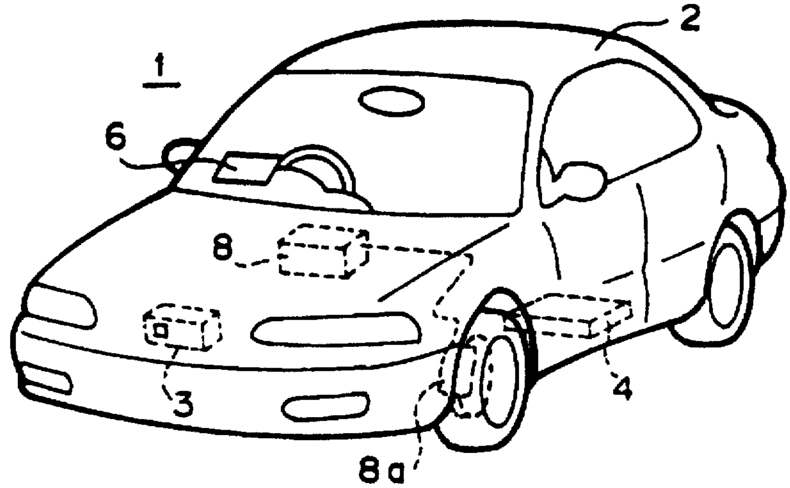
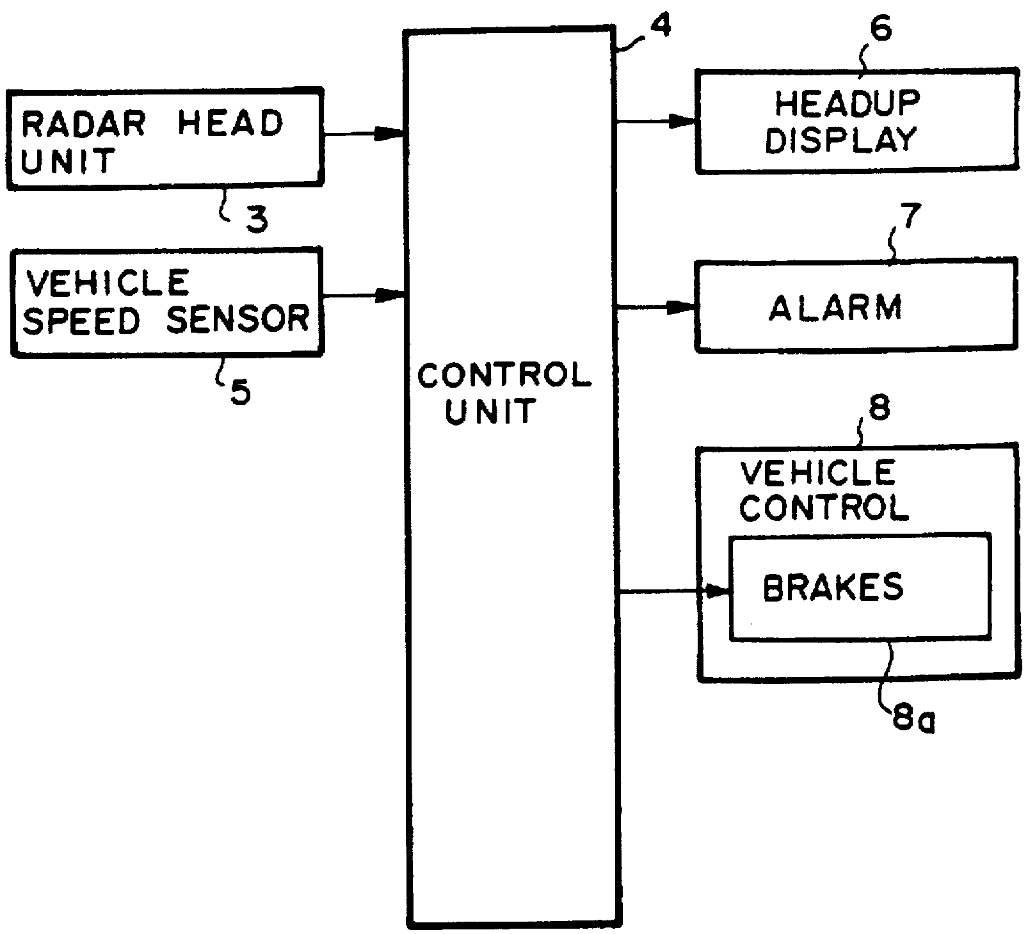

1
2
6
8
3
4
8a

FIG.2


RADAR HEAD UNIT
3
VEHICLE SPEED SENSOR
5
CONTROL UNIT
4
HEADUP DISPLAY
6
ALARM
7
VEHICLE CONTROL
8
BRAKES
8a

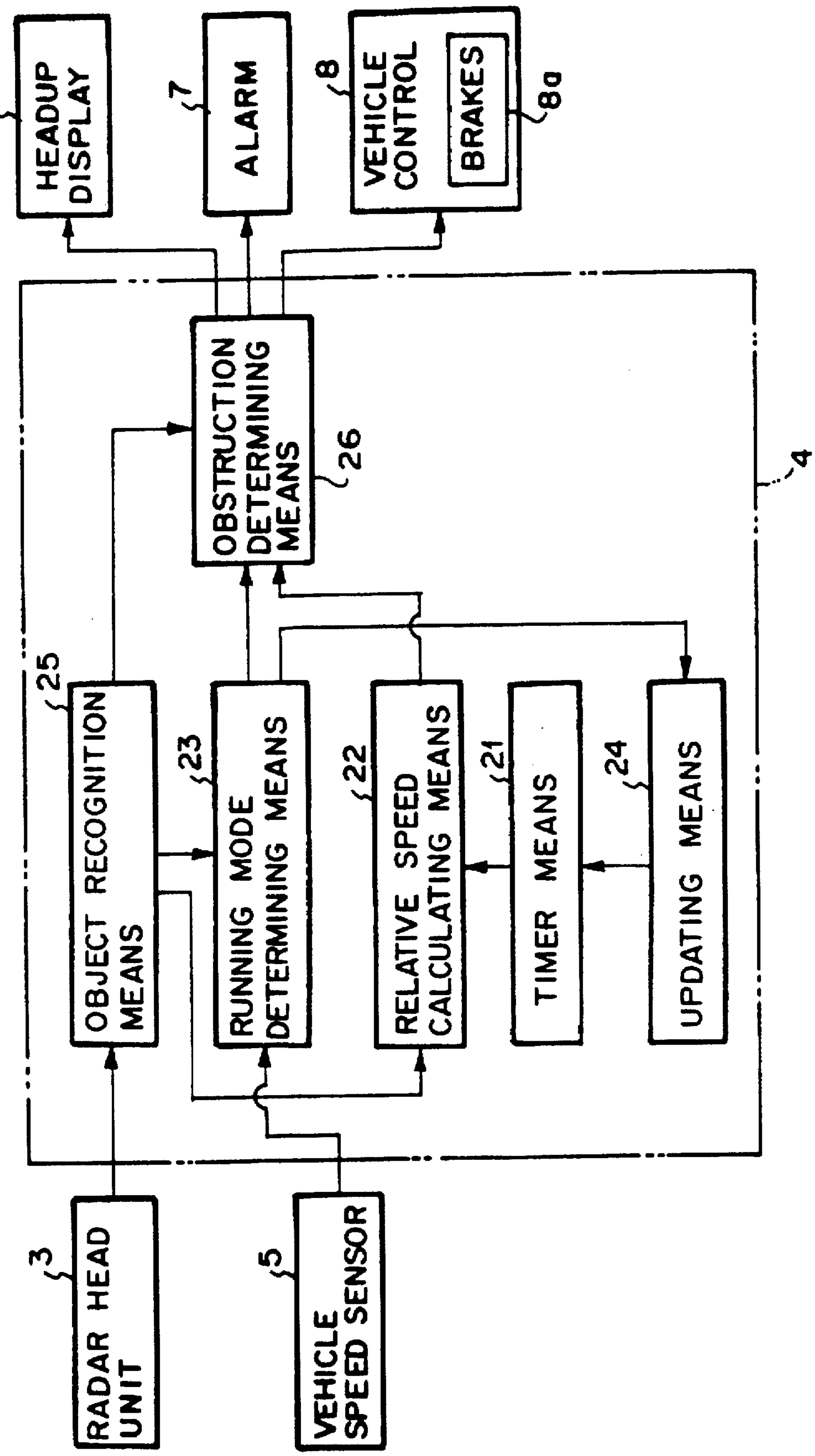

HEADUP DISPLAY
6
ALARM
7
VEHICLE CONTROL
8
BRAKES
8a
OBSTRUCTION DETERMINING MEANS
26
4
OBJECT RECOGNITION MEANS
25
RUNNING MODE DETERMINING MEANS
23
RELATIVE SPEED CALCULATING MEANS
22
TIMER MEANS
21
UPDATING MEANS
24
RADAR HEAD UNIT
3
VEHICLE SPEED SENSOR
5

FIG. 3

FIG.4

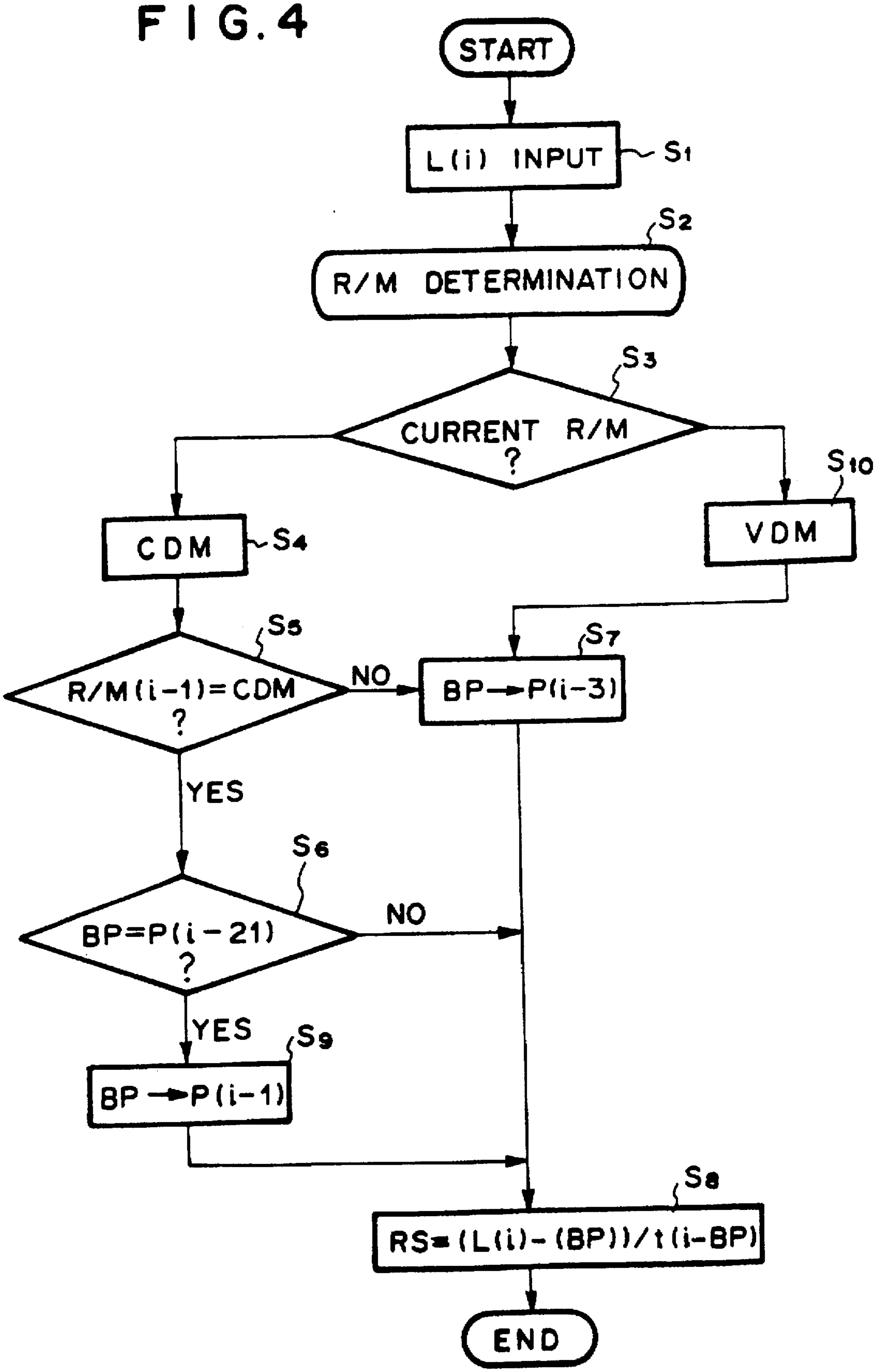

START
L(i) INPUT
S1
S2
R/M DETERMINATION
S3
CURRENT R/M ?
S10
VDM
CDM
S4
S5
R/M(i-1)=CDM ?
NO
S7
BP→P(i-3)
YES
S6
BP=P(i-21) ?
NO
YES
S9
BP→P(i-1)
S8
RS=(L(i)-(BP))/t(i-BP)
END

FIG.5

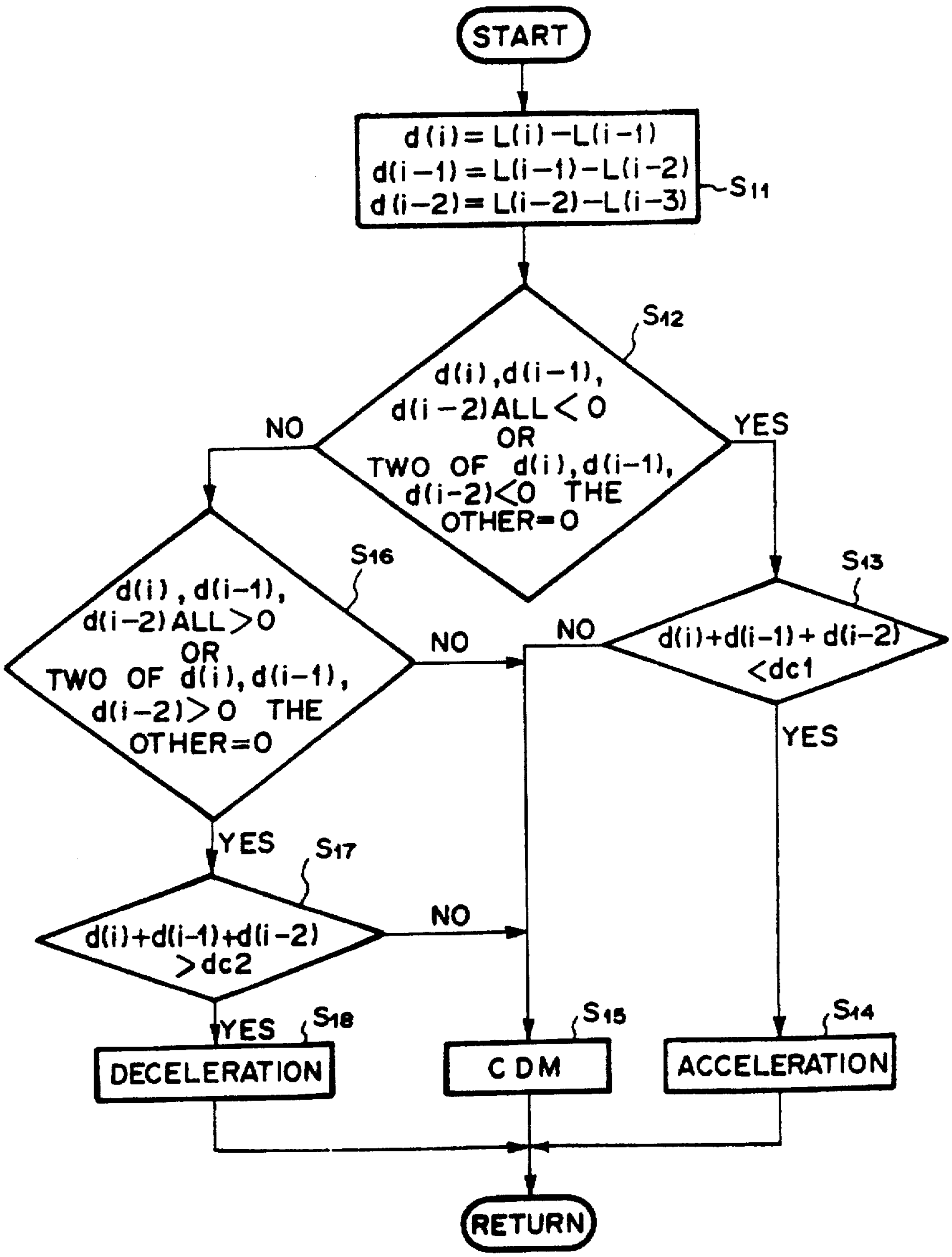
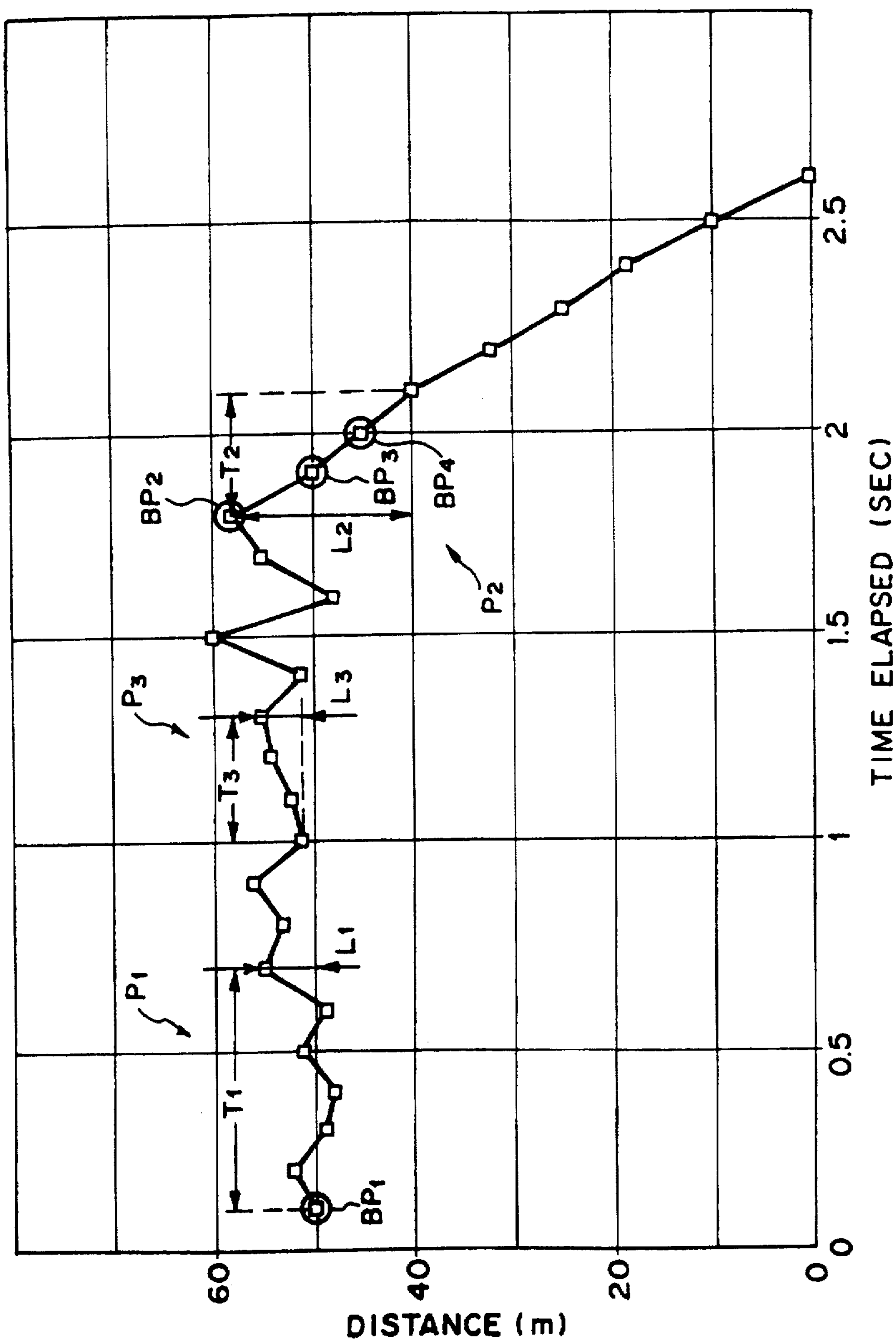

START
d(i)=L(i)−L(i−1)
d(i−1)=L(i−1)−L(i−2)
d(i−2)=L(i−2)−L(i−3)
S11
S12
d(i),d(i−1),
d(i−2)ALL<0
OR
TWO OF d(i),d(i−1),
d(i−2)<0 THE
OTHER=0
NO
YES
S16
d(i),d(i−1),
d(i−2)ALL>0
OR
TWO OF d(i),d(i−1),
d(i−2)>0 THE
OTHER=0
NO
S13
d(i)+d(i−1)+d(i−2)
<dc1
NO
YES
YES
S17
d(i)+d(i−1)+d(i−2)
>dc2
NO
YES
S18
DECELERATION
S15
CDM
S14
ACCELERATION
RETURN

FIG.6


BP1
BP2
BP3
BP4
P1
P2
P3
T1
T2
T3
L1
L2
L3
0
0.5
1
1.5
2
2.5
TIME ELAPSED (SEC)
0
20
40
60
DISTANCE (m)

VEHICLE RUNNING MODE DETECTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates a vehicle running mode detecting system which is provided with a relative speed calculating means which calculates the relative speed of a vehicle to a forward object being ahead of the vehicle in the way on the basis of a time elapsed from a reference time and a change in the distance between the vehicle and the forward object during the time elapsed.

2. Description of the Related Art

As disclosed, for instance, in Japanese Unexamined Patent Publication No. 61 (1986)-146644, there has been known a vehicle running mode detecting system in which the relative speed of a vehicle to the forward vehicle running ahead thereof is calculated on the basis of changes in the distance between the vehicles during different time intervals, thereby eliminating necessity of additional relative speed calculating means.

However in the system, since the relative speed is uniformly calculated independently from the running mode of the vehicle, i.e., whether the vehicle is running substantially at a constant distance from the forward vehicle or at a decreasing or increasing distance from the forward vehicle, efficiency of calculating the relative speed is low.

SUMMARY OF THE INVENTION

In view of the foregoing observations and description, the primary object of the present invention is to provide a vehicle running mode detecting system which can detect the relative speed of a vehicle to a forward object (e.g., a forward vehicle) at a high efficiency.

In accordance with one aspect of the present invention, there is provided a vehicle running mode detecting system comprising a relative speed calculating means which calculates the relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed, a running mode determining means which determines whether the vehicle is running in a constant distance mode where the distance between the vehicle and the forward object is kept substantially constant or in a varying distance mode where the vehicle is accelerating or decelerating relative to the forward object and the distance between the vehicle and the forward object is varying on the basis of the change in the distance between the vehicle and the forward object, and a reference time updating means which receives an output of the running mode determining means and updates the reference time less frequently when the running mode determining means determines that the vehicle is running in the constant distance mode than when the running mode determining means determines that the vehicle is running in the varying distance mode.

In an embodiment, the reference time is updated at predetermined intervals which are set longer when the running mode determining means determines that the vehicle is running in the constant distance mode than when the running mode determining means determines that the vehicle is running in the varying distance mode.

In another embodiment, the running mode determining means determines that the vehicle is running in the constant distance mode unless the distance to the forward object decreases or increases continuously.

In still another embodiment, the running mode determining means determines that the vehicle is running in the constant distance mode when the change in the distance to the forward object is small even if the distance to the forward object decreases or increases continuously.

In still another embodiment, the reference time updating means updates the reference time when the running mode determining means keeps determining that the vehicle is running in the constant distance mode for a time not shorter than a predetermined time.

In accordance with another aspect of the present invention, there is provided a vehicle running mode detecting system comprising a relative speed calculating means which calculates the relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed, a running mode determining means which determines that the vehicle is running in a varying distance mode where the vehicle is accelerating or decelerating relative to the forward object and the distance between the vehicle and the forward object is varying on the basis of the change in the distance between the vehicle and the forward object, and a reference time updating means which receives an output of the running mode determining means and updates the reference time more frequently as the degree of acceleration or deceleration of the vehicle increases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a vehicle equipped with a running control system employing a vehicle running mode detecting system in accordance with an embodiment of the present invention,

FIG. 2 is a schematic block diagram of the running control system,

FIG. 3 is a block diagram of the control unit,

FIG. 4 is a flow chart for illustrating the basic control of the control unit,

FIG. 5 is a flow chart for illustrating the manner of determining the running mode of the vehicle, and

FIG. 6 is a view for illustrating the manner of determining the running mode of the vehicle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1, a vehicle **1** is equipped with a running control system comprising a radar head unit **3** mounted in the front of the vehicle body **2**, a control unit **4**, a vehicle speed sensor **5**, a headup display **6**, an alarm **7** (FIG. **2**) and a vehicle control device **8**.

The radar head unit **3** emits a pulse laser beam (as a radar wave) forward of the vehicle **1** from a source and receives reflected light beam reflected by a forward object in the way such as a vehicle, thereby measuring the distance from the vehicle **1** to the forward object. The radar head unit **3** is of a scan type which causes a pulse laser beam, which is small in width and like a sector in a vertical cross-section, to scan horizontally through a relatively wide angle.

As shown in FIG. **2**, signals from the radar head unit **3** and the vehicle speed sensor **5** which detects the running speed of the vehicle 1 are input into the control unit 4 and the running mode of the vehicle 1 is determined by the control unit 4 and shown by the headup display 6. When it is determined that the forward object is an obstruction for the vehicle 1 to clear, the alarm 7 operates and the vehicle control device 8 automatically causes brakes 8a of the vehicle 1 to operate to decelerate the vehicle 1.

As shown in FIG. 3, the control unit 4 comprises an object recognition means 25 which receives a signal from the radar head unit 3 and recognizes a forward object such as a forward vehicle in the way of the vehicle 1, a relative speed calculating means 22 which receives signals from the object recognition means 25 and a timer means 21 and calculates the relative speed of the vehicle 1 to the forward object on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle 1 and the forward object during the time elapsed, a running mode determining means 23 which receives outputs of the object recognition means 25 and the vehicle speed sensor 5 and determines whether the vehicle 1 is running in a constant distance mode where the distance between the vehicle 1 and the forward object is kept substantially constant or in a varying distance mode where the vehicle 1 is accelerating or decelerating relative to the forward object and the distance between the vehicle 1 and the forward object is varying, and a reference time updating means 24 which receives an output of the running mode determining means 23 and sets the reference time updating frequency by the relative speed calculating means 22 lower when the running mode determining means 23 determines that the vehicle 1 is running in the constant distance mode than when the running mode determining means 23 determines that the vehicle 1 is running in the varying distance mode.

The control unit 4 further comprises an obstruction determining means 26 which receives outputs of the object recognition means 25 and the relative speed calculating means 22 and determines whether the forward object is an obstruction for the vehicle 1 to clear.

The running mode determining means 23 determines that the vehicle is running in the constant distance mode unless the distance to the forward object decreases or increases continuously and also determines that the vehicle is running in the constant distance mode when the change in the distance to the forward object is small even if the distance to the forward object decreases or increases continuously. Further the running mode determining means 23 determines whether the vehicle 1 is accelerating, decelerating or running at a constant speed on the basis of the signal from the vehicle speed sensor 5.

The reference time updating means 24 updates the reference time when the running mode determining means 23 keeps determining that the vehicle 1 is running in the constant distance mode for a time not shorter than a predetermined time in order to prevent deterioration in accuracy of detecting the relative speed.

The control by the control unit 4 will be described hereinbelow with reference to FIG. 4 assuming that a forward vehicle is recognized as the forward object. In this particular example, the object recognition means 25 detects the vehicle-to-vehicle distance (the distance between the forward vehicle and the vehicle 1) at regular intervals on the basis of the signal from the radar head unit 3. In the following description, L(i) denotes the current vehicle-to-vehicle distance.

In FIG. 4, the vehicle-to-vehicle distance L(i) is input. (step S1) More particularly, the last 19 vehicle-to-vehicle distances L(i-19) to L(i-1) are stored by the object recognition means 25.

Then the running mode (R/M) of the vehicle 1 is determined on the basis of the change in the vehicle-to-vehicle distance calculated on the basis of the output of the object recognition means 25 and the running speed of the vehicle 1 detected by the vehicle speed sensor 5. (step S2) Then the running mode determining means determines whether the current running mode is the constant distance mode (CDM) or the varying distance mode (VDM). (step S3)

When it is determined that the current running mode is constant distance mode, it is registered in the obstruction determining means 26. (step S4) Thereafter it is determined whether the preceding running mode (the running mode one point before) was the constant distance mode. (step S5) When it is determined that the preceding running mode was also the constant distance mode, it is determined that the current base point (or the reference time) from which the time elapsed is measured is the point which is 21 point before. When it is determined in step S5 that the preceding running mode was not the constant distance mode, that is, when the preceding running mode was the varying distance mode, the base point is updated to the point 3 point before (step S7) and then the relative speed is calculated according to the following formula (step S8).

$$Rs=\{L(i)-L(BP)\}/t(i-BP)$$

wherein Rs represents the relative speed, L(i) represents the vehicle-to-vehicle distance at the current point, L(BP) represents the vehicle-to-vehicle distance at the base point BP and t(i−BP) represents the time difference (the time elapsed) between the current point and the base point BP.

For example, assuming that the time elapsed from the base point BP1 is T1 and the change in the vehicle-to-vehicle distance during the time T1 is L1 in the part indicated at P1 in FIG. 6, the relative speed Rs is L1/T1.

When it is determined in step S6 that the current base point is the point which is 21 point before, the base point is updated to the point 1 point before (step S9) and then step S8 is executed. That is, when the running mode is the constant distance mode at successive tow points including the current point, the base point is not updated until the running mode keeps being the constant distance mode. In this particular embodiment, the base point is updated every 21 points when the running mode keeps being the constant distance mode.

When it is determined in step S3 that the current running mode is the varying distance mode, the step 7 is executed and the base point BP is updated to the point 3 point before after that the current running mode is the varying distance mode is registered in the obstruction determining means 26 in step S10. For example, when the vehicle-to-vehicle distance is decreasing, i.e., when the vehicle 1 is accelerating relative to the forward vehicle as in the part indicated at P2 in FIG. 6, the base point BP is changed from BP1 to BP2 and the relative speed Rs is L2/T2 assuming that the time elapsed from the base point BP2 is T2 and the change in the vehicle-to-vehicle distance during the time T2 is L2. Thus when the varying distance mode continues, the base point BP is constantly updated to BP3, BP4 and so on so that the relative speed Rs can be calculated following abrupt change in the same.

In step S3, the running mode is determined in the manner shown in FIG. 5. That is, the changes in the vehicle-to-vehicle distance between each of last three points and the preceding point d(i), d(i-1) and d(i-2) are calculated as follows. (step S11)

$d(i)=L(i)-L(i-1)$

$d(i-1)=L(i-1)-L(i-2)$

$d(i-2)=L(i-2)-L(i-3)$

Then it is determined whether or not the changes d(i), d(i-1) and d(i-2) are all negative or two of them are negative with the other being 0. (step S12) When it is determined that the changes d(i), d(i-1) and d(i-2) are all negative or two of them are negative with the other being 0, it is determined whether the sum of the changes d(i), d(i-1) and d(i-2) is smaller than a predetermined value dc1. (step S13) When it is determined the former is smaller than the latter, that is, when the change in the vehicle-to-vehicle distance is large, it is determined that the vehicle 1 is accelerating relative to the forward vehicle. (step S14) Otherwise it is determined that the vehicle 1 is running at a constant distance from the forward vehicle since the degree of acceleration is low. (step S15)

When it is not determined in step S12 that the changes d(i), d(i-1)) and d(i-2) are all negative or two of them are negative with the other being 0, it is determined whether or not the changes d(i), d(i-1) and d(i-2) are all positive or two of them are positive with the other being 0. (step S16) When it is determined that the changes d(i), d(i-1) and d(i-2) are all positive or two of them are positive with the other being 0, it is determined whether the sum of the changes d(i), d(i-1) and d(i-2) is larger than a predetermined value dc2. (step S17) When it is determined the former is larger than the latter, that is, when the change in the vehicle-to-vehicle distance is large, it is determined that the vehicle 1 is decelerating relative to the forward vehicle. (step S18) Otherwise it is determined that the vehicle 1 is running at a constant distance from the forward vehicle since the degree of deceleration is low. (step S15)

Thus when all the changes in the vehicle-to-vehicle distance in the last three intervals are not of the same sign (including 0), the running mode is determined to be the constant distance mode and the relative speed is calculated without changing the base point. Further even if all the changes in the vehicle-to-vehicle distance in the last three intervals are of the same sign (including 0), the change in the vehicle-to-vehicle distance is determined to be not abrupt and the running mode is determined to be the constant distance mode if the absolute value of the sum of the changes is smaller than a predetermined value. For example, in the part indicated at P3 in FIG. 6, though the three successive changes in the vehicle-to-vehicle distance are all positive, it is determined that the running mode is the constant distance mode since the change L3 in the elapsed time T3 is small. In this case, the relative speed is L3/T3.

Thus in the vehicle running mode detecting system of the present invention, the reference time is updated less frequently when the vehicle is running in the constant distance mode where the relative speed of the vehicle to the forward object need not be calculated so accurately than when the vehicle is running in a varying distance mode where the relative speed should be calculated accurately. Accordingly, the efficiency of calculating the relative speed can be improved.

What is claimed is:

1. A vehicle running mode detecting system comprising a relative speed calculating means which calculates the relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed,

a running mode determining means which determines whether the vehicle is running in a constant distance mode where the distance between the vehicle and the forward object is kept substantially constant or in a varying distance mode where the vehicle is accelerating or decelerating relative to the forward object and the distance between the vehicle and the forward object is varying on the basis of the change in the distance between the vehicle and the forward object, and

a reference time updating means which receives an output of the running mode determining means and updates the reference time less frequently when the running mode determining means determines that the vehicle is running in the constant distance mode than when the running mode determining means determines that the vehicle is running in the varying distance mode.

2. A vehicle running mode detecting system as defined in claim 1 in which said reference time updating means updates the reference time at predetermined intervals which are set longer when the running mode determining means determines that the vehicle is running in the constant distance mode than when the running mode determining means determines that the vehicle is running in the varying distance mode.

3. A vehicle running mode detecting system as defined in claim 2 in which the running mode determining means determines that the vehicle is running in the constant distance mode unless the distance to the forward object decreases or increases continuously.

4. A vehicle running mode detecting system as defined in claim 3 in which the running mode determining means determines that the vehicle is running in the constant distance mode when the change in the distance to the forward object is small even if the distance to the forward object decreases or increases continuously.

5. A vehicle running mode detecting system as defined in claim 4 in which the reference time updating means updates the reference time when the running mode determining means keeps determining that the vehicle is running in the constant distance mode for a time not shorter than a predetermined time.

6. A vehicle running mode detecting system as defined in claim 1 in which the running mode determining means determines that the vehicle is running in the constant distance mode unless the distance to the forward object decreases or increases continuously.

7. A vehicle running mode detecting system as defined in claim 1 in which the running mode determining means determines that the vehicle is running in the constant distance mode when the change in the distance to the forward object is small even if the distance to the forward object decreases or increases continuously.

8. A vehicle running mode detecting system as defined in claim 1 in which the reference time updating means updates the reference time when the running mode determining means keeps determining that the vehicle is running in the constant distance mode for a time not shorter than a predetermined time.

9. A vehicle running mode detecting system comprising

a relative speed calculating means which calculates the relative speed of a vehicle, equipped with the vehicle running mode detecting system, to a forward object on the basis of a time elapsed from a reference time based on which the time elapsed is measured and a change in the distance between the vehicle and the forward object during the time elapsed, a running mode determining means which determines a degree of acceleration or deceleration of the vehicle relative to the forward object and a variation in the distance between the vehicle and the forward object on the basis of the change in the distance between the vehicle and the forward object, and

a reference time updating means which receives an output of the running mode determining means and updates the reference time more frequently as the degree of acceleration or deceleration of the vehicle increases.

* * * * *

EXHIBIT 6

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS

EASTERN DIVISION

VELOCITY PATENT LLC,	)	
Plaintiff,	)	Civil Action No. 1:13-cv-08418
v.	)	Hon. Joan B. Gottschall
AUDI OF AMERICA, INC.	)	**JURY TRIAL DEMANDED**
Defendant.	)	

VELOCITY PATENT LLC'S INITIAL INFRINGEMENT CONTENTIONS PURSUANT TO LOCAL PATENT RULE 2.2

Plaintiff Velocity Patent LLC ("Velocity") hereby provides, pursuant to N.D. Ill. Local Patent Rule 2.2 of the Northern District of Illinois, the following Initial Infringement Contentions. Velocity contends that Audi of America, Inc. ("Audi") infringes each of the identified claims. The following contentions are based on knowledge and information in Velocity's possession, custody and control after a reasonable investigation of publicly-available sources and the limited number of documents produced by Audi pursuant to Local Patent Rule 2.1. The accused Audi products implement some of the infringing functionality in whole or in part using circuitry and associated programs, which are neither publicly available nor described in Audi's production to date. Therefore, Velocity reserves the right to revise, amend and supplement these contentions as discovery progresses and new information becomes available.

A. Identification of Infringed Claims and Applicable Statutory Section of 35 U.S.C. § 271

Claims 1-2, 4-5, 7-8, 10, 12-13, 15, and 17-32 of U.S. Patent No. 5,954,781 are directly infringed under 35 U.S.C § 271(a) by the accused Audi vehicles identified below.

B. Identification of Accused Instrumentalities By Claim

As set forth in the accompanying claim chart, Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster vehicles that include the identified features, infringe on or more of the claims identified above. On a claim-by-claim basis, the following Audi vehicles are accused of infringement by Velocity:

Claim 1 – Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 2 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 4 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 5 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 7 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 8 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 10 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 12 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 13 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 15 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster;

Claim 17 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 18 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 19 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 20 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 21 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 22 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 23 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 24 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 25 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 26 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 27 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 28 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 29 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 30 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 31 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7;

Claim 32 - Audi's A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, and Q7.

C. Claim Chart Comparing Each Element of the Asserted Claims to the Accused Instrumentalities

A claim chart identifying where each element of each asserted claim is found within each Accused Audi vehicle is attached.

D. Identification of Whether Each Element of Each Asserted Claim is Present in the Accused Instrumentalities Literally or Under the Doctrine of Equivalents

At this time, Velocity asserts that all of the asserted claim elements are literally present in the Accused Audi vehicles.

At this time, sections (e)-(f) of Local Patent Rule 2.2 are not applicable. Velocity expressly reserves the right to revise, amend and supplement these contentions as discovery progresses and new information becomes available.

Dated: April 8, 2014

Respectfully submitted,

/s/ James A. Shimota

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PROOF OF SERVICE

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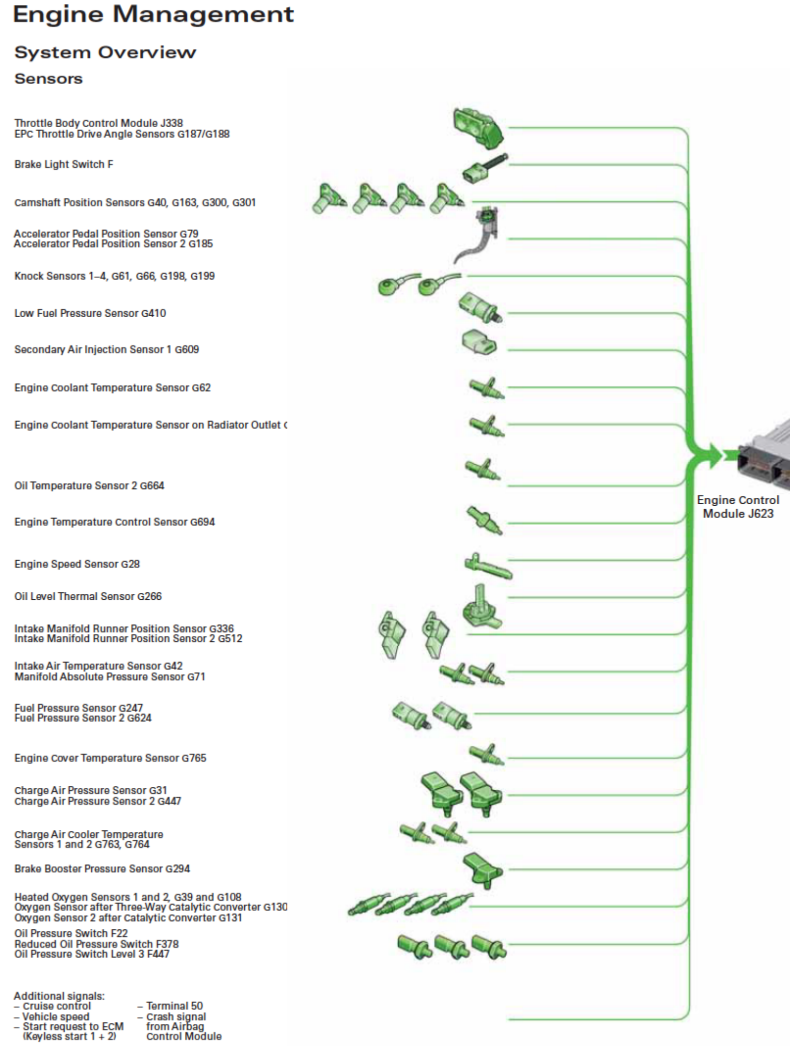
Velocity Patent LLC Preliminary Infringement Contentions Against Audi Defendants Pursuant to N.D. Ill. LPR 2.1

Claim 1	Corresponding Element in Audi Vehicles[1]
1A. Apparatus for optimizing operation of a vehicle, comprising:[2]	The accused Audi vehicles[3] include an apparatus for optimizing operation of a vehicle. For example, the accused Audi vehicles include computer-controlled vehicle systems with one or more computer processors that monitor various vehicle systems and optimize the fuel economy, safety and performance of the vehicle.

[1] Velocity contends that the accused vehicles literally and directly infringe each element of the asserted claims.
[2] Velocity's citations related to any claim preamble in this claim chart should not be interpreted as an admission that the preamble is limiting.
[3] The accused features and vehicles identified in these preliminary contentions are representative only. Velocity accuses all Audi vehicle models for model years 2007 to 2014 that incorporate features that are similar to the accused features identified in these preliminary contentions, including the A3, A4, S4, A5, A5 Cabriolet, S5, S5 Cabriolet, RS5, A6, S6, A7, S7, RS7, A8, S8, S8, A8L, allroad, Q5, Q5 hybrid, SQ5, Q7, TT, TTS, TT Roadster, and TTS Roadster. Discovery has just begun in this case. Velocity reserves the right to supplement and identify additional infringing models (*e.g.*, 2015 models currently being tested) as it learns facts through discovery.

Claim 1	Corresponding Element in Audi Vehicles[1]
	On-board computer You can call up the following information in the on-board computer: – Date – Driving time (h) from the short-term memory – Average consumption in MPG (l/100 km) from the short-term memory – Average speed in mph (km/h) from the short-term memory – Distance driven in miles (km) from the short-term memory – Current fuel consumption in MPG (l/100 km) – Short-term memory overview – Long-term memory overview The short-term memory collects driving information from the time the ignition is switched on until it is switched off. If you continue driving within two hours after switching the ignition off, the new values are included when calculating the current trip information. Unlike the short-term memory, the long-term memory is not erased automatically. You can select the time period for evaluating trip information yourself. (*See, e.g.,* Exhibits Audi-1, 2014 A7/S7 Owner's Manual at 26; Audi-2, 2014 A4/S4 Owner's Manual at 25-26; Audi-3, 2014 A5 Coupe/S5 Coupe Owner's Manual at 25-26; Audi-4, 2014 A5 Cabriolet/S5 Cabriolet Owner's Manual at 25-26; Audi-5, 2014 A6/S6 Owner's Manual at 26; Audi-6, 2014 Q5/SQ5 Owner's Manual at 23-24; Audi-7, 2014 Q7 Owner's Manual at 24-25; Audi-8, 2013 Audi A3 Owner's Manual at 25-26; Audi-9, 2013 A8/S8 Owner's Manual at 24-25; Audi-10, 2013 allroad Owner's Manual at 24-25; Audi-11, 2013 TT/TTS Roadster Owner's Manual at 23-24; Audi-12, 2013 TT/TTS/TT RS Coupe Owner's Manual at 23-24).

Claim 1	Corresponding Element in Audi Vehicles[1]
1B. a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor;	The accused Audi vehicles include a plurality of sensors coupled to the vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor. *See, e.g.*, citations for claim element 1A (describing processor controlled vehicle systems that monitor vehicle system characteristics and operations). More specifically, when equipped with an Audi 4.0L TFSI V8 engine, a 3.0L TFSI V6 engine, a 2.0L TFSI V4 engine, or a 1.8L TFSI V4 engine, the accused Audi vehicle includes a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor coupled to the engine control module ("ECM") of the vehicle:

Claim 1	Corresponding Element in Audi Vehicles[1]
	

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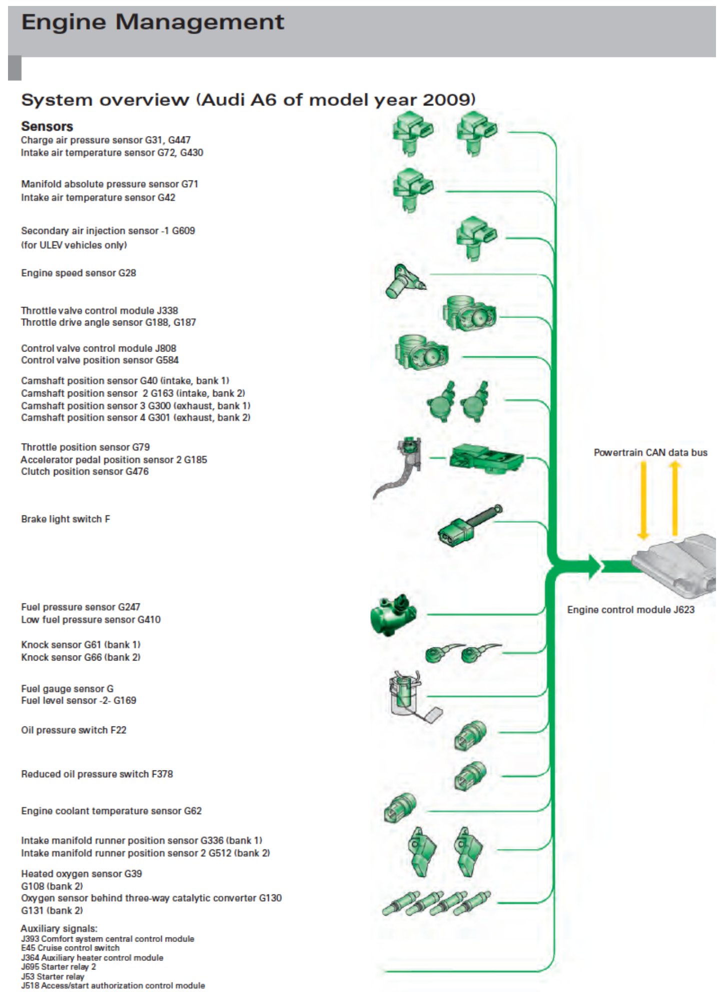
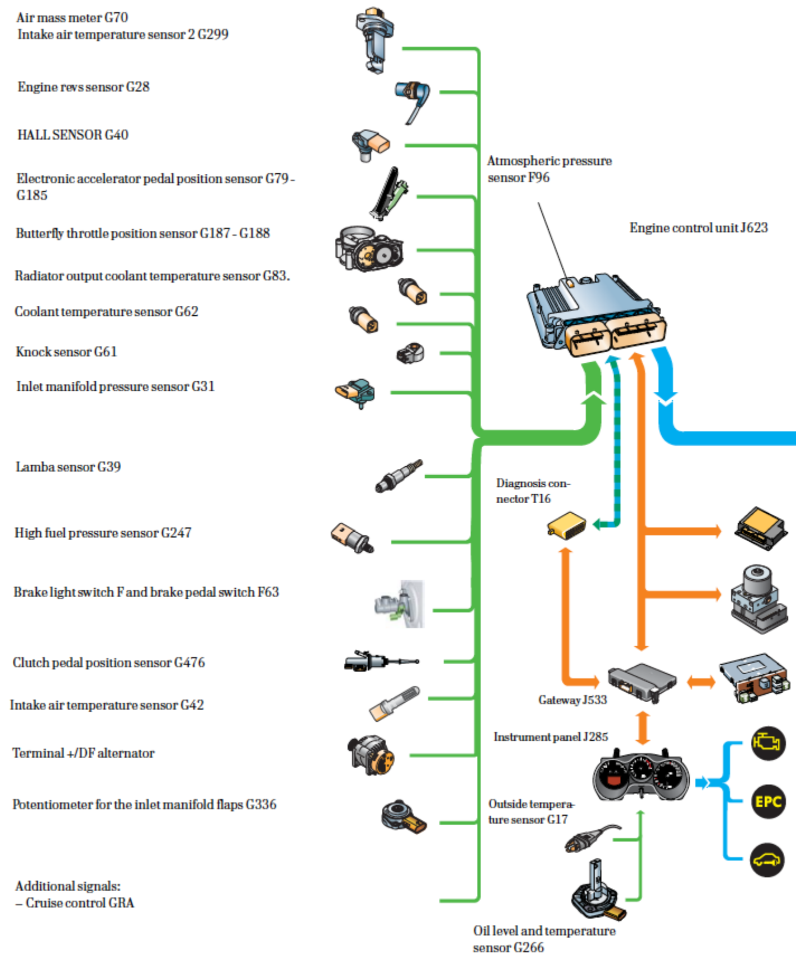
Claim 1	Corresponding Element in Audi Vehicles[1]
	(*See, e.g.*, Exhibit Audi-13, 4.0L V8 TFSI Self-Study Program at 82). 

Claim 1	Corresponding Element in Audi Vehicles[1]
	(*See, e.g.*, Exhibit Audi-14, 3.0L V6 TFSI Self-Study Program at 44). **Technical Description** **Four Cylinder, Four Valve, FSI Turbocharged Gasoline Engine** **Engine Block** – Cast Iron Crankcase – Balancer Shafts in Crankcase – Forged Steel Crankshaft – Self-Regulating Sump-Mounted Oil Pump — Chain-Driven by Crankshaft – Timing Gear Chain — Front End of Engine – Balancer — Chain-Driven at Front End of Engine **Cylinder Head** – 4-Valve Cylinder Head – 1 INA Intake Camshaft Adjuster – Audi Valve Lift System (AVS) on exhaust camshaft only **Intake Manifold** – Tumble Flap **Fuel Supply** – Demand Controlled on Low and High-pressure Ends – Multi-Port High-Pressure Injector **Engine Management** – MED 17 Engine Control – Hot-Film Air Mass Flow with Integral Temperature Sensor – Throttle Valve with Contactless Sensor – Map-Controlled Ignition with Cylinder-Selective, Digital Knock Control – Single-Spark Ignition Coils **Turbocharging** – Integral Exhaust Turbocharger – Charge-Air Cooler – Boost Pressure Control with Overpressure – Electrical Wastegate Valve **Exhaust** – Single-Chamber Exhaust System with Close-Coupled Pre-Catalyst **Combustion Process** – Fuel Straight Injection  (*See, e.g.*, Exhibit Audi-15, 2.0L V4 TFSI Self-Study Program at 2).

Claim 1	Corresponding Element in Audi Vehicles[1]
	 (*See, e.g.*, Exhibit Audi-16, 1.8L V4 TFSI Self-Study Program at 36).

Claim 1	Corresponding Element in Audi Vehicles[1]
	(*See also* Exhibits Audi-1 at 11; Audi-2 at 10; Audi-3 at 10; Audi-4 at 10; Audi-5 at 11; Audi-6 at 10; Audi-7 at 10; Audi-8 at 10; Audi-9 at 10; Audi-10 at 10; Audi-11 at 10; Audi-12 at 10 (all showing displays coupled to sensors for engine speed and road speed)). Additionally, on information and belief, vehicles equipped with Audi's FSI and TDI engines also include a plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, an engine speed sensor, a manifold pressure sensor and a throttle position sensor coupled to the engine control module ("ECM") of the vehicle.
1C. a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	The accused Audi vehicles include a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom.

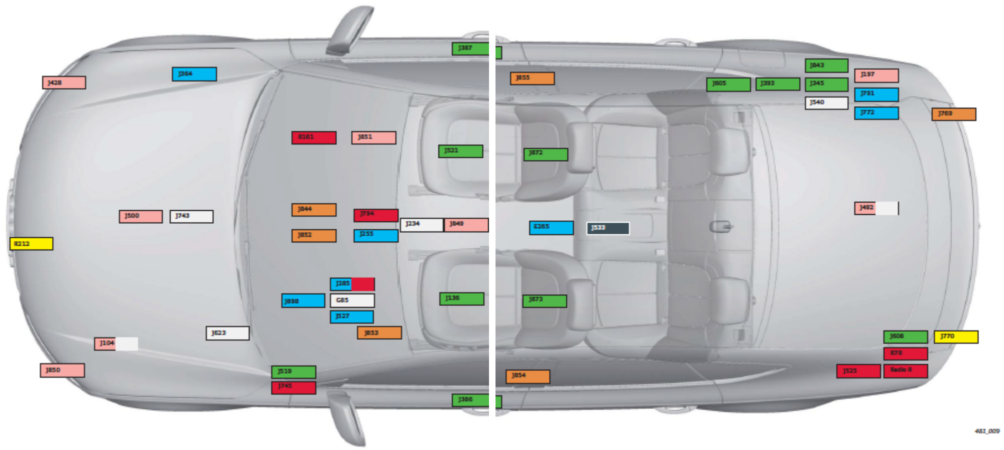
Claim 1	Corresponding Element in Audi Vehicles[1]
	(see below)

Networking

Installation locations of the control units

Some of the control units shown in the overview are optional and/or country-specific equipment.

Refer to the current service literature for details of controls unit positions, as well as instructions for installation and removal.



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Legend:

Control units on the convenience CAN bus
- J136 Seat and steering column adjustment control unit with memory
- J345 Trailer detector control unit
- J386 Door control unit, driver side
- J387 Door control unit, front passenger side
- J393 Convenience system central control unit
- J519 Onboard power supply control unit
- J521 Seat adjustment control unit with memory
- J605 Rear lid control unit
- J608 Special vehicle control unit
- J843 Vehicle tracking system interface control unit
- J872 Multi-contour seat control unit, front passenger side
- J873 Multi-contour seat control unit, driver side

CAN display and operation control units
- E265 Rear air conditioner/Climatronic operating and display unit
- J255 Climatronic control unit
- J285 Control unit in dash panel insert
- J364 Additional heater control unit
- J527 Steering column electronics control unit
- J772 Reversing camera system control unit
- J791 Audi parking system control unit
- J898 Windscreen projection system control unit

Control units on the powertrain CAN bus
- G85 Steering angle sender
- J234 Airbag control unit
- J540 Electromechanical park and handbrake control unit
- J623 Engine control unit
- J743 Twin clutch gearbox mechatronics

Control units on the extended CAN bus
- J745 Cornering light and headlight range control unit
- J769 Audi lane assist control unit
- J844 Headlight assist control unit
- J852 Camera control unit
- J853 Night vision system control unit
- J854 Front left belt pretensioner control unit
- J855 Front right belt pretensioner control unit

Control units on the MOST bus
- J285 Control unit in dash panel insert
- J525 Digital sound package control unit
- J794 Information electronics control unit 1
- R Radio
- R78 TV tuner
- R161 DVD auto changer

Control units on the FlexRay bus
- J104 ABS control unit
- J197 Adaptive suspension control unit
- J428 ACC control unit
- J492 Four-wheel drive control unit
- J500 Power steering control unit
- J849 Sensor electronics control unit
- J850 ACC control unit 2
- J851 Image processing control unit

Sub-bus users
- R212 Night vision system camera
- J770 Audi lane assist control unit 2

Users of all bus systems (gateway)
- J533 Data bus diagnostic interface

8

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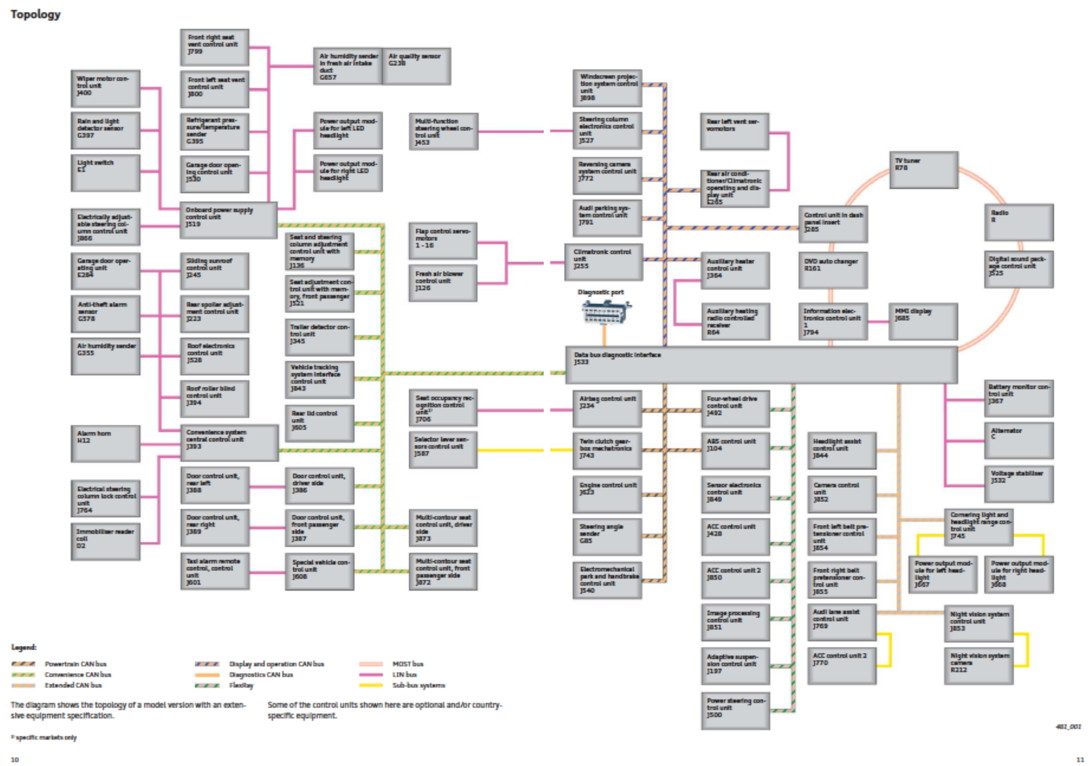
Claim 1	Corresponding Element in Audi Vehicles[1]
	 (*See, e.g.*, Exhibit Audi-20, Audi A7 Sportback Onboard Power Supply and Networking Self-Study Program at 8-11). (*See also, e.g.*, citations for claim elements 1A (describing processor controlled vehicle systems that monitor vehicle system characteristics and operations) and 1B (describing sensors coupled to ECM that measure system characteristics).
1D. a memory subsystem,	On information and belief, the accused Audi vehicles have a memory subsystem, coupled to said

Claim 1	Corresponding Element in Audi Vehicles[1]
coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors;	processor subsystem, said memory subsystem storing therein a manifold pressure set point, an RPM set point, and present and prior levels for each one of said plurality of sensors. For example, the accused Audi vehicles include one or more memories that form a memory subsystem for storing information relating to vehicle system operations and features described in the vehicle manuals:

Claim 1	Corresponding Element in Audi Vehicles[1]
	On-board computer You can call up the following information in the on-board computer: – Date – Driving time (h) from the short-term memory – Average consumption in MPG (l/100 km) from the short-term memory – Average speed in mph (km/h) from the short-term memory – Distance driven in miles (km) from the short-term memory – Current fuel consumption in MPG (l/100 km) – Short-term memory overview – Long-term memory overview The short-term memory collects driving information from the time the ignition is switched on until it is switched off. If you continue driving within two hours after switching the ignition off, the new values are included when calculating the current trip information. Unlike the short-term memory, the long-term memory is not erased automatically. You can select the time period for evaluating trip information yourself. (*See, e.g.*, Exhibits Audi-1 at 26; Audi-2 at 25-26; Audi-3 at 25-26; Audi-4 at 25-26; Audi-5 at 26; Audi-6 at 23-24; Audi-7 at 24-25; Audi-8 at 25-26; Audi-9 at 24-26; Audi-10 at 24-25; Audi-11 at 23-24; Audi-12 at 23-24).

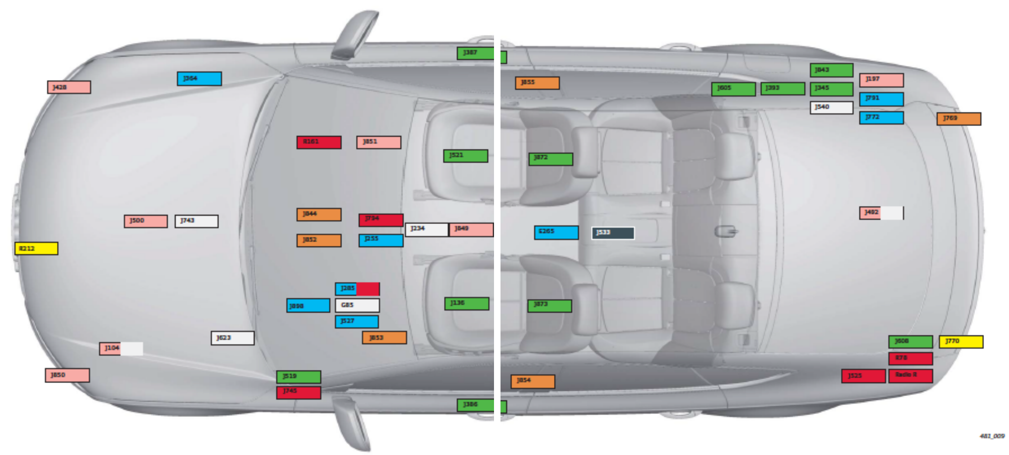
Claim 1	Corresponding Element in Audi Vehicles[1]
	(see reproduced page below)

Networking

Installation locations of the control units

Some of the control units shown in the overview are optional and/or country-specific equipment.

Refer to the current service literature for details of controls unit positions, as well as instructions for installation and removal.



481_009

Legend:

Control units on the convenience CAN bus
- J136 Seat and steering column adjustment control unit with memory
- J345 Trailer detector control unit
- J386 Door control unit, driver side
- J387 Door control unit, front passenger side
- J393 Convenience system central control unit
- J519 Onboard power supply control unit
- J521 Seat adjustment control unit with memory
- J605 Rear lid control unit
- J608 Special vehicle control unit
- J843 Vehicle tracking system interface control unit
- J872 Multi-contour seat control unit, front passenger side
- J873 Multi-contour seat control unit, driver side

CAN display and operation control units
- E265 Rear air conditioner/Climatronic operating and display unit
- J255 Climatronic control unit
- J285 Control unit in dash panel insert
- J364 Additional heater control unit
- J527 Steering column electronics control unit
- J772 Reversing camera system control unit
- J791 Audi parking system control unit
- J898 Windscreen projection system control unit

Control units on the powertrain CAN bus
- G85 Steering angle sender
- J234 Airbag control unit
- J540 Electromechanical park and handbrake control unit
- J623 Engine control unit
- J743 Twin clutch gearbox mechatronics

Control units on the extended CAN bus
- J745 Cornering light and headlight range control unit
- J769 Audi lane assist control unit
- J844 Headlight assist control unit
- J852 Camera control unit
- J853 Night vision system control unit
- J854 Front left belt pretensioner control unit
- J855 Front right belt pretensioner control unit

Control units on the MOST bus
- J285 Control unit in dash panel insert
- J525 Digital sound package control unit
- J794 Information electronics control unit 1
- R Radio
- R78 TV tuner
- R161 DVD auto changer

Control units on the FlexRay bus
- J104 ABS control unit
- J197 Adaptive suspension control unit
- J428 ACC control unit
- J492 Four-wheel drive control unit
- J500 Power steering control unit
- J849 Sensor electronics control unit
- J850 ACC control unit 2
- J851 Image processing control unit

Sub-bus users
- R212 Night vision system camera
- J770 Audi lane assist control unit 2

Users of all bus systems (gateway)
- J533 Data bus diagnostic interface

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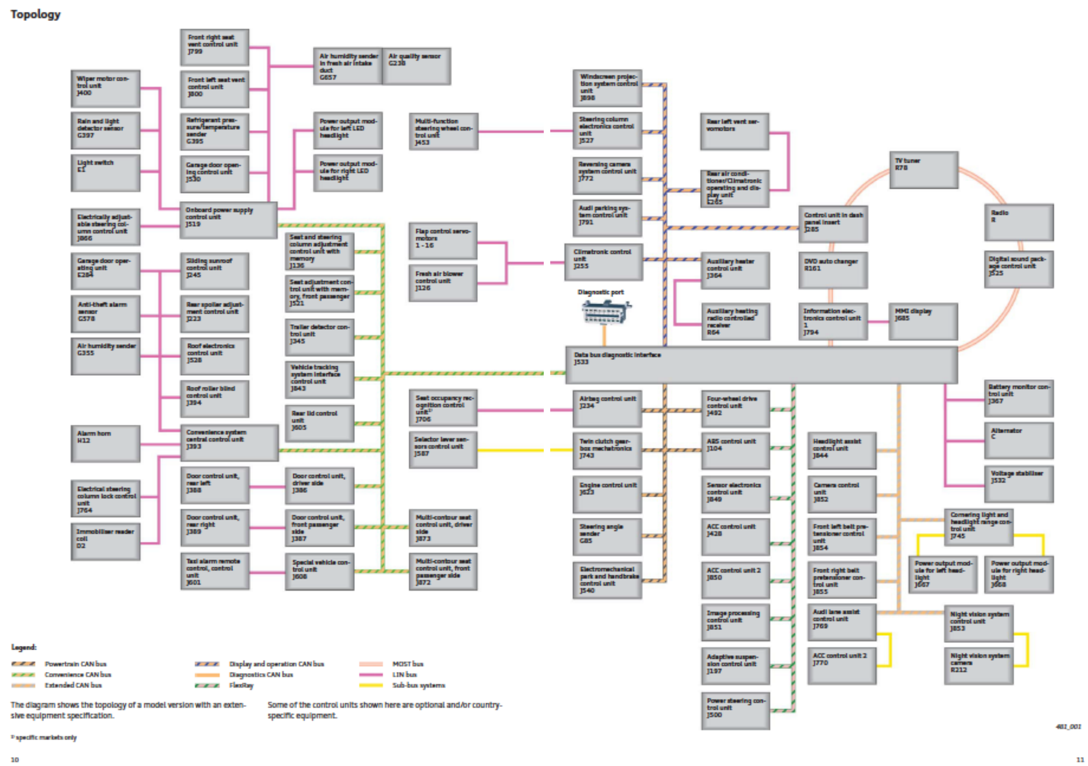
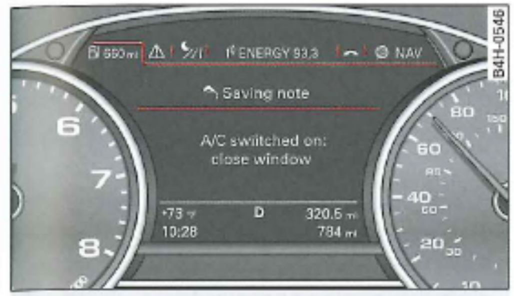
Claim 1	Corresponding Element in Audi Vehicles[1]
	 (*See, e.g.*, Exhibit Audi-20, Audi A7 Sportback Onboard Power Supply and Networking Self-Study Program at 8-11).

Claim 1	Corresponding Element in Audi Vehicles[1]
	Tips – If you switch the ignition or the adaptive cruise control off, the set speed is erased from the system memory. – You cannot switch the Electronic Stabilization Control (ESC) to the SPORT mode when adaptive cruise control is switched on. (*See, e.g.*, Exhibits Audi-1 at 89; Audi-2 at 103; Audi-3 at 94; Audi-4 at 96; Audi-5 at 87; Audi-6 at 110; Audi-7 at 114; Audi-9 at 96; Audi-10 at 94).
1E. a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	The accused Audi vehicles include a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle. For example, the accused Audi vehicles include one or more fuel overinjection notification circuits coupled to said processor subsystem:

Claim 1	Corresponding Element in Audi Vehicles[1]
	Cylinder on demand System Applies to vehicles: with 4.0 TFSI engine  **Fig. 10** Instrument cluster: fuel consumption To save fuel, the engine automatically turns four cylinders on or off, depending on the amount of power needed. This action is not felt by the passengers. **Displaying cylinder mode** Requirement: the on-board computer is displayed ⇨ *page 26*. ▸ Turn the thumbwheel until the current fuel consumption display is shown in the instrument cluster. If the green bar is displayed, you are driving in 4-cylinder mode. (*See, e.g.,* Audi-1 at 27; Audi-5 at 27; Audi-9 at 26).

Claim 1	Corresponding Element in Audi Vehicles[1]
	Fuel economy messages  Fig. 9 Display: example of a fuel economy message Fuel economy messages are displayed when fuel consumption is increased by certain conditions. If you follow these fuel economy messages, you can reduce your vehicle's consumption of fuel. The messages appear automatically and are only displayed in the efficiency program. The fuel economy messages turn off automatically after a certain period of time. ▸ To turn an economy message off immediately after it appears, press any button on the multifunction steering wheel. (*See, e.g.*, Audi-1 at 27; Audi-2 at 27-28; Audi-3 at 28-29; Audi-4 at 27-28; Audi-5 at 27; Audi-6 at 25-26; Audi-7 at 27; Audi-8 at 29-30; Audi-9 at 25-26; Audi-10 at 26-27; Audi-11 at 27; Audi-12 at 27).

Claim 1	Corresponding Element in Audi Vehicles[1]
	The current fuel consumption can be displayed using a bar ⇨ *page 27, fig. 10*. The average consumption (mpg) stored in the short-term memory is also displayed. Electrical energy can be stored in the battery when the vehicle is coasting or driving downhill (recuperation). The bar will move toward ▭. (*See, e.g.*, Audi-1 at 26; Audi-2 at 25-26; Audi-3 at 25-26; Audi-4 at 25-26; Audi-5 at 26; Audi-6 at 23-24; Audi-7 at 24-25; Audi-8 at 25-26; Audi-9 at 25; Audi-10 at 24-25; Audi-11 at 23-24; Audi-12 at 23-24).

Claim 1	Corresponding Element in Audi Vehicles[1]
	Speed warning system **Introduction** *The speed warning system helps you to stay under a specified maximum speed.* The speed warning system warns you if you are exceeding the maximum speed that you have set. You will hear a warning tone when your speed exceeds the stored value by approximately 3 mph (3 km/h). An indicator light (USA models)/ (Canada models) in the instrument cluster display also turns on at the same time. The indicator light / turns off when the speed decreases below the stored maximum speed. Setting a threshold is recommended if you would like to be reminded when you reach a certain maximum speed. Situations where you may want to do so include driving in a country with a general speed limit or if there is a specified maximum speed for winter tires. (*See, e.g.*, Audi-1 at 84; Audi-2 at 87-88; Audi-3 at 78-79; Audi-4 at 81-82; Audi-5 at 82; Audi-6 at 93-94; Audi-7 at 28-29; Audi-8 at 31-32; Audi-9 at 90; Audi-10 at 81-82; Audi-11 at 76-77; Audi-12 at 74-75).

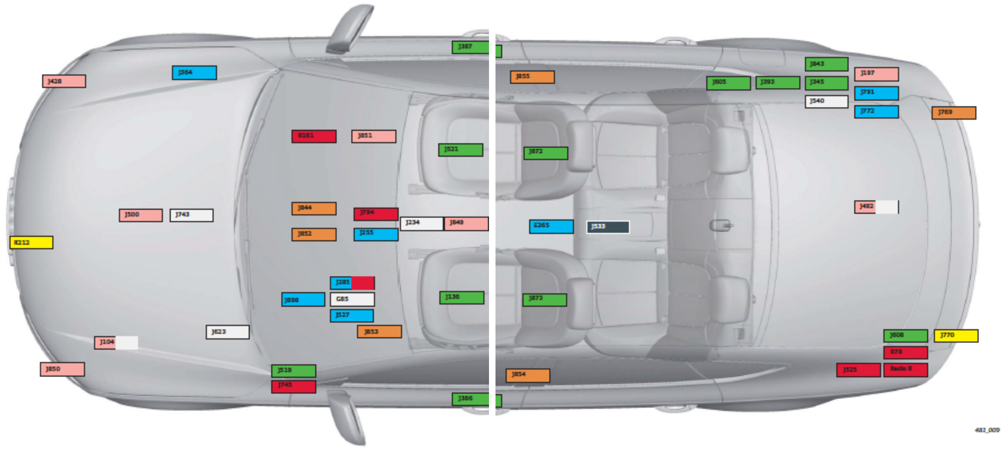
Claim 1	Corresponding Element in Audi Vehicles[1]

Networking

Installation locations of the control units

Some of the control units shown in the overview are optional and/or country-specific equipment.

Refer to the current service literature for details of controls unit positions, as well as instructions for installation and removal.



Legend:

Control units on the convenience CAN bus
- J136 Seat and steering column adjustment control unit with memory
- J345 Trailer detector control unit
- J386 Door control unit, driver side
- J387 Door control unit, front passenger side
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- J791 Audi parking system control unit
- J898 Windscreen projection system control unit

Control units on the powertrain CAN bus
- G85 Steering angle sender
- J234 Airbag control unit
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- J623 Engine control unit
- J743 Twin clutch gearbox mechatronics

Control units on the extended CAN bus
- J745 Cornering light and headlight range control unit
- J769 Audi lane assist control unit
- J844 Headlight assist control unit
- J852 Camera control unit
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- J854 Front left belt pretensioner control unit
- J855 Front right belt pretensioner control unit

Control units on the MOST bus
- J285 Control unit in dash panel insert
- J525 Digital sound package control unit
- J794 Information electronics control unit 1
- R Radio
- R78 TV tuner
- R161 DVD auto changer

Control units on the FlexRay bus
- J104 ABS control unit
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- J492 Four-wheel drive control unit
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- J849 Sensor electronics control unit
- J850 ACC control unit 2
- J851 Image processing control unit

Sub-bus users
- R212 Night vision system camera
- J770 Audi lane assist control unit 2

Users of all bus systems (gateway)
- J533 Data bus diagnostic interface

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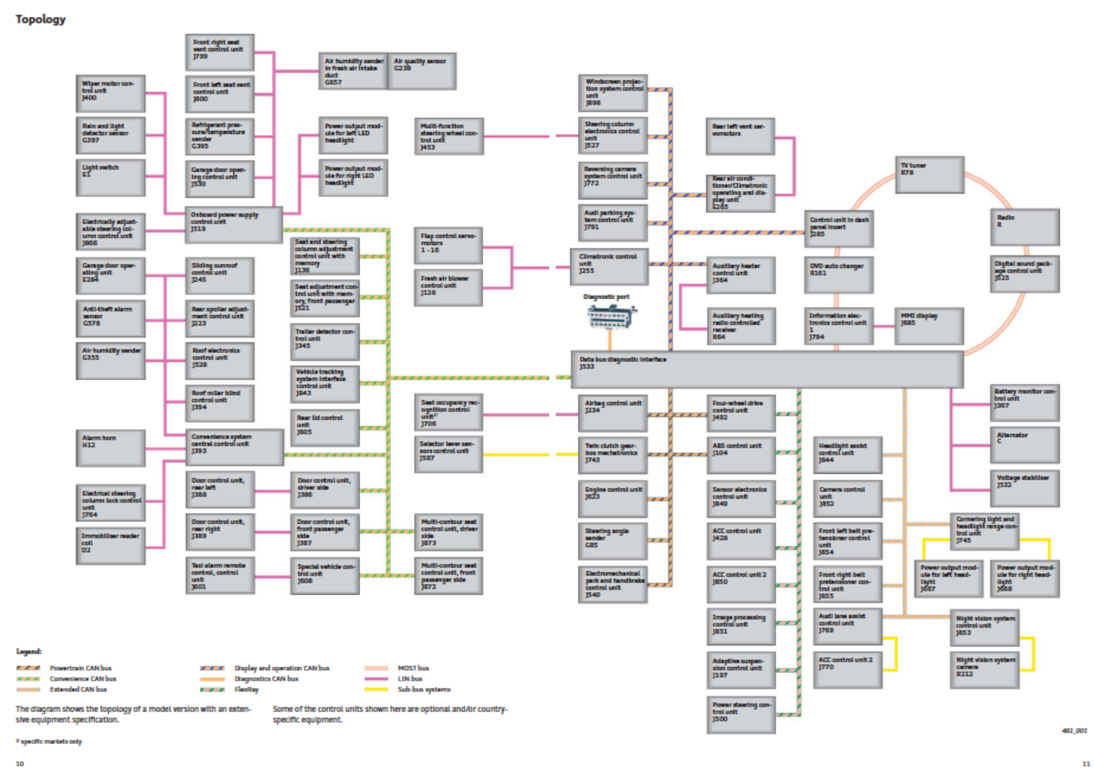
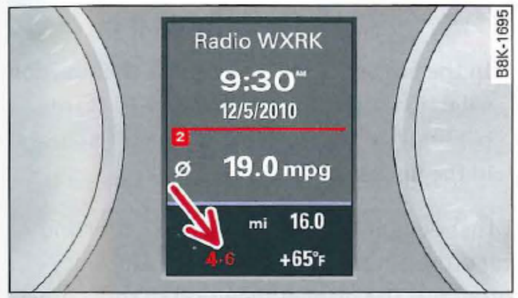
Claim 1	Corresponding Element in Audi Vehicles[1]
	 (*See, e.g.*, Exhibit Audi-20, Audi A7 Sportback Onboard Power Supply and Networking Self-Study Program at 8-11).
1F. an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that	The accused Audi vehicles include an upshift notification circuit coupled to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed. For example, the accused Audi vehicles include one or more upshift notification circuits coupled

Claim 1	Corresponding Element in Audi Vehicles[1]
said engine of said vehicle is being operated at an excessive speed;	to said processor subsystem, said upshift notification circuit issuing a notification that said engine of said vehicle is being operated at an excessive speed. **Efficiency program** The efficiency program can help you to use less fuel. It evaluates driving information in reference to fuel consumption and shows other equipment influencing consumption as well as shift recommendations. ⇨ *page 26*. Fuel economy messages ⇨ *page 27* provide tips for efficient driving. The efficiency program uses distance and consumption data from trip computer 1. (*See, e.g.,* Exhibits Audi-1 at 26; Audi-2 at 27-28; Audi-3 at 27-28; Audi-4 at 27; Audi-5 at 26; Audi-6 at 25; Audi-7 at 26; Audi-8 at 29; Audi-9 at 25; Audi-10 at 26; Audi-11 at 26-27; Audi-12 at 26-27).

Claim 1	Corresponding Element in Audi Vehicles[1]
	Gearshift Indicator Applies to vehicles: with manual transmission and gear-shift indicator *This indicator can help conserve fuel.*  **Fig. 12** Display: Gearshift indicator In order to become familiar with the gearshift indictor, at first just drive the way you are used to. If the current gear - and the driving situation - is not the best one for conserving fuel, then the indicator will display the recommended gear. The display shows the current gear and the gear that is recommended ⇨ *fig. 12*. – **Upshifting** The display will light up to the **right** of the gear currently selected if it is recommending a higher gear.

Claim 1	Corresponding Element in Audi Vehicles[1]
	– **Downshifting:** The display will light up to the **left** of the gear currently selected if it is recommending a lower gear. Sometimes the indicator will recommend skipping a gear (3 > 5). If there is no gearshift recommendation, then just drive in the appropriate gear for conserving fuel. (*See, e.g.*, Exhibits Audi-2 at 27; Audi-3 at 27; Audi-8 at 24).

Claim 1	Corresponding Element in Audi Vehicles[1]

Enhanced shift indicator

Applies to vehicles: with manual transmission and trip computer with efficiency program

Fig. 14 Display: enhanced shift indicator

► In the efficiency program, press the function selection switch ⇨ *page 26, fig. 11* Ⓑ repeatedly until the enhanced shift indicator appears in the display.

The efficiency program also has an enhanced shift indicator. This enhanced shift indicator follows the same concept as the "standard" shift indicator ⇨ *page 27*. The selected and the recommended gears are highlighted in colors like a traffic light.

The color of the circle indicates if the most suitable gear is engaged or if you should shift up or down.

Green circle without or with a gear	No gear or the most suitable gear is engaged
Yellow circle ⇨ *fig. 14*	Shift up or down one gear
Red circle	Shift up two gears

Note

This enhanced shift indicator can help you conserve fuel. It is not designed to recommend the correct gear in all driving situations. Only the driver can decide which

(*See*, *e.g.*, Exhibits Audi-2 at 28; Audi-3 at 28).

Claim 1	Corresponding Element in Audi Vehicles[1]

Control unit with display in dash panel insert

The upshift indicator

Upshift indicator in Midline or Highline dash panel insert   393_043

Function

The upshift indicator in the driver information system is a new function designed to help the driver to reduce fuel consumption. The function is integrated in the engine management software. It is featured on all petrol and diesel models with manual gearbox.

As modern vehicle engines deliver high torque even at low rpm, it is often possible to drive in a higher gear.In this case, a gearshift recommendation is indicated to the driver via the driver information system. The gearshift recommendation may involve skipping a gear.

The actual gear position is indicated continuously in the driver information system. This information is derived from the actual engine speed and road speed signals. Neither the actual gear position nor any gearshift recommendations are indicated while the clutch is actuated (for longer than 2 seconds). No gearshift recommendation is given when the engine is operating at full throttle either.

Normally no gearshift recommendation is issued when the vehicle is in overrun. However, if the engine speed drops below a critical threshold, a recommendation to shift down a gear will be given.

To implement the "upshift indicator" function, the engine control unit also requires information from the steering angle sender G85, the ABS control unit J104 and the convenience system control unit J393. The engine control unit receives this information via CAN bus.

Indicator

The gearshift recommendation computed by the engine control unit is transmitted via CAN bus to the dash panel insert and displayed in the driver information system. There are two possible states of the display:

1 The actual gear position is displayed with or without a gearshift recommendation.

2 No display. This is the case if the clutch is actuated for longer than two seconds or if the driver has deactivated the function on the MMI.

12

Claim 1	Corresponding Element in Audi Vehicles[1]
	(*See, e.g.*, Exhibit Audi-21, Audi A5 Convenience Electronics and Drive Assist Systems Self-Study Program at 12). **All of the performance for all of the senses** The dynamic steering adjusts to road and weather conditions. The RS 7 exclusive head up LED shift indicators reveal the precise moment to unleash the next gear. And a transmission tuned for an ultra-responsive, G-inducing throttle. All designed to maximize every exhilarating aspect of the driving experience. (*See, e.g.,* Exhibit Audi-17, 2014 RS7 Specification at 3). **Transmission overheating: Please drive conservatively** The transmission temperature has increased significantly due to the sporty driving manner. Drive in a less sporty manner until the temperature returns to the normal range and the indicator light switches of. (*See, e.g.*, Exhibits Audi-1 at 114; Audi-2 at 97; Audi-3 at 88; Audi-4 at 91; Audi-5 at 112-13; Audi-6 at 128; Audi-7 at 128; Audi-9 at 119; Audi-10 at 89).

Claim 1	Corresponding Element in Audi Vehicles[1]

Automatic Transmission 1

⚠ WARNING

Hill descent control cannot overcome physical limitations, so it may not be able to maintain a constant speed under all conditions. Always be ready to apply the brakes.

Manual shift program

Applies to vehicles: with S tronic/tiptronic

Using the manual shift program you can manually select gears.

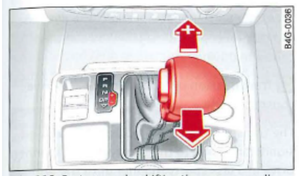


Fig. 119 Center console: shifting the gears manually

Fig. 120 Steering wheel: Shift buttons*

Gear selection with selector lever

The tiptronic mode can be selected either with the vehicle stationary or on the move.

- Push the selector lever to the right from D/S. An M appears in the instrument cluster display as soon as the transmission has shifted.
- To upshift, push the selector lever forward to the plus position ⊕ ⇨ *fig. 119*.
- To downshift, push the lever to the minus position ⊖.

Gear selection with paddle levers*

The shift buttons are activated when the selector lever is in D/S or the tiptronic manual shift program.

- To upshift, touch the button on the right ⊕ ⇨ *fig. 120*.
- To downshift, touch the button on the left ⊖.

The transmission automatically shifts up or down before critical engine speed is reached.

The transmission only allows manual shifting when the engine speed is within the permitted range.

ⓘ **Tips**

- When you shift into the next lower gear, the transmission will downshift only when there is no possibility of over-revving the engine.
- When the kick-down comes on, the transmission will shift down to a lower gear, depending on vehicle and engine speeds.
- Tiptronic is inoperative when the transmission is in the fail-safe mode.

Kick-down

Applies to vehicles: with S tronic/tiptronic

Kick-down enables maximum acceleration.

When you depress the accelerator pedal beyond the resistance point, the automatic transmission downshifts into a lower gear, depending on vehicle speed and engine speed. The upshift into the next higher gear takes place once the maximum specified engine speed is reached.

⚠ WARNING

Please note that the drive wheels can spin if kick-down is used on a smooth slippery road - there is a risk of skidding.

(*See, e.g.,* Exhibits Audi-1 at 113; Audi-2 at 96; Audi-3 at 86-87; Audi-4 at 89-90; Audi-5 at 111; Audi-6 at 127; Audi-7 at 140-41; Audi-8 at 99-100; Audi-9 at 118; Audi-10 at 89; Audi-11 at 85-86; Audi-12 at 84).

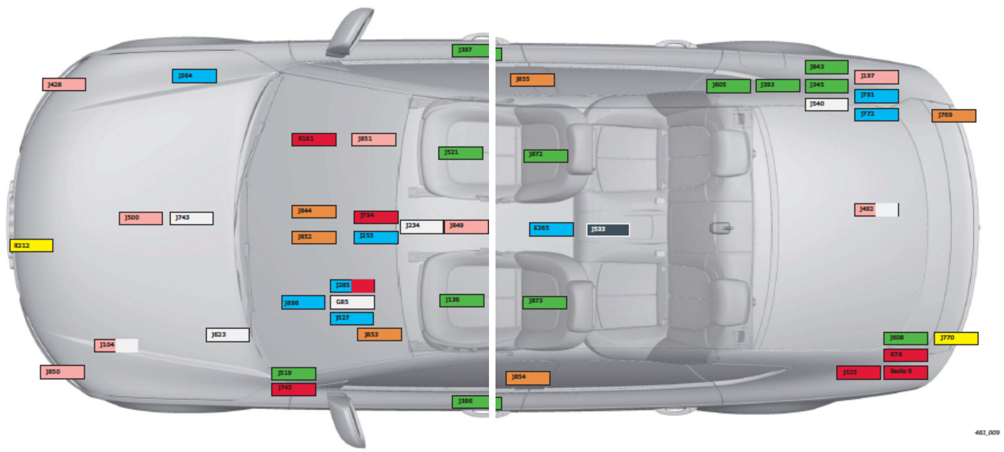
Claim 1	Corresponding Element in Audi Vehicles[1]

Networking

Installation locations of the control units

Some of the control units shown in the overview are optional and/or country-specific equipment.

Refer to the current service literature for details of controls unit positions, as well as instructions for installation and removal.



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Legend:

Control units on the convenience CAN bus
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Sub-bus users
- R212 Night vision system camera
- J770 Audi lane assist control unit 2

Users of all bus systems (gateway)
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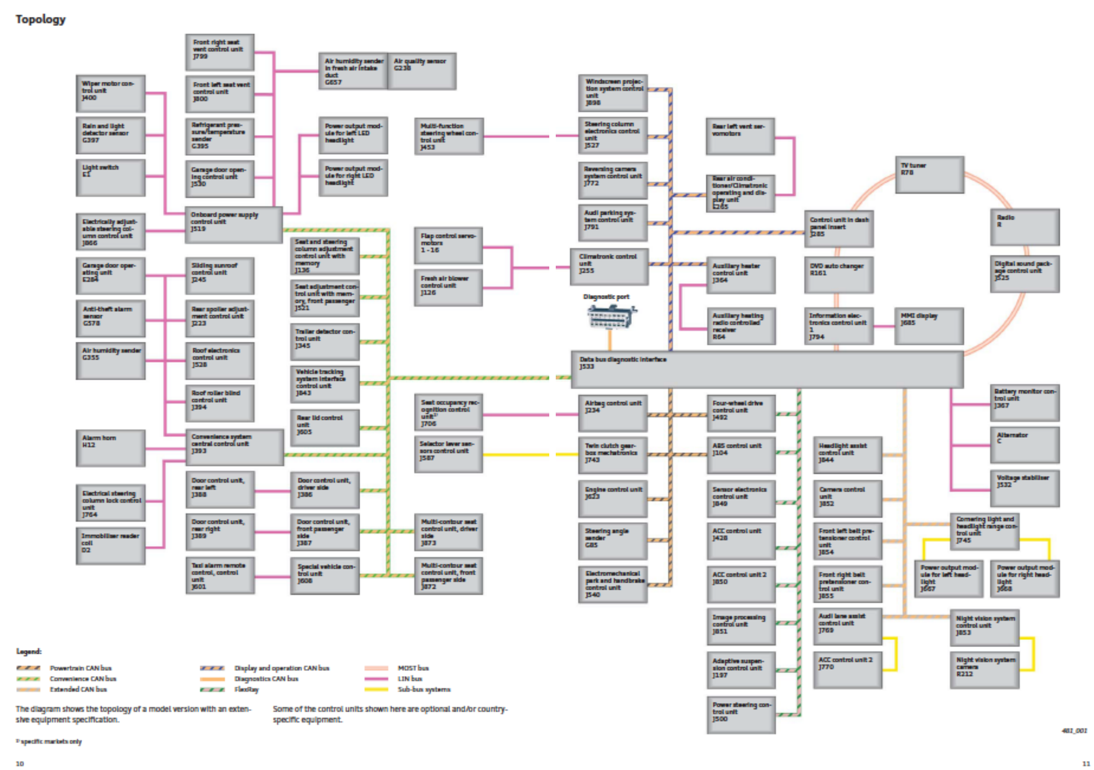
Claim 1	Corresponding Element in Audi Vehicles[1]
	 (*See, e.g.*, Exhibit Audi-20, Audi A7 Sportback Onboard Power Supply and Networking Self-Study Program at 8-11).
1G. said processor subsystem determining, based upon data received from said plurality of	On information and belief, the accused Audi vehicles include a processor subsystem that determines based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.

Claim 1	Corresponding Element in Audi Vehicles[1]
sensors, when to activate said fuel overinjection circuit and when to activate said upshift notification circuit.	*See, e.g.*, citations for elements 1A-1F.

Claim 2	**Corresponding Element in Audi Vehicles**
2A. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises: *See, e.g.*, citations for claim 1.
2B. means for determining when road speed for said vehicle is increasing;	The accused Audi vehicles include a means for determining when road speed for said vehicle is increasing. *See, e.g.*, citations for claim elements 1B-1D. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when road speed for said vehicle is increasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to Road Speed Sensor 18, Memory Subsystem 14, and Processor Subsystem 12.
2C. means for determining when throttle position for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when throttle position for said vehicle is increasing. *See, e.g.*, citations for claim elements 1B-1D. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when throttle position for said vehicle is increasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to Throttle Sensor 24, Memory Subsystem 14, and Processor Subsystem 12.
2D. means for comparing manifold pressure to said manifold pressure set point;	The accused Audi vehicles include a means for comparing manifold pressure to said manifold pressure set point. *See, e.g.*, citations for claim elements 1B-1D.

Claim 2	Corresponding Element in Audi Vehicles
	To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "comparing manifold pressure to said manifold pressure set point" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to Manifold PSI Sensor 22, Memory Subsystem 14, and Processor Subsystem 12.
2E. said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	On information and belief, the accused Audi vehicles include a processor subsystem that activates said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point. *See, e.g.*, citations for claim elements 1E, 1G.

Claim 4	Corresponding Element in Audi Vehicles
4A. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises: *See, e.g.*, citations for claim 1.
4B. means for determining when road speed for said vehicle is decreasing;	The accused Audi vehicles include a means for determining when road speed for said vehicle is decreasing. *See, e.g.*, citations for claim element 2B. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when road speed for said vehicle is decreasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to Road Speed Sensor 18, Memory Subsystem 14, and Processor Subsystem 12.
4C. means for determining when throttle position for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when throttle position for said vehicle is increasing. *See, e.g.*, citations for claim element 2C.
4D. means for determining when manifold pressure for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when manifold pressure for said vehicle is increasing. *See, e.g.*, citations for claim elements 1B-1D. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when manifold pressure for said vehicle is increasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to Manifold PSI Sensor 22, Memory Subsystem 14, and Processor

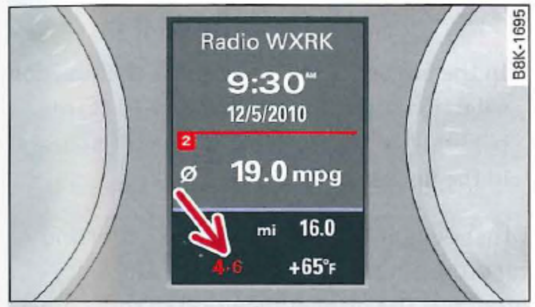
Claim 4	Corresponding Element in Audi Vehicles
	Subsystem 12.
4E. means for determining when engine speed for said vehicle is decreasing;	The accused Audi vehicles include a means for determining when engine speed for said vehicle is decreasing. *See, e.g.*, citations for claim elements 1B-1D. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when engine speed for said vehicle is decreasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to RPM Sensor 20, Memory Subsystem 14, and Processor Subsystem 12.
4F. said processor subsystem activating said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing.	On information and belief, the accused Audi vehicles include a processor subsystem that activates said fuel overinjection notification circuit if both throttle position and manifold pressure for said vehicle are increasing and road speed and engine speed for said vehicle are decreasing. *See, e.g.*, citations for claim elements 1E, 1G.

Claim 5	Corresponding Element in Audi Vehicles
5A. Apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle according to claim 1 wherein said processor subsystem further comprises: *See, e.g.*, citations for claim 1.
5B. means for determining when road speed for said vehicle is increasing;	The accused Audi vehicles include a means for determining when road speed for said vehicle is increasing. *See, e.g.*, citations for claim element 2B.
5C. means for determining when throttle position for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when throttle position for said vehicle is increasing. *See, e.g.*, citations for claim element 2C.
5D. means for comparing manifold pressure to said manifold pressure set point;	The accused Audi vehicles include a means for comparing manifold pressure to said manifold pressure set point. *See, e.g.*, citations for claim element 2D.
5E. means for comparing engine speed to said RPM set point;	The accused Audi vehicles include a means for comparing engine speed to said RPM set point. *See, e.g.*, citations for claim elements 1B-1D. To the extent that 35 U.S.C. §112(6) applies to this claim limitation, the structure(s), act(s), or materials(s) that perform the claimed function of "determining when engine speed for said vehicle is decreasing" are described in, for example, Figures 1 and 2 and associated text of the '781 patent relating to RPM Sensor 20, Memory Subsystem 14, and Processor Subsystem 12.
5F. said processor subsystem activating said	On information and belief, the accused Audi vehicles include a processor subsystem that activates said upshift notification circuit if both road speed and throttle position for said vehicle

Claim 5	Corresponding Element in Audi Vehicles
upshift notification circuit if both road speed and throttle position for said vehicle are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point.	are increasing, manifold pressure for said vehicle is at or below said manifold pressure set point and engine speed for said vehicle is at or above said RPM set point. *See, e.g.*, citations for claim elements 1F, 1G.

Claim 7	Corresponding Element in Audi Vehicles
7A. Apparatus for optimizing operation of a vehicle, comprising:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle. *See, e.g.*, citations for claim 1.
7B. a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor;	The accused Audi vehicles include a plurality of sensors coupled to a vehicle having an engine, said plurality of sensors, which collectively monitor operation of said vehicle, including a road speed sensor, a manifold pressure sensor and a throttle position sensor; *See, e.g.*, citations for claim element 1B.
7C. a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom;	The accused Audi vehicles include a processor subsystem, coupled to each one of said plurality of sensors, to receive data therefrom. *See, e.g.*, citations for claim element 1C.
7D. a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors;	The accused Audi vehicles include a memory subsystem, coupled to said processor subsystem, said memory subsystem storing therein a manifold pressure set point and present and prior levels for each one of said plurality of sensors; *See, e.g.*, citations for claim element 1D.
7E. a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection	The accused Audi vehicles include a fuel overinjection notification circuit coupled to said processor subsystem, said fuel overinjection notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;

Claim 7	Corresponding Element in Audi Vehicles
notification circuit issuing a notification that excessive fuel is being supplied to said engine of said vehicle;	*See, e.g.*, citations for claim element 1E.
7F. a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and	The accused Audi vehicles include a downshift notification circuit coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient engine speed; and For example, the accused Audi vehicles include one or more downshift notification circuits coupled to said processor subsystem, said downshift notification circuit issuing a notification that said engine of said vehicle is being operated at an insufficient speed. **Efficiency program** The efficiency program can help you to use less fuel. It evaluates driving information in reference to fuel consumption and shows other equipment influencing consumption as well as shift recommendations. ⇨ *page 26*. Fuel economy messages ⇨ *page 27* provide tips for efficient driving. The efficiency program uses distance and consumption data from trip computer 1. (*See, e.g.,* Exhibits Audi-1 at 26; Audi-2 at 27-28; Audi-3 at 27-28; Audi-4 at 27; Audi-5 at 26; Audi-6 at 25; Audi-7 at 26; Audi-8 at 29; Audi-9 at 25; Audi-10 at 26; Audi-11 at 26-27; Audi-12 at 26-27).

Claim 7	Corresponding Element in Audi Vehicles
	Gearshift Indicator Applies to vehicles: with manual transmission and gear-shift indicator *This indicator can help conserve fuel.*  **Fig. 12** Display: Gearshift indicator In order to become familiar with the gearshift indictor, at first just drive the way you are used to. If the current gear - and the driving situation - is not the best one for conserving fuel, then the indicator will display the recommended gear. The display shows the current gear and the gear that is recommended ⇨ *fig. 12*. – **Upshifting** The display will light up to the **right** of the gear currently selected if it is recommending a higher gear.

Claim 7	Corresponding Element in Audi Vehicles
	– **Downshifting:** The display will light up to the **left** of the gear currently selected if it is recommending a lower gear. Sometimes the indicator will recommend skipping a gear (3 > 5). If there is no gearshift recommendation, then just drive in the appropriate gear for conserving fuel. (*See, e.g.*, Exhibits Audi-2 at 27; Audi-3 at 27; Audi-8 at 24).

Claim 7	Corresponding Element in Audi Vehicles

Enhanced shift indicator

Applies to vehicles: with manual transmission and trip computer with efficiency program

Fig. 14 Display: enhanced shift indicator

- In the efficiency program, press the function selection switch ⇨ *page 26, fig. 11* Ⓑ repeatedly until the enhanced shift indicator appears in the display.

The efficiency program also has an enhanced shift indicator. This enhanced shift indicator follows the same concept as the "standard" shift indicator ⇨ *page 27*. The selected and the recommended gears are highlighted in colors like a traffic light.

The color of the circle indicates if the most suitable gear is engaged or if you should shift up or down.

Green circle without or with a gear	No gear or the most suitable gear is engaged
Yellow circle ⇨ *fig. 14*	Shift up or down one gear
Red circle	Shift up two gears

Note

This enhanced shift indicator can help you conserve fuel. It is not designed to recommend the correct gear in all driving situations. Only the driver can decide which

(*See, e.g.*, Exhibits Audi-2 at 28; Audi-3 at 28).

Claim 7	Corresponding Element in Audi Vehicles

⚠ WARNING

Hill descent control cannot overcome physical limitations, so it may not be able to maintain a constant speed under all conditions. Always be ready to apply the brakes.

Manual shift program

Applies to vehicles: with S tronic/tiptronic

Using the manual shift program you can manually select gears.

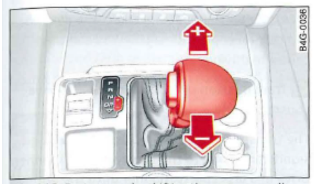


Fig. 119 Center console: shifting the gears manually

Fig. 120 Steering wheel: Shift buttons*

Gear selection with selector lever

The tiptronic mode can be selected either with the vehicle stationary or on the move.

- Push the selector lever to the right from D/S. An M appears in the instrument cluster display as soon as the transmission has shifted.
- To upshift, push the selector lever forward to the plus position ⊕ ⇒ *fig. 119*.
- To downshift, push the lever to the minus position ⊖.

Gear selection with paddle levers*

The shift buttons are activated when the selector lever is in D/S or the tiptronic manual shift program.

- To upshift, touch the button on the right ⊕ ⇒ *fig. 120*.
- To downshift, touch the button on the left ⊖.

The transmission automatically shifts up or down before critical engine speed is reached.

The transmission only allows manual shifting when the engine speed is within the permitted range.

ⓘ Tips

- When you shift into the next lower gear, the transmission will downshift only when there is no possibility of over-revving the engine.
- When the kick-down comes on, the transmission will shift down to a lower gear, depending on vehicle and engine speeds.
- Tiptronic is inoperative when the transmission is in the fail-safe mode.

Kick-down

Applies to vehicles: with S tronic/tiptronic

Kick-down enables maximum acceleration.

When you depress the accelerator pedal beyond the resistance point, the automatic transmission downshifts into a lower gear, depending on vehicle speed and engine speed. The upshift into the next higher gear takes place once the maximum specified engine speed is reached.

⚠ WARNING

Please note that the drive wheels can spin if kick-down is used on a smooth slippery road - there is a risk of skidding.

(*See, e.g.,* Exhibits Audi-1 at 113; Audi-2 at 96; Audi-3 at 86-87; Audi-4 at 89-90; Audi-5 at 111; Audi-6 at 127; Audi-7 at 140-41; Audi-8 at 99-100; Audi-9 at 118; Audi-10 at 89; Audi-11 at 85-

Claim 7	Corresponding Element in Audi Vehicles
	86; Audi-12 at 84).
7G. said processor subsystem determining, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit.	On information and belief, the accused Audi vehicles include a processor subsystem that determines, based upon data received from said plurality of sensors, when to activate said fuel overinjection circuit and when to activate said downshift notification circuit. *See, e.g.*, citations for elements 1G, 7F.

Claim 8	Corresponding Element in Audi Vehicles
8A. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises: *See, e.g.*, citations for claim 1.
8B. means for determining when road speed for said vehicle is increasing;	The accused Audi vehicles include a means for determining when road speed for said vehicle is increasing. *See, e.g.*, citations for claim element 2B.
8C. means for determining when throttle position for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when throttle position for said vehicle is increasing. *See, e.g.*, citations for claim element 2C.
8D. means for comparing manifold pressure to said manifold pressure set point;	The accused Audi vehicles include a means for comparing manifold pressure to said manifold pressure set point. *See, e.g.*, citations for claim element 2D.
8E. said processor subsystem activating said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point.	On information and belief, the accused Audi vehicles include a processor subsystem that activates said fuel overinjection notification circuit if both road speed and throttle position for said vehicle are increasing and manifold pressure for said vehicle is above said manifold pressure set point. *See, e.g.*, citations for claim element 2E.

Claim 10	Corresponding Element in Audi Vehicles
10A. Apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises:	The accused Audi vehicles include an apparatus for optimizing operation of a vehicle according to claim 7 wherein said processor subsystem further comprises: *See, e.g.*, citations for claim element 1.
10B. means for determining when road speed for said vehicle is decreasing;	The accused Audi vehicles include a means for determining when road speed for said vehicle is decreasing. *See, e.g.*, citations for claim element 4B.
10C. means for determining when throttle position for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when throttle position for said vehicle is increasing. *See, e.g.*, citations for claim element 2C.
10D. means for determining when manifold pressure for said vehicle is increasing; and	The accused Audi vehicles include a means for determining when manifold pressure for said vehicle is increasing. *See, e.g.*, citations for claim element 4D.
10E. means for determining when engine speed for said vehicle is decreasing;	The accused Audi vehicles include a means for determining when engine speed for said vehicle is decreasing. *See, e.g.*, citations for claim element 4E.
10F. said processor subsystem activating said	On information and belief, the accused Audi vehicles include a processor subsystem that activates said downshift notification circuit if both road speed and engine speed are decreasing

Claim 10	Corresponding Element in Audi Vehicles
downshift notification circuit if both road speed and engine speed are decreasing and both throttle position and manifold pressure for said vehicle are increasing.	and both throttle position and manifold pressure for said vehicle are increasing. *See, e.g.*, citations for claim elements 1G, 7F.