FILE HISTORY

US 6,738,697

PATENT:	6,738,697
INVENTORS:	Breed, David S.
TITLE:	Telematics system for vehicle diagnostics
APPLICATION NO:	US2002188673A
FILED:	03 JUL 2002
ISSUED:	18 MAY 2004
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10/188673
07/03/02

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U.S. UTILITY Patent Application

PATENT NUMBER and DATE
6738697

APPL NUM	FILING DATE	CLASS	SUBCLASS	GAU	EXAMINER
10188673	07/03/2002	340		2632	

**APPLICANTS: Breed David;

**CONTINUING DATA VERIFIED:

This application is a CIP of 10/174,709 06/19/2002
which is a CIP of 09/753,186 01/02/2001
which is a CIP of 09/137,918 08/20/1998 PAT 6,175,787
which is a CIP of 08/476,077 06/07/1995 PAT 5,809,437
This application 10/188,673 06/19/2002
is a CIP of 10/079,065 02/19/2002
which is a CIP of 09/765,558 01/19/2001
which claims benefit of 60/269,415 02/16/2001
and claims benefit of 60/291,511 05/16/2001
and claims benefit of 60/304,013 07/09/2001
and claims benefit of 60/231,378 09/08/2000

** FOREIGN APPLICATIONS VERIFIED:

PG-PUB	DO NOT PUBLISH ☐	RESCIND ☐

Foreign priority claimed ☐ yes ☐ no
35 USC 119 conditions met ☐ yes ☐ no
Verified and Acknowledged Examiners's intials

ATTORNEY DOCKET NO
ATI-296

TITLE : Telematics system for vehicle diagnostics

U.S DEPT. OF COMM./PAT.& TM-PTO-436 L(Rev. 12-94)

3/25/04 38 7/3/02

NOTICE OF ALLOWANCE MAILED		CLAIMS ALLOWED	
12/9/03	Assistant Examiner	Total Claims 62	Print Claim for O.G 1

ISSUE FEE			DRAWING		
Amount Due	Date Paid		Sheets Drwg.	Figs. Drwg.	Print Fig.
665	3-3-04	YONEL BEAULIEU PRIMARY EXAMINER Primary Examiner	38	62	5

☐ TERMINAL DISCLAMER

Bates 12/9 Application Examiner

PREPARED FOR ISSUE

WARNING: The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Code Title 35, Sections 122, 181 and 368, Possession outside the U.S. Patent & Trademark Office is restricted to authorized employees and contractors only.

ISSUE FEE IN FILE

FILED WITH: ☐ DISK (CRF) ☐ CD-ROM
(Attached in pocket on right inside flap)

6,738,697

TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

Transaction History

Date	Transaction Description
7/3/2002	Workflow - Drawings Finished
7/3/2002	Workflow - Drawings Matched with File at Contractor
7/3/2002	Information Disclosure Statement (IDS) Filed
7/3/2002	Information Disclosure Statement (IDS) Filed
7/3/2002	Initial Exam Team nn
8/5/2002	IFW Scan & PACR Auto Security Review
8/6/2002	IFW Scan & PACR Auto Security Review
8/8/2002	Referred by L&R for Third-Level Security Review. Agency Referral Letter Generated
8/25/2002	Receipt of all Acknowledgement Letters
9/16/2002	Application Is Now Complete
9/19/2002	Application Dispatched from OIPE
3/4/2003	Information Disclosure Statement (IDS) Filed
3/4/2003	Information Disclosure Statement (IDS) Filed
3/5/2003	Transfer Inquiry to GAU
3/14/2003	Case Docketed to Examiner in GAU
9/22/2003	Non-Final Rejection
9/30/2003	Mail Non-Final Rejection
10/27/2003	Response after Non-Final Action
10/31/2003	Date Forwarded to Examiner
12/8/2003	Notice of Allowance Data Verification Completed
12/9/2003	Dispatch to Publications
12/9/2003	Mail Notice of Allowance
12/11/2003	Workflow - File Sent to Contractor
12/11/2003	Receipt into Pubs
2/12/2004	Receipt into Pubs
2/14/2004	Receipt into Pubs
2/25/2004	Receipt into Pubs
3/3/2004	Issue Fee Payment Verified
3/3/2004	Issue Fee Payment Received

3/19/2004	Receipt into Pubs
3/25/2004	Application Is Considered Ready for Issue
3/29/2004	Receipt into Pubs
3/31/2004	Receipt into Pubs
4/8/2004	Receipt into Pubs
4/15/2004	Receipt into Pubs
4/29/2004	Issue Notification Mailed
5/18/2004	Recordation of Patent Grant Mailed
5/18/2004	Patent Issue Date Used in PTA Calculation

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10/188673
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INITIALS ________

CONTENTS

		Date Received (incl. C. of M.) or Date Mailed			Date Received (incl. C. of M.) or Date Mailed
1.	Application Prints papers.		31.		
2.	IDS	7-3-02	32.		
3.	IDS	3/4/03	33.		
4.	9/22 Res (3)	9/30/03	34.		
5.		10/27/03	35.		
6.	NOA		36.		
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8.	QUERY 2/10/04	02/20/04	38.		
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ISSUE SLIP STAPLE AREA (for additional cross-references)

ISSUING CLASSIFICATION

ORIGINAL		CROSS REFERENCE(S)						
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
701	29	701	34					

INTERNATIONAL CLASSIFICATION
G01N 17/00
G06F 7/00
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INDEX OF CLAIMS

✓ .... Rejected — (Through numeral) ... Canceled N .... Non-elected A .... Appeal
= .... Allowed + ... Restricted I .... Interference O .... Objected

Final	Original	16 Sep 03	4/12/03	Final	Original	16 Sep 03	4/12/03	Final	Original	Date
1	1	✓	=	51	51	O	=		101	
2	2			52	52	O			102	
3	3			53	53	✓			103	
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14	14	O			64				114	
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33	33	✓			83				133	
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If more than 150 claims or 9 actions staple additional sheet here

826 7/13/02

SEARCH

Class	Sub.	Date	Exmr.
701	29	21 July '03	YB
	33		
	34		
340	438		
	439		
Updated 3 Dec. '03			YB
701	36	4 Dec '03	YB

SEARCH NOTES

(List databases searched. Attach search strategy inside.)

	Date	Exmr.
WEST	21 July '03	YB
	16 Sept '03	YB

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
701	29	4 Dec '03	YB
	34		

WEST

Generate Collection Print

L13: Entry 28 of 54 File: PGPB Aug 1, 2002

DOCUMENT-IDENTIFIER: US 20020103622 A1
TITLE: Decision-aid system based on wirelessly-transmitted vehicle crash sensor information

Abstract Paragraph (1):

A decision-aid system that receives, analyzes, manages and communicates data from vehicle crash sensors for use by trauma system personnel in treating injured occupants from the vehicles which produced the crash sensor data. The system utilizes a computer system that accepts and analyzes vehicle crash data from vehicle communication systems connected to crash sensors that generate data when a vehicle is involved in a crash. Crash sensor data is stored on a central network for remote access by trauma system personnel and others providing response services and medical services to injured vehicle occupants. By gaining access to crash sensor data, analyzed crash sensor data and other information, accurate patient transport, handling and treatment decisions can be made.

Summary of Invention Paragraph (2):

[0001] This invention relates to medical decision-aid systems generally, and more specifically to decision-aid systems that provide information based on the analysis of vehicle crash sensor data to providers of emergency medical care.

Summary of Invention Paragraph (4):

[0002] The present invention is a decision-aid system that receives, manages, analyzes and communicates wirelessly-transmitted vehicle crash sensor data in order to improve the decision-making ability of trauma systems with respect to the handling of motor vehicle accident victims from the vehicles in which the crash sensor data originated. The term "trauma system" as used herein includes all elements of the emergency response process set in motion when an individual is involved in an automobile accident, including emergency medical systems (EMS) and dispatch systems as they relate to motor vehicle trauma as well as the hospitals, trauma centers and other facilities that handle and treat victims of motor vehicle trauma.

Summary of Invention Paragraph (5):

[0003] Automobile accidents are a leading cause of death in the United States, killing over 40,000 people each year. While approximately half of those killed will die at the scene of the accident, the other half will be treated by various medical and emergency response professionals that make up modern trauma systems. Motor vehicle-related trauma is usually referred to as "blunt trauma" because most injuries are internal injuries. Vehicle occupants are injured primarily by the extreme forces placed on their bodies when their vehicle rapidly decelerates from a high rate of speed to a low rate of speed, usually in a fraction of a second. It is well known amongst trauma professionals that blunt trauma is a disease of time. The more rapidly that a severely injured occupant receives surgical treatment, the greater their chances of survival. Modern trauma systems attempt to provide this treatment within the first hour after injury, during what is commonly referred to as "The Golden Hour."

Summary of Invention Paragraph (6):

[0004] There are at least five distinct activities that must be performed by a trauma system in order for a severely injured vehicle occupant to receive surgical treatment: (1) a 911 dispatcher receives notification of an accident and dispatches an ambulance; (2) the ambulance travels to scene; (3) on-scene triage and treatment is performed by emergency medical personnel; (4) the injured occupant is transported to a treating facility; and (5) the occupant's injuries are diagnosed by physicians at the treating facility. These activities may take a significant amount of time to perform, often exceeding the Golden Hour. The decisions that drive these activities are based on the information available to the trauma system regarding the injuries to the specific occupants involved ("trauma decision-making system").

Summary of Invention Paragraph (7):
[0005] The injuries received by a specific occupant will depend upon the forces generated in the collision as well as the areas of the body that absorbed those forces. These may be affected by several factors including: (1) the dynamics of the impact; (2) the crashworthiness of the vehicle; (3) the vehicle safety features; (4) whether the occupant was wearing restraints; (5) the position of the occupant within the vehicle cabin; and (6) characteristics of the occupant such as their size, weight, age and medical condition. Under present trauma decision-making systems, the only available information regarding these factors is usually that gathered at the scene of the accident by emergency responders such as police, fireman, emergency medical technicians (EMT's) and paramedics. As a result, delayed or incorrect decisions caused by a lack of precise information could delay surgical intervention, which may result in loss of life or increased injury.

Summary of Invention Paragraph (9):
[0007] Another problem with present trauma decision-making systems is that emergency responders have little advance knowledge of what they may find at an accident scene. They generally do not know how many injured occupants may be present, or what type of injuries they can expect. They may not have information suggesting whether vehicle extrication may be required, or whether they will face hazards from potential vehicle fires, fuel leaks or explosions. They may need to call for backup or air transport, and may not know what their destination facility will be or who will ultimately be directing the trauma team. Simple decisions such as what type of equipment to carry from the ambulance to the damaged vehicle could be impacted by the level of knowledge that an emergency responder has regarding the crash event.

Summary of Invention Paragraph (10):
[0008] Another problem with present trauma decision-making systems relates to "mechanism of injury" data. The term "mechanism of injury" is used to describe information about the movements of the occupant within the vehicle, including the forces sustained by the various body parts of the occupant. Given the difficulty in diagnosing blunt trauma injuries, which are often internal, mechanism of injury information is very important in determining the likely injuries and their severity. As a result, mechanism of injury data is often relied upon by emergency response and medical professionals to make decisions about pre-transport treatment, facility selection, trauma team activation and diagnostic procedures. Under present trauma decision-making systems, mechanism of injury data may only be estimated by emergency responders based on their visual observations about the crashed vehicles and their occupants.

Summary of Invention Paragraph (11):
[0009] Another problem with present trauma decision-making systems is the quality of data used to select the destination facility. Most trauma centers have specific admission criteria that is usually based on the extent of injury perceived by the emergency responders. However, it is very difficult for an emergency responder to diagnose an internal brain, abdominal or pelvic injury in the field that may not exhibit external signs. Restrained occupants may not strike anything within the vehicle during the crash except for safety restraint systems, yet suffer severe injuries resulting purely from rapid deceleration. As a result, there is a significant population of severely injured patients who will be initially transported to either a hospital emergency department or a lower-level trauma center. The severity of their injuries will likely be discovered at those facilities, where they either will attempt treatment or transfer to a specialized trauma facility depending upon the stability of the patient. This costs precious time that may be needed in order to save the life of the patient.

Summary of Invention Paragraph (12):

[0010] Another problem with present trauma decision-making systems is that existing mechanism of injury data is not accurate enough to reliably predict trauma team resources which need to be activated. Specific criteria must usually be met by a patient in order to activate a trauma team, or to activate specific trauma team members such as a neurosurgeon. If a patient fails to initially meet this criteria but has a hidden severe head or abdominal injury, key trauma personnel may not be available in a timely manner in order to treat them. Additionally, diagnostic resources (X-ray, CT-scan) may also need to be coordinated to be sure they are available, and insure that no delays take place during patient handling. CT scans and X-rays are critical diagnostic tools for injury diagnosis. CT scanners are extremely expensive, and may be located several floors and hundreds of yards away from the patient location. When dealing with a multiply injured patient that has thoracic, abdominal, pelvic or other injuries causing substantial hemorrhage, lifesaving surgery may have to be postponed because a definitive CT scan diagnosis cannot be obtained.

Summary of Invention Paragraph (13):
[0011] Another problem with trauma decision-making systems is that surgeons are forced to make critical diagnosis and treatment decisions based on very little information. While the emergency responders to the accident scene may be able to provide some mechanism of injury information, this information is often unreliable. Deteriorating patient condition often forces the surgeon to stop the diagnostic process before a definitive diagnosis can be made, and make guesses about likely injuries so the patient does not die while being diagnosed. The surgeon often has no choice but to rely on obtained mechanism of injury information obtained from emergency responders.

Summary of Invention Paragraph (14):
[0012] Another problem with trauma decision-making systems is that trauma surgeons are often faced with daunting task of treating severely and multiply injured patients, under tremendous time pressure, and with little information about how they were injured. As a result, some injuries will necessarily be missed that, if discovered earlier, may have saved a life. Brain, abdominal and pelvic injuries represent three areas that are particularly hard to diagnose.

Summary of Invention Paragraph (15):
[0013] The prior art describes attempts to overcome some of the above drawbacks. For example, the systems disclosed by Shaibani (U.S. Pat. No. 5,586,024) and Dormond, et al. (U.S. Pat. No. 4,839,822) disclose computer systems for diagnosing trauma injuries in which system users input information about the victim and the accident circumstances, and the computer system provides a possible injury list or suggested treatments. These systems are designed to process the existing information available to trauma surgeons through the trauma system, and do not disclose the capture and analysis of vehicle sensor and other crash-related information. Nor do they provide a delivery system for the various entities in the trauma system as disclosed by the present invention. Thus trauma decision-aid systems in the prior art do not solve many of the problems that currently exist in trauma decision-making systems.

Summary of Invention Paragraph (16):
[0014] There is therefore a need for a trauma decision-aid system that provides information from sensors within the crash-involved vehicles to trauma system personnel. The present invention is designed to utilize detailed vehicle crash sensor information, transmitted through vehicle wireless communication systems such as the General Motors OnStar system or the Mercedes Benz Tele-Aid system, in providing a decision-aid system for trauma system personnel responding to motor vehicle accidents. The present invention provides a decision-aid system for trauma system personnel that involves analyzing this information and delivering it to various participants in the trauma system, providing superior information upon which to determine crash severity and predict potential injuries in order to assist emergency response personnel in response, transport, diagnosis and treatment of injured vehicle occupants.

Summary of Invention Paragraph (18):
[0015] A decision aid system is disclosed for (1) receiving on-board sensor data wirelessly transmitted from crash-involved vehicles, (2) analyzing this data and (3)

delivering the results to data users, notably emergency medical personnel. This system enables trauma system personnel to make accurate patient-handling decisions by gaining access to crash sensor data obtained directly from the vehicles involved in the accidents to which they are responding.

Summary of Invention Paragraph (19):
[0016] In general, a vehicle is shown as including an on-board communications system connected to crash sensors that generate data when a vehicle is involved in a crash. The crash sensors are preferably located within an occupant restraint system, and include vehicle movement sensors, occupant sensors and system sensors. The vehicle owner or driver preferably subscribers to a vehicle communication service, and authorizes the transmission of crash sensor data generated by these sensors through a wireless network to the operations center rendering location-based services. At the time crash sensor data is received, the operations center forwards the data to a Crash Data Delivery and Processing System (Crash Data D&PS) along with any stored subscriber data about the driver, vehicle and occupants. The Crash Data D&PS is the heart of the decision-aid system, and includes computer systems for managing, analyzing and presenting crash event data. Data users that seek to use the decision-aid system, including medical response personnel in the field, can access crash event data through landline and wireless networks.

Summary of Invention Paragraph (21):
[0018] A decision-aid system that manages crash event data for subscribers to a vehicle communication service

Summary of Invention Paragraph (22):
[0019] A decision-aid system that enables subscribers of vehicle communication services to authorize the capture and transmission of crash sensor data

Summary of Invention Paragraph (23):
[0020] A decision-aid system that enables crash sensor data to be correlated with subscriber data stored by the provider of a vehicle communication service

Summary of Invention Paragraph (24):
[0021] A decision-aid system that uses the sensors contained within a safety restraint control system to determine when to transmit crash sensor data to a remote location

Summary of Invention Paragraph (25):
[0022] A decision-aid system that predicts occupant injury based on crash sensor data

Summary of Invention Paragraph (27):
[0024] A decision-aid system that bases accident severity predictions on predictions of injury based on analysis of crash sensor data

Summary of Invention Paragraph (29):
[0026] A decision-aid system that notifies trauma personnel about crash events that are relevant to their response obligations

Summary of Invention Paragraph (30):
[0027] A decision-aid system that enables data to be manually inserted into crash event records where other trauma personnel can access the data

Summary of Invention Paragraph (31):
[0028] A decision-aid system that analyzes crash sensor data against a database of other crash sensor data

Summary of Invention Paragraph (32):
[0029] A decision-aid system that analyzes crash sensor data against a database of historical injury records

Summary of Invention Paragraph (33):
[0030] A decision-aid system that analyzes crash sensor data using vehicle crashworthiness data specific to the crash-involved vehicle

Summary of Invention Paragraph (34):
[0031] A decision-aid system that uses a rules-based expert system to analyze crash sensor data

Summary of Invention Paragraph (35):
[0032] A decision-aid system that uses a case-based reasoning system to analyze crash sensor data

Summary of Invention Paragraph (36):
[0033] A decision-aid system that notifies trauma personnel about the availability of crash event data based on geographic data about the crash event and jurisdiction of the trauma personnel

Summary of Invention Paragraph (37):
[0034] A decision-aid system that enables trauma system personnel to access crash event data using any device commonly used to access the internet, including portable wireless access devices.

Summary of Invention Paragraph (38):
[0035] A decision-aid system that enables trauma system personnel to configure the characteristics of crash event data displayed to them

Summary of Invention Paragraph (39):
[0036] A decision-aid system that configures the presentation of crash event data according to the type of device used to access the data

Summary of Invention Paragraph (41):
[0038] A decision-aid system that provides for collaboration between trauma system personnel and crash data experts

Summary of Invention Paragraph (42):
[0039] A decision-aid system that provides for communication between injured vehicle occupants and crash data experts that can provide medical assistance and capture medical information

Summary of Invention Paragraph (43):
[0040] A decision-aid system that notifies trauma system personnel that decision-aid information is available for a particular crash event

Summary of Invention Paragraph (44):
[0041] A decision-aid system that provides for crash event data to be used in determining the resources that should be dispatched to an accident scene

Summary of Invention Paragraph (45):
[0042] A decision-aid system that provides for crash event data to be used in the coordination of facility resources for responding to injured trauma patients

Summary of Invention Paragraph (46):
[0043] A decision-aid system that provides for crash event data to be used to dispatch a surgeon to an accident scene

Summary of Invention Paragraph (47):
[0044] A decision-aid system that provides for crash event data to be used in authorizing reimbursement for medical care costs incurred based on the use of crash event data

Brief Description of Drawings Paragraph (8):
[0052] FIG. 7a is a schematic block diagram of a crash data management system.

Brief Description of Drawings Paragraph (9):
[0053] FIG. 7b is a bock diagram showing the different security levels for the crash event databases.

Brief Description of Drawings Paragraph (10):

[0054] FIG. 7c is an exemplary archived crash event record.

Brief Description of Drawings Paragraph (11):
[0055] FIG. 7d is an exemplary active crash event record.

Brief Description of Drawings Paragraph (13):
[0057] FIG. 8a is a schematic block diagram of a crash data analysis system.

Brief Description of Drawings Paragraph (14):
[0058] FIG. 8b is a flowchart illustrating a process for generating a crash event report.

Brief Description of Drawings Paragraph (15):
[0059] FIG. 8c shows an exemplary crash event report.

Brief Description of Drawings Paragraph (17):
[0061] FIG. 8e is an overview diagram of the legacy data correlation attributes that may be used by a crash data expert to analyze crash event data

Brief Description of Drawings Paragraph (18):
[0062] FIG. 8f is an exemplary expert system for analyzing crash event data

Brief Description of Drawings Paragraph (19):
[0063] FIG. 9a is a schematic diagram of a crash data presentation system

Brief Description of Drawings Paragraph (20):
[0064] FIG. 10a is a schematic diagram of crash event report push sub-system

Brief Description of Drawings Paragraph (23):
[0067] FIG. 11 is an exemplary input screen for configuring delivery of crash event data

Brief Description of Drawings Paragraph (32):
[0076] FIG. 17 shows an exemplary vehicle safety data table and selected input data sources

Brief Description of Drawings Paragraph (37):
[0081] FIG. 20b is an overview diagram showing access to the Crash Data D & PS by several types of data users

Brief Description of Drawings Paragraph (38):
[0082] FIG. 21 is an overview diagram showing a crash data expert providing medical advice to an injured communication systems subscriber

Brief Description of Drawings Paragraph (41):
[0085] FIG. 24a is a flowchart illustrating a process for delivering crash event reports.

Brief Description of Drawings Paragraph (42):
[0086] FIG. 24b is a continuation of a flowchart illustrating a process for delivering crash event reports.

Brief Description of Drawings Paragraph (43):
[0087] FIG. 25 is a flowchart illustrating a process for evaluating the resources to dispatch to a crash scene using crash event data.

Brief Description of Drawings Paragraph (44):
[0088] FIG. 26 is a flowchart illustrating a process for coordinating facility resources using crash event data.

Brief Description of Drawings Paragraph (45):
[0089] FIG. 27a is a flowchart illustrating a more detailed process for determining resources to dispatch to a crash scene using crash event data.

Brief Description of Drawings Paragraph (46):

[0090] FIG. 27b is continuation of a flowchart illustrating a more detailed process for determining resources to dispatch to a crash scene using crash event data.

Brief Description of Drawings Paragraph (47):
[0091] FIG. 28 is a flowchart illustrating a process for enhancing a trauma diagnosis protocol using crash event data.

Brief Description of Drawings Paragraph (48):
[0092] FIG. 29 is a flowchart illustrating a process for administering remote treatment to a crash victim using crash event data.

Brief Description of Drawings Paragraph (49):
[0093] FIG. 30 is a flowchart illustrating a process for determining the survival probability of a crash victim using crash event data.

Brief Description of Drawings Paragraph (50):
[0094] FIG. 31 is a flowchart illustrating a process for obtaining consumer authorization to transmit and display crash event data.

Brief Description of Drawings Paragraph (51):
[0095] FIG. 32 is a flowchart illustrating a process for obtaining consumer authorization for use of crash event data by an automobile manufacturer

Brief Description of Drawings Paragraph (52):
[0096] FIG. 33 is a flowchart illustrating a process for authorizing reimbursement of medical costs using crash event data.

Brief Description of Drawings Paragraph (53):
[0097] FIG. 34 is a flowchart illustrating a second process for authorizing reimbursement of medical costs using crash event data.

Detail Description Paragraph (3):
[0099] FIG. 1 shows an overview of the system, including a Vehicle 70. As shown in FIG. 1, On-board Sensors 90 located in Vehicle 70 capture On-Board Sensor Data 1030 when Vehicle 70 is involved in a vehicle crash ("crash event"), such as striking another vehicle, striking an object or rolling over. Most new vehicles today have multiple sensors that capture detailed information during a crash event. On-board Sensors 90 can include a variety of sensors, including acceleration sensors ("accelerometers") that are part of most modern airbag systems. These sensors are capable of capturing detailed information about the acceleration change of the vehicle during a crash event, information that can usually be measured in millisecond or smaller increments.

Detail Description Paragraph (4):
[0100] After a crash occurs, the On-Board Sensor Data 1030 can be transferred to an On-board Data System 80, here shown as a passenger vehicle voice and data communications system such as an OnStar or Tele-Aid system. The On-Board Data System 80 can then wirelessly transmit the On-Board Sensor Data 1030 through a Wireless Network 100. The Wireless Network 100 could be any wireless network, including a cellular telephone network, paging network, satellite communications network, local radio network or other wireless network commonly used as a communication system for wireless data and/or voice.

Detail Description Paragraph (5):
[0101] After being transmitted through Wireless Network 100, the On-Board Sensor Data 1030 is received by a Control Center 110 in a remote location. The Control Center 110 may be any operations center configured to receive data from On-Board Data System 80, including a provider of subscription-based emergency services to vehicle communication system subscribers (such as a General Motors OnStar service), a provider of messaging or location-tracking services to commercial vehicles, or a Public Safety Answering Point (PSAP). After receiving the On-Board Sensor Data 1030, the control center 110 transfers the On-Board Sensor Data 1030 to a Crash Data Delivery and Processing System 130 (Crash Data D&PS). The Control Center 110 and Crash Data D&PS 130 may be connected by a local network if located in the same facility, or may be connected by the internet or other wide area network if located

in different geographic areas.

Detail Description Paragraph (6):
[0102] The Crash Data D&PS 130 is configured to receive On-Board Sensor Data 1030, analyze it, and deliver the results to various Data Users 150 that may need the data in order to perform medical or public safety functions. The Crash Data D&PS 130 may be comprised of one or more computers configured to store and process incoming crash event data obtained from vehicle On-board Sensors 90 as well as from other data input sources. Crash event data may also include subscriber data obtained from the Subscriber Database 210 at Control Center 110.

Detail Description Paragraph (7):
[0103] The Crash Data D&PS 130 is preferably located within a secure structure designed to withstand power outages and natural disasters. The Crash Data D&PS 130 receives the On-Board Sensor Data 1030, and performs functions such as interpreting the data, analyzing the data to predict potential occupant injury, and calculating crash event severity. The Crash Data D&PS 130 is connected to a Network 140 which allows access to crash event data, including the analysis of crash event data. Crash event data may be accessed and analyzed by Data Users 150, including Data Experts 200, Hospital Emergency Departments 170, Trauma Centers 160, Emergency Medical Responders 180 and Public Safety Agencies 190.

Detail Description Paragraph (8):
[0104] Crash Data Experts 200 preferably include individuals trained in the interpretation of On-board Sensor Data 1030, and may be skilled in fields such as crash sensor data interpretation, biomechanics, blunt trauma diagnosis and treatment, vehicle crash performance, accident reconstruction or other fields which give them particular expertise in understanding the significance of Onboard Sensor Data 1030. Crash Data Experts 200 are preferably located at or near the site of the Crash Data D&PS 130, and may access the Crash Data D&PS 130 through a high speed Local Area Network (LAN) or other network access system. Crash Data Experts 200 may provide assistance to other Data Users 150, such as data interpretation, analysis, recommendations regarding data reliability, as well as interpretation and analysis of the results of processing of On-board Sensor Data 1030 by the Crash Data D&PS 130. This assistance may be provided in a written or electronic report form, an oral report, direct voice or data communication or any other reliable means of communication.

Detail Description Paragraph (9):
[0105] The Network 140 preferably includes connection to the internet, or other wide area network which allows direct access by Data Users 150 located in different geographic areas, including Crash Data Experts 200 which may be located remotely. Direct access by Hospital Emergency Departments 170, Trauma Centers 160, Emergency Medical Responders 180 and Public Safety Agencies 190 is desired to allow full use of the interactive features of the system by remote Data Users 150, including: (1) the ability to supplement crash event records with additional data; (2) the ability to directly interact with the Crash Data D&PS 130 without the intervention of a Crash Data Expert 200; (3) the ability to analyze the operational characteristics of the Crash Data D&PS 130; (4) the ability to search, query and analyze records stored in the Crash Data D&PS 130; (5) the ability to view models and simulations of vehicle and occupant movements; (6) the ability to selectively run software applications made available through the Crash Data D&PS 130 for processing of On-board Sensor Data 1030.

Detail Description Paragraph (10):
[0106] Trauma Centers 160 include regional trauma centers and medical facilities that maintain special resources and procedures for the emergency medical treatment of trauma victims beyond that ordinarily provided by basic hospitals. Emergency Medical Responders 180 include Emergency Medical Technicians, ambulance services, paramedics, fireman and other public and private responders commonly dispatched to motor vehicle accident scenes such as police. Other Data Users 150 may include government agencies, Universities, research organizations and other entities and individuals who may be interested in study and analysis of data stored in the Crash Data D&PS 130.

Detail Description Paragraph (11):
[0107] In operation, subscriber data pertinent to a crash event may be transferred from the Control Center 110 to the Crash Data D&PS 130. This subscriber data preferably includes any data stored or processed at the Control Center 110 regarding the vehicle, vehicle occupants, vehicle location or other data regarding the crash event that may affect emergency response decisions. As shown in FIG. 2, vehicle communication systems generally contain a Subscriber Database 210 and Emergency Services Database 220. The Subscriber Database 210 contains subscriber data regarding the vehicle and vehicle occupants, and is usually a relational database stored in a computer. Examples of subscriber data stored in the subscriber database 210 may include:

Detail Description Paragraph (18):
[0114] Vehicle data

Detail Description Paragraph (19):
[0115] Vehicle make and model

Detail Description Paragraph (20):
[0116] Vehicle year

Detail Description Paragraph (22):
[0118] Vehicle color

Detail Description Paragraph (33):
[0129] An example of a Communication System Subscriber 250 would be an individual that subscribes to the OnStar System from General Motors or the Tele-Aid System from Mercedes Benz. A Communication System Subscriber 250 may purchase a Communication-enabled Vehicle 70 equipped with an On-board Data System, or may have an On-board Data System installed post-purchase. The Communication System Subscriber 250 generally subscribes to a fee-based service that allows wireless communication between Control Center Operators 230 and Communication System Subscribers 250 through a Wireless Network 100. Services rendered often include stolen vehicle tracking, 911 assistance, driving directions and assistance with emergency roadside service. FIG. 2 shows a Control Center Operator 230 communicating with a Communication System Subscriber 250 located in a Damaged Vehicle 240. Other types of vehicle communication systems may store different type of data, and provide different services.

Detail Description Paragraph (34):
[0130] FIG. 2 also shows an Emergency Services Database 220 which contains contact information about emergency services, and may store geographically-coded information about Public Safety Answering Point (PSAP) jurisdictional boundaries. PSAPs are agencies which handle incoming 911 calls and assist with the dispatch of emergency assistance. The Emergency Services Database 220 allows the control center to utilize location information obtained from the vehicle to contact the appropriate PSAP for the jurisdiction in which the vehicle is located, and thereby provide proper 911 assistance and dispatch services. Data transferred from the Control Center 110 to the Crash Data D&PS 130 may also include data regarding communications between Control Center Operators 230 and public safety agencies contacted in regard to the crash event, as well as the identity, location and contact information for these public safety agencies.

Detail Description Paragraph (35):
[0131] FIG. 3 shows a vehicle level block diagram of an On-board Data System 80 exemplary of a passenger vehicle communications system. On-board Sensors 300 which may provide data to the On-board Data System 80 may be any type of vehicle sensors capable of providing information about a motor vehicle crash, and include sensor types such as Vehicle Movement Sensors 310, Occupant Sensors 320, Vehicle System Sensors 330 and Other Sensors 340. These On-board Sensors 300 may include:

Detail Description Paragraph (36):
[0132] Vehicle Movement Sensors 310

Detail Description Paragraph (40):

[0136] Longitudinal Crash Pulse

Detail Description Paragraph (41):
[0137] Lateral Crash Pulse

Detail Description Paragraph (42):
[0138] Vertical Crash Pulse

Detail Description Paragraph (43):
[0139] Vehicle Direction

Detail Description Paragraph (44):
[0140] Vehicle Rotation

Detail Description Paragraph (46):
[0142] Rollover

Detail Description Paragraph (53):
[0149] Time from Impact to Air Bag Deployment

Detail Description Paragraph (67):
[0163] Vehicle System Sensors 330

Detail Description Paragraph (68):
[0164] Vehicle Speed

Detail Description Paragraph (85):
[0181] Active Diagnostic Codes

Detail Description Paragraph (90):
[0186] On-board Sensors 300 as defined herein specifically exclude airbag indictor sensors that are currently transmitted by some existing On-board Data Systems 80 and that notify a Control Center 110 that an airbag has deployed. Additional sensors developed in the future which provide information about motor vehicle crash events should be considered as falling within the scope of the present invention. On-board Sensors 300 may be connected to a Vehicle Data Bus 390, shown in FIG. 3 connected to an On-board Data System 80, or may connect directly to the On-board Data System 80.

Detail Description Paragraph (91):
[0187] On-board Sensor Data 1030 is preferably captured by monitoring various On-board Sensors 90 and periodically storing measurements from On-board Sensors 90 based on a pre-defined measurement frequency in a buffer for a pre-selected period of time which correlates to the predicted duration of a crash event. The buffer could be any memory module within the vehicle, including the Memory 360 of the On-board Data System 80. It could also be the Memory 420 or Electronic Data Recorder 400 of a Safety Restraint Control System 440 as shown in FIG. 4. Additional On-board Sensor Data 1030 is also captured upon detection of a crash event. The specific On-board Sensor Data 1030 which is captured, as well as the frequency of capture and duration of capture, is preferably based upon a pre-determined relationship between the On-board Sensor Data 1030 and potential occupant injuries received in a crash event.

Detail Description Paragraph (92):
[0188] The On-board Data System 80 in FIG. 3 is shown as a computer containing a Processor 350, I/O Interface 370, and Memory 360. It is also shown with a Wireless Communications Device 270 and Location Device 280. The Wireless Communications Device may be any wireless device known in the art to be capable of transmitting data across a Wireless Network 100, including a wireless modem, cellular telephone, pager, radio or satellite terminal. The Location Device 280 is preferably a Global Positioning System (GPS) receiver, and could be any Radio Frequency (RF device used to determine location through location-determination methods commonly known in the art including but not limited to Time Distance of Arrival, Angle of Arrival, wireless-assisted GPS, RF Fingerprinting and Loran. Location Network 290 is preferably the network of satellites which comprise the GPS System, and could represent a network used for one of the aforementioned location-determination

methods or an advanced cellular network capable of determining the location of cellular transceivers.

Detail Description Paragraph (93):
[0189] The Wireless Communication Device 270 is preferably a digital or analog cellular radio and the Wireless Network 100 is preferably the digital or analog cellular radio system. Cellular radios and networks are commonly used in today's vehicle communication systems such as General Motors OnStar and Mercedes Tele-Aid. The Wireless Communication Device 270 enables crash data to be transferred through the Wireless Network 100 from the On-board Data System, where it is received by Control Center 110.

Detail Description Paragraph (94):
[0190] FIG. 4 shows the preferred embodiment where some of the On-board Sensors 300 function as part of a vehicle safety system, including a Safety Restraint Control System 440 containing an Electronic Data Recorder 400. In this embodiment, On-board Sensors 300 have the dual function of both: (1) control or measurement of vehicle systems; and (2) capture of crash event data that may be used in a Crash Data D & PS 130. The Safety Restraint Control System 440 may also serve the dual function of: (1) managing the performance of vehicle safety systems; and (2) serving as a collection and management point for crash event data. Safety Restraint Control System 440 preferably contains an I/O Interface 410, Memory 420 and Processor 430. Safety Restraint Control System 440 may receive data from Vehicle Movement Sensors 310, Occupant Sensors 320 and Vehicle System Sensors 330 and utilizes this data to manage performance of vehicle safety systems, including Inflatable Restraint System 450 and Seat Belt System 460. Inflatable Restraint System 450 is preferably a front or side airbag system. Electronic Data Recorder 400 records data from the Safety Restraint Control System 440, and stores this data in the event a vehicle crash is detected. Safety Restraint Control Systems 440 such as that depicted in FIG. 4 are known in the art and are used to assist with the performance of vehicle restraint systems. Electronic Data Recorders 400 are also known in the art, and may be used in a post-crash manner to evaluate the performance of a Safety Restraint Control System 440 located in a vehicle that has been involved in a crash event.

Detail Description Paragraph (95):
[0191] As shown in FIG. 4, On-board Sensor Data 1030 may be obtained from On-board Sensors 300 that function as part of a Safety Restraint Control System 440. This On-board Sensor Data 1030 is then transferred to an On-board Data System 80 allowing On-board Sensor Data 1030 to be wirelessly transmitted to a remote location by the On-board Data System 80. On-board Sensor Data 1030 may be stored in an Electronic Data Recorder 400, and Safety Restraint Control System 440 may be connected to an On-board Data System 80 through a Vehicle Data Bus 390. Those skilled in the art may know of several means for transferring data from the Safety Restraint Control System 440 to an On-board Data System 80 in order to allow On-board Sensor Data 1030 to be wirelessly transmitted to a remote location at the time of a crash event. This means may vary based on the type of vehicle or restraint control system as well as where and how the data is stored.

Detail Description Paragraph (96):
[0192] Vehicle Movement Sensors 310 and Occupant Sensors 320 which are part of a Safety Restraint Control System 440, are primarily designed to assist with proper deployment of an Inflatable Restraint System 450 to prevent injury caused by the Inflatable Restraint System 450 during a crash event while minimizing injury caused by the crash event forces. On-board Sensors 300 may capture, measure or transmit additional data beyond that necessary for performance of their control functions for vehicle systems or safety restraint systems, including data which has a pre-determined relationship to potential occupant movements, occupant injuries, vehicle movements or vehicle damage which may occur during a crash event. (See FIG. 3f for a system for development of relationships between On-board Sensor Data 1030 and potential occupant injuries). For example, Occupant Sensors 320 which detect the position of an occupant in relation to an inflatable restraint, could also be utilized to determine occupant positions subsequent to inflatable restraint deployment in order to determine occupant movements resulting from crash event forces and restraint use, including structures which may be struck by the occupant during the crash event.

Detail Description Paragraph (97):
[0193] Safety Restraint Control System 440 may also manage, process, store or transmit data from On-board Sensors 300 beyond that necessary for performance of managing restraint systems, including data which has a pre-determined relationship to potential occupant movements, occupant injuries, vehicle movements or vehicle damage which may occur during a crash event. Data elements from Vehicle Movement Sensors 310 and Occupant Sensors 320 may currently be monitored by Safety Restraint Control System 440 and recorded by an Electronic Data Recorder 400 at frequencies and durations which have a pre-determined relationship to their respective functions of managing and recording Safety Restraint Control System 440 performance. These sensors may be sampled and recorded at a different frequency and duration by Safety Restraint Control System 440 based on a pre-determined relationship to the additional function of determining potential occupant injuries received during the crash event.

Detail Description Paragraph (98):
[0194] An exemplary block diagram of a Crash Data D&PS 130 is shown in FIG. 5 as being comprised of a Crash Data Management System 490 which receives On-board Sensor Data 1030 and subscriber data from the Control Center 110 relating to the crash event. A Crash Data Analysis System 500 assists with processing of On-board Sensor Data 1030 into a Crash Event Report 2425 that can be utilized by medical personnel and emergency responders to make treatment and handling decisions. An exemplary Crash Event Report 2425 is shown in FIG. 8c. The Crash Event Report 2425 may include crash event data including On-board Sensor Data 1030, analyzed On-board Sensor Data 1030, subscriber data, Manual Input Data 1790 (see FIGS. 20a and 20b) and external vehicle data. Crash Event Report 2425 may be automatically generated by the Crash Data D&PS, or may be generated with the assistance of Data Users 150 (See FIGS. 8b and 8c). External vehicle data includes crashworthiness data about the crashworthiness of a particular vehicle such as that contained in Crash Test Databases 750, as well as design data about vehicle design attributes such as dimensions, weights, safety features, materials, seating configurations, fuel systems, safety systems, seat and headrest attributes and other vehicle design attributes known to those skilled in the art.

Detail Description Paragraph (99):
[0195] Crash event data is analyzed and formatted by one or more software applications executed within the Crash Data Analysis System 500, and/or based on analysis by a Crash Data Expert 200. A Crash Data Presentation System 510 enables presentation of data to Data Users 150 through a Network 140. Data presented to Data Users 150 may include On-board Sensor Data 1030, data transferred from Control Centers 110 and outside data sources, and results from processing in the Crash Data Analysis System 500 through a Network 140. Data presented to Data Users 150 may include Crash Event Reports 2425 configured to the specific data needs of Data Users 150 or configured based on the type of communication device or access method being used by Data users 150 to access data.

Detail Description Paragraph (100):
[0196] As shown in FIG. 5, Data Users 150 may access the Crash Data D&PS 130 and Crash Event Reports 2425 through a variety of communication devices. A Stationary Access Device 540 is shown as a personal computer (PC) with a landline connection to Network 140. Stationary Access Device 540 is preferably a standard PC of common use by the Data User 150 for non-Crash Data D&PS 130 applications, with a commonly used operating system such as Microsoft Windows and standard web browser software such as Microsoft Explorer or Netscape Navigator for viewing data presented by the Crash Data D&PS 130 via the internet. Stationary Access Device 540 may be a PC located in any facility where access to crash event data may be desired, including:

Detail Description Paragraph (109):
[0205] Vehicle Rescue and Extrication Agency

Detail Description Paragraph (110):
[0206] Commercial Vehicle Fleet Management Center

Detail Description Paragraph (111):

[0207] Crash Data Analysis Center

Detail Description Paragraph (117):
[0213] Wireless access is also shown for mobile Data Users 150, including a Portable Wireless Access Device 520 and a Mobile Access Device 530. Portable Wireless Access Device 520 is preferably a wireless phone or personal digital assistant ("PDA") with wireless communications capability such as a cellular modem or pager. Crash Data Presentation System 510 is preferably enabled for internet content viewing via standard wireless internet delivery protocols allowing limited access to internet site data through standard wireless devices without the need for Data Users 150 to purchase wireless equipment having capabilities, configurations or software different than that which is commonly used by consumers and business personnel for wireless internet access. Wireless internet protocols currently in use or development for portable wireless devices include:

Detail Description Paragraph (130):
[0226] Portable Wireless Access Device 520 may be utilized by paramedics responding to an automobile accident dispatch request, or other emergency personnel responding to an accident scene such as police, nurses, physicians, surgeons, accident reconstruction personnel and insurance personnel. Crash Data Presentation System 510 preferably configures crash event data into a Crash Event Report 2425 for rapid retrieval of relevant crash event data by Data Users 150 utilizing Portable Wireless Access Devices 520. Capabilities which may assist in this process may include recognition of voice commands by the Crash Data D&PS 130 using a voice recognition technology engine.

Detail Description Paragraph (131):
[0227] Portable Wireless Access Device 520 accesses content from the Crash Data Presentation System 510 through Wireless Network 1 525, which is preferably a commonly used wireless communication system, including:

Detail Description Paragraph (145):
[0241] A Mobile Access Device 530 is also shown in FIG. 5, which is preferably a notebook or laptop computer which enables full internet access through use of a wireless modem, such as a circuit-switched analog modem, Cellular Digital Packet Data radio or digital cellular radio modem based on one of the digital cellular standards such as GSM, TDMA or CDMA, or combination of any of the preceding. Mobile Access Device 530 accesses content through Wireless Network 2 535 which may also be one of the standard wireless communication systems listed above. Mobile Access Device 530 preferably enables access to the full functionality of the Crash Data D&PS 130 with comparable capabilities to a Stationary Access Device 540.

Detail Description Paragraph (146):
[0242] FIG. 6 shows an exemplary user interface for accessing information from the Crash Data D&PS 130. The Data Window 580 displays the data from the Crash Data D&PS 130, including crash event record data, Crash Event Reports 2425 and other information obtained from On-board Sensors 90, Subscriber Databases 210, and other information inputs into the Crash Data D&PS 130. A Monitor 560 is shown as providing Data Window 580, which could be any computer monitor suitable for displaying data through personal computer software, including a standard PC monitor or monitor from a notebook, laptop, or other form of mobile computing device. Client Software 570 is preferably a common and standard internet browser that can be downloaded through Network 140.

Detail Description Paragraph (148):
[0244] FIG. 7a depicts a block diagram of a Crash Data Management System 490, shown as a central database server. The primary function of the Crash Data Management System 490 is to manage the data records of the Crash Data D&PS 130. A Data Storage Device 630 is shown which may contain a variety of databases, including Active Crash Event Database 640, Archived Crash Event Database 650 and User Access Database 660. The Crash Data Management System 490 includes a Processor 600, Communication Port 620, and Memory 610 for managing the operations of the Crash Data Management System 490, including: (1) inputting of new crash event data; (2) data inquiries regarding specific records; (3) data inquiries for display of current crash events through Crash Data Presentation System 510; (4) management of Data User 150 access; (5)

transfer of crash event records from Active Crash Event Database 640 to Archived Crash Event Database 650; and (6) database searches and queries for data analysis by Data Users 150.

Detail Description Paragraph (149):
[0245] The Active Crash Event Database 640 contains time-sensitive data regarding recent crash events and is preferably easily accessible by those providing emergency response and medical services to potentially injured vehicle occupants. The Active Crash Event Database 640 is shown in FIG. 7b as employing a Base Security Access Level 642. Data in the Active Crash Event Database 640 will often be used to support emergency response services and immediate medical treatment to individuals injured in the subject crash event, including decisions relating to triage, transport, resource allocation, resource scheduling, severity scoring, injury diagnosis and treatment. Base Security Access Level 642 may be a warning only, and preferably allows open access without requirement for a password. The Archived Crash Event Database 650 contains records which are not as time-sensitive, does not need to be as accessible, and employs an Enhanced Security Access Level 652 to protect the privacy of individual records from public disclosure.

Detail Description Paragraph (150):
[0246] Active Crash Event Records 645 may be displayed in a manner that enables sensitive data to be partially or completely inaccessible to Data Users 150 accessing Active Crash Event Records 645 through Network 140, while enabling the missing data to be determined or confirmed using other means. Here, a Masked Crash Event Record Data 658 is shown in FIG. 7d that prevents complete public disclosure of personal identification information while still allowing rapid and unrestricted access for Data Users 150. Masked Crash Event Record Data 658 may partially or completely conceal one or more personal identification data fields from disclosure. Data Users 150 may verify the data in Masked Crash Event Record 658 by looking up the record in the Archived Crash Event Database 650 or comparing partial data found in the Masked Crash Event Record 658 with personal identification information found in the possession of injured vehicle occupants. Active Crash Event Records 645 are stored in Active Crash Event Database 640 temporarily based on a Critical Time Period in which relatively open data access is desired. All Active Crash Event Records 645 are also stored in duplicate in the Archived Crash Event Database 650 (shown in FIG. 7c), with the Archived Crash Event Database 650 record being overwritten by the Active Crash Event Record 645 for the subject event at expiration of the Critical Time Period.

Detail Description Paragraph (151):
[0247] FIG. 7e illustrates a process for determining when to transfer Active Crash Event Records 645 to the Archived Crash Event Database 650 using a Critical Time Period. After Crash Event Data is received 670 then a Critical Time Period is established 673 and Crash Event Data is temporarily stored in the Active Crash Event Database 640 as an Active Crash Event Record 645 until the Critical Timer Period has ended 676. A decision may be made to extend the Critical Time Period 678, in which case a Revised Critical Time Period is established 679 replacing the originally established Critical Time Period 681. If not extended, the Critical Time Period Expires 683 and the Crash Event Record overwrites the record for the event in the Archived Crash Event Database 688.

Detail Description Paragraph (153):
[0249] FIG. 8a depicts a block diagram of a Crash Data Analysis System 500, shown as a central applications server. The Crash Data Analysis System 500 may be utilized by Crash Data Experts 200 as well as by other Data Users 150, and serves a primary function of interpreting and analyzing On-board Sensor Data 1030 and other related data. The Crash Data Analysis System 500 includes a Processor 690, Communication Port 710, and Memory 700 for managing the operations of the Crash Data Analysis System 500, which may include: (1) Analyzing crash event severity to assist in determining appropriate level of emergency response; (2) Predicting potential occupant injuries; (3) Predicting injury severity scores; (4) Predicting occupant survival probabilities; (5) predicting occupant survival times; (6) modeling crash event vehicle movements; (7) modeling crash event occupant movements; (8) Predicting occupant injury mechanisms; (9) Predicting medical resources and medical procedures needed for injured occupant treatment; (10) Providing recommended diagnostic or

treatment protocols. The Data Storage Device 720 is also shown which may contain a variety of databases utilized by the Crash Data Analysis System 500, including an Applications Database 730 and databases containing legacy data which may be used in the analysis of crash event data such as a Historical Injury Database 740 and a Crash Test Database 750.

Detail Description Paragraph (154):
[0250] A simplistic illustration of the use of the Crash Data D&PS 130 by Data Users 150, here shown as Crash Data Experts 200, is illustrated in FIG. 8b. First, Crash Data Experts 200 receive crash event data 2390. Second, Crash Data Experts 200 interpret and analyze crash event data 2400. Third, Crash Data Experts 200 form opinions and recommendations regarding crash event data 2410. Shown as a fourth step 2420, some Data Users 150, particularly Crash Data Experts 200, may also generate a Crash Event Report 2425 for communication of crash event data to other Data Users 150 or other parties interested in viewing crash event data.

Detail Description Paragraph (155):
[0251] FIG. 8c illustrates an exemplary Crash Event Report 2425, here shown as a highly detailed communication generated with input from Data Users 150 in the form of Crash Data Experts 200. Crash Event Reports 2425 may include Onboard Sensor Data 1030, interpretations of On-board Sensor Data 1030 by Crash Data Experts 200, as well as the results of applications run within the Crash Data Analysis System 500 which are either selectively run by Crash Data Experts 200 or automatically run by the Crash Data Analysis System 500 upon the occurrence of a crash Event. Identity Data 2320 may be included in Crash Event Reports 2425 in order to correctly match the crash event data to the injured vehicle occupants. Identity Data 2320 may be derived from Subscriber Database 210 and preferably includes data regarding the date, time and location of the crash event, as well as identifying information regarding the vehicle, the registered vehicle driver, the occupant position for the injured occupant and an event ID. Data Reliability Data 2330 may be included in order to give Data Users 150 an indication of the data value and accuracy. Data Reliability Data 2330 preferably includes an analysis of the reliability of sensor data, the data sample that was transmitted, and the quality of the transmission. Predictive Injury List 2340 may be included in order to assist emergency response agencies and medical treatment providers in making treatment and handling decisions regarding an injured vehicle occupant. Predictive Injury List 2340 may be included, and preferably includes a list of most likely injuries, with probabilities of the likelyhood that these injuries are present. Predicted Severity 2350 may be included in order to assist emergency response agencies and medical treatment providers in making treatment and handling decisions regarding an injured vehicle occupant. Predicted Severity 2350 preferably includes an AIS score, and may include scores from any commonly used trauma scoring systems. Mechanics Analysis 2360 may be included, in which an analysis and interpretation of crash event data is provided by a Crash Data Expert 200. Mechanics Analysis 2360 preferably includes an analysis of vehicle movements, occupant position, restraint use and likely movements, likely injury mechanisms, injuries to watch for and any other data or data analysis which may assist emergency response agencies, medical treatment providers and others engaged in the handling and treatment of the injured occupant. Mechanics Analysis 2360 may also include explanations of reasoning utilized by Crash Data Expert 200 and justifications for conclusions reached by Crash Data Expert 200, including the use of any computer-assistance for conclusions. Recommendations 2370 may be included in which actions are suggested for those involved in the handling and treatment of the injured vehicle occupant. Recommendations 2370 preferably includes recommendations for transport, diagnosis and treatment of an injured vehicle occupant, and any other recommendations which may assist emergency response agencies and medical treatment providers in the handling and treatment of an injured vehicle occupant. Crash Event Reports 2425 can be configured to the specific data needs of various Data Users 150, as well as the access devices used to access Network 140. Crash Event Reports 2425 can be relatively complex as shown in FIG. 8c, or as simple as transmitting an accident severity reading to an EMT's Portable Wireless Access Device 520 in the field.

Detail Description Paragraph (156):
[0252] Data Users 150 may also utilize data stored in the Crash Data Management System 490 to assist them in interpreting crash event data, as illustrated in FIG.

8d. Data User 150 is shown as a Crash Data Expert 200 running a database query in order to determine the frequency of injuries found in past crash events based on query criteria established by the Crash Data Expert 200. First, crash event query criteria is set 2290. Second, crash event query criteria is used to search a database 2300. The database searched could be the Archived Crash Event Database 650 as shown in the Crash Data Management System 490 in FIG. 7a, or a Historical Injury Database 740 as shown in the Crash Data Analysis System 500 in FIG. 8a. Third, the database query returns an injury frequency report 2310. The injury frequency report preferably contains a listing of probabilities of each injury contained in the injury frequency report based on the number of matching database injuries found which list each injury as a potential injury based on the event query criteria which was used.

Detail Description Paragraph (157):
[0253] In cases where it is desirable to search a legacy database which does not contain On-board Sensor Data 1030, Legacy Data Correlation Attributes 2570 may be used to link characteristics of a crash event to characteristics of historical crash events contained in legacy databases as illustrated in FIG. 8c. Legacy Data Correlation Attributes 2570 may include a Crashworthiness Evaluation of Vehicle 2580, which could be a relative measure of vehicle crashworthiness such as a NHTSA or IIHS crash test score. Other attributes may include Occupant Characteristics 2590 where records are compared based on age, gender, size or weight of occupants. Other attributes may include Crash Event Data 2600 that can be correlated between databases such as Delta V, principal direction of force and restraint use. Legacy Data Correlation Attributes 2570 may be created on a case-by case basis after crash event data is received, or may be created in advance of crash events based on particular rules which may be stored in, and selected from a database. Legacy Data Correlation Attributes 2570 may be manually determined by a Crash Data Expert 200, or may be generated by a software application within the Crash Data Analysis System 500.

Detail Description Paragraph (158):
[0254] Data sources for correlation include a Linked Accident Factor-injury Database 2520 created by linking the Multiple Causes of Death (MCOD) Database 2530 and the Federal Accident Reporting System (FARS) Database by a Death Certificate Link 2550. Another data source for correlation may include the National Accident Sampling System--Crashworthiness Data System (NASSCDS) Database 2560. Another data source for correlation may include a Vehicle Crash Test Database 750, including the Insurance Institute for Highway Safety (IIHS) Crash Test Database 1380 or the National Highway Transportation Safety Administration (NHTSA) Crash Test Database 1370.

Detail Description Paragraph (159):
[0255] FIG. 8f shows an application within the Crash Data Analysis System 500 in the form of an expert system which automatically generates Data Analysis Results 2610 based on Expert System Input Data 3260. An Inference Engine 3260 is used to generate Data Analysis Results 3260 based on Rules 3270 Established by experts in various Expert Knowledge Domains 3280 including Onboard Sensor Performance 3290, Vehicle Crash Performance 3300, Biomechanics of Automobile Accidents 3310 and Blunt Trauma Diagnosis and Treatment 3320. Data Analysis Results 2610 may also be generated by a Case Based Reasoning System 3395 which utilizes Cases 3330 as a knowledge base by linking attributes of a crash event to attributes of cases using a Case History Attribute Index 3390. Cases 3330 may include Crashworthiness Test Cases 3340, Historical Accident Cases 3350, Archived Crash Events 3360, Cadaver Biomechanics Studies 3370 and Animal Biomechanics Studies 3380. Cases 3330 may be indexed into a relational database.

Detail Description Paragraph (162):
[0258] FIG. 9 depicts a block diagram of a Crash Data Presentation System 510, shown as a central web server. The primary function of the Crash Data Presentation System 510 is to communicate crash event data to Data Users 150 in a controlled manner. The Crash Data Presentation System 510 includes a Processor 770, Communication Port 790, and Memory 780 for managing the operations of the Crash Data Presentation System 510, which may include: (1) Displaying crash event data at a specific network location such as an internet address; (2) Managing network requests for data in coordination with the Crash Data Management System 490; (3) Managing specific

application requests and delivery of application results in coordination with the Crash Data Analysis System 500; (4) Managing data display configuration requests by data users 150; (5) Managing Data User 150 access; (6) Tracking network utilization; (7) Serving-up forms for data input into Crash Data Management System 490; (8) Facilitating and managing wireless access to data and applications; and (9) Delivering reports via email, fax, voice, and various wireless delivery mechanisms.

Detail Description Paragraph (165):
[0261] Crash Event Reports 2425 may be delivered to Data Users 150 using a variety of push-type mechanisms as illustrated in FIG. 10a, including Fax Data Delivery 1940, Voice Data Delivery 1950, Email Data Delivery 1960, Network Push Data Delivery 1970 or Wireless Data Delivery 1975. Crash Event Reports 2425 may pushed to Data Users 150 by a Crash Event Report Push Server 1930 to a certain address retrieved from a Medical Provider Database 1920 or from information input by a Data User 150 through a Report Delivery Configuration Interface 2260 as shown in FIG. 11. Crash Event Report Push Server 1930 may include a fax server, voice server, email server, http address server, wireless data server or any automatic data delivery system which utilizes an address retrieved from a database for delivery of a Crash Event Report 2425. Push delivery addresses which may be used to send Crash Event Data to Data Users 150 may include:

Detail Description Paragraph (176):
[0272] FIG. 11 illustrates three configuration interface screens which allow Data Users 150 to configure the manner in which they are alerted regarding crash event data and the manner in which Crash Event Reports 2425 or other forms of crash event data is delivered, including an Access Interface 2240 for gaining access to configuration functions, an Alert Configuration Interface 2250 for inputting of alert address information by a Data User 150, and a Report Delivery Configuration Interface 2260 for specifying an address for which a Data User 150 wants Crash Event Reports 2425 or other crash event data to be automatically delivered. The Alert Configuration Interface 2250 allows a Data User to be alerted when a crash event has occurred in their area which they may need to be aware of, and allows them to choose the manner in which they would like to be alerted. The Report Delivery Configuration Interface 2260 allows a Data User 150 to receive a Crash Event Report 2425 to an address they specify, in the manner in which they would like to receive the information.

Detail Description Paragraph (178):
[0274] FIG. 12 illustrates an exemplary Collaboration Mechanism 2450 which may be used for Data Users 150 to discuss crash event data and Crash Event Reports 2425 with Crash Data Experts 200 using multiple forms of two-way communication. Collaboration Mechanism 2450 may take the form of any type of reliable two-way communication mechanism, including Telephone 2460, Email 2470, Voice over Internet Protocol 2480, Instant Chat 2490 and Videoconferencing 2500. Preferably both Data Users 150 and Crash Data Experts 200 are connected to the Crash Data D&PS 130 at the time of collaboration, or are simultaneously viewing a Crash Event Report 2425 for a particular crash event in order to jointly discuss and analyze data regarding a particular crash event, including On-board Sensor Data 1030, crash event data, data reliability, data interpretation, application results, predicted diagnosis, response and treatment resources, and potential courses of treatment.

Detail Description Paragraph (180):
[0276] FIG. 13 shows a Geographic Configuration Interface 1710 which allows a Data User 150 to determine the geographic areas of crash events that they would like displayed to them when the access the Crash Data D&PS 130. Configuration settings selected by Data Users 150 may be retained by storing configuration settings in a cookie stored on the Data User's 150 computer hard drive, or in a User Access Database 660 in the Crash Data Management System 490 which contains a reference identifier which matches a reference identifier in a cookie stored on the Data User's computer hard drive. Configuration settings may be stored by other means known in the art for storing configuration settings. Data Users 150 may refine the number of crash event records displayed to them by selecting the State 1720, County 1730 or PSAP Jurisdiction 1740 within which the location of event records must exist in order for them to be displayed to Data User 150. Alternatively, Data User may configure crash event records displayed based on Coordinate Block 1750 by entering

values for Latitude Boundaries 1760 and Longitude Boundaries 1770 which correspond to the geographic coverage area desired.

Detail Description Paragraph (182):
[0278] FIG. 14a illustrates an exemplary Primary Event Table 920 that may be used as the default display of Active Crash Event Data to Data Users 150. The function of the Primary Event Table 920 is to provide a Data User 150 with an overview of relevant crash events. When a crash event occurs, a date and time of the event may be measured, which can be generated by a GPS receiver, a Control Center 110 or the Crash Data D&PS 130 or any other computer that is notified of the crash event. The measured date and time of the crash event populates a Date 930 field and Time 940 field in Primary Event Table 920, and will indicate to the Data User 150 whether the data in a given record is relevant to a timely crash event in which emergency assistance may be needed. Individual crash event records are identified by the Crash Data D&PS 130 by an Event ID 950 which may be assigned by the Crash Data Management System 490. A County 960 is shown, which will help Data Users determine the locale of a given event, and assist them in determining which crash events may require their involvement. County 960 data for each crash event may be obtained from analysis of GPS or other location coordinates of the crash event which may be transmitted by the On-board Data System 80 to the Control Center 110, or in cases where location coordinates are unavailable this data may be obtained by vehicle occupants or emergency responders. A PSAP 970 is also shown, which represents a Public Safety Answering Point (PSAP), which will also help Data Users 150 determine which crash events may require their involvement, and will also alert them regarding public safety agencies with whom they may need to coordinate response resources. PSAP 970 identification data will in most cases be obtained from the Control Center 110 as described in FIG. 2.

Detail Description Paragraph (183):
[0279] A Location 980 is also shown in the form of geographic positioning coordinates which will enable Data Users to more accurately determine the location of the crash event. Location 980 may also be obtained from a GPS receiver, Control Center 110 or other location determination means which is enabled by the On-board Data System 80. An example Severity 990 measurement is shown in the form of an AIS score, a standardized scoring system commonly used to measure automobile accident severity. Severity 990 measurement may be used by Data Users 150 to determine relative crash event severity or response level, and to coordinate resources, select destination facilities and prioritize activities. Severity 990 could be expressed in terms of any commonly used scoring system familiar to medical responders, including a Trauma Score, Revised Trauma Score, Injury Severity Score or AIS scores for each body region of concern.

Detail Description Paragraph (184):
[0280] A Driver ID 1000 is shown which may be used as a secondary identifier of a particular crash event record, and a primary identifier for medical and emergency response personnel to correlate crash event data to injured vehicle occupants. Driver ID 1000 will in most cases be transferred to Crash Data D&PS 130 from the Control Center 110 where it is stored in a Subscriber Database 210. Driver ID 1000 may also be obtained through communication with vehicle occupants or emergency responders that access driver identification information through evidence gathered from the driver's person or vehicle, in which case Driver ID 1000 may be manually entered. In some circumstances Driver ID 1000 obtained from a Control Center 110 may be overwritten by manually entered Driver ID 1000, for example when the listed driver in Subscriber Database 210 is different than the individual driving the Communication-enabled Vehicle 70 at the time of a crash event.

Detail Description Paragraph (185):
[0281] Vehicle 1010 identification data is shown which may be used by Data Users 150 to determine general crashworthiness of a particular vehicle involved in a crash event. Data Users 150 may use Vehicle 1010 identification data to look up external vehicle data such as historical injury data, crash testing data or vehicle design data for the identified vehicle to assess vehicle crashworthiness and crash characteristics. For example, historical injury data and crash testing data may be obtained from the Historical Injury Database 740 and Crash Test Database 750 shown in FIG. 8a, and processed in an application within the Crash Data Analysis System

500. The availability of Mechanics 1020 data is also shown, as indicating the availability status of detailed data indicative of vehicle movements during a crash event. Mechanics 1020 data may include On-board Sensor Data 1030 as well as the results of processing of On-board Sensor Data 1030 by the Crash Data Analysis System 500 or the results of analysis of On-board Sensor Data 1030 by Crash Data Experts 200. Mechanics 1020 data may be represented in Primary Event Table 920 in terms of the availability of Mechanics 1020 data or may describe the status of any processing being performed on On-board Sensor Data 1020 such as an estimated time for completion of a software application that is analyzing Mechanics 1020 data.

Detail Description Paragraph (186):
[0282] Analysis Data 1030 is shown which represents the availability status of crash data analyzed by the Crash Data Analysis System 500, Crash Data Experts 200 or both, such as modeling of vehicle movements during the crash event, modeling of occupant movements, predicted occupant injuries and other data analysis results. Analysis Data 1030 may be represented in the Primary Event Table 920 in terms of availability of Analysis Data 1030 or may describe the status of any processing being performed on crash event data, such as an estimated time for completion of a software application that is analyzing crash event data, estimated file size of software application results, estimated download time of software application results, or any other item of status information which a Data User 150 would like to know before deciding to examine Analysis Data 1030 in greater detail.

Detail Description Paragraph (187):
[0283] FIG. 14b illustrates an exemplary linkage of a Primary Event Table 920 element to an application, shown in the form of a Location 980 record which triggers an Electronic Map Display 1060 shown in FIG. 14d when Location 980 record is selected by a Pointer Device 1100. This provides Data Users 150 a visual tool for analysis of the location of a particular crash event, which may assist them in utilizing Location 980 data to estimate dispatch and transport times, possible traffic delays, and to make decisions regarding transport, destination medical facility, resource allocation, resource coordination, and other decisions regarding emergency response which may be affected by crash event location.

Detail Description Paragraph (188):
[0284] The Electronic Map Display 1060 is generated by the Electronic Map Display System 1070 shown in FIG. 14c, which includes a Map Engine and Display System 1090 and Geo-coded Map Data 1080. Electronic map display systems are commonly known in the art which are capable of generating an electronic map from geographic coordinates. These systems are used by vehicle communication system providers such as GM OnStar and Mercedes Tele-Aid to provide location-based services (such as driving directions), as well as internet-based providers of location services such as the MapQuest Corporation.

Detail Description Paragraph (189):
[0285] FIG. 15 illustrates an exemplary Mechanics Table 1120 that contains On-board Sensor Data 1030 and interpretation of On-board Sensor Data 1030 suggestive of vehicle movements during a crash event. Sensor Detail 1130 is shown which allows differentiation between different types of On-board Sensors 90 which may be employed by different vehicle manufacturers, including different types of sensors, different management of sensors, and any other information which may assist Data Users 150 to evaluate On-board Sensor Data 1030 in terms of accuracy, reliability, type of data, amount of data, and other factors which may be determined based on sensor type and sensor operating characteristics. Sensor Detail 1130 may include information obtained from the vehicle manufacturer, sensor developer or manufacturer, safety system developer or manufacturer, or other source which has information regarding sensor performance and operating characteristics, including an analysis of the type and reliability of On-board Sensor Data 1030 which may be obtained from a particular vehicle with particular On-board Sensors 90. Other data dlements which may be obtained from On-board Sensors 90 or determined by analysis of On-board Sensor Data 1030 by the Crash Data D&PS 130 or Crash Data Experts 200 include Delta V 1140, Point of Impact 1150, # of Impacts 1160, Rollovers 1170 and Passengers 1180 are also shown, and may be important factors that data users may utilize to infer likely occupant injuries and crash event severity.

Detail Description Paragraph (190):
[0286] FIG. 16 illustrates an exemplary Occupant Mechanics Table 1190 which contains data which may indicate movements of vehicle occupants during a crash event to assist Data Users 150 in determining potential injuries and injury severity of specific vehicle occupants. Data elements are segregated by occupant, such as Driver Detail 1200 and Front Right Passenger Detail 1260. Exemplary data elements are shown as including occupant Sex 1210, Age 1120, Seatbelt 1230 which indicates whether the occupant was wearing their seatbelt, Airbag 1240 which indicates whether the occupant received airbag protection during the crash, and Ejected 1250 which indicates whether the occupant was thrown from the vehicle during the crash. Occupant Mechanics Table 1190 data may be obtained from On-board Sensors 90, directly from vehicle occupants or emergency responders, or may represent the result of data analysis by a Crash Data Expert 200 or the Crash Data Analysis System 500.

Detail Description Paragraph (191):
[0287] FIG. 17 illustrates an exemplary Vehicle Safety Detail Table 1280 containing specific information regarding the crashworthiness and safety features of a specific vehicle. Restraints 1290 and Airbags 1300 are shown as indicating the type of, and location of seat belt systems and inflatable restrain systems on the specific vehicle involved in the crash event. This information may be obtained by the Crash Data Management System 490 from a Vehicle Identification Number (VIN) Database 1360 as shown in FIG. 17, or may be stored as part of a Subscriber Record for a Communication System Subscriber 250 or obtained from data stored in a Safety Restraint Control System 440 or stored in a database containing information obtained from vehicle manufacturers. NHTSA 1310, IIHS Overall 1320, IIHS Structure 1330, IIHS Kinematics 1340, and IIHS Injury 1350 are all shown as results of crash testing performed on the specific vehicle involved in the crash event. This data may be retrieved by the Crash Data Management System 490 from one or more crash test databases, including the National Highway Transportation Administration (NHTSA) Crash Test Database 1370 and the Insurance Institute for Highway Safety (IIHS) Crash Test Database 1380.

Detail Description Paragraph (192):
[0288] FIG. 18 illustrates an exemplary Occupant Information Table 1400 for a vehicle driver containing characteristics of a particular occupant that may impact potential injuries received during a crash event. Height 1410 and Weight 1420 are shown, and may be correlated to predicted injuries which may differ among different sized individuals subjected to the same crash forces. In addition, Height 1410 and Weight 1420 provides important input for Occupant Simulation Applications 1650 and Occupant Modeling Applications 1620 (as shown in FIG. 20). Medical Condition 1430, Current Meds 1440, Base EKG 1470 and Allergies 1460 are also shown, and may impact an individual's response to a particular crash event as well as effect the manner in which they are treated. Blood Type 1450 is shown which may effect emergency response resources, method of transport and manner of treatment based on blood type availability and other factors. Insurance Information 1480 and Primary Physician 1490 are shown which may help locate additional medical data on the injured occupant. All or part of this data may be retrieved from a Medical Information Database 1500, from information found on a vehicle occupant such as a medical information card, or directly from occupants or emergency responders (as shown in FIG. 21). Information on other occupants may also be stored as part of the crash event record, as shown in FIG. 18b for Front Right Passenger 1510.

Detail Description Paragraph (193):
[0289] FIG. 20 illustrates an exemplary Analysis Data Table 1520 that contains the results of analysis performed by the Crash Data Analysis System 500 or by Crash Data Experts 200. Most data categories shown may be utilized by Data Users 150 to prioritize treatments, alter diagnosis procedures, determine response levels and resources and other factors which may affect medical outcome of treatment of an injured vehicle occupant. Predictive Injury List 1530 and Expert Analysis 1540 may be generated from an application within the Crash Data Analysis System 500, or may be generated by an evaluation of the crash event data by a Crash Data Expert 1600. Crash Model 1550 represents the results of a Crash Modeling Application 1610 run on the crash event data within the Crash Data Analysis System 500. Crash Modeling Application 1610 may be an existing software application used for accident reconstruction. Occupant Model 1560 represents the results of an Occupant Modeling

Application 1620 run on the crash event data within the Crash Data Analysis System 500. Occupant modeling Application 1620 may be an existing software application used for accident reconstruction that demonstrates occupant kinematics. Crash Simulation 1570 represents the results of a Crash Simulation Application 1630 which may be run from an application within the Crash Data Analysis System 500 or may represent a simulation with similar characteristics which is selected from a Crash Simulation Database 1640. Crash Simulation Applications 1630 are known to exist in the art, such as finite element programs and other programs such as PC-CRASH, ED-CRASH and ED-SMAC the latter two of which are sold by the Engineering Dynamics Corporation. Occupant Simulation 1580 represents the results of an Occupant Simulation Application 1650 which may be run from an application within the Crash Data Analysis System 500 or may represent a simulation with similar characteristics which is selected from an Occupant Simulation Database 1660. Occupant Simulation Applications 1650 are known in the art, such as rigid body programs like the Articulate Total Body (ATB) program, finite element programs such as PAM-SAFE and programs that represent hybrids between rigid body and finite element programs such as MADYMO sold by TNO Automotive.

Detail Description Paragraph (195):
[0291] FIG. 20a illustrates an exemplary Input Screen 1795 for the entry of Manual Input Data 1790. Manual Input Data 1790 may be manually added to crash event record in the Active Crash Event Database 640 by a Data User 150. FIG. 20a demonstrates entry of Manual Input Data 1790 through an Input Screen 1795 for data entry by an emergency medical responder of key information which may need to be added to a record or information that is preferably confirmed such as Driver ID 1800 for confirmation of driver identity, a Seat Belt 1810 for confirmation that an occupant was wearing a seat belt at the time of the crash event, Airbag 1820 for confirmation of whether an airbag inflated for the occupant, Ejected 1830 to indicate if an occupant was thrown from the vehicle, and Age 1840 to confirm the age of the occupant. Passenger 1 ID 1850 is shown, along with Seat Location 1860 to reflect the possible presence of additional occupants. An Input Individual Name 1870 and Position and Jurisdiction 1880 are also shown to identify the individual, as well as their role in emergency response, to increase the reliability of the data. Information captured by Manual Input Data 1790 will in most cases be added to Active Crash Event Database 640. A Data Input Security Access Level 1815 is shown, which represents a higher level of access security than the Base Security Access Level 642 applicable to the Active Crash Event Database 640. Manual Input Data 1790 may be utilized for other data such as post-treatment injury coding, result coding, physician and nurse notations, and other information which may be useful to compile as part of a single record, and may be added to either the Active Crash Event Database 640 or Archived Crash Event Database 650. Manual Input Data 1790 may also be given verbally by a Data User 150 to an individual in a remote location over the telephone who may then enter Manual Input Data 1790 into a crash event record. Manual Input Data 1790 may be verbally given to a Crash Data Expert 200, nurse, or other individual. An example would be an EMT at an accident scene who calls a hospital emergency department using a radio, and recites Manual Input Data 1790 to a nurse, who later enters Manual Input Data 1790 into a crash event record.

Detail Description Paragraph (196):
[0292] FIG. 20b illustrates several Data Users 150 that may input data into a crash event record using various methods of access to the Crash Data D&PS 130. An Emergency Medical Responder 1890 may input data through a Mobile Access Device 530 which accesses Network 140 through a Wireless Network 1 525. FIG. 20b also shows PSAP Dispatcher 1900 and a Hospital Nurse Station 1910 accessing the Crash Data D & PS through Network 140.

Detail Description Paragraph (198):
[0294] FIG. 21 shows a Crash Data Expert 200 providing medical advice to an injured Communication System Subscriber 250 in a Damaged Vehicle 240. The communication link is shown as being a wireless voice call between the injured Communication System Subscriber 250 and a Control Center Operator 230 which is transferred to the Crash Data D&PS 130 enabling direct communication between the Crash Data Expert 200 and Communication System Subscriber 250, while the Crash Data Expert 200 is viewing crash event information. This enables Crash Data Expert 200 to assist Communication System Subscriber 250 in treating their injuries, preventing exacerbation of

injuries, and in gathering additional information regarding their injuries. This additional information may then be entered into a crash event record as Manual Input Data 1790. In addition, the communication link shown in FIG. 21 may also be utilized by Data Users 150 at the scene, including paramedics and EMTs that may communicate Manual Input Data 1790 to a Control Center 110 or a Crash Data Expert 200 if the voice call has been transferred to the Crash Data D & PS 130.

Detail Description Paragraph (200):
[0296] There are several ways that emergency medical personnel can be notified that crash event data can be obtained for a crash event to which they are responding. One way this occurs is by a PSAP dispatcher 1900 being notified by a Control Center Operator 230. As shown in FIG. 2, Control Center Operators 230 have access to an Emergency Services Database 220 which includes contact information for PSAPs (911 dispatch call centers) that have responsibility for dispatching emergency response agencies to a crash event scene. Control Center Operators 230 are usually notified that one of their subscribers has been involved in a crash event upon receiving an automatic crash notification (ACN) signal indicating an air bag has deployed. The usual procedure followed by Control Center Operators 230 in this circumstance is to call the PSAP that covers the particular jurisdiction in which the crash event took place using the Emergency Services Database 220 that is geo-coded based on GPS coordinates. Control Center Operators 230 are able to determine the appropriate PSAP by matching up the GPS coordinates received from the On-Board Data System 80 (along with the ACN signal) using the Emergency Services Database 220. At the time Control Center Operators 230 inform the responding PSAP that a crash has occurred, they may also communicate that crash event data is available at the Crash Data D&PS 130 through Network 140. The PSAP may in turn notify emergency response agencies that crash event data is available.

Detail Description Paragraph (201):
[0297] FIG. 22 illustrates an exemplary On-board Data System 80 with an Audio Output Device 372 which may be used to notify emergency response agencies that On-board Sensor Data 1030 has been transmitted from the Vehicle 70 and is available for review and analysis. On-board Data System 80 is shown in FIG. 22 as including both an Audio Output Device 372 and Audio Input Device 373, which is standard for most existing passenger vehicle On-board Data Systems 80. After a crash event has occurred, Control Center Operators 230 at Control Center 110 may monitor sound within the vehicle, and announce the availability of crash event data upon hearing sounds through Audio Input Device 373 which indicate that emergency response agencies are nearby the vehicle 70. Alternatively, operators connected to the Crash Data D&PS 130 may also monitor sound within the vehicle 70, after either having an active wireless connection with the Vehicle 70 transferred to them by Control Center 110 or by calling the On-board Data System 80 directly. Sound may be monitored through Audio Input Device 373. This process may take place while Crash Data Experts 200 are engaged in providing triage services to vehicle occupants as shown in FIG. 21. Alternatively, On-board Data System 80 may also include an Audio Generation Device 374 as shown in FIG. 22, that generates an audible announcement regarding the availability of crash event data, thereby alerting response agencies that crash event data is available. Audio Generation Device 374 may be any form of audio generation device known in the art, including a memory microchip that stores the audible announcement.

Detail Description Paragraph (202):
[0298] As shown in FIG. 23, Visual Notification Devices 4000 may also be employed to alert emergency response agencies that crash event data has been transmitted from a given Vehicle 70. Visual Notification Devices 4000 employ a message which indicates the crash data is available, and contains an address where more information can be obtained such as a telephone number of website address. Notification Sticker 4010 could be any type of sticker commonly used for automotive applications, including an adhesive sticker or a static-cling sticker. Notification Sticker 4010 is preferably placed with the message facing outward, in a location where emergency response agencies are likely to see it such as the inside driver's side corner of the windshield or the driver's side door window. Wallet Notification Card 4020 could be made from any type of material, and is preferably sized to fit the average wallet similar to business cards and driver's licenses. Wallet Notification Card 4020 is preferably of a distinctive color which allows Wallet Notification Card 4020 to be

easily discovered by emergency response agencies which may examine an injured occupant's wallet. Restraint Notification Label 4030 is preferably a sewn or printed label which is securely fastened to an emergency restraint device inside the Vehicle 70, including an air bag, seat belt, seat belt latch or crash-activated window curtain. Keyring Notification Card 4040 is preferably a moisture-protected card with a punched hole for placement on a key ring. Keyring Notification Card 4040 is preferably of a distinctive color to assist emergency response agencies with discovery of Keyring Notification Card 4040 when assisting an injured vehicle occupant.

Detail Description Paragraph (203):
[0299] As shown in FIGS. 10a, 10b, 10c, Crash Data D&PS 130 also includes databases for emergency services. These databases may be utilized to track down emergency medical responders responding to a particular crash event, and notify them of the existence of crash event data or provide them a Crash Event Report 2425. FIG. 24a illustrates a method for actively determining the identity of an Emergency Medical Response (EMR) agency which is responding to a particular crash event, as well as the destination medical facility of the injured vehicle occupants and delivering Crash Event Data relevant to the crash event. The location of the crash event is first obtained from the Control Center 110 responsive to the vehicle communications system in the subject vehicle 2100, the location information may include the Public Safety Answering Point which has jurisdiction over the crash event location. The vehicle location is matched with EMR agency database, which may contain geographically coded PSAP information as well as geographically coded information about paramedic, Emergency Medical Technician (EMT), Fire Department and other potential EMR agencies that may respond to an accident scene 2110. The most likely EMR agency is selected from the potential list of EMR agencies in the crash event area which may be responding to the crash event, and contact is attempted with the EMR agency 2120. The EMR agency is queried regarding their involvement in responding to the subject crash event 2130, 2140. If the chosen EMR agency is not responding to the event, they are ruled out 2150 and another EMR agency is selected from the potential list of EMR agencies in the crash event area 2160. If the EMR agency is responding to the crash event, they are notified of the availability of crash event information 2170 and they are queried regarding the destination medical facility of injured vehicle occupants 2180. Crash event information is then delivered to the EMR agency 2190 based on their delivery mechanism of choice 2190 and the destination medical facility is contacted and notified of the availability of crash event data 2200 as shown in FIG. 24b. The mechanism of information delivery, address and recipient is confirmed with the destination medical facility 2210 and the crash data is delivered 2220.

Detail Description Paragraph (205):
[0301] In addition to the above-disclosed methods and process for using the Crash Data D&PS 130 as a decision-aid system for medical, FIGS. 25 through 34 show additional specific uses of the disclosed decision-aid system.

Detail Description Paragraph (206):
[0302] FIG. 25 is a flowchart illustrating a process for evaluating the emergency response resources that need to be dispatched to the scene of a crash event utilizing On-board Sensor Data 1030. First, crash data is captured 2670 by Onboard Sensors 90. Second, crash data is transmitted 2680 by an On-board Data System 80 that wirelessly transmits data to a remote location. Third, crash data is analyzed 2690 to predict crash severity and potential occupant injuries. Fourth, emergency response resources are selected 2700, such as personnel and equipment, based on crash data. Fifth, emergency response resources are dispatched 2710 to the crash scene.

Detail Description Paragraph (207):
[0303] FIG. 26 is a flowchart illustrating a process for coordinating trauma resources at a medical facility utilizing On-board Sensor Data 1030. First, crash data is captured 2730 by On-board Sensors 90. Second, crash data is transmitted 2740 by an On-board Data System 80 that wirelessly transmits data to a remote location. Third, crash data is analyzed 2750 to predict crash severity and potential occupant injuries. Fourth, medical facility resources are selected 2760, such as surgeons, nurses, diagnostic personnel, anesthesiologists, diagnostic equipment, operating

rooms and other emergency medical equipment and personnel based on crash data. Fifth, medical facility resources are coordinated 2770 in advance of injured occupant arrival at medical facility.

Detail Description Paragraph (208):
[0304] FIGS. 27a and 27b are a flowchart representing a process for determining whether advanced life support equipment and personnel should be dispatched to a crash event scene for performance of potentially lifesaving medical treatment which, in the absence of crash event data, would otherwise be rendered at a medical facility. First, crash data is captured 2790 by On-board Sensors 90. Second, crash data is transmitted 2800 by an On-board Data System 80 that wirelessly transmits data to a remote location. Third, crash data is analyzed 2810 to predict crash severity and potential occupant injuries. Fourth, organ injuries are predicted 2820 based on crash data. Fifth, organ injury severity is scored 2830 using an injury scoring system and probability of injuries requiring potentially lifesaving medical treatment is determined. Sixth, survival time without potentially lifesaving medical treatment is estimated 2840 for injured vehicle occupant. Seventh, time of treatment is estimated 2850 for potentially lifesaving medical treatment to be administered at a medical facility for injured occupant. Eighth, estimated survival time is compared to estimated time of treatment 2860. Nine, a decision is made to administer potentially lifesaving medical treatment at a medical facility 2870 or to consider administering potentially lifesaving medical treatment at scene or during transport 2880. Ten, estimated survival time is compared to estimated time of administration of potential lifesaving medical treatment at the crash scene or during transport 2890. Eleven, a decision is made whether resources should be dispatched to the crash scene capable of administering potentially lifesaving medical treatment 2900 or whether the injured occupant should be transported to a medical facility 2910 for potentially lifesaving medical treatment.

Detail Description Paragraph (209):
[0305] FIG. 28 is a flowchart illustrating a process for modifying a trauma diagnosis protocol based on crash event data. First, a diagnosis protocol is established 2930 for diagnosis of the injuries of a vehicle occupant injured in a crash. Second, crash data is captured 2940 by On-board Sensors 90. Third, crash data is transmitted 2945 by an On-board Data System 80 that wirelessly transmits data to a remote location. Fourth, crash data is analyzed 2950, which may include prediction of crash severity and potential occupant injuries. Fifth, the diagnosis protocol is revised 2960 based on analyzed crash data. Sixth, an injured occupant is diagnosed 2970 based on the revised diagnosis protocol.

Detail Description Paragraph (210):
[0306] FIG. 29 is a flowchart illustrating a process for remotely treating an injured vehicle occupant using crash event data. First, On-board Sensor Data 1030 is captured 2990 by On-board Sensors 90. Second, On-board Sensor Data 1030 is transmitted 3000 by an On-board Data System 80 that wirelessly transmits data to a remote location. Third, crash event data is accessed 3010 by Crash Data Experts 200 at a remote location. Fourth, communication is established 3020 between Crash Data Experts 200 and emergency personnel responding to the crash event. Fifth, Crash Data Experts 200 assist 3030 emergency personnel with the treatment and handling of injured occupants based on crash event data.

Detail Description Paragraph (211):
[0307] FIG. 30 is a flowchart illustrating a process for determining the survival probability of an injured vehicle occupant using crash event data. First, On-board Sensor Data 1030 is captured 3050 by On-board Sensors 90. Second, On-board Sensor Data 1030 is transmitted 3060 by an On-board Data System 80 that wirelessly transmits data to a remote location. Third, crash event data is analyzed 3070 to predict injury mechanisms. Fourth, organ injuries are predicted 3080 based on predicted injury mechanisms. Fifth, an injury score is generated 3090 using an injury scoring method. Sixth, an injury severity score is generated 3100 if multiple severe injuries are predicted. Seventh, a coma score is generated 3110 based on eye, verbal and motor responses of injured occupant. Eighth, a revised trauma score is generated 3120 based on coma score, blood pressure and respiratory rate of injured occupant. Ninth, survival probability is determined 3130 based on revised trauma score, injury severity score, patient age and comparison of these factors to

historical trauma outcomes.

Detail Description Paragraph (212):
[0308] FIG. 31 is a flowchart illustrating a process for obtaining consumer authorization to transmit and display crash event data: First, an On-board Data System 80 is installed 3150 into a vehicle. Second, the vehicle is sold or leased 3160. Third, an individual who purchased or leased the vehicle is presented a contract for provision of services utilizing the On-board Data System 80 which contains a provision stating that the individual authorizes data obtained from the On-board Sensors 90 may be wirelessly transmitted by the On-board Data System 80 in the event of a crash, and may be presented 3180 through a Crash Data D&IS 130. Fourth, the individual signs the contract 3170.

Detail Description Paragraph (213):
[0309] FIG. 32 is a flowchart illustrating a process for authorizing use of crash event data by the manufacturer of the vehicle. First, an On-board Data System 80 is installed 3200 into a vehicle. Second, the vehicle is sold or leased 3210. Third, an individual who purchased or leased the vehicle is presented a contract for provision of services utilizing the On-board Data System 80 which contains a provision stating that the individual authorizes data obtained from the On-board Sensors 90 may be wirelessly transmitted by the On-board Data System 80 in the event of a crash, and may be used by the vehicle manufacturer for evaluation of the performance of vehicle safety systems 3230. Fourth, the individual signs the contract 3220.

Detail Description Paragraph (214):
[0310] FIG. 33 is a flowchart illustrating a process for authorizing reimbursement to a medical provider for services rendered to an injured vehicle occupant based on crash event data. FIG. 34 is a flowchart illustrating a process for authorizing reimbursement to a medical provider for services rendered to an injured vehicle occupant based on crash event data, using pre-established criteria regarding the sufficiency and accuracy of crash event data.

CLAIMS:

1. A method for transmitting from a vehicle to a remote location on-board sensor data associated with a crash event, the vehicle including a safety restraint control system and an on-board data system that is capable of transmitting crash event data to the remote location, the method comprising: receiving on-board sensor data with the safety restraint control system from at least one on-board sensor; and storing the on-board sensor data; and transferring the on-board sensor data from the safety restraint control system to the on-board data system when the safety restraint control system detects a crash event.

2. The method of claim 1 wherein the receiving step comprises: receiving on-board sensor data for a predetermined period of time after detecting the crash event and before transmitting the on-board sensor data to the remote location.

3. A method for transmitting from a vehicle to a remote location onboard sensor data associated with a crash event, the vehicle including a safety restraint control system and an on-board data system that is capable of transmitting crash event data to the remote location, the method comprising: receiving on-board sensor data by the safety restraint control system from at least one on-board sensor; and storing the on-board sensor data; detecting a crash event; transferring the on-board sensor data from the safety restraint control system to the on-board data system, and transmitting the on-board sensor data from the on-board data system to a remote location.

4. The method of claim 3 wherein the transferring step comprises: transferring the on-board sensor data to the on-board data system through a vehicle data bus.

5. The method of claim 4 further comprising: completing a communication circuit between the safety restraint control system and the vehicle data bus when the crash-event is detected.

6. The method of claim 5 wherein the transmitting step comprises: transmitting the

on-board sensor data wherein the on-board sensor data includes data that is indicative of potential injuries sustained by vehicle occupants.

7. A method for transmitting crash event information from a vehicle to a remote location, comprising the steps of: monitoring at least one on-board sensor capable of providing data during a crash event that has a predetermined relationship to potential occupant injuries; and

8. A method for maintaining a crash event database, the crash event database including subscriber data which includes personal data and vehicle data, the method comprising: receiving crash-event data from a vehicle when the vehicle experiences a crash event, the crash event data including on-board sensor data associated with the crash event and a vehicle identifier; reading the vehicle identifier; and correlating the crash event data with subscriber data corresponding to the vehicle identifier.

9. A method for predicting potential injuries to occupants in a vehicle resulting from a crash event, the method comprising: receiving crash event data, the crash event data including on-board sensor data associated with a crash event of a vehicle with occupants; analyzing the crash event data; determining potential injuries to the occupants; communicating the potential injuries to medical personnel.

10. A system for managing crash events, the system comprising: a computer system configured to: receive crash event data, the crash event data including on-board sensor data associated with a crash event of a vehicle with occupants and display the crash event data to an operator; a communication system for communicating a crash event report to an emergency service providers (ESP).

11. A system for managing crash events as claimed in claim 10 wherein the computer system is configured to receive a crash event report indicative of potential injuries to the occupants from the operator.

12. A system for managing crash events as claimed in claim 10 wherein the communication system includes a network connected to the compute system for transmitting the crash event report to the ESP.

13. A system for managing crash events as claimed in claim 10 wherein the communication system includes a telephone system.

14. A system for managing crash events as claimed in claim 10, wherein the communication system communicates the crash-event report to ESPs having a likelihood for responding to the crash event.

15. A system for managing crash events as claimed in claim 10 further comprising a database of emergency services providers.

16. A system for managing crash events as claimed in claim 10 wherein the computer system includes an operator input and a graphics display.

17. A system for managing crash events as claimed in claim 10 wherein the communication system includes a wireless network configured to allow trauma personnel to access the computer system.

18. A method for notifying trauma personnel about a crash event of a vehicle with occupants, the method comprising: maintaining a trauma personnel database including . . . receiving crash event data including location data; looking up in the database trauma personnel corresponding to the location data; and notifying the trauma personnel of the crash event.

19. A method for notifying trauma personnel about a crash event of a vehicle with occupants as claimed in claim 18, wherein the maintaining step comprises: receiving from a trauma person, emergency response information including a predetermined response boundary; storing the emergency response information in a database;

20. A method for notifying trauma personnel about a crash event of a vehicle with

occupants as claimed in claim 19, wherein the maintaining step further comprises: receiving communication information from the trauma person.

21. A method for notifying trauma personnel about a crash event of a vehicle with occupants as claimed in claim 18, wherein the notifying step comprises notifying the trauma personnel of a crash-event report.

22. A method for notifying trauma personnel about a crash event of a vehicle with occupants as claimed in claim 21, wherein the maintaining step comprises; configuring the database into relevant geographic areas.

23. A method for notifying trauma personnel about a crash event of a vehicle with occupants as claimed in claim 18, wherein the notifying step comprises the step of: notifying a trauma person if a crash event criteria required exceeds a predetermined threshold.

24. A method for remotely accessing crash event data associated with a crash event of a vehicle with occupants, the method comprising: receiving notification associated with a crash event; and accessing a wireless network to retrieve crash event data associated with the crash event.

25. A method for remotely accessing crash event data associated with a crash event of a vehicle with occupants as claimed in claim 24, wherein the receiving step comprises: visually accessing information from the vehicle.

26. A method for remotely accessing crash event data associated with a crash event of a vehicle with occupants as claimed in claim 24, wherein the receiving step comprises: receiving a crash event report.

27. A method for remotely accessing crash event data associated with a crash event of a vehicle with occupants as claimed in claim 24, wherein the receiving step includes: receiving the crash event report on a portable electronic device.

28. A method for managing the crash event data of drivers of vehicles who have subscribed to an automotive service, the crash event data including subscriber data and on-board sensor data, the subscriber data including personal data and vehicle data, the on-board sensor data including vehicle movement sensors and occupant sensors, the method comprising: receiving on-board sensor data associated with one of the drivers; analyzing the on-board sensor data; communicating the on-board sensor data to a trauma services provider.

33. A method for assisting a driver of a vehicle who has subscribed to an automotive service in obtaining medical care after a vehicle accident, the driver having user data including subscriber data and on-board sensor data, the subscriber data including personal data and vehicle data, the on-board sensor data including data generated by vehicle movement sensors and occupant sensors when the vehicle is in a crash event, the method comprising: receiving authorization from a driver to receive the crash event data; receiving crash event data from the vehicle when a crash event occurs; and communicating the crash event data to medical personnel.

35. The method in claim 33 further comprising: analyzing the crash event data before communicating the crash event data to medical personnel.

36. The method of claim 33 further comprising: communicating the crash event data to a third party.

37. A method for obtaining crash event data from a vehicle with a driver to assess performance of a safety system in the vehicle in a crash event, the driver of the vehicle having subscribed to an automotive service in obtaining medical care when a crash event occurs, the driver having user data including subscriber data and on-board sensor data, the subscriber data including personal data and vehicle data, the on-board sensor data including data generated by vehicle movement sensors and occupant sensors when the vehicle is in a crash event, the method comprising: receiving authorization from a driver to receive the crash event data; receiving crash event data from the vehicle when a crash event occurs; and communicating the

crash event data to a third party.

38. A method for analyzing crash event data, the method comprising: receiving crash event data; comparing the crash event data to a database containing crash event data from other crash events;

39. A system for predicting trauma injuries to an occupant of a vehicle resulting from a crash event, the system comprising: a computer with a memory configured to automatically receive crash event data associated with a crash event, the crash event data including on-board sensor data; a database in communication with the computer, the database including a set of historical accident records that include injury mechanism data and sustained injuries; means for comparing the injury mechanism data for the crash event to the injury mechanism data in the set of historical accident records; means for generating a list of potential injuries including the sustained injuries from each of the historical accident records in the database in which the injury mechanism data substantially matches the injury mechanism data for the crash event; and means for displaying the list of potential injuries.

45. The system of claim 44 wherein the on-board sensor data includes data obtained from vehicle movement sensors and occupant sensors.

47. An expert system for predicting trauma injuries resulting from a crash event of a vehicle, the system comprising: a database including: a knowledge base having rules relating injury mechanism information to potential occupant injuries; expert system input data containing information about the crash event; a computer in communication with the database for executing an inference engine for generating a list of potential occupant injuries based on applying the rules to the expert system input data.

51. A data processing system for analyzing crash event data of a vehicle, the crash event data including a crash pulse, the system comprising: (a) computer processor means for processing data; (b) storage means for storing data on a storage medium; (c) first means for processing data regarding the crash pulse recorded by the vehicle; (d) second means for processing data regarding the crashworthiness of the vehicle.

52. The data processing system in claim 51, including a third means for processing data regarding a principal direction of force recorded by the vehicle during the crash event.

53. The data processing system in claim 51, including a fourth means for processing data regarding a vehicle restraint system recorded by the vehicle during the crash event.

54. The data processing system in claim 51, including a fifth means for processing data regarding the occupant position within the vehicle cabin recorded by a vehicle during a crash event.

56. A method for evaluating a patient with injuries resulting from a crash event of a vehicle, the vehicle generating crash event data when the crash event occurs, the method comprising: receiving information based on crash event data; evaluating the patient to determine potential injuries; and accessing the crash event data to confirm the potential injuries.

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L14: Entry 7 of 8 File: USPT Dec 3, 1996

DOCUMENT-IDENTIFIER: US 5581464 A
**** See image for Certificate of Correction ******
**** See image for Reexamination Certificate ******
TITLE: Recording of operational events in an automotive vehicle

Brief Summary Text (9):
In the area of automobile accident reconstruction, an accident analyst determines how an accident most probably occurred by measuring, among other things, the length of skid marks, the extent of vehicle and nearby property damage, and the condition of the road at the time of the accident. This method of reconstructing accidents has been shown to be expensive and inaccurate at times. Accordingly, it would be desirable for automotive vehicles to have a system that would function as an event recording "black box". Such a system should record information relating to the vehicle and the environment around the vehicle prior to an accident. Such data should be readable after an accident for use in reconstructing the events leading up to the accident. An accident could then be reconstructed using real historical data, as opposed to post-accident estimated data.

Detailed Description Text (8):
The input/output module 4 also has a display and/or actuators 4b, for displaying indications to a user and/or controlling various aspects of vehicle operation (for example, flashing a dashboard warning light to a user if a vehicle is approaching too rapidly, and/or, in extreme conditions, automatically activating the vehicle brakes and/or air bag).

Detailed Description Text (31):
To read out the data collected in the RAM card 20, the RAM card 20 is removed from the interface receptacle on the automotive system and inserted in a similar interface coupled to a personal computer. The data can then be displayed on the computer or stored on a different memory device, such as a floppy disk or a hard drive in the computer.

Detailed Description Text (34):
Once data has been retrieved from the RAM card 20, it can be displayed on the PC in a variety of ways, such as in various tabular forms, depending on whether the information represents accident reconstruction information, trip monitoring information, maintenance information, or other information. The manner of presentation of the data is a matter of design choice.

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L8	L7 and 11	15	L8
L7	15 and L6	100	L7
L6	rfid	2753	L6
L5	saw	107588	L5
L4	5056023.pn.	2	L4
L3	11 near L2	10	L3
L2	communication adj device	61893	L2
L1	diagnos$3 adj system	13775	L1

END OF SEARCH HISTORY

US006738697B2

(12) United States Patent
Breed

(10) Patent No.: US 6,738,697 B2
(45) Date of Patent: May 18, 2004

(54) TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

(75) Inventor: David S. Breed, Boonton Township, Morris County, NJ (US)

(73) Assignee: Automotive Technologies International Inc., Denville, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 27 days.

(21) Appl. No.: 10/188,673

(22) Filed: Jul. 3, 2002

(65) Prior Publication Data

US 2003/0009270 A1 Jan. 9, 2003

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/753,186, filed on Jan. 2, 2001, now Pat. No. 6,484,080, which is a continuation-in-part of application No. 09/137,918, filed on Aug. 20, 1998, now Pat. No. 6,175,787, which is a continuation-in-part of application No. 08/476,077, filed on Jun. 7, 1995, now Pat. No. 5,809,437, application No. 10/188,673, application No. 10/079,065, filed on Feb. 19, 2002, which is a continuation-in-part of application No. 09/765,558, filed on Jan. 19, 2001, application No. 10/188,673, which is a continuation-in-part of application No. 10/174,709, filed on Jun. 19, 2002.

(60) Provisional application No. 60/304,013, filed on Jul. 9, 2001, provisional application No. 60/291,511, filed on May 16, 2001, provisional application No. 60/269,415, filed on Feb. 16, 2001, and provisional application No. 60/231,378, filed on Sep. 8, 2000.

(51) Int. Cl.[7] G01N 17/00; G06F 7/00

(52) U.S. Cl. 701/29; 701/34

(58) Field of Search 701/29, 33, 34, 701/36; 340/438, 439

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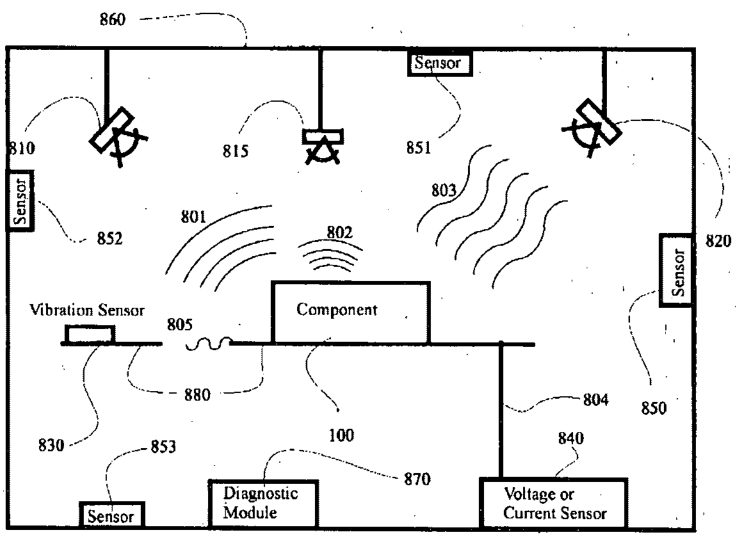
Primary Examiner—Yonel Beaulieu
(74) *Attorney, Agent, or Firm*—Brian Roffe

(57) ABSTRACT

Vehicle diagnostic system which diagnoses the state of the vehicle or the state of a component of the vehicle and generates an output indicative or representative thereof. A communications device transmits the output of the diagnostic system to a remote location, possibly via a satellite or the Internet. The diagnostic system can include sensors mounted on the vehicle, each providing a measurement related to a state of the sensor or a measurement related to a state of the mounting location, and a processor coupled to the sensors and arranged to receive data from the sensors and process the data to generate the output indicative or representative of the state of the vehicle or its component. The processor may embody a pattern recognition algorithm trained to generate the output from the data received from the sensors and be arranged to control parts of the vehicle based on the output.

62 Claims, 38 Drawing Sheets



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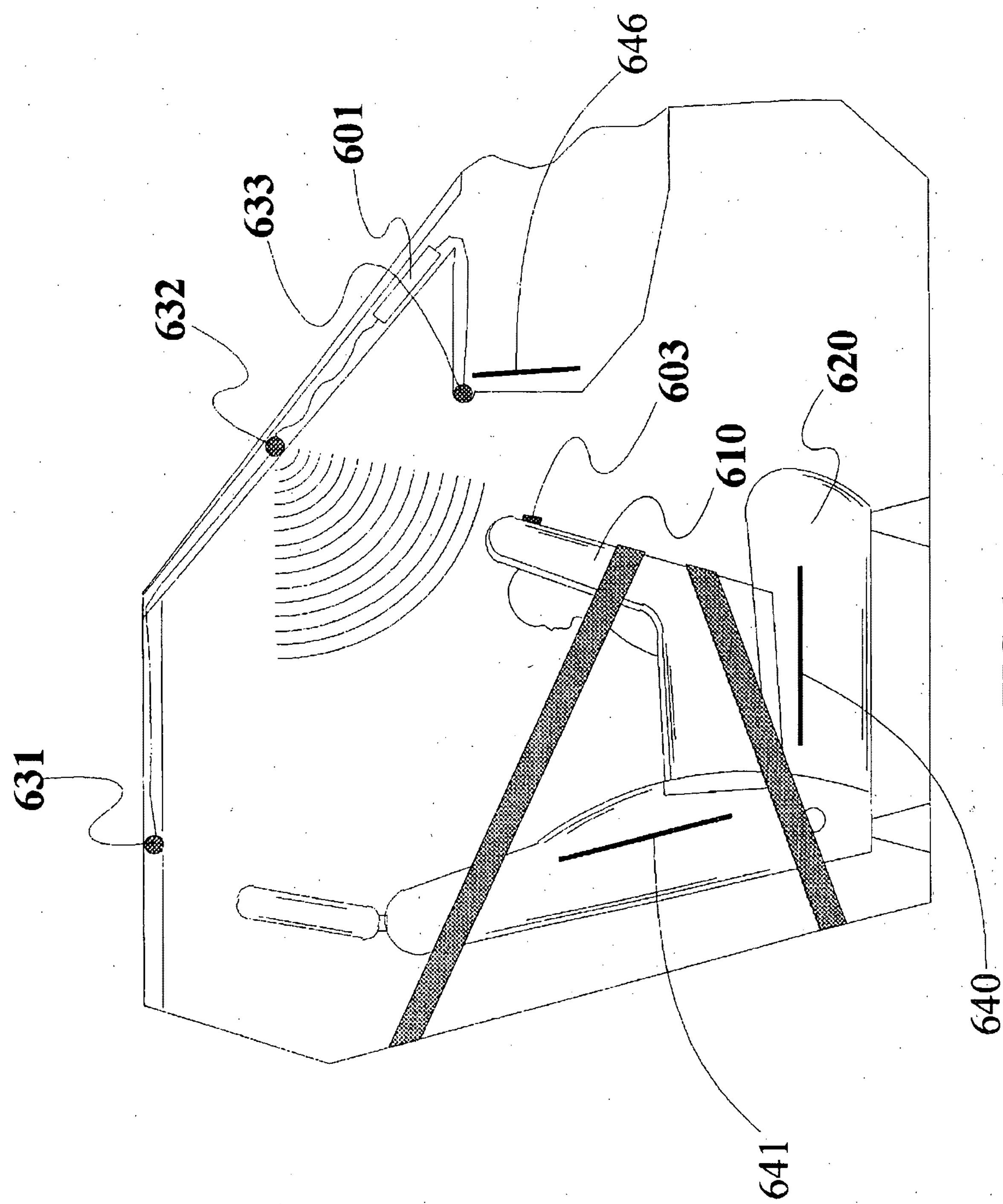


FIG. 1

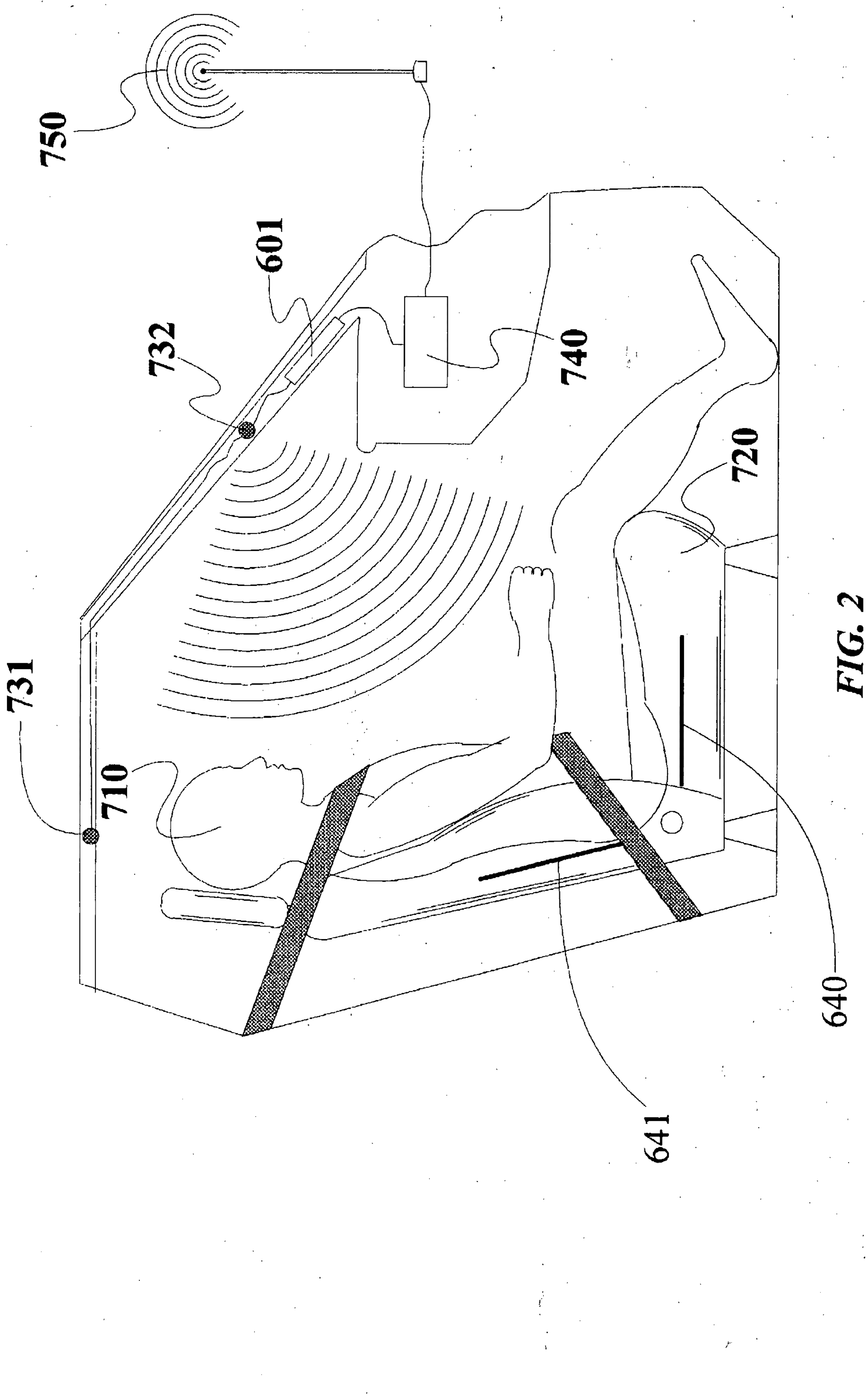


FIG. 2

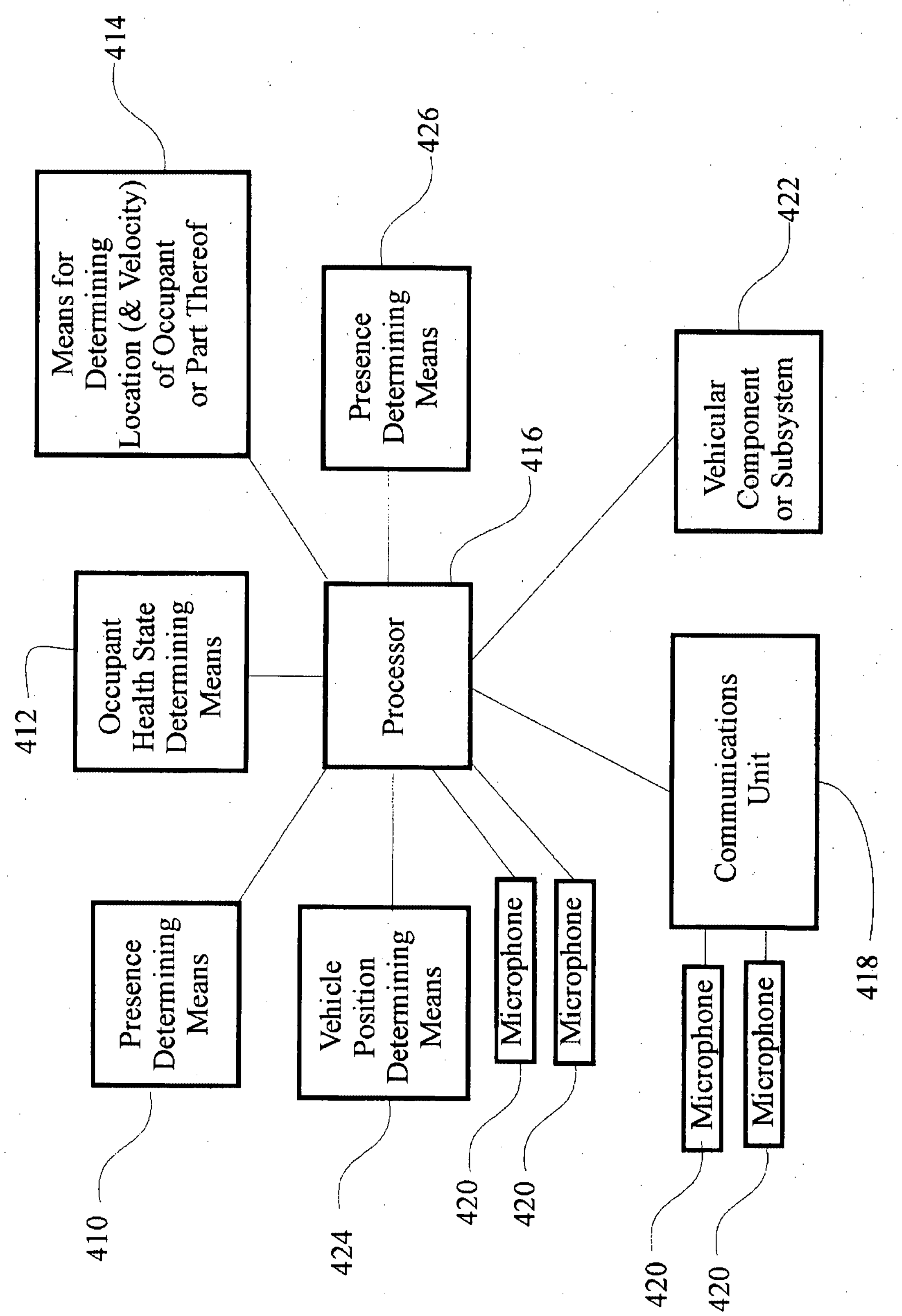

Means for Determining Location (& Velocity) of Occupant or Part Thereof
414
Presence Determining Means
426
Vehicular Component or Subsystem
422
Occupant Health State Determining Means
412
Processor
416
Communications Unit
418
Presence Determining Means
410
Vehicle Position Determining Means
424
Microphone
420

FIG. 3

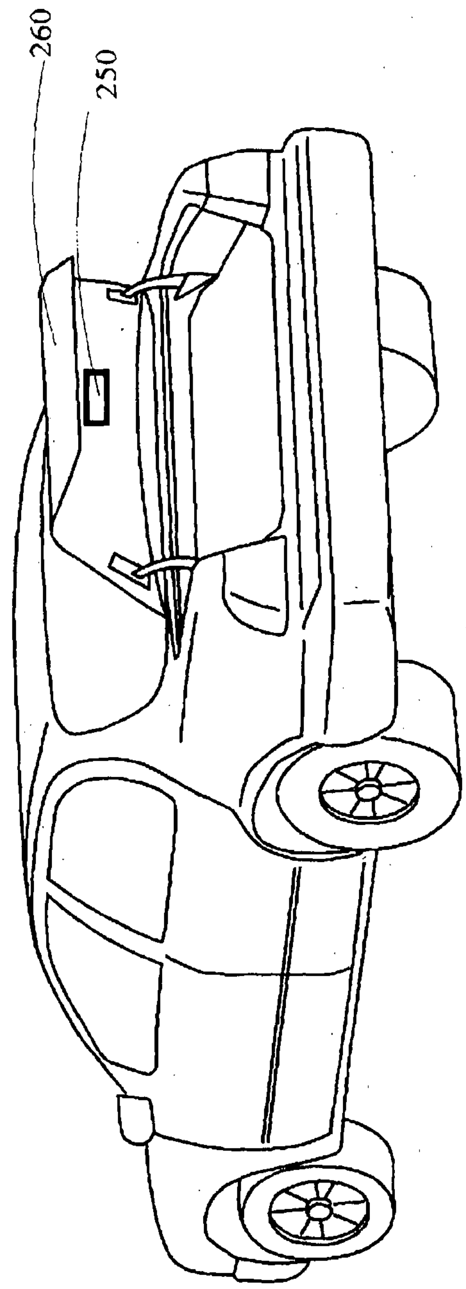


FIG. 4

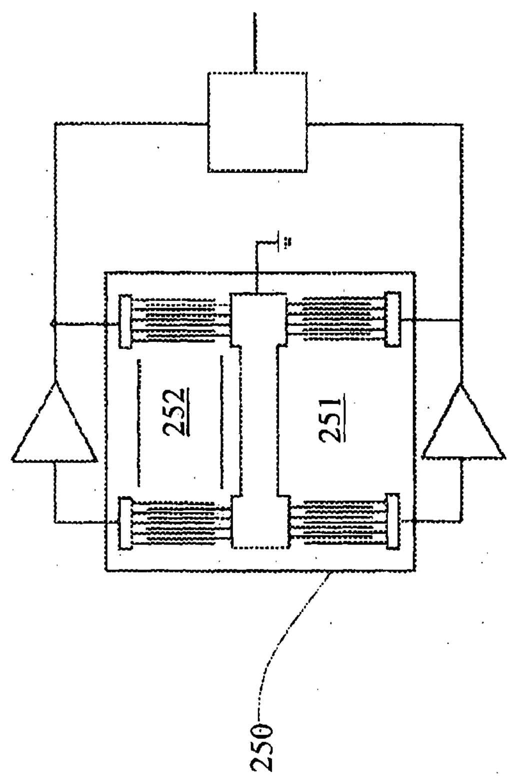
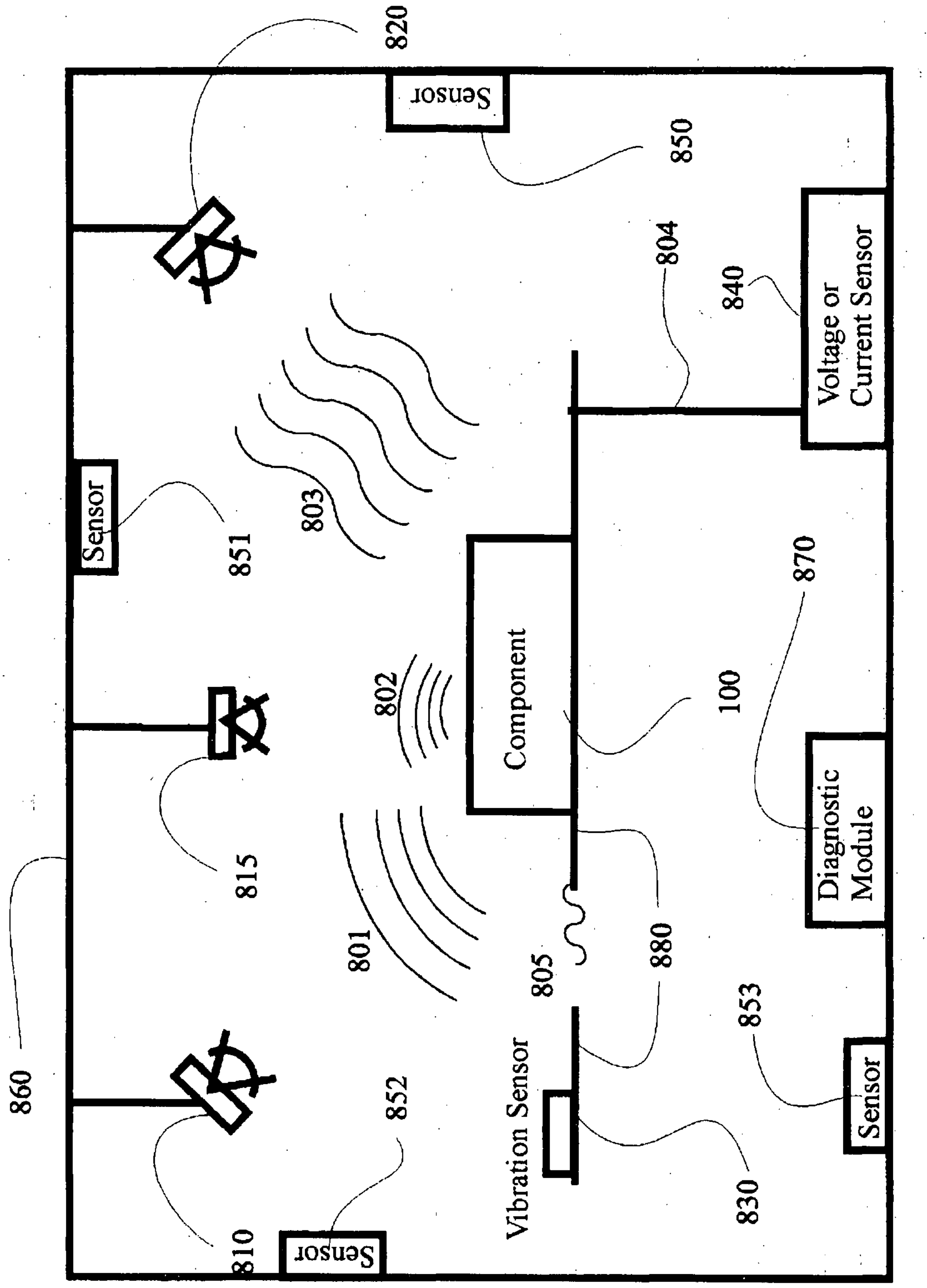


FIG. 4A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Sensor
850
804
840
Voltage or Current Sensor
Sensor
851
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870
802
Component
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Diagnostic Module
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880
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Vibration Sensor
Sensor
830
810
Sensor

FIG. 5

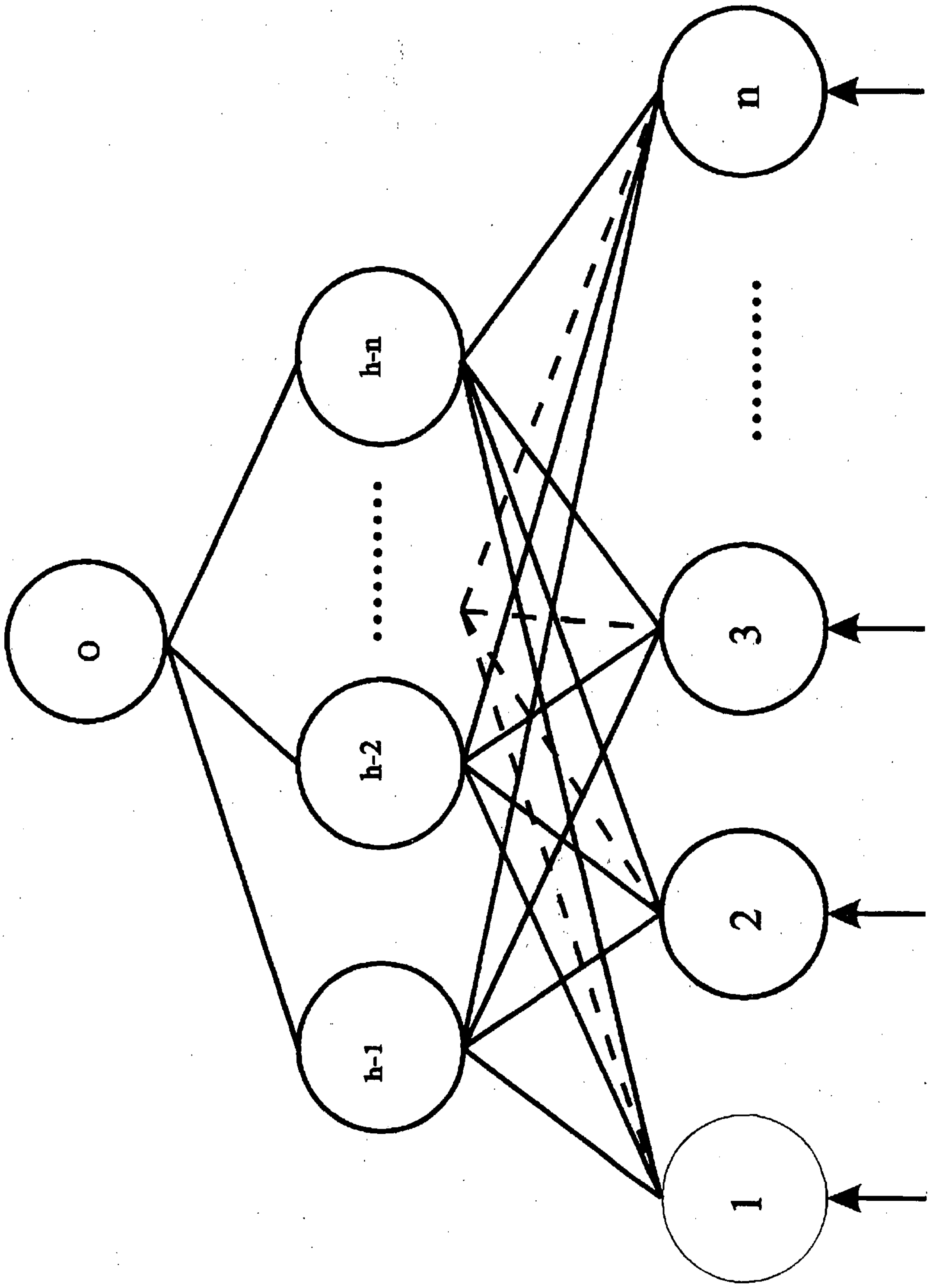
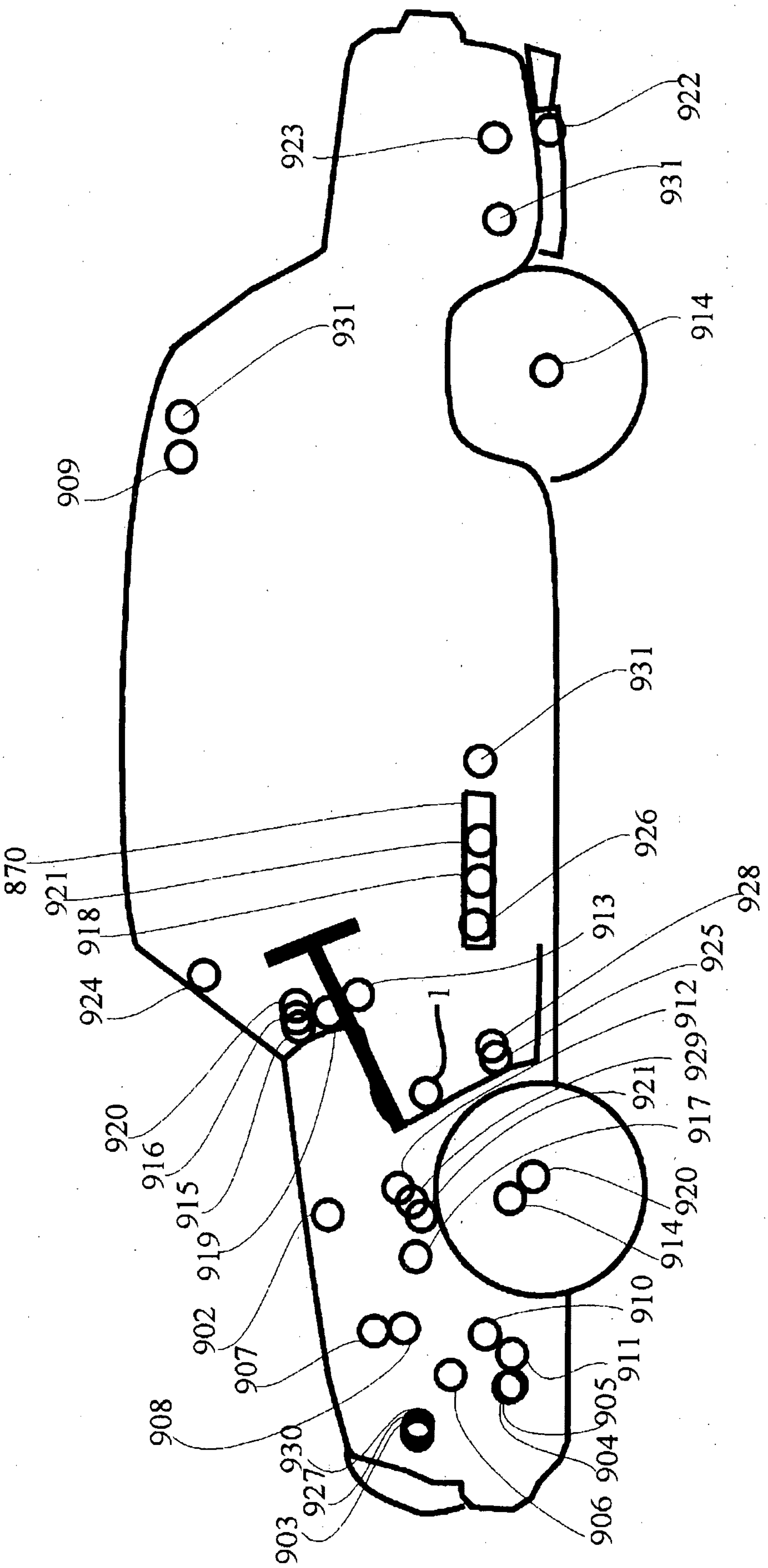


FIG. 6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921
917
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927
903

FIG. 7

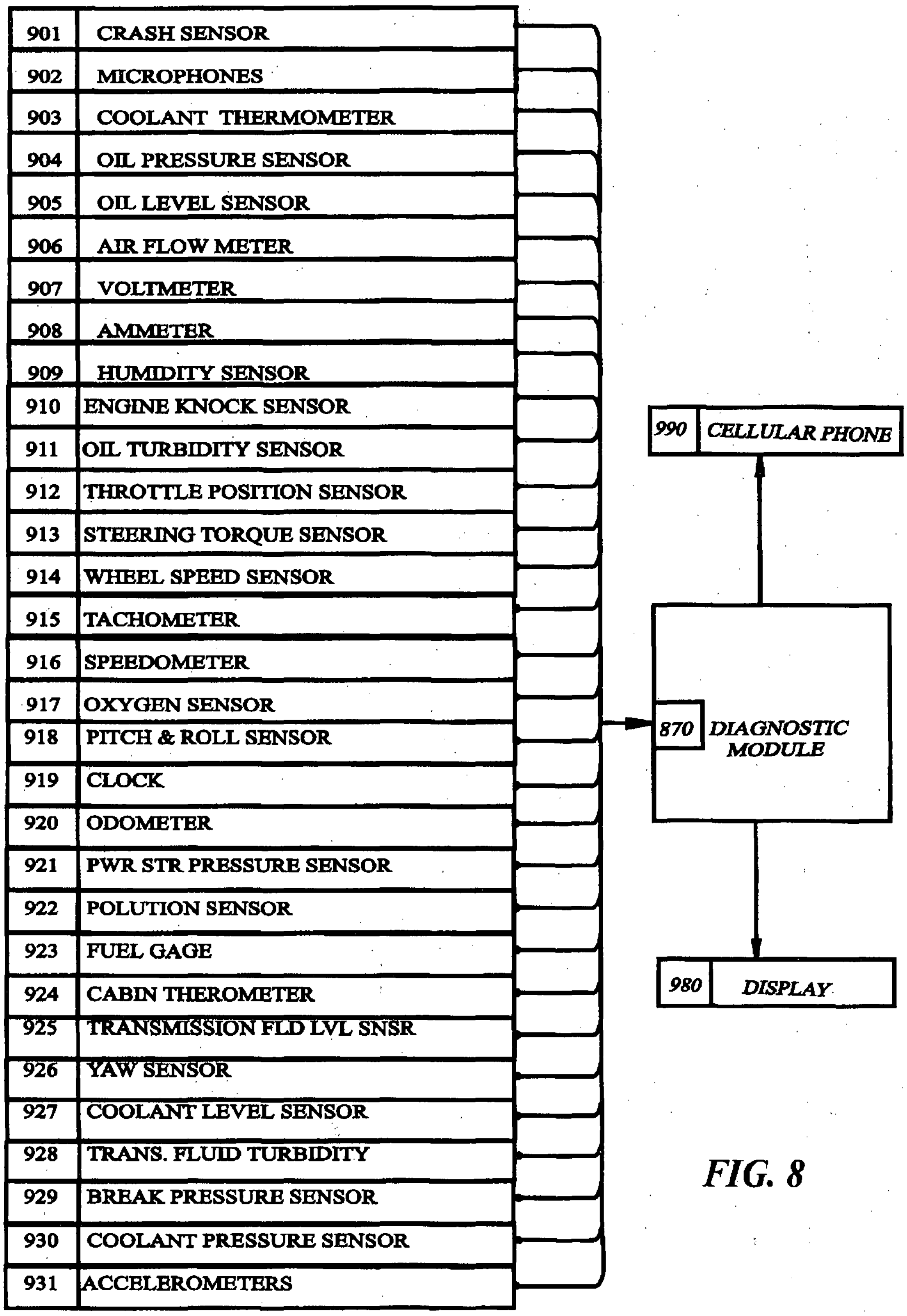

901 CRASH SENSOR
902 MICROPHONES
903 COOLANT THERMOMETER
904 OIL PRESSURE SENSOR
905 OIL LEVEL SENSOR
906 AIR FLOW METER
907 VOLTMETER
908 AMMETER
909 HUMIDITY SENSOR
910 ENGINE KNOCK SENSOR
911 OIL TURBIDITY SENSOR
912 THROTTLE POSITION SENSOR
913 STEERING TORQUE SENSOR
914 WHEEL SPEED SENSOR
915 TACHOMETER
916 SPEEDOMETER
917 OXYGEN SENSOR
918 PITCH & ROLL SENSOR
919 CLOCK
920 ODOMETER
921 PWR STR PRESSURE SENSOR
922 POLUTION SENSOR
923 FUEL GAGE
924 CABIN THEROMETER
925 TRANSMISSION FLD LVL SNSR
926 YAW SENSOR
927 COOLANT LEVEL SENSOR
928 TRANS. FLUID TURBIDITY
929 BREAK PRESSURE SENSOR
930 COOLANT PRESSURE SENSOR
931 ACCELEROMETERS
990 CELLULAR PHONE
870 DIAGNOSTIC MODULE
980 DISPLAY

FIG. 8

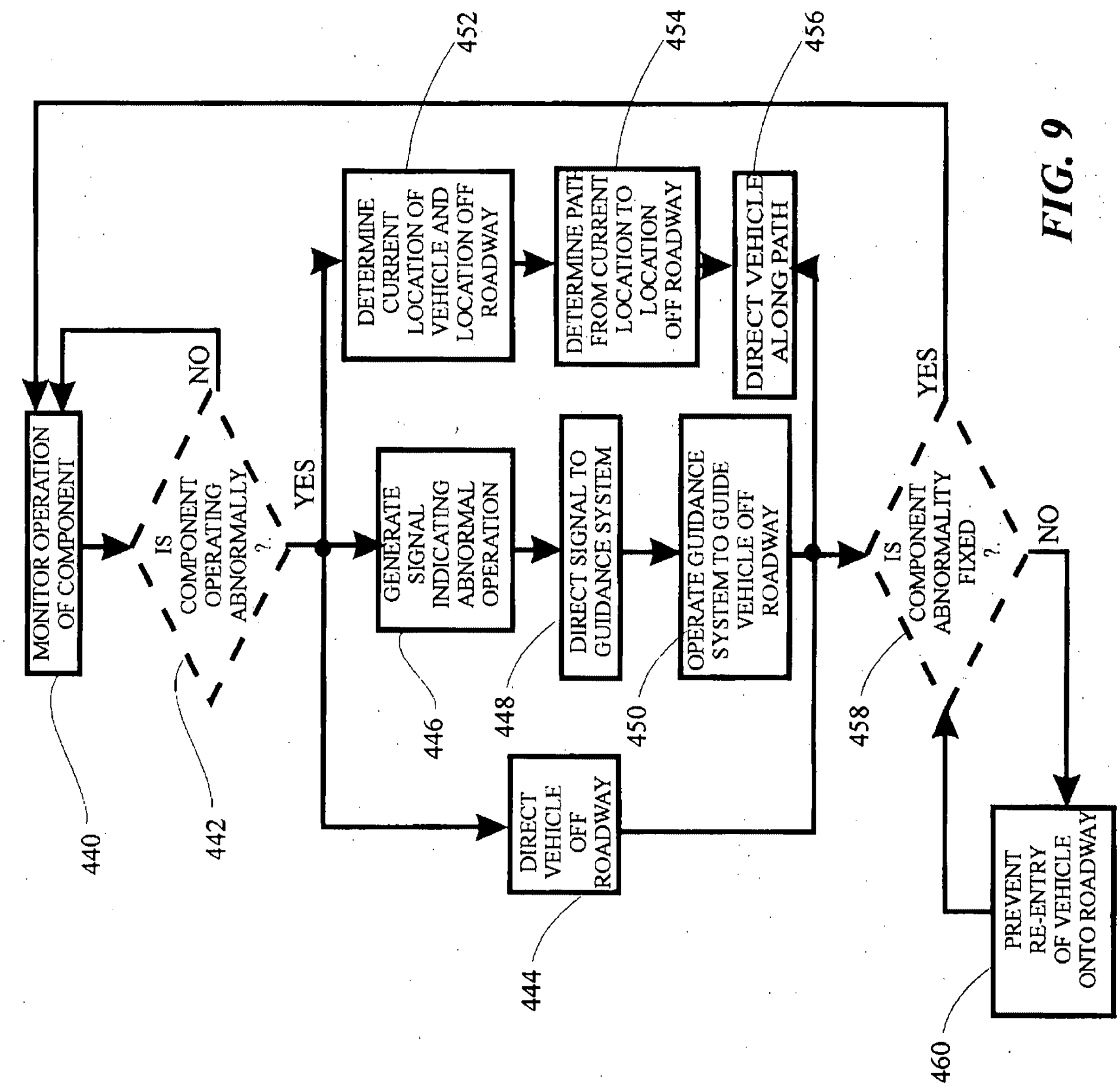

MONITOR OPERATION OF COMPONENT
440
IS COMPONENT OPERATING ABNORMALLY ?
442
NO
YES
DIRECT VEHICLE OFF ROADWAY
444
GENERATE SIGNAL INDICATING ABNORMAL OPERATION
446
DIRECT SIGNAL TO GUIDANCE SYSTEM
448
OPERATE GUIDANCE SYSTEM TO GUIDE VEHICLE OFF ROADWAY
450
DETERMINE CURRENT LOCATION OF VEHICLE AND LOCATION OFF ROADWAY
452
DETERMINE PATH FROM CURRENT LOCATION TO LOCATION OFF ROADWAY
454
DIRECT VEHICLE ALONG PATH
456
IS COMPONENT ABNORMALITY FIXED ?
458
YES
NO
PREVENT RE-ENTRY OF VEHICLE ONTO ROADWAY
460

FIG. 9

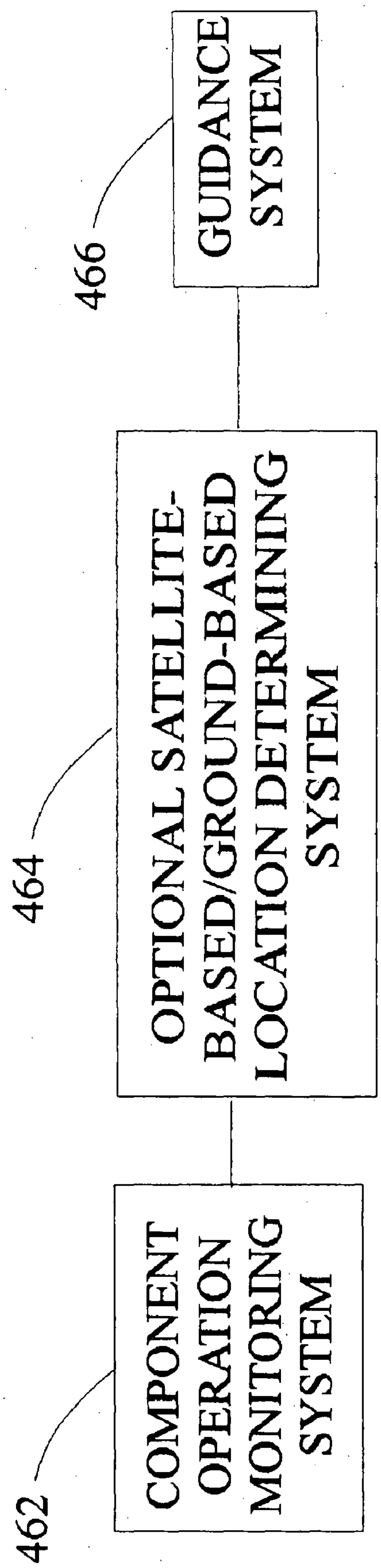

466
GUIDANCE SYSTEM
464
OPTIONAL SATELLITE-BASED/GROUND-BASED LOCATION DETERMINING SYSTEM
462
COMPONENT OPERATION MONITORING SYSTEM

FIG. 10

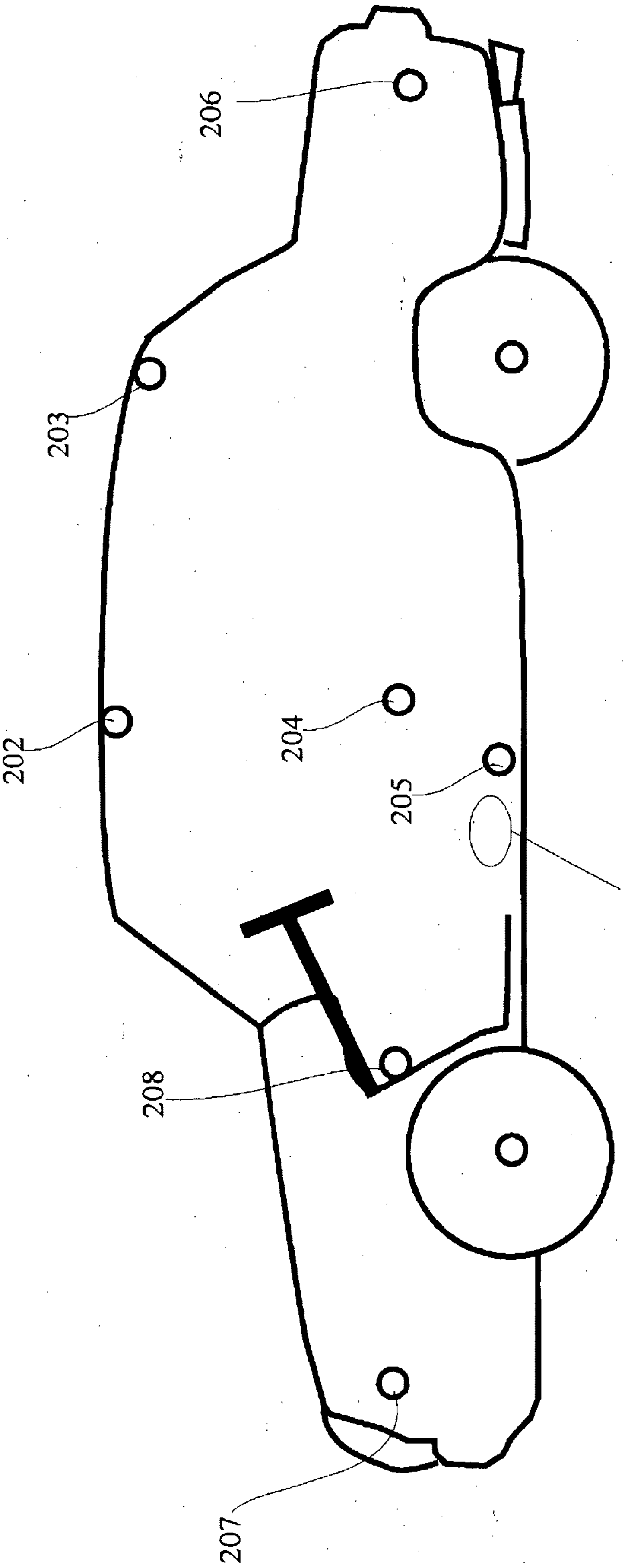
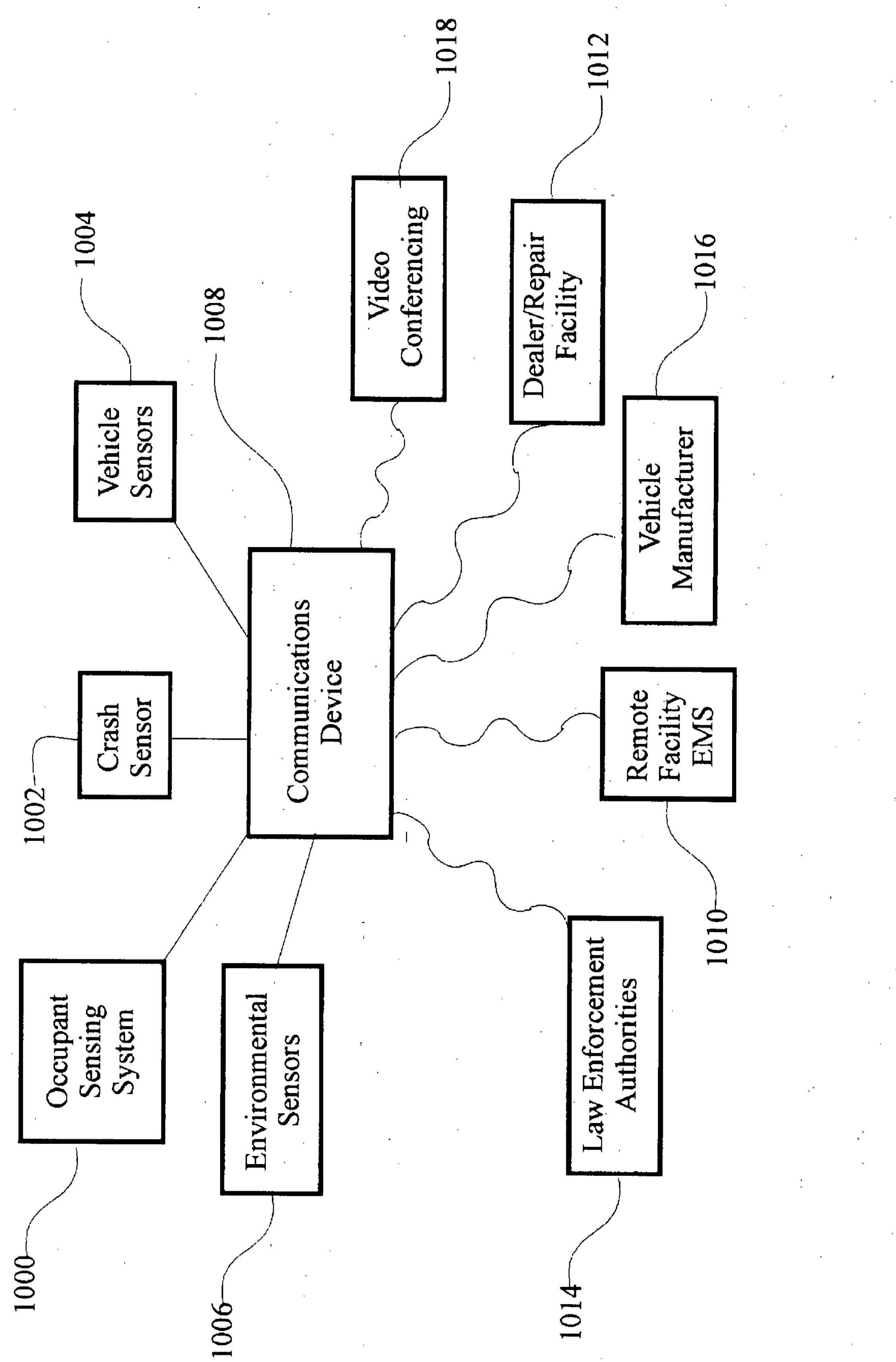


FIG. 11



Occupant Sensing System
1000
Crash Sensor
1002
Vehicle Sensors
1004
Environmental Sensors
1006
Communications Device
1008
Video Conferencing
1018
Dealer/Repair Facility
1012
Vehicle Manufacturer
1016
Remote Facility EMS
1010
Law Enforcement Authorities
1014

FIG. 12

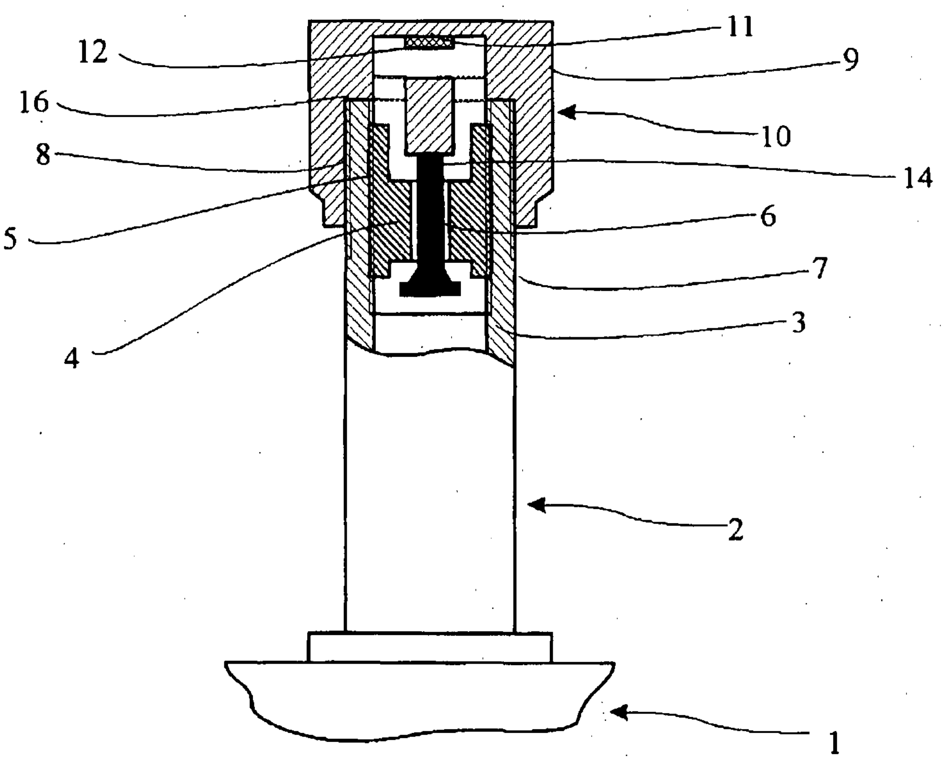


FIG. 13A

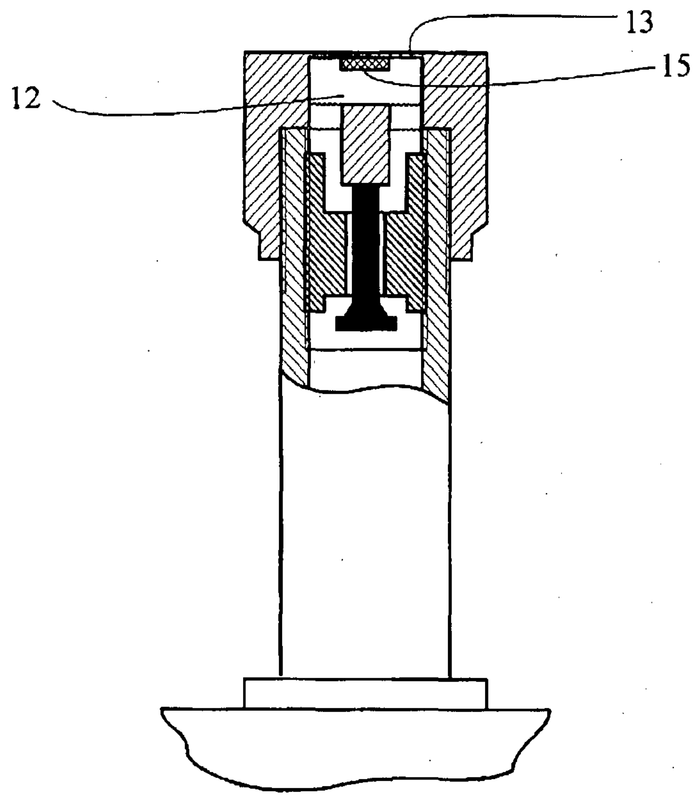


FIG. 13B

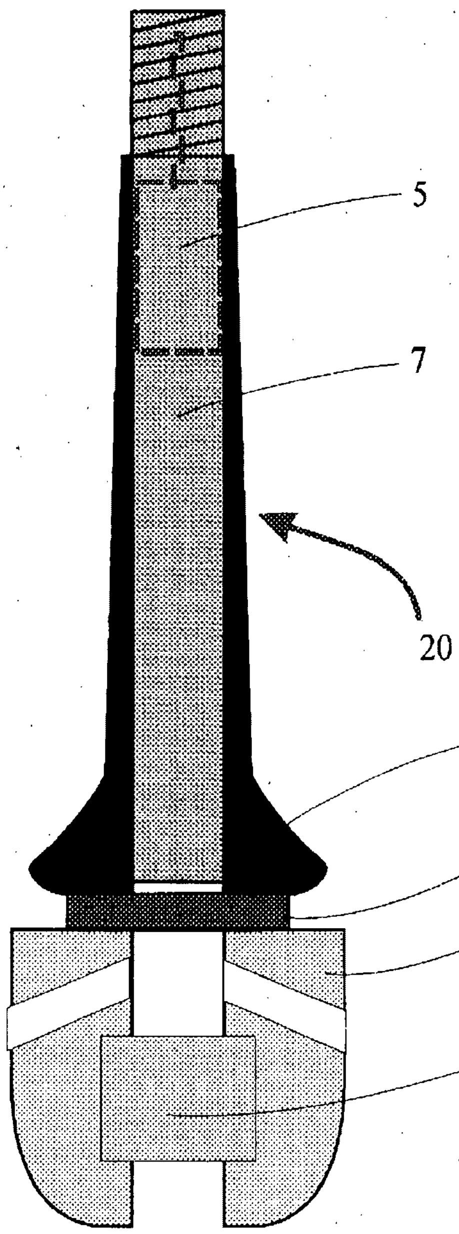


FIG. 14

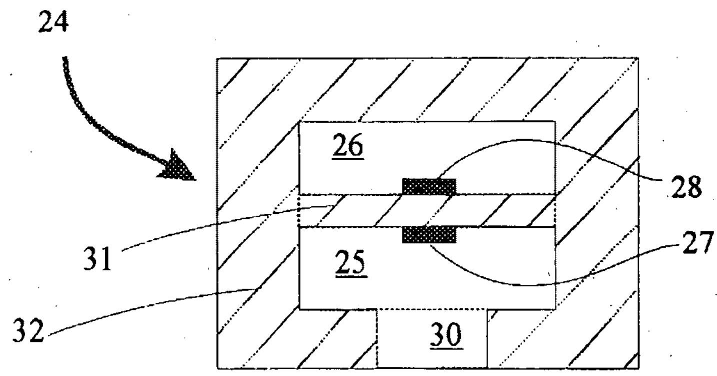


FIG. 14A

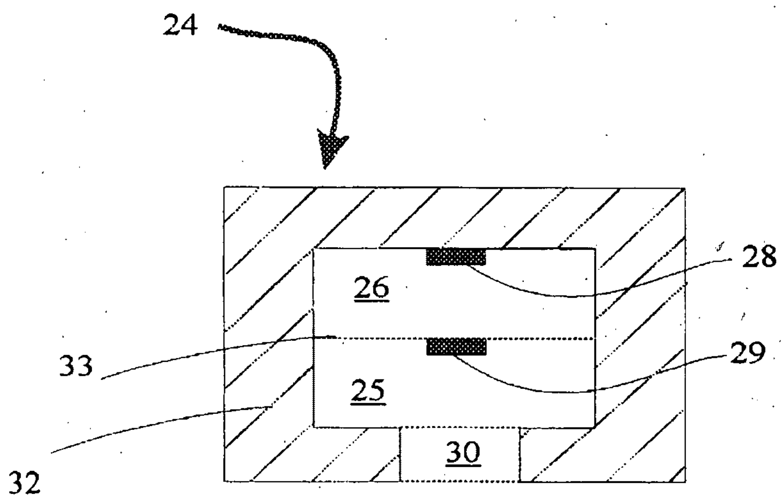


FIG. 14B

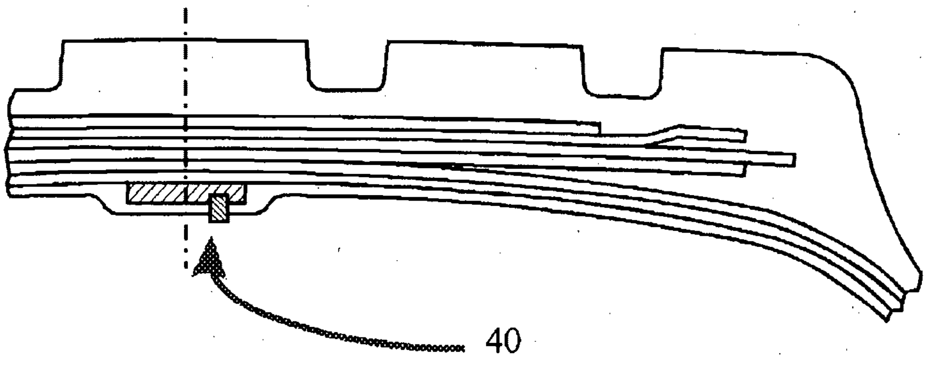


FIG. 15A

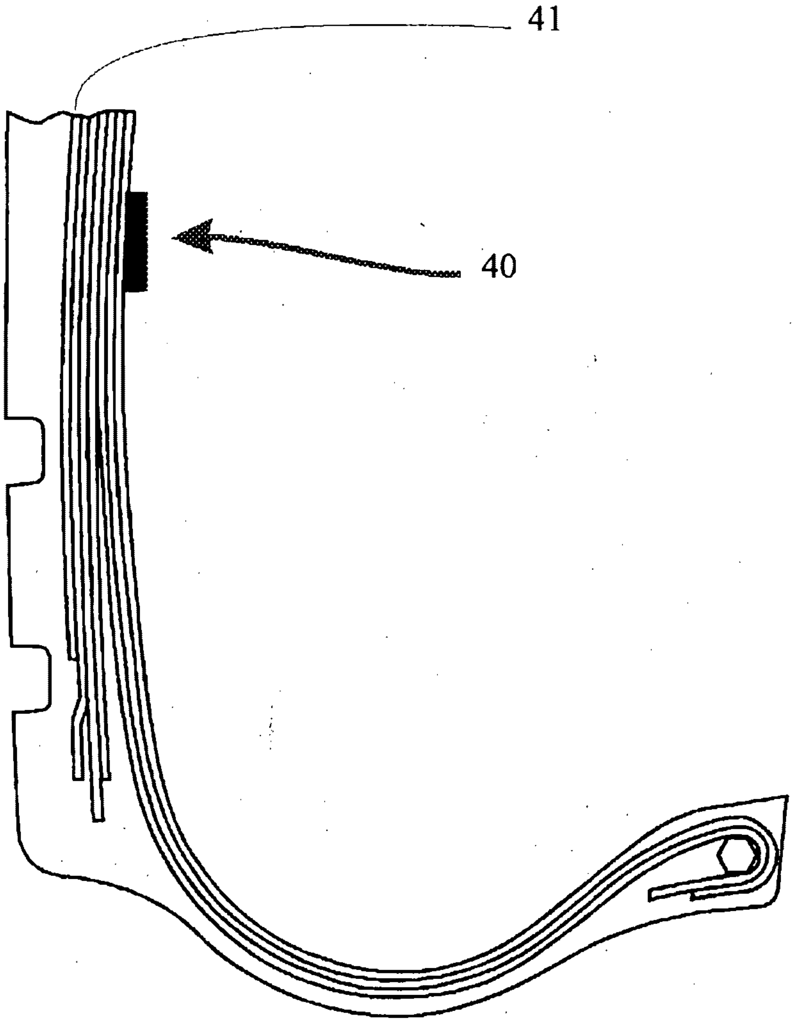


FIG. 15

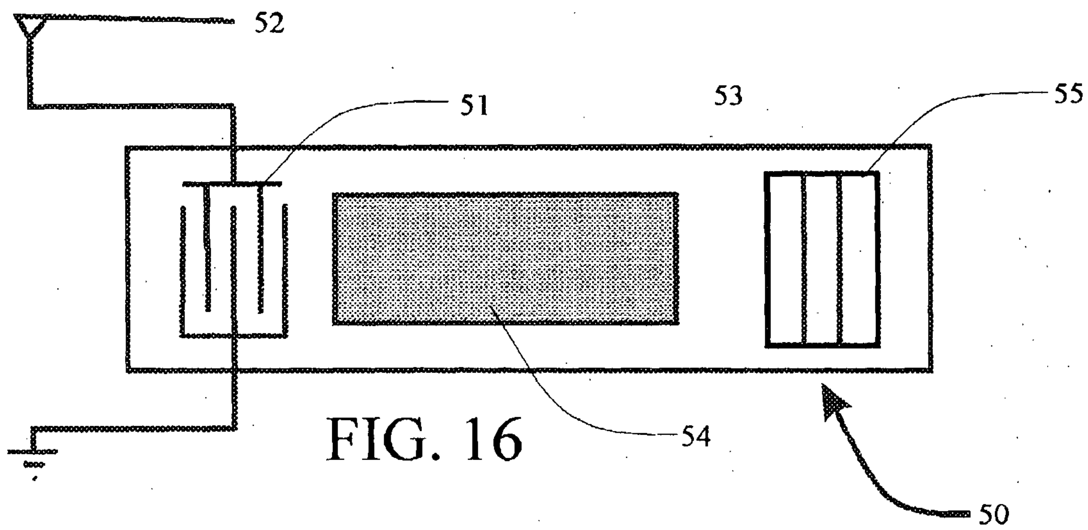


FIG. 16

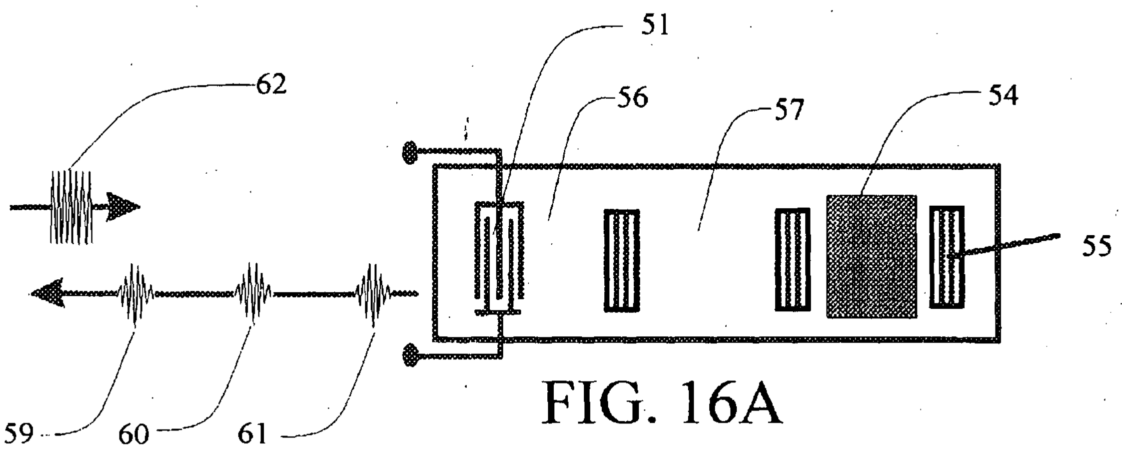


FIG. 16A

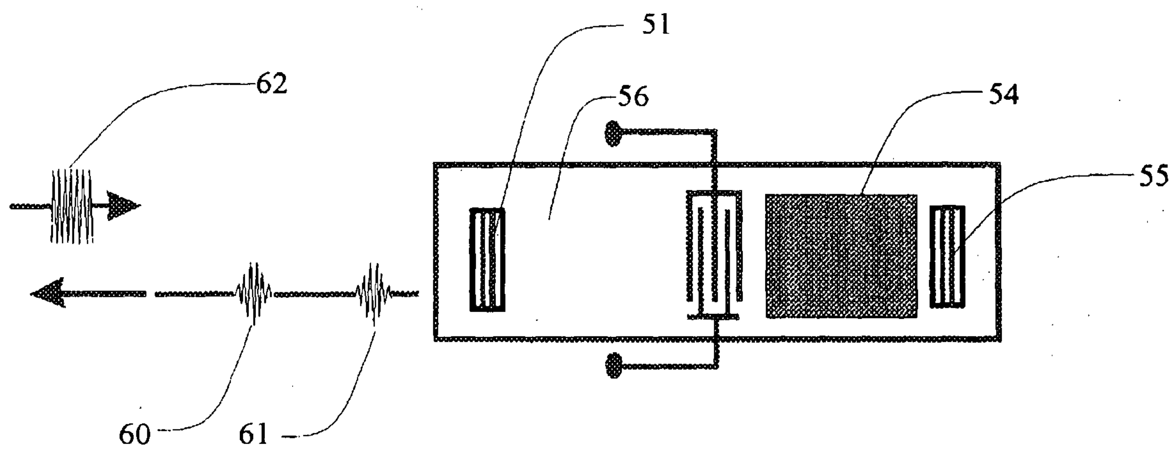


FIG. 16B

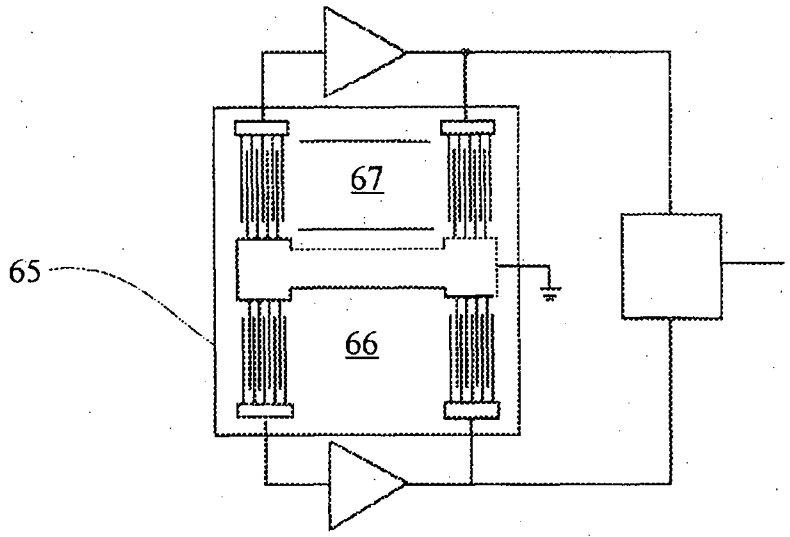


FIG. 17B

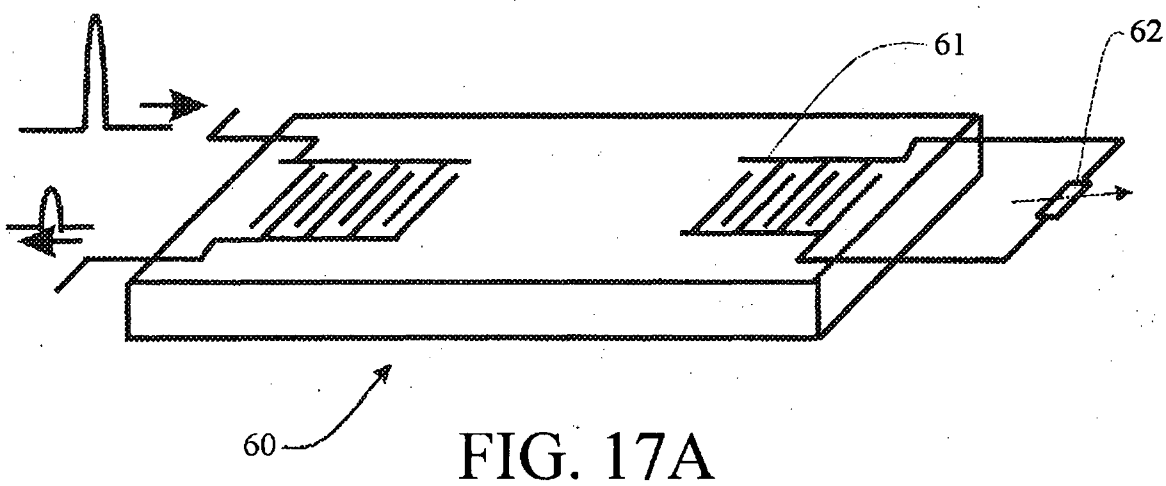


FIG. 17A

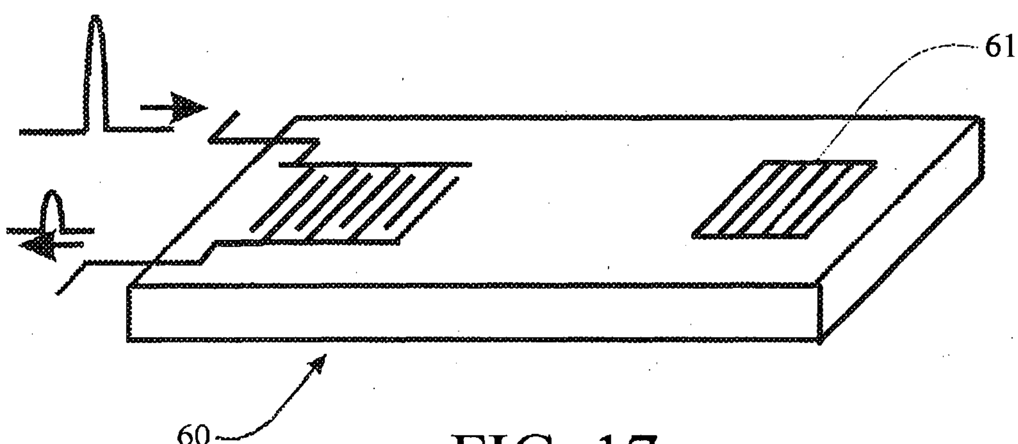


FIG. 17

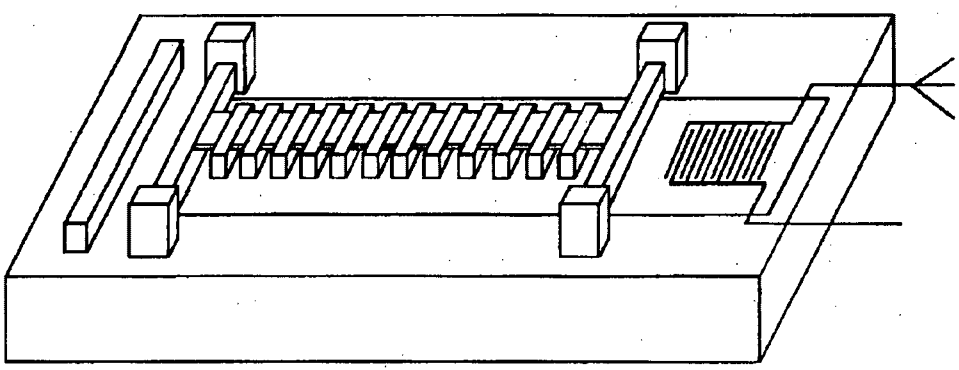


FIG. 18A

PRIOR ART

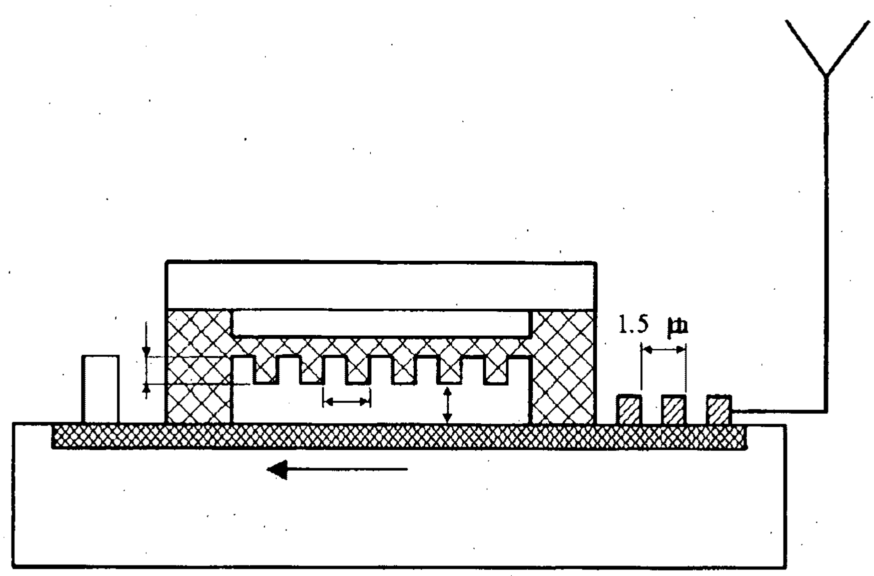


FIG. 18

PRIOR ART

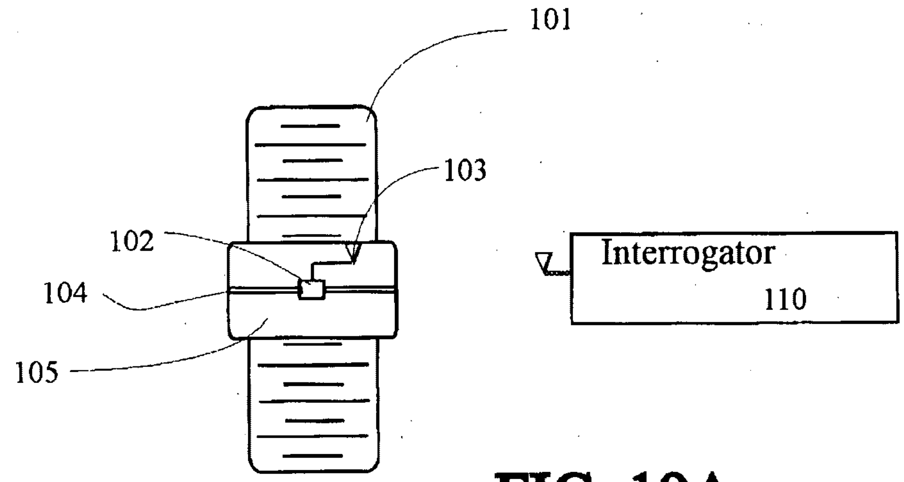


FIG. 19A

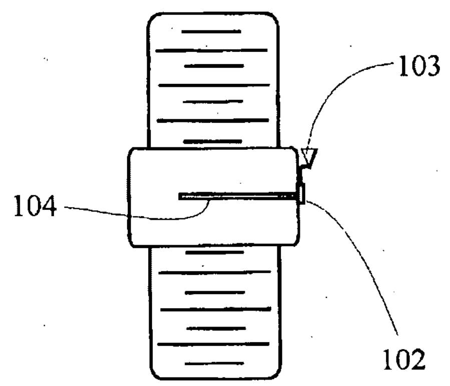


FIG. 19B

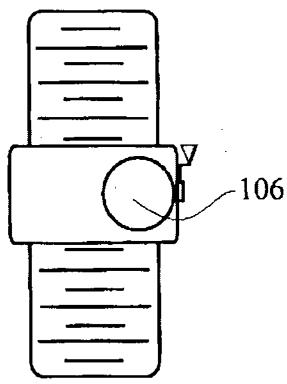


FIG. 19C

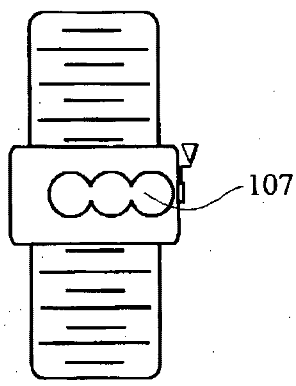


FIG. 19D

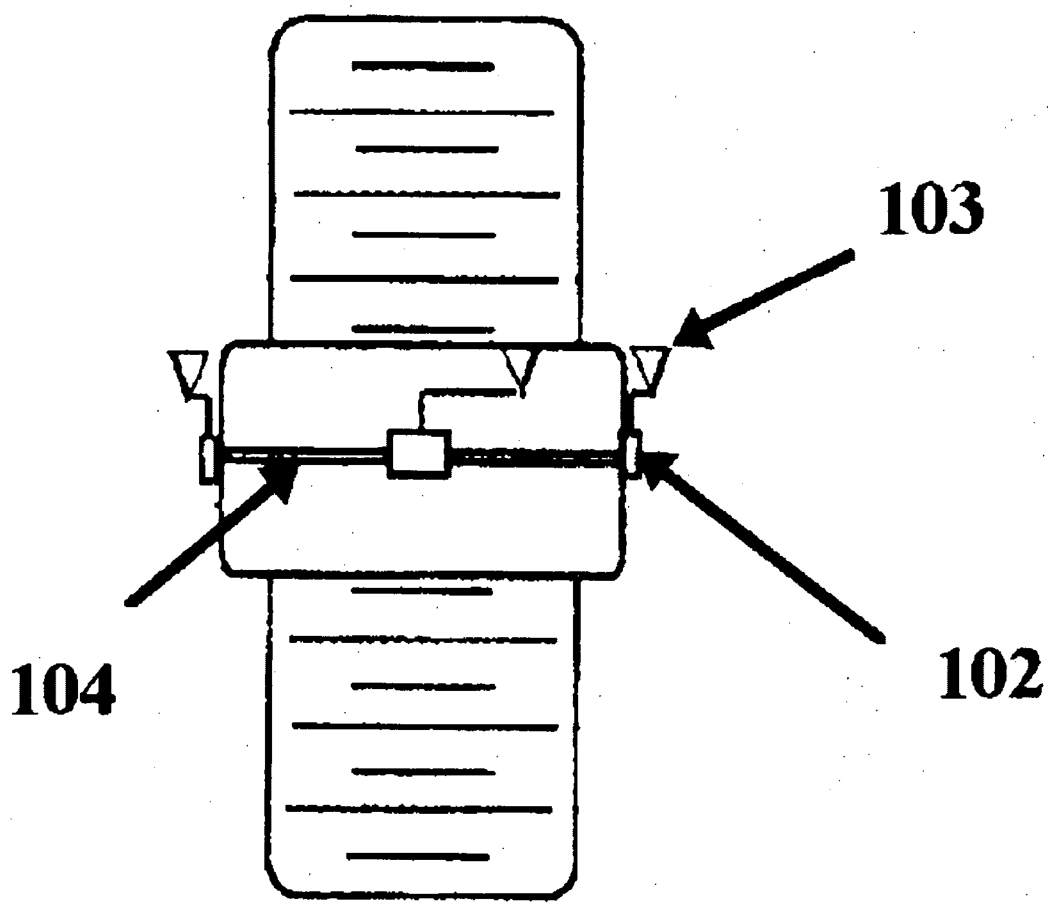


FIG. 19E

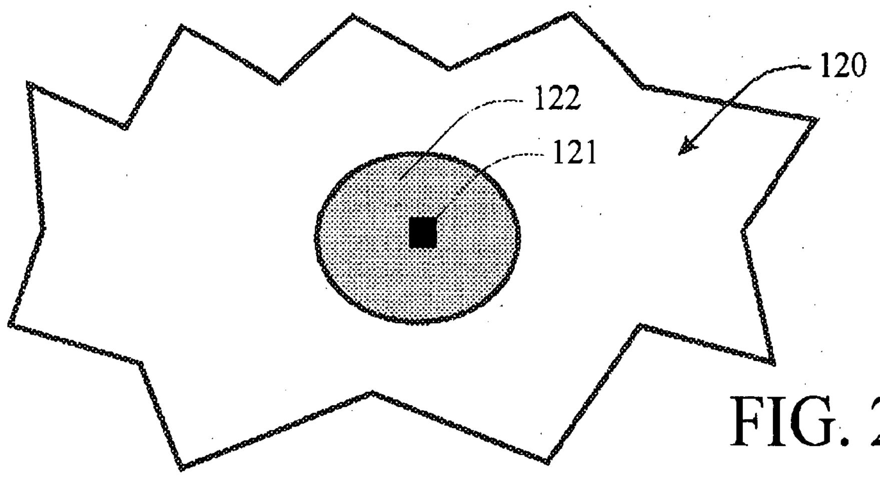


FIG. 20A

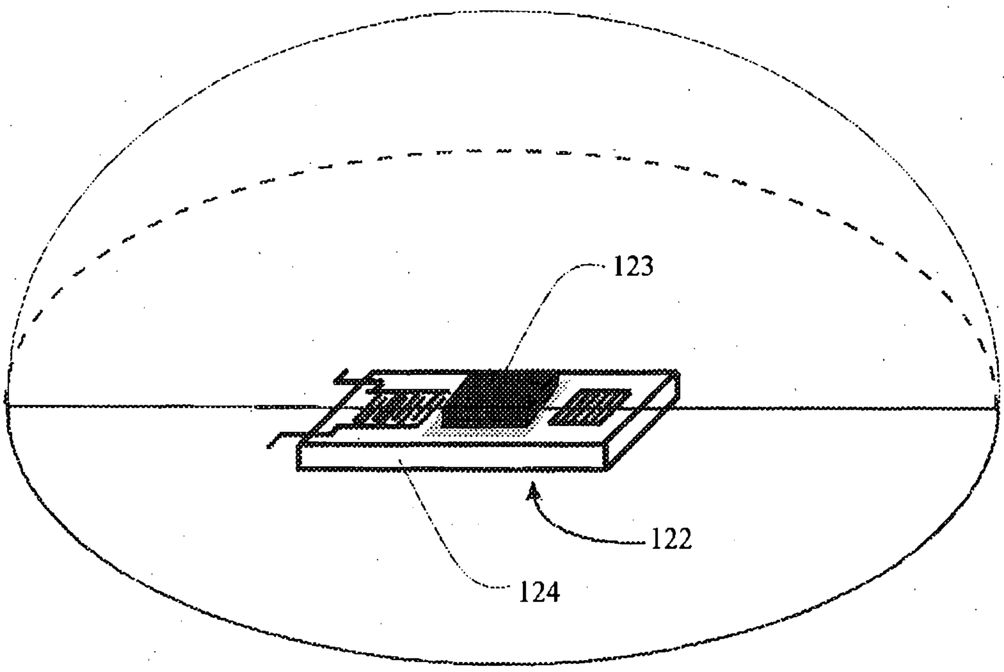


FIG. 20B

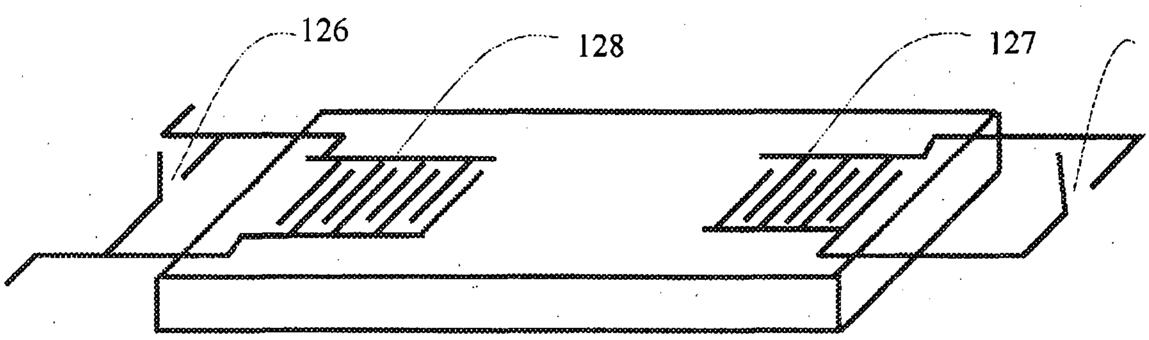


FIG. 20C

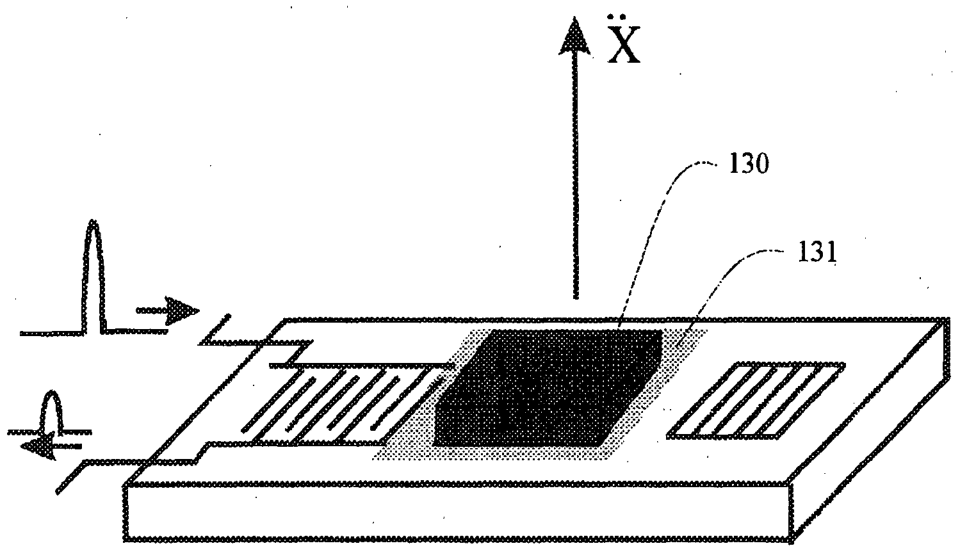


FIG. 21A

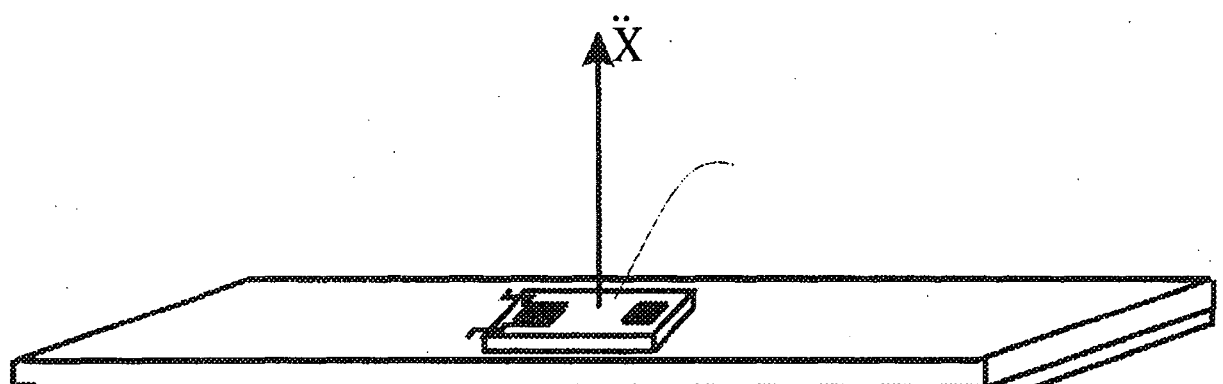


FIG. 21B

Prior Art

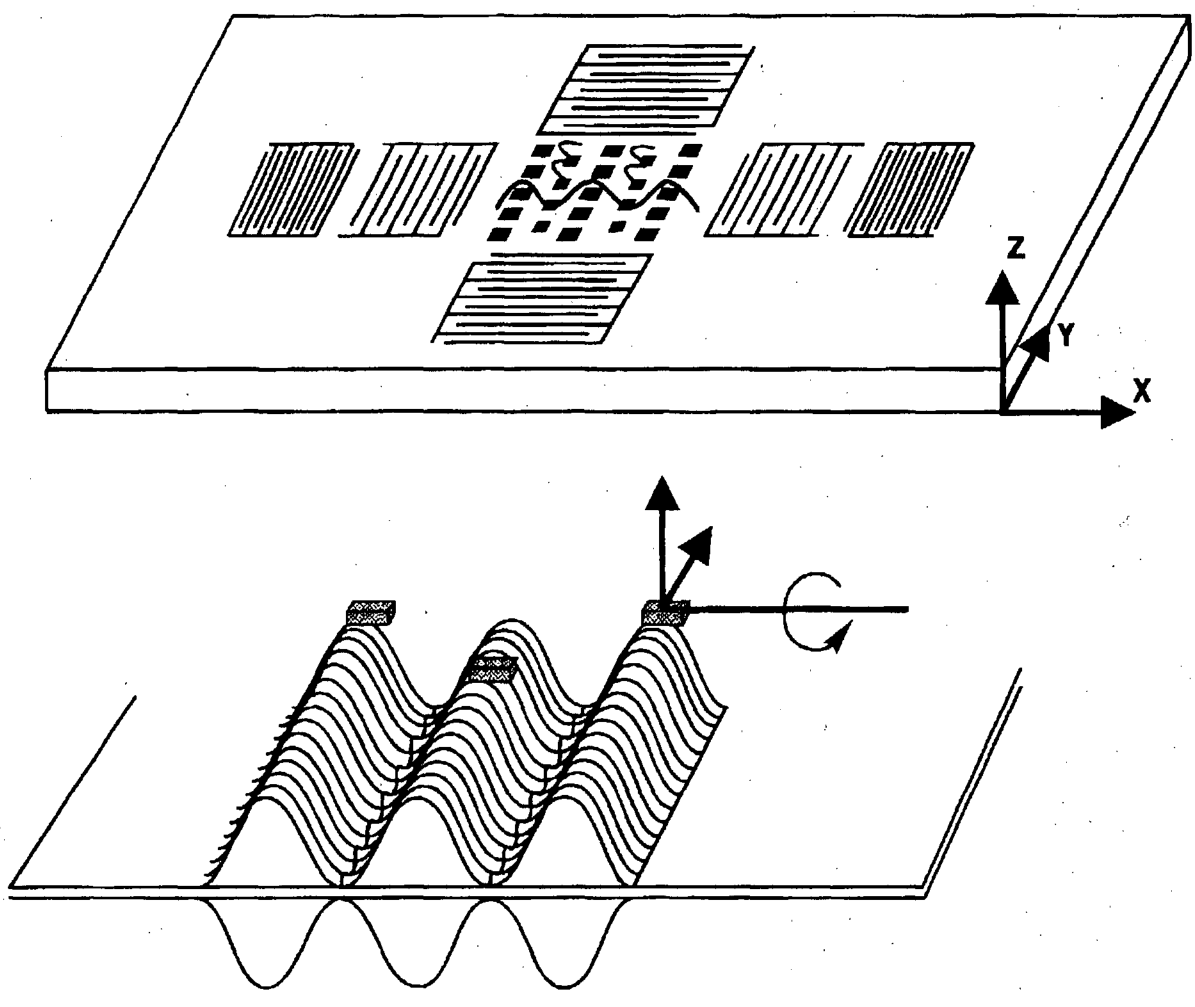


FIG. 22

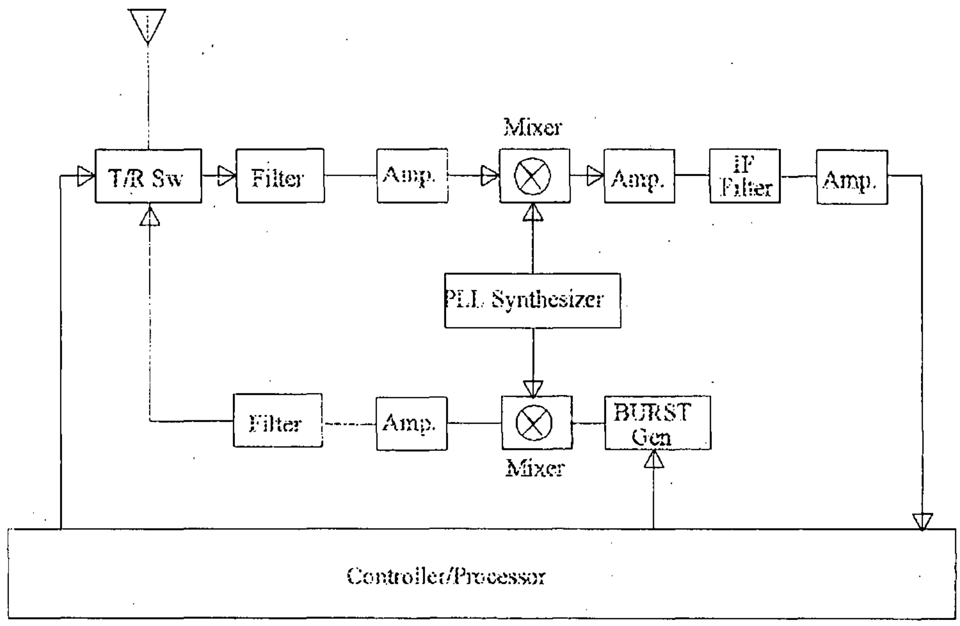


FIG. 23A

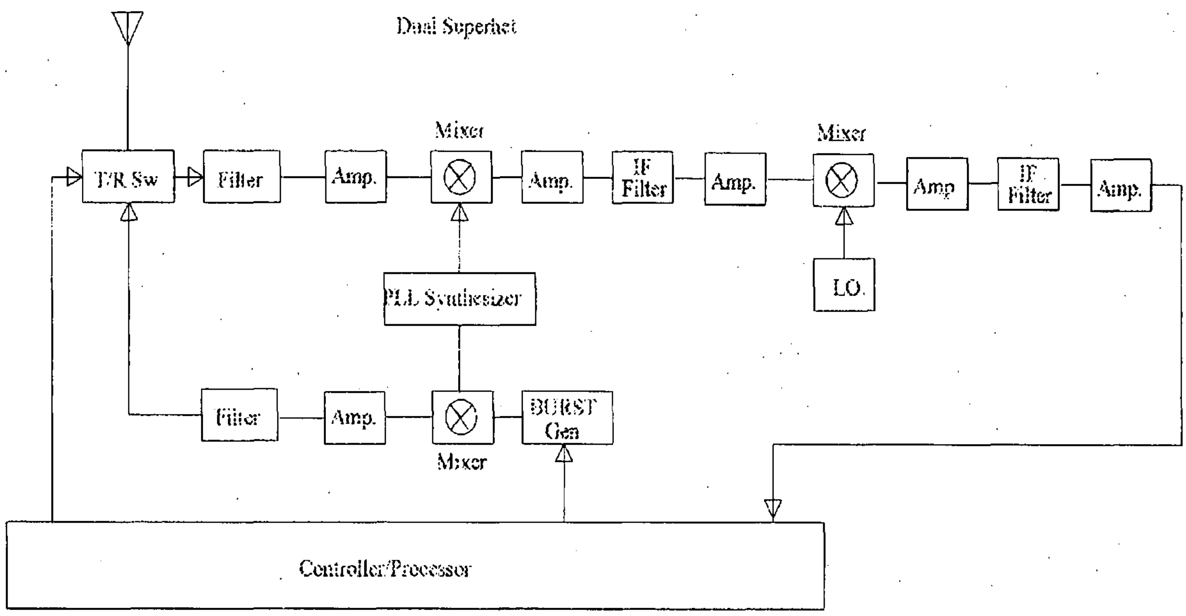


FIG. 23B

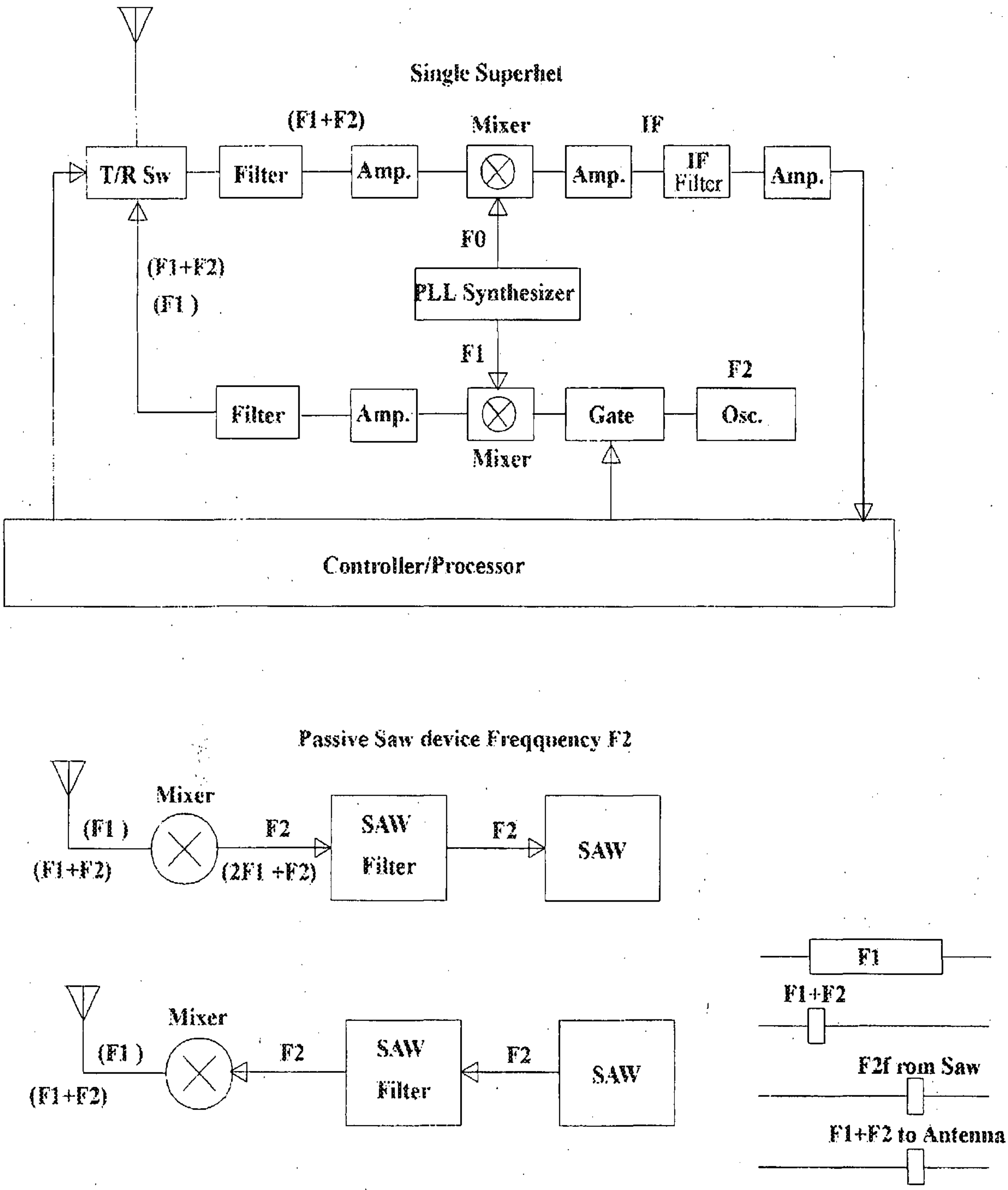

Single Superhet
(F1+F2)
Mixer
IF
T/R Sw
Filter
Amp.
Amp.
IF Filter
Amp.
F0
(F1+F2)
(F1)
PLL Synthesizer
F1
F2
Filter
Amp.
Gate
Osc.
Mixer
Controller/Processor
Passive Saw device Freqquency F2
Mixer
(F1)
(F1+F2)
F2
(2F1 +F2)
SAW Filter
F2
SAW
Mixer
(F1)
(F1+F2)
F2
SAW Filter
F2
SAW
F1
F1+F2
F2f rom Saw
F1+F2 to Antenna

FIG. 23C

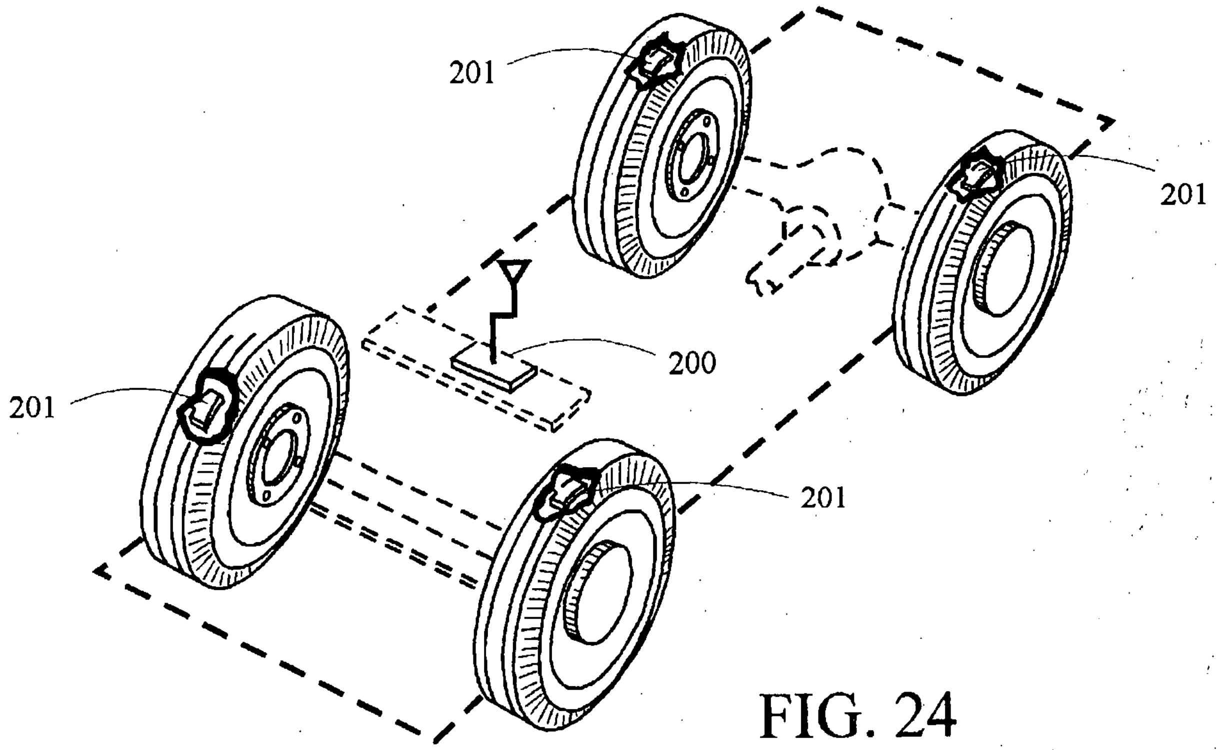


FIG. 24

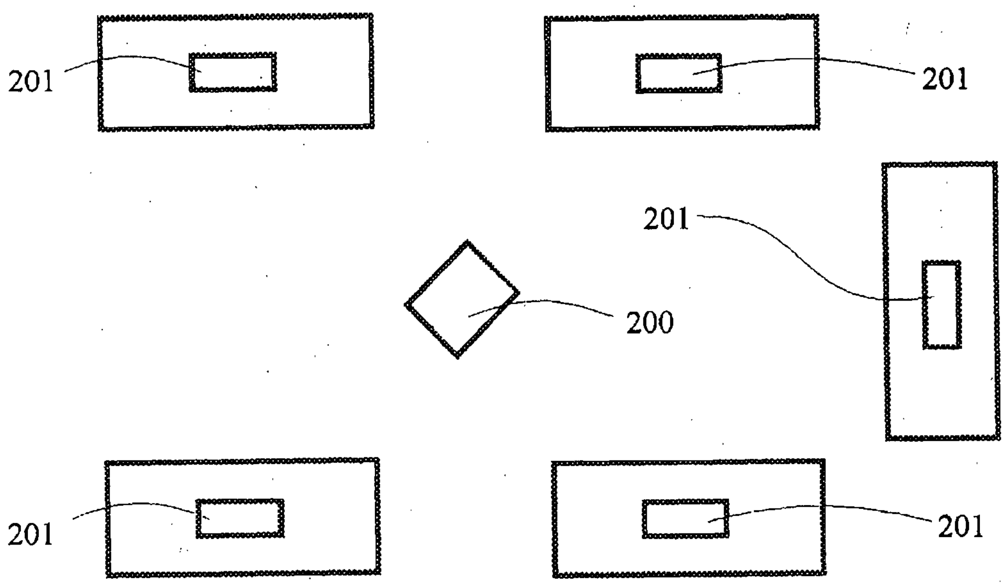


FIG. 24A

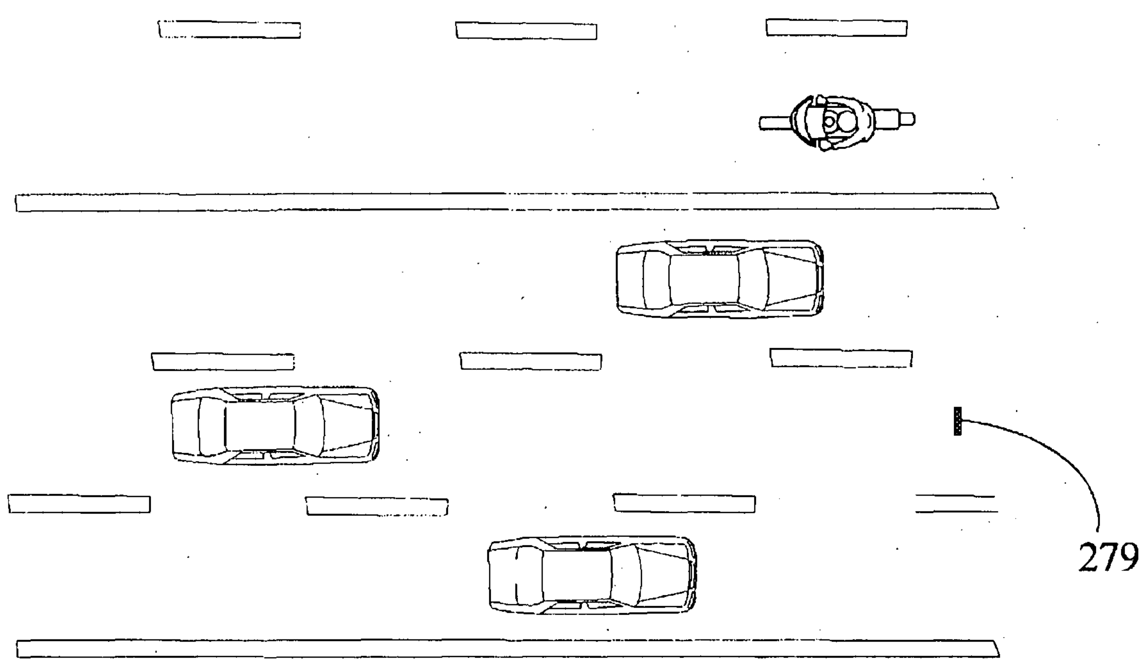


FIG. 25

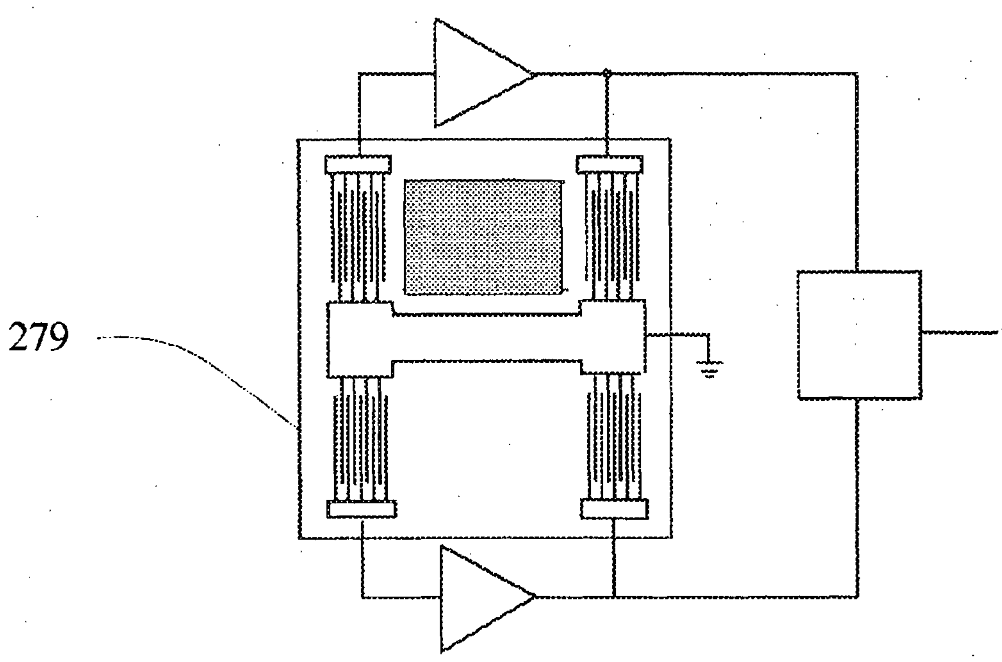


FIG. 25A

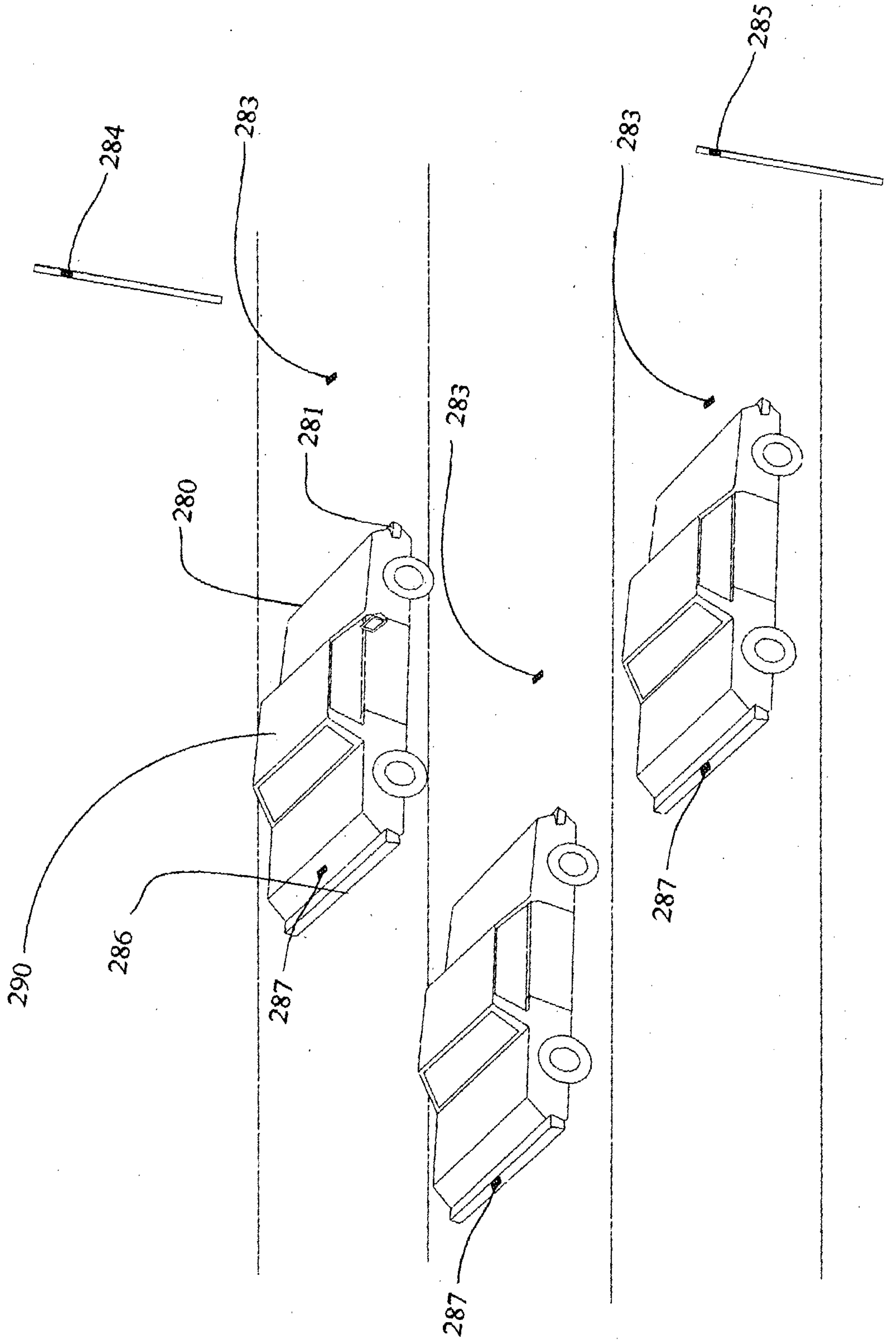


FIG. 26

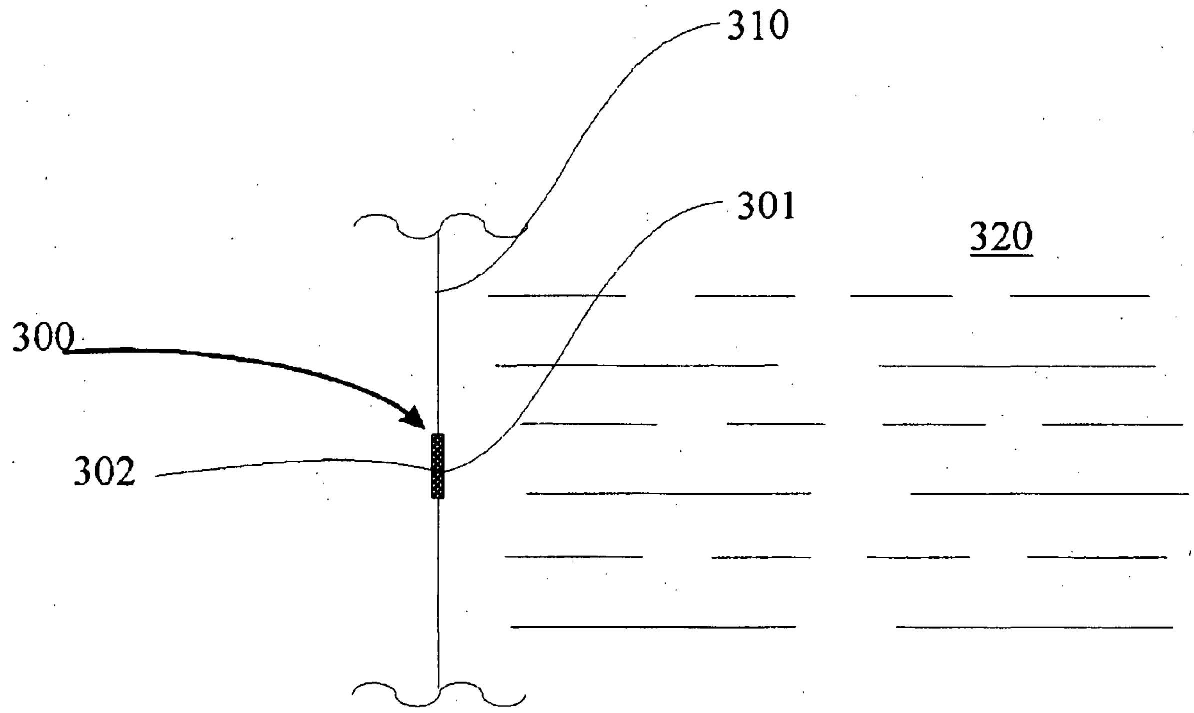


FIG. 27

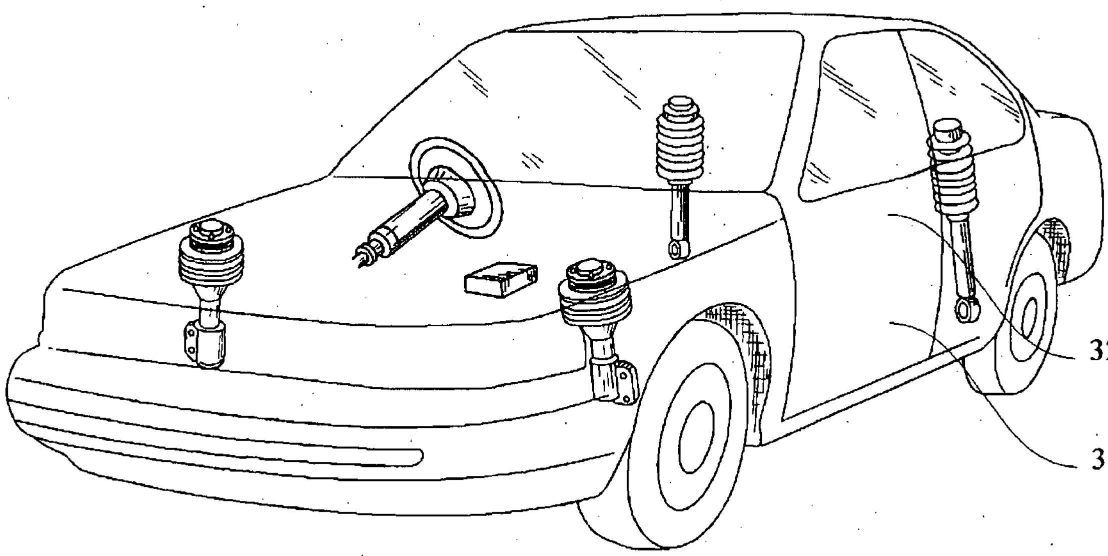
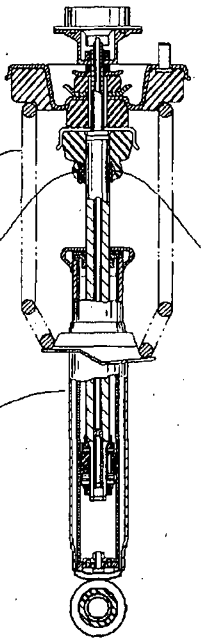


FIG. 28



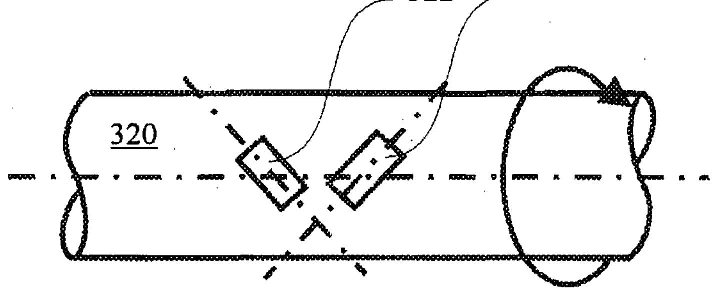


FIG. 28B

FIG. 28A

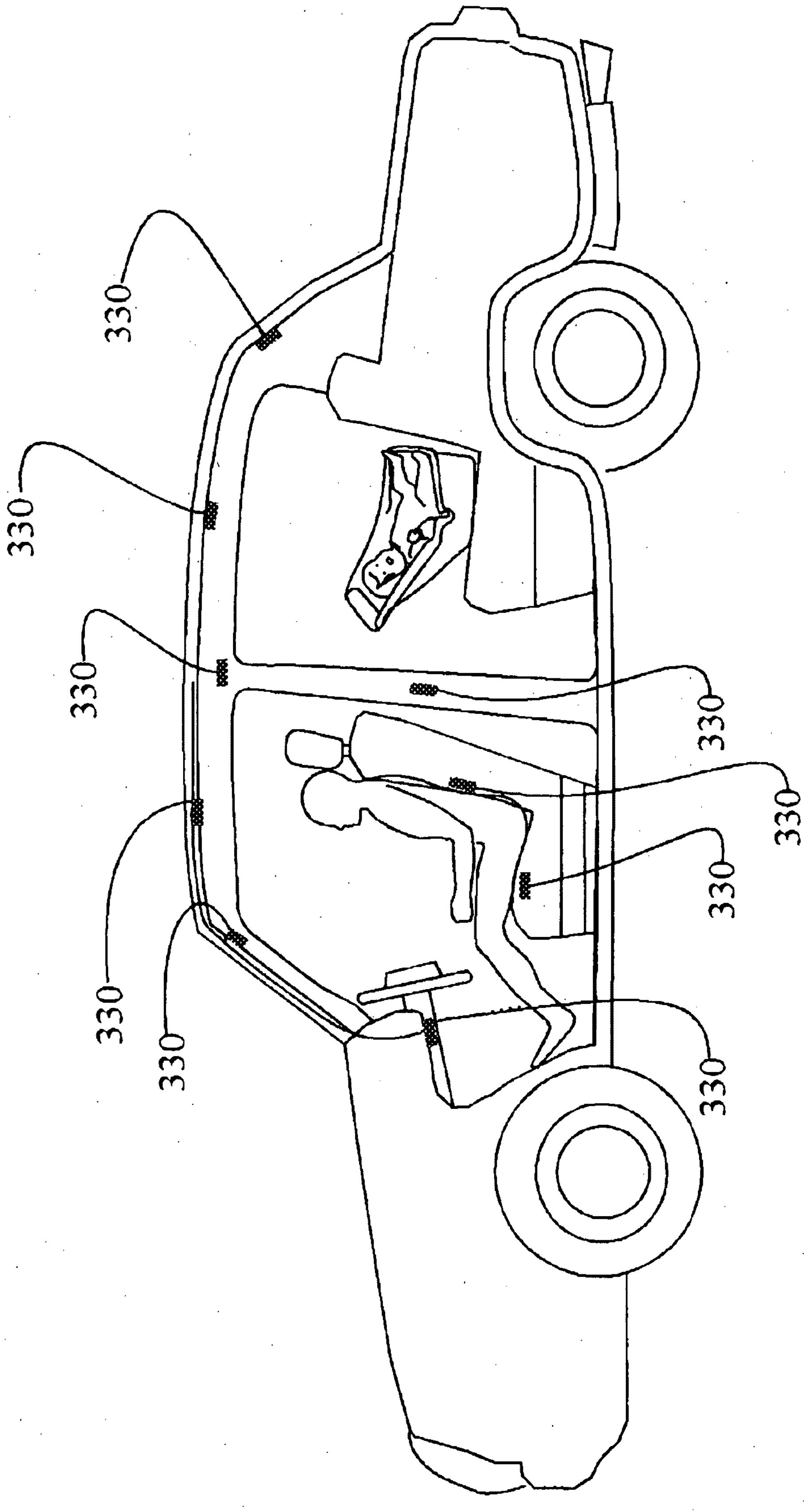


FIG. 29

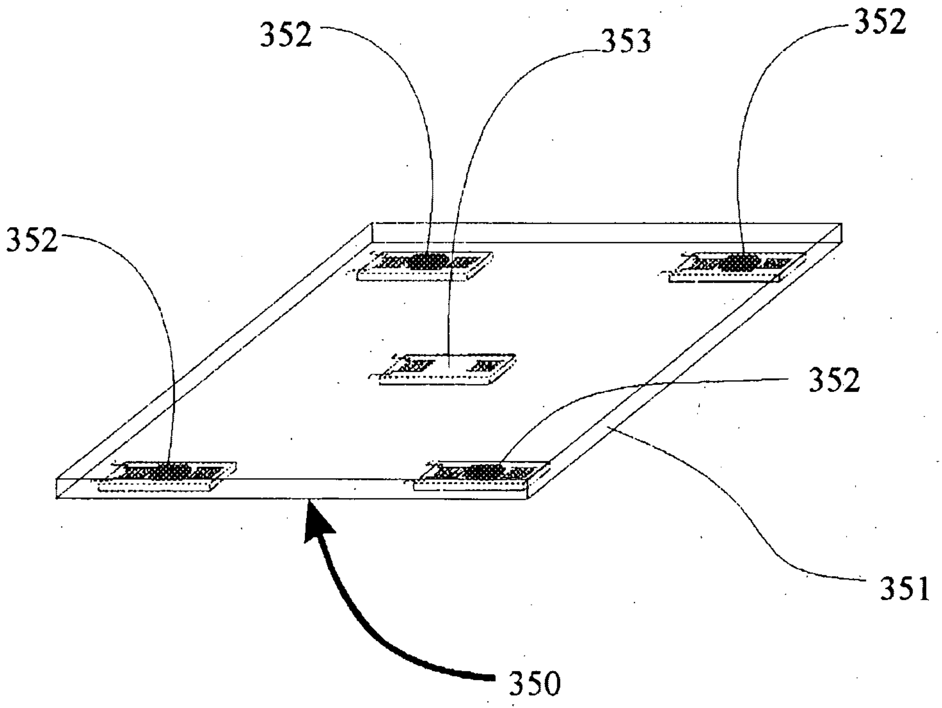


FIG. 30A

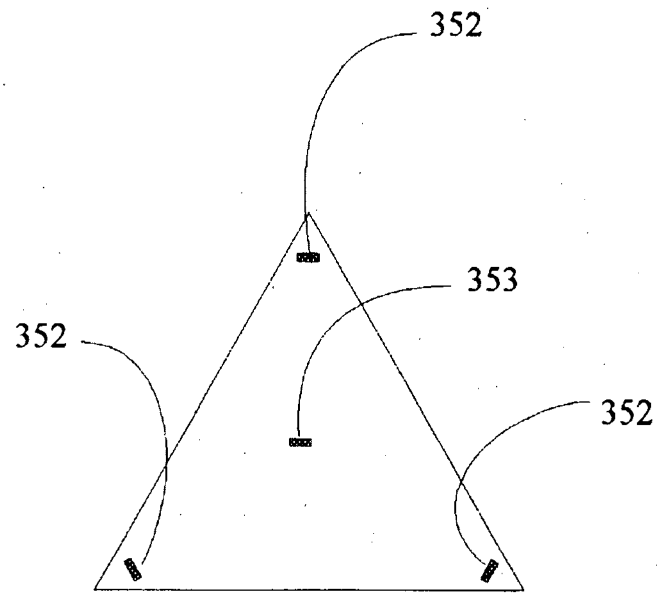


FIG. 30B

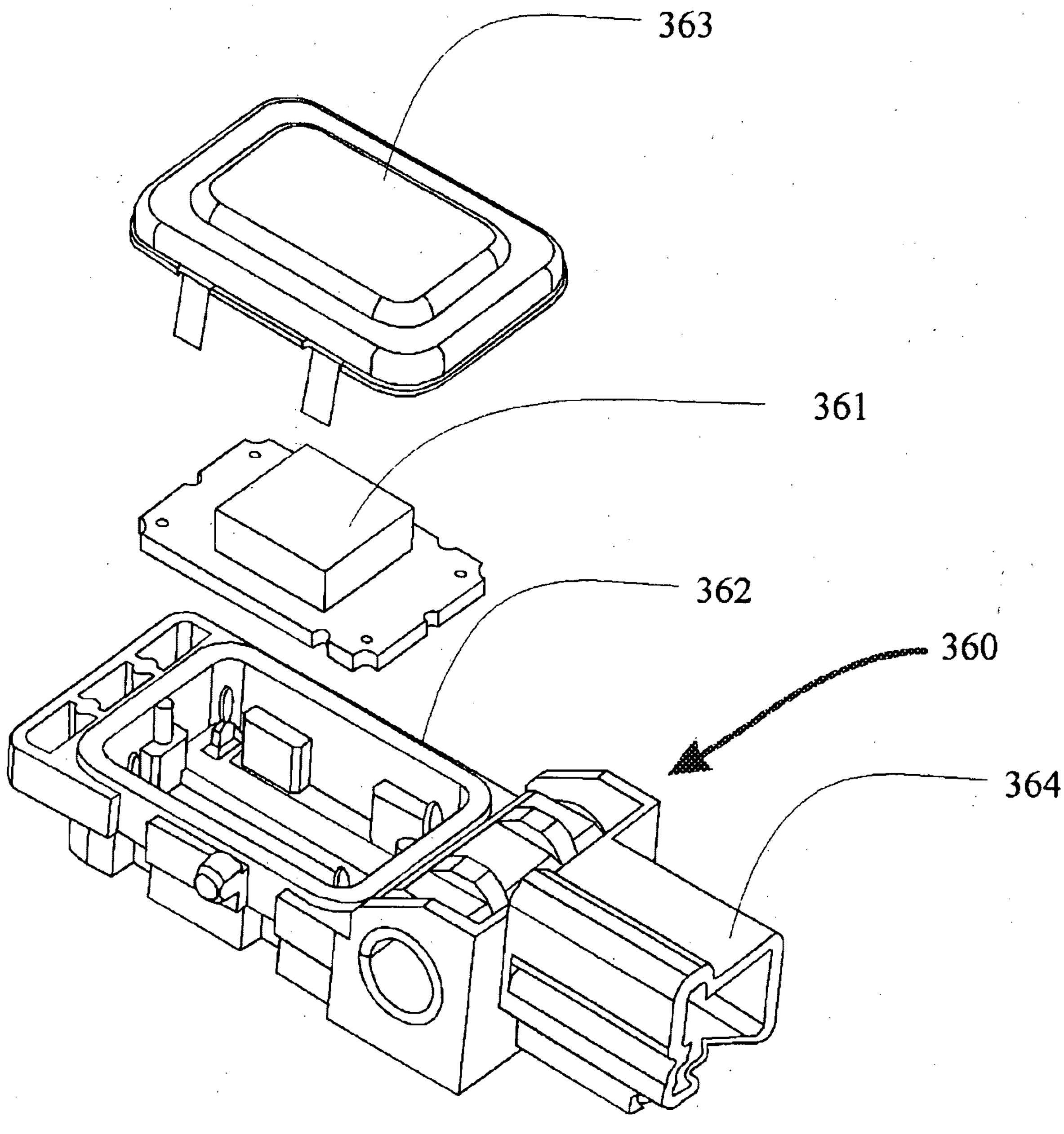


FIG. 31

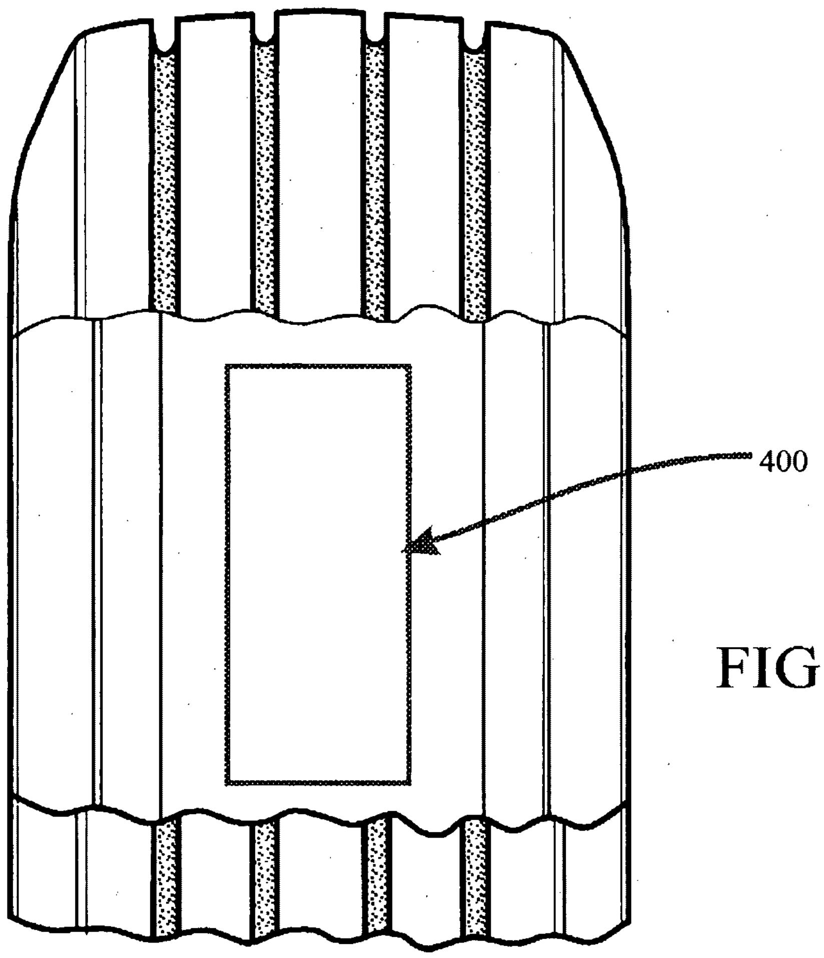


FIG. 32

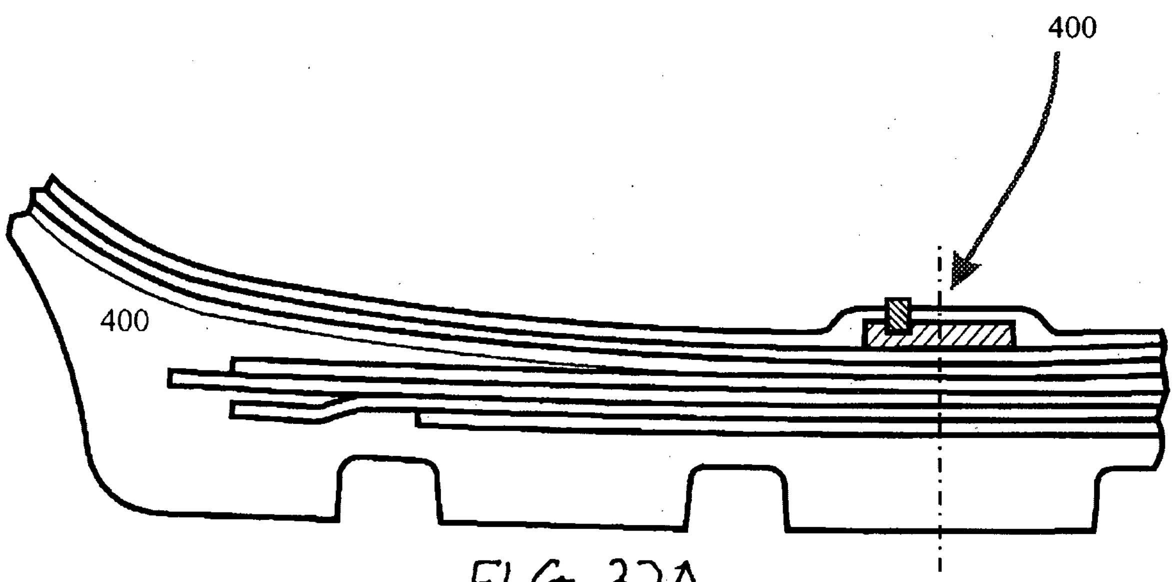


FIG. 32A

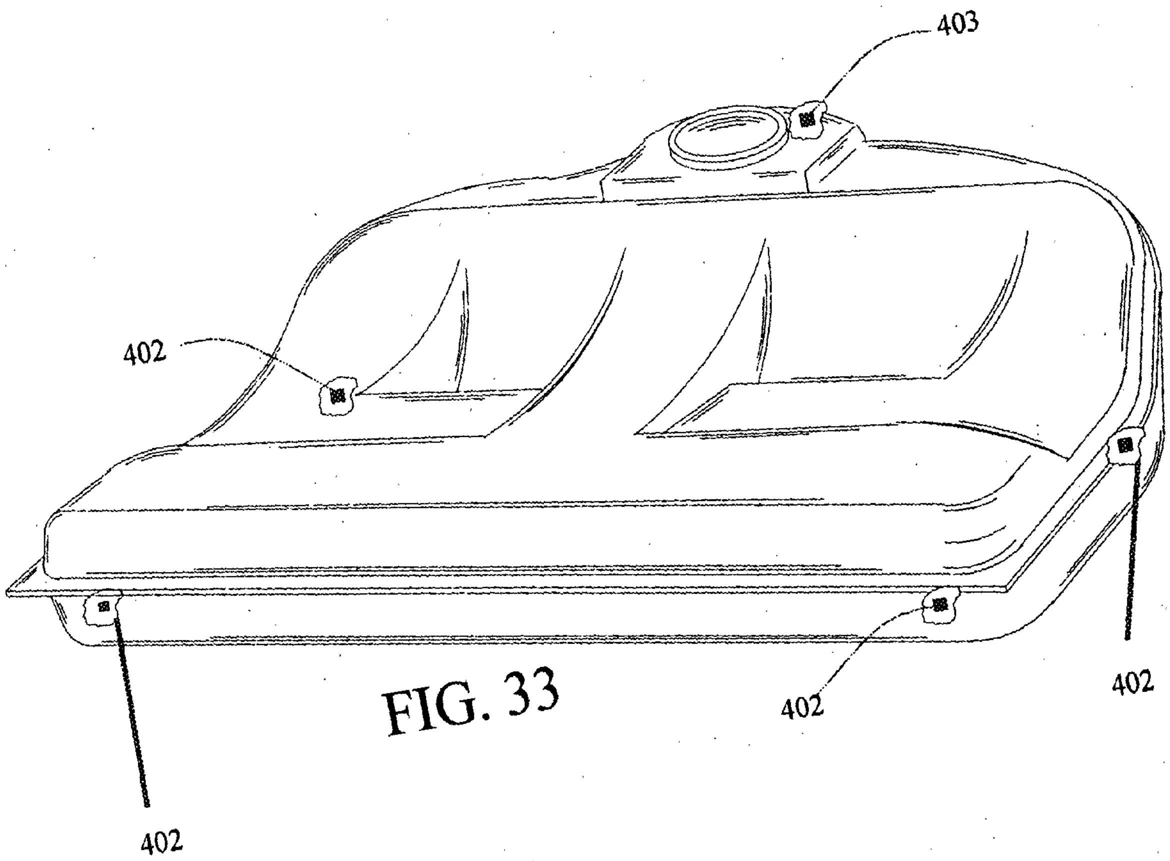


FIG. 33

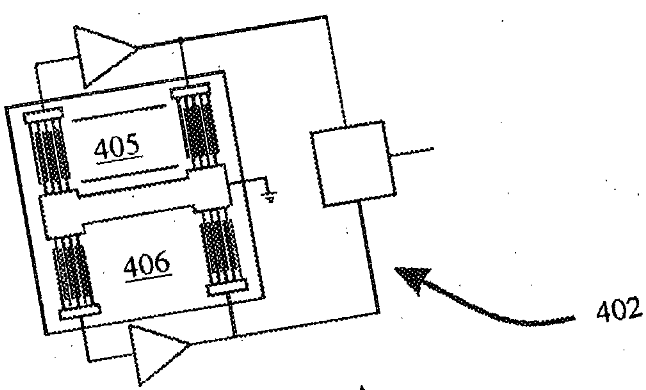


FIG. 33A

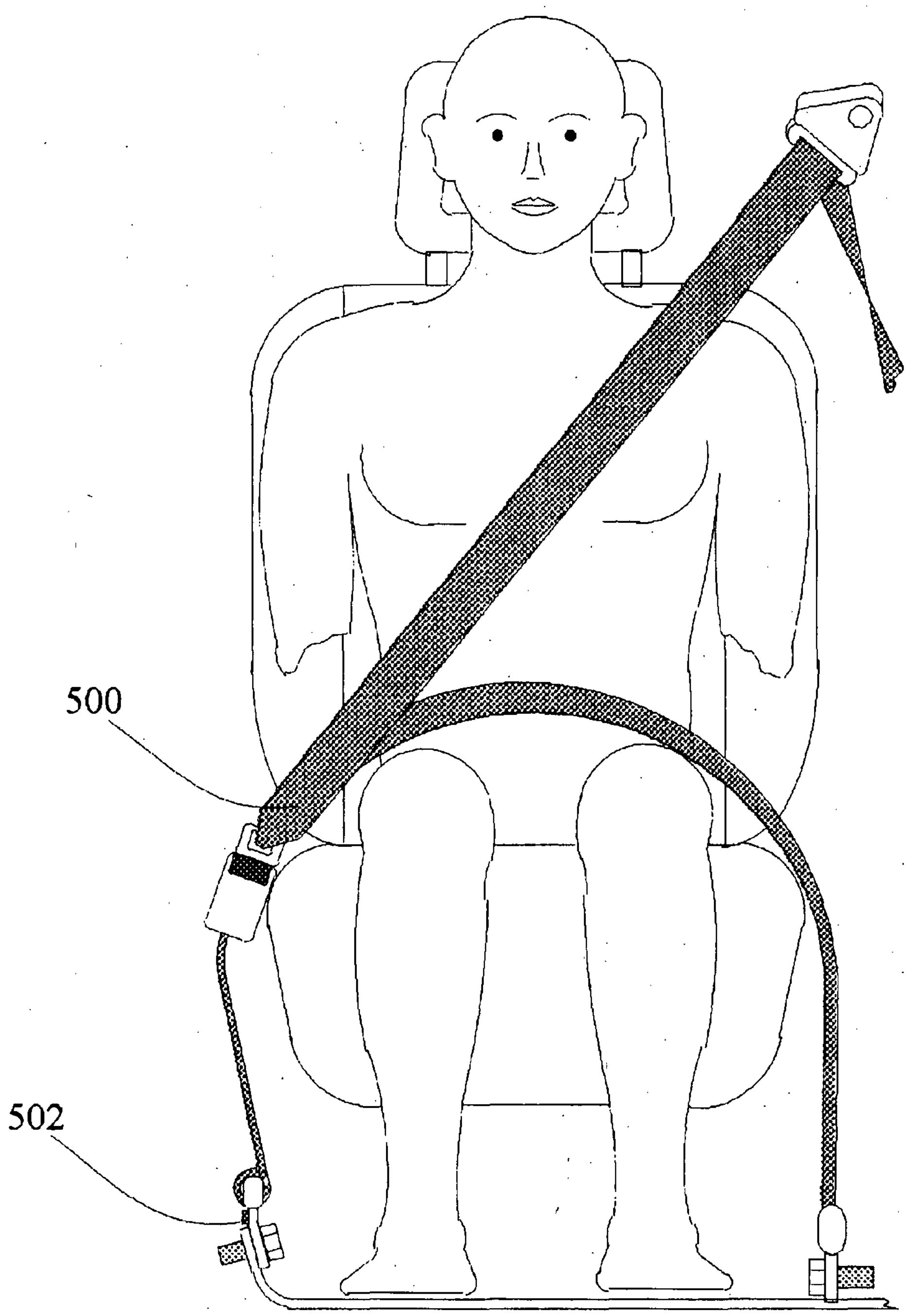


FIG. 34

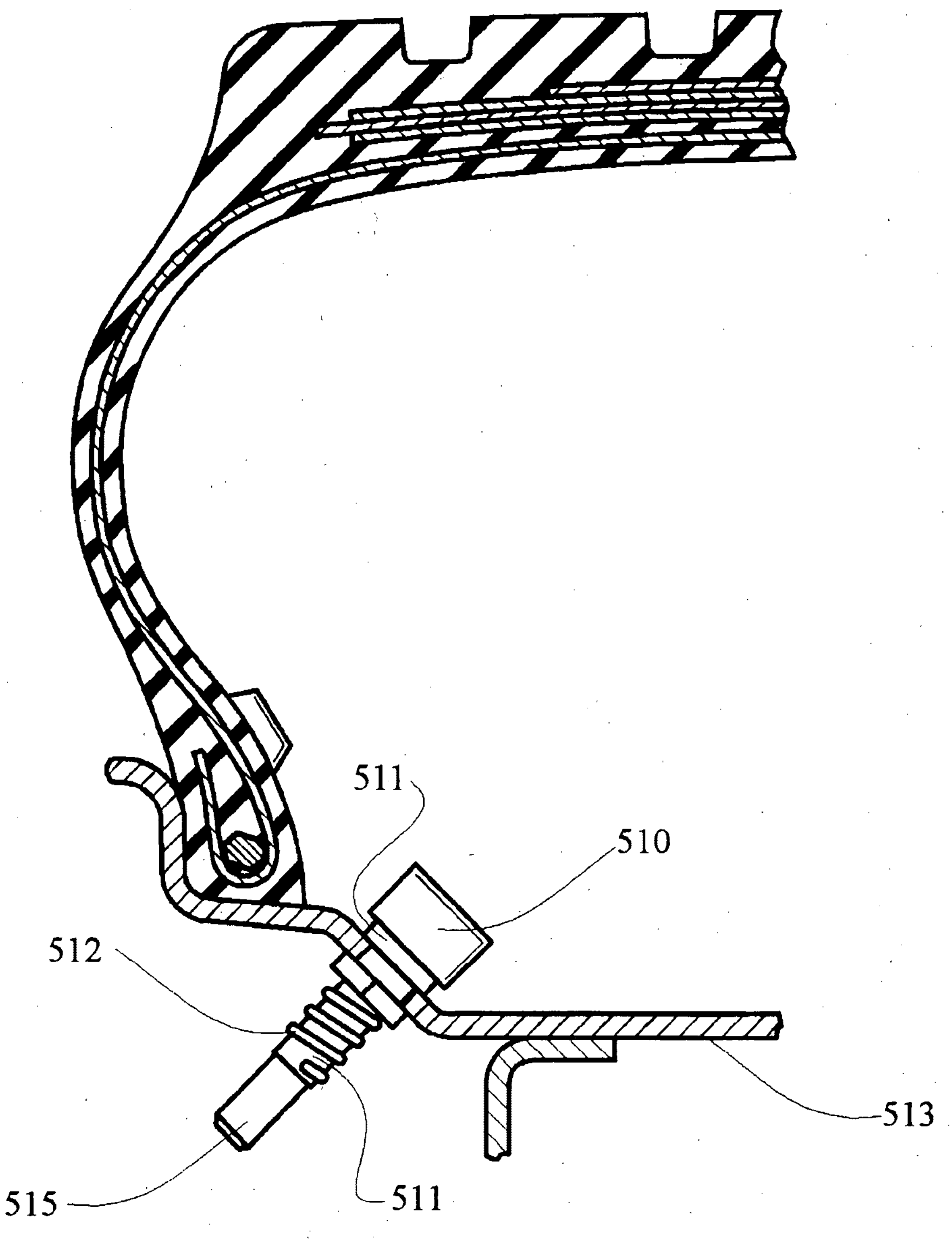


FIG. 35

Prior Art

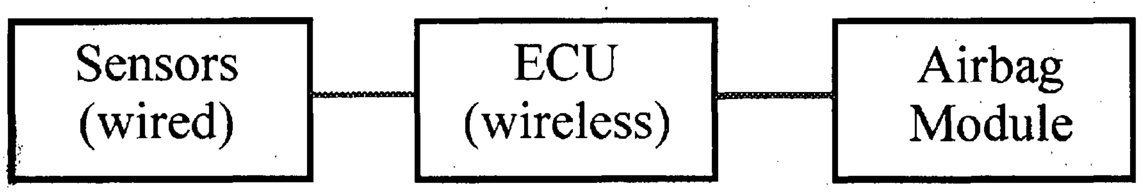


FIG. 36A

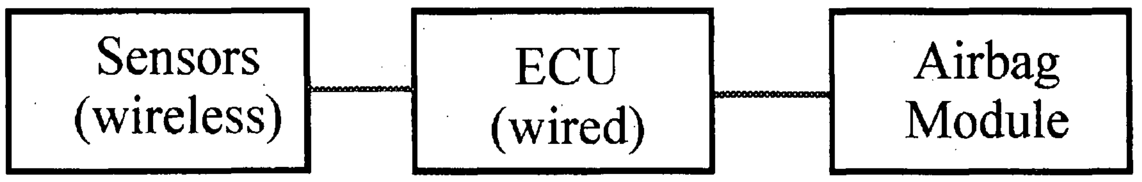


FIG. 36B

TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. patent application Ser. No. 09/753,186 filed Jan. 2, 2001, now U.S. Pat. No. 6,484,080, which in turn is a continuation-in-part of U.S. patent application Ser. No. 09/137,918 filed Aug. 20, 1998, now U.S. Pat. No. 6,175,787, which in turn is a continuation-in-part of U.S. patent application Ser. No. 08/476,077 filed Jun. 7, 1995, now U.S. Pat. No. 5,809,437.

This application is a continuation-in-part of U.S. patent application Ser. No. 10/079,065 filed Feb. 19, 2002 which in turn is a continuation-in-part of U.S. patent application Ser. No. 09/765,558 filed Jan. 19, 2001, which claims priority under 35 U.S.C. § 119(e) of U.S. provisional patent application Ser. No. 60/231,378 filed Sep. 8, 2000.

This application claims priority under 35 U.S.C. § 119(e) of U.S. provisional patent application Ser. No. 60/269,415 filed Feb. 16, 2001, U.S. provisional patent application Ser. No. 60/291,511 filed May 16, 2001 and U.S. provisional patent application Ser. No. 60/304,013 filed Jul. 9, 2001 through U.S. patent application Ser. No. 10/079,065 filed Feb. 19, 2002.

This application is a continuation-in-part of U.S. patent application Ser. No. 10/174,709 filed Jun. 19, 2002 and claims benefit of provisional application Ser. No. 60/269,415 filed Feb. 16, 2001.

All of the above-mentioned patents and applications are incorporated by reference herein in their entirety as if they had each been set forth herein in full.

FIELD OF THE INVENTION

The present invention relates to methods and apparatus for diagnosing components in a vehicle and transmitting data relating to the diagnosis of the components in the vehicle and other information relating to the operating conditions of the vehicle to one or more remote locations distant from the vehicle, i.e., via a telematics link.

The present invention also relates to systems and method for diagnosing the state or condition of a vehicle, e.g., whether the vehicle is about to rollover or is experiencing a crash and whether the vehicle has a component which is operating abnormally and could possibly fail resulting in a crash or severe handicap for the operator, and transmitting data relating to the diagnosis of the components in the vehicle and optionally other information relating to the operating conditions of the vehicle to one or more remote locations, i.e., via a telematics link.

The present invention further relates to methods and apparatus for diagnosing components in a vehicle and determining the status of occupants in a vehicle and transmitting data relating to the diagnosis of the components in the vehicle, and optionally other information relating to the operating conditions of the vehicle, and data relating to the occupants to one or more remote facilities such as a repair facility and an emergency response station.

BACKGROUND OF THE INVENTION

It is now generally recognized that it is important to monitor the occupancy of a passenger compartment of a vehicle. For example, U.S. Pat. No. 5,829,782 (Breed et al.) describes a vehicle interior monitoring system that utilizes pattern recognition techniques and wave-receiving sensors to obtain information about the occupancy of the passenger compartment and uses this information to affect the operation of one or more systems in the vehicle, including an occupant restraint device, an entertainment system, a heating and air-conditioning system, a vehicle communication system, a distress notification system, a light filtering system and a security system.

Of particular interest, Breed et al. mentions that the presence of a child in a rear facing child seat placed on the right front passenger seat may be detected as this has become an industry-wide concern to prevent deployment of an occupant restraint device in these situations. The U.S. automobile industry is continually searching for an easy, economical solution, which will prevent the deployment of the passenger side airbag if a rear facing child seat is present.

Another important aspect disclosed in Breed et al. relates to the operation of the cellular communications system in conjunction with the vehicle interior monitoring system. Vehicles can be provided with a standard cellular phone as well as the Global Positioning System (GPS), an automobile navigation or location system with an optional connection to a manned assistance facility. In the event of an accident, the phone may automatically call 911 for emergency assistance and report the exact position of the vehicle. If the vehicle also has a system as described below for monitoring each seat location, the number and perhaps the condition of the occupants could also be reported. In that way, the emergency service (EMS) would know what equipment and how many ambulances to send to the accident site. Moreover, a communication channel can be opened between the vehicle and a monitoring facility/emergency response facility or personnel to determine how badly people are injured, the number of occupants in the vehicle, and to enable directions to be provided to the occupant(s) of the vehicle to assist in any necessary first aid prior to arrival of the emergency assistance personnel.

Communications between a vehicle and a remote assistance facility are also important for the purpose of diagnosing problems with the vehicle and forecasting problems with the vehicle, called prognostics. Motor vehicles contain complex mechanical systems that are monitored and regulated by computer systems such as electronic control units (ECUs) and the like. Such ECUs monitor various components of the vehicle including engine performance, carburation, speed/acceleration control, transmission, exhaust gas recirculation (EGR), braking systems, etc. However, vehicles perform such monitoring typically only for the vehicle driver and without communication of any impending results, problems and/or vehicle malfunction to a remote site for troubleshooting, diagnosis or tracking for data mining.

In the past, systems that provide for remote monitoring did not provide for automated analysis and communication of problems or potential problems and recommendations to the driver. As a result, the vehicle driver or user is often left stranded, or irreparable damage occurs to the vehicle as a result of neglect or driving the vehicle without the user knowing the vehicle is malfunctioning until it is too late, such as low oil level and a malfunctioning warning light, fan belt about to fail, failing radiator hose etc.

In this regard, U.S. Pat. No. 5,400,018 (Scholl et al.) describes a system for relaying raw sensor output from an off road work site relating to the status of a vehicle to a remote location over a communications data link. The information consists of fault codes generated by sensors and electronic control modules indicating that a failure has occurred rather than forecasting a failure. The vehicle does not include a system for performing diagnosis. Rather, the raw sensor data is processed at an off-vehicle location in order to arrive at a diagnosis of the vehicle's operating condition. Bi-directional communications are described in that a request for additional information can be sent to the vehicle from the remote location with the vehicle responding and providing the requested information but no such communication takes place with the vehicle operator and not of an operator of a vehicle traveling on a road. Also, Scholl et al. does not teach the diagnostics of the problem or potential problem on the vehicle itself nor does it teach the automatic diagnostics or any prognostics. In Scholl et al. the determination of the problem occurs at the remote site by human technicians.

U.S. Pat. No. 5,754,965 (Hagenbuch) describes an apparatus for diagnosing the state of health of a vehicle and providing the operator of the vehicle with a substantially real-time indication of the efficiency of the vehicle in performing as assigned task with respect to a predetermined goal. A processor in the vehicle monitors sensors that provide information regarding the state of health of the vehicle and the amount of work the vehicle has done. The processor records information that describes events leading up to the occurrence of an anomaly for later analysis. The sensors are also used to prompt the operator to operate the vehicle at optimum efficiency.

U.S. Pat. No. 5,955,942 (Slifkin et al.) describes a method for monitoring events in vehicles in which electrical outputs representative of events in the vehicle are produced, the characteristics of one event are compared with the characteristics of other events accumulated over a given period of time and departures or variations of a given extent from the other characteristics are determined as an indication of a significant event. A warning is sent in response to the indication, including the position of the vehicle as determined by a global positioning system on the vehicle. For example, for use with a railroad car, a microprocessor responds to outputs of an accelerometer by comparing acceleration characteristics of one impact with accumulated acceleration characteristics of other impacts and determines departures of a given magnitude from the other characteristics as a failure indication which gives rise of a warning.

Every automobile driver fears that his or her vehicle will breakdown at some unfortunate time, e.g., when he or she is traveling at night, during rush hour, or on a long trip away from home. To help alleviate that fear, certain luxury automobile manufacturers provide roadside service in the event of a breakdown. Nevertheless, unless the vehicle is equipped with OnStar® or an equivalent service, the vehicle driver must still be able to get to a telephone to call for service. It is also a fact that many people purchase a new automobile out of fear of a breakdown with their current vehicle. This invention is primarily concerned with preventing breakdowns and with minimizing maintenance costs by predicting component failure that would lead to such a breakdown before it occurs.

When a vehicle component begins to fail, the repair cost is frequently minimal if the impending failure of the component is caught early, but increases as the repair is delayed. Sometimes if a component in need of repair is not caught in a timely manner, the component, and particularly the impending failure thereof, can cause other components of the vehicle to deteriorate. One example is where the water pump fails gradually until the vehicle overheats and blows a head gasket. It is desirable, therefore, to determine that a vehicle component is about to fail as early as possible so as to minimize the probability of a breakdown and the resulting repair costs.

There are various gages on an automobile which alert the driver to various vehicle problems. For example, if the oil pressure drops below some predetermined level, the driver is warned to stop his vehicle immediately. Similarly, if the coolant temperature exceeds some predetermined value, the driver is also warned to take immediate corrective action. In these cases, the warning often comes too late as most vehicle gages alert the driver after he or she can conveniently solve the problem. Thus, what is needed is a component failure warning system that alerts the driver to the impending failure of a component sufficiently in advance of the time when the problem gets to a catastrophic point.

Some astute drivers can sense changes in the performance of their vehicle and correctly diagnose that a problem with a component is about to occur. Other drivers can sense that their vehicle is performing differently but they don't know why or when a component will fail or how serious that failure will be, or possibly even what specific component is the cause of the difference in performance. The invention disclosed herein will, in most cases, solve this problem by predicting component failures in time to permit maintenance and thus prevent vehicle breakdowns.

Presently, automobile sensors in use are based on specific predetermined or set levels, such as the coolant temperature or oil pressure, whereby an increase above the set level or a decrease below the set level will activate the sensor, rather than being based on changes in this level over time. The rate at which coolant heats up, for example, can be an important clue that some component in the cooling system is about to fail. There are no systems currently on automobiles to monitor the numerous vehicle components over time and to compare component performance with normal performance. Nowhere in the vehicle is the vibration signal of a normally operating front wheel stored, for example, or for that matter, any normal signal from any other vehicle component. Additionally, there is no system currently existing on a vehicle to look for erratic behavior of a vehicle component and to warn the driver or the dealer that a component is misbehaving and is therefore likely to fail in the very near future.

Sometimes, when a component fails, a catastrophic accident results. In the Firestone tire case, for example, over 100 people were killed when a tire of a Ford Explorer blew out which caused the Ford Explorer to rollover. Similarly, other component failures can lead to loss of control of the vehicle and a subsequent accident. It is thus very important to accurately forecast that such an event will take place but furthermore, for those cases where the event takes place suddenly without warning, it is also important to diagnose the state of the entire vehicle, which in some cases can lead to automatic corrective action to prevent unstable vehicle motion or rollovers resulting in an accident. Finally, an accurate diagnostic system for the entire vehicle can determine much more accurately the severity of an automobile crash once it has begun by knowing where the accident is taking place on the vehicle (e.g., the part of or location on the vehicle which is being impacted by an object) and what is colliding with the vehicle based on a knowledge of the force deflection characteristics of the vehicle at that location. Therefore, in addition to a component diagnostic, the teachings of this invention also provide a diagnostic system for the entire vehicle prior to and during accidents. In particular, this invention is concerned with the simultaneous monitoring of multiple sensors on the vehicle so that the best possible determination of the state of the vehicle can be determined. Current crash sensors operate independently or at most one sensor may influence the threshold at which another sensor triggers a deployable restraint. In the teachings of this invention, two or more sensors, frequently accelerometers, are monitored simultaneously and the combination of the outputs of these multiple sensors are combined continuously in making the crash severity analysis.

Marko et al. (U.S. Pat. No. 5,041,976) is directed to a diagnostic system using pattern recognition for electronic automotive control systems and particularly for diagnosing faults in the engine of a motor vehicle after they have occurred. For example, Marko et al. is interested in determining cylinder specific faults after the cylinder is operating abnormally. More specifically, Marko et al. is directed to detecting a fault in a vehicular electromechanical system indirectly, i.e., by means of the measurement of parameters of sensors which are affected by that system, and after that fault has already manifested itself in the system. In order to form the fault detecting system, the parameters from these sensors are input to a pattern recognition system for training thereof Then known faults are introduced and the parameters from the sensors are inputted into the pattern recognition system with an indicia of the known fault. Thus, during subsequent operation, the pattern recognition system can determine the fault of the electromechanical system based on the parameters of the sensors, assuming that the fault was "trained" into the pattern recognition system and has already occurred.

When the electromechanical system is an engine, the parameters input into the pattern recognition system for training thereof, and used for fault detection during operation, all relate to the engine. (If the electromechanical system is other than the engine, then the parameters input into the pattern recognition system would relate to that system.) In other words, each parameter will be affected by the operation of the engine and depend thereon and changes in the operation of the engine will alter the parameter, e.g., the manifold absolute pressure is an indication of the airflow into the engine. In this case, the signal from the manifold absolute pressure sensor may be indicative of a fault in the intake of air into the engine, e.g., the engine is drawing in too much or too little air, and is thus affected by the operation of the engine. Similarly, the mass air flow is the airflow into the engine and is an alternative to the manifold absolute pressure. It is thus a parameter that is directly associated with, related to and dependent on the engine. The exhaust gas oxygen sensor is also affected by the operation of the engine, and thus directly associated therewith, since during normal operation, the mixture of the exhaust gas is neither rich or lean whereas during abnormal engine operation, the sensor will detect an abrupt change indicative of the mixture being too rich or too lean.

Thus, the system of Marko et al. is based on the measurement of sensors which affect or are affected by, i.e., are directly associated with, the operation of the electromechanical system for which faults are to be detected. However, the system of Marko et al. does not detect faults in the sensors that are conducting the measurements, e.g., a fault in the exhaust gas oxygen sensor, or faults that are only developing but have not yet manifested themselves or faults in other systems. Rather, the sensors are used to detect a fault in the system after it has occurred.

Asami et al. (U.S. Pat. No. 4,817,418) is directed to a failure diagnosis system for a vehicle including a failure display means for displaying failure information to a driver. This system only reports failures after they have occurred and does not predict them.

Tiernan et al. (U.S. Pat. No. 5,313,407) is directed, inter alia, to a system for providing an exhaust active noise control system, i.e., an electronic muffler system, including an input microphone **60** which senses exhaust noise at a first location **61** in an exhaust duct **58**. An engine has exhaust manifolds **56,57** feeding exhaust air to the exhaust duct **58**. The exhaust noise sensed by the microphone **60** is processed to obtain an output from an output speaker **65** arranged downstream of the input microphone **61** in the exhaust path in order to cancel the noise in the exhaust duct **58**.

Haramaty et al. (U.S. Pat. No. 5,406,502) describes a system that monitors a machine in a factory and notifies maintenance personnel remote from the machine (not the machine operator) that maintenance should be scheduled at a time when the machine is not in use. Haramaty et al. does not expressly relate to vehicular applications.

NASA Technical Support Package MFS-26529 "Engine Monitoring Based on Normalized Vibration Spectra", describes a technique for diagnosing engine health using a neural network based system and is incorporated by reference herein in its entirety.

A paper "Using acoustic emission signals for monitoring of production processes" by H. K. Tonshoff et al. also provides a good description of how acoustic signals can be used to predict the state of machine tools and is incorporated by reference herein in its entirety.

Based on the monitoring of vehicular components, systems and subsystems as well as to the measurement of physical and chemical characteristics relating to the vehicle or its components, systems and subsystems, it becomes possible to control and/or affect one or more vehicular system.

An important component or system which is monitored is the tires as failure of one or more of the tires can often lead to a fatal accident. Indeed, tire monitoring is extremely important since NHTSA (National Highway Traffic Safety Administration) has recently linked 148 deaths and more than 525 injuries in the United States to separations, blowouts and other tread problems in Firestone's ATX, ATX II and Wilderness AT tires, 5 million of which were recalled in 2000. Many of the tires were standard equipment on the Ford Explorer. Ford recommends that the Firestone tires on the Explorer sport utility vehicle be inflated to 26 psi, while Firestone recommends 30 psi. It is surprising that a tire can go from a safe condition to an unsafe condition based on an under inflation of 4 psi.

Recent studies in the United States conducted by the Society of Automotive Engineers show that low tire pressure causes about 260,000 accidents annually. Another finding is that about 75% of tire failures each year are preceded by slow air leaks or inadequate tire inflation. Nissan, for example, warns that incorrect tire pressures can compromise the stability and overall handling of a vehicle and can contribute to an accident. Additionally, most non-crash auto fatalities occur while drivers are changing flat tires. Thus, tire failures are clearly a serious automobile safety problem that requires a solution.

About 16% of all car accidents are a result of incorrect tire pressure. Thus, effective pressure and wear monitoring is extremely important. Motor Trend magazine stated that one of the most overlooked maintenance areas on a car is tire pressure. An estimated 40 to 80 percent of all vehicles on the road are operating with under-inflated tires. When under-inflated, a tire tends to flex its sidewall more, increasing its rolling resistance which decreases fuel economy. The extra flex also creates excessive heat in the tire that can shorten its service life.

The Society of Automotive Engineers reports that about 87 percent of all flat tires have a history of under-inflation.

About 85% of pressure loss incidents are slow punctures caused either by small-diameter objects trapped in the tire or by larger diameter nails. The leak will be minor as long as the nail is trapped. If the nail comes out, pressure can decrease rapidly. Incidents of sudden pressure loss are potentially the most dangerous for drivers and account for about 15% of all cases.

A properly inflated tire loses approximately 1 psi per month. A defective time can lose pressure at a more rapid rate. About 35 percent of the recalled Bridgestone tires had improper repairs.

Research from a variety of sources suggests that under-inflation can be significant to both fuel economy and tire life. Industry experts have determined that tires under-inflated by a mere 10% wear out about 15% faster. An average driver with an average set of tires can drive an extra 5,000 to 7,000 miles before buying new tires by keeping the tire properly inflated.

The American Automobile Association has determined that under inflated tires cut a vehicle's fuel economy by as much as 2% per psi below the recommended level. If each of a car's tires is supposed to have a pressure of 30 psi and instead has a pressure of 25 psi, the car's fuel efficiency drops by about 10%. Depending on the vehicle and miles driven that could cost from $100 to $500 a year.

The ability to control a vehicle is strongly influenced by tire pressure. When the tire pressure is kept at proper levels, optimum vehicle braking, steering, handling and stability are accomplished. Low tire pressure can also lead to damage to both the tires and wheels.

A Michelin study revealed that the average driver doesn't recognize a low tire until it's 14 psi too low. One of the reasons is that today's radial tire is hard to judge visually because the sidewall flexes even when properly inflated.

Despite all the recent press about keeping tires properly inflated, new research shows that most drivers do not know the correct inflation pressure. In a recent survey, only 45 percent of respondents knew where to look to find the correct pressure, even though 78 percent thought they knew. Twenty-seven percent incorrectly believed the sidewall of the tire carries the correct information and did not know that the sidewall only indicates the maximum pressure for the tire, not the optimum pressure for the vehicle. In another survey, about 60% of the respondents reported that they check tire pressure but only before going on a long trip. The National Highway Traffic Safety Administration estimates that at least one out of every five tires is not properly inflated.

The problem is exacerbated with the new run-flat tires where a driver may not be aware that a tire is flat until it is destroyed. Run-flat tires can be operated at air pressures below normal for a limited distance and at a restricted speed (125 miles at a maximum of 55 mph). The driver must therefore be warned of changes in the condition of the tires so that she can adapt her driving to the changed conditions.

One solution to this problem is to continuously monitor the pressure and perhaps the temperature in the tire. Pressure loss can be automatically detected in two ways: by directly measuring air pressure within the tire or by indirect tire rotation methods. Various indirect methods are based on the number of revolutions each tire makes over an extended period of time through the ABS system and others are based on monitoring the frequency changes in the sound emitted by the tire. In the direct detection case, a sensor is mounted into each wheel or tire assembly, each with its own identity. An on-board computer collects the signals, processes and displays the data and triggers a warning signal in the case of pressure loss.

Under-inflation isn't the only cause of sudden tire failure. A variety of mechanical problems including a bad wheel bearing or a "dragging" brake can cause the tire to heat up and fail. In addition, as may have been a contributing factor in the Firestone case, substandard materials can lead to intra-tire friction and a buildup of heat. The use of re-capped truck tires is another example of heat caused failure as a result by intra-tire friction. An overheated tire can fail suddenly without warning.

As discussed in more detail below, tire monitors, such as those disclosed below, permit the driver to check the vehicle tire pressures from inside the vehicle.

The *Transportation Recall Enhancement Accountability and Documentation Act*, (H.R. 5164, or Public Law No. 106-414) known as the TREAD Act, was signed by President Clinton on Nov. 1, 2000. Section 12, TIRE PRESSURE WARNING, states that: "Not later than one year after the date of enactment of this Act, the Secretary of Transportation, acting through the National Highway Traffic Safety Administration, shall complete a rulemaking for a regulation to require a warning system in a motor vehicle to indicate to the operator when a tire is significantly under-inflated. Such requirement shall become effective not later than 2 years after the date of the completion of such rulemaking." Thus, it is expected that a rule requiring continuous tire monitoring will take effect for the 2004 model year.

This law will dominate the first generation of such systems as automobile manufacturers move to satisfy the requirement. In subsequent years, more sophisticated systems that in addition to pressure will monitor temperature, tire footprint, wear, vibration, etc. Although the Act requires that the tire pressure be monitored, it is believed by the inventors that other parameters are as important as the tire pressure or even more important than the tire pressure as described in more detail below.

Consumers are also in favor of tire monitors. Johnson Controls' market research showed that about 80 percent of consumers believe a low tire pressure warning system is an important or extremely important vehicle feature. Thus, as with other safety products such as airbags, competition to meet customer demands will soon drive this market.

Although, as with most other safety products, the initial introductions will be in the United States, speed limits in the United States and Canada are sufficiently low that tire pressure is not as critical an issue as in Europe, for example, where the drivers often drive much faster.

The advent of microelectromechanical (MEMS) pressure sensors, especially those based on surface acoustical wave (SAW) technology, has now made the wireless and powerless monitoring of tire pressure feasible. This is the basis of the tire pressure monitors described below. According to a Frost and Sullivan report on the U.S. Micromechanical Systems (MEMS) market (June 1997): "A MEMS tire pressure sensor represents one of the most profound opportunities for MEMS in the automotive sector."

There are many wireless tire temperature and pressure monitoring systems disclosed in the prior art patents such as for example, U.S. Pat. Nos. 4,295,102, 4,296,347, 4,317,372, 4,534,223, 5,289,160, 5,612,671, 5,661,651, 5,853,020 and 5,987,980 and International Publication No. WO 01/07271(A1), all of which are illustrative of the state of the art of tire monitoring and are incorporated by reference herein.

Devices for measuring the pressure and/or temperature within a vehicle tire directly can be categorized as those containing electronic circuits and a power supply within the tire, those which contain electronic circuits and derive the power to operate these circuits either inductively, from a generator or through radio frequency radiation, and those that do not contain electronic circuits and receive their operating power only from received radio frequency radiation. For the reasons discussed above, the discussion herein is mainly concerned with the latter category. This category contains devices that operate on the principles of surface acoustic waves (SAW) and the disclosure below is concerned primarily with such SAW devices.

International Publication No. WO 01/07271 describes a tire pressure sensor that replaces the valve and valve stem in a tire.

U.S. Pat. No. 5,231,827 contains a good description and background of the tire-monitoring problem. The device disclosed, however, contains a battery and electronics and is not a SAW device. Similarly, the device described in U.S. Pat. No. 5,285,189 contains a battery as do the devices described in U.S. Pat. Nos. 5,335,540 and 5,559,484. U.S. Pat. No. 5,945,908 applies to a stationary tire monitoring system and does not use SAW devices.

One of the first significant SAW sensor patents is U.S. Pat. No. 4,534,223. This patent describes the use of SAW devices for measuring pressure and also a variety of methods for temperature compensation but does not mention wireless transmission.

U.S. Pat. No. 5,987,980 describes a tire valve assembly using a SAW pressure transducer in conjunction with a sealed cavity. This patent does disclose wireless transmission. The assembly includes a power supply and thus this also distinguishes it from a preferred system of this invention. It is not a SAW system and thus the antenna for interrogating the device in this design must be within one meter, which is closer than needed for a preferred device of this invention.

U.S. Pat. No. 5,698,786 relates to the sensors and is primarily concerned with the design of electronic circuits in an interrogator. U.S. Pat. No. 5,700,952 also describes circuitry for use in the interrogator to be used with SAW devices. In neither of these patents is the concept of using a SAW device in a wireless tire pressure monitoring system described. These patents also do not describe including an identification code with the temperature and/or pressure measurements in the sensors and devices.

U.S. Pat. No. 5,804,729 describes circuitry for use with an interrogator in order to obtain more precise measurements of the changes in the delay caused by the physical or chemical property being measured by the SAW device. Similar comments apply to U.S. Pat. No. 5,831,167. Other related prior art includes U.S. Pat. No. 4,895,017.

Other patents disclose the placement of an electronic device in the sidewall or opposite the tread of a tire but they do not disclose either an accelerometer or a surface acoustic wave device. In most cases, the disclosed system has a battery and electronic circuits.

One method of measuring pressure that is applicable to this invention is disclosed in V. V. Varadan, Y. R. Roh and V. K. Varadan "Local/Global SAW Sensors for Turbulence", IEEE 1989 Ultrasonics Symposium p. 591–594 makes use of a polyvinylidene fluoride (PVDF) piezoelectric film to measure pressure. Mention is made in this article that other piezoelectric materials can also be used. Experimental results are given where the height of a column of oil is measured based on the pressure measured by the piezoelectric film used as a SAW device. In particular, the speed of the surface acoustic wave is determined by the pressure exerted by the oil on the SAW device. For the purposes of the instant invention, air pressure can also be measured in a similar manner by first placing a thin layer of a rubber material onto the surface of the SAW device which serves as a coupling agent from the air pressure to the SAW surface. In this manner, the absolute pressure of a tire, for example, can be measured without the need for a diaphragm and reference pressure greatly simplifying the pressure measurement. Other examples of the use of PVDF film as a pressure transducer can be found in U.S. Pat. Nos. 4,577,510 and 5,341,687, which are incorporated by reference herein, although they are not used as SAW devices.

The following U.S. patents provide relevant information to this invention, and to the extent necessary, all of them are incorporated by reference herein: U.S. Pat. Nos. 4,361,026, 4,620,191, 4,7033,27, 4,724,443, 4,725,841, 4,734,698, 5,691,698, 5,841,214, 6,060,815, 6,107,910, 6,114,971, 6,144,332.

In recent years, SAW devices have been used as sensors in a broad variety of applications. Compared with sensors utilizing alternative technologies, SAW sensors possess outstanding properties, such as high sensitivity, high resolution, and ease of manufacturing by microelectronic technologies. However, the most attractive feature of SAW sensors is that they can be interrogated wirelessly.

DEFINITIONS

As used herein, a diagnosis of the "state of the vehicle" means a diagnosis of the condition of the vehicle with respect to its stability and proper running and operating condition. Thus, the state of the vehicle could be normal when the vehicle is operating properly on a highway or abnormal when, for example, the vehicle is experiencing excessive angular inclination (e.g., two wheels are off the ground and the vehicle is about to rollover), the vehicle is experiencing a crash, the vehicle is skidding, and other similar situations. A diagnosis of the state of the vehicle could also be an indication that one of the parts of the vehicle, e.g., a component, system or subsystem, is operating abnormally.

As used herein, an "occupant restraint device" includes any type of device which is deployable in the event of a crash involving the vehicle for the purpose of protecting an occupant from the effects of the crash and/or minimizing the potential injury to the occupant. Occupant restraint devices thus include frontal airbags, side airbags, seatbelt tensioners, knee bolsters, side curtain airbags, externally deployable airbags and the like.

As used herein, a "part" of the vehicle includes any component, sensor, system or subsystem of the vehicle such as the steering system, braking system, throttle system, navigation system, airbag system, seatbelt retractor, air bag inflation valve, air bag inflation controller and airbag vent valve, as well as those listed below in the definitions of "component" and "sensor".

As used herein, a "sensor system" includes any of the sensors listed below in the definition of "sensor" as well as any type of component or assembly of components which detect, sense or measure something.

The term "gage" as used herein interchangeably with the terms "sensor" and "sensing device".

Preferred embodiments of the invention are described below and unless specifically noted, it is the applicants' intention that the words and phrases in the specification and claims be given the ordinary and accustomed meaning to those of ordinary skill in the applicable art(s). If the applicant intends any other meaning, he will specifically state he is applying a special meaning to a word or phrase.

Likewise, applicants' use of the word "function" here is not intended to indicate that the applicants seek to invoke the special provisions of 35 U.S.C. § 112, sixth paragraph, to define their invention. To the contrary, if applicants wish to invoke the provisions of 35 U.S.C. § 112, sixth paragraph, to define their invention, they will specifically set forth in the claims the phrases "means for" or "step for" and a function, without also reciting in that phrase any structure, material or act in support of the function. Moreover, even if applicants invoke the provisions of 35 U.S.C. § 112, sixth paragraph, to define their invention, it is the applicants' intention that their inventions not be limited to the specific structure, material or acts that are described in the preferred embodiments herein. Rather, if applicants claim their inventions by specifically invoking the provisions of 35 U.S.C. § 112, sixth paragraph, it is nonetheless their intention to cover and include any and all structure, materials or acts that perform the claimed function, along with any and all known or later developed equivalent structures, materials or acts for performing the claimed function.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a new and improved method and system for diagnosing components in a vehicle and the operating status of the vehicle and alerting the vehicle's dealer, or another repair facility, via a telematics link that a component of the vehicle is functioning abnormally and may be in danger of failing.

It is still another object of the present invention to provide a new and improved method and apparatus for obtaining information about a vehicle system and components in the vehicle in conjunction with failure of the component or the vehicle and sending this information to the vehicle manufacturer.

It is an object of the present invention to provide a new and improved method and system for diagnosing components in a vehicle by monitoring the patterns of signals emitted from the vehicle components and, through the use of pattern recognition technology, forecasting component failures before they occur. Vehicle component behavior is thus monitored over time in contrast to systems that wait until a serious condition occurs. The forecast of component failure can be transmitted to a remote location via a telematics link.

It is another object of the present invention to provide a new and improved on-board vehicle diagnostic module utilizing pattern recognition technologies which are trained to differentiate normal from abnormal component behavior. The diagnosis of component behavior can be transmitted to a remote location via a telematics link.

It is yet another object of the present invention to provide a diagnostic module that determines whether a component is operating normally or abnormally based on a time series of data from a single sensor or from multiple sensors that contain a pattern indicative of the operating status of the component. The diagnosis of component operation can be transmitted to a remote location via a telematics link.

It is still another object of the present invention to provide a diagnostic module that determines whether a component is operating normally or abnormally based on data from one or more sensors that are not directly associated with the component, i.e., do not depend on the operation of the component. The diagnosis of component operation can be transmitted to a remote location via a telematics link.

It is an additional object of the present invention to simultaneously monitor several sensors, primarily accelerometers, gyroscopes and strain gages, to determine the state of the vehicle and optionally its occupants and to determine that a vehicle is out of control and possibly headed for an accident, for example. If so, then a signal can be sent to a part of the vehicle control system to attempt to re-establish stability. If this is unsuccessful, then the same system of sensors can monitor the early stages of a crash to make an assessment of the severity of the crash and what occupant protection systems should be deployed and how such occupant protection systems should be deployed.

Another object of the invention to provide new and improved sensors for a vehicle which wirelessly transmits information about a state measured or detected by the sensor.

It is another object of the invention to incorporate surface acoustic wave technology into sensors on a vehicle with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is another object of the invention to provide new and improved sensors for measuring the pressure, temperature and/or acceleration of tires with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is yet another object of the invention to provide new and improved weight or load measuring sensors, switches, temperature sensors, acceleration sensors, angular position sensors, angular rate sensors, angular acceleration sensors, proximity sensors, rollover sensors, occupant presence and position sensors, strain sensors and humidity sensors which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is still another object of the present invention to provide new and improved sensors for detecting the presence of fluids or gases which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Yet another object of the present invention to provide new and improved sensors for detecting the condition or friction of a road surface which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Still another object of the present invention to provide new and improved sensors for detecting chemicals which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is another object of the invention to utilize any of the foregoing sensors for a vehicular component control system in which a component, system or subsystem in the vehicle is controlled based on the information provided by the sensor. Additionally, the information provided by the sensor can be transmitted via a telematics link to one or more remote facilities for further analysis.

A more general object of the invention is to provide new and improved sensors which obtain and provide information about the vehicle, about individual components, systems, vehicle occupants, subsystems, or about the roadway, ambient atmosphere, travel conditions and external objects with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Accordingly to achieve one or more of the above objects, a vehicle in accordance with the invention comprises a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof and a communications device coupled to the diagnostic system and arranged to transmit the output of the diagnostic system. The diagnostic system may comprise a plurality of vehicle sensors mounted on the vehicle, each sensor providing a measurement related to a state of the sensor or a measurement related to a state of the mounting location, and a processor coupled to the sensors and arranged to receive data from the sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle. The sensors may be wirelessly coupled to the processor and arranged at different locations on the vehicle. The processor may embody a pattern recognition algorithm trained to generate the output from the data received from the sensors, such as a neural network, fuzzy logic, sensor fusion and the like, and be arranged to control one or more parts of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle. The state of the vehicle can include angular motion of the vehicle.

A display may be arranged in the vehicle in a position to be visible from the passenger compartment. Such as display is coupled to the diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

A warning device may also be coupled to the diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by the diagnostic system.

The communications device may comprise a cellular telephone system including an antenna as well as other similar or different electronic equipment capable of transmitting a signal to a remote location, optionally via a satellite. Transmission via the Internet, i.e., to a web site or host computer associated with the remote location is also a possibility for the invention. If the vehicle is considered it sown site, then the transmission would be a site-to-site transmission via the Internet.

An occupant sensing system can be provided to determine at least one property or characteristic of occupancy of the vehicle. In this case, the communications device is coupled to the occupant sensing system and transmits the determined property or characteristic of occupancy of the vehicle.

In a similar manner, at least one environment sensor can be provided, each sensing a state of the environment around the vehicle. In this case, the communications device is coupled to the environment sensor(s) and transmits the sensed state of the environment around the vehicle.

Moreover, a location determining system, optionally incorporating GPS technology, could be provided on the vehicle to determine the location of the vehicle and transmitted to the remote location along with the diagnosis of the state of the vehicle or its component.

A memory unit may be coupled to the diagnostic system and the communications device. The memory unit receives the diagnosis of the state of the vehicle or the state of a component of the vehicle from the diagnostic system and stores the diagnosis. The communications device then interrogates the memory unit to obtain the stored diagnosis to enable transmission thereof, e.g., at periodic intervals.

The sensors may be any known type of sensor including, but not limited to, a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope. The sensors may include an RFID response unit and an RFID interrogator device which causes the RFID response units to transmit a signal representative of the measurement of the associated sensor to the processor. In addition to or instead or an RFID-based system, one or more SAW sensors can be arranged on the vehicle, each receiving a signal and returning a signal modified by virtue of the state of the sensor or the state of the mounting location of the sensor. For example, the SAW sensor can measure temperature and/or pressure of a component of the vehicle or in a certain location or space on the vehicle, or the concentration and/or presence of a chemical

A method for monitoring a vehicle comprises diagnosing the state of the vehicle or the state of a component of the vehicle by means of a diagnostic system arranged on the vehicle, generating an output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle, and transmitting the output to a remote location. Transmission of the output to a remote location may entail arranging a communications device comprising a cellular telephone system including an antenna on the vehicle. The output may be to a satellite for transmission from the satellite to the remote location. The output could also be transmitted via the Internet to a web site or host computer associated with the remote location.

It is important to note that raw sensor data is not transmitted from the vehicle the remote location for analysis and processing by the devices and/or personnel at the remote location. Rather, in accordance with the invention, a diagnosis of the vehicle or the vehicle component is performed on the vehicle itself and this resultant diagnosis is transmitted.

The diagnosis of the state of the vehicle may encompass determining whether the vehicle is stable or is about to rollover or skid and/or determining a location of an impact between the vehicle and another object.

A display may be arranged in the vehicle in a position to be visible from the passenger compartment in which case, the state of the vehicle or the state of a component of the vehicle is displayed thereon. Further, a warning can be relayed to an occupant of the vehicle relating to the state of the vehicle.

In addition to the transmission of vehicle diagnostic information obtained by analysis of data from sensors performed on the vehicle, at least one property or characteristic of occupancy of the vehicle may be determined (such as the number of occupants, the status of the occupants-breathing or not, injured or not, etc.) and transmitted to a remote location, the same or a different remote location to which the diagnostic information is sent. The information can also be sent in a different manner than the information relating to the diagnosis of the vehicle.

Additional information for transmission by the components on the vehicle may include a state of the environment around the vehicle, for example, the temperature, pressure, humidity, etc. in the vicinity of the vehicle, and the location of the vehicle.

A memory unit may be provided in the vehicle, possibly as part of a microprocessor, and arranged to receive the diagnosis of the state of the vehicle or the state of the component of the vehicle and store the diagnosis. As such, this memory unit can be periodically interrogated to obtain the stored diagnosis to enable transmission thereof.

Diagnosis of the state of the vehicle or the state of the component of the vehicle may entail mounting a plurality of sensors on the vehicle, measuring a state of each sensor or a state of the mounting location of each sensor and diagnosing the state of the vehicle or the state of a component of the vehicle based on the measurements of the state of the sensors or the state of the mounting locations of the sensors. These functions can be achieved by a processor which is wirelessly coupled to the sensors.

The sensors can optionally be provided with RFID technology, i.e., an RFID response unit, whereby an RFID interrogator device is mounted on the vehicle and signals transmitted via the RFID interrogator device causes the RFID response units of any properly equipped sensors to transmit a signal representative of the measurements of that sensor to the processor.

SAW sensors can also be used, in addition to or instead of RFID-based sensors.

One embodiment of the diagnostic module in accordance with the invention utilizes information which already exists in signals emanating from various vehicle components along with sensors which sense these signals and, using pattern recognition techniques, compares these signals with patterns characteristic of normal and abnormal component performance to predict component failure, vehicle instability or a crash earlier than would otherwise occur if the diagnostic module was not utilized. If fully implemented, this invention is a total diagnostic system of the vehicle. In most implementations, the module is attached to the vehicle and electrically connected to the vehicle data bus where it analyzes data appearing on the bus to diagnose components of the vehicle. In some implementations, multiple distributed accelerometers and/or microphones are present on the vehicle and, in some cases, some of the sensors will communicate using wireless technology to the vehicle bus or directly to the diagnostic module.

Principal objects and advantages of this invention or other inventions disclosed herein are thus:

1. To prevent vehicle breakdowns.
2. To alert the driver of the vehicle that a component of the vehicle is functioning differently than normal and might be in danger of failing.
3 To alert the dealer, or other repair facility, that a component of the vehicle is functioning differently than normal and is in danger of failing.
4. To provide an early warning of a potential component failure and to thereby minimize the cost of repairing or replacing the component.
5. To provide a device which will capture available information from signals emanating from vehicle components for a variety of uses such as current and future vehicle diagnostic purposes.
6. To provide a device that uses information from existing sensors for new purposes thereby increasing the value of existing sensors and, in some cases, eliminating the need for sensors that provide redundant information.
7. To provide a device which is trained to recognize deterioration in the performance of a vehicle component, or of the entire vehicle, based on information in signals emanating from the component or from vehicle angular and linear accelerations.
8. To provide a device which analyzes vibrations from various vehicle components that are transmitted through the vehicle structure and sensed by existing vibration sensors such as vehicular crash sensors used with airbag systems or by special vibration sensors, accelerometers, or gyroscopes.
9. To provide a device which provides information to the vehicle manufacturer of the events leading to a component failure.
10. To apply pattern recognition techniques based on training to diagnosing potential vehicle component failures.
11. To apply component diagnostic techniques in combination with intelligent or smart highways wherein vehicles may be automatically guided without manual control in order to permit the orderly exiting of the vehicle from a restricted roadway prior to a breakdown of the vehicle.
12. To apply trained pattern recognition techniques using multiple sensors to provide an early prediction of the existence and severity of an accident.
13. To utilize pattern recognition techniques and the output from multiple sensors to determine at an early stage that a vehicle rollover might occur and to take corrective action through control of the vehicle acceleration, brakes and steering to prevent the rollover or if it is preventable, to deploy side head protection airbags to reduce the injuries.
14. To use the output from multiple sensors to determine that the vehicle is skidding or sliding and to send messages to the various vehicle control systems to activate the throttle, brakes and/or steering to correct for the vehicle sliding or skidding motion.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiments taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings are illustrative of embodiments of the system developed or adapted using the teachings of this invention and are not meant to limit the scope of the invention as encompassed by the claims.

FIG. **1** is a side view with parts cutaway and removed of a vehicle showing the passenger compartment containing a rear facing child seat on the front passenger seat and a preferred mounting location for an occupant and rear facing child seat presence detector.

FIG. **2** is a side view with parts cutaway and removed showing schematically the interface between the vehicle interior monitoring system of this invention and the vehicle cellular communication system.

FIG. **3** is a diagram of one exemplifying embodiment of the invention.

FIG. **4** is a perspective view of a carbon dioxide SAW sensor for mounting in the trunk lid for monitoring the inside of the trunk for detecting trapped children or animals.

FIG. **4A** is a detailed view of the SAW carbon dioxide sensor of FIG. **4**.

FIG. **5** is a schematic illustration of a generalized component with several signals being emitted and transmitted along a variety of paths, sensed by a variety of sensors and analyzed by the diagnostic module in accordance with the invention and for use in a method in accordance with the invention.

FIG. **6** is a schematic of one pattern recognition methodology known as a neural network which may be used in a method in accordance with the invention.

FIG. **7** is a schematic of a vehicle with several components and several sensors and a total vehicle diagnostic system in accordance with the invention utilizing a diagnostic module in accordance with the invention and which may be used in a method in accordance with the invention.

FIG. **8** is a flow diagram of information flowing from various sensors onto the vehicle data bus and thereby into the diagnostic module in accordance with the invention with outputs to a display for notifying the driver, and to the vehicle cellular phone for notifying another person, of a potential component failure.

FIG. **9** is a flow chart of the methods for automatically monitoring a vehicular component in accordance with the invention.

FIG. **10** is a schematic illustration of the components used in the methods for automatically monitoring a vehicular component.

FIG. **11** is a schematic of a vehicle with several accelerometers and/or gyroscopes at preferred locations in the vehicle.

FIG. **12** is a schematic view of overall telematics system in accordance with the invention.

FIG. **13**A is a partial cutaway view of a tire pressure monitor using an absolute pressure measuring SAW device.

FIG. **13**B is a partial cutaway view of a tire pressure monitor using a differential pressure measuring SAW device.

FIG. **14** is a partial cutaway view of an interior SAW tire temperature and pressure monitor mounted onto and below the valve stem.

FIG. **14**A is a sectioned view of the SAW tire pressure and temperature monitor of FIG. **14** incorporating an absolute pressure SAW device.

FIG. **14**B is a sectioned view of the SAW tire pressure and temperature monitor of FIG. **14** incorporating a differential pressure SAW device.

FIG. **15** is a view of an accelerometer-based tire monitor also incorporating a SAW pressure and temperature monitor and cemented to the interior of the tire opposite the tread.

FIG. **15**A is a view of an accelerometer-based tire monitor also incorporating a SAW pressure and temperature monitor and inserted into the tire opposite the tread during manufacture.

FIG. **16** is a detailed view of a polymer on SAW pressure sensor.

FIG. **16**A is a view of a SAW temperature and pressure monitor on a single SAW device.

FIG. **16**B is a view of an alternate design of a SAW temperature and pressure monitor on a single SAW device.

FIG. **17** is a perspective view of a SAW temperature sensor.

FIG. **17**A is a perspective view of a device that can provide two measurements of temperature or one of temperature and another of some other physical or chemical property such as pressure or chemical concentration.

FIG. **17**B is a top view of an alternate SAW device capable of determining two physical or chemical properties such as pressure and temperature.

FIGS. **18** and **18**A are views of a prior art SAW accelerometer that can be used for the tire monitor assembly of FIG. **15**.

FIGS. **19**A, **19**B, **19**C, **19**D and **19**E are views of occupant seat weight sensors using a slot spanning SAW strain gage and other strain concentrating designs.

FIG. **20**A is a view of a view of a SAW switch sensor for mounting on or within a surface such as a vehicle armrest.

FIG. **20**B is a detailed perspective view of the device of FIG. **20**A with the force-transmitting member rendered transparent.

FIG. **20**C is a detailed perspective view of an alternate SAW device for use in FIGS. **20**A and **20**B showing the use of one of two possible switches, one that activates the SAW and the other that suppresses the SAW.

FIG. **21**A is a detailed perspective view of a polymer and mass on SAW accelerometer for use in crash sensors, vehicle navigation, etc.

FIG. **21**B is a detailed perspective view of a normal mass on SAW accelerometer for use in crash sensors, vehicle navigation, etc.

FIG. **22** is a view of a prior art SAW gyroscope that can be used with this invention.

FIGS. **23**A, **23**B and **23**C are a block diagrams of three interrogators that can be used with this invention to interrogate several different devices.

FIG. **24** is a perspective view of a SAW antenna system adapted for mounting underneath a vehicle and for communicating with the four mounted tires.

FIG. **24**A is a detail view of an antenna system for use in the system of FIG. **24**.

FIG. **25** is an overhead view of a roadway with vehicles and a SAW road temperature and humidity monitoring sensor.

FIG. **25**A is a detail drawing of the monitoring sensor of FIG. **25**.

FIG. **26** is a perspective view of a SAW system for locating a vehicle on a roadway, and on the earth surface if accurate maps are available. It also illustrates the use of a SAW transponder in the license plate for the location of preceding vehicles and preventing rear end impacts.

FIG. **27** is a partial cutaway view of a section of a fluid reservoir with a SAW fluid pressure and temperature sensor for monitoring oil, water, or other fluid pressure.

FIG. **28** is a perspective view of a vehicle suspension system with SAW load sensors.

FIG. **28**A is a cross section detail view of a vehicle spring and shock absorber system with a SAW torque sensor system mounted for measuring the stress in the vehicle spring of the suspension system of FIG. **28**.

FIG. **28**B is a detail view of a SAW torque sensor and shaft compression sensor arrangement for use with the arrangement of FIG. **28**.

FIG. **29** is a cutaway view of a vehicle showing possible mounting locations for vehicle interior temperature, humidity, carbon dioxide, carbon monoxide, alcohol or other chemical or physical property measuring sensors.

FIG. **30**A is a perspective view of a SAW tilt sensor using four SAW assemblies for tilt measurement and one for temperature.

FIG. **30**B is a top view of a SAW tilt sensor using three SAW assemblies for tilt measurement each one of which can also measure temperature.

FIG. **31** is a perspective exploded view of a SAW crash sensor for sensing frontal, side or rear crashes.

FIG. **32** is a partial cutaway view of a piezoelectric generator and tire monitor using PVDF film.

FIG. **32**A is a cutaway view of the PVDF sensor of FIG. **32**.

FIG. **33** is a perspective view with portions cutaway of a SAW based vehicle gas gage.

FIG. 33A is a top detailed view of a SAW pressure and temperature monitor for use in the system of FIG. 33.

FIG. 34 is a partial cutaway view of a vehicle drives wearing a seatbelt with SAW force sensors.

FIG. 35 is an alternate arrangement of a SAW tire pressure and temperature monitor installed in the wheel rim facing inside.

FIG. 36A is a schematic of a prior art deployment scheme for an airbag module.

FIG. 36B is a schematic of a deployment scheme for an airbag module in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

As noted above, the invention relates generally to telematics and the transmission of information from a vehicle to one or more remote sites which can react to the position or status of the vehicle or occupant(s) therein.

Initially, sensing of the occupancy of the vehicle and the optional transmission of this information, which may include images, to remote locations will be discussed. This entails obtaining information from various sensors about the occupants in the passenger compartment of the vehicle, e.g., the number of occupants, their type and their motion, if any. Thereafter, a discussion of general vehicle diagnostic methods will be discussed with the diagnosis being transmittable via a communications device to the remote locations. Finally, an extensive discussion of various sensors for use on the vehicle to sense different operating parameters and conditions of the vehicle is provided. All of the sensors discussed herein can be coupled to a communications device enabling transmission of data, signals and/or images to the remote locations, and reception of the same from the remote locations.

Referring to the accompanying drawings wherein the same reference numerals refer to the same or similar elements, FIG. **1** is a side view, with parts cutaway and removed of a vehicle showing the passenger compartment containing a rear facing child seat **610** on a front passenger seat **620** and one mounting location for a first embodiment of a vehicle interior monitoring system in accordance with the invention. The interior monitoring system is capable of detecting the presence of an object, determining the type of object, determining the location of the object, and/or determining another property or characteristic of the object. A property of the object could be the orientation of a child seat, the velocity of an adult and the like. For example, the vehicle interior monitoring system can determine that an object is present on the seat, that the object is a child seat and that the child seat is rear-facing. The vehicle interior monitoring system could also determine that the object is an adult, that he is drunk and that he is out of position relative to the airbag.

In this embodiment, six transducers **631, 632, 633, 640, 641** and **646** are used, although any number of transducers may be used. Each transducer **631, 632, 633, 640, 641, 646** may comprise only a transmitter which transmits energy, waves or radiation, only a receiver which receives energy, waves or radiation, both a transmitter and a receiver capable of transmitting and receiving energy, waves or radiation, an electric field sensor, a capacitive sensor, or a self-tuning antenna-based sensor, weight sensor, chemical sensor, motion sensor or vibration sensor, for example.

Such transducers or receivers may be of the type which emit or receive a continuous signal, a time varying signal (such as a capacitor or electric field sensor) or a spacial varying signal such as in a scanning system. One particular type of radiation-receiving receiver for use in the invention is a receiver capable of receiving electromagnetic waves.

When ultrasonic energy is used, transducer **632** can be used as a transmitter and transducers **631,633** as receivers. Naturally, other combinations can be used such as where all transducers are transceivers (transmitters and receivers). For example, transducer **632** can be constructed to transmit ultrasonic energy toward the front passenger seat, which is modified, in this case by the occupying item of the passenger seat, i.e., the rear facing child seat **610**, and the modified waves are received by the transducers **631** and **633**, for example. A more common arrangement is where transducers **631, 632** and **633** are all transceivers. Modification of the ultrasonic energy may constitute reflection of the ultrasonic energy as the ultrasonic energy is reflected back by the occupying item of the seat. The waves received by transducers **631** and **633** vary with time depending on the shape of the object occupying the passenger seat, in this case the rear facing child seat **610**. Each object will reflect back waves having a different pattern. Also, the pattern of waves received by transducer **631** will differ from the pattern received by transducer **633** in view of its different mounting location. This difference generally permits the determination of location of the reflecting surface (i.e., the rear facing child seat **610**) through triangulation. Through the use of two transducers **631,633**, a sort of stereographic image is received by the two transducers and recorded for analysis by processor **601**, which is coupled to the transducers **631,632, 633**. This image will differ for each object that is placed on the vehicle seat and it will also change for each position of a particular object and for each position of the vehicle seat. Elements **631, 632, 633**, although described as transducers, are representative of any type of component used in a wave-based analysis technique.

Mention is made above of the use of wave-type sensors as the transducers **631, 632, 633** as well as electric field sensors. Electric field sensors and wave sensors are essentially the same from the point of view of sensing the presence of an occupant in a vehicle. In both cases, a time varying electric field is disturbed or modified by the presence of the occupant. At high frequencies in the visual, infrared and high frequency radio wave region, the sensor is based on its capability to sense change of wave characteristics of the electromagnetic field, such as amplitude, phase or frequency. As the frequency drops, other characteristics of the field are measured. At still lower frequencies, the occupant's dielectric properties modify parameters of the reactive electric field in the occupied space between/near the plates of a capacitor. In this latter case, the sensor senses the change in charge distribution on the capacitor plates by measuring, for example, the current wave magnitude or phase in the electric circuit that drives the capacitor. These measured parameters are directly connected with parameters of the displacement current in the occupied space. In all cases, the presence of the occupant reflects, absorbs or modifies the waves or variations in the electric field in the space occupied by the occupant. Thus for the purposes of this invention, capacitance, electric field or electromagnetic wave sensors are equivalent and although they are all technically "field" sensors they will be considered as "wave" sensors herein. What follows is a discussion comparing the similarities and differences between two types of field or wave sensors, electromagnetic wave sensors and capacitive sensors as exemplified by Kithil in U.S. Pat. No. 5,702,634.

An electromagnetic field disturbed or emitted by a passenger in the case of an electromagnetic wave sensor, for example, and the electric field sensor of Kithil, for example, are in many ways similar and equivalent for the purposes of this invention. The electromagnetic wave sensor is an actual electromagnetic wave sensor by definition because they sense parameters of a wave, which is a coupled pair of continuously changing electric and magnetic fields. The electric field here is not a static, potential one. It is essentially a dynamic, rotational electric field coupled with a changing magnetic one, that is, an electromagnetic wave. It cannot be produced by a steady distribution of electric charges. It is initially produced by moving electric charges in a transmitter, even if this transmitter is a passenger body for the case of a passive infrared sensor.

In the Kithil sensor, a static electric field is declared as an initial material agent coupling a passenger and a sensor (see Column 5, lines 5–7): "The proximity sensor **12** each function by creating an electrostatic field between oscillator input loop **54** and detector output loop **56**, which is affected by presence of a person near by, as a result of capacitive coupling, . . . "). It is a potential, non-rotational electric field. It is not necessarily coupled with any magnetic field. It is the electric field of a capacitor. It can be produced with a steady distribution of electric charges. Thus, it is not an electromagnetic wave by definition but if the sensor is driven by a varying current, then it produces a quasistatic electric field in the space between/near the plates of the capacitor.

Kithil declares that his capacitance sensor uses a static electric field. Thus, from the consideration above, one can conclude that Kithil's sensor cannot be treated as a wave sensor because there are no actual electromagnetic waves but only a static electric field of the capacitor in the sensor system. However, this is not believed to be the case. The Kithil system could not operate with a true static electric field because a steady system does not carry any information. Therefore, Kithil is forced to use an oscillator, causing an alternate current in the capacitor and a reactive quasistatic electric field in the space between the capacitor plates, and a detector to reveal an informative change of the sensor capacitance caused by the presence of an occupant (see FIG. 7 and its description). In this case, the system becomes a "wave sensor" in the sense that it starts generating actual time-varying electric field that certainly originates electromagnetic waves according to the definition above. That is, Kithil's sensor can be treated as a wave sensor regardless of the shape of the electric field that it creates, a beam or a spread shape.

As follows from the Kithil patent, the capacitor sensor is likely a parametric system where the capacitance of the sensor is controlled by influence of the passenger body. This influence is transferred by means of the near electromagnetic field (i.e., the wave-like process) coupling the capacitor electrodes and the body. It is important to note that the same influence takes place with a real static electric field also, that is in absence of any wave phenomenon. This would be a situation if there were no oscillator in Kithil's system. However, such a system is not workable and thus Kithil reverts to a dynamic system using time-varying electric fields.

Thus, although Kithil declares the coupling is due to a static electric field, such a situation is not realized in his system because an alternating electromagnetic field ("quasi-wave") exists in the system due to the oscillator. Thus, his sensor is actually a wave sensor, that is, it is sensitive to a change of a wave field in the vehicle compartment. This change is measured by measuring the change of its capacitance. The capacitance of the sensor system is determined by the configuration of its electrodes, one of which is a human body, that is, the passenger inside of and the part which controls the electrode configuration and hence a sensor parameter, the capacitance.

The physics definition of "wave" from Webster's Encyclopedic Unabridged Dictionary is: "11. Physics. A progressive disturbance propagated from point to point in a medium or space without progress or advance of the points themselves, . . . ". In a capacitor, the time that it takes for the disturbance (a change in voltage) to propagate through space, the dielectric and to the opposite plate is generally small and neglected but it is not zero. As the frequency driving the capacitor increases and the distance separating the plates increases, this transmission time as a percentage of the period of oscillation can become significant. Nevertheless, an observer between the plates will see the rise and fall of the electric field much like a person standing in the water of an ocean. The presence of a dielectric body between the plates causes the waves to get bigger as more electrons flow to and from the plates of the capacitor. Thus, an occupant affects the magnitude of these waves which is sensed by the capacitor circuit. Thus, the electromagnetic field is a material agent that carries information about a passenger's position in both Kithil's and a beam-type electromagnetic wave sensor.

For ultrasonic systems, the "image" recorded from each ultrasonic transducer/receiver, is actually a time series of digitized data of the amplitude of the received signal versus time. Since there are two receivers, two time series are obtained which are processed by the processor **601**. The processor **601** may include electronic circuitry and associated, embedded software. Processor **601** constitutes one form of generating means in accordance with the invention which generates information about the occupancy of the passenger compartment based on the waves received by the transducers **631,632,633**.

When different objects are placed on the front passenger seat, the two images from transducers **631,633**, for example, are different but there are also similarities between all images of rear facing child seats, for example, regardless of where on the vehicle seat it is placed and regardless of what company manufactured the child seat. Alternately, there will be similarities between all images of people sitting on the seat regardless of what they are wearing, their age or size. The problem is to find the "rules" which differentiate the images of one type of object from the images of other types of objects, e.g., which differentiate the occupant images from the rear facing child seat images. The similarities of these images for various child seats are frequently not obvious to a person looking at plots of the time series and thus computer algorithms are developed to sort out the various patterns. For a more detailed discussion of pattern recognition see U.S. Pat. No. 5,943,295 to Varga et. al., which is incorporated herein by reference.

The determination of these rules is important to the pattern recognition techniques used in this invention. In general, three approaches have been useful, artificial intelligence, fuzzy logic and artificial neural networks (including cellular and modular or combination neural networks and support vector machines) (although additional types of pattern recognition techniques may also be used, such as sensor fusion). In some implementations of this invention, such as the determination that there is an object in the path of a closing window as described below, the rules are sufficiently obvious that a trained researcher can sometimes look at the returned signals and devise a simple algorithm to make the required determinations. In others, such as the determination of the presence of a rear facing child seat or of an occupant, artificial neural networks are used to determine the rules. One such set of neural network software for determining the pattern recognition rules is available from the NeuralWare Corporation of Pittsburgh, Pa.

The system used in a preferred implementation of this invention for the determination of the presence of a rear facing child seat, of an occupant or of an empty seat is the artificial neural network. In this case, the network operates on the two returned signals as sensed by transducers **631** and **633**, for example. Through a training session, the system is taught to differentiate between the three cases. This is done by conducting a large number of experiments where all possible child seats are placed in all possible orientations on the front passenger seat. Similarly, a sufficiently large number of experiments are run with human occupants and with boxes, bags of groceries and other objects (both inanimate and animate). Sometimes as many as 1,000,000 such experiments are run before the neural network is sufficiently trained so that it can differentiate among the three cases and output the correct decision with a very high probability. Of course, it must be realized that a neural network can also be trained to differentiate among additional cases, e.g., a forward facing child seat.

Once the network is determined, it is possible to examine the result using tools supplied by NeuralWare or International Scientific Research, for example, to determine the rules that were finally arrived at by the trial and error techniques. In that case, the rules can then be programmed into a microprocessor resulting in a fuzzy logic or other rule based system. Alternately, a neural computer, or cellular neural network, can be used to implement the net directly. In either case, the implementation can be carried out by those skilled in the art of pattern recognition. If a microprocessor is used, a memory device is also required to store the data from the analog to digital converters that digitize the data from the receiving transducers. On the other hand, if a neural network computer is used, the analog signal can be fed directly from the transducers to the neural network input nodes and an intermediate memory is not required. Memory of some type is needed to store the computer programs in the case of the microprocessor system and if the neural computer is used for more than one task, a memory is needed to store the network specific values associated with each task.

Electromagnetic energy based occupant sensors exist that use many portions of the electromagnetic spectrum. A system based on the ultraviolet, visible or infrared portions of the spectrum generally operate with a transmitter and a receiver of reflected radiation. The receiver may be a camera or a photo detector such as a pin or avalanche diode as described in detail in above-referenced patents and patent applications. At other frequencies, the absorption of the electromagnetic energy is primarily and at still other frequencies the capacitance or electric field influencing effects are used. Generally, the human body will reflect, scatter, absorb or transmit electromagnetic energy in various degrees depending on the frequency of the electromagnetic waves. All such occupant sensors are included herein.

In the embodiment wherein electromagnetic energy is used, it is to be appreciated that any portion of the electromagnetic signals that impinges upon, surrounds or involves a body portion of the occupant is at least partially absorbed by the body portion. Sometimes, this is due to the fact that the human body is composed primarily of water, and that electromagnetic energy of certain frequencies is readily absorbed by water. The amount of electromagnetic signal absorption is related to the frequency of the signal, and size or bulk of the body portion that the signal impinges upon. For example, a torso of a human body tends to absorb a greater percentage of electromagnetic energy than a hand of a human body.

Thus, when electromagnetic waves or energy signals are transmitted by a transmitter, the returning waves received by a receiver provide an indication of the absorption of the electromagnetic energy. That is, absorption of electromagnetic energy will vary depending on the presence or absence of a human occupant, the occupant's size, bulk, surface reflectivity, etc. depending on the frequency, so that different signals will be received relating to the degree or extent of absorption by the occupying item on the seat. The receiver will produce a signal representative of the returned waves or energy signals which will thus constitute an absorption signal as it corresponds to the absorption of electromagnetic energy by the occupying item in the seat.

One or more of the transducers **631, 632, 633** can also be image-receiving devices, such as cameras, which take images of the interior of the passenger compartment. These images can be transmitted to a remote facility to monitor the passenger compartment or can be stored in a memory device for use in the event of an accident, i.e., to determine the status of the occupants of the vehicle prior to the accident. In this manner, it can be ascertained whether the driver was falling asleep, talking on the phone, etc.

A memory device for storing the images of the passenger compartment, and also for receiving and storing any of the other information, parameters and variables relating to the vehicle or occupancy of the vehicle, may be in the form a standardized "black box" (instead of or in addition to a memory part in a processor **601**). The IEEE Standards Association is currently beginning to develop an international standard for motor vehicle event data recorders. The information stored in the black box and/or memory unit in the processor **601**, can include the images of the interior of the passenger compartment as well as the number of occupants and the health state of the occupants. The black box would preferably be tamper-proof and crash-proof and enable retrieval of the information after a crash.

FIG. **2** shows schematically the interface between a vehicle interior monitoring system in accordance with the invention and the vehicle's cellular or other telematics communication system. An adult occupant **710** is shown sitting on the front passenger seat **720** and four transducers **731, 732, 640** and **641** are used to determine the presence (or absence) of the occupant on that seat **720**. One of the transducers **732** in this case acts as both a transmitter and receiver while transducer **731** acts only as a receiver. Alternately, transducer **731** could serve as both a transmitter and receiver or the transmitting function could be alternated between the two devices. Also, in many cases more that two transmitters and receivers are used and in still other cases other types of sensors, such as electric field, capacitance, self-tuning antennas (collectively represented by **140** and **141**), weight, seatbelt, heartbeat, motion and seat position sensors, are also used in combination with the radiation sensors.

For a general object, transducers **731, 732, 140, 141** can also be used to determine the type of object, determine the location of the object, and/or determine another property or characteristic of the object. A property of the object could be the orientation of a child seat, the velocity of an adult and the like. For example, the transducers **731, 732, 140, 141** can be designed to enable a determination that an object is present on the seat, that the object is a child seat and that the child seat is rear-facing.

The transducers **731** and **732** are attached to the vehicle buried in the A-pillar trim, where their presence can be disguised, and are connected to processor **601** that may also be hidden in the trim as shown (this being a non-limiting position for the processor **601**). The A-pillar is the roof support pillar that is closest to the front of the vehicle and which, in addition to supporting the roof, also supports the front windshield and the front door. Other mounting locations can also be used. For example, transducers **731, 732** can be mounted inside the seat (along with or in place of transducers **140** and **141**), in the ceiling of the vehicle, in the B-pillar, in the C-pillar and in the doors. Indeed, the vehicle interior monitoring system in accordance with the invention may comprise a plurality of monitoring units, each arranged to monitor a particular seating location. In this case, for the rear seating locations, transducers might be mounted in the B-pillar or C-pillar or in the rear of the front seat or in the rear side doors. Possible mounting locations for transducers, transmitters, receivers and other occupant sensing devices are disclosed in the above-referenced patent applications and all of these mounting locations are contemplated for use with the transducers described herein.

The cellular phone or other communications system **740** outputs to an antenna **750A**. The transducers **731, 732, 140** and **141** in conjunction with the pattern recognition hardware and software, which is implemented in processor **601** and is packaged on a printed circuit board or flex circuit along with the transducers **731** and **732**, determine the presence of an occupant within a few seconds after the vehicle is started, or within a few seconds after the door is closed. Similar systems located to monitor the remaining seats in the vehicle, also determine the presence of occupants at the other seating locations and this result is stored in the computer memory which is part of each monitoring system processor **601**.

Periodically and in particular in the event of an accident, the electronic system associated with the cellular phone system **740** interrogates the various interior monitoring system memories and arrives at a count of the number of occupants in the vehicle, and optionally, even makes a determination as to whether each occupant was wearing a seatbelt and if he or she is moving after the accident. The phone or other communications system then automatically dials the EMS operator (such as 911 or through a telematics service such as OnStart®) and the information obtained from the interior monitoring systems is forwarded so that a determination can be made as to the number of ambulances and other equipment to send to the accident site, for example. Such vehicles will also have a system, such as the global positioning system, which permits the vehicle to determine its exact location and to forward this information to the EMS operator.

Thus, in basic embodiments of the invention, wave or other energy-receiving transducers are arranged in the vehicle at appropriate locations, trained if necessary depending on the particular embodiment, and function to determine whether a life form is present in the vehicle and if so, how many life forms are present and where they are located etc. To this end, transducers can be arranged to be operative at only a single seating locations or at multiple seating locations with a provision being made to eliminate repetitive count of occupants. A determination can also be made using the transducers as to whether the life forms are humans, or more specifically, adults, child in child seas, etc. As noted above and below, this is possible using pattern recognition techniques. Moreover, the processor or processors associated with the transducers can be trained to determine the location of the life forms, either periodically or continuously or possibly only immediately before, during and after a crash. The location of the life forms can be as general or as specific as necessary depending on the system requirements, i.e., a determination can be made that a human is situated on the driver's seat in a normal position (general) or a determination can be made that a human is situated on the driver's seat and is leaning forward and/or to the side at a specific angle as well as the position of his or her extremities and head and chest (specifically). The degree of detail is limited by several factors, including, for example, the number and position of transducers and training of the pattern recognition algorithm.

In addition to the use of transducers to determine the presence and location of occupants in a vehicle, other sensors could also be used. For example, a heartbeat sensor which determines the number and presence of heartbeats can also be arranged in the vehicle, which would thus also determine the number of occupants as the number of occupants would be equal to the number of heartbeats. Conventional heartbeat sensors can be adapted to differentiate between a heartbeat of an adult, a heartbeat of a child and a heartbeat of an animal. As its name implies, a heartbeat sensor detects a heartbeat, and the magnitude thereof, of a human occupant of the 'seat, if such a human occupant is present. The output of the heartbeat sensor is input to the processor of the interior monitoring system. One heartbeat sensor for use in the invention may be of the types as disclosed in McEwan (U.S. Pat. Nos. 5,573,012 and 5,766,208 which are incorporated herein in their entirety by reference). The heartbeat sensor can be positioned at any convenient position relative to the seats where occupancy is being monitored. A preferred location is within the vehicle seatback.

An alternative way to determine the number of occupants is to monitor the weight being applied to the seats, i.e., each seating location, by arranging weight sensors at each seating location which might also be able to provide a weight distribution of an object on the seat. Analysis of the weight and/or weight distribution by a predetermined method can provide an indication of occupancy by a human, an adult or child, or an inanimate object.

Another type of sensor which is not believed to have been used in an interior monitoring system heretofore is a micropower impulse radar (MIR) sensor which determines motion of an occupant and thus can determine his or her heartbeat (as evidenced by motion of the chest). Such an MIR sensor can be arranged to detect motion in a particular area in which the occupant's chest would most likely be situated or could be coupled to an arrangement which determines the location of the occupant's chest and then adjusts the operational field of the MIR sensor based on the determined location of the occupant's chest. A motion sensor utilizing a micro-power impulse radar (MIR) system as disclosed, for example, in McEwan (U.S. Pat. No. 5,361,070, which is incorporated herein by reference), as well as many other patents by the same inventor. Motion sensing is accomplished by monitoring a particular range from the sensor as disclosed in that patent. MIR is one form of radar which has applicability to occupant sensing and can be mounted at various locations in the vehicle. It has an advantage over ultrasonic sensors in that data can be acquired at a higher speed and thus the motion of an occupant can be more easily tracked. The ability to obtain returns over the entire occupancy range is somewhat more difficult than with ultrasound resulting in a more expensive system overall. MIR has additional advantages in lack of sensitivity to temperature variation and has a comparable resolution to about 40 kHz ultrasound. Resolution comparable to higher frequency is also possible. Additionally, multiple MIR sensors can be used when high speed tracking of the motion of an occupant during a crash is required since they can be individually pulsed without interfering with each through time division multiplexing.

An alternative way to determine motion of the occupant (s) is to monitor the weight distribution of the occupant whereby changes in weight distribution after an accident would be highly suggestive of movement of the occupant. A system for determining the weight distribution of the occupants could be integrated or otherwise arranged in the seats **620**, **720** of the vehicle and several patents and publications describe such systems.

More generally, any sensor which determines the presence and health state of an occupant can also be integrated into the vehicle interior monitoring system in accordance with the invention. For example, a sensitive motion sensor can determine whether an occupant is breathing and a chemical sensor can determine the amount of carbon dioxide, or the concentration of carbon dioxide, in the air in the vehicle which can be correlated to the health state of the occupant(s). The motion sensor and chemical sensor can be designed to have a fixed operational field situated where the occupant's mouth is most likely to be located. In this manner, detection of carbon dioxide in the fixed operational field could be used as an indication of the presence of a human occupant in order to enable the determination of the number of occupants in the vehicle. In the alternative, the motion sensor and chemical sensor can be adjustable and adapted to adjust their operational field in conjunction with a determination by an occupant position and location sensor which would determine the location of specific parts of the occupant's body, e.g., his or her chest or mouth Furthermore, an occupant position and location sensor can be used to determine the location of the occupant's eyes and determine whether the occupant is conscious, i.e., whether his or her eyes are open or closed or moving.

The use of chemical sensors can also be used to detect whether there is blood present in the vehicle, for example, after an accident. Additionally, microphones can detect whether there is noise in the vehicle caused by groaning, yelling, etc., and transmit any such noise through the cellular or other communication connection to a remote listening facility (such as operated by OnStar®.

FIG. **3** shows a schematic diagram of an embodiment of the invention including a system for determining the presence and health state of any occupants of the vehicle and a telecommunications link. This embodiment includes means for determining the presence of any occupants **410** which may take the form of a heartbeat sensor or motion sensor as described above and means for determining the health state of any occupants **412**. The latter means may be integrated into the means for determining the presence of any occupants, i.e., one and the same component, or separate therefrom. Further, means for determining the location, and optionally velocity, of the occupants or one or more parts thereof **414** are provided and may be any conventional occupant position sensor or preferably, one of the occupant position sensors as described herein (e.g., those utilizing waves, electromagnetic radiation or electric fields) or as described in the current assignee's patents and patent applications referenced above.

A processor **416** is coupled to the presence determining means **410**, the health state determining means **412** and the location determining means **414**. A communications unit **418** is coupled to the processor **416**. The processor **416** and/or communications unit **418** can also be coupled to microphones **420** that can be distributed throughout the vehicle and include voice-processing circuitry to enable the occupant(s) to effect vocal control of the processor **416**, communications unit **418** or any coupled component or oral communications via the communications unit **418**. The processor **416** is also coupled to another vehicular system, component or subsystem **422** and can issue control commands to effect adjustment of the operating conditions of the system, component or subsystem. Such a system, component or subsystem can be the heating or air-conditioning system, the entertainment system, an occupant restraint device such as an airbag, a glare prevention system, etc. Also, a positioning system **424** could be coupled to the processor **416** and provides an indication of the absolute position of the vehicle, preferably using satellite-based positioning technology (e.g., a GPS receiver).

In normal use (other than after a crash), the presence determining means **410** determine whether any human occupants are present, i.e., adults or children, and the location determining means **414** determine the occupant's location. The processor **416** receives signals representative of the presence of occupants and their location and determines whether the vehicular system, component or subsystem **422** can be modified to optimize its operation for the specific arrangement of occupants. For example, if the processor **416** determines that only the front seats in the vehicle are occupied, it could control the heating system to provide heat only through vents situated to provide heat for the front-seated occupants.

Another possible vehicular system, component or subsystem is a navigational aid, i.e., a route display or map. In this case, the position of the vehicle as determined by the positioning system **424** is conveyed through processor **416** to the communications unit **418** to a remote facility and a map is transmitted from this facility to the vehicle to be displayed on the route display. If directions are needed, a request for the same could be entered into an input unit **426** associated with the processor **416** and transmitted to the facility. Data for the display map and/or vocal instructions could be transmitted from this facility to the vehicle.

Moreover, using this embodiment, it is possible to remotely monitor the health state of the occupants in the vehicle and most importantly, the driver. The health state determining means **412** may be used to detect whether the driver's breathing is erratic or indicative of a state in which the driver is dozing off. The health state determining means **412** could also include a breath-analyzer to determine whether the driver's breath contains alcohol. In this case, the health state of the driver is relayed through the processor **416** and the communications unit **418** to the remote facility and appropriate action can be taken. For example, it would be possible to transmit a command to the vehicle to activate an alarm or illuminate a warning light or if the vehicle is equipped with an automatic guidance system and ignition shut-off, to cause the vehicle to come to a stop on the shoulder of the roadway or elsewhere out of the traffic stream. The alarm, warning light, automatic guidance system and ignition shut-off are thus particular vehicular components or subsystems represented by **422**.

In use after a crash, the presence determining means **410**, health state determining means **412** and location determining means **414** can obtain readings from the passenger compartment and direct such readings to the processor **416**. The processor **416** analyzes the information and directs or controls the transmission of the information about the occupant(s) to a remote, manned facility. Such information would include the number and type of occupants, i.e., adults, children, infants, whether any of the occupants have stopped breathing or are breathing erratically, whether the occupants are conscious (as evidenced by, e.g., eye motion), whether blood is present (as detected by a chemical sensor) and whether the occupants are making noise. Moreover, the communications link through the communications unit **418** can be activated immediately after the crash to enable personnel at the remote facility to initiate communications with the vehicle.

An occupant sensing system can also involve sensing for the presence of a living occupant in a trunk of a vehicle or in a closed vehicle, for example, when a child is inadvertently left in the vehicle or enters the trunk and the trunk closes. To this end, a SAW-based chemical sensor **250** is illustrated in FIG. **4**A for mounting in a vehicle trunk as illustrated in FIG. **4**. The chemical sensor **250** is designed to measure carbon dioxide concentration through the mass loading effects as described in U.S. Pat. No. 4,895,017, which is incorporated by reference herein, with a polymer coating selected that is sensitive to carbon dioxide. The speed of the surface acoustic wave is a function of the carbon dioxide level in the atmosphere. Section **252** of the chemical sensor **250** contains a coating of such a polymer and the acoustic velocity in this section is a measure of the carbon dioxide concentration. Temperature effects are eliminated through a comparison of the sonic velocities in sections **251** and **252** as described above.

Thus, when trunk lid **260** is closed and a source of carbon dioxide such as a child or animal is trapped within the trunk, the chemical sensor **250** will provide information indicating the presence of the carbon dioxide producing object to the interrogator which can then release the trunk lock permitting trunk to automatically open. In this manner, the problem of children and animals suffocating in closed trunks is eliminated. Alternately, information that a person or animal is trapped in a trunk can be sent by the telematics system to law enforcement authorities or other location remote from the vehicle.

A similar device can be distributed at various locations within the passenger compartment of vehicle along with a combined temperature sensor. If the car has been left with a child or other animal while owner is shopping, for example, and if the temperature rises within the vehicle to an unsafe level or, alternately, if the temperature drops below an unsafe level, then the vehicle can be signaled to take appropriate action which may involve opening the windows or starting the vehicle with either air conditioning or heating as appropriate. Alternately, information that a person or animal is trapped within a vehicle can be sent by the telematics system to law enforcement authorities or other location remote from the vehicle. Thus, through these simple wireless powerless sensors, the problem of suffocation either from lack of oxygen or death from excessive heat or cold can all be solved in a simple, low-cost manner through using an interrogator as disclosed in the current assignee's U.S. patent application Ser. No. 10/079,065 incorporated by reference herein in its entirety.

Additionally, a sensitive layer on a SAW can be made to be sensitive to other chemicals such as water vapor for humidity control or alcohol for drunk driving control. Similarly, the sensitive layer can be designed to be sensitive to carbon monoxide thereby preventing carbon monoxide poisoning. Many other chemicals can be sensed for specific applications such as to check for chemical leaks in commercial vehicles, for example. Whenever such a sensor system determines that a dangerous situation is developing, an alarm can be sounded and/or the situation can be automatically communicated to an off vehicle location through telematics, a cell phone such as a 911 call, the Internet or though a subscriber service such as OnStar®.

Described above is a system for determining the status of occupants in a vehicle, and in the event of an accident or at any other appropriate time, transmitting the status of the occupants, and optionally additional information, via a communications channel or link to a remote monitoring facility. In addition to the status of the occupant, it is also important to be able to analyze the operating conditions of the vehicle and detect when a component of the vehicle is about to fail. By notifying the driver of the impending failure of the component, appropriate corrective action can be taken to avoid such failure.

The operating conditions of the vehicle can also be transmitted along with the status of the occupants to a remote monitoring facility. The operating conditions of the vehicle include whether the motor is running and whether the vehicle is moving. Thus, in a general embodiment in which information on both occupancy of the vehicle and the operating conditions of the vehicle are transmitted, one or more properties or characteristics of occupancy of the vehicle are determined, such constituting information about the occupancy of the vehicle, and one or more states of the vehicle or of a component of the vehicle is determined, such constituting information about the operation of the vehicle. The information about the occupancy of the vehicle and operation of the vehicle are selectively transmitted, possibly the information about occupancy to an emergency response center and the information about the vehicle to a dealer or repair facility.

Transmission of the information about the operation of the vehicle, i.e., diagnostic information, may be achieved via a satellite and/or via the Internet. The vehicle would thus include appropriate electronic hardware and/or software to enable the transmission of a signal to a satellite, from where it could be re-transmitted to a remote location, and/or to enable the transmission to a web site or host computer. In the latter case, the vehicle could be assigned a domain name or e-mail address for identification or transmission origination purposes

It is important to appreciate that the preferred embodiment of the vehicle diagnostic unit described below performs the diagnosis, i.e., processes the input from the various sensors, on the vehicle using for example a processor embodying a pattern recognition technique such as a neural network. The processor thus receives data or signals from the sensors and generates an output indicative or representative of the operating conditions of the vehicle or its component. A signal could thus be generated indicative of an underinflated tire, or an overheating engine.

For the discussion below, the following terms are defined as follows:

The term "component" refers to any part or assembly of parts which is mounted to or a part of a motor vehicle and which is capable of emitting a signal representative of its operating state. The following is a partial list of general automobile and truck components, the list not being exclusive:

engine;

transmission;

brakes and associated brake assembly;

tires;

wheel;
steering wheel and steering column assembly;
water pump;
alternator;
shock absorber;
wheel mounting assembly;
radiator;
battery;
oil pump;
fuel pump;
air conditioner compressor;
differential gear;
exhaust system;
fan belts;
engine valves;
steering assembly;
vehicle suspension including shock absorbers;
vehicle wiring system; and
engine cooling fan assembly.

The term "sensor" refers to any measuring or sensing device mounted on a vehicle or any of its components including new sensors mounted in conjunction with the diagnostic module in accordance with the invention. A partial, non-exclusive list of common sensors mounted on an automobile or truck is as follows:

airbag crash sensor;
accelerometer;
microphone;
camera;
antenna, capacitance sensor or other electromagnetic wave sensor;
stress or strain sensor;
pressure sensor;
weight sensor;
magnetic field sensor;
coolant thermometer;
oil pressure sensor;
oil level sensor;
air flow meter;
voltmeter;
ammeter;
humidity sensor;
engine knock sensor;
oil turbidity sensor;
throttle position sensor;
steering wheel torque sensor;
wheel speed sensor;
tachometer;
speedometer;
other velocity sensors;
other position or displacement sensors;
oxygen sensor;
yaw, pitch and roll angular sensors;
clock;
odometer;
power steering pressure sensor;
pollution sensor;
fuel gauge;
cabin thermometer;
transmission fluid level sensor;
gyroscopes or other angular rate sensors including yaw, pitch and roll rate sensors;
coolant level sensor;
transmission fluid turbidity sensor;
break pressure sensor;
tire pressure sensor;
tire temperature sensor, and
coolant pressure sensor.

The term "signal" herein refers to any time varying output from a component including electrical, acoustic, thermal, or electromagnetic radiation, or mechanical vibration.

Sensors on a vehicle are generally designed to measure particular parameters of particular vehicle components. However, frequently these sensors also measure outputs from other vehicle components. For example, electronic airbag crash sensors currently in use contain an accelerometer for determining the accelerations of the vehicle structure so that the associated electronic circuitry of the airbag crash sensor can determine whether a vehicle is experiencing a crash of sufficient magnitude so as to require deployment of the airbag. This accelerometer continuously monitors the vibrations in the vehicle structure regardless of the source of these vibrations. If a wheel is out of balance, or if there is extensive wear of the parts of the front wheel mounting assembly, or wear in the shock absorbers, the resulting abnormal vibrations or accelerations can, in many cases, be sensed by the crash sensor accelerometer. There are other cases, however, where the sensitivity or location of the airbag crash sensor accelerometer is not appropriate and one or more additional accelerometers may be mounted onto a vehicle for the purposes of this invention. Some airbag crash sensors are not sufficiently sensitive accelerometers or have sufficient dynamic range for the purposes herein.

Every component of a vehicle emits various signals during its life. These signals can take the form of electromagnetic radiation, acoustic radiation, thermal radiation, vibrations transmitted through the vehicle structure, and voltage or current fluctuations, depending on the particular component. When a component is functioning normally, it may not emit a perceptible signal. In that case, the normal signal is no signal, i.e., the absence of a signal. In most cases, a component will emit signals that change over its life and it is these changes which contain information as to the state of the component, e.g., whether failure of the component is impending. Usually components do not fail without warning. However, most such warnings are either not perceived or if perceived are not understood by the vehicle operator until the component actually fails and, in some cases, a breakdown of the vehicle occurs. In a few years, it is expected that various roadways will have systems for automatically guiding vehicles operating thereon. Such systems have been called "smart highways" and are part of the field of intelligent transportation systems (ITS). If a vehicle operating on such a smart highway were to breakdown, serious disruption of the system could result and the safety of other users of the smart highway could be endangered.

In accordance with the invention, each of these signals emitted by the vehicle components is converted into electrical signals and then digitized (i.e., the analog signal is converted into a digital signal) to create numerical time series data which is then entered into a processor. Pattern recognition algorithms then are applied in the processor to attempt to identify and classify patterns in this time series data. For a particular component, such as a tire for example, the algorithm attempts to determine from the relevant digital data whether the tire is functioning properly or whether it requires balancing, additional air, or perhaps replacement.

Frequently, the data entered into the computer needs to be preprocessed before being analyzed by a pattern recognition algorithm. The data from a wheel speed sensor, for example, might be used as is for determining whether a particular tire is operating abnormally in the event it is unbalanced, whereas the integral of the wheel speed data over a long time period (a preprocessing step), when compared to such sensors on different wheels, might be more useful in determining whether a particular tire is going flat and therefore needs air. In some cases, the frequencies present in a set of data are a better predictor of component failures than the data itself. For example, when a motor begins to fail due to worn bearings, certain characteristic frequencies began to appear. In most cases, the vibrations arising from rotating components, such as the engine, will be normalized based on the rotational frequency as disclosed in the NASA TSP referenced above. Moreover, the identification of which component is causing vibrations present in the vehicle structure can frequently be accomplished through a frequency analysis of the data. For these cases, a Fourier transformation of the data is made prior to entry of the data into a pattern recognition algorithm. Other mathematical transformations are also made for particular pattern recognition purposes in practicing the teachings of this invention. Some of these include shifting and combining data to determine phase changes for example, differentiating the data, filtering the data, and sampling the data. Also, there exist certain more sophisticated mathematical operations that attempt to extract or highlight specific features of the data. This invention contemplates the use of a variety of these preprocessing techniques and the choice of which ones is left to the skill of the practitioner designing a particular diagnostic module.

Another technique that is contemplated for some implementations of this invention is the use of multiple accelerometers and/or microphones that will allow the system to locate the source of any measured vibrations based on the time of flight and/or triangulation techniques. Once a distributed accelerometer installation has been implemented to permit this source location, the same sensors can be used for smarter crash sensing as it will permit the determination of the location of the impact on the vehicle. Once the impact location is known, a highly tailored algorithm can be used to accurately forecast the crash severity making use of a knowledge on the force vs. crush properties of the vehicle at the impact location.

When a vehicle component begins to change its operating behavior, it is not always apparent from the particular sensors, if any, which are monitoring that component. The output from any one of these sensors can be normal even though the component is failing. By analyzing the output of a variety of sensors, however, the pending failure can be diagnosed. For example, the rate of temperature rise in the vehicle coolant, if it were monitored, might appear normal unless it were known that the vehicle was idling and not traveling down a highway at a high speed. Even the level of coolant temperature which is in the normal range could be in fact abnormal in some situations signifying a failing coolant pump, for example, but not detectable from the coolant thermometer alone.

The pending failure of some components is difficult to diagnose and sometimes the design of the component requires modification so that the diagnosis can be more readily made. A fan belt, for example, frequently begins failing by a cracking of the inner surface. The belt can be designed to provide a sonic or electrical signal when this cracking begins in a variety of ways. Similarly, coolant hoses can be designed with an intentional weak spot where failure will occur first in a controlled manner that can also cause a whistle sound as a small amount of steam exits from the hose. This whistle sound can then be sensed by a general purpose microphone, for example.

In FIG. **5**, a generalized component **800** emitting several signals which are transmitted along a variety of paths, sensed by a variety of sensors and analyzed by the diagnostic device in accordance with the invention is illustrated schematically. Component **800** is mounted to a vehicle **880** and during operation it emits a variety of signals such as acoustic **801**, electromagnetic radiation **802**, thermal radiation **803**, current and voltage fluctuations in conductor **804** and mechanical vibrations **805**. Various sensors are mounted in the vehicle to detect the signals emitted by the component **800**. These include one or more vibration sensors (accelerometers) **830**, **850** and/or gyroscopes also mounted to the vehicle, one or more acoustic sensors **810**, **851**, electromagnetic radiation sensor **815**, heat radiation sensor **820**, and voltage or current sensor **840**.

In addition, various other sensors **852**, **853** measure other parameters of other components that in some manner provide information directly or indirectly on the operation of component **800**. All of the sensors illustrated on FIG. **5** can be connected to a data bus **860**. A diagnostic module **870**, in accordance with the invention, can also be attached to the vehicle data bus **860** and receives the signals generated by the various sensors. The sensors may however be wirelessly connected to the diagnostic module **870** and be integrated into a wireless power and communications system or a combination of wired and wireless connections.

As shown in FIG. **5**, the diagnostic module **870** has access to the output data of each of the sensors that have information relative to the component **800**. This data appears as a series of numerical values each corresponding to a measured value at a specific point in time. The cumulative data from a particular sensor is called a time series of individual data points. The diagnostic module **870** compares the patterns of data received from each sensor individually, or in combination with data from other sensors, with patterns for which the diagnostic module has been trained to determine whether the component is functioning normally or abnormally.

Important to this invention is the manner in which the diagnostic module **870** determines a normal pattern from an abnormal pattern and the manner in which it decides what data to use from the vast amount of data available. This is accomplished using pattern recognition technologies such as artificial neural networks and training. The theory of neural networks including many examples can be found in several books on the subject including: (1) *Techniques And Application Of Neural Networks*, edited by Taylor, M. and Lisboa, P., Ellis Horwood, West Sussex, England, 1993; (2) *Naturally Intelligent Systems*, by Caudill, M. and Butler, C., MIT Press, Cambridge Mass., 1990; (3) J. M. Zaruda, *Introduction to Artificial Neural Systems*, West publishing Co., N.Y., 1992, (4) *Digital Neural Networks*, by Kung, S. Y., PTR Prentice Hall, Englewood Cliffs, N.J., 1993, Eberhart, R., Simpson, P., (5) Dobbins, R., *Computational Intelligence PC Tools*, Academic Press, Inc., 1996, Orlando, Fla., (6) Cristianini, N. and Shawe-Taylor, J. *An Introduction to Support Vector Machines and other kernal-based learning methods*, Cambridge University Press, Cambridge England, 2000; (7) *Proceedings of the* 2000 6th *IEEE International Workshop on Cellular Neural Networks and their Applica-*

tions (*CNNA* 2000), IEEE, Piscataway N.J.; and (8) Sinha, N. K. and Gupta, M. M. *Soft Computing & Intelligent Systems*, Academic Press 2000 San Diego, Calif., all of which are incorporated herein by reference. The neural network pattern recognition technology is one of the most developed of pattern recognition technologies. The invention described herein frequently uses combinations of neural networks to improve the pattern recognition process.

The neural network pattern recognition technology is one of the most developed of pattern recognition technologies. The neural network will be used here to illustrate one example of a pattern recognition technology but it is emphasized that this invention is not limited to neural networks. Rather, the invention may apply any known pattern recognition technology including sensor fusion and various correlation technologies. A brief description of a particular example of a neural network pattern recognition technology is set forth below.

Neural networks are constructed of processing elements known as neurons that are interconnected using information channels call interconnects. Each neuron can have multiple inputs but only one output. Each output however is usually connected to all other neurons in the next layer. The neurons in the first layer operate collectively on the input data as described in more detail below. Neural networks learn by extracting relational information from the data and the desired output. Neural networks have been applied to a wide variety of pattern recognition problems including automobile occupant sensing, speech recognition, optical character recognition, and handwriting analysis.

To train a neural network, data is provided in the form of one or more time series that represents the condition to be diagnosed as well as normal operation. As an example, the simple case of an out of balance tire will be used. Various sensors on the vehicle can be used to extract information from signals emitted by the tire such as an accelerometer, a torque sensor on the steering wheel, the pressure output of the power steering system, a tire pressure monitor or tire temperature monitor. Other sensors that might not have an obvious relationship to tire unbalance are also included such as, for example, the vehicle speed or wheel speed that can be determined from the ABS system. Data is taken from a variety of vehicles where the tires were accurately balanced under a variety of operating conditions also for cases where varying amounts of unbalance was intentionally introduced. Once the data had been collected, some degree of preprocessing or feature extraction is usually performed to reduce the total amount of data fed to the neural network. In the case of the unbalanced tire, the time period between data points might be chosen such that there are at least ten data points per revolution of the wheel. For some other application, the time period might be one minute or one millisecond.

Once the data has been collected, it is processed by a neural network-generating program, for example, if a neural network pattern recognition system is to be used. Such programs are available commercially, e.g., from NeuralWare of Pittsburgh, Pa. or from International Scientific Research, Inc., of Romeo Mich. for modular neural networks. The program proceeds in a trial and error manner until it successfully associates the various patterns representative of abnormal behavior, an unbalanced tire, with that condition. The resulting neural network can be tested to determine if some of the input data from some of the sensors, for example, can be eliminated. In this way, the engineer can determine what sensor data is relevant to a particular diagnostic problem. The program then generates an algorithm that is programmed onto a microprocessor, microcontroller, neural processor, FPGA, or DSP (herein collectively referred to as a microprocessor or processor). Such a microprocessor appears inside the diagnostic module **870** in FIG. **5**. Once trained, the neural network, as represented by the algorithm, will now recognize an unbalanced tire on a vehicle when this event occurs. At that time, when the tire is unbalanced, the diagnostic module **870** will output a message to the driver indicating that the tire should be now be balanced as described in more detail below. The message to the driver is provided by output means coupled to or incorporated within the module **870** and may be, e.g., a light on the dashboard, a vocal tone or any other recognizable indication apparatus. A similar message may also be sent to the dealer or other repair facility or remote facility.

It is important to note that there may be many neural networks involved in a total vehicle diagnostic system. These can be organized either in parallel, series, as an ensemble, cellular neural network or as a modular neural network system. In one implementation of a modular neural network, a primary neural network identifies that there is an abnormality and tries to identify the likely source. Once a choice has been made as to the likely source of the abnormality, another of a group of neural networks is called upon to determine the exact cause of the abnormality. In this manner, the neural networks are arranged in a tree pattern with each neural network trained to perform a particular pattern recognition task.

Discussions on the operation of a neural network can be found in the above references on the subject and are well understood by those skilled in the art. Neural networks are the most well known of the pattern recognition technologies based on training, although neural networks have only recently received widespread attention and have been applied to only very limited and specialized problems in motor vehicles. Other non-training based pattern recognition technologies exist, such as fuzzy logic. However, the programming required to use fuzzy logic, where the patterns must be determine by the programmer, render these systems impractical for general vehicle diagnostic problems such as described herein. Therefore, preferably the pattern recognition systems that learn by training are used herein.

The neural network is the first highly successful of what will be a variety of pattern recognition techniques based on training. There is nothing that suggests that it is the only or even the best technology. The characteristics of all of these technologies which render them applicable to this general diagnostic problem include the use of time-based input data and that they are trainable. In all cases, the pattern recognition technology learns from examples of data characteristic of normal and abnormal component operation.

A diagram of one example of a neural network used for diagnosing an unbalanced tire, for example, based on the teachings of this invention is shown in FIG. **6**. The process can be programmed to periodically test for an unbalanced tire. Since this need be done only infrequently, the same processor can be used for many such diagnostic problems. When the particular diagnostic test is run, data from the previously determined relevant sensors is preprocessed and analyzed with the neural network algorithm. For the unbalanced tire, using the data from an accelerometer for example, the digital acceleration values from the analog to digital converter in the accelerometer are entered into nodes **1** through n and the neural network algorithm compares the pattern of values on nodes **1** through n with patterns for which it has been trained as follows.

Each of the input nodes is connected to each of the second layer nodes, **h-1**,**h-2**, . . . ,**h-n**, called the hidden layer, either electrically as in the case of a neural computer, or through mathematical functions containing multiplying coefficients called weights, in the manner described in more detail in the above references. At each hidden layer node, a summation occurs of the values from each of the input layer nodes, which have been operated on by functions containing the weights, to create a node value. Similarly, the hidden layer nodes are in like manner connected to the output layer node(s), which in this example is only a single node **0** representing the decision to notify the driver, and/or a remote facility, of the unbalanced tire. During the training phase, an output node value of 1, for example, is assigned to indicate that the driver should be notified and a value of 0 is assigned to not doing so. Once again, the details of this process are described in above-referenced texts and will not be presented in detail here.

In the example above, twenty input nodes were used, five hidden layer nodes and one output layer node. In this example, only one sensor was considered and accelerations from only one direction were used. If other data from other sensors such as accelerations from the vertical or lateral directions were also used, then the number of input layer nodes would increase. Again, the theory for determining the complexity of a neural network for a particular application has been the subject of many technical papers and will not be presented in detail here. Determining the requisite complexity for the example presented here can be accomplished by those skilled in the art of neural network design.

Briefly, the neural network described above defines a method, using a pattern recognition system, of sensing an unbalanced tire and determining whether to notify the driver, and/or a remote facility, and comprises the steps of:

(a) obtaining an acceleration signal from an accelerometer mounted on a vehicle;

(b) converting the acceleration signal into a digital time series;

(c) entering the digital time series data into the input nodes of the neural network;

(d) performing a mathematical operation on the data from each of the input nodes and inputting the operated on data into a second series of nodes wherein the operation performed on each of the input node data prior to inputting the operated on value to a second series node is different from that operation performed on some other input node data;

(e) combining the operated on data from all of the input nodes into each second series node to form a value at each second series node;

(f) performing a mathematical operation on each of the values on the second series of nodes and inputting this operated on data into an output series of nodes wherein the operation performed on each of the second series node data prior to inputting the operated on value to an output series node is different from that operation performed on some other second series node data;

(g) combining the operated on data from all of the second series nodes into each output series node to form a value at each output series node; and,

(h) notifying a driver if the value on one output series node is within a chosen range signifying that a tire requires balancing.

This method can be generalized to a method of predicting that a component of a vehicle will fail comprising the steps of:

(a) sensing a signal emitted from the component;

(b) converting the sensed signal into a digital time series;

(c) entering the digital time series data into a pattern recognition algorithm;

(d) executing the pattern recognition algorithm to determine if there exists within the digital time series data a pattern characteristic of abnormal operation of the component; and

(e) notifying a driver and/or a remote facility if the abnormal pattern is recognized.

The particular neural network described and illustrated above contains a single series of hidden layer nodes. In some network designs, more than one hidden layer is used, although only rarely will more than two such layers appear. There are of course many other variations of the neural network architecture illustrated above which appear in the referenced literature. For the purposes herein, therefore, "neural network" will be defined as a system wherein the data to be processed is separated into discrete values which are then operated on and combined in at least a two stage process and where the operation performed on the data at each stage is in general different for each discrete value and where the operation performed is at least determined through a training process.

The implementation of neural networks can take on at least two forms, an algorithm programmed on a digital microprocessor, FPGA, DSP or in a neural computer (including a cellular neural network or support vector machine). In this regard, it is noted that neural computer chips are now becoming available.

In the example above, only a single component failure was discussed using only a single sensor since the data from the single sensor contains a pattern which the neural network was trained to recognize as either normal operation of the component or abnormal operation of the component. The diagnostic module **870** contains preprocessing and neural network algorithms for a number of component failures. The neural network algorithms are generally relatively simple, requiring only a relatively small number of lines of computer code. A single general neural network program can be used for multiple pattern recognition cases by specifying different coefficients for the various terms, one set for each application. Thus, adding different diagnostic checks has only a small affect on the cost of the system. Also, the system has available to it all of the information available on the data bus. During the training process, the pattern recognition program sorts out from the available vehicle data on the data bus or from other sources, those patterns that predict failure of a particular component.

In FIG. **7**, a schematic of a vehicle with several components and several sensors is shown in their approximate locations on a vehicle along with a total vehicle diagnostic system in accordance with the invention utilizing a diagnostic module in accordance with the invention. A flow diagram of information passing from the various sensors shown in FIG. **7** onto the vehicle data bus and thereby into the diagnostic device in accordance with the invention is shown in FIG. **8** along with outputs to a display for notifying the driver and to the vehicle cellular phone, or other communication device, for notifying the dealer, vehicle manufacturer or other entity concerned with the failure of a component in the vehicle. If the vehicle is operating on a smart highway, for example, the pending component failure information may also be communicated to a highway control system and/or to other vehicles in the vicinity so that an orderly exiting of the vehicle from the smart highway can be facilitated. FIG. **8** also contains the names of the sensors shown numbered on FIG. **7**.

Sensor **901** is a crash sensor having an accelerometer (alternately one or more dedicated accelerometers **931** can be used), sensor **902** is represents one or more microphones, sensor **903** is a coolant thermometer, sensor **904** is an oil pressure sensor, sensor **905** is an oil level sensor, sensor **906** is an air flow meter, sensor **907** is a voltmeter, sensor **908** is an ammeter, sensor **909** is a humidity sensor, sensor **910** is an engine knock sensor, sensor **911** is an oil turbidity sensor, sensor **912** is a throttle position sensor, sensor **913** is a steering torque sensor, sensor **914** is a wheel speed sensor, sensor **915** is a tachometer, sensor **916** is a speedometer, sensor **917** is an oxygen sensor, sensor **918** is a pitch/roll sensor, sensor **919** is a clock, sensor **920** is an odometer, sensor **921** is a power steering pressure sensor, sensor **922** is a pollution sensor, sensor **923** is a fuel gauge, sensor **924** is a cabin thermometer, sensor **925** is a transmission fluid level sensor, sensor **926** is a yaw sensor, sensor **927** is a coolant level sensor, sensor **928** is a transmission fluid turbidity sensor, sensor **929** is brake pressure sensor and sensor **930** is a coolant pressure sensor. Other possible sensors include a temperature transducer, a pressure transducer, a liquid level sensor, a flow meter, a position sensor, a velocity sensor, a RPM sensor, a chemical sensor and an angle sensor, angular rate sensor or gyroscope.

If a distributed group of acceleration sensors or accelerometers are used to permit a determination of the location of a vibration source, the same group can, in some cases, also be used to measure the pitch, yaw and/or roll of the vehicle eliminating the need for dedicated angular rate sensors. In addition, as mentioned above, such a suite of sensors can also be used to determine the location and severity of a vehicle crash and additionally to determine that the vehicle is on the verge of rolling over. Thus, the same suite of accelerometers optimally performs a variety of functions including inertial navigation, crash sensing, vehicle diagnostics, roll over sensing etc.

Consider now some examples. The following is a partial list of potential component failures and the sensors from the list on FIG. **8** that might provide information to predict the failure of the component:

Out of balance tires	901,913,914,915,920,921
Front end out of alignment	901,913,921,926
Tune up required	901,903,910,912,915,917,920,922
Oil change needed	903,904,905,911
Motor failure	901,902,903,904,905,906,910,912,915,917,922
Low tire pressure	901,913,914,915,920,921
Front end looseness	901,913,916,921,926
Cooling system failure	903,915,924,927,930
Alternator problems	901,902,907,908,915,919,920
Transmission problems	901,903,912,915,916,920,925,928
Differential problems	901,912,914
Brakes	901,902,914,918,920,926,929
Catalytic converter and muffler	901,902,912,915,922
Ignition	901,902,907,908,909,910,912,917,923
Tire wear	901,913,914,915,918,920,921,926
Fuel leakage	920,923
Fan belt slippage	901,902,903,907,908,912,915,919,920
Alternator deterioration	901,902,907,908,915,919
Coolant pump failure	901,902,903,924,927,930
Coolant hose failure	901,902,903,927,930
Starter failure	901,902,907,908,909,912,915
Dirty air filter	902,903,906,911,912,917,922

Several interesting facts can be deduced from a review of the above list. First, all of the failure modes listed can be at least partially sensed by multiple sensors. In many cases, some of the sensors merely add information to aid in the interpretation of signals received from other sensors. In today's automobile, there are few if any cases where multiple sensors are used to diagnose or predict a problem. In fact, there is virtually no failure prediction undertaken at all. Second, many of the failure modes listed require information from more than one sensor. Third, information for many of the failure modes listed cannot be obtained by observing one data point in time as is now done by most vehicle sensors. Usually an analysis of the variation in a parameter as a function of time is necessary. In fact, the association of data with time to create a temporal pattern for use in diagnosing component failures in automobile is unique to this invention as in the combination of several such temporal patterns. Fourth, the vibration measuring capability of the airbag crash sensor, or other accelerometer, is useful for most of the cases discussed above yet there is no such current use of accelerometers. The airbag crash sensor is used only to detect crashes of the vehicle. Fifth, the second most used sensor in the above list, a microphone, does not currently appear on any automobiles yet sound is the signal most often used by vehicle operators and mechanics to diagnose vehicle problems. Another sensor that is listed above which also does not currently appear on automobiles is a pollution sensor. This is typically a chemical sensor mounted in the exhaust system for detecting emissions from the vehicle. It is expected that this and other chemical sensors will be used more in the future.

In addition, from the foregoing depiction of different sensors which receive signals from a plurality of components, it is possible for a single sensor to receive and output signals from a plurality of components which are then analyzed by the processor to determine if any one of the components for which the received signals were obtained by that sensor is operating in an abnormal state. Likewise, it is also possible to provide for a multiplicity of sensors each receiving a different signal related to a specific component which are then analyzed by the processor to determine if that component is operating in an abnormal state. Note that neural networks can simultaneously analyze data from multiple sensors of the same type or different types.

The discussion above has centered on notifying the vehicle operator of a pending problem with a vehicle component. Today, there is great competition in the automobile marketplace and the manufacturers and dealers who are most responsive to customers are likely to benefit by increased sales both from repeat purchasers and new customers. The diagnostic module disclosed herein benefits the dealer by making him instantly aware, through the cellular telephone system, or other communication link, coupled to the diagnostic module or system in accordance with the invention, when a component is likely to fail. As envisioned, on some automobiles, when the diagnostic module **870** detects a potential failure it not only notifies the driver through a display **980**, but also automatically notifies the dealer through a vehicle cellular phone **990** or other telematics communication link. The dealer can thus contact the vehicle owner and schedule an appointment to undertake the necessary repair at each party's mutual convenience. Contact by the dealer to the vehicle owner can occur as the owner is driving the vehicle, using a communications device. Thus, the dealer can, contact the driver and informed him of their mutual knowledge of the problem and discuss scheduling maintenance to attend to the problem. The customer is pleased since a potential vehicle breakdown has been avoided and the dealer is pleased since he is likely to perform the repair work. The vehicle manufacturer also benefits by early and accurate statistics on the failure rate of vehicle components. This early warning system can reduce the cost of a potential recall for components having design defects. It could even have saved lives if such a system had been in place during the Firestone tire failure problem mentioned above. The vehicle manufacturer will thus be guided toward producing higher quality vehicles thus improving his competitiveness. Finally, experience with this system will actually lead to a reduction in the number of sensors on the vehicle since only those sensors that are successful in predicting failures will be necessary.

For most cases, it is sufficient to notify a driver that a component is about to fail through a warning display. In some critical cases, action beyond warning the driver may be required. If, for example, the diagnostic module detected that the alternator was beginning to fail, in addition to warning the driver of this eventuality, the module could send a signal to another vehicle system to turn off all non-essential devices which use electricity thereby conserving electrical energy and maximizing the time and distance that the vehicle can travel before exhausting the energy in the battery. Additionally, this system can be coupled to a system such as OnStar*) or a vehicle route guidance system, and the driver can be guided to the nearest open repair facility or a facility of his or her choice.

In the discussion above, the diagnostic module of this invention assumes that a vehicle data bus exists which is used by all of the relevant sensors on the vehicle. Most vehicles today do not have a data bus although it is widely believed that most vehicles will have one in the near future. Naturally, the relevant signals can be transmitted to the diagnostic module through a variety of coupling means other than through a data bus and this invention is not limited to vehicles having a data bus. For example, the data can be sent wirelessly to the diagnostic module using the Bluetooth™ specification. In some cases, even the sensors do not have to be wired and can obtain their power via RF from the interrogator as is well known in the RFID—radio frequency identification (either silicon or surface acoustic wave (SAW) based)) field. Alternately an inductive or capacitive power transfer system can be used.

As can be appreciated from the above discussion, the invention described herein brings several new improvements to automobiles including, but not limited to, the use of pattern recognition technologies to diagnose potential vehicle component failures, the use of trainable systems thereby eliminating the need of complex and extensive programming, the simultaneous use of multiple sensors to monitor a particular component, the use of a single sensor to monitor the operation of many vehicle components, the monitoring of vehicle components which have no dedicated sensors, and the notification of both the driver and possibly an outside entity of a potential component failure in time so that the failure can be averted and vehicle breakdowns substantially eliminated. Additionally, improvements to the vehicle stability, crash avoidance, crash anticipation and occupant protection are available.

To implement a component diagnostic system for diagnosing the component utilizing a plurality of sensors not directly associated with the component, i.e., independent of the component, a series of tests are conducted. For each test, the signals received from the sensors are input into a pattern recognition training algorithm with an indication of whether the component is operating normally or abnormally (the component being intentionally altered to provide for abnormal operation). The data from the test are used to generate the pattern recognition algorithm, e.g., neural network, so that in use, the data from the sensors is input into the algorithm and the algorithm provides an indication of abnormal or normal operation of the component. Also, to provide a more versatile diagnostic module for use in conjunction with diagnosing abnormal operation of multiple components, tests may be conducted in which each component is operated abnormally while the other components are operating normally, as well as tests in which two or more components are operating abnormally. In this manner, the diagnostic module may be able to determine based on one set of signals from the sensors during use that either a single component or multiple components are operating abnormally.

Furthermore, the pattern recognition algorithm may be trained based on patterns within the signals from the sensors. Thus, by means of a single sensor, it would be possible to determine whether one or more components are operating abnormally. To obtain such a pattern recognition algorithm, tests are conducted using a single sensor, such as a microphone, and causing abnormal operation of one or more components, each component operating abnormally while the other components operate normally and multiple components operating abnormally. In this manner, in use, the pattern recognition algorithm may analyze a signal from a single sensor and determine abnormal operation of one or more components. Note that in some cases, simulations can be used to analytically generate the relevant data.

The invention is also particularly useful in light of the foreseeable implementation of smart highways. Smart highways will result in vehicles traveling down highways under partial or complete control of an automatic system, i.e., not being controlled by the driver. The on-board diagnostic system will thus be able to determine failure of a component prior to or upon failure thereof and inform the vehicle's guidance system to cause the vehicle to move out of the stream of traffic, i.e., onto a shoulder of the highway, in a safe and orderly manner. Moreover, the diagnostic system may be controlled or programmed to prevent the movement of the disabled vehicle back into the stream of traffic until the repair of the component is satisfactorily completed.

In a method in accordance with this embodiment, the operation of the component would be monitored and if abnormal operation of the component is detected, e.g., by any of the methods and apparatus disclosed herein (although other component failure systems may of course be used in this implementation), the guidance system of the vehicle which controls the movement of the vehicle would be notified, e.g., via a signal from the diagnostic module to the guidance system, and the guidance system would be programmed to move the vehicle out of the stream of traffic, or off of the restricted roadway, possibly to a service station or dealer, upon reception of the particular signal from the diagnostic module. The automatic guidance systems for vehicles traveling on highways may be any existing system or system being developed, such as one based on satellite positioning techniques or ground-based positioning techniques. Since the guidance system may be programmed to ascertain the vehicle's position on the highway, it can determine the vehicle's current position, the nearest location out of the stream of traffic, or off of the restricted roadway, such as an appropriate shoulder or exit to which the vehicle may be moved, and the path of movement of the vehicle from the current position to the location out of the stream of traffic, or off of the restricted roadway. The vehicle may thus be moved along this path under the control of the automatic guidance system. In the alternative, the path may be displayed to a driver and the driver can follow the path, i.e., manually control the vehicle. The diagnostic module and/or guidance system may be designed to prevent re-entry of the vehicle into the stream of traffic, or off of the restricted roadway, until the abnormal operation of the component is satisfactorily addressed.

FIG. **9** is a flow chart of some of the methods for directing a vehicle off of a roadway if a component is operating abnormally. The component's operation is monitored at **440** and a determination is made at **442** whether its operation is abnormal. If not, the operation of the component is monitored further. If the operation of the component is abnormal, the vehicle can be directed off the roadway at **444**. More particularly, this can be accomplished by generating a signal indicating the abnormal operation of the component at **446**, directing this signal to a guidance system in the vehicle at **448** that guides movement of the vehicle off of the roadway at **450**. Also, if the component is operating abnormally, the current position of the vehicle and the location of a site off of the roadway can be determined at **452**, e.g., using satellite-based or ground-based location determining techniques, a path from the current location to the off-roadway location determined at **454** and then the vehicle directed along this path at **456**. Periodically, a determination is made at **458** whether the component's abnormality has been satisfactorily addressed and/or corrected and if so, the vehicle can re-enter the roadway and operation of the component begins again. If not, the re-entry of the vehicle onto the roadway is prevented at **460**.

FIG. **10** schematically shows the basic components for performing this method, i.e., a component operation monitoring system **462** (such as described above), an optional satellite-based or ground-based positioning system **464** and a vehicle guidance system **466**.

FIG. **11** illustrates the placement of a variety of sensors, primarily accelerometers and/or gyroscopes, which can be used to diagnose the state of the vehicle itself. Sensor **202** can be located in the headliner or attached to the vehicle roof above the side door. Typically, there can be two such sensors one on either side of the vehicle. Sensor **203** is shown in a typical mounting location midway between the sides of the vehicle attached to or near the vehicle roof above the rear window. Sensor **206** is shown in a typical mounting location in the vehicle trunk adjacent the rear of the vehicle. Either one, two or three such sensors can be used depending on the application. If three such sensors are use one would be adjacent each side of vehicle and one in the center. Sensor **204** is shown in a typical mounting location in the vehicle door and sensor **205** is shown in a typical mounting location on the sill or floor below the door. Sensor **207**, which can be also multiple sensors, is shown in a typical mounting location forward in the crush zone of the vehicle. Finally, sensor **208** can measure the acceleration of the firewall or instrument panel and is located thereon generally midway between the two sides of the vehicle. If three such sensors are used, one would be adjacent each vehicle side and one in the center.

In general, sensors **202–208** provide a measurement of the state of the vehicle, such as its velocity, acceleration, angular orientation or temperature, or a state of the location at which the sensor is mounted. Thus, measurements related to the state of the sensor would include measurements of the acceleration of the sensor, measurements of the temperature of the mounting location as well as changes in the state of the sensor and rates of changes of the state of the sensor. As such, any described use or function of the sensors **202–208** above is merely exemplary and is not intended to limit the form of the sensor or its function.

Each of the sensors **202–208** may be single axis, double axis or triaxial accelerometers and/or gyroscopes typically of the MEMS type. These sensors **202–208** can either be wired to the central control module or processor directly wherein they would receive power and transmit information, or they could be connected onto the vehicle bus or, in some cases, using RFID, SAW or similar technology, the sensors can be wireless and would receive their power through RF from one or more interrogators located in the vehicle. In this case, the interrogators can be connected either to the vehicle bus or directly to control module. Alternately, an inductive or capacitive power and information transfer system can be used.

One particular implementation will now be described. In this case, each of the sensors **202–208** is a single or dual axis accelerometer. They are made using silicon micromachined technology such as disclosed in U.S. Pat. Nos. 5,121,180 and 5,894,090. These are only representative patents of these devices and there exist more than 100 other relevant U.S. patents describing this technology. Commercially available MEMS gyroscopes such as from Systron Doner have accuracies of approximately one degree per second. In contrast, optical gyroscopes typically have accuracies of approximately one degree per hour. Unfortunately, the optical gyroscopes are prohibitively expensive for automotive applications. On the other hand, typical MEMS gyroscopes are not sufficiently accurate for many control applications.

The angular rate function can be obtained through placing accelerometers at two separated, non-co-located points in a vehicle and using the differential acceleration to obtain an indication of angular motion and angular acceleration. From the variety of accelerometers shown on FIG. **11**, it can be appreciated that not only will all accelerations of key parts of the vehicle be determined, but the pitch, yaw and roll angular rates can also be determined based on the accuracy of the accelerometers. By this method, low cost systems can be developed which, although not as accurate as the optical gyroscopes, are considerably more accurate than conventional MEMS gyroscopes. Alternately, it has been found that from a single package containing up to three low cost MEMS gyroscopes and three low cost MEMS accelerometers, when carefully calibrated, an accurate inertial measurement unit (IMU) can be constructed that performs as well as units costing a great deal more. Such a package is sold by Crossbow Technology, Inc. 41 Daggett Dr., San Jose, Calif. 95134. If this IMU is combined with a GPS system and sometimes other vehicle sensor inputs using a Kalman filter, accuracy approaching that of expensive military units can be achieved.

Instead of using two accelerometers at separate locations on the vehicle, a single conformal MEMS-IDT gyroscope may be used. Such a conformal MEMS-IDT gyroscope is described in a paper by V. K. Karadan, Conformal MEMS-IDT Gyroscopes and Their Comparison With Fiber Optic Gyro, incorporated in its entirety herein. The MEMS-IDT gyroscope is based on the principle of surface acoustic wave (SAW) standing waves on a piezoelectric substrate. A surface acoustic wave resonator is used to create standing waves inside a cavity and the particles at the anti-nodes of the standing waves experience large amplitude of vibrations, which serves as the reference vibrating motion for the gyroscope. Arrays of metallic dots are positioned at the anti-node locations so that the effect of Coriolis force due to rotation will acoustically amplify the magnitude of the waves. Unlike other MEMS gyroscopes, the MEMS-IDT gyroscope has a planar configuration with no suspended resonating mechanical structures. Other SAW-based gyroscopes are also now under development.

The system of FIG. **11** using dual axis accelerometers, or the IMU Kalman filter system, therefore provides a complete diagnostic system of the vehicle itself and its dynamic motion. Such a system is far more accurate than any system currently available in the automotive market. This system provides very accurate crash discrimination since the exact location of the crash can be determined and, coupled with a knowledge of the force deflection characteristics of the vehicle at the accident impact site, an accurate determination of the crash severity and thus the need for occupant restraint deployment can be made. Similarly, the tendency of a vehicle to roll over can be predicted in advance and signals sent to the vehicle steering, braking and throttle systems to attempt to ameliorate the rollover situation or prevent it. In the event that it cannot be prevented, the deployment side curtain airbags can be initiated in a timely manner.

Similarly, the tendency of the vehicle to the slide or skid can be considerably more accurately determined and again the steering, braking and throttle systems commanded to minimize the unstable vehicle behavior.

Thus, through the sample deployment of inexpensive accelerometers at a variety of locations in the vehicle, or the IMU Kalman filter system significant improvements are made in the vehicle stability control, crash sensing, rollover sensing, and resulting occupant protection technologies.

Finally, as mentioned above, the combination of the outputs from these accelerometer sensors and the output of strain gage weight sensors in a vehicle seat, or in or on a support structure of the seat, can be used to make an accurate assessment of the occupancy of the seat and differentiate between animate and inanimate occupants as well as determining where in the seat the occupants are sitting. This can be done by observing the acceleration signals from the sensors of FIG. 11 and simultaneously the dynamic strain gage measurements from seat mounted strain gages. The accelerometers provide the input function to the seat and the strain gages measure the reaction of the occupying item to the vehicle acceleration and thereby provide a method of determining dynamically the mass of the occupying item and its location. This is particularly important during occupant position sensing during a crash event. By combining the outputs of the accelerometers and the strain gages and appropriately processing the same, the mass and weight of an object occupying the seat can be determined as well as the gross motion of such an object so that an assessment can be made as to whether the object is a life form such as a human being.

For this embodiment, sensor **209** represents one or more strain gage weight sensors mounted on the seat or in connection with the seat or its support structure. Suitable mounting locations and forms of weight sensors are discussed in the current assignee's U.S. patent application Ser. No. 09/193,209 and contemplated for use in this invention as well. The mass or weight of the occupying item of the seat can thus be measured based on the dynamic measurement of the strain gages with optional consideration of the measurements of accelerometers on the vehicle, which are represented by any of sensors **202–208**.

FIG. **12** shows a schematic of the integration of the occupant sensing with a telematics link and the vehicle diagnosis with a telematics link. As envisioned, the occupant sensing system **1000** includes those components which determine the presence, position, health state, and other information relating to the occupants, for example the transducers discussed above with reference to FIGS. **1–3** and the SAW device discussed above with reference to FIG. **4**. Information relating to the occupants includes information as to what the driver is doing, talking on the phone, communicating with OnStar® or other route guidance, listening to the radio, sleeping, drunk, drugged, having a heart attack The occupant sensing system may also be any of those systems and apparatus described in any of the current assignee's above-referenced patents and patent applications incorporated by reference herein, or any other comparable occupant sensing system which performs any or all of the same functions as they relate to occupant sensing. Examples of sensors which might be installed on a vehicle and constitute the occupant sensing system include heartbeat sensors, motion sensors, weight sensors, microphones and optical sensors.

A crash sensor **1002** is provided and determines when the vehicle experiences a crash. Crash sensor **1002** may be any type of crash sensor.

Vehicle sensors **1004** include sensors which detect the operating conditions of the vehicle such as those sensors discussed with reference to FIGS. **4–8** above. Also included are tire sensors such as disclosed in U.S. patent application Ser. No. 10/079,065. Other examples include velocity and acceleration sensors, and angular and angular rate pitch, roll and yaw sensors. Of particular importance are sensors that tell what the car is doing: speed, skidding, sliding, location, communicating with other cars or the infrastructure, etc.

Environment sensors **1006** includes sensors which provide data to the operating environment of the vehicle, e.g., the inside and outside temperatures, the time of day, the location of the sun and lights, the locations of other vehicles, rain, snow, sleet, visibility (fog), general road condition information, pot holes, ice, snow cover, road visibility, assessment of traffic, video pictures of an accident, etc. Possible sensors include optical sensors which obtain images of the environment surrounding the vehicle, blind spot detectors which provides data on the blind spot of the driver, automatic cruise control sensors that can provide images of vehicles in front of the host vehicle, various radar devices which provide the position of other vehicles and objects relative to the subject vehicle.

The occupant sensing system **1000**, crash sensors **1002**, vehicle sensors **1004**, environment sensors **1006** all are coupled to a communications device **1008** which may contain a memory unit and appropriate electrical hardware to communicate with all of the sensors, process data from the sensors, and transmit data from the sensors. The memory unit would be useful to store data from the sensors, updated periodically, so that such information could be transmitted at set time intervals.

The communications device **308** can be designed to transmit information to any number of different types of facilities. For example, the communications device **1008** would be designed to transmit information to an emergency response facility **1010** in the event of an accident involving the vehicle. The transmission of the information would be triggered by a signal from the crash sensor **1002** that the vehicle was experiencing a crash or experienced a crash. The information transmitted would come from the occupant sensing system **1000** so that the emergency response could be tailored to the status of the occupants. For example, if the vehicle was determined to have ten occupants, multiple ambulances might be sent than if the vehicle contained only a single occupant. Also, if the occupants are determined not be breathing, then a higher priority call with living survivors might receive assistance first. As such, the information from the occupant sensing system **1000** would be used to prioritize the duties of the emergency response personnel.

Information from the vehicle sensors **1004** and environment sensors **1006** could also be transmitted to law enforcement authorities **1014** in the event of an accident so that the cause(s) of the accident could be determined. Such information can also include information from the occupant sensing system **1000**, which might reveal that the driver was talking on the phone, putting on make-up, or another distracting activity, information from the vehicle sensors **1004** which might reveal a problem with the vehicle, and information from the environment sensors **1006** which might reveal the existence of slippery roads, dense fog and the like.

Information from the occupant sensing system **1000**, vehicle sensors **1004** and environment sensors **1006** could also be transmitted to the vehicle manufacturer **1016** in the event of an accident so that a determination can be made as to whether failure of a component of the vehicle causes or contributed to the cause of the accident. For example, the vehicle sensors might determine that the tire pressure was too low so that advice can be disseminated to avoid maintaining the tire pressure too low in order to avoid an accident. Information from the vehicle sensors **1004** relating to component failure could be transmitted to a dealer/repair facility **1012** which could schedule maintenance to correct the problem.

The communications device **1008** could be designed to transmit particular information to each site, i.e., only information important to be considered by the personnel at that site. For example, the emergency response personnel have no need for the fact that the tire pressure was too low but such information is important to the law enforcement authorities **1014** (for the possible purpose of issuing a recall of the tire and/or vehicle) and the vehicle manufacturer **1016**.

The communication device can be a cellular phone, OnStar® or other subscriber-based telematics system, a peer-to-peer vehicle communication system that eventually communicates to the infrastructure and then, perhaps, to the Internet with email to the dealer, manufacturer, vehicle owner, law enforcement authorities or others. It can also be a vehicle to LEO or Geostationary satellite system such as SkyBytes which can then forward the information to the appropriate facility either directly or through the Internet.

The communication may need to be secret so as not to violate the privacy of the occupants and thus encrypted communication may in many cases be required. Other innovations described herein include the transmission of any video data from a vehicle to another vehicle or to a facility remote from the vehicle by any means such as a telematics communication system such as OnStar®, a cellular phone system, a communication via GEO, geocentric or other satellite system and any communication that communicates the results of a pattern recognition system analysis. Also, any communication from a vehicle that combines sensor information with location information.

When optical sensors are provided as part of the occupant sensing system **1000**, video conferencing becomes a possibility, whether or not the vehicle experiences a crash. That is, the occupants of the vehicle can engage in a video conference with people at another location **1018** via establishment of a communications channel by the communications device **1008**.

The vehicle diagnostic system described above using a telematics link can transmit information from any type of sensors on the vehicle.

In one particular use of the invention, a wireless sensing and communication system is provided whereby the information or data obtained through processing of input from sensors of the wireless sensing and communication system is further transmitted for reception by a remote facility. Thus, in such a construction, there is an intra-vehicle communications between the sensors on the vehicle and a processing system (control module, computer or the like) and remote communications between the same or a coupled processing system (control module, computer or the like). The electronic components for the intra-vehicle communication may be designed to transmit and receive signals over short distances whereas the electronic components which enable remote communications should be designed to transmit and receive signals over relatively long distances.

The wireless sensing and communication system includes sensors that are located on the vehicle or in the vicinity of the vehicle and which provide information which is transmitted to one or more interrogators in the vehicle by wireless radio frequency means, using wireless radio frequency transmission technology. In some cases, the power to operate a particular sensor is supplied by the interrogator while in other cases, the sensor is independently connected to either a battery, generator, vehicle power source or some source of power external to the vehicle.

The sensors for a system installed in a vehicle would likely include tire pressure, temperature and acceleration monitoring sensors, weight or load measuring sensors, switches, temperature, acceleration, angular position, angular rate, angular acceleration, proximity, rollover, occupant presence, humidity, presence of fluids or gases, strain, road condition and friction, chemical sensors and other similar sensors providing information to a vehicle system, vehicle operator or external site. The sensors can provide information about the vehicle and its interior or exterior environment, about individual components, systems, vehicle occupants, subsystems, or about the roadway, ambient atmosphere, travel conditions and external objects.

The system can use one or more interrogators each having one or more antennas that transmit radio frequency energy to the sensors and receive modulated radio frequency signals from the sensors containing sensor and/or identification information. One interrogator can be used for sensing multiple switches or other devices. For example, an interrogator may transmit a chirp form of energy at 905 MHz to 925 MHz to a variety of sensors located within or in the vicinity of the vehicle. These sensors may be of the RFID electronic type or of the surface acoustic wave (SAW) type. In the electronic type, information can be returned immediately to the interrogator in the form of a modulated RF signal. In the case of SAW devices, the information can be returned after a delay. Naturally, one sensor can respond in both the electronic and SAW delayed modes.

When multiple sensors are interrogated using the same technology, the returned signals from the various sensors can be time, code, space or frequency multiplexed. For example, for the case of the SAW technology, each sensor can be provided with a different delay. Alternately, each sensor can be designed to respond only to a single frequency or several frequencies. The radio frequency can be amplitude or frequency modulated. Space multiplexing can be achieved through the use of two or more antennas and correlating the received signals to isolate signals based on direction.

In many cases, the sensors will respond with an identification signal followed by or preceded by information relating to the sensed value, state and/or property. In the case of a SAW-based switch, for example, the returned signal may indicate that the switch is either on or off or, in some cases, an intermediate state can be provided signifying that a light should be dimmed, rather than or on or off, for example.

Great economies are achieved by using a single interrogator or even a small number of interrogators to interrogate many types of devices. For example, a single interrogator may monitor tire pressure and temperature, the weight of an occupying item of the seat, the position of the seat and seatback, as well as a variety of switches controlling windows, door locks, seat position, etc. in a vehicle. Such an interrogator may use one or multiple antennas and when multiple antennas are used, may switch between the antennas depending on what is being monitored.

More particularly, the tire monitoring system of this invention actually comprises three separate systems corresponding to three stages of product evolution. Generation **1** is a tire valve cap that provides information as to the pressure within the tire as described below. Generation **2** requires the replacement of the tire valve stem, or the addition of a new stem-like device, with a new valve stem that also measures temperature and pressure within the tire or it may be a device that attaches to the vehicle wheel rim. Generation **3** is a product that is attached to the inside of the tire adjacent the tread and provides a measure of the diameter of the footprint between the tire and the road, the tire pressure and temperature, indications of tire wear and, in some cases, the coefficient of friction between the tire and the road.

Surface acoustic wave technology permits the measurement of many physical and chemical parameters without the requirement of local power or energy. Rather, the energy to run devices can be obtained from radio frequency electromagnetic waves. These waves excite an antenna that is coupled to the SAW device. Through various means, the properties of the acoustic waves on the surface of the SAW device are modified as a function of the variable to be measured. The SAW device belongs to the field of microelectromechanical systems (MEMS) and can be produced in high-volume at low cost.

For the generation **1** system, a valve cap contains a SAW material at the end of the valve cap, which may be polymer covered. This device senses the absolute pressure in the valve cap. Upon attaching the valve cap to the valve stem, a depressing member gradually depresses the valve permitting the air pressure inside the tire to communicate with a small volume inside the valve cap. As the valve cap is screwed onto the valve stem, a seal prevents the escape of air to the atmosphere. The SAW device is electrically connected to the valve cap, which is also electrically connected to the valve stem that acts as an antenna for transmitting and receiving radio frequency waves. An interrogator located within 20 feet of the tire periodically transmits radio waves that power the SAW device. The SAW device measures the absolute pressure in the valve cap that is equal to the pressure in the tire. U.S. Pat. Nos. 5,641,902, 5,819,779 and 4,103,549 illustrate a valve cap pressure sensor where a visual output is provided. Other related prior art includes U.S. Pat. No. 4,545,246.

The generation **2** system permits the measurement of both the tire pressure and tire temperature. In this case, the tire valve stem is removed and replaced with a new tire valve stem that contains a SAW device attached at the bottom of the valve stem. This device actually contains two SAW devices, one for measuring temperature and the second for measuring pressure through a novel technology discussed below. This second generation device therefore permits the measurement of both the pressure and the temperature inside the tire. Alternately, this device can be mounted inside the tire, attached to the rim or attached to another suitable location. An external pressure sensor is mounted in the interrogator to measure the pressure of the atmosphere to compensate for altitude and/or barometric changes.

The generation **3** device contains a pressure and temperature sensor, as in the case of the generation **2** device, but additionally contains one or more accelerometers which measure at least one component of the acceleration of the vehicle tire tread adjacent the device. This acceleration varies in a known manner as the device travels in an approximate circle attached to the wheel. This device is capable of determining when the tread adjacent the device is in contact with road surface. It is also able to measure the coefficient of friction between the tire and the road surface. In this manner, it is capable of measuring the length of time that this tread portion is in contact with the road and thereby provides a measure of the diameter of the tire footprint on the road. A technical discussion of the operating principle of a tire inflation and load detector based on flat area detection follows:

When tires are inflated and not in contact with the ground, the internal pressure is balanced by the circumferential tension in the fibers of the shell. Static equilibrium demands that tension is equal to the radius of curvature multiplied by the difference between the internal and the external gas pressure. Tires support the weight of the automobile by changing the curvature of the part of the shell that touches the ground. The relation mentioned above is still valid. In the part of the shell that gets flattened, the radius of curvature increases while the tension in the tire structure stays the same. Therefore, the difference between the external and internal pressures becomes small to compensate for the growth of the radius. If the shell were perfectly flexible, the tire contact with the ground would develop into a flat spot with an area equal to the load divided by the pressure.

A tire operating at correct values of load and pressure has a precise signature in terms of variation of the radius of curvature in the loaded zone. More flattening indicates under-inflation or overloading, while less flattening indicates over-inflation or under-loading. Note that tire loading has essentially no effect on internal pressure.

From the above, one can conclude that monitoring the curvature of the tire as it rotates can provide a good indication of its operational state. A sensor mounted inside the tire at its largest diameter can accomplish this measurement. Preferably, the sensor would measure mechanical strain. However, a sensor measuring acceleration in any one axis could also serve the purpose.

In the case of the strain measurement, the sensor would indicate a constant strain as it spans the arc over which the tire is not in contact with the ground, and a pattern of increased stretch during the arc of close proximity with the ground. A simple ratio of the times of duration of these two states would provide a good indication of inflation, but more complex algorithms could be employed, where the values and the shape of the period of increased strain are utilized.

In the case of acceleration measurement, the system would utilize the fact that the part of the tire in contact with the ground possesses zero velocity for a finite period of time, while the rest of the tire is accelerating and decelerating in a cyclic fashion. The resulting acceleration profiles in the circumferential axis or the radial axis present a characteristic near-zero portion, the length of which, when related to the rest of the rotation, is a result of the state of tire inflation.

As an indicator of tire health, the measurement of strain on the largest inside diameter of the tire is believed to be superior to the measurement of stress, such as inflation pressure, because, the tire could be deforming, as it ages or otherwise progresses toward failure, without any changes in inflation pressure. Radial strain could also be measured on the inside of the tire sidewall thus indicating the degree of flexure that the tire undergoes.

The accelerometer approach has the advantage of giving a signature from which a harmonic analysis of once-per-revolution disturbances could indicate developing problems such as hernias, flat spots, loss of part of the tread, sticking of foreign bodies to the tread, etc.

As a bonus, both of the above-mentioned sensors give clear once-per-revolution signals for each tire that could be used as inputs for speedometers, odometers, differential slip indicators, tire wear indicators, etc.

Tires can fail for a variety of reasons including low pressure, high temperature, delamination of the tread, excessive flexing of the sidewall, and wear (see, e.g., Summary Root Cause Analysis Bridgestone/Firestone, Inc." http://www.bridgestone-firestone.com/homeimgs/rootcause.htm, Printed March, 2001). Most tire failures can be predicted based on tire pressure alone and the TREAD Act thus addresses the monitoring of tire pressure. However, some failures, such as the Firestone tire failures, can result from substandard materials especially those that are in contact with a steel-reinforcing belt. If the rubber adjacent the steel belt begins to move relative to the belt, then heat will be generated and the temperature of the tire will rise until the tire fails catastrophically. This can happen even in properly inflated tires.

Finally, tires can fail due to excessive vehicle loading and excessive sidewall flexing even if the tire is properly inflated. This can happen if the vehicle is overloaded or if the wrong size tire has been mounted on the vehicle. In most cases, the tire temperature will rise as a result of this additional flexing, however, this is not always the case, and it may even occur too late. Therefore, the device which measures the diameter of the tire footprint on the road is a superior method of measuring excessive loading of the tire.

Generation 1 devices monitor pressure only while generation 2 devices also monitor the temperature and therefore will provide a warning of imminent tire failure more often than through monitoring pressure alone. Generation **3** devices will give an indication that the vehicle is overloaded before either a pressure or temperature monitoring system can respond. The generation **3** system can also be augmented to measure the vibration signature of the tire and thereby detect when a tire has worn to the point that the steel belt is contacting the road. In this manner, the generation **3** system also provides an indication of a worn out tire and, as will be discussed below, an indication of the road coefficient of friction.

Each of these devices communicates to an interrogator with pressure, temperature, and acceleration as appropriate In none of these generational devices is a battery mounted within the vehicle tire required, although in some cases a generator can be used. In most cases, the SAW devices will optionally provide an identification number corresponding to the device to permit the interrogator to separate one tire from another.

Key advantages of the tire monitoring system disclosed herein over most of the currently known prior art are:

- very small size and insignificant weight eliminating the need for wheel counterbalance,
- cost competitive for tire monitoring only, significant cost advantage when systems are combined,
- exceeds customers' price targets,
- high update rate,
- self-diagnostic,
- automatic wheel identification,
- no batteries required—powerless,
- no wires required—wireless.

SAW devices have been used for sensing many parameters including devices for chemical sensing and materials characterization in both the gas and liquid phase. They also are used for measuring pressure, strain, temperature, acceleration, angular rate and other physical states of the environment.

The monitoring of temperature and or pressure of a tire can take place infrequently. It is adequate to check the pressure and temperature of vehicle tires once every ten seconds to once per minute. To utilize the centralized interrogator of this invention, the tire monitoring system would preferably use SAW technology and the device could be located in the valve stem, wheel, tire side wall, tire tread, or other appropriate location with access to the internal tire pressure of the tires. A preferred system is based on a SAW technology discussed above.

At periodic intervals, such as once every minute, the interrogator sends a radio frequency signal at a frequency such as 905 MHz to which the tire monitor sensors have been sensitized. When receiving this signal, the tire monitor sensors (of which there are five in a typical configuration) respond with a signal providing an optional identification number, temperature and pressure data. In one implementation, the interrogator would use multiple, typically two or four, antennas which are spaced apart. By comparing the time of the returned signals from the tires to the antennas, the location of each of the senders can be approximately determined. That is, the antennas can be so located that each tire is a different distance from each antenna and by comparing the return time of the signals sensed by the antennas, the location of each tire can be determined and associated with the returned information. If at least three antennas are used, then returns from adjacent vehicles can be eliminated.

An identification number can accompany each transmission from each tire sensor and can also be used to validate that the transmitting sensor is in fact located on the subject vehicle. In traffic situations, it is possible to obtain a signal from the tire of an adjacent vehicle. This would immediately show up as a return from more than five vehicle tires and the system would recognize that a fault had occurred. The sixth return can be easily eliminated, however, since it could contain an identification number that is different from those that have heretofore been returned frequently to the vehicle system or based on a comparison of the signals sensed by the different antennas. Thus, when the vehicle tire is changed or tires are rotated, the system will validate a particular return signal as originating from the tire-monitoring sensor located on the subject vehicle.

This same concept is also applicable for other vehicle-mounted sensors. This permits a plug and play scenario whereby sensors can be added to, changed, or removed from a vehicle and the interrogation system will automatically adjust. The system will know the type of sensor based on the identification number, frequency, delay and/or its location on the vehicle. For example, a tire monitor could have a different code in the identification number from a switch or weight-monitoring device. This also permits new kinds of sensors to be retroactively installed on a vehicle. If a totally new type of the sensor is mounted to the vehicle, the system software would have to be updated to recognize and know what to do with the information from the new sensor type. By this method, the configuration and quantity of sensing systems on a vehicle can be easily changed and the system interrogating these sensors need only be updated with software upgrades which could occur automatically over the Internet.

Preferred tire-monitoring sensors for use with this invention use the surface acoustic wave (SAW) technology. A radio frequency interrogating signal is sent to all of the tire gages simultaneously and the received signal at each tire gage is sensed using an antenna. The antenna is connected to the IDT transducer that converts the electrical wave to an acoustic wave that travels on the surface of a material such as lithium niobate, or other piezoelectric material such as zinc oxide, Langasite or the polymer polyvinylidene fluoride (PVDF). During its travel on the surface of the piezoelectric material, either the time delay, resonant frequency, amplitude, or phase of the signal (or even possibly combinations thereof) is modified based on the temperature and/or pressure in the tire. This modified wave is sensed by one or more IDT transducers and converted back to a radio frequency wave that is used to excite an antenna for re-broadcasting the wave back to interrogator. The interrogator receives the wave at a time delay after the original transmission that is determined by the geometry of the SAW transducer and decodes this signal to determine the temperature and/or pressure in the subject tire. By using slightly different geometries for each of the tire monitors, slightly different delays can be achieved and randomized so that the probability of two sensors having the same delay is small. The interrogator transfers the decoded information to a central processor that then determines whether the temperature and/or pressure of each of the tires exceed specifications. If so, a warning light can be displayed informing the vehicle driver of the condition. In some cases, this random delay is all that is required to separate the five tire signals and to identify which tires are on the vehicle and thus ignore responses from adjacent vehicles.

With an accelerometer mounted in the tire, as is the case for the generation **3** system, information is present to diagnose other tire problems. For example, when the steel belt wears through the rubber tread, it will make a distinctive noise and create a distinctive vibration when it contacts the pavement. This can be sensed by the SAW accelerometer. The interpretation of various such signals can be done using neural network technology. Similar systems are described more detail in U.S. Pat. No. 5,829,782, incorporated by reference herein. As the tread begins to separate from the tire as in the Bridgestone cases, a distinctive vibration is created which can also be sensed by a tire-mounted accelerometer.

As the tire rotates, stresses are created in the rubber tread surface between the center of the footprint and the edges. If the coefficient of friction on the pavement is low, these stresses can cause the shape of the footprint to change. The generation **3** system, which measures the circumferential length of the footprint, can therefore also be used to measure the friction coefficient between the tire and the pavement.

Similarly, the same or a different interrogator can be used to monitor various components of the vehicle's safety system including occupant position sensors, vehicle acceleration sensors, vehicle angular position, velocity and acceleration sensors, related to both frontal, side or rear impacts as well as rollover conditions. The interrogator could also be used in conjunction with other detection devices such as weight sensors, temperature sensors, accelerometers which are associated with various systems in the vehicle to enable such systems to be controlled or affected based on the measured state.

Some specific examples of the use of interrogators and responsive devices will now be described.

The antennas used for interrogating the vehicle tire pressure transducers will be located outside of the vehicle passenger compartment. For many other transducers to be sensed the antennas must be located at various positions within passenger compartment. This invention contemplates, therefore, a series of different antenna systems, which can be electronically switched by the interrogator circuitry. Alternately, in some cases, all of the antennas can be left connected and total transmitted power increased.

There are several applications for weight or load measuring devices in a vehicle including the vehicle suspension system and seat weight sensors for use with automobile safety systems. As reported in U.S. Pat. Nos. 4,096,740, 4,623,813, 5,585,571, 5,663,531, 5,821,425 and 5,910,647 and International Publication No. WO 00/65320(A1), all of which are incorporated by reference herein to the extent the disclosure of these publications is necessary, SAW devices are appropriate candidates for such weight measurement systems. In this case, the surface acoustic way on the lithium niobate, or other piezoelectric material, is modified in delay time, resonant frequency, amplitude and/or phase based on strain of the member upon which the SAW device is mounted. For example, the conventional bolt that is typically used to connect the passenger seat to the seat adjustment slide mechanism can be replaced with a stud which is threaded on both ends. A SAW strain device is mounted to the center unthreaded section of the stud and the stud is attached to both the seat and the slide mechanism using appropriate threaded nuts. Based on the particular geometry of the SAW device used, the stud can result in as little as a 3 mm upward displacement of the seat compared to a normal bolt mounting system. No wires are required to attach the SAW device to the stud. The interrogator transmits a radio frequency pulse at, for example, 925 MHz that excites antenna on the SAW strain measuring system. After a delay caused by the time required for the wave to travel the length of the SAW device, a modified wave is re-transmitted to the interrogator providing an indication of the strain of the stud with the weight of an object occupying the seat corresponding to the strain. For a seat that is normally bolted to the slide mechanism with four bolts, at least four SAW strain sensors would be used. Since the individual SAW devices are very small, multiple devices can be placed on a stud to provide multiple redundant measurements, or permit bending strains to be determined, and/or to permit the stud to be arbitrarily located with at least one SAW device always within direct view of the interrogator antenna. In some cases, the bolt or stud will be made on non-conductive material to limit the blockage of the RF signal. In other cases, it will be insulated from the slide (mechanism) and used as an antenna.

If two longitudinally spaced apart antennas are used to receive the SAW transmissions from the seat weight sensors, one antenna in front of the seat and the other behind the seat, then the position of the seat can be determined eliminating the need for current seat position sensors. A similar system can be used for other seat and seatback position measurements.

For strain gage weight sensing, the frequency of interrogation would be considerably higher than that of the tire monitor, for example. However, if the seat is unoccupied then the frequency of interrogation can be substantially reduced. For an occupied seat, information as to the identity and/or category and position of an occupying item of the seat can be obtained through the multiple weight sensors described. For this reason, and due to the fact that during the pre-crash event the position of an occupying item of the seat may be changing rapidly, interrogations as frequently as once every 10 milliseconds can be desirable. This would also enable a distribution of the weight being applied to the seat to be obtained which provides an estimation of the position of the object occupying the seat. Using pattern recognition technology, e.g., a trained neural network, sensor fusion, fuzzy logic, etc., the identification of the object can be ascertained based on the determined weight and/or determined weight distribution.

There are many other methods by which SAW devices can be used to determine the weight and/or weight distribution of an occupying item other than the method described above and all such uses of SAW strain sensors for determining the weight and weight distribution of an occupant are contemplated. For example, SAW devices with appropriate straps can be used to measure the deflection of the seat cushion top or bottom caused by an occupying item, or if placed on the seat belts, the load on the belts can determined wirelessly and powerlessly. Geometries similar to those disclosed in U.S. Pat. No. 6,242,701 (which discloses multiple strain gage geometries, the entire disclosure of this patent is incorporated by reference herein to the extent the disclosure is necessary) using SAW strain-measuring devices can also be constructed, e.g., any of the multiple strain gage geometries shown therein.

Although a preferred method for using the invention is to interrogate each of the SAW devices using wireless means, in some cases it may be desirable to supply power to and/or obtain information from one or more of the devices using wires. As such, the wires would be an optional feature.

One advantage of the weight sensors of this invention along with the geometries disclosed in the '701 patent and herein below, is that in addition to the axial stress in the seat support, the bending moments in the structure can be readily determined. For example, if a seat is supported by four "legs", it is possible to determine the state of stress, assuming that axial twisting can be ignored, using four strain gages on each leg support for a total of 16 such gages. If the seat is supported by three legs, then this can be reduced to 12. Naturally, a three-legged support is preferable than four since with four, the seat support is over-determined severely complicating the determination of the stress caused by an object on the seat. Even with three supports, stresses can be introduced depending on the nature of the support at the seat rails or other floor-mounted supporting structure. If simple supports are used that do not introduce bending moments into the structure, then the number of gages per seat can be reduced to three providing a good model of the seat structure is available. Unfortunately, this is usually not the case and most seats have four supports and the attachments to the vehicle not only introduce bending moments into the structure but these moments vary from one position to another and with temperature. The SAW strain gages of this invention lend themselves to the placement of multiple gages onto each support as needed to approximately determine the state of stress and thus the weight of the occupant depending on the particular vehicle application. Furthermore, the wireless nature of these gages greatly simplifies the placement of such gages at those locations that are most appropriate.

One additional point should be mentioned. In many cases, the determination of the weight of an occupant from the static strain gage readings yields inaccurate results due to the indeterminate stress state in the support structure. However, the dynamic stresses to a first order are independent of the residual stress state. Thus, the change in stress that occurs as a vehicle travels down a roadway caused by dips in the roadway can provide an accurate measurement of the weight of an object in a seat. This is especially true if an accelerometer is used to measure the vertical excitation provided to the seat.

Some vehicle models provide load leveling and ride control functions that depend on the magnitude and distribution of load carried by the vehicle suspension. Frequently, wire strain gage technology is used for these functions. That is, the wire strain gages are used to sense the load and/or load distribution of the vehicle on the vehicle suspension system. Such strain gages can be advantageously replaced with strain gages based on SAW technology with the significant advantages in terms of cost, wireless monitoring, dynamic range, and signal level. In addition, SAW strain gage systems can be significantly more accurate than wire strain gage systems.

A strain detector in accordance with this invention can convert mechanical strain to variations in electrical 'signal frequency with a large dynamic range and high accuracy even for very small displacements. The frequency variation is produced through use of a surface acoustic wave delay line as the frequency control element of an oscillator. A surface acoustic wave delay line comprises a transducer deposited on a piezoelectric material such as quartz or lithium niobate which is disposed so as to be deformed by strain in the member which is to be monitored. Deformation of the piezoelectric substrate changes the frequency control characteristics of the surface acoustic wave delay line, thereby changing the frequency of the oscillator. Consequently, the oscillator frequency change is a measure of the strain in the member being monitored and thus the weight applied to the seat. A SAW strain transducer is capable of a degree of accuracy substantially greater than that of a conventional resistive strain gage.

Other applications of weight measuring systems for an automobile include measuring the weight of the fuel tank or other containers of fluid to determine quantity of fluid contained therein.

One problem with SAW devices is that if they are designed to operate at the GHz frequency, the feature sizes become exceeding small and the devices are difficult to manufacture. On the other hand, if the frequencies are considerably lower, for example, in the tens of megahertz range, then the antenna sizes become excessive. It is also more difficult to obtain antenna gain at the lower frequencies. This is also related to antenna size. One method of solving this problem is to transmit an interrogation signal in the many GHz range which is modulated at the hundred MHz range. At the SAW transducer, the transducer is tuned to the modulated frequency. Using a nonlinear device such as a Shocky diode, the modified signal can be mixed with the incoming high frequency signal and re-transmitted through the same antenna. For this case, the interrogator could continuously broadcast the carrier frequency.

In addition to measuring the weight of an occupying item on a seat, the location of the seat and setback can also be determined by the interrogator. Since the SAW devices inherently create a delayed return signal, either that delay must be very accurately known or an alternate approach is required. One such alternate approach is to use the heterodyne principal described above to cause the antenna to return a signal of a different frequency. By comparing the phases of the sending and received signal, the distance to the device can be determined. Also, as discussed above, multiple antennas can be used for seat position and seatback position sensing.

With respect to switches, devices based on RFID technology can be used as switches in a vehicle as described in U.S. Pat. Nos. 6,078,252 and 6,144,288, and U.S. provisional patent application Ser. No. 60/231,378 all of which are incorporated by reference herein. There are many ways that it can be accomplished. A switch can be used to connect an antenna to either an RFID electronic device or to an RFID

SAW device. This of course requires contacts to the closed by the switch activation. An alternate approach is to use pressure from an occupant's finger, for example, to alter the properties of the acoustic wave on the SAW material much as in a SAW touch screen. These properties that can be modified include the amplitude of the acoustic wave, and its phase, and/or the time delay or an external impedance connected to one of the SAW reflectors as disclosed in U.S. Pat. No. 6,084,503, incorporated by reference herein. In this implementation, the SAW transducer can contain two sections, one which is modified by the occupant and the other which serves as a reference. A combined signal is sent to the interrogator that decodes the signal to determine that the switch has been activated. By any of these technologies, switches can be arbitrarily placed within the interior of an automobile, for example, without the need for wires. (The wires would be an optional feature.) Since wires and connectors are the clause of most warranty repairs in an automobile, not only is the cost of switches substantially reduced but also the reliability of the vehicle electrical system is substantially improved.

The interrogation of switches can take place with moderate frequency such as once every 100 milliseconds. Either through the use of different frequencies or different delays, a large number of switches can be either time, code, space or frequency multiplexed to permit separation of the signals obtained by the interrogator.

Another approach is to attach a variable impedance device across one of the reflectors on the SAW device. The impedance can therefore used to determine the relative reflection from the reflector compared to other reflectors on the SAW device. In this way, the magnitude as well as the presence of a force exerted by an occupant's finger, for example, can be used to provide a rate sensitivity to the desired function. In an alternate design, as shown U.S. Pat. No. 6,144,288, incorporated by reference herein, the switch is used to connect the antenna to the SAW device. Of course, in this case the interrogator will not get a return from the SAW switch unless it is depressed.

Temperature measurement is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW temperature sensors.

U.S. Pat. No. 4,249,418, incorporated by reference herein, is one of many examples of prior art SAW temperature sensors. Temperature sensors are commonly used within vehicles and many more applications might exist if a low cost wireless temperature sensor is available, i.e., the invention. The SAW technology can be used for such temperature sensing tasks. These tasks include measuring the vehicle coolant temperature, air temperature within passenger compartment at multiple locations, seat temperature for use in conjunction with seat warming and cooling systems, outside temperatures and perhaps tire surface temperatures to provide early warning to operators of road freezing conditions. One example, is to provide air temperature sensors in the passenger compartment in the vicinity of ultrasonic transducers used in occupant sensing systems as described in the current assignee's U.S. Pat. No. 5,943,295 (Varga et al.), incorporated by reference herein, since the speed of sound in the air varies by approximately 20% from −40° C. to 85° C. The subject matter of this patent is included in the invention to form a part thereof. Current ultrasonic occupant sensor systems do not measure or compensate for this change in the speed of sound with the effect of significantly reducing the accuracy of the systems at the temperature extremes. Through the judicious placement of SAW temperature sensors in the vehicle, the passenger compartment air temperature can be accurately estimated and the information provided wirelessly to the ultrasonic occupant sensor system thereby permitting corrections to be made for the change in speed of sound.

Acceleration sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW accelerometers.

U.S. Pat. Nos. 4,199,990, 4,306,456 and 4,549,436, all of which are incorporated by reference herein, are examples of prior art SAW accelerometers. Most airbag crash sensors for determining whether the vehicle is experiencing a frontal or side impact currently use micromachined accelerometers. These accelerometers are usually based on the deflection of a mass which is sensed using either capacitive or piezoresistive technologies. SAW technology has heretofore not been used as a vehicle accelerometer or for vehicle crash sensing. Due to the importance of this function, at least one interrogator could be dedicated to this critical function. Acceleration signals from the crash sensors should be reported at least preferably every 100 microseconds. In this case, the dedicated interrogator would send an interrogation pulse to all crash sensor accelerometers every 100 microseconds and receive staggered acceleration responses from each of the SAW accelerometers wirelessly. This technology permits the placement of multiple low-cost accelerometers at ideal locations for crash sensing including inside the vehicle side doors, in the passenger compartment and in the frontal crush zone. Additionally crash sensors can now be located in the rear of the vehicle in the crush zone to sense rear impacts. Since the acceleration data is transmitted wirelessly, concern about the detachment or cutting of wires from the sensors disappears. One of the main concerns, for example, of placing crash sensors in the vehicle doors where they most appropriately can sense vehicle side impacts, is the fear that an impact into the A-pillar of the automobile would sever the wires from the door-mounted crash sensor before the crash was sensed. This problem disappears with the current wireless technology of this invention. If two accelerometers are placed at some distance from each other, the roll rate of the vehicle can be determined and thus the tendency of the vehicle to rollover can be predicted in time to automatically take corrective action and/or deploy a curtain airbag or other airbag(s).

Although the sensitivity of measurement is considerably greater than that obtained with conventional piezoelectric accelerometers, the frequency deviation remains low in absolute value. Accordingly, the frequency drift of thermal origin has to be made as low as possible by selecting a suitable cut of the piezoelectric material. The resulting accuracy is impressive as presented in U.S. Pat. No. 4,549,436, incorporated by reference herein, which discloses an angular accelerometer with a dynamic a range of 1 million, temperature coefficient of 0.005%/deg F, an accuracy of 1 microradian/sec^2, a power consumption of 1 milliwatt, a drift of 0.01% per year, a volume of 1 cc/axis and a frequency response of 0 to 1000 Hz. The subject matter of this patent is hereby included in the invention to constitute a part of the invention. A similar design can be used for acceleration sensing.

In a similar manner as the polymer coated SAW device is used to measure pressure, a similar device wherein a seismic mass is attached to a SAW device through a polymer interface can be made to sense acceleration. This geometry has a particular advantage for sensing accelerations below 1 G, which has proved to be very difficult in conventional micromachined accelerometers due to their inability to both measure low accelerations and withstand shocks.

Gyroscopes are another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW gyroscopes.

The SAW technology is particularly applicable for gyroscopes as described in International Publication No. WO 00/79217A2 to Varadan et al. The output of such gyroscopes can be determined with an interrogator that is also used for the crash sensor accelerometers, or a dedicated interrogator can be used. Gyroscopes having an accuracy of approximately 1 degree per second have many applications in a vehicle including skid control and other dynamic stability functions. Additionally, gyroscopes of similar accuracy can be used to sense impending vehicle rollover situations in time to take corrective action.

SAW gyroscopes of the type described in WO 00/79217A2 have the capability of achieving accuracies approaching 3 degrees per hour. This high accuracy permits use of such gyroscopes in an inertial measuring unit (IMU) that can be used with accurate vehicle navigation systems and autonomous vehicle control based on differential GPS corrections. Such a system is described in the current assignee's U.S. patent application Ser. No. 09/177,041. Such navigation systems depend on the availability of four or more GPS satellites and an accurate differential correction signal such as provided by the OmniStar Corporation or NASA or through the National Differential GPS system now being deployed. The availability of these signals degrades in urban canyon environments, tunnels, and on highways when the vehicle is in the vicinity of large trucks. For this application, an IMU system should be able to accurately control the vehicle for perhaps 15 seconds and preferably for up to five minutes. An IMU based on SAW technology or the technology of U.S. Pat. No. 4,549,436 discussed above are the best-known devices capable of providing sufficient accuracies for this application at a reasonable cost. Other accurate gyroscope technologies such as fiber optic systems are more accurate but can cost many thousands of dollars. In contrast, in high volume production, an IMU of the required accuracy based on SAW technology should cost less than $100.

Once an IMU of the accuracy described above is available in the vehicle, this same device can be used to provide significant improvements to vehicle stability control and rollover prediction systems.

Keyless entry systems are another field in which SAW technology can be applied and the invention encompasses several embodiments of access control systems using SAW devices.

A common use of SAW technology is for access control to buildings. RFID technology using electronics is also applicable for this purpose; however, the range of electronic RFID technology is usually limited to one meter or less. In contrast, the SAW technology can permit sensing up to about 30 meters. As a keyless entry system, an automobile can be configured such that the doors unlock as the holder of a card containing the SAW ID system approaches the vehicle and similarly, the vehicle doors can be automatically locked when occupant with the card travels beyond a certain distance from the vehicle. When the occupant enters the vehicle, the doors can again automatically lock either through logic or through a current system wherein doors automatically lock when the vehicle is placed in gear. An occupant with such a card would also not need to have an ignition key. The vehicle would recognize that the SAW based card was inside vehicle and then permit the vehicle to be started by issuing an oral command if a voice recognition system is present or by depressing a button, for example, without the need for an ignition key.

Occupant presence and position sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW occupant presence and/or position sensors.

Many sensing systems are available for the use to identify and locate occupants or other objects in a passenger compartment of the vehicle. Such sensors include ultrasonic sensors, chemical sensors (e.g. carbon dioxide), cameras, radar systems, heat sensors, capacitance, magnetic or other field change sensors, etc. Most of these sensors require power to operate and return information to a central processor for analysis. An ultrasonic sensor, for example, may be mounted in or near the headliner of the vehicle and periodically it transmits a few ultrasonic waves and receives reflections of these waves from occupying items of the passenger seat. Current systems on the market are controlled by electronics in a dedicated ECU.

An alternate method as taught in this invention is to use an interrogator to send a signal to the headliner-mounted ultrasonic sensor causing that sensor to transmit and receive ultrasonic waves. The sensor in this case would perform mathematical operations on the received waves and create a vector of data containing perhaps twenty to forty values and transmit that vector wirelessly to the interrogator. By means of this system, the ultrasonic sensor need only be connected to the vehicle power system and the information could be transferred to and from the sensor wirelessly. Such a system significantly reduces the wiring complexity especially when there may be multiple such sensors distributed in the passenger compartment. Now, only a power wire needs to be attached to the sensor and there does not need to be any direct connection between the sensor and the control module. Naturally, the same philosophy would apply to radar-based sensors, electromagnetic sensors of all kinds including cameras, capacitive or other electromagnetic field change sensitive sensors etc. In some cases, the sensor itself can operate on power supplied by the interrogator through radio frequency transmission. In this case, even the connection to the power line can be omitted. This principle can be extended to the large number of sensors and actuators that are currently in the vehicle where the only wires that are needed are those to supply power to the sensors and actuators and the information is supplied wirelessly.

Such wireless powerless sensors can also be use, for example, as close proximity sensors based on measurement of thermal radiation from an occupant. Such sensors can be mounted on any of the surfaces in the passenger compartment, including the seats, which are likely to receive such radiation.

A significant number of people are suffocated each year in automobiles due to excessive heat, carbon dioxide, carbon monoxide, or other dangerous fumes. The SAW sensor technology is particularly applicable to solving these kinds of problems. The temperature measurement capabilities of SAW transducers have been discussed above. If the surface of a SAW device is covered with a material which captures carbon dioxide, for example, such that the mass, elastic constants or other property of surface coating changes, the characteristics of the surface acoustic waves can be modified as described in detail in U.S. Pat. No. 4,637,987 and elsewhere. Once again, an interrogator can sense the condition of these chemical-sensing sensors without the need to supply power and connect the sensors with either wireless communication or through the power wires. If a concentration of carbon monoxide is sensed, for example, an alarm can be sounded, the windows opened, and/or the engine extinguished. Similarly, if the temperature within the passenger compartment exceeds a certain level, the windows can be automatically opened a little to permit an exchange of air reducing the inside temperature and thereby perhaps saving the life of an infant or pet left in the vehicle unattended.

In a similar manner, the coating of the surface wave device can contain a chemical which is responsive to the presence of alcohol. In this case, the vehicle can be prevented from operating when the concentration of alcohol vapors in the vehicle exceeds some determined limit.

Each year a number of children and animals are killed when they are locked into a vehicle trunk. Since children and animals emit significant amounts of carbon dioxide, a carbon dioxide sensor connected to the vehicle system wirelessly and powerlessly provides an economic way of detecting the presence of a life form in the trunk. If a life form is detected, then a control system can release a trunk lock thereby opening the trunk. Alarms can also be sounded or activated when a life form is detected in the trunk.

Although they will not be discussed in detail, SAW sensors operating in the wireless mode can also be used to sense for ice on the windshield or other exterior surfaces of the vehicle, condensation on the inside of the windshield or other interior surfaces, rain sensing, heat load sensing and many other automotive sensing functions. They can also be used to sense outside environmental properties and states including temperature, humidity, etc.

SAW sensors can be economically used to measure the temperature and humidity at numerous places both inside and outside of a vehicle. When used to measure humidity inside the vehicle, a source of water vapor can be activated to increase the humanity when desirable and the air conditioning system can be activated to reduce the humidity when necessary. Temperature and humidity measurements outside of the vehicle can be an indication of potential road icing problems. Such information can be used to provide early warning to a driver of potentially dangerous conditions. Although the invention described herein is related to land vehicles, many of these advances are equally applicable to other vehicles such as boats, airplanes and even, in some cases, homes and buildings. The invention disclosed herein, therefore, is not limited to automobiles or other land vehicles.

Road condition sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW road condition sensors.

The temperature and moisture content of the surface of a roadway are critical parameters in determining the icing state of the roadway. Attempts have been made to measure the coefficient of friction between a tire and the roadway by placing strain gages in the tire tread. Naturally, such strain gages are ideal for the application of SAW technology especially since they can be interrogated wirelessly from a distance and they require no power for operation. As discussed above, SAW accelerometers can also perform this function. The measurement of the friction coefficient, however, is not predictive and the vehicle operator is only able to ascertain the condition after the fact. SAW based transducers have the capability of being interrogated as much as 100 feet from the interrogator. Therefore, the judicious placement of low-cost powerless SAW temperature and humidity sensors in or on the roadway at critical positions can provide an advance warning to vehicle operators that road is slippery ahead. Such devices are very inexpensive and therefore could be placed at frequent intervals along a highway.

An infrared sensor that looks down the highway in front of the vehicle can actually measure the road temperature prior to the vehicle traveling on that part of the roadway. This system also would not give sufficient warning if the operator waited for the occurrence of a frozen roadway. The probability of the roadway becoming frozen, on the other hand, can be predicted long before it occurs, in most cases, by watching the trend in the temperature.

Some lateral control of the vehicle can also be obtained from SAW transducers or electronic RFID tags placed down the center of the lane, either above the vehicles or in the roadway, for example. A vehicle having two receiving antennas approaching such devices, through triangulation, is able to determine the lateral location of the vehicle relative to these SAW devices. If the vehicle also has an accurate map of the roadway, the identification number associated with each such device can be used to obtain highly accurate longitudinal position determinations. Ultimately, the SAW devices can be placed on structures beside the road and perhaps on every mile or tenth of a mile marker. If three antennas are used, as discussed herein, the distances to the SAW device can be determined.

Electronic RFID tags are also suitable for lateral and longitudinal positioning purposes, however, the range available for electronic RFID systems is considerably less than that of SAW based systems. On the other hand, as taught in U.S. provisional patent application Ser. No. 60/231,378, the time of flight of the RFID system can be used to determine the distance from the vehicle to the RFID tag. Because of the inherent delay in the SAW devices and its variation with temperature, accurate distance measurement is probably not practical based on time of flight but somewhat less accurate distance measurements based on relative time of arrival can be made. Even if the exact delay imposed by the SAW device was accurately known at one temperature, such devices are usually reasonably sensitive to changes in temperature, hence they make good temperature sensors, and thus the accuracy of the delay in the SAW device is more difficult to maintain. An interesting variation of an electronic RFID that is particularly applicable to this and other applications of this invention is disclosed in A. Pohl, L. Reindl, "New passive sensors", Proc. 16th IEEE Instrumentation and Measurement Technology Conf., IMTC/99, 1999, pp. 1251–1255, which is incorporated by reference herein in its entirety.

Many SAW devices are based on lithium niobate or similar strong piezoelectric materials. Such materials have high thermal expansion coefficients. An alternate material is quartz that has a very low thermal expansion coefficient. However, its piezoelectric properties are inferior to lithium niobate. One solution to this problem is to use lithium niobate as the coupling system between the antenna and the material upon which the surface acoustic wave travels. In this matter, the advantages of a low thermal expansion coefficient material can be obtained while using the lithium niobate for its strong piezoelectric properties. Other useful materials such as Langasite have properties that are intermediate between lithium niobate and quartz. Note that it is also possible to use combinations of materials to achieve particular objectives with property measurement since different materials respond differently to different sensed properties or environments.

The use of SAW tags as an accurate precise positioning system as described above would be applicable for accurate vehicle location, as discussed in U.S. patent application Ser. No. 09/177,041, for lanes in tunnels, for example, or other cases where loss of satellite lock is common.

The various technologies discussed above can be used in combination. The electronic RFID tag can be incorporated into a SAW tag providing a single device that provides both an instant reflection of the radio frequency waves as well as a re-transmission at a later time. This marriage of the two technologies permits the strengths of each technology to be exploited in the same device. For most of the applications described herein, the cost of mounting such a tag in a vehicle or on the roadway far exceeds the cost of the tag itself. Therefore, combining the two technologies does not significantly affect the cost of implementing tags onto vehicles or roadways or side structures.

An alternate method to the electronic RFID tag is to simply use a radar reflector and measure the time of flight to the reflector and back. The radar reflector can even be made of a series of reflecting surfaces displaced from each other to achieve some simple coding.

Another field in which SAW technology can be applied is for "ultrasound-on-a-surface" type of devices.

U.S. Pat. No. 5,629,681, assigned to the same assignee herein and incorporated by reference herein, describes many uses of ultrasound in a tube. Many of the applications are also candidates for ultrasound-on-a-surface devices. In this case, a micromachined SAW device will in general be replaced by a much larger structure.

Touch screens based on surface acoustic waves are well known in the art. The use of this technology for a touch pad for use with a heads-up display is disclosed in the current assignee's U.S. patent application Ser. No. 09/645,709. The use of surface acoustic waves in either one or two dimensional applications has many other possible uses such as for pinch protection on window and door closing systems, crush sensing crash sensors, occupant presence detector and butt print measurement systems, generalized switches such as on the circumference or center of the steering wheel, etc. Since these devices typically require significantly more power than the micromachined SAW devices discussed above, most of these applications will require a power connection. On the other hand, the output of these devices can go through a SAW micromachined device or, in some other manner, be attached to an antenna and interrogated using a remote interrogator thus eliminating the need for a direct wire communication link.

One example would be to place a surface acoustic wave device on the circumference of the steering wheel. Upon depressing a section of this device, the SAW wave would be attenuated. The interrogator would notify the acoustic wave device at one end of the device to launch an acoustic wave and then monitor output from the antenna. Depending on the phase, time delay, and/or amplitude of the output wave, the interrogator would know where the operator had depressed the steering wheel SAW switch and therefore know the function desired by the operator.

Piezoelectric generators are another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW piezoelectric generators.

An alternate approach for some applications, such as tire monitoring, where it is difficult to interrogate the SAW device as the wheel, and thus the antenna, is rotating, the transmitting power can be significantly increased if there is a source of energy inside the tire. Many systems now use a battery but this leads to problems related to having to periodically replace the battery and temperature effects. In some cases, the manufacturers recommend that the battery be replaced as often as every 6 to 12 months. Batteries also sometimes fail to function properly at cold temperatures and have their life reduced when operated at high temperatures. For these reasons, there is a strong belief that a tire monitoring system should obtain its power from some source external of the tire. Similar problems can be expected for other applications.

One novel solution to this problem is to use the flexing of the tire itself to generate electricity. If a thin film of PVDF is attached to the tire inside and adjacent to the tread, then as the tire rotates the film will flex and generate electricity. This energy can then be stored on one or more capacitors and used to power the tire monitoring circuitry. Also, since the amount of energy that is generated depends of the flexure of the tire, this generator can also be used to monitor the health of the tire in a similar manner as the generation 3 accelerometer system described above.

As mentioned above, the transmissions from different SAW devices can be time multiplexed by varying the delay time from device to device, frequency multiplexed by varying the natural frequencies of the SAW devices, code multiplexed by varying the identification code of the SAW devices or space multiplexed by using multiple antennas. Considering the time multiplexing case, varying the length of the SAW device and thus the delay before retransmission can separate different classes of devices. All seat sensors can have one delay which would be different from tire monitors or light switches etc.

Referring now to FIGS. **13A–36B**, a first embodiment of a valve cap **10** including a tire pressure monitoring system in accordance with the invention is shown generally at 10 in FIG. **13A**. A tire **1** has a protruding, substantially cylindrical valve stem **2** which is shown in a partial cutaway view in FIG. **13A**. The valve stem **2** comprises a sleeve **3** and a tire valve assembly **5**. The sleeve **3** of the valve stem **2** is threaded on both its inner surface and its outer surface. The tire valve assembly **5** is arranged in the sleeve **3** and includes threads on an outer surface which are mated with the threads on the inner surface of the sleeve **3**. The valve assembly **5** comprises a valve seat **4** and a valve pin **6** arranged in an aperture in the valve seat **4**. The valve assembly **5** is shown in the open condition in FIG. **13A** whereby air flows through a passage between the valve seat **4** and the valve pin **6**.

The valve cap **10** includes a substantially cylindrical body **9** and is attached to the valve stem **2** by means of threads **8** arranged on an inner cylindrical surface of body **9** which are mated with the threads on the outer surface of the sleeve **3**. The valve cap **10** comprises a valve pin depressor **14** arranged in connection with the body **9** and a SAW pressure sensor **11**. The valve pin depressor **14** engages the valve pin **6** upon attachment of the valve cap **10** to the valve stem **2** and depresses it against its biasing spring, not shown, thereby opening the passage between the valve seat **4** and the valve pin **6** allowing air to pass from the interior of tire **1** into a reservoir or chamber **12** in the body **9**. Chamber **12** contains the SAW pressure sensor **11** as described in more detail below.

Pressure sensor **11** is an absolute pressure-measuring device. It functions based on the principle that the increase in air pressure and thus air density in the chamber **12** increases the mass loading on a SAW device changing the velocity of surface acoustic wave on the piezoelectric material. The pressure sensor **11** is therefore positioned in an exposed position in the chamber **12**.

A second embodiment of a valve cap **10'** in accordance with the invention is shown in FIG. **13B** and comprises a SAW strain sensing device **15** that is mounted onto a flexible membrane **13** attached to the body **9'** of the valve cap **10'** and in a position in which it is exposed to the air in the chamber **12'**. When the pressure changes in chamber **12'**, the deflection of the membrane **13** changes thereby changing the stress in the SAW device **15**.

Strain sensor **15** is thus a differential pressure-measuring device. It functions based on the principle that changes in the flexure of the membrane **13** can be correlated to changes in pressure in the chamber **12'** and thus, if an initial pressure and flexure are known, the change in pressure can be determined from the change in flexure.

FIGS. **13A** and **13B** therefore illustrate two different methods of using a SAW sensor in a valve cap for monitoring the pressure inside a tire. The precise manner in which the SAW sensors **11,15** operate is discussed fully below but briefly, each sensor **11,15** includes an antenna and an interdigital transducer which receives a wave via the antenna from an interrogator which proceeds to travel along a substrate. The time in which the waves travel across the substrate and return to the interdigital transducer is dependent on the temperature, the mass loading on the substrate (in the embodiment of FIG. **13A**) or the flexure of membrane **13** (in the embodiment of FIG. **13B**). The antenna transmits a return wave which is receives and the time delay between the transmitted and returned wave is calculated and correlated to the pressure in the chamber **12** or **12'**.

Sensors **11** and **15** are electrically connected to the metal valve cap **10** that is electrically connected to the valve stem **2**. The valve stem **2** is electrically isolated from the tire rim and serves as an antenna for transmitting radio frequency electromagnetic signals from the sensors **11** and **15** to a vehicle mounted interrogator, not shown, to be described in detail below. As shown in FIG. **13A**., a pressure seal **16** is arranged between an upper rim of the sleeve **3** and an inner shoulder of the body **9** of the valve cap **10** and serves to prevent air from flowing out of the tire **1** to the atmosphere.

The speed of the surface acoustic wave on the piezoelectric substrate changes with temperature in a predictable manner as well as with pressure. For the valve cap implementations, a separate SAW device can be attached to the outside of the valve cap and protected with a cover where it is subjected to the same temperature as the SAW sensors **11** or **15** but is not subject to pressure or strain. This requires that each valve cap comprise two SAW devices, one for pressure sensing and another for temperature sensing. Since the valve cap is exposed to ambient temperature, a preferred approach is to have a single device on the vehicle which measures ambient temperature outside of the vehicle passenger compartment. Many vehicles already have such a temperature sensor. For those installations where access to this temperature data is not convenient, a separate SAW temperature sensor can be mounted associated with the interrogator antenna, as illustrated below, or some other convenient place.

Although the valve cap **10** is provided with the pressure seal **16**, there is a danger that the valve cap **10** will not be properly assembled onto the valve stem **2** and a small quantity of the air will leak over time. FIG. **14** provides an alternate design where the SAW temperature and pressure measuring devices are incorporated into the valve stem. This embodiment is thus particularly useful in the initial manufacture of a tire.

The valve stem assembly is shown generally at **20** and comprises a brass valve stem **7** which contains a tire valve assembly **5**. The valve stem **7** is covered with a coating **21** of a resilient material such as rubber, which has been partially removed in the drawing. A metal conductive ring **22** is electrically attached to the valve stem **7**. A rubber extension **23** is also attached to the lower end of the valve stem **7** and contains a SAW pressure and temperature sensor **24**. The SAW pressure and temperature sensor **24** can be of at least two designs wherein the SAW sensor is used as an absolute pressure sensor as shown in FIG. **14A** or an as a differential sensor based on membrane strain as shown in FIG. **14B**.

In FIG. **14A**, the SAW sensor **24** comprises a capsule **32** having an interior chamber in communication with the interior of the tire via a passageway **30**. A SAW absolute pressure sensor **27** is mounted onto one side of a rigid membrane or separator **31** in the chamber in the capsule **32**. Separator **31** divides the interior chamber of the capsule **32** into two compartments **25** and **26**, with only compartment **25** being in flow communication with the interior of the tire. The SAW absolute pressure sensor **27** is mounted in compartment **25** which is exposed to the pressure in the tire through passageway **30**. A SAW temperature sensor **28** is attached to the other side of the separator **31** and is exposed to the pressure in compartment **26**. The pressure in compartment **26** is unaffected by the tire pressure and is determined by the atmospheric pressure when the device was manufactured and the effect of temperature on this pressure. The speed of sound on the SAW temperature sensor **28** is thus affected by temperature but not by pressure in the tire.

The operation of SAW sensors **27** and **28** is discussed elsewhere more fully but briefly, since SAW sensor **27** is affected by the pressure in the tire, the wave which travels along the substrate is affected by this pressure and the time delay between the transmission and reception of a wave can be correlated to the pressure. Similarly, since SAW sensor **28** is affected by the temperature in the tire, the wave which travels along the substrate is affected by this temperature and the time delay between the transmission and reception of a wave can be correlated to the temperature.

FIG. **14B** illustrates an alternate configuration of sensor **24** where a flexible membrane **33** is used instead of the rigid separator **31** shown in the embodiment of FIG. **14A**, and a SAW device is mounted on flexible member **33**. In this embodiment, the SAW temperature sensor **28** is mounted to a different wall of the capsule **32**. A SAW device **29** is thus affected both by the strain in membrane **33** and the absolute pressure in the tire. Normally, the strain effect will be much larger with a properly designed membrane **33**.

The operation of SAW sensors **28** and **29** is discussed elsewhere more fully but briefly, since SAW sensor **28** is affected by the temperature in the tire, the wave which travels along the substrate is affected by this temperature and the time delay between the transmission and reception of a wave can be correlated to the temperature. Similarly, since SAW sensor **29** is affected by the pressure in the tire, the wave which travels along the substrate is affected by this pressure and the time delay between the transmission and reception of a wave can be correlated to the pressure.

In both of the embodiments shown in FIG. **14A** and FIG. **14B**, a separate temperature sensor is illustrated. This has two advantages. First, it permits the separation of the temperature effect from the pressure effect on the SAW device. Second, it permits a measurement of tire temperature to be recorded. Since a normally inflated tire can experience excessive temperature caused, for example, by an overload condition, it is desirable to have both temperature and pressure measurements of each vehicle tire

The SAW devices **27, 28** and **29** are electrically attached to the valve stem **7** which again serves as an antenna to transmit radio frequency information to an interrogator. This electrical connection can be made by a wired connection; however, the impedance between the SAW devices and the antenna may not be properly matched. An alternate approach as described in Varadan, V. K. et al., "Fabrication, characterization and testing of wireless MEMS-IDT based microaccelerometers" Sensors and Actuators A 90 (2001) p. 7–19, 2001 Elsevier Netherlands, incorporated herein by reference, is to inductively couple the SAW devices to the brass tube.

Although an implementation into the valve stem and valve cap examples have been illustrated above, an alternate approach is to mount the SAW temperature and pressure monitoring devices elsewhere within the tire. Similarly, although the tire stem in both cases above serves the antenna, in many implementations, it is preferable to have a separately designed antenna mounted within or outside of the vehicle tire. For example, such an antenna can project into the tire from the valve stem or can be separately attached to the tire or tire rim either inside or outside of the tire. In some cases, it can be mounted on the interior of the tire on the sidewall.

A more advanced embodiment of a tire monitor in accordance with the invention is illustrated generally at **40** in FIGS. **15** and **15A**. In addition to temperature and pressure monitoring devices as described in the previous applications, the tire monitor assembly **40** comprises an accelerometer of any of the types to be described below which is configured to measure either or both of the tangential and radial accelerations. Tangential accelerations as used herein mean accelerations tangent to the direction of rotation of the tire and radial accelerations as used herein mean accelerations toward or away from the wheel axis. For either accelerometer case, the acceleration will be zero when the monitor assembly **40** is closest to the road and will be at a maximum when the monitor assembly **40** is at its maximum distance from the road. Both accelerations will increase and decrease at all positions in between.

In FIG. **15**, the tire monitor assembly **40** is cemented to the interior of the tire opposite the tread. In FIG. **15A**, the tire monitor assembly **40** is inserted into the tire opposite the tread during manufacture.

Superimposed on the acceleration signals will be vibrations introduced into tire from road interactions and due to tread separation and other defects. Additionally, the presence of the nail or other object attached to the tire will, in general, excite vibrations that can be sensed by the accelerometers. When the tread is worn to the extent that the wire belts **41** begin impacting the road, additional vibrations will be induced.

Through monitoring the acceleration signals from the tangential or radial accelerometers within the tire monitor assembly **40**, delamination, a worn tire condition, imbedded nails, other debris attached to the tire tread, hernias, can all be sensed. Additionally, as previously discussed, the length of time that the tire tread is in contact with the road opposite tire monitor **40** can be measured and, through a comparison with the total revolution time, the length of the tire footprint on the road can be determined. This permits the load on the tire to be measured, thus providing an indication of excessive tire loading. As discussed above, a tire can fail due to over loading even when the tire interior temperature and pressure are within acceptable limits. Other tire monitors cannot sense such conditions.

Since the acceleration changes during the rotation of the tire, a simple switch containing an acceleration sensing mass can now be designed that would permit data transmission only during one part of the tire rotation. Such a switch can be designed, for example, such that it shorts out the antenna except when the tire is experiencing zero acceleration at which time it permits the device to transmit data to the interrogator. Such a system would save on battery power, for example, for powered systems and minimize bandwidth use for passive systems.

In the discussion above, the use of the tire valve stem as an antenna has been discussed. An antenna can also be placed within the tire when the tire sidewalls are not reinforced with steel. In some cases and for some frequencies, it is sometimes possible to use the tire steel bead or steel belts as an antenna, which in some cases can be coupled to inductively. Alternately, the antenna can be designed integral with the tire beads or belts and optimized and made part of the tire during manufacture.

Although the discussion above has centered on the use of SAW devices, the configuration of FIG. **15** can also be effectively accomplished with other pressure, temperature and accelerometer sensors. One of the advantages of using SAW devices is that they are totally passive thereby eliminating the requirement of a battery. For the implementation of tire monitor assembly **40**, the changes in acceleration can also be used to generate sufficient electrical energy to power a silicon microcircuit. In this configuration, additional devices, typically piezoelectric devices, are used as a generator of electricity that can be stored in one or more conventional capacitors or ultra-capacitors. Naturally, other types of electrical generators can be used such as those based on a moving coil and a magnetic field etc. A PVDF piezoelectric polymer can also be used to generate electrical energy based on the flexure of the tire as described below.

FIG. **16** illustrates an absolute pressure sensor based on surface acoustic wave (SAW) technology. A SAW absolute pressure sensor **50** has an interdigital transducer (IDT) **51** which is connected to antenna **52**. Upon receiving an RF signal of the proper frequency, the antenna induces a surface acoustic wave in the material **53** which can be lithium niobate, quartz, zinc oxide, or other appropriate piezoelectric material. As the wave passes through a pressure sensing area **54** formed on the material **53**, its velocity is changed depending on the air pressure exerted on the sensing area **54**. The wave is then reflected by reflectors **55** where it returns to the IDT **51** and to the antenna **52** for retransmission back to the interrogator. The material in the pressure sensing area **54** can be a thin (such as one micron) coating of a polymer that absorbs or reversibly reacts with oxygen or nitrogen where the amount absorbed depends on the air density.

In FIG. **16A**, two additional sections of the SAW device, designated **56** and **57**, are provided such that the air pressure affects sections **56** and **57** differently than pressure sensing area **54**. This is achieved by providing three reflectors. The three reflecting areas cause three reflected waves to appear, **59**, **60** and **61** when input wave **62** is provided. The spacing between waves **59** and **60**, and between waves **60** and **61** provides a measure of the pressure. This construction of a pressure sensor may be utilized in the embodiments of FIGS. **13A–15** or in any embodiment wherein a pressure measurement by a SAW device is obtained.

There are many other ways in which the pressure can be measured based on either the time between reflections or on the frequency or phase change of the SAW device as is well known to those skilled in the art. FIG. **16B**, for example, illustrates an alternate SAW geometry where only two sections are required to measure both temperature and pressure. This construction of a temperature and pressure sensor may be utilized in the embodiments of FIGS. **13A–15** or in any embodiment wherein both a pressure measurement and a temperature measurement by a single SAW device is obtained.

Another method where the speed of sound on a piezoelectric material can be changed by pressure was first reported in Varadan et al., "Local/Global SAW Sensors for Turbulence" referenced above. This, phenomenon has not been applied to solving pressure sensing problems within an automobile until now. The instant invention is believed to be the first application of this principle to measuring tire pressure, oil pressure, coolant pressure, pressure in a gas tank, etc. Experiments to date, however, have been unsuccessful.

In some cases, a flexible membrane is placed loosely over the SAW device to prevent contaminants from affecting the SAW surface. The flexible membrane permits the pressure to be transferred to the SAW device without subjecting the surface to contaminants. Such a flexible membrane can be used in most if not all of the embodiments described herein.

A SAW temperature sensor **60** is illustrated in FIG. **17**. Since the SAW material, such as lithium niobate, expands significantly with temperature, the natural frequency of the device also changes. Thus, for a SAW temperature sensor to operate, a material for the substrate is selected which changes its properties as a function of temperature, i.e., expands. Similarly, the time delay between the insertion and retransmission of the signal also varies measurably. Since speed of a surface wave is typically 100,000 times slower then the speed of light, usually the time for the electromagnetic wave to travel to the SAW device and back is small in comparison to the time delay of the SAW wave and therefore the temperature is approximately the time delay between transmitting electromagnetic wave and its reception.

An alternate approach as illustrated in FIG. **17A** is to place a thermistor **62** across an interdigital transducer (IDT) **61**, which is now not shorted as it was in FIG. **17**. In this case, the magnitude of the returned pulse varies with the temperature. Thus, this device can be used to obtain two independent temperature measurements, one based on time delay or natural frequency of the device **60** and the other based on the resistance of the thermistor **62**.

When some other property such as pressure is being measured by the device **65** as shown in FIG. **17B**, two parallel SAW devices are commonly used. These devices are designed so that they respond differently to one of the parameters to be measured. Thus, SAW device **66** and SAW device **67** can be designed to both respond to temperature and respond to pressure. However, SAW device **67**, which contains a surface coating, will respond differently to pressure than SAW device **66**. Thus, by measuring natural frequency or the time delay of pulses inserted into both SAW devices **66** and **67**, a determination can be made of both the pressure and temperature, for example. Naturally, the device which is rendered sensitive to pressure in the above discussion could alternately be rendered sensitive to some other property such as the presence or concentration of a gas, vapor, or liquid chemical as described in more detail below.

An accelerometer that can be used for either radial or tangential acceleration in the tire monitor assembly of FIG. **15** is illustrated in FIGS. **18** and **18A**. The design of this accelerometer is explained in detail in Varadan, V. K. et al., "Fabrication, characterization and testing of wireless MEMS-IDT based microaccelerometers" referenced above, which is incorporated in its entirety herein by reference, and will not be repeated herein.

A stud which is threaded on both ends and which can be used to measure the weight of an occupant seat is illustrated in FIGS. **19A–19D**. The operation of this device is disclosed in U.S. patent application Ser. No. 09/849,558 wherein the center section of stud **101** is solid. It has been discovered that sensitivity of the device can be significantly improved if a slotted member is used as described in U.S. Pat. No. 5,539,236, which is incorporated herein by reference. FIG. **19A** illustrates a SAW strain gage **102** mounted on a substrate and attached to span a slot **104** in a center section **105** of the stud **101**. This technique can be used with any other strain-measuring device.

FIG. **19B** is a side view of the device of FIG. **19A**.

FIG. **19C** illustrates use of a single hole **106** drilled off-center in the center section **105** of the stud **101**. A single hole **106** also serves to magnify the strain as sensed by the strain gage **102**. It has the advantage in that strain gage **102** does not need to span an open space. The amount of magnification obtained from this design, however, is significantly less than obtained with the design of FIG. **19A**.

To improve the sensitivity of the device shown in FIG. **19C**, multiple smaller holes **107** can be used as illustrated in FIG. **19D**. FIG. **19E** in an alternate configuration showing four gages for determining the bending moments as well as the axial stress in the support member.

In operation, the SAW strain gage **102** receives radio frequency waves from an interrogator **110** and returns electromagnetic waves via a respective antenna **103** which are delayed based on the strain sensed by strain gage **102**.

A SAW device can also be used as a wireless switch as shown in FIGS. **20A** and **20B**. FIG. **20A** shows a surface **120** containing a projection **122** on top of a SAW device **121**. Surface material **120** could be, for example, the armrest of an automobile, the steering wheel airbag cover, or any other surface within the passenger compartment of an automobile or elsewhere. Projection **122** will typically be a material capable of transmitting force to the surface of SAW device **121**. As shown in FIG. **20B**, a projection **123** may be placed on top of the SAW device **124**. This projection **123** permits force exerted on the projection **122** to create a pressure on the SAW device **124**. This increased pressure changes the time delay or natural frequency of the SAW wave traveling on the surface of material. Alternately, it can affect the magnitude of the returned signal. The projection **123** is typically held slightly out of contact with the surface until forced into contact with it.

An alternate approach is to place a switch across the IDT **127** as shown in FIG. **20C**. If switch **125** is open, then the device will not return a signal to the interrogator. If it is closed, than the IDT **127** will act as a reflector sending a single back to IDT **128** and thus to the interrogator. Alternately, a switch **126** can be placed across the SAW device. In this case, a switch closure shorts the SAW device and no signal is returned to the interrogator. For the embodiment of FIG. **20C**, using switch **126** instead of switch **125**, a standard reflector IDT would be used in place of the IDT **127**.

Most SAW-based accelerometers work on the principle of straining the SAW surface and thereby changing either the time delay or natural frequency of the system. An alternate novel accelerometer is illustrated FIG. **21A** wherein a mass **130** is attached to a silicone rubber coating **131** which has been applied the SAW device. Acceleration of the mass in FIG. **21** in the direction of arrow X changes the amount of rubber in contact with the surface of the SAW device and thereby changes the damping, natural frequency or the time delay of the device. By this method, accurate measurements of acceleration below 1 G are readily obtained. Furthermore, this device can withstand high deceleration shocks without damage. FIG. **21B** illustrates a more conventional approach where the strain in a beam **137** caused by the acceleration acting on a mass **136** is measured with a SAW strain sensor **135**.

It is important to note that all of these devices have a high dynamic range compared with most competitive technologies. In some cases, this dynamic range can exceed 100,000.

This is the direct result of the ease with which frequency and phase can be accurately measured.

A gyroscope, which is suitable for automotive applications, is illustrated in FIG. 22 and described in detail in V. K. Varadan's International Application No. WO 00/79217, which is incorporated by reference herein in its entirety. This SAW-based gyroscope has applicability for the vehicle navigation, dynamic control, and rollover sensing among others.

Note that any of the disclosed applications can be interrogated by the central interrogator of this invention and can either be powered or operated powerlessly as described in general above. Block diagrams of three interrogators suitable for use in this invention are illustrated in FIGS. 23A–23C. FIG. 23A illustrates a superheterodyne circuit and FIG. 23B illustrates a dual superheterodyne circuit. FIG. 23C operates as follows. During the burst time two frequencies, F1 and F1+F2, are sent by the transmitter after being generated by mixing using oscillator Osc. The two frequencies are needed by the SAW transducer where they are mixed yielding F2 which is modulated by the SAW and contains the information. Frequency (F1+F2) is sent only during the burst time while frequency F1 remains on until the signal F2 returns from the SAW. This signal is used for mixing. The signal returned from the SAW transducer to the interrogator is F1+F2 where F2 has been modulated by the SAW transducer. It is expected that the mixing operations will result in about 12 db loss in signal strength.

FIG. 24 illustrates a central antenna mounting arrangement for permitting interrogation of the tire monitors for four tires and is similar to that described in U.S. Pat. No. 4,237,728, which is incorporated by reference herein. An antenna package 200 is mounted on the underside of the vehicle and communicates with devices 201 through their antennas as described above. In order to provide for antennas both inside (for example for weight sensor interrogation) and outside of the vehicle, another antenna assembly (not shown) can be mounted on the opposite side of the vehicle floor from the antenna assembly 200.

FIG. 24A is a schematic of the vehicle shown in FIG. 24. The antenna package 200, which can be considered as an electronics module, contains a time domain multiplexed antenna array that sends and receives data from each of the five tires (including the spare tire), one at a time. It comprises a microstrip or stripline antenna array and a microprocessor on the circuit board The antennas that face each tire are in an X configuration so that the transmissions to and from the tire can be accomplished regardless of the tire rotation angle.

Based on the frequency and power available, and on FCC limitations, SAW devices can be designed to permit transmission distances of up to 100 feet or more. Since SAW devices can measure both temperature and humidity, they are also capable of monitoring road conditions in front of and around a vehicle. Thus, a properly equipped vehicle can determine the road conditions prior to entering a particular road section if such SAW devices are embedded in the road surface or on mounting structures close to the road surface as shown at 279 in FIG. 25. Such devices could provide advance warning of freezing conditions, for example. Although at 60 miles per hour, such devices may only provide a one second warning, this can be sufficient to provide information to a driver to prevent dangerous skidding. Additionally, since the actual temperature and humidity can be reported, the driver will be warned prior to freezing of the road surface. SAW device 279 is shown in detail in FIG. 25A.

If a SAW device 283 is placed in a roadway, as illustrated in FIG. 26, and if a vehicle 290 has two receiving antennas 280 and 281, an interrogator can transmit a signal from either of the two antennas and at a later time, the two antennas will receive the transmitted signal from the SAW device. By comparing the arrival time of the two received pulses, the position of vehicle on a lane can precisely determined (since the direction from each antenna 280,281 to the SAW device 283 can be calculated). If the SAW device 283 has an identification code encoded into the returned signal generated thereby, then the vehicle 290 can determine, providing a precise map is available, its position on the surface of the earth. If another antenna 286 is provided, for example, at the rear of the vehicle 290 then the longitudinal position of the vehicle can also be accurately determined as the vehicle passes the SAW device 283. Of course the SAW device 283 need not be in the center of the road. Alternate locations for positioning of the SAW device 283 are on overpasses above the road and on poles such as 284 and 285 on the roadside. Such a system has an advantage over a competing system using radar and reflectors in that it is easier to measure the relative time between the two received pulses than it is to measure time of flight of a radar signal to a reflector and back. Such a system operates in all weather conditions and is known as a precise location system. Eventually such a SAW device 283 can be placed every tenth of a mile along the roadway or at some other appropriate spacing.

If a vehicle is being guided by a DGPS and accurate map system such as disclosed in U.S. Pat. application Ser. No. 09/679,317 filed Oct. 4, 2000, which is incorporated by reference herein, a problem arises when the GPS receiver system looses satellite lock as would happen when the vehicle enters a tunnel, for example. If a precise location system as described above is placed at the exit of the tunnel then the vehicle will know exactly where it is and can re-establish satellite lock in as little as one second rather than typically 15 seconds as might otherwise be required. Other methods making use of the cell phone system can be used to establish an approximate location of the vehicle suitable for rapid acquisition of satellite lock as described in G. M. Djuknic, R. E. Richton "Geolocation and Assisted GPS", Computer Magazine, February 2001, IEEE Computer Society, which is incorporated by reference herein in its entirety.

More particularly, geolocation technologies that rely exclusively on wireless networks such as time of arrival, time difference of arrival, angle of arrival, timing advance, and multipath fingerprinting offer a shorter time-to-first-fix (TTFF) than GPS. They also offer quick deployment and continuous tracking capability for navigation applications, without the added complexity and cost of upgrading or replacing any existing GPS receiver in vehicles. Compared to either mobile-station-based, stand-alone GPS or network-based geolocation, assisted-GPS (AGPS) technology offers superior accuracy, availability, and coverage at a reasonable cost. AGPS for use with vehicles would comprise a communications unit with a partial GPS receiver arranged in the vehicle, an AGPS server with a reference GPS receiver that can simultaneously "see" the same satellites as the communications unit, and a wireless network infrastructure consisting of base stations and a mobile switching center. The network can accurately predict the GPS signal the communication unit will receive and convey that information to the mobile, greatly reducing search space size and shortening the TTFF from minutes to a second or less. In addition, an AGPS receiver in the communication unit can detect and demodulate weaker signals than those that conventional GPS receivers require. Because the network performs the location calculations, the communication unit only needs to contain a scaled-down GPS receiver. It is accurate within about 15 meters when they are outdoors, an order of magnitude more sensitive than conventional GPS.

Since an AGPS server can obtain the vehicle's position from the mobile switching center, at least to the level of cell and sector, and at the same time monitor signals from GPS satellites seen by mobile stations, it can predict the signals received by the vehicle for any given time. Specifically, the server can predict the Doppler shift due to satellite motion of GPS signals received by the vehicle, as well as other signal parameters that are a function of the vehicle's location. In a typical sector, uncertainty in a satellite signal's predicted time of arrival at the vehicle is about ±5 ps, which corresponds to ±5 chips of the GPS coarse acquisition (C/A) code. Therefore, an AGPS server can predict the phase of the pseudorandom noise (PRN) sequence that the receiver should use to despread the C/A signal from a particular satellite—each GPS satellite transmits a unique PRN sequence used for range measurements—and communicate that prediction to the vehicle. The search space for the actual Doppler shift and PRN phase is thus greatly reduced, and the AGPS receiver can accomplish the task in a fraction of the time required by conventional GPS receivers. Further, the AGPS server maintains a connection with the vehicle receiver over the wireless link, so the requirement of asking the communication unit to make specific measurements, collect the results, and communicate them back is easily met. After despreading and some additional signal processing, an AGPS receiver returns back "pseudoranges" —that is, ranges measured without taking into account the discrepancy between satellite and receiver clocks—to the AGPS server, which then calculates the vehicle's location. The vehicle can even complete the location fix itself without returning any data to the server.

Sensitivity assistance, also known as modulation wipe-off, provides another enhancement to detection of GPS signals in the vehicle's receiver. The sensitivity-assistance message contains predicted data bits of the GPS navigation message, which are expected to modulate the GPS signal of specific satellites at specified times. The mobile station receiver can therefore remove bit modulation in the received GPS signal prior to coherent integration. By extending coherent integration beyond the 20-ms GPS data-bit period—to a second or more when the receiver is stationary and to 400 ms when it is fast-moving-this approach improves receiver sensitivity. Sensitivity assistance provides an additional 3-to-4-dB improvement in receiver sensitivity. Because some of the gain provided by the basic assistance—code phases and Doppler shift values—is lost when integrating the GPS receiver chain into a mobile system, this can prove crucial to making a practical receiver.

Achieving optimal performance of sensitivity assistance in TIA/EIA-95 CDMA systems is relatively straightforward because base stations and mobiles synchronize with GPS time. Given that global system for mobile communication (GSM), time division multiple access (TDMA), or advanced mobile phone service (AMPS) systems do not maintain such stringent synchronization, implementation of sensitivity assistance and AGPS technology in general will require novel approaches to satisfy the timing requirement. The standardized solution for GSM and TDMA adds time calibration receivers in the field—location measurement units—that can monitor both the wireless-system timing and GPS signals used as a timing reference.

Many factors affect the accuracy of geolocation technologies, especially terrain variations such as hilly versus flat and environmental differences such as urban versus suburban versus rural. Other factors, like cell size and interference, have smaller but noticeable effects. Hybrid approaches that use multiple geolocation technologies appear to be the most robust solution to problems of accuracy and coverage.

AGPS provides a natural fit for hybrid solutions because it uses the wireless network to supply assistance data to GPS receivers in vehicles. This feature makes it easy to augment the assistance-data message with low-accuracy distances from receiver to base stations measured by the network equipment. Such hybrid solutions benefit from the high density of base stations in dense urban environments, which are hostile to GPS signals. Conversely, rural environments—where base stations are too scarce for network-based solutions to achieve high accuracy—provide ideal operating conditions for AGPS because GPS works well there.

SAW transponders can also be placed in the license plates **287** (FIG. **26**) of all vehicles at nominal cost. An appropriately equipped automobile can then determine the angular location of vehicles in its vicinity. If a third antenna **286** is placed at the center of the vehicle front, then an indication of the distance to a license plate of a preceding vehicle can also be obtained as described above. Thus, once again, a single interrogator coupled with multiple antenna systems can be used for many functions. Alternately, if more than one SAW transponders is placed spaced apart on a vehicle and if two antennas are on the other vehicle, then the direction and position of the SAW vehicle can be determined by the receiving vehicle.

A general SAW temperature and pressure gage which can be wireless and powerless is shown generally at **300** located in the sidewall **310** of a fluid container **320** in FIG. **27**. A pressure sensor **301** is located on the inside of the container **320**, where it measures deflection of the container wall, and the fluid temperature sensor **302** on the outside. The temperature measuring SAW **300** can be covered with an insulating material to avoid influence from the ambient temperature outside of the container **320**.

A SAW load sensor can also be used to measure load in the vehicle suspension system powerless and wirelessly as shown in FIG. **28**. FIG. **28**A illustrates a strut **315** such as either of the rear struts of the vehicle of FIG. **28**. A coil spring **320** stresses in torsion as the vehicle encounters disturbances from the road and this torsion can be measured using SAW strain gages as described in U.S. Pat. No. 5,585,571 for measuring the torque in shafts. This concept is also disclosed in U.S. Pat. No. 5,714,695. The disclosures of both patents are incorporated herein by reference. The use of SAW strain gages to measure the torsional stresses in a spring, as shown in FIG. **28**B, and in particular in an automobile suspension spring has, to the knowledge of the inventors, not been heretofore disclosed. In FIG. **28**B, the strain measured by SAW strain gage **322** is subtracted from the strain measured by SAW strain gage **321** to get the temperature compensated strain in spring **320**.

Since a portion of the dynamic load is also carried by the shock absorber, the SAW strain gages **321** and **322** will only measure the steady or average load on the vehicle. However, additional SAW strain gages **325** can be placed on a piston rod **326** of the shock absorber to obtain the dynamic load. These load measurements can then be used for active or passive vehicle damping or other stability control purposes.

FIG. **29** illustrates a vehicle passenger compartment, and the engine compartment, with multiple SAW temperature sensors **330**. SAW temperature sensors are distributed throughout the passenger compartment, such as on the A-pillar, on the B-pillar, on the steering wheel, on the seat, on the ceiling, on the headliner, and on the rear glass and generally in the engine compartment. These sensors, which can be independently coded with different IDs and different delays, can provide an accurate measurement of the temperature distribution within the vehicle interior. Such a system can be used to tailor the heating and air conditioning system based on the temperature at a particular location in the passenger compartment. If this system is augmented with occupant sensors, then the temperature can be controlled based on seat occupancy and the temperature at that location. If the occupant sensor system is based on ultrasonics than the temperature measurement system can be used to correct the ultrasonic occupant sensor system for the speed of sound within the passenger compartment. Without such a correction, the error in the sensing system can be as large as about 20 percent.

In one case, the SAW temperature sensor can be made from PVDF film and incorporated within the ultrasonic transducer assembly. For the 40 kHz ultrasonic transducer case, for example, the SAW temperature sensor would return the several pulses sent to drive the ultrasonic transducer to the control circuitry using the same wires used to transmit the pulses to the transducer after a delay that is proportional to the temperature within the transducer housing. Thus a very economical device can add this temperature sensing function using much of the same hardware that is already present for the occupant sensing system. Since the frequency is low, PVDF could be fabricated into a very low cost temperature sensor for this purpose. Other piezoelectric materials could also be used.

Other sensors can be combined with the temperature sensors **330**, or used separately, to measure carbon dioxide, carbon monoxide, alcohol, humidity or other desired chemicals as discussed above.

The SAW temperature sensors **330** provide the temperature at their mounting location to a processor unit **332** via an interrogator with the processor unit including appropriate control algorithms for controlling the heating and air conditioning system based on the detected temperatures. The processor unit can control, e.g., which vents in the vehicle are open and closed, the flow rate through vents and the temperature of air passing through the vents. In general, the processor unit can control whatever adjustable components are present or form part of the heating and air conditioning system.

As shown in FIG. **29**, a child seat **334** is present on the rear vehicle seat. The child seat **334** can be fabricated with one or more RFID tags or SAW tags **336**. The RFID tag(s) and SAW tag(s) can be constructed to provide information on the occupancy of the child seat, i.e., whether a child is present, based on the weight. Also, the mere transmission of waves from the RFID tag(s) or SAW tag(s) on the child seat would be indicative of the presence of a child seat. The RFID tag(s) and SAW tag(s) can also be constructed to provide information about the orientation of the child seat, i.e., whether it is facing rearward or forward. Such information about the presence and occupancy of the child seat and its orientation can be used in the control of vehicular systems, such as the vehicle airbag system. In this case, a processor would control the airbag system and would receive information from the RFID tag(s) and SAW tag(s) via an interrogator.

There are many applications for which knowledge of the pitch and/or roll orientation of a vehicle or other object is desired. An accurate tilt sensor can be constructed using SAW devices. Such a sensor is illustrated in FIG. **30**A and designated **350**. This sensor **350** utilizes a substantially planar and rectangular mass **351** and four supporting SAW devices **352** which are sensitive to gravity. For example, the mass act to deflect a membrane on which the SAW device resides thereby straining the SAW device. Other properties can also be used for a tilt sensor such as the direction of the earth's magnetic field. SAW devices **352** are shown arranged at the corners of the planar mass **351**, but it must be understood that this arrangement is a preferred embodiment only and not intended to limit the invention. A fifth SAW device **353** can be provided to measure temperature. By comparing the outputs of the four SAW devices **352**, the pitch and roll of the automobile can be measured. This sensor **350** can be used to correct errors in the SAW rate gyros described above. If the vehicle has been stationary for a period of time, the yaw SAW rate gyro can initialized to 0 and the pitch and roll SAW gyros initialized to a value determined by the tilt sensor of FIG. **30**A. Many other geometries of tilt sensors utilizing one or more SAW devices can now be envisioned for automotive and other applications. In particular, an alternate preferred configuration is illustrated in FIG. **30**B where a triangular geometry is used. In this embodiment, the planar mass is triangular and the SAW devices **352** are arranged at the corners, although as with FIG. **30**A, this is a non-limiting, preferred embodiment.

Either of the SAW accelerometers described above can be utilized for crash sensors as shown in FIG. **31**. These accelerometers have a substantially higher dynamic range than competing accelerometers now used for crash sensors such as those based on MEMS silicon springs and masses and others based on MEMS capacitive sensing. As discussed above, this is partially a result of the use of frequency or phase shifts which can be easily measured over a very wide range. Additionally, many conventional accelerometers that are designed for low acceleration ranges are unable to withstand high acceleration shocks without breaking. This places practical limitations on many accelerometer designs so that the stresses in the silicon springs are not excessive. Also for capacitive accelerometers, there is a narrow limit over which distance, and thus acceleration, can be measured.

The SAW accelerometer for this particular crash sensor design is housed in a container **361** which is assembled into a housing **362** and covered with a cover **363**. This particular implementation shows a connector **364** indicating that this sensor would require power and the response would be provided through wires. Alternately, as discussed for other devices above, the connector **364** can be eliminated and the information and power to operate the device transmitted wirelessly. Such sensors can be used as frontal, side or rear impact sensors. They can be used in the crush zone, in the passenger compartment or any other appropriate vehicle location. If two such sensors are separated and have appropriate sensitive axes, then the angular acceleration of the vehicle can be also be determined. Thus, for example, forward-facing accelerometers mounted in the vehicle side doors can used to measure the yaw acceleration of the vehicle. Alternately two vertical sensitive axis accelerometers in the side doors can be used to measure the roll acceleration of vehicle, which would be useful for rollover sensing.

Although piezoelectric SAW devices normally use rigid material such as quartz or lithium niobate, it is also possible to utilize polyvinylidene fluoride (PVDF) providing the frequency is low. A piece of PVDF film can also be used as a sensor of tire flexure by itself. Such a sensor is illustrated in FIGS. 32 and 32A at 400. The output of flexure of the PVDF film can be used to supply power to a silicon microcircuit that contains pressure and temperature sensors. The waveform of the output from the PVDF film also provides information as to the flexure of an automobile tire and can be used to diagnose problems with the tire as well as the tire footprint in a manner similar to the device described in FIG. 15. In this case, however, the PVDF film supplies sufficient power to permit significantly more transmission energy to be provided. The frequency and informational content can be made compatible with the SAW interrogator described above such that the same interrogator can be used. The power available for the interrogator, however, can be significantly greater thus increasing the reliability and reading range of the system.

There is a general problem with tire pressure monitors as well as systems that attempt to interrogate passive SAW or electronic RFID type devices in that the FCC severely limits the frequencies and radiating power that can be used. Once it becomes evident that these systems will eventually save many lives, the FCC can be expected to modify their position. In the meantime, various schemes can be used to help alleviate this problem. The lower frequencies that have been opened for automotive radar permit higher power to be used and they could be candidates for the devices discussed above. It is also possible, in some cases, to transmit power on multiple frequencies and combine the received power to boost the available energy. Energy can of course be stored and periodically used to drive circuits and work is ongoing to reduce the voltage required to operate semiconductors. The devices of this invention will make use of some or all of these developments as they take place.

If the vehicle has been at rest for a significant time period, power will leak from the storage capacitors and will not be available for transmission. However, a few tire rotations are sufficient to provide the necessary energy.

U.S. patent application Ser. No. 08/819,609, assigned to the current assignee of this invention, provides multiple means for determining the amount of gas in a gas tank. Using the SAW pressure devices of this invention, multiple pressure sensors can be placed at appropriate locations within a fuel tank to measure the fluid pressure and thereby determine the quantity of fuel remaining in the tank. This is illustrated in FIG. 33. In this example, four SAW pressure transducers 402 are placed on the bottom of the fuel tank and one SAW pressure transducer 403 is placed at the top of the fuel tank to eliminate the effects of vapor pressure within tank. Using neural networks, or other pattern recognition techniques, the quantity of fuel in the tank can be accurately determined from these pressure readings in a manner similar that described the '609 patent application. The SAW measuring device illustrated in FIG. 33A combines temperature and pressure measurements in a single unit using parallel paths 405 and 406 in the same manner as described above

Occupant weight sensors can give erroneous results if the seatbelt is pulled tight pushing the occupant into the seat. This is particularly a problem when the seatbelt is not attached to the seat. For such cases, it has been proposed to measure the tension in various parts of the seatbelt. Using conventional technology requires that such devices be hardwired into the vehicle complicating the wire harness.

With reference to FIG. 34, using a SAW strain gage as described above, the tension in the seat belt 500 can be measured without the requirement of power or signal wires. FIG. 34 illustrates a powerless and wireless passive SAW strain gage based device 502 for this purpose. There are many other places that such a device can be mounted to measure the tension in the seatbelt at one or at multiple places.

FIG. 35 illustrates another version of a tire temperature and/or pressure monitor 510. Monitor 510 may include at an inward end, any one of the temperature transducers or sensors described above and/or any one of the pressure transducers or sensors described above, or any one of the combination temperature and pressure transducers or sensors described above.

The monitor 510 has an elongate body attached through the wheel rim 513 typically on the inside of the tire so that the under-vehicle mounted antenna(s) have a line of sight view of antenna 515. Monitor 510 is connected to an inductive wire 512, which matches the output of the device with the antenna 515, which is part of the device assembly. Insulating material 511 surrounds the body which provides an air tight seal and prevents electrical contact with the wheel rim 513.

FIG. 36A shows a schematic of a prior art airbag module deployment scheme in which sensors, which detect data for use in determining whether to deploy an airbag in the airbag module, are wired to an electronic control unit (ECU) and a command to initiate deployment of the airbag in the airbag module is sent wirelessly.

By contrast, as shown in FIG. 36B, in accordance with the invention, the sensors are wireless connected to the electronic control unit and thus transmit data wirelessly. The ECU is however wired to the airbag module.

SAW sensors also have applicability to various other sectors of the vehicle, including the powertrain, chassis, and occupant comfort and convenience. For example, SAW sensors have applicability to sensors for the powertrain area including oxygen sensors, gear-tooth Hall effect sensors, variable reluctance sensors, digital speed and position sensors, oil condition sensors, rotary position sensors, low pressure sensors, manifold absolute pressure/manifold air temperature (MAP/MAT) sensors, medium pressure sensors, turbo pressure sensors, knock sensors, coolant/fluid temperature sensors, and transmission temperature sensors.

SAW sensors for chassis applications include gear-tooth Hall effect sensors, variable reluctance sensors, digital speed and position sensors, rotary position sensors, non-contact steering position sensors, and digital ABS (anti-lock braking system) sensors.

SAW sensors for the occupant comfort and convenience area include low-pressure sensors, IVAC temperature and humidity sensors, air temperature sensors, and oil condition sensors.

SAW sensors also have applicability such areas as controlling evaporative emissions, transmission shifting, mass air flow meters, oxygen, NOx and hydrocarbon sensors. SAW based sensors are particularly useful in high temperature environments where many other technologies fail.

SAW sensors can facilitate compliance with U.S. regulations concerning evaporative system monitoring in vehicles, through a SAW fuel vapor pressure and temperature sensors that measure fuel vapor pressure within the fuel tank as well as temperature. If vapors leak into the atmosphere, the pressure within the tank drops. The sensor notifies the system of a fuel vapor leak, resulting in a warning signal to the driver and/or notification to a repair facility. This application is particularly important since the condition within the furl tank can be ascertained wirelessly reducing the chance of a fuel fire in an accident. The same interrogator that monitors the tire pressure SAW sensors can also monitor the fuel vapor pressure and temperature sensors resulting in significant economies.

A SAW humidity sensor can be used for measuring the relative humidity and the resulting information can be input to the engine management system or the heating, ventilation, and air conditioning (HVAC) system for more efficient operation. The relative humidity of the air entering an automotive engine impacts the engine's combustion efficiency; i.e., the ability of the spark plugs to ignite the fuel/air mixture in the combustion chamber at the proper time. A SAW humidity sensor in this case can measure the humidity level of the incoming engine air, helping to calculate a more precise fuel/air ratio for improved fuel economy and reduced emissions.

Dew point conditions are reached when the air is fully saturated with water. When the cabin dew point temperature matches the windshield glass temperature, water from the air condenses quickly, creating frost or fog. A SAW humidity sensor with a temperature-sensing element and a window glass-temperature-sensing element can prevent the formation of visible fog formation by automatically controlling the HVAC system.

Among the inventions disclosed above is an arrangement for obtaining and conveying information about occupancy of a passenger compartment of a vehicle comprises at least one wave-receiving sensor for receiving waves from the passenger compartment, generating means coupled to the wave-receiving sensor(s) for generating information about the occupancy of the passenger compartment based on the waves received by the wave-receiving sensor(s) and communications means coupled to the generating means for transmitting the information about the occupancy of the passenger compartment. As such, response personnel can receive the information about the occupancy of the passenger compartment and respond appropriately, if necessary. There may be several wave-receiving sensors and they may be, e.g., ultrasonic wave-receiving sensors, electromagnetic wave-receiving sensors, capacitance or electric field sensors, or combinations thereof. The information about the occupancy of the passenger compartment can include the number of occupants in the passenger compartment, as well as whether each occupant is moving non-reflexively and breathing. A transmitter may be provided for transmitting waves into the passenger compartment such that each wave-receiving sensor receives waves transmitted from the transmitter and modified by passing into and at least partially through the passenger compartment. One or more memory units may be coupled to the generating means for storing the information about the occupancy of the passenger compartment and to the communications means. The communications means then can interrogate the memory unit(s) upon a crash of the vehicle to thereby obtain the information about the occupancy of the passenger compartment. In one particularly useful embodiment, means for determining the health state of at least one occupant are provided, e.g., a heartbeat sensor, a motion sensor such as a micropower impulse radar sensor for detecting motion of the at least one occupant and motion sensor for determining whether the occupant(s) is/are breathing, and coupled to the communications means. The communications means can interrogate the health state determining means upon a crash of the vehicle to thereby obtain and transmit the health state of the occupant(s). The health state determining means can also comprise a chemical sensor for analyzing the amount of carbon dioxide in the passenger compartment or around the at least one occupant or for detecting the presence of blood in the passenger compartment. Movement of the occupant can be determined by monitoring the weight distribution of the occupant(s), or an analysis of waves from the space occupied by the occupant(s). Each wave-receiving sensor generates a signal representative of the waves received thereby and the generating means may comprise a processor for receiving and analyzing the signal from the wave-receiving sensor in order to generate the information about the occupancy of the passenger compartment. The processor can comprise pattern recognition means for classifying an occupant of the seat so that the information about the occupancy of the passenger compartment includes the classification of the occupant. The wave-receiving sensor may be a micropower impulse radar sensor adapted to detect motion of an occupant whereby the motion of the occupant or absence of motion of the occupant is indicative of whether the occupant is breathing. As such, the information about the occupancy of the passenger compartment generated by the generating means is an indication of whether the occupant is breathing. Also, the wave-receiving sensor may generate a signal representative of the waves received thereby and the generating means receive this signal over time and determine whether any occupants in the passenger compartment are moving. As such, the information about the occupancy of the passenger compartment generated by the generating means includes the number of moving and non-moving occupants in the passenger compartment.

A related method for obtaining and conveying information about occupancy of a passenger compartment of a vehicle comprises the steps of receiving waves from the passenger compartment, generating information about the occupancy of the passenger compartment based on the received waves, and transmitting the information about the occupancy of the passenger compartment whereby response personnel can receive the information about the occupancy of the passenger compartment. Waves may be transmitted into the passenger compartment whereby the transmitted waves are modified by passing into and at least partially through the passenger compartment and then received. The information about the occupancy of the passenger compartment may be stored in at least one memory unit which is subsequently interrogated upon a crash of the vehicle to thereby obtain the information about the occupancy of the passenger compartment. A signal representative of the received waves can be generated by sensors and analyzed in order to generate the information about the state of health of at least one occupant of the passenger compartment and/or to generate the information about the occupancy of the passenger compartment (i.e., determine non-reflexive movement and/or breathing indicating life). Pattern recognition techniques, e.g., a trained neural network, can be applied to analyze the signal and thereby recognize and identify any occupants of the passenger compartment. In this case, the identification of the occupants of the passenger compartment can be included into the information about the occupancy of the passenger compartment.

All of the above-described methods and apparatus, as well as those further described below, may be used in conjunction with one another and in combination with the methods and apparatus for optimizing the driving conditions for the occupants of the vehicle described herein.

Also described above is an embodiment of a component diagnostic system for diagnosing the component in accordance with the invention which comprises a plurality of sensors not directly associated with the component, i.e., independent therefrom, such that the component does not directly affect the sensors, each sensor detecting a signal containing information as to whether the component is operating normally or abnormally and outputting a corresponding electrical signal, processor means coupled to the sensors for receiving and processing the electrical signals and for determining if the component is operating abnormally based on the electrical signals, and output means coupled to the processor means for affecting another system within the vehicle if the component is operating abnormally. The processor means preferably comprise pattern recognition means such as a trained pattern recognition algorithm, a neural network, modular neural networks, an ensemble of neural networks, a cellular neural network, or a support vector machine. In some cases, fuzzy logic will be used which can be combined with a neural network to form a neural fuzzy algorithm. The another system may be a display for indicating the abnormal state of operation of the component arranged in a position in the vehicle to enable a driver of the vehicle to view the display and thus the indicated abnormal operation of the component. At least one source of additional information, e.g., the time and date, may be provided and input means coupled to the vehicle for inputting the additional information into the processor means. The another system may also be a warning device including transmission means for transmitting information related to the component abnormal operating state to a site remote from the vehicle, e.g., a vehicle repair facility.

In another embodiment of the component diagnostic system discussed above, at least one sensor detects a signal containing information as to whether the component is operating normally or abnormally and outputs a corresponding electrical signal. A processor or other computing device is coupled to the sensor(s) for receiving and processing the electrical signal(s) and for determining if the component is operating abnormally based thereon. The processor preferably comprises or embodies a pattern recognition algorithm for analyzing a pattern within the signal detected by each sensor. An output device (or multiple output devices) is coupled to the processor for affecting another system within the vehicle if the component is operating abnormally. The other system may be a display as mentioned above or a warning device.

A method for automatically monitoring one or more components of a vehicle during operation of the vehicle on a roadway entails, as discussed above, the steps of monitoring operation of the component in order to detect abnormal operation of the component, e.g., in one or the ways described above, and if abnormal operation of the component is detected, automatically directing the vehicle off of the restricted roadway. For example, in order to automatically direct the vehicle off of the restricted roadway, a signal representative of the abnormal operation of the component may be generated and directed to a guidance system of the vehicle that guides the movement of the vehicle. Possibly the directing the vehicle off of the restricted roadway may entail applying satellite positioning techniques or ground-based positioning techniques to enable the current position of the vehicle to be determined and a location off of the restricted highway to be determined and thus a path for the movement of the vehicle. Re-entry of the vehicle onto the restricted roadway may be prevented until the abnormal operation of the component is satisfactorily addressed.

Although several preferred embodiments are illustrated and described above, there are possible combinations using other signals and sensors for the components and different forms of the neural network implementation or different pattern recognition technologies that perform the same functions which can be utilized in accordance with the invention. Also, although the neural network and modular neural networks have been described as an example of one means of pattern recognition, other pattern recognition means exist and still others are being developed which can be used to identify potential component failures by comparing the operation of a component over time with patterns characteristic of normal and abnormal component operation. In addition, with the pattern recognition system described above, the input data to the system may be data which has been pre-processed rather than the raw signal data either through a process called "feature extraction" or by various mathematical transformations. Also, any of the apparatus and methods disclosed herein may be used for diagnosing the state of operation or a plurality of discrete components.

In other embodiments disclosed above, the state of the entire vehicle is diagnosed whereby two or more sensors, preferably acceleration sensors and gyroscopes, detect the state of the vehicle and if the state is abnormal, output means are coupled to the processor means for affecting another system in the vehicle. The another system may be the steering control system, the brake system, the accelerator or the frontal or side occupant protection system. An exemplifying control system for controlling a part of the vehicle in accordance with the invention thus comprises a plurality of sensor systems mounted at different locations on the vehicle, each sensor system providing a measurement related to a state of the sensor system or a measurement related to a state of the mounting location, and a processor coupled to the sensor systems and arranged to diagnose the state of the vehicle based on the measurements of the sensor system, e.g., by the application of a pattern recognition technique. The processor controls the part based at least in part on the diagnosed state of the vehicle. At least one of the sensor systems may be a high dynamic range accelerometer or a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope, and may optionally include an RFID response unit. The gyroscope may be a MEMS-IDT gyroscope including a surface acoustic wave resonator which applies standing waves on a piezoelectric substrate. If an RFID response unit is present, the control system would then comprise an RFID interrogator device which causes the RFID response unit(s) to transmit a signal representative of the measurement of the sensor system associated therewith to the processor.

The state of the vehicle diagnosed by the processor may be the vehicle's angular motion, angular acceleration and/or angular velocity. As such, the steering system, braking system or throttle system may be controlled by the processor in order to maintain the stability of the vehicle. The processor can also be arranged to control an occupant restraint or protection device in an attempt to minimize injury to an occupant.

The state of the vehicle diagnosed by the processor may also be a determination of a location of an impact between the vehicle and another object. In this case, the processor can forecast the severity of the impact using the force/crush properties of the vehicle at the impact location and control an occupant restraint or protection device based at least in part on the severity of the impact.

The system can also include a weight sensing system coupled to a seat in the vehicle for sensing the weight of an occupying item of the seat. The weight sensing system is coupled to the processor whereby the processor controls deployment or actuation of the occupant restraint or protection device based on the state of the vehicle and the weight of the occupying item of the seat sensed by the weight sensing system.

A display may be coupled to the processor for displaying an indication of the state of the vehicle as diagnosed by the processor. A warning device may be coupled to the processor for relaying a warning to an occupant of the vehicle relating to the state of the vehicle as diagnosed by the processor. Further, a transmission device may be coupled to the processor for transmitting a signal to a remote site relating to the state of the vehicle as diagnosed by the processor.

The state of the vehicle diagnosed by the processor may include angular acceleration of the vehicle whereby angular velocity and angular position or orientation are derivable from the angular acceleration. The processor can then be arranged to control the vehicle's navigation system based on the angular acceleration of the vehicle.

A method for controlling a part of the vehicle in accordance with the invention comprises the step of mounting a plurality of sensor systems at different locations on the vehicle, measuring a state of the sensor system or a state of the respective mounting location of the sensor system, diagnosing the state of the vehicle based on the measurements of the state of the sensor systems or the state of the mounting locations of the sensor systems, and controlling the part based at least in part on the diagnosed state of the vehicle. The state of the sensor system may be any one or more of the acceleration, angular acceleration, angular velocity or angular orientation of the sensor system. Diagnosis of the state of the vehicle may entail determining whether the vehicle is stable or is about to rollover or skid and/or determining a location of an impact between the vehicle and another object. Diagnosis of the state of the vehicle may also entail determining angular acceleration of the vehicle based on the acceleration measured by accelerometers if multiple accelerometers are present as the sensor systems.

Another control system for controlling a part of the vehicle in accordance with the invention comprises a plurality of sensor systems mounted on the vehicle, each providing a measurement of a state of the sensor system or a state of the mounting location of the sensor system and generating a signal representative of the measurement, and a pattern recognition system for receiving the signals from the sensor systems and diagnosing the state of the vehicle based on the measurements of the sensor systems. The pattern recognition system generates a control signal for controlling the part based at least in part on the diagnosed state of the vehicle. The pattern recognition system may comprise one or more neural networks. The features of the control system described above may also be incorporated into this control system to the extent feasible.

The state of the vehicle diagnosed by the pattern recognition system may include a state of an abnormally operating component whereby the pattern recognition system is designed to identify a potentially malfunctioning component based on the state of the component measured by the sensor systems and determine whether the identified component is operating abnormally based on the state of the component measured by the sensor systems.

In one preferred embodiment, the pattern recognition system may comprise a neural network system and the state of the vehicle diagnosed by the neural network system includes a state of an abnormally operating component. The neural network system includes a first neural network for identifying a potentially malfunctioning component based on the state of the component measured by the sensor systems and a second neural network for determining whether the identified component is operating abnormally based on the state of the component measured by the sensor systems.

Modular neural networks can also be used whereby the neural network system includes a first neural network arranged to identify a potentially malfunctioning component based on the state of the component measured by the sensor systems and a plurality of additional neural networks. Each of the additional neural networks is trained to determine whether a specific component is operating abnormally so that the measurements of the state of the component from the sensor systems-are input into that one of the additional neural networks trained on a component which is substantially identical to the identified component.

Another method for controlling a part of the vehicle comprises the steps of mounting a plurality of sensor systems on the vehicle, measuring a state of the sensor system or a state of the respective mounting location of the sensor system, generating signals representative of the measurements of the sensor systems, inputting the signals into a pattern recognition system to obtain a diagnosis of the state of the vehicle and controlling the part based at least in part on the diagnosis of the state of the vehicle.

In one notable embodiment, a potentially malfunctioning component is identified by the pattern recognition system based on the states measured by the sensor systems and the pattern recognition system determine whether the identified component is operating abnormally based on the states measured by the sensor systems. If the pattern recognition system comprises a neural network system, identification of the component entails inputting the states measured by the sensor systems into a first neural network of the neural network system and the determination of whether the identified component is operating abnormally entails inputting the states measured by the sensor systems into a second neural network of the neural network system. A modular neural network system can also be applied in which the states measured by the sensor systems are input into a first neural network and a plurality of additional neural networks are provided, each being trained to determine whether a specific component is operating abnormally, whereby the states measured by the sensor systems are input into that one of the additional neural networks trained on a component which is substantially identical to the identified component.

Another control system for controlling a part of the vehicle based on occupancy of the seat in accordance with the invention comprises a plurality of strain gages mounted in connection with the seat, each measuring strain of a respective mounting location caused by occupancy of the seat, and a processor coupled to the strain gages and arranged to determine the weight of an occupying item based on the strain measurements from the strain gages over a period of time, i.e., dynamic measurements. The processor controls the part based at least in part on the determined weight of the occupying item of the seat. The processor can also determine motion of the occupying item of the seat based on the strain measurements from the strain gages over the period of time. One or more accelerometers may be mounted on the vehicle for measuring acceleration in which case, the processor may control the part based at least in part on the determined weight of the occupying item of the seat and the acceleration measured by the accelerometer(s). By comparing the output of various sensors in the vehicle, it is possible to determine activities that are affecting parts of the vehicle while not affecting other parts. For example, by monitoring the vertical accelerations of various parts of the vehicle and comparing these accelerations with the output of strain gage load cells placed on the seat support structure, a characterization can be made of the occupancy of the seat. Not only can the weight of an object occupying the seat be determined, but also the gross motion of such an object can be ascertained and thereby an assessment can be made as to whether the object is a life form such as a human being.

Strain gage weight sensors are disclosed in U.S. patent application Ser. No. 09/193,209 filed Nov. 17, 1998 (corresponding to International Publication No. WO 00/29257), which is incorporated herein by reference its entirety as if the entire application were set forth herein. In particular, the inventors contemplate the combination of all of the ideas expressed in this patent application with those expressed in the current invention.

Although several preferred embodiments are illustrated and described above, there are possible combinations using other geometries, sensors, materials and different dimensions for the components that perform the same functions. This invention is not limited to the above embodiments and should be determined by the following claims.

I claim:

1. A vehicle, comprising:

a diagnostic system arranged on the vehicle to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to automatically establish a communications channel between the vehicle and a remote facility without manual intervention and wirelessly transmit the output of said diagnostic system to the remote facility.

2. The vehicle of claim 1, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

3. The vehicle of claim 2, wherein said sensors are wirelessly coupled to said processor.

4. The vehicle of claim 2, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

5. The vehicle of claim 1, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

6. The vehicle of claim 1, wherein said communications device comprises a cellular telephone system including an antenna.

7. The vehicle of claim 1, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle to the remote facility.

8. The vehicle of claim 1, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle to the remote facility.

9. The vehicle of claim 1, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrogate said memory unit to obtain the stored diagnosis to enable transmission thereof.

10. The vehicle of claim 1, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

11. The vehicle of claim 10, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

12. The vehicle of claim 10, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing said RFID response unit of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

13. The vehicle of claim 10, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

14. The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of temperature and pressure.

15. The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of the presence and concentration of a chemical.

16. The vehicle of claim 1, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

17. The vehicle of claim 2, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

18. The vehicle of claim 1, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

19. The vehicle of claim 1, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle to the remote facility.

20. The vehicle of claim 19, wherein said location determining system uses GPS technology.

21. A method for monitoring a vehicle, comprising the steps of:

diagnosing the state of the vehicle or the state of a component of the vehicle by means of a diagnostic system arranged on the vehicle;

generating an output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle; and

transmitting the output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle from the vehicle to a remote location.

22. The vehicle of claim 21, wherein the step of transmitting the output to a remote location comprises the step of arranging a communications device comprising a cellular telephone system including an antenna on the vehicle.

23. The method of claim 21, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor embodying a pattern recognition algorithm.

24. The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining whether the vehicle is stable or is about to rollover or skid.

25. The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining a location of an impact between the vehicle and another object.

26. The method of claim 21, further comprising the steps of:

arranging a display in the vehicle in a position to be visible from the passenger compartment; and

displaying the state of the vehicle or the state of a component of the vehicle on the display.

27. The method of claim 21, further comprising the step of relaying a warning to an occupant of the vehicle relating to the state of the vehicle.

28. The method of claim 21, further comprising the steps of:

determining at least one property or characteristic of occupancy of the vehicle; and

transmitting the determined property or characteristic of occupancy of the vehicle to a remote location.

29. The method of claim 28, wherein the step of determining at least one property or characteristic of occupancy of the vehicle comprises the step of determining the number of occupants in the passenger compartment.

30. The method of claim 21, further comprising the steps of:

sensing a state of the environment around the vehicle; and

transmitting information about the environment of the vehicle to a remote location.

31. The method of claim 21, further comprising the steps of:

providing a memory unit in the vehicle to receive the diagnosis of the state of the vehicle or the state of the component of the vehicle and store the diagnosis; and

interrogating the memory unit to obtain the stored diagnosis to enable transmission thereof.

32. The method of claim 21, wherein the step of diagnosing the state of the vehicle or the state of the component of the vehicle comprises the steps of mounting a plurality of sensors on the vehicle, measuring a state of each sensor or a state of the mounting location of each sensor and diagnosing the state of the vehicle or the state of a component of the vehicle based on the measurements of the state of the sensors or the state of the mounting locations of the sensors.

33. The method of claim 32, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor, further comprising the step of wirelessly coupling the sensors to the processor.

34. The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the steps of:

providing at least one of the sensors with an RFID response unit;

mounting at least one RFID interrogator device on the vehicle; and

transmitting signals via the at least one RFID interrogator device to cause the RFID response units of the at least one sensor to transmit a signal representative of the measurements of the at least one sensor to the processor.

35. The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the step of providing at least one of the sensors as a SAW sensor capable of receiving a signal and returning a signal modified by virtue of the state of the SAW sensor or the state of the mounting location of the SAW sensor.

36. The method of claim 35, wherein the SAW sensor is arranged to measure at least one of temperature and pressure.

37. The method of claim 35, wherein the SAW sensor is arranged to measure at least one of concentration and presence of a chemical.

38. The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output to a satellite for transmission from the satellite to the remote location.

39. The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output via the Internet to a web site or host computer associated with the remote location.

40. The method of claim 21, further comprising the steps of:

determining the location of the vehicle; and

transmitting the determined location of the vehicle to the remote location in conjunction with the output.

41. A vehicle, comprising:

a diagnostic system arranged on the vehicle to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system,

said communications device including a transmitter for transmitting a signal representative of the output of said diagnostic system to a satellite for transmission from the satellite to a remote site.

42. The vehicle of claim 41, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

43. The vehicle of claim 42, wherein said sensors are wirelessly coupled to said processor.

44. The vehicle of claim 42, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

45. The vehicle of claim 41, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

46. The vehicle of claim 41, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle.

47. The vehicle of claim 41, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being

coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle.

48. The vehicle of claim **41**, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrogate said memory unit to obtain the stored diagnosis to enable transmission thereof.

49. The vehicle of claim **41**, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

50. The vehicle of claim **49**, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

51. The vehicle of claim **49**, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing said RFID response units of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

52. The vehicle of claim **49**, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

53. The vehicle of claim **41**, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

54. The vehicle of claim **49**, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

55. The vehicle of claim **41**, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

56. The vehicle of claim **41**, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle.

57. A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof, said diagnostic system comprising a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors, at least one of said sensors including an RFID response unit;

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system; and

at least one RFID interrogator device, said at least one interrogator device causing said RFID response unit of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

58. A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof, said diagnostic system comprising a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors, at least one of said sensors including a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system.

59. The vehicle of claim **58**, wherein said SAW sensor is arranged to measure at least one of temperature and pressure.

60. The vehicle of claim **58**, wherein said SAW sensor is arranged to measure at least one of the presence and concentration of a chemical.

61. The method of claim **21**, wherein the step of transmitting the output to the emote facility comprises the step of automatically establishing a communications channel between the vehicle and the remote facility without manual intervention to thereby enable the output to be transmitted from the vehicle to the remote facility.

62. The vehicle of claim **41**, wherein said communications device is arranged to automatically establish a communications channel between the vehicle and the remote site without manual intervention and transmit the output of said diagnostic system to the remote site.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

Bib Data Sheet

CONFIRMATION NO. 4201

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/188,673	07/03/2002 RULE	701	3661	ATI-296

APPLICANTS

David S. Breed, Boonton Township, NJ;

** CONTINUING DATA *************************
This application is a CIP of 10/174,709 06/19/2002
which is a CIP of 09/753,186 01/02/2001 PAT 6,484,080
which is a CIP of 09/137,918 08/20/1998 PAT 6,175,787
which is a CIP of 08/476,077 06/07/1995 PAT 5,809,437
This application 10/188,673
is a CIP of 10/079,065 02/19/2002 PAT 6,662,642
which is a CIP of 09/765,558 01/19/2001 ABN
which claims benefit of 60/269,415 02/16/2001
and claims benefit of 60/291,511 05/16/2001
and claims benefit of 60/304,013 07/09/2001
and claims benefit of 60/231,378 09/08/2000

** FOREIGN APPLICATIONS ********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 09/11/2002

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☐ no	NJ	38	56	3
35 USC 119 (a-d) conditions met	☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged	Examiner's Signature Initials				

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22846
BRIAN ROFFE, ESQ
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VALLEY STREAM , NY
11580-6170

TITLE
TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

FILING FEE RECEIVED 834	FEES: Authority has been given in Paper No. _________ to charge/credit DEPOSIT ACCOUNT No. _________ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other ________ ❑ Credit

DRS

PATENT APPLICATION SERIAL NO. ____________________

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

07/15/2002 MBIZUNES 00000020 500266 10188673

01 FC:201 370.00 CH
02 FC:203 324.00 CH

PTO-1556
(5/87)

07-05-02 10188673 .070502

PTO/SB/05 (03-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	ATI-296
First Inventor	David S. Breed
Title	Telematics System Using...
Express Mail Label No.	EV047227550US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [X] Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing)
2. [X] Applicant claims small entity status. See 37 CFR 1.27.
3. [X] Specification [Total Pages 114]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. [X] Drawing(s) (35 U.S.C. 113) [Total Sheets 38]
5. Oath or Declaration [Total Pages 2]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 CFR 1.63 (d)) (for continuation/divisional with Box 18 completed)
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76
7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix)
8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
   a. [ ] Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [X] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
11. [ ] English Translation Document (if applicable)
12. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [X] Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
15. [ ] Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. [ ] Nonpublication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. [ ] Other: ....

18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:

[ ] Continuation [ ] Divisional [X] Continuation-in-part (CIP) of prior application No.: 10 / 174709

Prior application information: Examiner: ________ Group Art Unit: ________

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label 22846 (Insert Customer No. or Attach bar code label here) or [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Fax	

Name (Print/Type)	Brian Roffe	Registration No. (Attorney/Agent)	35,336
Signature	Brian Roffe	Date	7/3/2002

10188673 .070302

PTO/SB/17 (10-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 734

Complete if Known	
Application Number	
Filing Date	July 3, 2002
First Named Inventor	David S. Breed
Examiner Name	
Group Art Unit	
Attorney Docket No.	ATI-296

METHOD OF PAYMENT

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number: 50-0266

Deposit Account Name: Automotive Tech. It'l

[X] Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

[X] Applicant claims small entity status. See 37 CFR 1.27

2. [ ] Payment Enclosed:
[ ] Check [ ] Credit card [ ] Money Order [ ] Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	740	201	370	Utility filing fee	370
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	

SUBTOTAL (1) ($) 370

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	56	-20** =	36	X	9	=	324
Independent Claims	3	-3** =	0	X		=	
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 324

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) ________________

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 40

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Brian Roffe	Registration No. (Attorney/Agent)	35,336	Telephone	516 295-1394
Signature	Brian Roffe			Date	7/3/2002

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

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents Washington, DC 20231.

10188673.070302

Attorney Docket No. ATI-296

UNITED STATES PATENT AND TRADEMARK OFFICE

Re:	Application of:	David S. Breed
	Serial No.:	Not yet known
	Filed:	July 3, 2002
	For:	Telematics System with Vehicle Diagnostics

EXPRESS MAIL CERTIFICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

July 3, 2002

Dear Sir:

Express Mail Label Number	EV 047 227 550 US
Date of Deposit:	July 3, 2002

I hereby certify that the following attached paper(s) or fees(s)

New U.S. Patent application of 114 pages with 37 pages of drawings; utility patent application transmittal, fee transmittal (in duplicate), Declaration/Power of Attorney (2 pages); Information Disclosure Statement; PTO-1449 (2 pages), 9 References Assignment and Recordation Cover Sheet,

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated above and is addressed to the "Assistant Commissioner for Patents, Washington, D.C. 20231"

Respectfully submitted,

Brian Roffe

10188673 .070302

Attorney Docket No. ATI-296

TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

CROSS REFERENCE TO RELATED APPLICATIONS

Ins. a1

This application is a continuation-in-part of U.S. patent application Ser. No. 09/753,186 ~~filed Jan.~~ 2, 2001 which in turn is a continuation-in-part of U.S. ~~patent~~ application Ser. No. 09/137,918 filed Aug. 20, 1998, ~~now U.S. Pat.~~ No. 6,175,787, which in turn is a continuation-in-part of U.S. patent application Ser. No. 08/476,077 filed Jun. 7, 1995, now U.S. Pat. No. 5,809,437.

This application is a continuation-in-part of U.S. patent application Ser. No. 10/079,065 filed Feb. 19, 2002 which in turn is a continuation-in-part of U.S. patent application Ser. No. 09/765,558 filed January 19, 2001, which claims priority under 35 U.S.C. §119(e) of U.S. provisional patent application Ser. No. 60/231,378 filed Sep. 8, 2000.

This application claims priority under 35 U.S.C. §119(e) of U.S. provisional patent application Ser. No. 60/269,415 filed Feb. 16, 2001, U.S. provisional patent application Ser. No. 60/291,511 filed May 16, 2001 and U.S. provisional patent application Ser. No. 60/304,013 filed Jul. 9, 2001 through U.S. patent application Ser. No. 10/079,065 filed Feb. 19, 2002.

This application is a continuation-in-part of U.S. patent application Ser. No. 10/174,709 filed Jun. 19, 2002, and claims benefit of provisional application Ser No 60/269,415 filed Feb 16, 2001.

All of the above-mentioned patents and applications are incorporated by reference herein in their entirety as if they had each been set forth herein in full.

FIELD OF THE INVENTION

The present invention relates to methods and apparatus for diagnosing components in a vehicle and transmitting data relating to the diagnosis of the components in the vehicle and other information relating to the operating conditions of the vehicle to one or more remote locations distant from the vehicle, i.e., via a telematics link.

The present invention also relates to systems and method for diagnosing the state or condition of a vehicle, e.g., whether the vehicle is about to rollover or is experiencing a crash and whether the vehicle has a component which is operating abnormally and could possibly fail resulting in a crash or severe handicap for the operator, and transmitting data relating to the diagnosis of the components in the vehicle and optionally other information relating to the operating conditions of the vehicle to one or more remote locations, i.e., via a telematics link.

The present invention further relates to methods and apparatus for diagnosing components in a vehicle and determining the status of occupants in a vehicle and transmitting data relating to the diagnosis of the components in the vehicle, and optionally other information relating to the operating conditions of the vehicle, and data relating to the occupants to one or more remote facilities such as a repair facility and an emergency response station.

BACKGROUND OF THE INVENTION

It is now generally recognized that it is important to monitor the occupancy of a passenger compartment of a vehicle. For example, U.S. Pat. No. 5,829,782 (Breed et al.) describes a vehicle interior monitoring system that utilizes pattern recognition techniques and wave-receiving sensors to obtain information about the occupancy of the passenger compartment and uses this information to affect the operation of one or more systems in the vehicle, including an occupant restraint device, an entertainment system, a heating and air-conditioning system, a vehicle communication system, a distress notification system, a light filtering system and a security system.

Of particular interest, Breed et al. mentions that the presence of a child in a rear facing child seat placed on the right front passenger seat may be detected as this has become an industry-wide concern to prevent deployment of an occupant restraint device in these situations. The U.S. automobile industry is continually searching for an easy, economical solution, which will prevent the deployment of the passenger side airbag if a rear facing child seat is present.

Another important aspect disclosed in Breed et al. relates to the operation of the cellular communications system in conjunction with the vehicle interior monitoring system. Vehicles can be provided with a standard cellular phone as well as the Global Positioning System (GPS), an automobile navigation or location system with an optional connection to a manned assistance facility. In the event of an accident, the phone may automatically call 911 for emergency assistance and report the exact position of the vehicle. If the vehicle also has a system as described below for monitoring each seat location, the number and perhaps the condition of the occupants could also be reported. In that way the emergency service (EMS) would know what equipment and how many ambulances to send to the accident site. Moreover, a communication channel can be opened between the vehicle and a monitoring facility/emergency response facility or personnel to determine how badly people are injured, the number of occupants in the vehicle, and to enable directions to be provided to the occupant(s) of the vehicle to assist in any necessary first aid prior to arrival of the emergency assistance personnel.

Communications between a vehicle and a remote assistance facility are also important for the purpose of diagnosing problems with the vehicle and forecasting problems with the vehicle, called prognostics. Motor vehicles contain complex mechanical systems that are monitored and regulated by computer systems such as electronic control units (ECUs) and the like. Such ECUs monitor various components of the vehicle including engine performance, carburation, speed/acceleration control, transmission, exhaust gas recirculation (EGR), braking systems, etc. However, vehicles perform such monitoring typically only for the vehicle driver and without communication of any impending results, problems and/or vehicle malfunction to a remote site for trouble-shooting, diagnosis or tracking for data mining.

In the past, systems that provide for remote monitoring did not provide for automated analysis and communication of problems or potential problems and recommendations to the driver. As a result, the vehicle driver or user is often left stranded, or irreparable damage occurs to the vehicle as a result of neglect or driving the vehicle without the user knowing the vehicle is malfunctioning until it is too late, such as low oil level and a malfunctioning warning light, fan belt about to fail, failing radiator hose etc.

In this regard, U.S. Pat. No. 5,400,018 (Scholl et al.) describes a system for relaying raw sensor output from an off road work site relating to the status of a vehicle to a remote location over a communications data link. The information consists of fault codes generated by sensors and electronic control modules indicating that a failure has occurred rather than forecasting a failure. The vehicle does not include a system for performing diagnosis. Rather, the raw sensor data is processed at an off-vehicle location in order to arrive at a diagnosis of the vehicle's operating condition. Bi-directional communications are described in that a request for additional information can be sent to the vehicle from the remote location with the vehicle responding and providing the requested information but no such communication takes place with the vehicle operator and not of an operator of a vehicle traveling on a road. Also, Scholl et al. does not teach the diagnostics of the problem or potential problem on the vehicle itself nor does it teach the automatic diagnostics or any prognostics. In Scholl et al. the determination of the problem occurs at the remote site by human technicians.

U.S. Pat. No. 5,754,965 (Hagenbuch) describes an apparatus for diagnosing the state of health of a vehicle and providing the operator of the vehicle with a substantially real-time indication of the efficiency of the vehicle in performing as assigned task with respect to a predetermined goal. A processor in the vehicle monitors sensors that provide information regarding the state of health of the vehicle and the amount of work the vehicle has done. The processor records information that describes events leading up to the occurrence of an anomaly for later analysis. The sensors are also used to prompt the operator to operate the vehicle at optimum efficiency.

U.S. Pat. No. 5,955,942 (Slifkin et al.) describes a method for monitoring events in vehicles in which electrical outputs representative of events in the vehicle are produced, the characteristics of one event are compared with the characteristics of other events accumulated over a given period of time and departures or variations of a given extent from the other characteristics are determined as an indication of a significant event. A warning is sent in response to the indication, including the position of the vehicle as determined by a global positioning system on the vehicle. For example, for use with a railroad car, a microprocessor responds to outputs of an accelerometer by comparing acceleration characteristics of one impact with accumulated acceleration characteristics of other impacts and determines departures of a given magnitude from the other characteristics as a failure indication which gives rise of a warning.

Every automobile driver fears that his or her vehicle will breakdown at some unfortunate time, e.g., when he or she is traveling at night, during rush hour, or on a long trip away from home. To help alleviate that fear, certain luxury automobile manufacturers provide roadside service in the event of a breakdown. Nevertheless, unless the vehicle is equipped with OnStar® or an equivalent service, the vehicle driver must still be able to get to a telephone to call for service. It is also a fact that many people purchase a new automobile out of fear of a breakdown with their current vehicle. This invention is primarily concerned with preventing breakdowns and with minimizing maintenance costs by predicting component failure that would lead to such a breakdown before it occurs.

When a vehicle component begins to fail, the repair cost is frequently minimal if the impending failure of the component is caught early, but increases as the repair is delayed. Sometimes if a component in need of repair is not caught in a timely manner, the component, and particularly the impending failure thereof, can cause other components of the vehicle to deteriorate. One example is where the water pump fails gradually until the vehicle overheats and blows a head gasket. It is desirable, therefore, to determine that a vehicle component is about to fail as early as possible so as to minimize the probability of a breakdown and the resulting repair costs.

There are various gages on an automobile which alert the driver to various vehicle problems. For example, if the oil pressure drops below some predetermined level, the driver is warned to stop his vehicle immediately. Similarly, if the coolant temperature exceeds some predetermined value, the driver is also warned to take immediate corrective action. In these cases, the warning often comes too late as most vehicle gages alert the driver after he or she can conveniently solve the problem. Thus, what is needed is a component failure warning system that alerts the driver to the impending failure of a component sufficiently in advance of the time when the problem gets to a catastrophic point.

Some astute drivers can sense changes in the performance of their vehicle and correctly diagnose that a problem with a component is about to occur. Other drivers can sense that their vehicle is performing differently but they don't know why or when a component will fail or how serious that failure will be, or possibly even what specific component is the cause of the difference in performance. The invention disclosed herein will, in most cases, solve this problem by predicting component failures in time to permit maintenance and thus prevent vehicle breakdowns.

Presently, automobile sensors in use are based on specific predetermined or set levels, such as the coolant temperature or oil pressure, whereby an increase above the set level or a decrease below the set level will activate the sensor, rather than being based on changes in this level over time. The rate at which coolant heats up, for example, can be an important clue that some component in the cooling system is about to fail. There are no systems currently on automobiles to monitor the numerous vehicle components over time and to compare component performance with normal performance. Nowhere in the vehicle is the vibration signal of a normally operating front wheel stored, for example, or for that matter, any normal signal from any other vehicle component. Additionally, there is no system currently existing on a vehicle to look for erratic behavior of a vehicle component and to warn the driver or the dealer that a component is misbehaving and is therefore likely to fail in the very near future.

Sometimes, when a component fails, a catastrophic accident results. In the Firestone tire case, for example, over 100 people were killed when a tire of a Ford Explorer blew out which caused the Ford Explorer to rollover. Similarly, other component failures can lead to loss of control of the vehicle and a subsequent accident. It is thus very important to accurately forecast that such an event will take place but furthermore, for those cases where the event takes place suddenly without warning, it is also important to diagnose the state of the entire vehicle, which in some cases can lead to automatic corrective action to prevent unstable vehicle motion or rollovers resulting in an accident. Finally, an accurate diagnostic system for the entire vehicle can determine much more accurately the severity of an automobile crash once it has begun by knowing where the accident is taking place on the vehicle (e.g., the part of or location on the vehicle which is being impacted by an object) and what is colliding with the vehicle based on a knowledge of the force deflection characteristics of the vehicle at that location. Therefore, in addition to a component diagnostic, the teachings of this invention also provide a diagnostic system for the entire vehicle prior to and during accidents. In particular, this invention is concerned with the simultaneous monitoring of multiple sensors on the vehicle so that the best possible determination of the state of the vehicle can be determined. Current crash sensors operate independently or at most one sensor may influence the threshold at which another sensor triggers a deployable restraint. In the teachings of this invention, two or more sensors, frequently accelerometers, are monitored simultaneously and the combination of the outputs of these multiple sensors are combined continuously in making the crash severity analysis.

Marko et al. (U.S. Pat. No. 5,041,976) is directed to a diagnostic system using pattern recognition for electronic automotive control systems and particularly for diagnosing faults in the engine of a motor vehicle after they have occurred. For example, Marko et al. is interested in determining cylinder specific faults after the cylinder is operating abnormally. More specifically, Marko et al. is directed to detecting a fault in a vehicular electromechanical system indirectly, i.e., by means of the measurement of parameters of sensors which are affected by that system, and after that fault has already manifested itself in the system. In order to form the fault detecting system, the parameters from these sensors are input to a pattern recognition system for training thereof. Then known faults are introduced and the parameters from the sensors are inputted into the pattern recognition system with an indicia of the known fault. Thus, during subsequent operation, the pattern recognition system can determine the fault of the electromechanical system based on the parameters of the sensors, assuming that the fault was "trained" into the pattern recognition system and has already occurred.

When the electromechanical system is an engine, the parameters input into the pattern recognition system for training thereof, and used for fault detection during operation, all relate to the engine. (If the electromechanical system is other than the engine, then the parameters input into the pattern recognition system would relate to that system.) In other words, each parameter will be affected by the operation of the engine and depend thereon and changes in the operation of the engine will alter the parameter, e.g., the manifold absolute pressure is an indication of the airflow into the engine. In this case, the signal from the manifold absolute pressure sensor may be indicative of a fault in the intake of air into the engine, e.g., the engine is drawing in too much or too little air, and is thus affected by the operation of the engine. Similarly, the mass air flow is the airflow into the engine and is an alternative to the manifold absolute pressure. It is thus a parameter that is directly associated with, related to and dependent on the engine. The exhaust gas oxygen sensor is also affected by the operation of the engine, and thus directly associated therewith, since during normal operation, the mixture of the exhaust gas is neither rich or lean whereas during abnormal engine operation, the sensor will detect an abrupt change indicative of the mixture being too rich or too lean.

Thus, the system of Marko et al. is based on the measurement of sensors which affect or are affected by, i.e., are directly associated with, the operation of the electromechanical system for which faults are to be detected.

However, the system of Marko et al. does not detect faults in the sensors that are conducting the measurements, e.g., a fault in the exhaust gas oxygen sensor, or faults that are only developing but have not yet manifested themselves or faults in other systems. Rather, the sensors are used to detect a fault in the system after it has occurred.

Asami et al. (U.S. Pat. No. 4,817,418) is directed to a failure diagnosis system for a vehicle including a failure display means for displaying failure information to a driver. This system only reports failures after they have occurred and does not predict them.

Tiernan et al. (U.S. Pat. No. 5,313,407) is directed, inter alia, to a system for providing an exhaust active noise control system, i.e., an electronic muffler system, including an input microphone 60 which senses exhaust noise at a first location 61 in an exhaust duct 58. An engine has exhaust manifolds 56,57 feeding exhaust air to the exhaust duct 58. The exhaust noise sensed by the microphone 60 is processed to obtain an output from an output speaker 65 arranged downstream of the input microphone 61 in the exhaust path in order to cancel the noise in the exhaust duct 58.

Haramaty et al. (U.S. Pat. No. 5,406,502) describes a system that monitors a machine in a factory and notifies maintenance personnel remote from the machine (not the machine operator) that maintenance should be scheduled at a time when the machine is not in use. Haramaty et al. does not expressly relate to vehicular applications.

NASA Technical Support Package MFS-26529 "Engine Monitoring Based on Normalized Vibration Spectra", describes a technique for diagnosing engine health using a neural network based system and is incorporated by reference herein in its entirety.

A paper "Using acoustic emission signals for monitoring of production processes" by H. K. Tonshoff et al. also provides a good description of how acoustic signals can be used to predict the state of machine tools and is incorporated by reference herein in its entirety.

Based on the monitoring of vehicular components, systems and subsystems as well as to the measurement of physical and chemical characteristics relating to the vehicle or its components, systems and subsystems, it becomes possible to control and/or affect one or more vehicular system.

An important component or system which is monitored is the tires as failure of one or more of the tires can often lead to a fatal accident. Indeed, tire monitoring is extremely important since NHTSA (National Highway Traffic Safety Administration) has recently linked 148 deaths and more than 525 injuries in the United States to separations, blowouts and other tread problems in Firestone's ATX, ATX II and Wilderness AT tires, 5 million of which were recalled in 2000. Many of the tires were standard equipment on the Ford Explorer. Ford recommends that the Firestone tires on the Explorer sport utility vehicle be inflated to 26 psi, while Firestone recommends 30 psi. It is surprising that a tire can go from a safe condition to an unsafe condition based on an under inflation of 4 psi.

Recent studies in the United States conducted by the Society of Automotive Engineers show that low tire pressure causes about 260,000 accidents annually. Another finding is that about 75% of tire failures each year are preceded by slow air leaks or inadequate tire inflation. Nissan, for example, warns that incorrect tire pressures can compromise the stability and overall handling of a vehicle and can contribute to an accident. Additionally, most non-crash auto fatalities occur while drivers are changing flat tires. Thus, tire failures are clearly a serious automobile safety problem that requires a solution.

About 16% of all car accidents are a result of incorrect tire pressure. Thus, effective pressure and wear monitoring is extremely important. Motor Trend magazine stated that one of the most overlooked maintenance areas on a car is tire pressure. An estimated 40 to 80 percent of all vehicles on the road are operating with under-inflated tires. When under-inflated, a tire tends to flex its sidewall more, increasing its rolling resistance which decreases fuel economy. The extra flex also creates excessive heat in the tire that can shorten its service life.

The Society of Automotive Engineers reports that about 87 percent of all flat tires have a history of under-inflation. About 85% of pressure loss incidents are slow punctures caused either by small-diameter objects trapped in the tire or by larger diameter nails. The leak will be minor as long as the nail is trapped. If the nail comes out, pressure can decrease rapidly. Incidents of sudden pressure loss are potentially the most dangerous for drivers and account for about 15% of all cases.

A properly inflated tire loses approximately 1 psi per month. A defective time can lose pressure at a more rapid rate. About 35 percent of the recalled Bridgestone tires had improper repairs.

Research from a variety of sources suggests that under-inflation can be significant to both fuel economy and tire life. Industry experts have determined that tires under-inflated by a mere 10% wear out about 15% faster. An average driver with an average set of tires can drive an extra 5,000 to 7,000 miles before buying new tires by keeping the tire properly inflated.

The American Automobile Association has determined that under inflated tires cut a vehicle's fuel economy by as much as 2% per psi below the recommended level. If each of a car's tires is supposed to have a pressure of 30 psi and instead has a pressure of 25 psi, the car's fuel efficiency drops by about 10%. Depending on the vehicle and miles driven that could cost from $100 to $500 a year.

The ability to control a vehicle is strongly influenced by tire pressure. When the tire pressure is kept at proper levels, optimum vehicle braking, steering, handling and stability are accomplished. Low tire pressure can also lead to damage to both the tires and wheels.

A Michelin study revealed that the average driver doesn't recognize a low tire until it's 14 psi too low. One of the reasons is that today's radial tire is hard to judge visually because the sidewall flexes even when properly inflated.

Despite all the recent press about keeping tires properly inflated, new research shows that most drivers do not know the correct inflation pressure. In a recent survey, only 45 percent of respondents knew where to look to find the correct pressure, even though 78 percent thought they knew. Twenty-seven percent incorrectly believed the sidewall of the tire carries the correct information and did not know that the sidewall only indicates the maximum pressure for the tire, not the optimum pressure for the vehicle. In another survey, about 60% of the respondents reported that they check tire pressure but only before going on a long trip. The National Highway Traffic Safety Administration estimates that at least one out of every five tires is not properly inflated.

The problem is exacerbated with the new run-flat tires where a driver may not be aware that a tire is flat until it is destroyed. Run-flat tires can be operated at air pressures below normal for a limited distance and at a restricted speed (125 miles at a maximum of 55 mph). The driver must therefore be warned of changes in the condition of the tires so that she can adapt her driving to the changed conditions.

One solution to this problem is to continuously monitor the pressure and perhaps the temperature in the tire. Pressure loss can be automatically detected in two ways: by directly measuring air pressure within the tire or by indirect tire rotation methods. Various indirect methods are based on the number of revolutions each tire makes over an extended period of time through the ABS system and others are based on monitoring the frequency changes in the sound emitted by the tire. In the direct detection case, a sensor is mounted into each wheel or tire assembly, each with its own identity. An on-board computer collects the signals, processes and displays the data and triggers a warning signal in the case of pressure loss.

Under-inflation isn't the only cause of sudden tire failure. A variety of mechanical problems including a bad wheel bearing or a "dragging" brake can cause the tire to heat up and fail. In addition, as may have been a contributing factor in the Firestone case, substandard materials can lead to intra-tire friction and a buildup of heat. The use of re-capped truck tires is another example of heat caused failure as a result by intra-tire friction. An overheated tire can fail suddenly without warning.

As discussed in more detail below, tire monitors, such as those disclosed below, permit the driver to check the vehicle tire pressures from inside the vehicle.

The Transportation Recall Enhancement, Accountability, and Documentation Act, (H.R. 5164, or Public Law No. 106-414) known as the TREAD Act, was signed by President Clinton on November 1, 2000. Section 12, TIRE PRESSURE WARNING, states that: "Not later than one year after the date of enactment of this Act, the Secretary of Transportation, acting through the National Highway Traffic Safety Administration, shall complete a rulemaking for a regulation to require a warning system in a motor vehicle to indicate to the operator when a tire is significantly under-inflated. Such requirement shall become effective not later than 2 years after the date of the completion of such rulemaking." Thus, it is expected that a rule requiring continuous tire monitoring will take effect for the 2004 model year.

This law will dominate the first generation of such systems as automobile manufacturers move to satisfy the requirement. In subsequent years, more sophisticated systems that in addition to pressure will monitor temperature, tire footprint, wear, vibration, etc. Although the Act requires that the tire pressure be monitored, it is believed by the inventors that other parameters are as important as the tire pressure or even more important than the tire pressure as described in more detail below.

Consumers are also in favor of tire monitors. Johnson Controls' market research showed that about 80 percent of consumers believe a low tire pressure warning system is an important or extremely important vehicle feature. Thus, as with other safety products such as airbags, competition to meet customer demands will soon drive this market.

Although, as with most other safety products, the initial introductions will be in the United States, speed limits in the United States and Canada are sufficiently low that tire pressure is not as critical an issue as in Europe, for example, where the drivers often drive much faster.

The advent of microelectromechanical (MEMS) pressure sensors, especially those based on surface acoustical wave (SAW) technology, has now made the wireless and powerless monitoring of tire pressure feasible. This is the basis of the tire pressure monitors described below. According to a Frost and Sullivan report on the U.S. Micromechanical Systems (MEMS) market (June 1997): "A MEMS tire pressure sensor represents one of the most profound opportunities for MEMS in the automotive sector."

There are many wireless tire temperature and pressure monitoring systems disclosed in the prior art patents such as for example, U.S. Pat. Nos. 4,295,102, 4,296,347, 4,317,372, 4,534,223, 5,289,160, 5,612,671, 5,661,651, 5,853,020 and 5,987,980 and International Publication No. WO 01/07271(A1), all of which are illustrative of the state of the art of tire monitoring and are incorporated by reference herein.

Devices for measuring the pressure and/or temperature within a vehicle tire directly can be categorized as those containing electronic circuits and a power supply within the tire, those which contain electronic circuits and derive the power to operate these circuits either inductively, from a generator or through radio frequency radiation, and those that do not contain electronic circuits and receive their operating power only from received radio frequency radiation. For the reasons discussed above, the discussion herein is mainly concerned with the latter category. This category contains devices that operate on the principles of surface acoustic waves (SAW) and the disclosure below is concerned primarily with such SAW devices.

International Publication No. WO 01/07271 describes a tire pressure sensor that replaces the valve and valve stem in a tire.

U.S. Pat. No. 5,231,827 contains a good description and background of the tire-monitoring problem. The device disclosed, however, contains a battery and electronics and is not a SAW device. Similarly, the device described in U.S. Pat. No. 5,285,189 contains a battery as do the devices described in U.S. Pat. Nos. 5,335,540 and 5,559,484. U.S. Pat. No. 5,945,908 applies to a stationary tire monitoring system and does not use SAW devices.

One of the first significant SAW sensor patents is U.S. Pat. No. 4,534,223. This patent describes the use of SAW devices for measuring pressure and also a variety of methods for temperature compensation but does not mention wireless transmission.

U.S. Pat. No. 5,987,980 describes a tire valve assembly using a SAW pressure transducer in conjunction with a sealed cavity. This patent does disclose wireless transmission. The assembly includes a power supply and thus this also distinguishes it from a preferred system of this invention. It is not a SAW system and thus the antenna for interrogating the device in this design must be within one meter, which is closer than needed for a preferred device of this invention.

U.S. Pat. No. 5,698,786 relates to the sensors and is primarily concerned with the design of electronic circuits in an interrogator. U.S. Pat. No. 5,700,952 also describes circuitry for use in the interrogator to be used with SAW devices. In neither of these patents is the concept of using a SAW device in a wireless tire pressure monitoring system described. These patents also do not describe including an identification code with the temperature and/or pressure measurements in the sensors and devices.

U.S. Pat. No. 5,804,729 describes circuitry for use with an interrogator in order to obtain more precise measurements of the changes in the delay caused by the physical or chemical property being measured by the SAW device. Similar comments apply to U.S. Pat. No. 5,831,167. Other related prior art includes U.S. Pat. No. 4,895,017.

Other patents disclose the placement of an electronic device in the sidewall or opposite the tread of a tire but they do not disclose either an accelerometer or a surface acoustic wave device. In most cases, the disclosed system has a battery and electronic circuits.

One method of measuring pressure that is applicable to this invention is disclosed in V.V. Varadan, Y.R. Roh and V.K. Varadan "Local/Global SAW Sensors for Turbulence", IEEE 1989 Ultrasonics Symposium p. 591-594 makes use of a polyvinylidene fluoride (PVDF) piezoelectric film to measure pressure. Mention is made in this article that other piezoelectric materials can also be used. Experimental results are given where the height of a column of oil is measured based on the pressure measured by the piezoelectric film used as a SAW device. In particular, the speed of the surface acoustic wave is determined by the pressure exerted by the oil on the SAW device. For the purposes of the instant invention, air pressure can also be measured in a similar manner by first placing a thin layer of a rubber material onto the surface of the SAW device which serves as a coupling agent from the air pressure to the SAW surface. In this manner, the absolute pressure of a tire, for example, can be measured without the need for a diaphragm and reference pressure greatly simplifying the pressure measurement. Other examples of the use of PVDF film as a pressure transducer can be found in U.S. Pat. Nos. 4,577,510 and 5 341,687, which are incorporated by reference herein, although they are not used as SAW devices.

The following U.S. patents provide relevant information to this invention, and to the extent necessary, all of them are incorporated by reference herein: 4,361,026, 4,620,191, 4,7033,27, 4,724,443, 4,725,841, 4,734,698, 5,691,698, 5,841,214, 6,060,815, 6,107,910, 6,114,971, 6,144,332.

In recent years, SAW devices have been used as sensors in a broad variety of applications. Compared with sensors utilizing alternative technologies, SAW sensors possess outstanding properties, such as high sensitivity, high resolution, and ease of manufacturing by microelectronic technologies. However, the most attractive feature of SAW sensors is that they can be interrogated wirelessly.

DEFINITIONS

As used herein, a diagnosis of the "state of the vehicle" means a diagnosis of the condition of the vehicle with respect to its stability and proper running and operating condition. Thus, the state of the vehicle could be normal when the vehicle is operating properly on a highway or abnormal when, for example, the vehicle is experiencing excessive angular inclination (e.g., two wheels are off the ground and the vehicle is about to rollover), the vehicle is experiencing a crash, the vehicle is skidding, and other similar situations. A diagnosis of the state of the vehicle could also be an indication that one of the parts of the vehicle, e.g., a component, system or subsystem, is operating abnormally.

As used herein, an "occupant restraint device" includes any type of device which is deployable in the event of a crash involving the vehicle for the purpose of protecting an occupant from the effects of the crash and/or minimizing the potential injury to the occupant. Occupant restraint devices thus include frontal airbags, side airbags, seatbelt tensioners, knee bolsters, side curtain airbags, externally deployable airbags and the like.

As used herein, a "part" of the vehicle includes any component, sensor, system or subsystem of the vehicle such as the steering system, braking system, throttle system, navigation system, airbag system, seatbelt retractor, air bag inflation valve, air bag inflation controller and airbag vent valve, as well as those listed below in the definitions of "component" and "sensor".

As used herein, a "sensor system" includes any of the sensors listed below in the definition of "sensor" as well as any type of component or assembly of components which detect, sense or measure something.

The term "gage" as used herein interchangeably with the terms "sensor" and "sensing device".

Preferred embodiments of the invention are described below and unless specifically noted, it is the applicants' intention that the words and phrases in the specification and claims be given the ordinary and accustomed meaning to those of ordinary skill in the applicable art(s). If the applicant intends any other meaning, he will specifically state he is applying a special meaning to a word or phrase.

Likewise, applicants' use of the word "function" here is not intended to indicate that the applicants seek to invoke the special provisions of 35 U.S.C. §112, sixth paragraph, to define their invention. To the contrary, if applicants wish to invoke the provisions of 35 U.S.C. §112, sixth paragraph to define their invention, they will specifically set forth in the claims the phrases "means for" or "step for" and a function, without also reciting in that phrase any structure, material or act in support of the function Moreover, even if applicants invoke the provisions of 35 U.S.C. §112, sixth paragraph, to define their invention, it is the applicants' intention that their inventions not be limited to the specific structure, material or acts that are described in the preferred embodiments herein. Rather, if applicants claim their inventions by specifically invoking the provisions of 35 U.S.C. §112, sixth paragraph, it is nonetheless their intention to cover and include any and all structure, materials or acts that perform the claimed function, along with any and all known or later developed equivalent structures, materials or acts for performing the claimed function.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a new and improved method and system for diagnosing components in a vehicle and the operating status of the vehicle and alerting the vehicle's dealer, or another repair facility, via a telematics link that a component of the vehicle is functioning abnormally and may be in danger of failing.

It is still another object of the present invention to provide a new and improved method and apparatus for obtaining information about a vehicle system and components in the vehicle in conjunction with failure of the component or the vehicle and sending this information to the vehicle manufacturer.

It is an object of the present invention to provide a new and improved method and system for diagnosing components in a vehicle by monitoring the patterns of signals emitted from the vehicle components and, through the use of pattern recognition technology, forecasting component failures before they occur. Vehicle component behavior is thus monitored over time in contrast to systems that wait until a serious condition occurs. The forecast of component failure can be transmitted to a remote location via a telematics link.

It is another object of the present invention to provide a new and improved on-board vehicle diagnostic module utilizing pattern recognition technologies which are trained to differentiate normal from abnormal component behavior. The diagnosis of component behavior can be transmitted to a remote location via a telematics link.

It is yet another object of the present invention to provide a diagnostic module that determines whether a component is operating normally or abnormally based on a time series of data from a single sensor or from multiple sensors that contain a pattern indicative of the operating status of the component. The diagnosis of component operation can be transmitted to a remote location via a telematics link.

It is still another object of the present invention to provide a diagnostic module that determines whether a component is operating normally or abnormally based on data from one or more sensors that are not directly associated with the component, i.e., do not depend on the operation of the component. The diagnosis of component operation can be transmitted to a remote location via a telematics link

It is an additional object of the present invention to simultaneously monitor several sensors, primarily accelerometers, gyroscopes and strain gages, to determine the state of the vehicle and optionally its occupants and to determine that a vehicle is out of control and possibly headed for an accident, for example. If so, then a signal can be sent to a part of the vehicle control system to attempt to re-establish stability. If this is unsuccessful, then the same system of sensors can monitor the early stages of a crash to make an assessment of the severity of the crash and what occupant protection systems should be deployed and how such occupant protection systems should be deployed.

Another object of the invention to provide new and improved sensors for a vehicle which wirelessly transmits information about a state measured or detected by the sensor.

It is another object of the invention to incorporate surface acoustic wave technology into sensors on a vehicle with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is another object of the invention to provide new and improved sensors for measuring the pressure, temperature and/or acceleration of tires with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is yet another object of the invention to provide new and improved weight or load measuring sensors, switches, temperature sensors, acceleration sensors, angular position sensors, angular rate sensors, angular acceleration sensors, proximity sensors, rollover sensors, occupant presence and position sensors, strain sensors and humidity sensors which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is still another object of the present invention to provide new and improved sensors for detecting the presence of fluids or gases which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Yet another object of the present invention to provide new and improved sensors for detecting the condition or friction of a road surface which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Still another object of the present invention to provide new and improved sensors for detecting chemicals which utilize wireless data transmission, wireless power transmission, and/or surface acoustic wave technology with the data obtained by the sensors being transmittable via a telematics link to a remote location.

It is another object of the invention to utilize any of the foregoing sensors for a vehicular component control system in which a component, system or subsystem in the vehicle is controlled based on the information provided by the sensor. Additionally, the information provided by the sensor can be transmitted via a telematics link to one or more remote facilities for further analysis.

A more general object of the invention is to provide new and improved sensors which obtain and provide information about the vehicle, about individual components, systems, vehicle occupants, subsystems, or about the roadway, ambient atmosphere, travel conditions and external objects with the data obtained by the sensors being transmittable via a telematics link to a remote location.

Accordingly to achieve one or more of the above objects, a vehicle in accordance with the invention comprises a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof and a communications device coupled to the diagnostic system and arranged to transmit the output of the diagnostic system. The diagnostic system may comprise a plurality of vehicle sensors mounted on the vehicle, each sensor providing a measurement related to a state of the sensor or a measurement related to a state of the mounting location, and a processor coupled to the sensors and arranged to receive data from the sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle. The sensors may be wirelessly coupled to the processor and arranged at different locations on the vehicle. The processor may embody a pattern recognition algorithm trained to generate the output from the data received from the sensors, such as a neural network, fuzzy logic, sensor fusion and the like, and be arranged to control one or more parts of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle. The state of the vehicle can include angular motion of the vehicle.

A display may be arranged in the vehicle in a position to be visible from the passenger compartment. Such as display is coupled to the diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

A warning device may also be coupled to the diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by the diagnostic system.

The communications device may comprise a cellular telephone system including an antenna as well as other similar or different electronic equipment capable of transmitting a signal to a remote location, optionally via a satellite. Transmission via the Internet, i.e., to a web site or host computer associated with the remote location is also a possibility for the invention. If the vehicle is considered it sown site, then the transmission would be a site-to-site transmission via the Internet.

An occupant sensing system can be provided to determine at least one property or characteristic of occupancy of the vehicle. In this case, the communications device is coupled to the occupant sensing system and transmits the determined property or characteristic of occupancy of the vehicle.

In a similar manner, at least one environment sensor can be provided, each sensing a state of the environment around the vehicle. In this case, the communications device is coupled to the environment sensor(s) and transmits the sensed state of the environment around the vehicle.

Moreover, a location determining system, optionally incorporating GPS technology, could be provided on the vehicle to determine the location of the vehicle and transmitted to the remote location along with the diagnosis of the state of the vehicle or its component.

A memory unit may be coupled to the diagnostic system and the communications device. The memory unit receives the diagnosis of the state of the vehicle or the state of a component of the vehicle from the diagnostic system and stores the diagnosis. The communications device then interrogates the memory unit to obtain the stored diagnosis to enable transmission thereof, e.g., at periodic intervals.

The sensors may be any known type of sensor including, but not limited to, a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope. The sensors may include an RFID response unit and an RFID interrogator device which causes the RFID response units to transmit a signal representative of the measurement of the associated sensor to the processor. In addition to or instead or an RFID-based system, one or more SAW sensors can be arranged on the vehicle, each receiving a signal and returning a signal modified by virtue of the state of the sensor or the state of the mounting location of the sensor. For example, the SAW sensor can measure temperature and/or pressure of a component of the vehicle or in a certain location or space on the vehicle, or the concentration and/or presence of a chemical.

A method for monitoring a vehicle comprises diagnosing the state of the vehicle or the state of a component of the vehicle by means of a diagnostic system arranged on the vehicle, generating an output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle, and transmitting the output to a remote location. Transmission of the output to a remote location may entail arranging a communications device comprising a cellular telephone system including an antenna on the vehicle. The output may be to a satellite for transmission from the satellite to the remote location. The output could also be transmitted via the Internet to a web site or host computer associated with the remote location.

It is important to note that raw sensor data is not transmitted from the vehicle the remote location for analysis and processing by the devices and/or personnel at the remote location. Rather, in accordance with the invention, a diagnosis of the vehicle or the vehicle component is performed on the vehicle itself and this resultant diagnosis is transmitted.

The diagnosis of the state of the vehicle may encompass determining whether the vehicle is stable or is about to rollover or skid and/or determining a location of an impact between the vehicle and another object.

A display may be arranged in the vehicle in a position to be visible from the passenger compartment in which case, the state of the vehicle or the state of a component of the vehicle is displayed thereon. Further, a warning can be relayed to an occupant of the vehicle relating to the state of the vehicle.

In addition to the transmission of vehicle diagnostic information obtained by analysis of data from sensors performed on the vehicle, at least one property or characteristic of occupancy of the vehicle may be determined (such as the number of occupants, the status of the occupants-breathing or not, injured or not, etc.) and transmitted to a remote location, the same or a different remote location to which the diagnostic information is sent. The information can also be sent in a different manner than the information relating to the diagnosis of the vehicle.

Additional information for transmission by the components on the vehicle may include a state of the environment around the vehicle, for example, the temperature, pressure, humidity, etc. in the vicinity of the vehicle, and the location of the vehicle.

A memory unit may be provided in the vehicle, possibly as part of a microprocessor, and arranged to receive the diagnosis of the state of the vehicle or the state of the component of the vehicle and store the diagnosis. As such, this memory unit can be periodically interrogated to obtain the stored diagnosis to enable transmission thereof.

Diagnosis of the state of the vehicle or the state of the component of the vehicle may entail mounting a plurality of sensors on the vehicle, measuring a state of each sensor or a state of the mounting location of each sensor and diagnosing the state of the vehicle or the state of a component of the vehicle based on the measurements of the state of the sensors or the state of the mounting locations of the sensors. These functions can be achieved by a processor which is wirelessly coupled to the sensors.

The sensors can optionally be provided with RFID technology, i.e., an RFID response unit, whereby an RFID interrogator device is mounted on the vehicle and signals transmitted via the RFID interrogator device causes the RFID response units of any properly equipped sensors to transmit a signal representative of the measurements of that sensor to the processor.

SAW sensors can also be used, in addition to or instead of RFID-based sensors.

One embodiment of the diagnostic module in accordance with the invention utilizes information which already exists in signals emanating from various vehicle components along with sensors which sense these signals and, using pattern recognition techniques, compares these signals with patterns characteristic of normal and abnormal component performance to predict component failure, vehicle instability or a crash earlier than would otherwise occur if the diagnostic module was not utilized. If fully implemented, this invention is a total diagnostic system of the vehicle. In most implementations, the module is attached to the vehicle and electrically connected to the vehicle data bus where it analyzes data appearing on the bus to diagnose components of the vehicle. In some implementations, multiple distributed accelerometers and/or microphones are present on the vehicle and, in some cases, some of the sensors will communicate using wireless technology to the vehicle bus or directly to the diagnostic module.

Principal objects and advantages of this invention or other inventions disclosed herein are thus:

1. To prevent vehicle breakdowns.

2. To alert the driver of the vehicle that a component of the vehicle is functioning differently than normal and might be in danger of failing.

3. To alert the dealer, or other repair facility, that a component of the vehicle is functioning differently than normal and is in danger of failing.

4. To provide an early warning of a potential component failure and to thereby minimize the cost of repairing or replacing the component.

5. To provide a device which will capture available information from signals emanating from vehicle components for a variety of uses such as current and future vehicle diagnostic purposes.

6. To provide a device that uses information from existing sensors for new purposes thereby increasing the value of existing sensors and, in some cases, eliminating the need for sensors that provide redundant information.

7. To provide a device which is trained to recognize deterioration in the performance of a vehicle component, or of the entire vehicle, based on information in signals emanating from the component or from vehicle angular and linear accelerations.

8. To provide a device which analyzes vibrations from various vehicle components that are transmitted through the vehicle structure and sensed by existing vibration sensors such as vehicular crash sensors used with airbag systems or by special vibration sensors, accelerometers, or gyroscopes.

9. To provide a device which provides information to the vehicle manufacturer of the events leading to a component failure.

10. To apply pattern recognition techniques based on training to diagnosing potential vehicle component failures.

11. To apply component diagnostic techniques in combination with intelligent or smart highways wherein vehicles may be automatically guided without manual control in order to permit the orderly exiting of the vehicle from a restricted roadway prior to a breakdown of the vehicle.

12. To apply trained pattern recognition techniques using multiple sensors to provide an early prediction of the existence and severity of an accident.

13. To utilize pattern recognition techniques and the output from multiple sensors to determine at an early stage that a vehicle rollover might occur and to take corrective action through control of the vehicle acceleration, brakes and steering to prevent the rollover or if it is preventable, to deploy side head protection airbags to reduce the injuries.

14. To use the output from multiple sensors to determine that the vehicle is skidding or sliding and to send messages to the various vehicle control systems to activate the throttle, brakes and/or steering to correct for the vehicle sliding or skidding motion.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiments taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings are illustrative of embodiments of the system developed or adapted using the teachings of this invention and are not meant to limit the scope of the invention as encompassed by the claims.

FIG. 1 is a side view with parts cutaway and removed of a vehicle showing the passenger compartment containing a rear facing child seat on the front passenger seat and a preferred mounting location for an occupant and rear facing child seat presence detector.

FIG. 2 is a side view with parts cutaway and removed showing schematically the interface between the vehicle interior monitoring system of this invention and the vehicle cellular communication system.

FIG. 3 is a diagram of one exemplifying embodiment of the invention.

FIG. 4 is a perspective view of a carbon dioxide SAW sensor for mounting in the trunk lid for monitoring the inside of the trunk for detecting trapped children or animals.

FIG. 4A is a detailed view of the SAW carbon dioxide sensor of FIG. 4.

FIG. 5 is a schematic illustration of a generalized component with several signals being emitted and transmitted along a variety of paths, sensed by a variety of sensors and analyzed by the diagnostic module in accordance with the invention and for use in a method in accordance with the invention.

FIG. 6 is a schematic of one pattern recognition methodology known as a neural network which may be used in a method in accordance with the invention.

FIG. 7 is a schematic of a vehicle with several components and several sensors and a total vehicle diagnostic system in accordance with the invention utilizing a diagnostic module in accordance with the invention and which may be used in a method in accordance with the invention.

FIG. 8 is a flow diagram of information flowing from various sensors onto the vehicle data bus and thereby into the diagnostic module in accordance with the invention with outputs to a display for notifying the driver, and to the vehicle cellular phone for notifying another person, of a potential component failure.

FIG. 9 is a flow chart of the methods for automatically monitoring a vehicular component in accordance with the invention.

FIG. 10 is a schematic illustration of the components used in the methods for automatically monitoring a vehicular component.

FIG. 11 is a schematic of a vehicle with several accelerometers and/or gyroscopes at preferred locations in the vehicle.

FIG. 12 is a schematic view of overall telematics system in accordance with the invention.

FIG. 13A is a partial cutaway view of a tire pressure monitor using an absolute pressure measuring SAW device.

FIG. 13B is a partial cutaway view of a tire pressure monitor using a differential pressure measuring SAW device.

FIG. 14 is a partial cutaway view of an interior SAW tire temperature and pressure monitor mounted onto and below the valve stem.

FIG. 14A is a sectioned view of the SAW tire pressure and temperature monitor of FIG. 14 incorporating an absolute pressure SAW device.

FIG. 14B is a sectioned view of the SAW tire pressure and temperature monitor of FIG. 14 incorporating a differential pressure SAW device.

FIG. 15 is a view of an accelerometer-based tire monitor also incorporating a SAW pressure and temperature monitor and cemented to the interior of the tire opposite the tread.

FIG. 15A is a view of an accelerometer-based tire monitor also incorporating a SAW pressure and temperature monitor and inserted into the tire opposite the tread during manufacture.

FIG. 16 is a detailed view of a polymer on SAW pressure sensor.

FIG. 16A is a view of a SAW temperature and pressure monitor on a single SAW device.

FIG. 16B is a view of an alternate design of a SAW temperature and pressure monitor on a single SAW device.

FIG. 17 is a perspective view of a SAW temperature sensor.

FIG. 17A is a perspective view of a device that can provide two measurements of temperature or one of temperature and another of some other physical or chemical property such as pressure or chemical concentration.

FIG. 17B is a top view of an alternate SAW device capable of determining two physical or chemical properties such as pressure and temperature.

FIGS. 18 and 18A are views of a prior art SAW accelerometer that can be used for the tire monitor assembly of FIG. 15.

FIGS. 19A, 19B, 19C, 19D and 19E are views of occupant seat weight sensors using a slot spanning SAW strain gage and other strain concentrating designs.

FIG. 20A is a view of a view of a SAW switch sensor for mounting on or within a surface such as a vehicle armrest.

FIG. 20B is a detailed perspective view of the device of FIG. 20A with the force transmitting member rendered transparent.

FIG. 20C is a detailed perspective view of an alternate SAW device for use in FIGS. 20A and 20B showing the use of one of two possible switches, one that activates the SAW and the other that suppresses the SAW.

FIG. 21A is a detailed perspective view of a polymer and mass on SAW accelerometer for use in crash sensors, vehicle navigation, etc.

FIG. 21B is a detailed perspective view of a normal mass on SAW accelerometer for use in crash sensors, vehicle navigation, etc.

FIG. 22 is a view of a prior art SAW gyroscope that can be used with this invention.

FIG. 23A, 23B and 23C are a block diagrams of three interrogators that can be used with this invention to interrogate several different devices.

FIG. 24 is a perspective view of a SAW antenna system adapted for mounting underneath a vehicle and for communicating with the four mounted tires.

FIG. 24A is a detail view of an antenna system for use in the system of FIG. 24.

FIG. 25 is an overhead view of a roadway with vehicles and a SAW road temperature and humidity monitoring sensor.

FIG. 25A is a detail drawing of the monitoring sensor of FIG. 25.

FIG. 26 is a perspective view of a SAW system for locating a vehicle on a roadway, and on the earth surface if accurate maps are available. It also illustrates the use of a SAW transponder in the license plate for the location of preceding vehicles and preventing rear end impacts.

FIG. 27 is a partial cutaway view of a section of a fluid reservoir with a SAW fluid pressure and temperature sensor for monitoring oil, water, or other fluid pressure.

FIG. 28 is a perspective view of a vehicle suspension system with SAW load sensors.

FIG. 28A is a cross section detail view of a vehicle spring and shock absorber system with a SAW torque sensor system mounted for measuring the stress in the vehicle spring of the suspension system of FIG. 28.

FIG. 28B is a detail view of a SAW torque sensor and shaft compression sensor arrangement for use with the arrangement of FIG. 28.

FIG. 29 is a cutaway view of a vehicle showing possible mounting locations for vehicle interior temperature, humidity, carbon dioxide, carbon monoxide, alcohol or other chemical or physical property measuring sensors.

FIG. 30A is a perspective view of a SAW tilt sensor using four SAW assemblies for tilt measurement and one for temperature.

FIG. 30B is a top view of a SAW tilt sensor using three SAW assemblies for tilt measurement each one of which can also measure temperature.

FIG. 31 is a perspective exploded view of a SAW crash sensor for sensing frontal, side or rear crashes.

FIG. 32 is a partial cutaway view of a piezoelectric generator and tire monitor using PVDF film.

FIG. 32A is a cutaway view of the PVDF sensor of FIG. 32.

FIG. 33 is a perspective view with portions cutaway of a SAW based vehicle gas gage.

FIG. 33A is a top detailed view of a SAW pressure and temperature monitor for use in the system of FIG. 33.

FIG. 34 is a partial cutaway view of a vehicle driver wearing a seatbelt with SAW force sensors.

FIG. 35 is an alternate arrangement of a SAW tire pressure and temperature monitor installed in the wheel rim facing inside.

FIG. ~~34~~36A is a schematic of a prior art deployment scheme for an airbag module.

FIG. 36B is a schematic of a deployment scheme for an airbag module in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

As noted above, the invention relates generally to telematics and the transmission of information from a vehicle to one or more remote sites which can react to the position or status of the vehicle or occupant(s) therein.

Initially, sensing of the occupancy of the vehicle and the optional transmission of this information, which may include images, to remote locations will be discussed. This entails obtaining information from various sensors about the occupants in the passenger compartment of the vehicle, e.g., the number of occupants, their type and their motion, if any. Thereafter, a discussion of general vehicle diagnostic methods will be discussed with the diagnosis being transmittable via a communications device to the remote locations. Finally, an extensive discussion of various sensors for use on the vehicle to sense different operating parameters and conditions of the vehicle is provided. All of the sensors discussed herein can be coupled to a communications device enabling transmission of data, signals and/or images to the remote locations, and reception of the same from the remote locations.

Referring to the accompanying drawings wherein the same reference numerals refer to the same or similar elements, FIG. 1 is a side view, with parts cutaway and removed of a vehicle showing the passenger compartment containing a rear facing child seat 610 on a front passenger seat 620 and one mounting location for a first embodiment of a vehicle interior monitoring system in accordance with the invention. The interior monitoring system is capable of detecting the presence of an object, determining the type of object, determining the location of the object, and/or determining another property or characteristic of the object. A property of the object could be the orientation of a child seat, the velocity of an adult and the like. For example, the vehicle interior monitoring system can determine that an object is present on the seat, that the object is a child seat and that the child seat is rear-facing. The vehicle interior monitoring system could also determine that the object is an adult, that he is drunk and that he is out of position relative to the airbag.

In this embodiment, six transducers 631, 632, 633, 640, 641 and 646 are used, although any number of transducers may be used. Each transducer 631, 632, 633, 640, 641, 646 may comprise only a transmitter which transmits energy, waves or radiation, only a receiver which receives energy, waves or radiation, both a transmitter and a receiver capable of transmitting and receiving energy, waves or radiation, an electric field sensor, a capacitive sensor, or a self-tuning antenna-based sensor, weight sensor, chemical sensor, motion sensor or vibration sensor, for example.

Such transducers or receivers may be of the type which emit or receive a continuous signal, a time varying signal (such as a capacitor or electric field sensor) or a spacial varying signal such as in a scanning system. One particular type of radiation-receiving receiver for use in the invention is a receiver capable of receiving electromagnetic waves.

When ultrasonic energy is used, transducer 632 can be used as a transmitter and transducers 631,633 as receivers. Naturally, other combinations can be used such as where all transducers are transceivers (transmitters and receivers). For example, transducer 632 can be constructed to transmit ultrasonic energy toward the front passenger seat, which is modified, in this case by the occupying item of the passenger seat, i.e., the rear facing child seat 610, and the modified waves are received by the transducers 631 and 633, for example. A more common arrangement is where transducers 631, 632 and 633 are all transceivers. Modification of the ultrasonic energy may constitute reflection of the ultrasonic energy as the ultrasonic energy is reflected back by the occupying item of the seat. The waves received by transducers 631 and 633 vary with time depending on the shape of the object occupying the passenger seat, in this case the rear facing child seat 610. Each object will reflect back waves having a different pattern. Also, the pattern of waves received by transducer 631 will differ from the pattern received by transducer 633 in view of its different mounting location. This difference generally permits the determination of location of the reflecting surface (i.e., the rear facing child seat 610) through triangulation. Through the use of two transducers 631,633, a sort of stereographic image is received by the two transducers and recorded for analysis by processor 601, which is coupled to the transducers 631,632,633. This image will differ for each object that is placed on the vehicle seat and it will also change for each position of a particular object and for each position of the vehicle seat. Elements 631, 632, 633, although described as transducers, are representative of any type of component used in a wave-based analysis technique.

Mention is made above of the use of wave-type sensors as the transducers 631, 632, 633 as well as electric field sensors. Electric field sensors and wave sensors are essentially the same from the point of view of sensing the presence of an occupant in a vehicle. In both cases, a time varying electric field is disturbed or modified by the presence of the occupant. At high frequencies in the visual, infrared and high frequency radio wave region, the sensor is based on its capability to sense change of wave characteristics of the electromagnetic field, such as amplitude, phase or frequency. As the frequency drops, other characteristics of the field are measured. At still lower frequencies, the occupant's dielectric properties modify parameters of the reactive electric field in the occupied space between/near the plates of a capacitor. In this latter case, the sensor senses the change in charge distribution on the capacitor plates by measuring, for example, the current wave magnitude or phase in the electric circuit that drives the capacitor. These measured parameters are directly connected with parameters of the displacement current in the occupied space. In all cases, the presence of the occupant reflects, absorbs or modifies the waves or variations in the electric field in the space occupied by the occupant. Thus for the purposes of this invention, capacitance, electric field or electromagnetic wave sensors are equivalent and although they are all technically "field" sensors they will be considered as "wave" sensors herein. What follows is a discussion comparing the similarities and differences between two types of field or wave sensors, electromagnetic wave sensors and capacitive sensors as exemplified by Kithil in U.S. Pat. No. 5,702,634.

An electromagnetic field disturbed or emitted by a passenger in the case of an electromagnetic wave sensor, for example, and the electric field sensor of Kithil, for example, are in many ways similar and equivalent for the purposes of this invention. The electromagnetic wave sensor is an actual electromagnetic wave sensor by definition because they sense parameters of a wave, which is a coupled pair of continuously changing electric and magnetic fields. The electric field here is not a static, potential one. It is essentially a dynamic, rotational electric field coupled with a changing magnetic one, that is, an electromagnetic wave. It cannot be produced by a steady distribution of electric charges. It is initially produced by moving electric charges in a transmitter, even if this transmitter is a passenger body for the case of a passive infrared sensor.

In the Kithil sensor, a static electric field is declared as an initial material agent coupling a passenger and a sensor (see Column 5, lines 5-7): "The proximity sensor 12 each function by creating an electrostatic field between oscillator input loop 54 and detector output loop 56, which is affected by presence of a person near by, as a result of capacitive coupling,..."). It is a potential non-rotational electric field. It is not necessarily coupled with any magnetic field. It is the electric field of a capacitor. It can be produced with a steady distribution of electric charges. Thus, it is not an electromagnetic wave by definition but if the sensor is driven by a varying current, then it produces a quasistatic electric field in the space between/near the plates of the capacitor.

Kithil declares that his capacitance sensor uses a static electric field. Thus, from the consideration above, one can conclude that Kithil's sensor cannot be treated as a wave sensor because there are no actual electromagnetic waves but only a static electric field of the capacitor in the sensor system. However, this is not believed to be the case. The Kithil system could not operate with a true static electric field because a steady system does not carry any information. Therefore, Kithil is forced to use an oscillator, causing an alternate current in the capacitor and a reactive quasi-static electric field in the space between the capacitor plates, and a detector to reveal an informative change of the sensor capacitance caused by the presence of an occupant (see Fig. 7 and its description). In this case, the system becomes a "wave sensor' in the sense that it starts generating actual time-varying electric field that certainly originates electromagnetic waves according to the definition above. That is, Kithil's sensor can be treated as a wave sensor regardless of the shape of the electric field that it creates, a beam or a spread shape.

As follows from the Kithil patent, the capacitor sensor is likely a parametric system where the capacitance of the sensor is controlled by influence of the passenger body. This influence is transferred by means of the near electromagnetic field (i.e., the wave-like process) coupling the capacitor electrodes and the body. It is important to note that the same influence takes place with a real static electric field also, that is in absence of any wave phenomenon. This would be a situation if there were no oscillator in Kithil's system However, such a system is not workable and thus Kithil reverts to a dynamic system using time-varying electric fields.

Thus, although Kithil declares the coupling is due to a static electric field, such a situation is not realized in his system because an alternating electromagnetic field ("quasi-wave") exists in the system due to the oscillator. Thus, his sensor is actually a wave sensor, that is, it is sensitive to a change of a wave field in the vehicle compartment. This change is measured by measuring the change of its capacitance. The capacitance of the sensor system is determined by the configuration of its electrodes, one of which is a human body, that is, the passenger inside of and the part which controls the electrode configuration and hence a sensor parameter, the capacitance.

The physics definition of "wave" from Webster's Encyclopedic Unabridged Dictionary is: " 11. *Physics.* A progressive disturbance propagated from point to point in a medium or space without progress or advance of the points themselves,...". In a capacitor, the time that it takes for the disturbance (a change in voltage) to propagate through space, the dielectric and to the opposite plate is generally small and neglected but it is not zero. As the frequency driving the capacitor increases and the distance separating the plates increases, this transmission time as a percentage of the period of oscillation can become significant. Nevertheless, an observer between the plates will see the rise and fall of the electric field much like a person standing in the water of an ocean. The presence of a dielectric body between the plates causes the waves to get bigger as more electrons flow to and from the plates of the capacitor. Thus, an occupant affects the magnitude of these waves which is sensed by the capacitor circuit. Thus, the electromagnetic field is a material agent that carries information about a passenger's position in both Kithil's and a beam-type electromagnetic wave sensor.

For ultrasonic systems, the "image" recorded from each ultrasonic transducer/receiver, is actually a time series of digitized data of the amplitude of the received signal versus time. Since there are two receivers, two time series are obtained which are processed by the processor 601. The processor 601 may include electronic circuitry and associated, embedded software. Processor 601 constitutes one form of generating means in accordance with the invention which generates information about the occupancy of the passenger compartment based on the waves received by the transducers 631,632,633.

When different objects are placed on the front passenger seat, the two images from transducers 631,633, for example, are different but there are also similarities between all images of rear facing child seats, for example, regardless of where on the vehicle seat it is placed and regardless of what company manufactured the child seat. Alternately, there will be similarities between all images of people sitting on the seat regardless of what they are wearing, their age or size. The problem is to find the "rules" which differentiate the images of one type of object from the images of other types of objects, e.g., which differentiate the occupant images from the rear facing child seat images. The similarities of these images for various child seats are frequently not obvious to a person looking at plots of the time series and thus computer algorithms are developed to sort out the various patterns. For a more detailed discussion of pattern recognition see U.S. Pat. No. 5,943,295 to Varga et. al., which is incorporated herein by reference.

The determination of these rules is important to the pattern recognition techniques used in this invention. In general, three approaches have been useful, artificial intelligence, fuzzy logic and artificial neural networks (including cellular and modular or combination neural networks and support vector machines) (although additional types of pattern recognition techniques may also be used, such as sensor fusion). In some implementations of this invention, such as the determination that there is an object in the path of a closing window as described below, the rules are sufficiently obvious that a trained researcher can sometimes look at the returned signals and devise a simple algorithm to make the required determinations. In others, such as the determination of the presence of a rear facing child seat or of an occupant, artificial neural networks are used to determine the rules. One such set of neural network software for determining the pattern recognition rules is available from the NeuralWare Corporation of Pittsburgh, Pennsylvania.

The system used in a preferred implementation of this invention for the determination of the presence of a rear facing child seat, of an occupant or of an empty seat is the artificial neural network. In this case, the network operates on the two returned signals as sensed by transducers 631 and 633, for example. Through a training session, the system is taught to differentiate between the three cases. This is done by conducting a large number of experiments where all possible child seats are placed in all possible orientations on the front passenger seat. Similarly, a sufficiently large number of experiments are run with human occupants and with boxes, bags of groceries and other objects (both inanimate and animate). Sometimes as many as 1,000,000 such experiments are run before the neural network is sufficiently trained so that it can differentiate among the three cases and output the correct decision with a very high probability. Of course, it must be realized that a neural network can also be trained to differentiate among additional cases, e.g., a forward facing child seat.

Once the network is determined, it is possible to examine the result using tools supplied by NeuralWare or International Scientific Research, for example, to determine the rules that were finally arrived at by the trial and error techniques. In that case, the rules can then be programmed into a microprocessor resulting in a fuzzy logic or other rule based system. Alternately, a neural computer, or cellular neural network, can be used to implement the net directly. In either case, the implementation can be carried out by those skilled in the art of pattern recognition. If a microprocessor is used, a memory device is also required to store the data from the analog to digital converters that digitize the data from the receiving transducers. On the other hand, if a neural network computer is used, the analog signal can be fed directly from the transducers to the neural network input nodes and an intermediate memory is not required. Memory of some type is needed to store the computer programs in the case of the microprocessor system and if the neural computer is used for more than one task, a memory is needed to store the network specific values associated with each task.

Electromagnetic energy based occupant sensors exist that use many portions of the electromagnetic spectrum. A system based on the ultraviolet, visible or infrared portions of the spectrum generally operate with a transmitter and a receiver of reflected radiation. The receiver may be a camera or a photo detector such as a pin or avalanche diode as described in detail in above-referenced patents and patent applications. At other frequencies, the absorption of the electromagnetic energy is primarily and at still other frequencies the capacitance or electric field influencing effects are used. Generally, the human body will reflect, scatter, absorb or transmit electromagnetic energy in various degrees depending on the frequency of the electromagnetic waves. All such occupant sensors are included herein.

In the embodiment wherein electromagnetic energy is used, it is to be appreciated that any portion of the electromagnetic signals that impinges upon, surrounds or involves a body portion of the occupant is at least partially absorbed by the body portion. Sometimes, this is due to the fact that the human body is composed primarily of water, and that electromagnetic energy of certain frequencies is readily absorbed by water. The amount of electromagnetic signal absorption is related to the frequency of the signal, and size or bulk of the body portion that the signal impinges upon. For example, a torso of a human body tends to absorb a greater percentage of electromagnetic energy than a hand of a human body.

Thus, when electromagnetic waves or energy signals are transmitted by a transmitter, the returning waves received by a receiver provide an indication of the absorption of the electromagnetic energy. That is, absorption of electromagnetic energy will vary depending on the presence or absence of a human occupant, the occupant's size, bulk, surface reflectivity, etc. depending on the frequency, so that different signals will be received relating to the degree or extent of absorption by the occupying item on the seat. The receiver will produce a signal representative of the returned waves or energy signals which will thus constitute an absorption signal as it corresponds to the absorption of electromagnetic energy by the occupying item in the seat.

One or more of the transducers 631, 632, 633 can also be image-receiving devices, such as cameras, which take images of the interior of the passenger compartment. These images can be transmitted to a remote facility to monitor the passenger compartment or can be stored in a memory device for use in the event of an accident, i.e., to determine the status of the occupants of the vehicle prior to the accident. In this manner, it can be ascertained whether the driver was falling asleep, talking on the phone, etc.

A memory device for storing the images of the passenger compartment, and also for receiving and storing any of the other information, parameters and variables relating to the vehicle or occupancy of the vehicle, may be in the form a standardized "black box" (instead of or in addition to a memory part in a processor 601). The IEEE Standards Association is currently beginning to develop an international standard for motor vehicle event data recorders. The information stored in the black box and/or memory unit in the processor 601, can include the images of the interior of the passenger compartment as well as the number of occupants and the health state of the occupants. The black box would preferably be tamper-proof and crash-proof and enable retrieval of the information after a crash.

FIG. 2 shows schematically the interface between a vehicle interior monitoring system in accordance with the invention and the vehicle's cellular or other telematics communication system. An adult occupant 710 is shown sitting on the front passenger seat 720 and four transducers 731, 732, 640 and 641 are used to determine the presence (or absence) of the occupant on that seat 720. One of the transducers 732 in this case acts as both a transmitter and receiver while transducer 731 acts only as a receiver. Alternately, transducer 731 could serve as both a transmitter and receiver or the transmitting function could be alternated between the two devices. Also, in many cases more that two transmitters and receivers are used and in still other cases other types of sensors, such as electric field, capacitance, self-tuning antennas (collectively represented by 140 and 141), weight, seatbelt, heartbeat, motion and seat position sensors, are also used in combination with the radiation sensors.

For a general object, transducers 731, 732, 140, 141 can also be used to determine the type of object, determine the location of the object, and/or determine another property or characteristic of the object. A property of the object could be the orientation of a child seat, the velocity of an adult and the like. For example, the transducers 731, 732, 140, 141 can be designed to enable a determination that an object is present on the seat, that the object is a child seat and that the child seat is rear-facing.

The transducers 731 and 732 are attached to the vehicle buried in the A-pillar trim, where their presence can be disguised, and are connected to processor 601 that may also be hidden in the trim as shown (this being a non-limiting position for the processor 601). The A-pillar is the roof support pillar that is closest to the front of the vehicle and which, in addition to supporting the roof, also supports the front windshield and the front door. Other mounting locations can also be used. For example, transducers 731, 732 can be mounted inside the seat (along with or in place of transducers 140 and 141), in the ceiling of the vehicle, in the B-pillar, in the C-pillar and in the doors. Indeed, the vehicle interior monitoring system in accordance with the invention may comprise a plurality of monitoring units, each arranged to monitor a particular seating location. In this case, for the rear seating locations, transducers might be mounted in the B-pillar or C-pillar or in the rear of the front seat or in the rear side doors. Possible mounting locations for transducers, transmitters, receivers and other occupant sensing devices are disclosed in the above-referenced patent applications and all of these mounting locations are contemplated for use with the transducers described herein.

The cellular phone or other communications system 740 outputs to an antenna 750A. The transducers 731, 732, 140 and 141 in conjunction with the pattern recognition hardware and software, which is implemented in processor 601 and is packaged on a printed circuit board or flex circuit along with the transducers 731 and 732, determine the presence of an occupant within a few seconds after the vehicle is started, or within a few seconds after the door is closed. Similar systems located to monitor the remaining seats in the vehicle, also determine the presence of occupants at the other seating locations and this result is stored in the computer memory which is part of each monitoring system processor 601.

Periodically and in particular in the event of an accident, the electronic system associated with the cellular phone system 740 interrogates the various interior monitoring system memories and arrives at a count of the number of occupants in the vehicle, and optionally, even makes a determination as to whether each occupant was wearing a seatbelt and if he or she is moving after the accident. The phone or other communications system then automatically dials the EMS operator (such as 911 or through a telematics service such as OnStar®) and the information obtained from the interior monitoring systems is forwarded so that a determination can be made as to the number of ambulances and other equipment to send to the accident site, for example. Such vehicles will also have a system, such as the global positioning system, which permits the vehicle to determine its exact location and to forward this information to the EMS operator.

Thus, in basic embodiments of the invention, wave or other energy-receiving transducers are arranged in the vehicle at appropriate locations, trained if necessary depending on the particular embodiment, and function to determine whether a life form is present in the vehicle and if so, how many life forms are present and where they are located etc. To this end, transducers can be arranged to be operative at only a single seating locations or at multiple seating locations with a provision being made to eliminate repetitive count of occupants. A determination can also be made using the transducers as to whether the life forms are humans, or more specifically, adults, child in child seas, etc. As noted above and below, this is possible using pattern recognition techniques. Moreover, the processor or processors associated with the transducers can be trained to determine the location of the life forms, either periodically or continuously or possibly only immediately before, during and after a crash. The location of the life forms can be as general or as specific as necessary depending on the system requirements, i.e., a determination can be made that a human is situated on the driver's seat in a normal position (general) or a determination can be made that a human is situated on the driver's seat and is leaning forward and/or to the side at a specific angle as well as the position of his or her extremities and head and chest (specifically). The degree of detail is limited by several factors, including, for example, the number and position of transducers and training of the pattern recognition algorithm.

In addition to the use of transducers to determine the presence and location of occupants in a vehicle, other sensors could also be used. For example, a heartbeat sensor which determines the number and presence of heartbeats can also be arranged in the vehicle, which would thus also determine the number of occupants as the number of occupants would be equal to the number of heartbeats. Conventional heartbeat sensors can be adapted to differentiate between a heartbeat of an adult, a heartbeat of a child and a heartbeat of an animal. As its name implies, a heartbeat sensor detects a heartbeat, and the magnitude thereof, of a human occupant of the seat, if such a human occupant is present. The output of the heartbeat sensor is input to the processor of the interior monitoring system. One heartbeat sensor for use in the invention may be of the types as disclosed in McEwan (U.S. Pat. Nos. 5,573,012 and 5,766,208 which are incorporated herein in their entirety by reference). The heartbeat sensor can be positioned at any convenient position relative to the seats where occupancy is being monitored. A preferred location is within the vehicle seatback.

An alternative way to determine the number of occupants is to monitor the weight being applied to the seats, i.e., each seating location, by arranging weight sensors at each seating location which might also be able to provide a weight distribution of an object on the seat. Analysis of the weight and/or weight distribution by a predetermined method can provide an indication of occupancy by a human, an adult or child, or an inanimate object.

Another type of sensor which is not believed to have been used in an interior monitoring system heretofore is a micropower impulse radar (MIR) sensor which determines motion of an occupant and thus can determine his or her heartbeat (as evidenced by motion of the chest). Such an MIR sensor can be arranged to detect motion in a particular area in which the occupant's chest would most likely be situated or could be coupled to an arrangement which determines the location of the occupant's chest and then adjusts the operational field of the MIR sensor based on the determined location of the occupant's chest. A motion sensor utilizing a micro-power impulse radar (MIR) system as disclosed, for example in McEwan

(U.S. Pat. No. 5,361,070, which is incorporated herein by reference), as well as many other patents by the same inventor. Motion sensing is accomplished by monitoring a particular range from the sensor as disclosed in that patent. MIR is one form of radar which has applicability to occupant sensing and can be mounted at various locations in the vehicle. It has an advantage over ultrasonic sensors in that data can be acquired at a higher speed and thus the motion of an occupant can be more easily tracked. The ability to obtain returns over the entire occupancy range is somewhat more difficult than with ultrasound resulting in a more expensive system overall. MIR has additional advantages in lack of sensitivity to temperature variation and has a comparable resolution to about 40 kHz ultrasound. Resolution comparable to higher frequency is also possible. Additionally, multiple MIR sensors can be used when high speed tracking of the motion of an occupant during a crash is required since they can be individually pulsed without interfering with each through time division multiplexing.

An alternative way to determine motion of the occupant(s) is to monitor the weight distribution of the occupant whereby changes in weight distribution after an accident would be highly suggestive of movement of the occupant. A system for determining the weight distribution of the occupants could be integrated or otherwise arranged in the seats 620, 720 of the vehicle and several patents and publications describe such systems.

More generally, any sensor which determines the presence and health state of an occupant can also be integrated into the vehicle interior monitoring system in accordance with the invention. For example, a sensitive motion sensor can determine whether an occupant is breathing and a chemical sensor can determine the amount of carbon dioxide, or the concentration of carbon dioxide, in the air in the vehicle which can be correlated to the health state of the occupant(s). The motion sensor and chemical sensor can be designed to have a fixed operational field situated where the occupant's mouth is most likely to be located. In this manner, detection of carbon dioxide in the fixed operational field could be used as an indication of the presence of a human occupant in order to enable the determination of the number of occupants in the vehicle. In the alternative, the motion sensor and chemical sensor can be adjustable and adapted to adjust their operational field in conjunction with a determination by an occupant position and location sensor which would determine the location of specific parts of the occupant's body, e.g., his or her chest or mouth. Furthermore, an occupant position and location sensor can be used to determine the location of the occupant's eyes and determine whether the occupant is conscious, i.e., whether his or her eyes are open or closed or moving.

The use of chemical sensors can also be used to detect whether there is blood present in the vehicle, for example, after an accident. Additionally, microphones can detect whether there is noise in the vehicle caused by groaning, yelling, etc., and transmit any such noise through the cellular or other communication connection to a remote listening facility (such as operated by OnStar®).

FIG. 3 shows a schematic diagram of an embodiment of the invention including a system for determining the presence and health state of any occupants of the vehicle and a telecommunications link. This embodiment includes means for determining the presence of any occupants 410 which may take the form of a heartbeat sensor or motion sensor as described above and means for determining the health state of any occupants 412. The latter means may be integrated into the means for determining the presence of any occupants, i.e., one and the same component, or separate therefrom. Further, means for determining the location, and optionally velocity, of the occupants or one or more parts thereof 414 are provided and may be any conventional occupant position sensor or preferably, one of the occupant position sensors as described herein (e.g., those utilizing waves. electromagnetic radiation or electric fields) or as described in the current assignee's patents and patent applications referenced above.

A processor 416 is coupled to the presence determining means 410, the health state determining means 412 and the location determining means 414. A communications unit 418 is coupled to the processor 416. The processor 416 and/or communications unit 418 can also be coupled to microphones 420 that can be distributed throughout the vehicle and include voice-processing circuitry to enable the occupant(s) to effect vocal control of the processor 416, communications unit 418 or any coupled component or oral communications via the communications unit 418. The processor 416 is also coupled to another vehicular system, component or subsystem 422 and can issue control commands to effect adjustment of the operating conditions of the system, component or subsystem. Such a system, component or subsystem can be the heating or air-conditioning system, the entertainment system, an occupant restraint device such as an airbag, a glare prevention system, etc. Also, a positioning system 424 could be coupled to the processor 416 and provides an indication of the absolute position of the vehicle, preferably using satellite-based positioning technology (e.g., a GPS receiver).

In normal use (other than after a crash), the presence determining means 410 determine whether any human occupants are present, i.e., adults or children, and the location determining means 414 determine the occupant's location. The processor 416 receives signals representative of the presence of occupants and their location and determines whether the vehicular system, component or subsystem 422 can be modified to optimize its operation for the specific arrangement of occupants. For example, if the processor 416 determines that only the front seats in the vehicle are occupied, it could control the heating system to provide heat only through vents situated to provide heat for the front-seated occupants.

Another possible vehicular system, component or subsystem is a navigational aid, i.e., a route display or map. In this case, the position of the vehicle as determined by the positioning system 424 is conveyed through processor 416 to the communications unit 418 to a remote facility and a map is transmitted from this facility to the vehicle to be displayed on the route display. If directions are needed, a request for the same could be entered into an input unit 426 associated with the processor 416 and transmitted to the facility. Data for the display map and/or vocal instructions could be transmitted from this facility to the vehicle.

Moreover, using this embodiment, it is possible to remotely monitor the health state of the occupants in the vehicle and most importantly, the driver. The health state determining means 412 may be used to detect whether the driver's breathing is erratic or indicative of a state in which the driver is dozing off. The health state determining means 412 could also include a breath-analyzer to determine whether the driver's breath contains alcohol. In this case, the health state of the driver is relayed through the processor 416 and the communications unit 418 to the remote facility and appropriate action can be taken. For example, it would be possible to transmit a command to the vehicle to activate an alarm or illuminate a warning light or if the vehicle is equipped with an automatic guidance system and ignition shut-off, to cause the vehicle to come to a stop on the shoulder of the roadway or elsewhere out of the traffic stream. The alarm, warning light, automatic guidance system and ignition shut-off are thus particular vehicular components or subsystems represented by 422.

In use after a crash, the presence determining means 410, health state determining means 412 and location determining means 414 can obtain readings from the passenger compartment and direct such readings to the processor 416. The processor 416 analyzes the information and directs or controls the transmission of the information about the occupant(s) to a remote, manned facility. Such information would include the number and type of occupants, i.e., adults, children, infants, whether any of the occupants have stopped breathing or are breathing erratically, whether the occupants are conscious (as evidenced by, e.g., eye motion), whether blood is present (as detected by a chemical sensor) and whether the occupants are making noise. Moreover, the communications link through the communications unit 418 can be activated immediately after the crash to enable personnel at the remote facility to initiate communications with the vehicle.

An occupant sensing system can also involve sensing for the presence of a living occupant in a trunk of a vehicle or in a closed vehicle, for example, when a child is inadvertently left in the vehicle or enters the trunk and the trunk closes. To this end, a SAW-based chemical sensor 250 is illustrated in FIG. 4A for mounting in a vehicle trunk as illustrated in FIG. 4. The chemical sensor 250 is designed to measure carbon dioxide concentration through the mass loading effects as described in U.S. Pat. No. 4,895,017, which is incorporated by reference herein, with a polymer coating selected that is sensitive to carbon dioxide. The speed of the surface acoustic wave is a function of the carbon dioxide level in the atmosphere. Section 252 of the chemical sensor 250 contains a coating of such a polymer and the acoustic velocity in this section is a measure of the carbon dioxide concentration. Temperature effects are eliminated through a comparison of the sonic velocities in sections 251 and 252 as described above.

Thus, when trunk lid 260 is closed and a source of carbon dioxide such as a child or animal is trapped within the trunk, the chemical sensor 250 will provide information indicating the presence of the carbon dioxide producing object to the interrogator which can then release the trunk lock permitting trunk to automatically open. In this manner, the problem of children and animals suffocating in closed trunks is eliminated. Alternately, information that a person or animal is trapped in a trunk can be sent by the telematics system to law enforcement authorities or other location remote from the vehicle.

A similar device can be distributed at various locations within the passenger compartment of vehicle along with a combined temperature sensor. If the car has been left with a child or other animal while owner is shopping, for example, and if the temperature rises within the vehicle to an unsafe level or, alternately, if the temperature drops below an unsafe level, then the vehicle can be signaled to take appropriate action which may involve opening the windows or starting the vehicle with either air conditioning or heating as appropriate. Alternately, information that a person or animal is trapped within a vehicle can be sent by the telematics system to law enforcement authorities or other location remote from the vehicle. Thus, through these simple wireless powerless sensors, the problem of suffocation either from lack of oxygen or death from excessive heat or cold can all be solved in a simple, low-cost manner through using an interrogator as disclosed in the current assignee's U.S. patent application Ser. No. 10/079,065 incorporated by reference herein in its entirety.

Additionally, a sensitive layer on a SAW can be made to be sensitive to other chemicals such as water vapor for humidity control or alcohol for drunk driving control. Similarly, the sensitive layer can be designed to be sensitive to carbon monoxide thereby preventing carbon monoxide poisoning. Many other chemicals can be sensed for specific applications such as to check for chemical leaks in commercial vehicles, for example. Whenever such a sensor system determines that a dangerous situation is developing, an alarm can be sounded and/or the situation can be automatically communicated to an off vehicle location through telematics, a cell phone such as a 911 call, the Internet or though a subscriber service such as OnStar®.

Described above is a system for determining the status of occupants in a vehicle, and in the event of an accident or at any other appropriate time, transmitting the status of the occupants, and optionally additional information, via a communications channel or link to a remote monitoring facility. In addition to the status of the occupant, it is also important to be able to analyze the operating conditions of the vehicle and detect when a component of the vehicle is about to fail. By notifying the driver of the impending failure of the component, appropriate corrective action can be taken to avoid such failure.

The operating conditions of the vehicle can also be transmitted along with the status of the occupants to a remote monitoring facility. The operating conditions of the vehicle include whether the motor is running and whether the vehicle is moving. Thus, in a general embodiment in which information on both occupancy of the vehicle and the operating conditions of the vehicle are transmitted, one or more properties or characteristics of occupancy of the vehicle are determined, such constituting information about the occupancy of the vehicle, and one or more states of the vehicle or of a component of the vehicle is determined, such constituting information about the operation of the vehicle. The information about the occupancy of the vehicle and operation of the vehicle are selectively transmitted, possibly the information about occupancy to an emergency response center and the information about the vehicle to a dealer or repair facility.

Transmission of the information about the operation of the vehicle, i.e., diagnostic information, may be achieved via a satellite and/or via the Internet. The vehicle would thus include appropriate electronic hardware and/or software to enable the transmission of a signal to a satellite, from where it could be re-transmitted to a remote location, and/or to enable the transmission to a web site or host computer. In the latter case, the vehicle could be assigned a domain name or e-mail address for identification or transmission origination purposes.

It is important to appreciate that the preferred embodiment of the vehicle diagnostic unit described below performs the diagnosis, i.e., processes the input from the various sensors, on the vehicle using for example a processor embodying a pattern recognition technique such as a neural network. The processor thus receives data or signals from the sensors and generates an output indicative or representative of the operating conditions of the vehicle or its component. A signal could thus be generated indicative of an underinflated tire, or an overheating engine.

For the discussion below, the following terms are defined as follows:

The term "component" refers to any part or assembly of parts which is mounted to or a part of a motor vehicle and which is capable of emitting a signal representative of its operating state. The following is a partial list of general automobile and truck components, the list not being exclusive:

engine;

transmission;

brakes and associated brake assembly;

tires;

wheel;

steering wheel and steering column assembly;

water pump;

alternator;

shock absorber;

wheel mounting assembly;

radiator;

battery;

oil pump;

fuel pump;

air conditioner compressor;

differential gear;

exhaust system;

fan belts;

engine valves;

steering assembly;

vehicle suspension including shock absorbers;

vehicle wiring system; and

engine cooling fan assembly.

The term "sensor" refers to any measuring or sensing device mounted on a vehicle or any of its components including new sensors mounted in conjunction with the diagnostic module in accordance with the invention. A partial, non-exclusive list of common sensors mounted on an automobile or truck is as follows:

airbag crash sensor;

accelerometer;

microphone;

camera;

antenna, capacitance sensor or other electromagnetic wave sensor;

stress or strain sensor;
pressure sensor;
weight sensor;
magnetic field sensor;
coolant thermometer;
oil pressure sensor;
oil level sensor;
air flow meter;
voltmeter;
ammeter;
humidity sensor;
engine knock sensor;
oil turbidity sensor;
throttle position sensor;
steering wheel torque sensor;
wheel speed sensor;
tachometer;
speedometer;
other velocity sensors;
other position or displacement sensors;
oxygen sensor;
yaw, pitch and roll angular sensors;
clock;
odometer;
power steering pressure sensor;
pollution sensor;
fuel gauge ;
cabin thermometer;
transmission fluid level sensor;
gyroscopes or other angular rate sensors including yaw, pitch and roll rate sensors;
coolant level sensor;
transmission fluid turbidity sensor;

break pressure sensor;

tire pressure sensor;

tire temperature sensor, and

coolant pressure sensor.

The term "signal" herein refers to any time varying output from a component including electrical, acoustic, thermal, or electromagnetic radiation, or mechanical vibration.

Sensors on a vehicle are generally designed to measure particular parameters of particular vehicle components. However, frequently these sensors also measure outputs from other vehicle components. For example, electronic airbag crash sensors currently in use contain an accelerometer for determining the accelerations of the vehicle structure so that the associated electronic circuitry of the airbag crash sensor can determine whether a vehicle is experiencing a crash of sufficient magnitude so as to require deployment of the airbag. This accelerometer continuously monitors the vibrations in the vehicle structure regardless of the source of these vibrations. If a wheel is out of balance, or if there is extensive wear of the parts of the front wheel mounting assembly, or wear in the shock absorbers, the resulting abnormal vibrations or accelerations can, in many cases, be sensed by the crash sensor accelerometer. There are other cases, however, where the sensitivity or location of the airbag crash sensor accelerometer is not appropriate and one or more additional accelerometers may be mounted onto a vehicle for the purposes of this invention. Some airbag crash sensors are not sufficiently sensitive accelerometers or have sufficient dynamic range for the purposes herein.

Every component of a vehicle emits various signals during its life. These signals can take the form of electromagnetic radiation, acoustic radiation, thermal radiation, vibrations transmitted through the vehicle structure, and voltage or current fluctuations, depending on the particular component. When a component is functioning normally, it may not emit a perceptible signal. In that case, the normal signal is no signal, i.e., the absence of a signal. In most cases, a component will emit signals that change over its life and it is these changes which contain information as to the state of the component, e.g., whether failure of the component is impending. Usually components do not fail without warning. However, most such warnings are either not perceived or if perceived are not understood by the vehicle operator until the component actually fails and, in some cases, a breakdown of the vehicle occurs. In a few years, it is expected that various roadways will have systems for automatically guiding vehicles operating thereon. Such systems have been called "smart highways" and are part of the field of intelligent transportation systems (ITS). If a vehicle operating on such a smart highway were to breakdown, serious disruption of the system could result and the safety of other users of the smart highway could be endangered

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In accordance with the invention, each of these signals emitted by the vehicle components is converted into electrical signals and then digitized (i.e., the analog signal is converted into a digital signal) to create numerical time series data which is then entered into a processor. Pattern recognition algorithms then are applied in the processor to attempt to identify and classify patterns in this time series data. For a particular component, such as a tire for example, the algorithm attempts to determine from the relevant digital data whether the tire is functioning properly or whether it requires balancing, additional air, or perhaps replacement.

Frequently, the data entered into the computer needs to be preprocessed before being analyzed by a pattern recognition algorithm. The data from a wheel speed sensor, for example, might be used as is for determining whether a particular tire is operating abnormally in the event it is unbalanced, whereas the integral of the wheel speed data over a long time period (a preprocessing step), when compared to such sensors on different wheels, might be more useful in determining whether a particular tire is going flat and therefore needs air. In some cases, the frequencies present in a set of data are a better predictor of component failures than the data itself. For example, when a motor begins to fail due to worn bearings, certain characteristic frequencies began to appear. In most cases, the vibrations arising from rotating components, such as the engine, will be normalized based on the rotational frequency as disclosed in the NASA TSP referenced above. Moreover, the identification of which component is causing vibrations present in the vehicle structure can frequently be accomplished through a frequency analysis of the data. For these cases, a Fourier transformation of the data is made prior to entry of the data into a pattern recognition algorithm. Other mathematical transformations are also made for particular pattern recognition purposes in practicing the teachings of this invention. Some of these include shifting and combining data to determine phase changes for example, differentiating the data, filtering the data, and sampling the data. Also, there exist certain more sophisticated mathematical operations that attempt to extract or highlight specific features of the data. This invention contemplates the use of a variety of these preprocessing techniques and the choice of which ones is left to the skill of the practitioner designing a particular diagnostic module.

Another technique that is contemplated for some implementations of this invention is the use of multiple accelerometers and/or microphones that will allow the system to locate the source of any measured vibrations based on the time of flight and/or triangulation techniques. Once a distributed accelerometer installation has been implemented to permit this source location, the same sensors can be used for smarter crash sensing as it will permit the determination of the location of the impact on the vehicle. Once the impact location is known, a highly tailored algorithm can be used to accurately forecast the crash severity making use of a knowledge on the force vs. crush properties of the vehicle at the impact location.

When a vehicle component begins to change its operating behavior, it is not always apparent from the particular sensors, if any, which are monitoring that component. The output from any one of these sensors can be normal even though the component is failing. By analyzing the output of a variety of sensors, however, the pending failure can be diagnosed. For example, the rate of temperature rise in the vehicle coolant, if it were monitored, might appear normal unless it were known that the vehicle was idling and not traveling down a highway at a high speed. Even the level of coolant temperature which is in the normal range could be in fact abnormal in some situations signifying a failing coolant pump, for example, but not detectable from the coolant thermometer alone.

The pending failure of some components is difficult to diagnose and sometimes the design of the component requires modification so that the diagnosis can be more readily made. A fan belt, for example, frequently begins failing by a cracking of the inner surface. The belt can be designed to provide a sonic or electrical signal when this cracking begins in a variety of ways. Similarly, coolant hoses can be designed with an intentional weak spot where failure will occur first in a controlled manner that can also cause a whistle sound as a small amount of steam exits from the hose. This whistle sound can then be sensed by a general purpose microphone, for example.

In FIG. 5, a generalized component 800 emitting several signals which are transmitted along a variety of paths, sensed by a variety of sensors and analyzed by the diagnostic device in accordance with the invention is illustrated schematically. Component 800 is mounted to a vehicle 880 and during operation it emits a variety of signals such as acoustic 801, electromagnetic radiation 802, thermal radiation 803, current and voltage fluctuations in conductor 804 and mechanical vibrations 805. Various sensors are mounted in the vehicle to detect the signals emitted by the component 800. These include one or more vibration sensors (accelerometers) 830, 850 and/or gyroscopes also mounted to the vehicle, one or more acoustic sensors 810, 851, electromagnetic radiation sensor 815, heat radiation sensor 820 and voltage or current sensor 840.

In addition, various other sensors 852, 853 measure other parameters of other components that in some manner provide information directly or indirectly on the operation of component 800. All of the sensors illustrated on FIG. 5 can be connected to a data bus 860. A diagnostic module 870, in accordance with the invention, can also be attached to the vehicle data bus 860 and receives the signals generated by the various sensors. The sensors may however be wirelessly connected to the diagnostic module 870 and be integrated into a wireless power and communications system or a combination of wired and wireless connections.

As shown in FIG. 5, the diagnostic module 870 has access to the output data of each of the sensors that have information relative to the component 800. This data appears as a series of numerical values each corresponding to a measured value at a specific point in time. The cumulative data from a particular sensor is called a time series of individual data points. The diagnostic module 870 compares the patterns of data received from each sensor individually, or in combination with data from other sensors, with patterns for which the diagnostic module has been trained to determine whether the component is functioning normally or abnormally.

Important to this invention is the manner in which the diagnostic module 870 determines a normal pattern from an abnormal pattern and the manner in which it decides what data to use from the vast amount of data available. This is accomplished using pattern recognition technologies such as artificial neural networks and training. The theory of neural networks including many examples can be found in several books on the subject including: (1) Techniques And Application Of Neural Networks, edited by Taylor, M. and Lisboa, P., Ellis Horwood, West Sussex, England, 1993; (2) Naturally Intelligent Systems, by Caudill, M. and Butler, C., MIT Press, Cambridge Massachusetts, 1990; (3) J. M. Zaruda, Introduction to Artificial Neural Systems, West publishing Co., N.Y., 1992, (4) Digital Neural Networks, by Kung, S. Y., PTR Prentice Hall, Englewood Cliffs, New Jersey, 1993, Eberhart, R., Simpson, P., (5) Dobbins, R., Computational Intelligence PC Tools, Academic Press, Inc., 1996, Orlando, Florida, (6) Cristianini, N. and Shawe-Taylor, J. An Introduction to Support Vector Machines and other kernal-based learning methods, Cambridge University Press, Cambridge England, 2000; (7) Proceedings of the 2000 6th IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA 2000), IEEE, Piscataway NJ; and (8) Sinha, N.K. and Gupta, M.M. Soft Computing & Intelligent Systems, Academic Press 2000 San Diego, CA, all of which are incorporated herein by reference. The neural network pattern recognition technology is one of the most developed of pattern recognition technologies. The invention described herein frequently uses combinations of neural networks to improve the pattern recognition process.

The neural network pattern recognition technology is one of the most developed of pattern recognition technologies. The neural network will be used here to illustrate one example of a pattern recognition technology but it is emphasized that this invention is not limited to neural networks. Rather, the invention may apply any known pattern recognition technology including sensor fusion and various correlation technologies. A brief description of a particular example of a neural network pattern recognition technology is set forth below.

Neural networks are constructed of processing elements known as neurons that are interconnected using information channels call interconnects. Each neuron can have multiple inputs but only one output. Each output however is usually connected to all other neurons in the next layer. The neurons in the first layer operate collectively on the input data as described in more detail below. Neural networks learn by extracting relational information from the data and the desired output. Neural networks have been applied to a wide variety of pattern recognition problems including automobile occupant sensing, speech recognition, optical character recognition, and handwriting analysis.

To train a neural network, data is provided in the form of one or more time series that represents the condition to be diagnosed as well as normal operation. As an example, the simple case of an out of balance tire will be used. Various sensors on the vehicle can be used to extract information from signals emitted by the tire such as an accelerometer, a torque sensor on the steering wheel, the pressure output of the power steering system, a tire pressure monitor or tire temperature monitor. Other sensors that might not have an obvious relationship to tire unbalance are also included such as, for example, the vehicle speed or wheel speed that can be determined from the ABS system. Data is taken from a variety of vehicles where the tires were accurately balanced under a variety of operating conditions also for cases where varying amounts of unbalance was intentionally introduced. Once the data had been collected, some degree of preprocessing or feature extraction is usually performed to reduce the total amount of data fed to the neural network. In the case of the unbalanced tire, the time period between data points might be chosen such that there are at least ten data points per revolution of the wheel. For some other application, the time period might be one minute or one millisecond.

Once the data has been collected, it is processed by a neural network-generating program, for example, if a neural network pattern recognition system is to be used. Such programs are available commercially, e.g., from NeuralWare of Pittsburgh, Pennsylvania or from International Scientific Research, Inc., of Romeo Michigan for modular neural networks. The program proceeds in a trial and error manner until it successfully associates the various patterns representative of abnormal behavior, an unbalanced tire, with that condition. The resulting neural network can be tested to determine if some of the input data from some of the sensors, for example, can be eliminated. In this way, the engineer can determine what sensor data is relevant to a particular diagnostic problem. The program then generates an algorithm that is programmed onto a microprocessor, microcontroller, neural processor, FPGA, or DSP (herein collectively referred to as a microprocessor or processor). Such a microprocessor appears inside the diagnostic module 870 in FIG. 5. Once trained, the neural network, as represented by the algorithm, will now recognize an unbalanced tire on a vehicle when this event occurs. At that time, when the tire is unbalanced, the diagnostic module 870 will output a message to the driver indicating that the tire should be now be balanced as described in more detail below. The message to the driver is provided by output means coupled to or incorporated within the module 870 and may be, e.g., a light on the dashboard, a vocal tone or any other recognizable indication apparatus. A similar message may also be sent to the dealer or other repair facility or remote facility.

It is important to note that there may be many neural networks involved in a total vehicle diagnostic system. These can be organized either in parallel, series, as an ensemble, cellular neural network or as a modular neural network system. In one implementation of a modular neural network, a primary neural network identifies that there is an abnormality and tries to identify the likely source. Once a choice has been made as to the likely source of the abnormality, another of a group of neural networks is called upon to determine the exact cause of the abnormality. In this manner, the neural networks are arranged in a tree pattern with each neural network trained to perform a particular pattern recognition task.

Discussions on the operation of a neural network can be found in the above references on the subject and are well understood by those skilled in the art. Neural networks are the most well known of the pattern recognition technologies based on training, although neural networks have only recently received widespread attention and have been applied to only very limited and specialized problems in motor vehicles. Other non-training based pattern recognition technologies exist, such as fuzzy logic. However, the programming required to use fuzzy logic, where the patterns must be determine by the programmer, render these systems impractical for general vehicle diagnostic problems such as described herein. Therefore, preferably the pattern recognition systems that learn by training are used herein.

The neural network is the first highly successful of what will be a variety of pattern recognition techniques based on training. There is nothing that suggests that it is the only or even the best technology. The characteristics of all of these technologies which render them applicable to this general diagnostic problem include the use of time-based input data and that they are trainable. In all cases, the pattern recognition technology learns from examples of data characteristic of normal and abnormal component operation.

A diagram of one example of a neural network used for diagnosing an unbalanced tire, for example, based on the teachings of this invention is shown in FIG. 6. The process can be programmed to periodically test for an unbalanced tire. Since this need be done only infrequently, the same processor can be used for many such diagnostic problems. When the particular diagnostic test is run data from the previously determined relevant sensors is preprocessed and analyzed with the neural network algorithm.

For the unbalanced tire, using the data from an accelerometer for example, the digital acceleration values from the analog to digital converter in the accelerometer are entered into nodes 1 through n and the neural network algorithm compares the pattern of values on nodes 1 through n with patterns for which it has been trained as follows.

Each of the input nodes is connected to each of the second layer nodes, h-1,h-2,... h-n, called the hidden layer, either electrically as in the case of a neural computer, or through mathematical functions containing multiplying coefficients called weights, in the manner described in more detail in the above references. At each hidden layer node, a summation occurs of the values from each of the input layer nodes, which have been operated on by functions containing the weights, to create a node value. Similarly, the hidden layer nodes are in like manner connected to the output layer node(s), which in this example is only a single node 0 representing the decision to notify the driver, and/or a remote facility, of the unbalanced tire. During the training phase, an output node value of 1, for example, is assigned to indicate that the driver should be notified and a value of 0 is assigned to not doing so. Once again, the details of this process are described in above-referenced texts and will not be presented in detail here.

In the example above, twenty input nodes were used, five hidden layer nodes and one output layer node. In this example, only one sensor was considered and accelerations from only one direction were used. If other data from other sensors such as accelerations from the vertical or lateral directions were also used, then the number of input layer nodes would increase. Again, the theory for determining the complexity of a neural network for a particular application has been the subject of many technical papers and will not be presented in detail here. Determining the requisite complexity for the example presented here can be accomplished by those skilled in the art of neural network design.

Briefly, the neural network described above defines a method, using a pattern recognition system, of sensing an unbalanced tire and determining whether to notify the driver, and/or a remote facility, and comprises the steps of:

(a) obtaining an acceleration signal from an accelerometer mounted on a vehicle;

(b) converting the acceleration signal into a digital time series;

(c) entering the digital time series data into the input nodes of the neural network;

(d) performing a mathematical operation on the data from each of the input nodes and inputting the operated on data into a second series of nodes wherein the operation performed on each of the input node data prior to inputting the operated on value to a second series node is different from that operation performed on some other input node data;

(e) combining the operated on data from all of the input nodes into each second series node to form a value at each second series node;

(f) performing a mathematical operation on each of the values on the second series of nodes and inputting this operated on data into an output series of nodes wherein the operation performed on each of the second series node data prior to inputting the operated on value to an output series node is different from that operation performed on some other second series node data;

(g) combining the operated on data from all of the second series nodes into each output series node to form a value at each output series node; and,

(h) notifying a driver if the value on one output series node is within a chosen range signifying that a tire requires balancing.

This method can be generalized to a method of predicting that a component of a vehicle will fail comprising the steps of:

(a) sensing a signal emitted from the component;

(b) converting the sensed signal into a digital time series;

(c) entering the digital time series data into a pattern recognition algorithm;

(d) executing the pattern recognition algorithm to determine if there exists within the digital time series data a pattern characteristic of abnormal operation of the component; and

(e) notifying a driver and/or a remote facility if the abnormal pattern is recognized.

The particular neural network described and illustrated above contains a single series of hidden layer nodes. In some network designs, more than one hidden layer is used, although only rarely will more than two such layers appear. There are of course many other variations of the neural network architecture illustrated above which appear in the referenced literature. For the purposes herein, therefore, "neural network" will be defined as a system wherein the data to be processed is separated into discrete values which are then operated on and combined in at least a two stage process and where the operation performed on the data at each stage is in general different for each discrete value and where the operation performed is at least determined through a training process.

The implementation of neural networks can take on at least two forms, an algorithm programmed on a digital microprocessor, FPGA, DSP or in a neural computer (including a cellular neural network or support vector machine). In this regard, it is noted that neural computer chips are now becoming available.

In the example above, only a single component failure was discussed using only a single sensor since the data from the single sensor contains a pattern which the neural network was trained to recognize as either normal operation of the component or abnormal operation of the component. The diagnostic module 870 contains preprocessing and neural network algorithms for a number of component failures. The neural network algorithms are generally relatively simple, requiring only a relatively small number of lines of computer code. A single general neural network program can be used for multiple pattern recognition cases by specifying different coefficients for the various terms, one set for each application. Thus, adding different diagnostic checks has only a small affect on the cost of the system. Also, the system has available to it all of the information available on the data bus. During the training process, the pattern recognition program sorts out from the available vehicle data on the data bus or from other sources, those patterns that predict failure of a particular component.

In FIG. 7, a schematic of a vehicle with several components and several sensors is shown in their approximate locations on a vehicle along with a total vehicle diagnostic system in accordance with the invention utilizing a diagnostic module in accordance with the invention. A flow diagram of information passing from the various sensors shown in FIG. 7 onto the vehicle data bus and thereby into the diagnostic device in accordance with the invention is shown in FIG. 8 along with outputs to a display for notifying the driver and to the vehicle cellular phone, or other communication device, for notifying the dealer, vehicle manufacturer or other entity concerned with the failure of a component in the vehicle. If the vehicle is operating on a smart highway, for example, the pending component failure information may also be communicated to a highway control system and/or to other vehicles in the vicinity so that an orderly exiting of the vehicle from the smart highway can be facilitated. FIG. 8 also contains the names of the sensors shown numbered on FIG. 7.

Sensor 901 is a crash sensor having an accelerometer (alternately one or more dedicated accelerometers 931 can be used), sensor 902 is represents one or more microphones, sensor 903 is a coolant thermometer, sensor 904 is an oil pressure sensor, sensor 905 is an oil level sensor, sensor 906 is an air flow meter, sensor 907 is a voltmeter, sensor 908 is an ammeter, sensor 909 is a humidity sensor, sensor 910 is an engine knock sensor, sensor 911 is an oil turbidity sensor, sensor 912 is a throttle position sensor, sensor 913 is a steering torque sensor, sensor 914 is a wheel speed sensor, sensor 915 is a tachometer, sensor 916 is a speedometer, sensor 917 is an oxygen sensor, sensor 918 is a pitch/roll sensor, sensor 919 is a clock, sensor 920 is an odometer, sensor 921 is a power steering pressure sensor, sensor 922 is a pollution sensor, sensor 923 is a fuel gauge, sensor 924 is a cabin thermometer, sensor 925 is a transmission fluid level sensor, sensor 926 is a yaw sensor, sensor 927 is a coolant level sensor, sensor 928 is a transmission fluid turbidity sensor, sensor 929 is brake pressure sensor and sensor 930 is a coolant pressure sensor. Other possible sensors include a temperature transducer, a pressure transducer, a liquid level sensor, a flow meter, a position sensor, a velocity sensor, a RPM sensor, a chemical sensor and an angle sensor, angular rate sensor or gyroscope.

If a distributed group of acceleration sensors or accelerometers are used to permit a determination of the location of a vibration source, the same group can, in some cases, also be used to measure the pitch, yaw and/or roll of the vehicle eliminating the need for dedicated angular rate sensors. In addition, as mentioned above, such a suite of sensors can also be used to determine the location and severity of a vehicle crash and additionally to determine that the vehicle is on the verge of rolling over. Thus, the same suite of accelerometers optimally performs a variety of functions including inertial navigation, crash sensing, vehicle diagnostics, roll over sensing etc.

Consider now some examples. The following is a partial list of potential component failures and the sensors from the list on FIG. 8 that might provide information to predict the failure of the component:

Out of balance tires	901,913,914,915,920,921
Front end out of alignment	901,913,921,926
Tune up required	901,903,910,912,915,917,920,922
Oil change needed	903,904,905,911
Motor failure	901,902,903,904,905,906,910,912,915,917,922
Low tire pressure	901,913,914,915,920,921
Front end looseness	901,913,916,921,926
Cooling system failure	903,915,924,927,930
Alternator problems	901,902,907,908,915,919,920
Transmission problems	901,903,912,915,916,920,925,928
Differential problems	901,912,914
Brakes	901,902,914,918,920,926,929
Catalytic converter and muffler	901,902,912,915,922
Ignition	901,902,907,908,909,910,912,917,923
Tire wear	901,913,914,915,918,920,921,926
Fuel leakage	920,923
Fan belt slippage	901,902,903,907,908,912,915,919,920
Alternator deterioration	901,902,907,908,915,919
Coolant pump failure	901,902,903,924,927,930
Coolant hose failure	901,902,903,927,930
Starter failure	901,902,907,908,909,912,915

Dirty air filter 902,903,906,911,912,917,922

Several interesting facts can be deduced from a review of the above list. First, all of the failure modes listed can be at least partially sensed by multiple sensors. In many cases, some of the sensors merely add information to aid in the interpretation of signals received from other sensors. In today's automobile, there are few if any cases where multiple sensors are used to diagnose or predict a problem. In fact, there is virtually no failure prediction undertaken at all. Second, many of the failure modes listed require information from more than one sensor. Third, information for many of the failure modes listed cannot be obtained by observing one data point in time as is now done by most vehicle sensors. Usually an analysis of the variation in a parameter as a function of time is necessary. In fact, the association of data with time to create a temporal pattern for use in diagnosing component failures in automobile is unique to this invention as in the combination of several such temporal patterns. Fourth, the vibration measuring capability of the airbag crash sensor, or other accelerometer, is useful for most of the cases discussed above yet there is no such current use of accelerometers. The airbag crash sensor is used only to detect crashes of the vehicle. Fifth, the second most used sensor in the above list, a microphone, does not currently appear on any automobiles yet sound is the signal most often used by vehicle operators and mechanics to diagnose vehicle problems. Another sensor that is listed above which also does not currently appear on automobiles is a pollution sensor. This is typically a chemical sensor mounted in the exhaust system for detecting emissions from the vehicle. It is expected that this and other chemical sensors will be used more in the future.

In addition, from the foregoing depiction of different sensors which receive signals from a plurality of components, it is possible for a single sensor to receive and output signals from a plurality of components which are then analyzed by the processor to determine if any one of the components for which the received signals were obtained by that sensor is operating in an abnormal state. Likewise, it is also possible to provide for a multiplicity of sensors each receiving a different signal related to a specific component which are then analyzed by the processor to determine if that component is operating in an abnormal state. Note that neural networks can simultaneously analyze data from multiple sensors of the same type or different types.

The discussion above has centered on notifying the vehicle operator of a pending problem with a vehicle component. Today, there is great competition in the automobile marketplace and the manufacturers and dealers who are most responsive to customers are likely to benefit by increased sales both from repeat purchasers and new customers. The diagnostic module disclosed herein benefits the dealer by making him instantly aware, through the cellular telephone system, or other communication link, coupled to the diagnostic module or system in accordance with the invention, when a component is likely to fail. As envisioned, on some automobiles, when the diagnostic module 870 detects a potential failure it not only notifies the driver through a display 980, but also automatically notifies the dealer through a vehicle cellular phone 990 or other telematics communication link. The dealer can thus contact the vehicle owner and schedule an appointment to undertake the necessary repair at each party's mutual convenience. Contact by the dealer to the vehicle owner can occur as the owner is driving the vehicle, using a communications device. Thus, the dealer can contact the driver and informed him of their mutual knowledge of the problem and discuss scheduling maintenance to attend to the problem. The customer is pleased since a potential vehicle breakdown has been avoided and the dealer is pleased since he is likely to perform the repair work. The vehicle manufacturer also benefits by early and accurate statistics on the failure rate of vehicle components. This early warning system can reduce the cost of a potential recall for components having design defects. It could even have saved lives if such a system had been in place during the Firestone tire failure problem mentioned above. The vehicle manufacturer will thus be guided toward producing higher quality vehicles thus improving his competitiveness. Finally, experience with this system will actually lead to a reduction in the number of sensors on the vehicle since only those sensors that are successful in predicting failures will be necessary.

For most cases, it is sufficient to notify a driver that a component is about to fail through a warning display. In some critical cases, action beyond warning the driver may be required. If, for example, the diagnostic module detected that the alternator was beginning to fail, in addition to warning the driver of this eventuality, the module could send a signal to another vehicle system to turn off all non-essential devices which use electricity thereby conserving electrical energy and maximizing the time and distance that the vehicle can travel before exhausting the energy in the battery. Additionally, this system can be coupled to a system such as OnStar® or a vehicle route guidance system, and the driver can be guided to the nearest open repair facility or a facility of his or her choice.

In the discussion above, the diagnostic module of this invention assumes that a vehicle data bus exists which is used by all of the relevant sensors on the vehicle. Most vehicles today do not have a data bus although it is widely believed that most vehicles will have one in the near future. Naturally, the relevant signals can be transmitted to the diagnostic module through a variety of coupling means other than through a data bus and this invention is not limited to vehicles having a data bus. For example, the data can be sent wirelessly to the diagnostic module using the Bluetooth™ specification. In some cases, even the sensors do not have to be wired and can obtain their power via RF from the interrogator as is well known in the RFID -radio frequency identification (either silicon or surface acoustic wave (SAW) based)) field. Alternately an inductive or capacitive power transfer system can be used.

As can be appreciated from the above discussion, the invention described herein brings several new improvements to automobiles including, but not limited to, the use of pattern recognition technologies to diagnose potential vehicle component failures, the use of trainable systems thereby eliminating the need of complex and extensive programming, the simultaneous use of multiple sensors to monitor a particular component, the use of a single sensor to monitor the operation of many vehicle components, the monitoring of vehicle components which have no dedicated sensors, and the notification of both the driver and possibly an outside entity of a potential component failure in time so that the failure can be averted and vehicle breakdowns substantially eliminated. Additionally, improvements to the vehicle stability, crash avoidance, crash anticipation and occupant protection are available.

To implement a component diagnostic system for diagnosing the component utilizing a plurality of sensors not directly associated with the component, i.e., independent of the component, a series of tests are conducted. For each test, the signals received from the sensors are input into a pattern recognition training algorithm with an indication of whether the component is operating normally or abnormally (the component being intentionally altered to provide for abnormal operation). The data from the test are used to generate the pattern recognition algorithm, e.g., neural network, so that in use, the data from the sensors is input into the algorithm and the algorithm provides an indication of abnormal or normal operation of the component. Also, to provide a more versatile diagnostic module for use in conjunction with diagnosing abnormal operation of multiple components, tests may be conducted in which each component is operated abnormally while the other components are operating normally, as well as tests in which two or more components are operating abnormally. In this manner, the diagnostic module may be able to determine based on one set of signals from the sensors during use that either a single component or multiple components are operating abnormally.

Furthermore, the pattern recognition algorithm may be trained based on patterns within the signals from the sensors. Thus, by means of a single sensor, it would be possible to determine whether one or more components are operating abnormally. To obtain such a pattern recognition algorithm, tests are conducted using a single sensor, such as a microphone, and causing abnormal operation of one or more components, each component operating abnormally while the other components operate normally and multiple components operating abnormally. In this manner, in use, the pattern recognition algorithm may analyze a signal from a single sensor and determine abnormal operation of one or more components. Note that in some cases, simulations can be used to analytically generate the relevant data.

The invention is also particularly useful in light of the foreseeable implementation of smart highways. Smart highways will result in vehicles traveling down highways under partial or complete control of an automatic system, i.e., not being controlled by the driver. The on-board diagnostic system will thus be able to determine failure of a component prior to or upon failure thereof and inform the vehicle's guidance system to cause the vehicle to move out of the stream of traffic, i.e., onto a shoulder of the highway, in a safe and orderly manner. Moreover, the diagnostic system may be controlled or programmed to prevent the movement of the disabled vehicle back into the stream of traffic until the repair of the component is satisfactorily completed.

In a method in accordance with this embodiment, the operation of the component would be monitored and if abnormal operation of the component is detected, e.g., by any of the methods and apparatus disclosed herein (although other component failure systems may of course be used in this implementation), the guidance system of the vehicle which controls the movement of the vehicle would be notified, e.g., via a signal from the diagnostic module to the guidance system, and the guidance system would be programmed to move the vehicle out of the stream of traffic, or off of the restricted roadway, possibly to a service station or dealer, upon reception of the particular signal from the diagnostic module. The automatic guidance systems for vehicles traveling on highways may be any existing system or system being developed, such as one based on satellite positioning techniques or ground-based positioning techniques. Since the guidance system may be programmed to ascertain the vehicle's position on the highway, it can determine the vehicle's current position, the nearest location out of the stream of traffic, or off of the restricted roadway, such as an appropriate shoulder or exit to which the vehicle may be moved, and the path of movement of the vehicle from the current position to the location out of the stream of traffic, or off of the restricted roadway. The vehicle may thus be moved along this path under the control of the automatic guidance system. In the alternative, the path may be displayed to a driver and the driver can follow the path, i.e., manually control the vehicle. The diagnostic module and/or guidance system may be designed to prevent re-entry of the vehicle into the stream of traffic, or off of the restricted roadway, until the abnormal operation of the component is satisfactorily addressed.

FIG. 9 is a flow chart of some of the methods for directing a vehicle off of a roadway if a component is operating abnormally. The component's operation is monitored at 440 and a determination is made at 442 whether its operation is abnormal. If not, the operation of the component is monitored further. If the operation of the component is abnormal, the vehicle can be directed off the roadway at 444. More particularly, this can be accomplished by generating a signal indicating the abnormal operation of the component at 446, directing this signal to a guidance system in the vehicle at 448 that guides movement of the vehicle off of the roadway at 450. Also, if the component is operating abnormally, the current position of the vehicle and the location of a site off of the roadway can be determined at 452, e.g. using satellite-based or ground-based location determining techniques, a path from the current location to the off-roadway location determined at 454 and then the vehicle directed along this path at 456. Periodically, a determination is made at 458 whether the component's abnormality has been satisfactorily addressed and/or corrected and if so, the vehicle can re-enter the roadway and operation of the component begins again. If not, the re-entry of the vehicle onto the roadway is prevented at 460.

FIG. 10 schematically shows the basic components for performing this method, i.e., a component operation monitoring system 462 (such as described above), an optional satellite-based or ground-based positioning system 464 and a vehicle guidance system 466.

FIG. 11 illustrates the placement of a variety of sensors, primarily accelerometers and/or gyroscopes, which can be used to diagnose the state of the vehicle itself. Sensor 202 can be located in the headliner or attached to the vehicle roof above the side door. Typically, there can be two such sensors one on either side of the vehicle. Sensor 203 is shown in a typical mounting location midway between the sides of the vehicle attached to or near the vehicle roof above the rear window. Sensor 206 is shown in a typical mounting location in the vehicle trunk adjacent the rear of the vehicle. Either one, two or three such sensors can be used depending on the application. If three such sensors are use one would be adjacent each side of vehicle and one in the center. Sensor 204 is shown in a typical mounting location in the vehicle door and sensor 205 is shown in a typical mounting location on the sill or floor below the door. Sensor 207, which can be also multiple sensors, is shown in a typical mounting location forward in the crush zone of the vehicle. Finally, sensor 208 can measure the acceleration of the firewall or instrument panel and is located thereon generally midway between the two sides of the vehicle. If three such sensors are used, one would be adjacent each vehicle side and one in the center.

In general, sensors 202-208 provide a measurement of the state of the vehicle, such as its velocity, acceleration, angular orientation or temperature, or a state of the location at which the sensor is mounted. Thus, measurements related to the state of the sensor would include measurements of the acceleration of the sensor, measurements of the temperature of the mounting location as well as changes in the state of the sensor and rates of changes of the state of the sensor. As such, any described use or function of the sensors 202-208 above is merely exemplary and is not intended to limit the form of the sensor or its function.

Each of the sensors 202-208 may be single axis, double axis or triaxial accelerometers and/or gyroscopes typically of the MEMS type. These sensors 202-208 can either be wired to the central control module or processor directly wherein they would receive power and transmit information, or they could be connected onto the vehicle bus or, in some cases, using RFID, SAW or similar technology, the sensors can be wireless and would receive their power through RF from one or more interrogators located in the vehicle. In this case, the interrogators can be connected either to the vehicle bus or directly to control module. Alternately, an inductive or capacitive power and information transfer system can be used.

One particular implementation will now be described. In this case, each of the sensors 202-208 is a single or dual axis accelerometer. They are made using silicon micromachined technology such as disclosed in U.S. Pat. Nos. 5,121,180 and 5,894,090. These are only representative patents of these devices and there exist more than 100 other relevant U.S. patents describing this technology. Commercially available MEMS gyroscopes such as from Systron Doner have accuracies of approximately one degree per second. In contrast, optical gyroscopes typically have accuracies of approximately one degree per hour. Unfortunately, the optical gyroscopes are prohibitively expensive for automotive applications. On the other hand, typical MEMS gyroscopes are not sufficiently accurate for many control applications.

The angular rate function can be obtained through placing accelerometers at two separated, non-co-located points in a vehicle and using the differential acceleration to obtain an indication of angular motion and angular acceleration. From the variety of accelerometers shown on FIG. 11, it can be appreciated that not only will all accelerations of key parts of the vehicle be determined, but the pitch, yaw and roll angular rates can also be determined based on the accuracy of the accelerometers. By this method, low cost systems can be developed which, although not as accurate as the optical gyroscopes, are considerably more accurate than conventional MEMS gyroscopes. Alternately, it has been found that from a single package containing up to three low cost MEMS gyroscopes and three low cost MEMS accelerometers, when carefully calibrated, an accurate inertial measurement unit (IMU) can be constructed that performs as well as units costing a great deal more. Such a package is sold by Crossbow Technology, Inc. 41 Daggett Dr., San Jose, CA 95134. If this IMU is combined with a GPS system and sometimes other vehicle sensor inputs using a Kalman filter, accuracy approaching that of expensive military units can be achieved.

Instead of using two accelerometers at separate locations on the vehicle, a single conformal MEMS-IDT gyroscope may be used. Such a conformal MEMS-IDT gyroscope is described in a paper by V.K. Karadan, Conformal MEMS-IDT Gyroscopes and Their Comparison With Fiber Optic Gyro, incorporated in its entirety herein. The MEMS-IDT gyroscope is based on the principle of surface acoustic wave (SAW) standing waves on a piezoelectric substrate. A surface acoustic wave resonator is used to create standing waves inside a cavity and the particles at the anti-nodes of the standing waves experience large amplitude of vibrations, which serves as the reference vibrating motion for the gyroscope. Arrays of metallic dots are positioned at the anti-node locations so that the effect of Coriolis force due to rotation will acoustically amplify the magnitude of the waves. Unlike other MEMS gyroscopes, the MEMS-IDT gyroscope has a planar configuration with no suspended resonating mechanical structures. Other SAW-based gyroscopes are also now under development.

The system of FIG. 11 using dual axis accelerometers, or the IMU Kalman filter system, therefore provides a complete diagnostic system of the vehicle itself and its dynamic motion. Such a system is far more accurate than any system currently available in the automotive market. This system provides very accurate crash discrimination since the exact location of the crash can be determined and, coupled with a knowledge of the force deflection characteristics of the vehicle at the accident impact site, an accurate determination of the crash severity and thus the need for occupant restraint deployment can be made. Similarly, the tendency of a vehicle to roll over can be predicted in advance and signals sent to the vehicle steering, braking and throttle systems to attempt to ameliorate the rollover situation or prevent it. In the event that it cannot be prevented, the deployment side curtain airbags can be initiated in a timely manner.

Similarly, the tendency of the vehicle to the slide or skid can be considerably more accurately determined and again the steering, braking and throttle systems commanded to minimize the unstable vehicle behavior.

Thus, through the sample deployment of inexpensive accelerometers at a variety of locations in the vehicle, or the IMU Kalman filter system significant improvements are made in the vehicle stability control, crash sensing, rollover sensing, and resulting occupant protection technologies.

Finally, as mentioned above, the combination of the outputs from these accelerometer sensors and the output of strain gage weight sensors in a vehicle seat, or in or on a support structure of the seat, can be used to make an accurate assessment of the occupancy of the seat and differentiate between animate and inanimate occupants as well as determining where in the seat the occupants are sitting. This can be done by observing the acceleration signals from the sensors of FIG. 11 and simultaneously the dynamic strain gage measurements from seat mounted strain gages. The accelerometers provide the input function to the seat and the strain gages measure the reaction of the occupying item to the vehicle acceleration and thereby provide a method of determining dynamically the mass of the occupying item and its location. This is particularly important during occupant position sensing during a crash event. By combining the outputs of the accelerometers and the strain gages and appropriately processing the same, the mass and weight of an object occupying the seat can be determined as well as the gross motion of such an object so that an assessment can be made as to whether the object is a life form such as a human being.

For this embodiment, sensor 209 represents one or more strain gage weight sensors mounted on the seat or in connection with the seat or its support structure. Suitable mounting locations and forms of weight sensors are discussed in the current assignee's U.S. patent application Ser. No. 09/193,209 and contemplated for use in this invention as well. The mass or weight of the occupying item of the seat can thus be measured based on the dynamic measurement of the strain gages with optional consideration of the measurements of accelerometers on the vehicle, which are represented by any of sensors 202-208.

FIG. 12 shows a schematic of the integration of the occupant sensing with a telematics link and the vehicle diagnosis with a telematics link. As envisioned, the occupant sensing system 1000 includes those components which determine the presence, position, health state, and other information relating to the occupants, for example the transducers discussed above with reference to FIGS. 1-3 and the SAW device discussed above with reference to FIG. 4. Information relating to the occupants includes information as to what the driver is doing, talking on the phone, communicating with OnStar® or other route guidance, listening to the radio, sleeping, drunk, drugged, having a heart attack The occupant sensing system may also be any of those systems and apparatus described in any of the current assignee's above-referenced patents and patent applications incorporated by reference herein, or any other comparable occupant sensing system which performs any or all of the same functions as they relate to occupant sensing. Examples of sensors which might be installed on a vehicle and constitute the occupant sensing system include heartbeat sensors, motion sensors, weight sensors, microphones and optical sensors.

A crash sensor 1002 is provided and determines when the vehicle experiences a crash. Crash sensor 1002 may be any type of crash sensor.

Vehicle sensors 1004 include sensors which detect the operating conditions of the vehicle such as those sensors discussed with reference to FIGS. 4-8 above. Also included are tire sensors such as disclosed in U.S. patent application Ser. No. 10/079,065. Other examples include velocity and acceleration sensors, and angular and angular rate pitch, roll and yaw sensors. Of particular importance are sensors that tell what the car is doing: speed, skidding, sliding, location, communicating with other cars or the infrastructure, etc.

Environment sensors 1006 includes sensors which provide data to the operating environment of the vehicle, e.g., the inside and outside temperatures, the time of day, the location of the sun and lights, the locations of other vehicles, rain, snow, sleet, visibility (fog), general road condition information, pot holes, ice, snow cover, road visibility, assessment of traffic, video pictures of an accident, etc. Possible sensors include optical sensors which obtain images of the environment surrounding the vehicle, blind spot detectors which provides data on the blind spot of the driver, automatic cruise control sensors that can provide images of vehicles in front of the host vehicle, various radar devices which provide the position of other vehicles and objects relative to the subject vehicle.

The occupant sensing system 1000, crash sensors 1002, vehicle sensors 1004, environment sensors 1006 all are coupled to a communications device 1008 which may contain a memory unit and appropriate electrical hardware to communicate with all of the sensors, process data from the sensors, and transmit data from the sensors. The memory unit would be useful to store data from the sensors, updated periodically, so that such information could be transmitted at set time intervals.

The communications device 308 can be designed to transmit information to any number of different types of facilities. For example, the communications device 1008 would be designed to transmit information to an emergency response facility 1010 in the event of an accident involving the vehicle. The transmission of the information would be triggered by a signal from the crash sensor 1002 that the vehicle was experiencing a crash or experienced a crash. The information transmitted would come from the occupant sensing system 1000 so that the emergency response could be tailored to the status of the occupants. For example, if the vehicle was determined to have ten occupants, multiple ambulances might be sent than if the vehicle contained only a single occupant. Also, if the occupants are determined not be breathing, then a higher priority call with living survivors might receive assistance first. As such, the information from the occupant sensing system 1000 would be used to prioritize the duties of the emergency response personnel.

Information from the vehicle sensors 1004 and environment sensors 1006 could also be transmitted to law enforcement authorities 1014 in the event of an accident so that the cause(s) of the accident could be determined. Such information can also include information from the occupant sensing system 1000, which might reveal that the driver was talking on the phone, putting on make-up, or another distracting activity, information from the vehicle sensors 1004 which might reveal a problem with the vehicle, and information from the environment sensors 1006 which might reveal the existence of slippery roads, dense fog and the like.

Information from the occupant sensing system 1000, vehicle sensors 1004 and environment sensors 1006 could also be transmitted to the vehicle manufacturer 1016 in the event of an accident so that a determination can be made as to whether failure of a component of the vehicle causes or contributed to the cause of the accident. For example, the vehicle sensors might determine that the tire pressure was too low so that advice can be disseminated to avoid maintaining the tire pressure too low in order to avoid an accident. Information from the vehicle sensors 1004 relating to component failure could be transmitted to a dealer/repair facility 1012 which could schedule maintenance to correct the problem.

The communications device 1008 could be designed to transmit particular information to each site, i.e., only information important to be considered by the personnel at that site. For example, the emergency response personnel have no need for the fact that the tire pressure was too low but such information is important to the law enforcement authorities 1014 (for the possible purpose of issuing a recall of the tire and/or vehicle) and the vehicle manufacturer 1016.

The communication device can be a cellular phone, OnStar® or other subscriber-based telematics system, a peer-to-peer vehicle communication system that eventually communicates to the infrastructure and then, perhaps, to the Internet with email to the dealer, manufacturer, vehicle owner, law enforcement authorities or others. It can also be a vehicle to LEO or Geostationary satellite system such as SkyBytes which can then forward the information to the appropriate facility either directly or through the Internet.

The communication may need to be secret so as not to violate the privacy of the occupants and thus encrypted communication may in many cases be required. Other innovations described herein include the transmission of any video data from a vehicle to another vehicle or to a facility remote from the vehicle by any means such as a telematics communication system such as OnStar®, a cellular phone system, a communication via GEO, geocentric or other satellite system and any communication that communicates the results of a pattern recognition system analysis. Also, any communication from a vehicle that combines sensor information with location information.

When optical sensors are provided as part of the occupant sensing system 1000, video conferencing becomes a possibility, whether or not the vehicle experiences a crash. That is, the occupants of the vehicle can engage in a video conference with people at another location 1018 via establishment of a communications channel by the communications device 1008.

The vehicle diagnostic system described above using a telematics link can transmit information from any type of sensors on the vehicle.

In one particular use of the invention, a wireless sensing and communication system is provided whereby the information or data obtained through processing of input from sensors of the wireless sensing and communication system is further transmitted for reception by a remote facility. Thus, in such a construction, there is an intra-vehicle communications between the sensors on the vehicle and a processing system (control module, computer or the like) and remote communications between the same or a coupled processing system (control module, computer or the like). The electronic components for the intra-vehicle communication may be designed to transmit and receive signals over short distances whereas the electronic components which enable remote communications should be designed to transmit and receive signals over relatively long distances.

The wireless sensing and communication system includes sensors that are located on the vehicle or in the vicinity of the vehicle and which provide information which is transmitted to one or more interrogators in the vehicle by wireless radio frequency means, using wireless radio frequency transmission technology. In some cases, the power to operate a particular sensor is supplied by the interrogator while in other cases, the sensor is independently connected to either a battery, generator, vehicle power source or some source of power external to the vehicle.

The sensors for a system installed in a vehicle would likely include tire pressure, temperature and acceleration monitoring sensors, weight or load measuring sensors, switches, temperature, acceleration, angular position, angular rate, angular acceleration, proximity, rollover, occupant presence, humidity, presence of fluids or gases, strain, road condition and friction, chemical sensors and other similar sensors providing information to a vehicle system, vehicle operator or external site. The sensors can provide information about the vehicle and its interior or exterior environment, about individual components, systems, vehicle occupants, subsystems, or about the roadway, ambient atmosphere, travel conditions and external objects.

The system can use one or more interrogators each having one or more antennas that transmit radio frequency energy to the sensors and receive modulated radio frequency signals from the sensors containing sensor and/or identification information. One interrogator can be used for sensing multiple switches or other devices. For example, an interrogator may transmit a chirp form of energy at 905 MHz to 925 MHz to a variety of sensors located within or in the vicinity of the vehicle. These sensors may be of the RFID electronic type or of the surface acoustic wave (SAW) type. In the electronic type, information can be returned immediately to the interrogator in the form of a modulated RF signal. In the case of SAW devices, the information can be returned after a delay. Naturally, one sensor can respond in both the electronic and SAW delayed modes.

When multiple sensors are interrogated using the same technology, the returned signals from the various sensors can be time, code, space or frequency multiplexed. For example, for the case of the SAW technology, each sensor can be provided with a different delay. Alternately, each sensor can be designed to respond only to a single frequency or several frequencies. The radio frequency can be amplitude or frequency modulated. Space multiplexing can be achieved through the use of two or more antennas and correlating the received signals to isolate signals based on direction.

In many cases, the sensors will respond with an identification signal followed by or preceded by information relating to the sensed value, state and/or property. In the case of a SAW-based switch, for example, the returned signal may indicate that the switch is either on or off or, in some cases, an intermediate state can be provided signifying that a light should be dimmed, rather than or on or off, for example.

Great economies are achieved by using a single interrogator or even a small number of interrogators to interrogate many types of devices. For example, a single interrogator may monitor tire pressure and temperature, the weight of an occupying item of the seat, the position of the seat and seatback, as well as a variety of switches controlling windows, door locks, seat position, etc. in a vehicle. Such an interrogator may use one or multiple antennas and when multiple antennas are used, may switch between the antennas depending on what is being monitored.

More particularly, the tire monitoring system of this invention actually comprises three separate systems corresponding to three stages of product evolution. Generation 1 is a tire valve cap that provides information as to the pressure within the tire as described below. Generation 2 requires the replacement of the tire valve stem, or the addition of a new stem-like device, with a new valve stem that also measures temperature and pressure within the tire or it may be a device that attaches to the vehicle wheel rim. Generation 3 is a product that is attached to the inside of the tire adjacent the tread and provides a measure of the diameter of the footprint between the tire and the road, the tire pressure and temperature, indications of tire wear and, in some cases, the coefficient of friction between the tire and the road.

Surface acoustic wave technology permits the measurement of many physical and chemical parameters without the requirement of local power or energy. Rather, the energy to run devices can be obtained from radio frequency electromagnetic waves. These waves excite an antenna that is coupled to the SAW device. Through various means, the properties of the acoustic waves on the surface of the SAW device are modified as a function of the variable to be measured. The SAW device belongs to the field of microelectromechanical systems (MEMS) and can be produced in high-volume at low cost.

For the generation 1 system, a valve cap contains a SAW material at the end of the valve cap, which may be polymer covered. This device senses the absolute pressure in the valve cap. Upon attaching the valve cap to the valve stem, a depressing member gradually depresses the valve permitting the air pressure inside the tire to communicate with a small volume inside the valve cap. As the valve cap is screwed onto the valve stem, a seal prevents the escape of air to the atmosphere. The SAW device is electrically connected to the valve cap, which is also electrically connected to the valve stem that acts as an antenna for transmitting and receiving radio frequency waves. An interrogator located within 20 feet of the tire periodically transmits radio waves that power the SAW device. The SAW device measures the absolute pressure in the valve cap that is equal to the pressure in the tire. U.S. Pat. Nos. 5,641,902, 5,819,779 and 4,103,549 illustrate a valve cap pressure sensor where a visual output is provided. Other related prior art includes U.S. Pat. No. 4,545,246.

The generation 2 system permits the measurement of both the tire pressure and tire temperature. In this case, the tire valve stem is removed and replaced with a new tire valve stem that contains a SAW device attached at the bottom of the valve stem. This device actually contains two SAW devices, one for measuring temperature and the second for measuring pressure through a novel technology discussed below. This second generation device therefore permits the measurement of both the pressure and the temperature inside the tire. Alternately, this device can be mounted inside the tire, attached to the rim or attached to another suitable location. An external pressure sensor is mounted in the interrogator to measure the pressure of the atmosphere to compensate for altitude and/or barometric changes.

The generation 3 device contains a pressure and temperature sensor, as in the case of the generation 2 device, but additionally contains one or more accelerometers which measure at least one component of the acceleration of the vehicle tire tread adjacent the device. This acceleration varies in a known manner as the device travels in an approximate circle attached to the wheel. This device is capable of determining when the tread adjacent the device is in contact with road surface. It is also able to measure the coefficient of friction between the tire and the road surface. In this manner, it is capable of measuring the length of time that this tread portion is in contact with the road and thereby provides a measure of the diameter of the tire footprint on the road. A technical discussion of the operating principle of a tire inflation and load detector based on flat area detection follows:

When tires are inflated and not in contact with the ground, the internal pressure is balanced by the circumferential tension in the fibers of the shell. Static equilibrium demands that tension is equal to the radius of curvature multiplied by the difference between the internal and the external gas pressure. Tires support the weight of the automobile by changing the curvature of the part of the shell that touches the ground. The relation mentioned above is still valid. In the part of the shell that gets flattened, the radius of curvature increases while the tension in the tire structure stays the same. Therefore, the difference between the external and internal pressures becomes small to compensate for the growth of the radius. If the shell were perfectly flexible, the tire contact with the ground would develop into a flat spot with an area equal to the load divided by the pressure.

A tire operating at correct values of load and pressure has a precise signature in terms of variation of the radius of curvature in the loaded zone. More flattening indicates under-inflation or overloading, while less flattening indicates over-inflation or under-loading. Note that tire loading has essentially no effect on internal pressure.

From the above, one can conclude that monitoring the curvature of the tire as it rotates can provide a good indication of its operational state. A sensor mounted inside the tire at its largest diameter can accomplish this measurement. Preferably, the sensor would measure mechanical strain. However, a sensor measuring acceleration in any one axis could also serve the purpose.

In the case of the strain measurement, the sensor would indicate a constant strain as it spans the arc over which the tire is not in contact with the ground, and a pattern of increased stretch during the arc of close proximity with the ground. A simple ratio of the times of duration of these two states would provide a good indication of inflation, but more complex algorithms could be employed, where the values and the shape of the period of increased strain are utilized.

In the case of acceleration measurement, the system would utilize the fact that the part of the tire in contact with the ground possesses zero velocity for a finite period of time, while the rest of the tire is accelerating and decelerating in a cyclic fashion. The resulting acceleration profiles in the circumferential axis or the radial axis present a characteristic near-zero portion, the length of which, when related to the rest of the rotation, is a result of the state of tire inflation.

As an indicator of tire health, the measurement of strain on the largest inside diameter of the tire is believed to be superior to the measurement of stress, such as inflation pressure, because, the tire could be deforming, as it ages or otherwise progresses toward failure, without any changes in inflation pressure. Radial strain could also be measured on the inside of the tire sidewall thus indicating the degree of flexure that the tire undergoes.

The accelerometer approach has the advantage of giving a signature from which a harmonic analysis of once-per-revolution disturbances could indicate developing problems such as hernias, flat spots, loss of part of the tread, sticking of foreign bodies to the tread, etc.

As a bonus, both of the above-mentioned sensors give clear once-per-revolution signals for each tire that could be used as inputs for speedometers, odometers, differential slip indicators, tire wear indicators, etc.

Tires can fail for a variety of reasons including low pressure, high temperature, delamination of the tread, excessive flexing of the sidewall, and wear (see, e.g., Summary Root Cause Analysis Bridgestone/Firestone, Inc." http: // www. bridgestone-firestone.com / homeimgs / rootcause. htm , Printed March, 2001). Most tire failures can be predicted based on tire pressure alone and the TREAD Act thus addresses the monitoring of tire pressure. However, some failures, such as the Firestone tire failures, can result from substandard materials especially those that are in contact with a steel-reinforcing belt. If the rubber adjacent the steel belt begins to move relative to the belt, then heat will be generated and the temperature of the tire will rise until the tire fails catastrophically. This can happen even in properly inflated tires.

Finally, tires can fail due to excessive vehicle loading and excessive sidewall flexing even if the tire is properly inflated. This can happen if the vehicle is overloaded or if the wrong size tire has been mounted on the vehicle. In most cases, the tire temperature will rise as a result of this additional flexing, however, this is not always the case, and it may even occur too late. Therefore, the device which measures the diameter of the tire footprint on the road is a superior method of measuring excessive loading of the tire.

Generation 1 devices monitor pressure only while generation 2 devices also monitor the temperature and therefore will provide a warning of imminent tire failure more often than through monitoring pressure alone. Generation 3 devices will give an indication that the vehicle is overloaded before either a pressure or temperature monitoring system can respond. The generation 3 system can also be augmented to measure the vibration signature of the tire and thereby detect when a tire has worn to the point that the steel belt is contacting the road. In this manner, the generation 3 system also provides an indication of a worn out tire and, as will be discussed below, an indication of the road coefficient of friction.

Each of these devices communicates to an interrogator with pressure, temperature, and acceleration as appropriate. In none of these generational devices is a battery mounted within the vehicle tire required, although in some cases a generator can be used. In most cases, the SAW devices will optionally provide an identification number corresponding to the device to permit the interrogator to separate one tire from another.

Key advantages of the tire monitoring system disclosed herein over most of the currently known prior art are:

- very small size and insignificant weight eliminating the need for wheel counterbalance.
- cost competitive for tire monitoring only, significant cost advantage when systems are combined,
- exceeds customers' price targets,
- high update rate,
- self-diagnostic,
- automatic wheel identification,
- no batteries required – powerless,
- no wires required – wireless.

SAW devices have been used for sensing many parameters including devices for chemical sensing and materials characterization in both the gas and liquid phase. They also are used for measuring pressure, strain, temperature, acceleration, angular rate and other physical states of the environment.

The monitoring of temperature and or pressure of a tire can take place infrequently. It is adequate to check the pressure and temperature of vehicle tires once every ten seconds to once per minute. To utilize the centralized interrogator of this invention, the tire monitoring system would preferably use SAW technology and the device could be located in the valve stem, wheel, tire side wall, tire tread, or other appropriate location with access to the internal tire pressure of the tires. A preferred system is based on a SAW technology discussed above.

At periodic intervals, such as once every minute, the interrogator sends a radio frequency signal at a frequency such as 905 MHz to which the tire monitor sensors have been sensitized. When receiving this signal, the tire monitor sensors (of which there are five in a typical configuration) respond with a signal providing an optional identification number, temperature and pressure data. In one implementation, the interrogator would use multiple, typically two or four, antennas which are spaced apart. By comparing the time of the returned signals from the tires to the antennas, the location of each of the senders can be approximately determined. That is, the antennas can be so located that each tire is a different distance from each antenna and by comparing the return time of the signals sensed by the antennas, the location of each tire can be determined and associated with the returned information. If at least three antennas are used, then returns from adjacent vehicles can be eliminated.

An identification number can accompany each transmission from each tire sensor and can also be used to validate that the transmitting sensor is in fact located on the subject vehicle. In traffic situations, it is possible to obtain a signal from the tire of an adjacent vehicle. This would immediately show up as a return from more than five vehicle tires and the system would recognize that a fault had occurred. The sixth return can be easily eliminated, however, since it could contain an identification number that is different from those that have heretofore been returned frequently to the vehicle system or based on a comparison of the signals sensed by the different antennas. Thus, when the vehicle tire is changed or tires are rotated, the system will validate a particular return signal as originating from the tire-monitoring sensor located on the subject vehicle.

This same concept is also applicable for other vehicle-mounted sensors. This permits a plug and play scenario whereby sensors can be added to, changed, or removed from a vehicle and the interrogation system will automatically adjust. The system will know the type of sensor based on the identification number, frequency, delay and/or its location on the vehicle. For example, a tire monitor could have a different code in the identification number from a switch or weight-monitoring device. This also permits new kinds of sensors to be retroactively installed on a vehicle. If a totally new type of the sensor is mounted to the vehicle, the system software would have to be updated to recognize and know what to do with the information from the new sensor type. By this method, the configuration and quantity of sensing systems on a vehicle can be easily changed and the system interrogating these sensors need only be updated with software upgrades which could occur automatically over the Internet.

Preferred tire-monitoring sensors for use with this invention use the surface acoustic wave (SAW) technology. A radio frequency interrogating signal is sent to all of the tire gages simultaneously and the received signal at each tire gage is sensed using an antenna. The antenna is connected to the IDT transducer that converts the electrical wave to an acoustic wave that travels on the surface of a material such as lithium niobate, or other piezoelectric material such as zinc oxide, Langasite or the polymer polyvinylidene fluoride (PVDF). During its travel on the surface of the piezoelectric material, either the time delay, resonant frequency, amplitude, or phase of the signal (or even possibly combinations thereof) is modified based on the temperature and/or pressure in the tire. This modified wave is sensed by one or more IDT transducers and converted back to a radio frequency wave that is used to excite an antenna for re-broadcasting the wave back to interrogator. The interrogator receives the wave at a time delay after the original transmission that is determined by the geometry of the SAW transducer and decodes this signal to determine the temperature and/or pressure in the subject tire. By using slightly different geometries for each of the tire monitors, slightly different delays can be achieved and randomized so that the probability of two sensors having the same delay is small. The interrogator transfers the decoded information to a central processor that then determines whether the temperature and/or pressure of each of the tires exceed specifications. If so, a warning light can be displayed informing the vehicle driver of the condition. In some cases, this random delay is all that is required to separate the five tire signals and to identify which tires are on the vehicle and thus ignore responses from adjacent vehicles.

With an accelerometer mounted in the tire, as is the case for the generation 3 system, information is present to diagnose other tire problems. For example, when the steel belt wears through the rubber tread, it will make a distinctive noise and create a distinctive vibration when it contacts the pavement. This can be sensed by the SAW accelerometer. The interpretation of various such signals can be done using neural network technology. Similar systems are described more detail in U.S. Pat. No. 5,829,782, incorporated by reference herein. As the tread begins to separate from the tire as in the Bridgestone cases a distinctive vibration is created which can also be sensed by a tire-mounted accelerometer.

As the tire rotates, stresses are created in the rubber tread surface between the center of the footprint and the edges. If the coefficient of friction on the pavement is low, these stresses can cause the shape of the footprint to change. The generation 3 system, which measures the circumferential length of the footprint, can therefore also be used to measure the friction coefficient between the tire and the pavement.

Similarly, the same or a different interrogator can be used to monitor various components of the vehicle's safety system including occupant position sensors, vehicle acceleration sensors, vehicle angular position, velocity and acceleration sensors, related to both frontal, side or rear impacts as well as rollover conditions. The interrogator could also be used in conjunction with other detection devices such as weight sensors, temperature sensors, accelerometers which are associated with various systems in the vehicle to enable such systems to be controlled or affected based on the measured state.

Some specific examples of the use of interrogators and responsive devices will now be described.

The antennas used for interrogating the vehicle tire pressure transducers will be located outside of the vehicle passenger compartment. For many other transducers to be sensed the antennas must be located at various positions within passenger compartment. This invention contemplates, therefore, a series of different antenna systems, which can be electronically switched by the interrogator circuitry. Alternately, in some cases, all of the antennas can be left connected and total transmitted power increased.

There are several applications for weight or load measuring devices in a vehicle including the vehicle suspension system and seat weight sensors for use with automobile safety systems. As reported in U.S. Pat. Nos. 4,096,740, 4,623,813, 5,585,571, 5,663,531, 5,821,425 and 5,910,647 and International Publication No. WO 00/65320(A1), all of which are incorporated by reference herein to the extent the disclosure of these publications is necessary, SAW devices are appropriate candidates for such weight measurement systems. In this case, the surface acoustic way on the lithium niobate, or other piezoelectric material, is modified in delay time, resonant frequency, amplitude and/or phase based on strain of the member upon which the SAW device is mounted. For example, the conventional bolt that is typically used to connect the passenger seat to the seat adjustment slide mechanism can be replaced with a stud which is threaded on both ends. A SAW strain device is mounted to the center unthreaded section of the stud and the stud is attached to both the seat and the slide mechanism using appropriate threaded nuts. Based on the particular geometry of the SAW device used, the stud can result in as little as a 3 mm upward displacement of the seat compared to a normal bolt mounting system. No wires are required to attach the SAW device to the stud. The interrogator transmits a radio frequency pulse at, for example, 925 MHz that excites antenna on the SAW strain measuring system. After a delay caused by the time required for the wave to travel the length of the SAW device, a modified wave is re-transmitted to the interrogator providing an indication of the strain of the stud with the weight of an object occupying the seat corresponding to the strain. For a seat that is normally bolted to the slide mechanism with four bolts, at least four SAW strain sensors would be used. Since the individual SAW devices are very small, multiple devices can be placed on a stud to provide multiple redundant measurements, or permit bending strains to be determined, and/or to permit the stud to be arbitrarily located with at least one SAW device always within direct view of the interrogator antenna. In some cases, the bolt or stud will be made on non-conductive material to limit the blockage of the RF signal. In other cases, it will be insulated from the slide (mechanism) and used as an antenna.

If two longitudinally spaced apart antennas are used to receive the SAW transmissions from the seat weight sensors, one antenna in front of the seat and the other behind the seat, then the position of the seat can be determined eliminating the need for current seat position sensors. A similar system can be used for other seat and seatback position measurements.

For strain gage weight sensing, the frequency of interrogation would be considerably higher than that of the tire monitor, for example. However, if the seat is unoccupied then the frequency of interrogation can be substantially reduced. For an occupied seat, information as to the identity and/or category and position of an occupying item of the seat can be obtained through the multiple weight sensors described. For this reason, and due to the fact that during the pre-crash event the position of an occupying item of the seat may be changing rapidly, interrogations as frequently as once every 10 milliseconds can be desirable. This would also enable a distribution of the weight being applied to the seat to be obtained which provides an estimation of the position of the object occupying the seat. Using pattern recognition technology, e.g., a trained neural network, sensor fusion, fuzzy logic, etc., the identification of the object can be ascertained based on the determined weight and/or determined weight distribution.

There are many other methods by which SAW devices can be used to determine the weight and/or weight distribution of an occupying item other than the method described above and all such uses of SAW strain sensors for determining the weight and weight distribution of an occupant are contemplated. For example, SAW devices with appropriate straps can be used to measure the deflection of the seat cushion top or bottom caused by an occupying item, or if placed on the seat belts, the load on the belts can determined wirelessly and powerlessly. Geometries similar to those disclosed in U.S. Pat. No. 6,242,701 (which discloses multiple strain gage geometries, the entire disclosure of this patent is incorporated by reference herein to the extent the disclosure is necessary) using SAW strain-measuring devices can also be constructed, e.g., any of the multiple strain gage geometries shown therein.

Although a preferred method for using the invention is to interrogate each of the SAW devices using wireless means, in some cases it may be desirable to supply power to and/or obtain information from one or more of the devices using wires. As such, the wires would be an optional feature.

One advantage of the weight sensors of this invention along with the geometries disclosed in the '701 patent and herein below, is that in addition to the axial stress in the seat support, the bending moments in the structure can be readily determined. For example, if a seat is supported by four "legs", it is possible to determine the state of stress, assuming that axial twisting can be ignored, using four strain gages on each leg support for a total of 16 such gages. If the seat is supported by three legs, then this can be reduced to 12. Naturally, a three-legged support is preferable than four since with four, the seat support is over-determined severely complicating the determination of the stress caused by an object on the seat. Even with three supports, stresses can be introduced depending on the nature of the support at the seat rails or other floor-mounted supporting structure. If simple supports are used that do not introduce bending moments into the structure, then the number of gages per seat can be reduced to three providing a good model of the seat structure is available. Unfortunately, this is usually not the case and most seats have four supports and the attachments to the vehicle not only introduce bending moments into the structure but these moments vary from one position to another and with temperature. The SAW strain gages of this invention lend themselves to the placement of multiple gages onto each support as needed to approximately determine the state of stress and thus the weight of the occupant depending on the particular vehicle application. Furthermore, the wireless nature of these gages greatly simplifies the placement of such gages at those locations that are most appropriate.

One additional point should be mentioned. In many cases, the determination of the weight of an occupant from the static strain gage readings yields inaccurate results due to the indeterminate stress state in the support structure. However, the dynamic stresses to a first order are independent of the residual stress state. Thus, the change in stress that occurs as a vehicle travels down a roadway caused by dips in the roadway can provide an accurate measurement of the weight of an object in a seat. This is especially true if an accelerometer is used to measure the vertical excitation provided to the seat.

Some vehicle models provide load leveling and ride control functions that depend on the magnitude and distribution of load carried by the vehicle suspension. Frequently, wire strain gage technology is used for these functions. That is, the wire strain gages are used to sense the load and/or load distribution of the vehicle on the vehicle suspension system. Such strain gages can be advantageously replaced with strain gages based on SAW technology with the significant advantages in terms of cost, wireless monitoring, dynamic range, and signal level. In addition, SAW strain gage systems can be significantly more accurate than wire strain gage systems.

A strain detector in accordance with this invention can convert mechanical strain to variations in electrical signal frequency with a large dynamic range and high accuracy even for very small displacements. The frequency variation is produced through use of a surface acoustic wave delay line as the frequency control element of an oscillator. A surface acoustic wave delay line comprises a transducer deposited on a piezoelectric material such as quartz or lithium niobate which is disposed so as to be deformed by strain in the member which is to be monitored. Deformation of the piezoelectric substrate changes the frequency control characteristics of the surface acoustic wave delay line, thereby changing the frequency of the oscillator. Consequently, the oscillator frequency change is a measure of the strain in the member being monitored and thus the weight applied to the seat. A SAW strain transducer is capable of a degree of accuracy substantially greater than that of a conventional resistive strain gage.

Other applications of weight measuring systems for an automobile include measuring the weight of the fuel tank or other containers of fluid to determine quantity of fluid contained therein.

One problem with SAW devices is that if they are designed to operate at the GHz frequency, the feature sizes become exceeding small and the devices are difficult to manufacture. On the other hand, if the frequencies are considerably lower, for example, in the tens of megahertz range, then the antenna sizes become excessive. It is also more difficult to obtain antenna gain at the lower frequencies. This is also related to antenna size. One method of solving this problem is to transmit an interrogation signal in the many GHz range which is modulated at the hundred MHz range. At the SAW transducer, the transducer is tuned to the modulated frequency. Using a nonlinear device such as a Shocky diode, the modified signal can be mixed with the incoming high frequency signal and re-transmitted through the same antenna. For this case, the interrogator could continuously broadcast the carrier frequency.

In addition to measuring the weight of an occupying item on a seat, the location of the seat and setback can also be determined by the interrogator. Since the SAW devices inherently create a delayed return signal, either that delay must be very accurately known or an alternate approach is required. One such alternate approach is to use the heterodyne principal described above to cause the antenna to return a signal of a different frequency. By comparing the phases of the sending and received signal, the distance to the device can be determined. Also, as discussed above, multiple antennas can be used for seat position and seatback position sensing.

With respect to switches, devices based on RFID technology can be used as switches in a vehicle as described in U.S. Pat. Nos. 6,078,252 and 6,144,288, and U.S. provisional patent application Ser. No.

60/231,378 all of which are incorporated by reference herein. There are many ways that it can be accomplished. A switch can be used to connect an antenna to either an RFID electronic device or to an RFID SAW device. This of course requires contacts to the closed by the switch activation. An alternate approach is to use pressure from an occupant's finger, for example, to alter the properties of the acoustic wave on the SAW material much as in a SAW touch screen. These properties that can be modified include the amplitude of the acoustic wave, and its phase, and/or the time delay or an external impedance connected to one of the SAW reflectors as disclosed in U.S. Pat. No. 6,084,503, incorporated by reference herein. In this implementation, the SAW transducer can contain two sections, one which is modified by the occupant and the other which serves as a reference. A combined signal is sent to the interrogator that decodes the signal to determine that the switch has been activated. By any of these technologies, switches can be arbitrarily placed within the interior of an automobile, for example, without the need for wires. (The wires would be an optional feature.) Since wires and connectors are the clause of most warranty repairs in an automobile, not only is the cost of switches substantially reduced but also the reliability of the vehicle electrical system is substantially improved.

The interrogation of switches can take place with moderate frequency such as once every 100 milliseconds. Either through the use of different frequencies or different delays, a large number of switches can be either time, code, space or frequency multiplexed to permit separation of the signals obtained by the interrogator.

Another approach is to attach a variable impedance device across one of the reflectors on the SAW device. The impedance can therefore used to determine the relative reflection from the reflector compared to other reflectors on the SAW device. In this way, the magnitude as well as the presence of a force exerted by an occupant's finger, for example, can be used to provide a rate sensitivity to the desired function. In an alternate design, as shown U.S. Pat. No. 6,144,288, incorporated by reference herein, the switch is used to connect the antenna to the SAW device. Of course, in this case the interrogator will not get a return from the SAW switch unless it is depressed.

Temperature measurement is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW temperature sensors.

U.S. Pat. No. 4,249,418, incorporated by reference herein, is one of many examples of prior art SAW temperature sensors. Temperature sensors are commonly used within vehicles and many more applications might exist if a low cost wireless temperature sensor is available, i.e., the invention. The SAW technology can be used for such temperature sensing tasks. These tasks include measuring the vehicle coolant temperature, air temperature within passenger compartment at multiple locations, seat temperature for use in conjunction with seat warming and cooling systems, outside temperatures and perhaps tire surface temperatures to provide early warning to operators of road freezing conditions. One example, is to provide air temperature sensors in the passenger compartment in the vicinity of ultrasonic transducers used in occupant sensing systems as described in the current assignee's U.S. Pat No. 5,943,295 (Varga et al.), incorporated by reference herein, since the speed of sound in the air varies by approximately 20% from -40 °C to 85 °C. The subject matter of this patent is included in the invention to form a part thereof. Current ultrasonic occupant sensor systems do not measure or compensate for this change in the speed of sound with the effect of significantly reducing the accuracy of the systems at the temperature extremes. Through the judicious placement of SAW temperature sensors in the vehicle, the passenger compartment air temperature can be accurately estimated and the information provided wirelessly to the ultrasonic occupant sensor system thereby permitting corrections to be made for the change in speed of sound.

Acceleration sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW accelerometers.

U.S. Pat. Nos. 4,199,990, 4,306,456 and 4,549,436, all of which are incorporated by reference herein, are examples of prior art SAW accelerometers. Most airbag crash sensors for determining whether the vehicle is experiencing a frontal or side impact currently use micromachined accelerometers. These accelerometers are usually based on the deflection of a mass which is sensed using either capacitive or piezoresistive technologies. SAW technology has heretofore not been used as a vehicle accelerometer or for vehicle crash sensing. Due to the importance of this function, at least one interrogator could be dedicated to this critical function. Acceleration signals from the crash sensors should be reported at least preferably every 100 microseconds. In this case, the dedicated interrogator would send an interrogation pulse to all crash sensor accelerometers every 100 microseconds and receive staggered acceleration responses from each of the SAW accelerometers wirelessly. This technology permits the placement of multiple low-cost accelerometers at ideal locations for crash sensing including inside the vehicle side doors, in the passenger compartment and in the frontal crush zone. Additionally crash sensors can now be located in the rear of the vehicle in the crush zone to sense rear impacts. Since the acceleration data is transmitted wirelessly, concern about the detachment or cutting of wires from the sensors disappears. One of the main concerns, for example, of placing crash sensors in the vehicle doors where they most appropriately can sense vehicle side impacts, is the fear that an impact into the A-pillar of the automobile would sever the wires from the door-mounted crash sensor before the crash was sensed. This problem disappears with the current wireless technology of this invention. If two accelerometers are placed at some distance from each other, the roll rate of the vehicle can be determined and thus the tendency of the vehicle to rollover can be predicted in time to automatically take corrective action and/or deploy a curtain airbag or other airbag(s).

Although the sensitivity of measurement is considerably greater than that obtained with conventional piezoelectric accelerometers, the frequency deviation remains low in absolute value. Accordingly, the frequency drift of thermal origin has to be made as low as possible by selecting a suitable cut of the piezoelectric material. The resulting accuracy is impressive as presented in U.S. Pat. No. 4,549,436, incorporated by reference herein, which discloses an angular accelerometer with a dynamic a range of 1 million, temperature coefficient of 0.005%/deg F, an accuracy of 1 microradian/sec^2, a power consumption of 1 milliwatt, a drift of 0.01% per year, a volume of 1 cc/axis and a frequency response of 0 to 1000 Hz. The subject matter of this patent is hereby included in the invention to constitute a part of the invention. A similar design can be used for acceleration sensing.

In a similar manner as the polymer coated SAW device is used to measure pressure, a similar device wherein a seismic mass is attached to a SAW device through a polymer interface can be made to sense acceleration. This geometry has a particular advantage for sensing accelerations below 1 G, which has proved to be very difficult in conventional micromachined accelerometers due to their inability to both measure low accelerations and withstand shocks.

Gyroscopes are another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW gyroscopes.

The SAW technology is particularly applicable for gyroscopes as described in International Publication No. WO 00/79217A2 to Varadan et al. The output of such gyroscopes can be determined with an interrogator that is also used for the crash sensor accelerometers, or a dedicated interrogator can be used. Gyroscopes having an accuracy of approximately 1 degree per second have many applications in a vehicle including skid control and other dynamic stability functions. Additionally, gyroscopes of similar accuracy can be used to sense impending vehicle rollover situations in time to take corrective action.

SAW gyroscopes of the type described in WO 00/79217A2 have the capability of achieving accuracies approaching 3 degrees per hour. This high accuracy permits use of such gyroscopes in an inertial measuring unit (IMU) that can be used with accurate vehicle navigation systems and autonomous vehicle control based on differential GPS corrections. Such a system is described in the current assignee's U.S. patent application Ser. No. 09/177,041. Such navigation systems depend on the availability of four or more GPS satellites and an accurate differential correction signal such as provided by the OmniStar Corporation or NASA or through the National Differential GPS system now being deployed. The availability of these signals degrades in urban canyon environments, tunnels, and on highways when the vehicle is in the vicinity of large trucks. For this application, an IMU system should be able to accurately control the vehicle for perhaps 15 seconds and preferably for up to five minutes. An IMU based on SAW technology or the technology of U.S. Pat. No. 4,549,436 discussed above are the best-known devices capable of providing sufficient accuracies for this application at a reasonable cost. Other accurate gyroscope technologies such as fiber optic systems are more accurate but can cost many thousands of dollars. In contrast, in high volume production, an IMU of the required accuracy based on SAW technology should cost less than $100.

Once an IMU of the accuracy described above is available in the vehicle, this same device can be used to provide significant improvements to vehicle stability control and rollover prediction systems.

Keyless entry systems are another field in which SAW technology can be applied and the invention encompasses several embodiments of access control systems using SAW devices.

A common use of SAW technology is for access control to buildings. RFID technology using electronics is also applicable for this purpose; however, the range of electronic RFID technology is usually limited to one meter or less. In contrast, the SAW technology can permit sensing up to about 30 meters. As a keyless entry system, an automobile can be configured such that the doors unlock as the holder of a card containing the SAW ID system approaches the vehicle and similarly, the vehicle doors can be automatically locked when occupant with the card travels beyond a certain distance from the vehicle. When the occupant enters the vehicle, the doors can again automatically lock either through logic or through a current system wherein doors automatically lock when the vehicle is placed in gear. An occupant with such a card would also not need to have an ignition key. The vehicle would recognize that the SAW based card was inside vehicle and then permit the vehicle to be started by issuing an oral command if a voice recognition system is present or by depressing a button, for example, without the need for an ignition key.

Occupant presence and position sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW occupant presence and/or position sensors.

Many sensing systems are available for the use to identify and locate occupants or other objects in a passenger compartment of the vehicle. Such sensors include ultrasonic sensors, chemical sensors (e.g. carbon dioxide), cameras, radar systems, heat sensors, capacitance, magnetic or other field change sensors, etc. Most of these sensors require power to operate and return information to a central processor for analysis. An ultrasonic sensor, for example, may be mounted in or near the headliner of the vehicle and periodically it transmits a few ultrasonic waves and receives reflections of these waves from occupying items of the passenger seat. Current systems on the market are controlled by electronics in a dedicated ECU.

An alternate method as taught in this invention is to use an interrogator to send a signal to the headliner-mounted ultrasonic sensor causing that sensor to transmit and receive ultrasonic waves. The sensor in this case would perform mathematical operations on the received waves and create a vector of data containing perhaps twenty to forty values and transmit that vector wirelessly to the interrogator. By means of this system, the ultrasonic sensor need only be connected to the vehicle power system and the information could be transferred to and from the sensor wirelessly. Such a system significantly reduces the wiring complexity especially when there may be multiple such sensors distributed in the passenger compartment. Now, only a power wire needs to be attached to the sensor and there does not need to be any direct connection between the sensor and the control module. Naturally, the same philosophy would apply to radar-based sensors, electromagnetic sensors of all kinds including cameras, capacitive or other electromagnetic field change sensitive sensors etc. In some cases, the sensor itself can operate on power supplied by the interrogator through radio frequency transmission. In this case, even the connection to the power line can be omitted. This principle can be extended to the large number of sensors and actuators that are currently in the vehicle where the only wires that are needed are those to supply power to the sensors and actuators and the information is supplied wirelessly.

Such wireless powerless sensors can also be use, for example, as close proximity sensors based on measurement of thermal radiation from an occupant. Such sensors can be mounted on any of the surfaces in the passenger compartment, including the seats, which are likely to receive such radiation.

A significant number of people are suffocated each year in automobiles due to excessive heat, carbon dioxide, carbon monoxide, or other dangerous fumes. The SAW sensor technology is particularly applicable to solving these kinds of problems. The temperature measurement capabilities of SAW transducers have been discussed above. If the surface of a SAW device is covered with a material which captures carbon dioxide, for example, such that the mass, elastic constants or other property of surface coating changes, the characteristics of the surface acoustic waves can be modified as described in detail in U.S. Pat. No. 4,637,987 and elsewhere. Once again, an interrogator can sense the condition of these chemical-sensing sensors without the need to supply power and connect the sensors with either wireless communication or through the power wires. If a concentration of carbon monoxide is sensed, for example, an alarm can be sounded, the windows opened, and/or the engine extinguished. Similarly, if the temperature within the passenger compartment exceeds a certain level, the windows can be automatically opened a little to permit an exchange of air reducing the inside temperature and thereby perhaps saving the life of an infant or pet left in the vehicle unattended.

In a similar manner, the coating of the surface wave device can contain a chemical which is responsive to the presence of alcohol. In this case, the vehicle can be prevented from operating when the concentration of alcohol vapors in the vehicle exceeds some determined limit.

Each year a number of children and animals are killed when they are locked into a vehicle trunk. Since children and animals emit significant amounts of carbon dioxide, a carbon dioxide sensor connected to the vehicle system wirelessly and powerlessly provides an economic way of detecting the presence of a life form in the trunk. If a life form is detected, then a control system can release a trunk lock thereby opening the trunk. Alarms can also be sounded or activated when a life form is detected in the trunk.

Although they will not be discussed in detail, SAW sensors operating in the wireless mode can also be used to sense for ice on the windshield or other exterior surfaces of the vehicle, condensation on the inside of the windshield or other interior surfaces, rain sensing, heat load sensing and many other automotive sensing functions. They can also be used to sense outside environmental properties and states including temperature, humidity, etc.

SAW sensors can be economically used to measure the temperature and humidity at numerous places both inside and outside of a vehicle. When used to measure humidity inside the vehicle, a source of water vapor can be activated to increase the humanity when desirable and the air conditioning system can be activated to reduce the humidity when necessary. Temperature and humidity measurements outside of the vehicle can be an indication of potential road icing problems. Such information can be used to provide early warning to a driver of potentially dangerous conditions. Although the invention described herein is related to land vehicles, many of these advances are equally applicable to other vehicles such as boats, airplanes and even, in some cases, homes and buildings. The invention disclosed herein, therefore, is not limited to automobiles or other land vehicles.

Road condition sensing is another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW road condition sensors.

The temperature and moisture content of the surface of a roadway are critical parameters in determining the icing state of the roadway. Attempts have been made to measure the coefficient of friction between a tire and the roadway by placing strain gages in the tire tread. Naturally, such strain gages are ideal for the application of SAW technology especially since they can be interrogated wirelessly from a distance and they require no power for operation. As discussed above, SAW accelerometers can also perform this function. The measurement of the friction coefficient, however, is not predictive and the vehicle operator is only able to ascertain the condition after the fact. SAW based transducers have the capability of being interrogated as much as 100 feet from the interrogator. Therefore, the judicious placement of low-cost powerless SAW temperature and humidity sensors in or on the roadway at critical positions can provide an advance warning to vehicle operators that road is slippery ahead. Such devices are very inexpensive and therefore could be placed at frequent intervals along a highway.

An infrared sensor that looks down the highway in front of the vehicle can actually measure the road temperature prior to the vehicle traveling on that part of the roadway. This system also would not give sufficient warning if the operator waited for the occurrence of a frozen roadway The probability of the roadway becoming frozen, on the other hand, can be predicted long before it occurs, in most cases, by watching the trend in the temperature.

Some lateral control of the vehicle can also be obtained from SAW transducers or electronic RFID tags placed down the center of the lane, either above the vehicles or in the roadway, for example. A vehicle having two receiving antennas approaching such devices, through triangulation, is able to determine the lateral location of the vehicle relative to these SAW devices. If the vehicle also has an accurate map of the roadway, the identification number associated with each such device can be used to obtain highly accurate longitudinal position determinations. Ultimately, the SAW devices can be placed on structures beside the road and perhaps on every mile or tenth of a mile marker. If three antennas are used, as discussed herein, the distances to the SAW device can be determined.

Electronic RFID tags are also suitable for lateral and longitudinal positioning purposes, however, the range available for electronic RFID systems is considerably less than that of SAW based systems. On the other hand, as taught in U.S. provisional patent application Ser. No. 60/231,378, the time of flight of the RFID system can be used to determine the distance from the vehicle to the RFID tag. Because of the inherent delay in the SAW devices and its variation with temperature, accurate distance measurement is probably not practical based on time of flight but somewhat less accurate distance measurements based on relative time of arrival can be made. Even if the exact delay imposed by the SAW device was accurately known at one temperature, such devices are usually reasonably sensitive to changes in temperature, hence they make good temperature sensors, and thus the accuracy of the delay in the SAW device is more difficult to maintain. An interesting variation of an electronic RFID that is particularly applicable to this and other applications of this invention is disclosed in A. Pohl, L. Reindl, "New passive sensors", Proc. 16th IEEE Instrumentation and Measurement Technology Conf., IMTC/99, 1999, pp. 1251-1255. which is incorporated by reference herein in its entirety.

Many SAW devices are based on lithium niobate or similar strong piezoelectric materials. Such materials have high thermal expansion coefficients. An alternate material is quartz that has a very low thermal expansion coefficient. However, its piezoelectric properties are inferior to lithium niobate. One solution to this problem is to use lithium niobate as the coupling system between the antenna and the material upon which the surface acoustic wave travels. In this matter, the advantages of a low thermal expansion coefficient material can be obtained while using the lithium niobate for its strong piezoelectric properties. Other useful materials such as Langasite have properties that are intermediate between lithium niobate and quartz. Note that it is also possible to use combinations of materials to achieve particular objectives with property measurement since different materials respond differently to different sensed properties or environments.

The use of SAW tags as an accurate precise positioning system as described above would be applicable for accurate vehicle location, as discussed in U.S. patent application Ser. No. 09/177,041, for lanes in tunnels, for example, or other cases where loss of satellite lock is common.

The various technologies discussed above can be used in combination. The electronic RFID tag can be incorporated into a SAW tag providing a single device that provides both an instant reflection of the radio frequency waves as well as a re-transmission at a later time. This marriage of the two technologies permits the strengths of each technology to be exploited in the same device. For most of the applications described herein, the cost of mounting such a tag in a vehicle or on the roadway far exceeds the cost of the tag itself. Therefore, combining the two technologies does not significantly affect the cost of implementing tags onto vehicles or roadways or side structures.

An alternate method to the electronic RFID tag is to simply use a radar reflector and measure the time of flight to the reflector and back. The radar reflector can even be made of a series of reflecting surfaces displaced from each other to achieve some simple coding.

Another field in which SAW technology can be applied is for "ultrasound-on-a-surface" type of devices.

U.S. Pat. No. 5,629,681, assigned to the same assignee herein and incorporated by reference herein, describes many uses of ultrasound in a tube. Many of the applications are also candidates for ultrasound-on-a-surface devices. In this case, a micromachined SAW device will in general be replaced by a much larger structure.

Touch screens based on surface acoustic waves are well known in the art. The use of this technology for a touch pad for use with a heads-up display is disclosed in the current assignee's U.S. patent application Ser. No. 09/645,709. The use of surface acoustic waves in either one or two dimensional applications has many other possible uses such as for pinch protection on window and door closing systems, crush sensing crash sensors, occupant presence detector and butt print measurement systems, generalized switches such as on the circumference or center of the steering wheel, etc. Since these devices typically require significantly more power than the micromachined SAW devices discussed above, most of these applications will require a power connection. On the other hand, the output of these devices can go through a SAW micromachined device or, in some other manner, be attached to an antenna and interrogated using a remote interrogator thus eliminating the need for a direct wire communication link.

One example would be to place a surface acoustic wave device on the circumference of the steering wheel. Upon depressing a section of this device, the SAW wave would be attenuated. The interrogator would notify the acoustic wave device at one end of the device to launch an acoustic wave and then monitor output from the antenna. Depending on the phase, time delay, and/or amplitude of the output wave, the interrogator would know where the operator had depressed the steering wheel SAW switch and therefore know the function desired by the operator.

Piezoelectric generators are another field in which SAW technology can be applied and the invention encompasses several embodiments of SAW piezoelectric generators.

An alternate approach for some applications, such as tire monitoring, where it is difficult to interrogate the SAW device as the wheel, and thus the antenna, is rotating, the transmitting power can be significantly increased if there is a source of energy inside the tire. Many systems now use a battery but this leads to problems related to having to periodically replace the battery and temperature effects. In some cases, the manufacturers recommend that the battery be replaced as often as every 6 to 12 months. Batteries also sometimes fail to function properly at cold temperatures and have their life reduced when operated at high temperatures. For these reasons, there is a strong belief that a tire monitoring system should obtain its power from some source external of the tire. Similar problems can be expected for other applications.

One novel solution to this problem is to use the flexing of the tire itself to generate electricity. If a thin film of PVDF is attached to the tire inside and adjacent to the tread, then as the tire rotates the film will flex and generate electricity. This energy can then be stored on one or more capacitors and used to power the tire monitoring circuitry. Also, since the amount of energy that is generated depends of the flexure of the tire, this generator can also be used to monitor the health of the tire in a similar manner as the generation 3 accelerometer system described above.

As mentioned above, the transmissions from different SAW devices can be time multiplexed by varying the delay time from device to device, frequency multiplexed by varying the natural frequencies of the SAW devices, code multiplexed by varying the identification code of the SAW devices or space multiplexed by using multiple antennas. Considering the time multiplexing case, varying the length of the SAW device and thus the delay before retransmission can separate different classes of devices. All seat sensors can have one delay which would be different from tire monitors or light switches etc.

Referring now to FIGS. 13A-36B, a first embodiment of a valve cap 10 including a tire pressure monitoring system in accordance with the invention is shown generally at 10 in FIG. 13A. A tire 1 has a protruding, substantially cylindrical valve stem 2 which is shown in a partial cutaway view in FIG. 13A. The valve stem 2 comprises a sleeve 3 and a tire valve assembly 5. The sleeve 3 of the valve stem 2 is threaded on both its inner surface and its outer surface. The tire valve assembly 5 is arranged in the sleeve 3 and includes threads on an outer surface which are mated with the threads on the inner surface of the sleeve 3. The valve assembly 5 comprises a valve seat 4 and a valve pin 6 arranged in an aperture in the valve seat 4. The valve assembly 5 is shown in the open condition in FIG. 13A whereby air flows through a passage between the valve seat 4 and the valve pin 6.

The valve cap 10 includes a substantially cylindrical body 9 and is attached to the valve stem 2 by means of threads 8 arranged on an inner cylindrical surface of body 9 which are mated with the threads on the outer surface of the sleeve 3. The valve cap 10 comprises a valve pin depressor 14 arranged in connection with the body 9 and a SAW pressure sensor 11. The valve pin depressor 14 engages the valve pin 6 upon attachment of the valve cap 10 to the valve stem 2 and depresses it against its biasing spring, not shown, thereby opening the passage between the valve seat 4 and the valve pin 6 allowing air to pass from the interior of tire 1 into a reservoir or chamber 12 in the body 9. Chamber 12 contains the SAW pressure sensor 11 as described in more detail below.

Pressure sensor 11 is an absolute pressure-measuring device. It functions based on the principle that the increase in air pressure and thus air density in the chamber 12 increases the mass loading on a SAW device changing the velocity of surface acoustic wave on the piezoelectric material. The pressure sensor 11 is therefore positioned in an exposed position in the chamber 12.

A second embodiment of a valve cap 10' in accordance with the invention is shown in FIG. 13B and comprises a SAW strain sensing device 15 that is mounted onto a flexible membrane 13 attached to the body 9' of the valve cap 10' and in a position in which it is exposed to the air in the chamber 12'. When the pressure changes in chamber 12', the deflection of the membrane 13 changes thereby changing the stress in the SAW device 15.

Strain sensor 15 is thus a differential pressure-measuring device. It functions based on the principle that changes in the flexure of the membrane 13 can be correlated to changes in pressure in the chamber 12' and thus, if an initial pressure and flexure are known, the change in pressure can be determined from the change in flexure.

FIGS. 13A and 13B therefore illustrate two different methods of using a SAW sensor in a valve cap for monitoring the pressure inside a tire. The precise manner in which the SAW sensors 11,15 operate is discussed fully below but briefly, each sensor 11,15 includes an antenna and an interdigital transducer which receives a wave via the antenna from an interrogator which proceeds to travel along a substrate. The time in which the waves travel across the substrate and return to the interdigital transducer is dependent on the temperature, the mass loading on the substrate (in the embodiment of FIG. 13A) or the flexure of membrane 13 (in the embodiment of FIG. 13B). The antenna transmits a return wave which is receives and the time delay between the transmitted and returned wave is calculated and correlated to the pressure in the chamber 12 or 12'.

Sensors 11 and 15 are electrically connected to the metal valve cap 10 that is electrically connected to the valve stem 2. The valve stem 2 is electrically isolated from the tire rim and serves as an antenna for transmitting radio frequency electromagnetic signals from the sensors 11 and 15 to a vehicle mounted interrogator, not shown, to be described in detail below. As shown in FIG. 13A., a pressure seal 16 is arranged between an upper rim of the sleeve 3 and an inner shoulder of the body 9 of the valve cap 10 and serves to prevent air from flowing out of the tire 1 to the atmosphere.

The speed of the surface acoustic wave on the piezoelectric substrate changes with temperature in a predictable manner as well as with pressure. For the valve cap implementations, a separate SAW device can be attached to the outside of the valve cap and protected with a cover where it is subjected to the same temperature as the SAW sensors 11 or 15 but is not subject to pressure or strain. This requires that each valve cap comprise two SAW devices, one for pressure sensing and another for temperature sensing. Since the valve cap is exposed to ambient temperature, a preferred approach is to have a single device on the vehicle which measures ambient temperature outside of the vehicle passenger compartment Many vehicles already have such a temperature sensor. For those installations where access to this temperature data is not convenient, a separate SAW temperature sensor can be mounted associated with the interrogator antenna, as illustrated below, or some other convenient place.

Although the valve cap 10 is provided with the pressure seal 16, there is a danger that the valve cap 10 will not be properly assembled onto the valve stem 2 and a small quantity of the air will leak over time. FIG. 14 provides an alternate design where the SAW temperature and pressure measuring devices are incorporated into the valve stem. This embodiment is thus particularly useful in the initial manufacture of a tire.

The valve stem assembly is shown generally at 20 and comprises a brass valve stem 7 which contains a tire valve assembly 5. The valve stem 7 is covered with a coating 21 of a resilient material such as rubber, which has been partially removed in the drawing. A metal conductive ring 22 is electrically attached to the valve stem 7. A rubber extension 23 is also attached to the lower end of the valve stem 7 and contains a SAW pressure and temperature sensor 24. The SAW pressure and temperature sensor 24 can be of at least two designs wherein the SAW sensor is used as an absolute pressure sensor as shown in FIG. 14A or an as a differential sensor based on membrane strain as shown in FIG. 14B.

In FIG. 14A, the SAW sensor 24 comprises a capsule 32 having an interior chamber in communication with the interior of the tire via a passageway 30. A SAW absolute pressure sensor 27 is mounted onto one side of a rigid membrane or separator 31 in the chamber in the capsule 32. Separator 31 divides the interior chamber of the capsule 32 into two compartments 25 and 26, with only compartment 25 being in flow communication with the interior of the tire. The SAW absolute pressure sensor 27 is mounted in compartment 25 which is exposed to the pressure in the tire through passageway 30. A SAW temperature sensor 28 is attached to the other side of the separator 31 and is exposed to the pressure in compartment 26. The pressure in compartment 26 is unaffected by the tire pressure and is determined by the atmospheric pressure when the device was manufactured and the effect of temperature on this pressure. The speed of sound on the SAW temperature sensor 28 is thus affected by temperature but not by pressure in the tire.

The operation of SAW sensors 27 and 28 is discussed elsewhere more fully but briefly, since SAW sensor 27 is affected by the pressure in the tire, the wave which travels along the substrate is affected by this pressure and the time delay between the transmission and reception of a wave can be correlated to the pressure. Similarly, since SAW sensor 28 is affected by the temperature in the tire, the wave which travels along the substrate is affected by this temperature and the time delay between the transmission and reception of a wave can be correlated to the temperature.

FIG. 14B illustrates an alternate configuration of sensor 24 where a flexible membrane 33 is used instead of the rigid separator 31 shown in the embodiment of FIG. 14A, and a SAW device is mounted on flexible member 33. In this embodiment, the SAW temperature sensor 28 is mounted to a different wall of the capsule 32. A SAW device 29 is thus affected both by the strain in membrane 33 and the absolute pressure in the tire. Normally, the strain effect will be much larger with a properly designed membrane 33.

The operation of SAW sensors 28 and 29 is discussed elsewhere more fully but briefly, since SAW sensor 28 is affected by the temperature in the tire, the wave which travels along the substrate is affected by this temperature and the time delay between the transmission and reception of a wave can be correlated to the temperature. Similarly, since SAW sensor 29 is affected by the pressure in the tire, the wave which travels along the substrate is affected by this pressure and the time delay between the transmission and reception of a wave can be correlated to the pressure.

In both of the embodiments shown in FIG. 14A and FIG. 14B, a separate temperature sensor is illustrated. This has two advantages. First, it permits the separation of the temperature effect from the pressure effect on the SAW device. Second, it permits a measurement of tire temperature to be recorded. Since a normally inflated tire can experience excessive temperature caused, for example, by an overload condition, it is desirable to have both temperature and pressure measurements of each vehicle tire

The SAW devices 27, 28 and 29 are electrically attached to the valve stem 7 which again serves as an antenna to transmit radio frequency information to an interrogator. This electrical connection can be made by a wired connection; however, the impedance between the SAW devices and the antenna may not be properly matched. An alternate approach as described in Varadan, V.K. et al., "Fabrication, characterization and testing of wireless MEMS-IDT based microaccelerometers" Sensors and Actuators A 90 (2001) p. 7-19, 2001 Elsevier Netherlands, incorporated herein by reference, is to inductively couple the SAW devices to the brass tube.

Although an implementation into the valve stem and valve cap examples have been illustrated above, an alternate approach is to mount the SAW temperature and pressure monitoring devices elsewhere within the tire. Similarly, although the tire stem in both cases above serves the antenna, in many implementations, it is preferable to have a separately designed antenna mounted within or outside of the vehicle tire. For example, such an antenna can project into the tire from the valve stem or can be separately attached to the tire or tire rim either inside or outside of the tire. In some cases, it can be mounted on the interior of the tire on the sidewall.

A more advanced embodiment of a tire monitor in accordance with the invention is illustrated generally at 40 in FIGS. 15 and 15A. In addition to temperature and pressure monitoring devices as described in the previous applications, the tire monitor assembly 40 comprises an accelerometer of any of the types to be described below which is configured to measure either or both of the tangential and radial accelerations. Tangential accelerations as used herein mean accelerations tangent to the direction of rotation of the tire and radial accelerations as used herein mean accelerations toward or away from the wheel axis. For either accelerometer case, the acceleration will be zero when the monitor assembly 40 is closest to the road and will be at a maximum when the monitor assembly 40 is at its maximum distance from the road. Both accelerations will increase and decrease at all positions in between.

In FIG. 15, the tire monitor assembly 40 is cemented to the interior of the tire opposite the tread. In FIG. 15A, the tire monitor assembly 40 is inserted into the tire opposite the tread during manufacture.

Superimposed on the acceleration signals will be vibrations introduced into tire from road interactions and due to tread separation and other defects. Additionally, the presence of the nail or other object attached to the tire will, in general, excite vibrations that can be sensed by the accelerometers. When the tread is worn to the extent that the wire belts 41 begin impacting the road, additional vibrations will be induced.

Through monitoring the acceleration signals from the tangential or radial accelerometers within the tire monitor assembly 40, delamination, a worn tire condition, imbedded nails, other debris attached to the tire tread, hernias, can all be sensed. Additionally, as previously discussed, the length of time that the tire tread is in contact with the road opposite tire monitor 40 can be measured and, through a comparison with the total revolution time, the length of the tire footprint on the road can be determined. This permits the load on the tire to be measured, thus providing an indication of excessive tire loading. As discussed above, a tire can fail due to over loading even when the tire interior temperature and pressure are within acceptable limits. Other tire monitors cannot sense such conditions.

Since the acceleration changes during the rotation of the tire, a simple switch containing an acceleration sensing mass can now be designed that would permit data transmission only during one part of the tire rotation. Such a switch can be designed, for example, such that it shorts out the antenna except when the tire is experiencing zero acceleration at which time it permits the device to transmit data to the interrogator. Such a system would save on battery power, for example, for powered systems and minimize bandwidth use for passive systems.

In the discussion above, the use of the tire valve stem as an antenna has been discussed. An antenna can also be placed within the tire when the tire sidewalls are not reinforced with steel. In some cases and for some frequencies, it is sometimes possible to use the tire steel bead or steel belts as an antenna, which in some cases can be coupled to inductively. Alternately, the antenna can be designed integral with the tire beads or belts and optimized and made part of the tire during manufacture.

Although the discussion above has centered on the use of SAW devices, the configuration of FIG. 15 can also be effectively accomplished with other pressure, temperature and accelerometer sensors. One of the advantages of using SAW devices is that they are totally passive thereby eliminating the requirement of a battery. For the implementation of tire monitor assembly 40, the changes in acceleration can also be used to generate sufficient electrical energy to power a silicon microcircuit. In this configuration, additional devices, typically piezoelectric devices, are used as a generator of electricity that can be stored in one or more conventional capacitors or ultra-capacitors. Naturally, other types of electrical generators can be used such as those based on a moving coil and a magnetic field etc. A PVDF piezoelectric polymer can also be used to generate electrical energy based on the flexure of the tire as described below.

FIG. 16 illustrates an absolute pressure sensor based on surface acoustic wave (SAW) technology. A SAW absolute pressure sensor 50 has an interdigital transducer (IDT) 51 which is connected to antenna 52. Upon receiving an RF signal of the proper frequency, the antenna induces a surface acoustic wave in the material 53 which can be lithium niobate, quartz, zinc oxide, or other appropriate piezoelectric material. As the wave passes through a pressure sensing area 54 formed on the material 53, its velocity is changed depending on the air pressure exerted on the sensing area 54. The wave is then reflected by reflectors 55 where it returns to the IDT 51 and to the antenna 52 for retransmission back to the interrogator. The material in the pressure sensing area 54 can be a thin (such as one micron) coating of a polymer that absorbs or reversibly reacts with oxygen or nitrogen where the amount absorbed depends on the air density.

In FIG. 16A, two additional sections of the SAW device, designated 56 and 57, are provided such that the air pressure affects sections 56 and 57 differently than pressure sensing area 54. This is achieved by providing three reflectors. The three reflecting areas cause three reflected waves to appear, 59, 60 and 61 when input wave 62 is provided. The spacing between waves 59 and 60, and between waves 60 and 61 provides a measure of the pressure. This construction of a pressure sensor may be utilized in the embodiments of FIGS. 13A-15 or in any embodiment wherein a pressure measurement by a SAW device is obtained.

There are many other ways in which the pressure can be measured based on either the time between reflections or on the frequency or phase change of the SAW device as is well known to those skilled in the art. FIG. 16B, for example, illustrates an alternate SAW geometry where only two sections are required to measure both temperature and pressure. This construction of a temperature and pressure sensor may be utilized in the embodiments of FIGS. 13A-15 or in any embodiment wherein both a pressure measurement and a temperature measurement by a single SAW device is obtained.

Another method where the speed of sound on a piezoelectric material can be changed by pressure was first reported in Varadan et al., "Local/Global SAW Sensors for Turbulence" referenced above. This, phenomenon has not been applied to solving pressure sensing problems within an automobile until now. The instant invention is believed to be the first application of this principle to measuring tire pressure, oil pressure, coolant pressure, pressure in a gas tank, etc. Experiments to date, however, have been unsuccessful.

In some cases, a flexible membrane is placed loosely over the SAW device to prevent contaminants from affecting the SAW surface. The flexible membrane permits the pressure to be transferred to the SAW device without subjecting the surface to contaminants. Such a flexible membrane can be used in most if not all of the embodiments described herein.

A SAW temperature sensor 60 is illustrated in FIG. 17. Since the SAW material, such as lithium niobate, expands significantly with temperature, the natural frequency of the device also changes. Thus, for a SAW temperature sensor to operate, a material for the substrate is selected which changes its properties as a function of temperature, i.e., expands. Similarly, the time delay between the insertion and retransmission of the signal also varies measurably. Since speed of a surface wave is typically 100,000 times slower then the speed of light, usually the time for the electromagnetic wave to travel to the SAW device and back is small in comparison to the time delay of the SAW wave and therefore the temperature is approximately the time delay between transmitting electromagnetic wave and its reception.

An alternate approach as illustrated in FIG. 17A is to place a thermistor 62 across an interdigital transducer (IDT) 61, which is now not shorted as it was in FIG. 17. In this case, the magnitude of the returned pulse varies with the temperature. Thus, this device can be used to obtain two independent temperature measurements, one based on time delay or natural frequency of the device 60 and the other based on the resistance of the thermistor 62.

When some other property such as pressure is being measured by the device 65 as shown in FIG. 17B, two parallel SAW devices are commonly used. These devices are designed so that they respond differently to one of the parameters to be measured. Thus, SAW device 66 and SAW device 67 can be designed to both respond to temperature and respond to pressure. However, SAW device 67, which contains a surface coating, will respond differently to pressure than SAW device 66. Thus, by measuring natural frequency or the time delay of pulses inserted into both SAW devices 66 and 67, a determination can be made of both the pressure and temperature, for example. Naturally, the device which is rendered sensitive to pressure in the above discussion could alternately be rendered sensitive to some other property such as the presence or concentration of a gas, vapor, or liquid chemical as described in more detail below.

An accelerometer that can be used for either radial or tangential acceleration in the tire monitor assembly of FIG. 15 is illustrated in FIGS. 18 and 18A. The design of this accelerometer is explained in detail in Varadan, V.K. et al., "Fabrication, characterization and testing of wireless MEMS-IDT based microaccelerometers" referenced above, which is incorporated in its entirety herein by reference, and will not be repeated herein.

A stud which is threaded on both ends and which can be used to measure the weight of an occupant seat is illustrated in FIGS. 19A-19D. The operation of this device is disclosed in U.S. patent application Ser. No. 09/849,558 wherein the center section of stud 101 is solid. It has been discovered that sensitivity of the device can be significantly improved if a slotted member is used as described in U.S. Pat. No. 5,539,236, which is incorporated herein by reference. FIG. 19A illustrates a SAW strain gage 102 mounted on a substrate and attached to span a slot 104 in a center section 105 of the stud 101. This technique can be used with any other strain-measuring device.

FIG. 19B is a side view of the device of FIG. 19A.

FIG. 19C illustrates use of a single hole 106 drilled off-center in the center section 105 of the stud 101. A single hole 106 also serves to magnify the strain as sensed by the strain gage 102. It has the advantage in that strain gage 102 does not need to span an open space. The amount of magnification obtained from this design, however, is significantly less than obtained with the design of FIG. 19A.

To improve the sensitivity of the device shown in FIG. 19C, multiple smaller holes 107 can be used as illustrated in FIG. 19D. FIG. 19E in an alternate configuration showing four gages for determining the bending moments as well as the axial stress in the support member.

In operation, the SAW strain gage 102 receives radio frequency waves from an interrogator 110 and returns electromagnetic waves via a respective antenna 103 which are delayed based on the strain sensed by strain gage 102.

A SAW device can also be used as a wireless switch as shown in FIGS. 20A and 20B. FIG. 20A shows a surface 120 containing a projection 122 on top of a SAW device 121. Surface material 120 could be, for example, the armrest of an automobile, the steering wheel airbag cover, or any other surface within the passenger compartment of an automobile or elsewhere. Projection 122 will typically be a material capable of transmitting force to the surface of SAW device 121. As shown in FIG. 20B, a projection 123 may be placed on top of the SAW device 124. This projection 123 permits force exerted on the projection 122 to create a pressure on the SAW device 124. This increased pressure changes the time delay or natural frequency of the SAW wave traveling on the surface of material. Alternately, it can affect the magnitude of the returned signal. The projection 123 is typically held slightly out of contact with the surface until forced into contact with it.

An alternate approach is to place a switch across the IDT 127 as shown in FIG. 20C. If switch 125 is open, then the device will not return a signal to the interrogator. If it is closed, than the IDT 127 will act as a reflector sending a single back to IDT 128 and thus to the interrogator. Alternately, a switch 126 can be placed across the SAW device. In this case, a switch closure shorts the SAW device and no signal is returned to the interrogator. For the embodiment of FIG. 20C, using switch 126 instead of switch 125, a standard reflector IDT would be used in place of the IDT 127.

Most SAW-based accelerometers work on the principle of straining the SAW surface and thereby changing either the time delay or natural frequency of the system. An alternate novel accelerometer is illustrated FIG. 21A wherein a mass 130 is attached to a silicone rubber coating 131 which has been applied the SAW device. Acceleration of the mass in FIG. 21 in the direction of arrow X changes the amount of rubber in contact with the surface of the SAW device and thereby changes the damping, natural frequency or the time delay of the device. By this method, accurate measurements of acceleration below 1 G are readily obtained. Furthermore, this device can withstand high deceleration shocks without damage. FIG. 21B illustrates a more conventional approach where the strain in a beam 137 caused by the acceleration acting on a mass 136 is measured with a SAW strain sensor 135.

It is important to note that all of these devices have a high dynamic range compared with most competitive technologies. In some cases, this dynamic range can exceed 100,000. This is the direct result of the ease with which frequency and phase can be accurately measured.

A gyroscope, which is suitable for automotive applications, is illustrated in FIG. 22 and described in detail in V.K. Varadan's International Application No. WO 00/79217, which is incorporated by reference herein in its entirety. This SAW-based gyroscope has applicability for the vehicle navigation, dynamic control, and rollover sensing among others.

Note that any of the disclosed applications can be interrogated by the central interrogator of this invention and can either be powered or operated powerlessly as described in general above. Block diagrams of three interrogators suitable for use in this invention are illustrated in FIGS. 23A-23C. FIG. 23A illustrates a superheterodyne circuit and FIG. 23B illustrates a dual superheterodyne circuit. FIG. 23C operates as follows. During the burst time two frequencies, F1 and F1+F2, are sent by the transmitter after being generated by mixing using oscillator Osc. The two frequencies are needed by the SAW transducer where they are mixed yielding F2 which is modulated by the SAW and contains the information. Frequency (F1+F2) is sent only during the burst time while frequency F1 remains on until the signal F2 returns from the SAW. This signal is used for mixing. The signal returned from the SAW transducer to the interrogator is F1+F2 where F2 has been modulated by the SAW transducer. It is expected that the mixing operations will result in about 12 db loss in signal strength.

FIG. 24 illustrates a central antenna mounting arrangement for permitting interrogation of the tire monitors for four tires and is similar to that described in U.S. Pat. No. 4,237,728, which is incorporated by reference herein. An antenna package 200 is mounted on the underside of the vehicle and communicates with devices 201 through their antennas as described above. In order to provide for antennas both inside (for example for weight sensor interrogation) and outside of the vehicle, another antenna assembly (not shown) can be mounted on the opposite side of the vehicle floor from the antenna assembly 200.

FIG. 24A is a schematic of the vehicle shown in FIG. 24. The antenna package 200, which can be considered as an electronics module, contains a time domain multiplexed antenna array that sends and receives data from each of the five tires (including the spare tire), one at a time. It comprises a microstrip or stripline antenna array and a microprocessor on the circuit board. The antennas that face each tire are in an X configuration so that the transmissions to and from the tire can be accomplished regardless of the tire rotation angle.

Based on the frequency and power available, and on FCC limitations, SAW devices can be designed to permit transmission distances of up to 100 feet or more. Since SAW devices can measure both temperature and humidity, they are also capable of monitoring road conditions in front of and around a vehicle. Thus, a properly equipped vehicle can determine the road conditions prior to entering a particular road section if such SAW devices are embedded in the road surface or on mounting structures close to the road surface as shown at 279 in FIG. 25. Such devices could provide advance warning of freezing conditions, for example. Although at 60 miles per hour, such devices may only provide a one second warning, this can be sufficient to provide information to a driver to prevent dangerous skidding. Additionally, since the actual temperature and humidity can be reported, the driver will be warned prior to freezing of the road surface. SAW device 279 is shown in detail in FIG. 25A.

If a SAW device 283 is placed in a roadway, as illustrated in FIG. 26, and if a vehicle 290 has two receiving antennas 280 and 281, an interrogator can transmit a signal from either of the two antennas and at a later time, the two antennas will receive the transmitted signal from the SAW device. By comparing the arrival time of the two received pulses, the position of vehicle on a lane can precisely determined (since the direction from each antenna 280,281 to the SAW device 283 can be calculated). If the SAW device 283 has an identification code encoded into the returned signal generated thereby, then the vehicle 290 can determine, providing a precise map is available, its position on the surface of the earth. If another antenna 286 is provided, for example, at the rear of the vehicle 290 then the longitudinal position of the vehicle can also be accurately determined as the vehicle passes the SAW device 283. Of course the SAW device 283 need not be in the center of the road. Alternate locations for positioning of the SAW device 283 are on overpasses above the road and on poles such as 284 and 285 on the roadside. Such a system has an advantage over a competing system using radar and reflectors in that it is easier to measure the relative time between the two received pulses than it is to measure time of flight of a radar signal to a reflector and back. Such a system operates in all weather conditions and is known as a precise location system. Eventually such a SAW device 283 can be placed every tenth of a mile along the roadway or at some other appropriate spacing.

If a vehicle is being guided by a DGPS and accurate map system such as disclosed in U.S. Pat. application Ser. No. 09/679,317 filed Oct. 4, 2000, which is incorporated by reference herein, a problem arises when the GPS receiver system looses satellite lock as would happen when the vehicle enters a tunnel, for example. If a precise location system as described above is placed at the exit of the tunnel then the vehicle will know exactly where it is and can re-establish satellite lock in as little as one second rather than typically 15 seconds as might otherwise be required. Other methods making use of the cell phone system can be used to establish an approximate location of the vehicle suitable for rapid acquisition of satellite lock as described in G.M. Djuknic, R.E. Richton "Geolocation and Assisted GPS", Computer Magazine, February 2001, IEEE Computer Society, which is incorporated by reference herein in its entirety.

More particularly, geolocation technologies that rely exclusively on wireless networks such as time of arrival, time difference of arrival, angle of arrival, timing advance, and multipath fingerprinting offer a shorter time-to-first-fix (TTFF) than GPS. They also offer quick deployment and continuous tracking capability for navigation applications, without the added complexity and cost of upgrading or replacing any existing GPS receiver in vehicles. Compared to either mobile-station-based, stand-alone GPS or network-based geolocation, assisted-GPS (AGPS) technology offers superior accuracy, availability, and coverage at a reasonable cost. AGPS for use with vehicles would comprise a communications unit with a partial GPS receiver arranged in the vehicle, an AGPS server with a reference GPS receiver that can simultaneously "see" the same satellites as the communications unit, and a wireless network infrastructure consisting of base stations and a mobile switching center. The network can accurately predict the GPS signal the communication unit will receive and convey that information to the mobile, greatly reducing search space size and shortening the TTFF from minutes to a second or less. In addition, an AGPS receiver in the communication unit can detect and demodulate weaker signals than those that conventional GPS receivers require. Because the network performs the location calculations, the communication unit only needs to contain a scaled-down GPS receiver. It is accurate within about 15 meters when they are outdoors, an order of magnitude more sensitive than conventional GPS.

Since an AGPS server can obtain the vehicle's position from the mobile switching center, at least to the level of cell and sector, and at the same time monitor signals from GPS satellites seen by mobile stations, it can predict the signals received by the vehicle for any given time. Specifically, the server can predict the Doppler shift due to satellite motion of GPS signals received by the vehicle, as well as other signal parameters that are a function of the vehicle's location. In a typical sector, uncertainty in a satellite signal's predicted time of arrival at the vehicle is about ±5 μs, which corresponds to ±5 chips of the GPS coarse acquisition (C/A) code. Therefore, an AGPS server can predict the phase of the pseudorandom noise (PRN) sequence that the receiver should use to despread the C/A signal from a particular satellite— each GPS satellite transmits a unique PRN sequence used for range measurements—and communicate that prediction to the vehicle. The search space for the actual Doppler shift and PRN phase is thus greatly reduced, and the AGPS receiver can accomplish the task in a fraction of the time required by conventional GPS receivers. Further, the AGPS server maintains a connection with the vehicle receiver over the wireless link, so the requirement of asking the communication unit to make specific measurements, collect the results, and communicate them back is easily met. After despreading and some additional signal processing, an AGPS receiver returns back "pseudoranges"—that is, ranges measured without taking into account the discrepancy between satellite and receiver clocks—to the AGPS server, which then calculates the vehicle's location. The vehicle can even complete the location fix itself without returning any data to the server.

Sensitivity assistance, also known as modulation wipe-off, provides another enhancement to detection of GPS signals in the vehicle's receiver. The sensitivity-assistance message contains predicted data bits of the GPS navigation message, which are expected to modulate the GPS signal of specific satellites at specified times. The mobile station receiver can therefore remove bit modulation in the received GPS signal prior to coherent integration. By extending coherent integration beyond the 20-ms GPS data-bit period—to a second or more when the receiver is stationary and to 400 ms when it is fast-moving—this approach improves receiver sensitivity. Sensitivity assistance provides an additional 3-to-4-dB improvement in receiver sensitivity. Because some of the gain provided by the basic assistance—code phases and Doppler shift values—is lost when integrating the GPS receiver chain into a mobile system, this can prove crucial to making a practical receiver.

Achieving optimal performance of sensitivity assistance in TIA/EIA-95 CDMA systems is relatively straightforward because base stations and mobiles synchronize with GPS time. Given that global system for mobile communication (GSM), time division multiple access (TDMA), or advanced mobile phone service (AMPS) systems do not maintain such stringent synchronization, implementation of sensitivity assistance and AGPS technology in general will require novel approaches to satisfy the timing requirement. The standardized solution for GSM and TDMA adds time calibration receivers in the field—location measurement units—that can monitor both the wireless-system timing and GPS signals used as a timing reference.

Many factors affect the accuracy of geolocation technologies, especially terrain variations such as hilly versus flat and environmental differences such as urban versus suburban versus rural Other factors, like cell size and interference, have smaller but noticeable effects. Hybrid approaches that use multiple geolocation technologies appear to be the most robust solution to problems of accuracy and coverage.

AGPS provides a natural fit for hybrid solutions because it uses the wireless network to supply assistance data to GPS receivers in vehicles. This feature makes it easy to augment the assistance-data message with low-accuracy distances from receiver to base stations measured by the network equipment. Such hybrid solutions benefit from the high density of base stations in dense urban environments, which are hostile to GPS signals. Conversely, rural environments—where base stations are too scarce for network-based solutions to achieve high accuracy— provide ideal operating conditions for AGPS because GPS works well there.

SAW transponders can also be placed in the license plates 287 (FIG. 26) of all vehicles at nominal cost. An appropriately equipped automobile can then determine the angular location of vehicles in its vicinity. If a third antenna 286 is placed at the center of the vehicle front, then an indication of the distance to a license plate of a preceding vehicle can also be obtained as described above. Thus, once again, a single interrogator coupled with multiple antenna systems can be used for many functions. Alternately, if more than one SAW transponders is placed spaced apart on a vehicle and if two antennas are on the other vehicle, then the direction and position of the SAW vehicle can be determined by the receiving vehicle.

A general SAW temperature and pressure gage which can be wireless and powerless is shown generally at 300 located in the sidewall 310 of a fluid container 320 in FIG. 27. A pressure sensor 301 is located on the inside of the container 320, where it measures deflection of the container wall, and the fluid temperature sensor 302 on the outside. The temperature measuring SAW 300 can be covered with an insulating material to avoid influence from the ambient temperature outside of the container 320.

A SAW load sensor can also be used to measure load in the vehicle suspension system powerless and wirelessly as shown in FIG. 28. FIG. 28A illustrates a strut 315 such as either of the rear struts of the vehicle of FIG. 28. A coil spring 320 stresses in torsion as the vehicle encounters disturbances from the road and this torsion can be measured using SAW strain gages as described in U.S. Pat. No. 5,585,571 for measuring the torque in shafts. This concept is also disclosed in U.S. Pat. No. 5,714,695. The disclosures of both patents are incorporated herein by reference. The use of SAW strain gages to measure the torsional stresses in a spring, as shown in FIG. 28B, and in particular in an automobile suspension spring has, to the knowledge of the inventors, not been heretofore disclosed. In FIG. 28B, the strain measured by SAW strain gage 322 is subtracted from the strain measured by SAW strain gage 321 to get the temperature compensated strain in spring 320.

Since a portion of the dynamic load is also carried by the shock absorber, the SAW strain gages 321 and 322 will only measure the steady or average load on the vehicle. However, additional SAW strain gages 325 can be placed on a piston rod 326 of the shock absorber to obtain the dynamic load. These load measurements can then be used for active or passive vehicle damping or other stability control purposes.

FIG. 29 illustrates a vehicle passenger compartment, and the engine compartment, with multiple SAW temperature sensors 330. SAW temperature sensors are distributed throughout the passenger compartment, such as on the A-pillar, on the B-pillar, on the steering wheel, on the seat, on the ceiling, on the headliner, and on the rear glass and generally in the engine compartment. These sensors, which can be independently coded with different IDs and different delays, can provide an accurate measurement of the temperature distribution within the vehicle interior. Such a system can be used to tailor the heating and air conditioning system based on the temperature at a particular location in the passenger compartment. If this system is augmented with occupant sensors, then the temperature can be controlled based on seat occupancy and the temperature at that location. If the occupant sensor system is based on ultrasonics than the temperature measurement system can be used to correct the ultrasonic occupant sensor system for the speed of sound within the passenger compartment. Without such a correction, the error in the sensing system can be as large as about 20 percent.

In one case, the SAW temperature sensor can be made from PVDF film and incorporated within the ultrasonic transducer assembly. For the 40 kHz ultrasonic transducer case, for example, the SAW temperature sensor would return the several pulses sent to drive the ultrasonic transducer to the control circuitry using the same wires used to transmit the pulses to the transducer after a delay that is proportional to the temperature within the transducer housing. Thus a very economical device can add this temperature sensing function using much of the same hardware that is already present for the occupant sensing system. Since the frequency is low, PVDF could be fabricated into a very low cost temperature sensor for this purpose. Other piezoelectric materials could also be used.

Other sensors can be combined with the temperature sensors 330, or used separately, to measure carbon dioxide, carbon monoxide, alcohol, humidity or other desired chemicals as discussed above.

The SAW temperature sensors 330 provide the temperature at their mounting location to a processor unit 332 via an interrogator with the processor unit including appropriate control algorithms for controlling the heating and air conditioning system based on the detected temperatures. The processor unit can control, e.g., which vents in the vehicle are open and closed, the flow rate through vents and the temperature of air passing through the vents. In general, the processor unit can control whatever adjustable components are present or form part of the heating and air conditioning system.

As shown in FIG. 29, a child seat 334 is present on the rear vehicle seat. The child seat 334 can be fabricated with one or more RFID tags or SAW tags 336. The RFID tag(s) and SAW tag(s) can be constructed to provide information on the occupancy of the child seat, i.e., whether a child is present, based on the weight. Also, the mere transmission of waves from the RFID tag(s) or SAW tag(s) on the child seat would be indicative of the presence of a child seat. The RFID tag(s) and SAW tag(s) can also be constructed to provide information about the orientation of the child seat, i.e., whether it is facing rearward or forward. Such information about the presence and occupancy of the child seat and its orientation can be used in the control of vehicular systems, such as the vehicle airbag system. In this case, a processor would control the airbag system and would receive information from the RFID tag(s) and SAW tag(s) via an interrogator.

There are many applications for which knowledge of the pitch and/or roll orientation of a vehicle or other object is desired. An accurate tilt sensor can be constructed using SAW devices. Such a sensor is illustrated in FIG. 30A and designated 350. This sensor 350 utilizes a substantially planar and rectangular mass 351 and four supporting SAW devices 352 which are sensitive to gravity. For example, the mass act to deflect a membrane on which the SAW device resides thereby straining the SAW device. Other properties can also be used for a tilt sensor such as the direction of the earth's magnetic field. SAW devices 352 are shown arranged at the corners of the planar mass 351, but it must be understood that this arrangement is a preferred embodiment only and not intended to limit the invention. A fifth SAW device 353 can be provided to measure temperature. By comparing the outputs of the four SAW devices 352, the pitch and roll of the automobile can be measured. This sensor 350 can be used to correct errors in the SAW rate gyros described above. If the vehicle has been stationary for a period of time, the yaw SAW rate gyro can initialized to 0 and the pitch and roll SAW gyros initialized to a value determined by the tilt sensor of FIG. 30A. Many other geometries of tilt sensors utilizing one or more SAW devices can now be envisioned for automotive and other applications. In particular, an alternate preferred configuration is illustrated in FIG. 30B where a triangular geometry is used. In this embodiment, the planar mass is triangular and the SAW devices 352 are arranged at the corners, although as with FIG. 30A, this is a non-limiting, preferred embodiment.

Either of the SAW accelerometers described above can be utilized for crash sensors as shown in FIG. 31. These accelerometers have a substantially higher dynamic range than competing accelerometers now used for crash sensors such as those based on MEMS silicon springs and masses and others based on

MEMS capacitive sensing. As discussed above, this is partially a result of the use of frequency or phase shifts which can be easily measured over a very wide range. Additionally, many conventional accelerometers that are designed for low acceleration ranges are unable to withstand high acceleration shocks without breaking. This places practical limitations on many accelerometer designs so that the stresses in the silicon springs are not excessive. Also for capacitive accelerometers, there is a narrow limit over which distance, and thus acceleration, can be measured.

The SAW accelerometer for this particular crash sensor design is housed in a container 361 which is assembled into a housing 362 and covered with a cover 363. This particular implementation shows a connector 364 indicating that this sensor would require power and the response would be provided through wires. Alternately, as discussed for other devices above, the connector 364 can be eliminated and the information and power to operate the device transmitted wirelessly. Such sensors can be used as frontal, side or rear impact sensors. They can be used in the crush zone, in the passenger compartment or any other appropriate vehicle location. If two such sensors are separated and have appropriate sensitive axes, then the angular acceleration of the vehicle can be also be determined. Thus, for example, forward-facing accelerometers mounted in the vehicle side doors can used to measure the yaw acceleration of the vehicle. Alternately two vertical sensitive axis accelerometers in the side doors can be used to measure the roll acceleration of vehicle, which would be useful for rollover sensing.

Although piezoelectric SAW devices normally use rigid material such as quartz or lithium niobate, it is also possible to utilize polyvinylidene fluoride (PVDF) providing the frequency is low. A piece of PVDF film can also be used as a sensor of tire flexure by itself. Such a sensor is illustrated in FIGS. 32 and 32A at 400. The output of flexure of the PVDF film can be used to supply power to a silicon microcircuit that contains pressure and temperature sensors. The waveform of the output from the PVDF film also provides information as to the flexure of an automobile tire and can be used to diagnose problems with the tire as well as the tire footprint in a manner similar to the device described in FIG. 15. In this case, however, the PVDF film supplies sufficient power to permit significantly more transmission energy to be provided. The frequency and informational content can be made compatible with the SAW interrogator described above such that the same interrogator can be used. The power available for the interrogator, however, can be significantly greater thus increasing the reliability and reading range of the system.

There is a general problem with tire pressure monitors as well as systems that attempt to interrogate passive SAW or electronic RFID type devices in that the FCC severely limits the frequencies and radiating power that can be used. Once it becomes evident that these systems will eventually save many lives, the FCC can be expected to modify their position. In the meantime, various schemes can be used to help alleviate this problem. The lower frequencies that have been opened for automotive radar permit higher power to be used and they could be candidates for the devices discussed above. It is also possible, in some cases, to transmit power on multiple frequencies and combine the received power to boost the available energy. Energy can of course be stored and periodically used to drive circuits and work is ongoing to reduce the voltage required to operate semiconductors. The devices of this invention will make use of some or all of these developments as they take place.

If the vehicle has been at rest for a significant time period, power will leak from the storage capacitors and will not be available for transmission. However, a few tire rotations are sufficient to provide the necessary energy.

U.S. patent application Ser. No. 08/819,609, assigned to the current assignee of this invention, provides multiple means for determining the amount of gas in a gas tank. Using the SAW pressure devices of this invention, multiple pressure sensors can be placed at appropriate locations within a fuel tank to measure the fluid pressure and thereby determine the quantity of fuel remaining in the tank. This is illustrated in FIG. 33. In this example, four SAW pressure transducers 402 are placed on the bottom of the fuel tank and one SAW pressure transducer 403 is placed at the top of the fuel tank to eliminate the effects of vapor pressure within tank. Using neural networks, or other pattern recognition techniques, the quantity of fuel in the tank can be accurately determined from these pressure readings in a manner similar that described the '609 patent application. The SAW measuring device illustrated in FIG. 33A combines temperature and pressure measurements in a single unit using parallel paths 405 and 406 in the same manner as described above.

Occupant weight sensors can give erroneous results if the seatbelt is pulled tight pushing the occupant into the seat. This is particularly a problem when the seatbelt is not attached to the seat. For such cases, it has been proposed to measure the tension in various parts of the seatbelt. Using conventional technology requires that such devices be hard-wired into the vehicle complicating the wire harness.

With reference to FIG. 34, using a SAW strain gage as described above, the tension in the seat belt 500 can be measured without the requirement of power or signal wires. FIG. 34 illustrates a powerless and wireless passive SAW strain gage based device 502 for this purpose. There are many other places that such a device can be mounted to measure the tension in the seatbelt at one or at multiple places

FIG. 35 illustrates another version of a tire temperature and/or pressure monitor 510. Monitor 510 may include at an inward end, any one of the temperature transducers or sensors described above and/or any one of the pressure transducers or sensors described above, or any one of the combination temperature and pressure transducers or sensors described above.

The monitor 510 has an elongate body attached through the wheel rim 513 typically on the inside of the tire so that the under-vehicle mounted antenna(s) have a line of sight view of antenna 515. Monitor 510 is connected to an inductive wire 512, which matches the output of the device with the antenna 515, which is part of the device assembly. Insulating material 511 surrounds the body which provides an air tight seal and prevents electrical contact with the wheel rim 513.

FIG. 36A shows a schematic of a prior art airbag module deployment scheme in which sensors, which detect data for use in determining whether to deploy an airbag in the airbag module, are wired to an electronic control unit (ECU) and a command to initiate deployment of the airbag in the a rbag module is sent wirelessly.

By contrast, as shown in FIG. 36B, in accordance with the invention, the sensors are wireless connected to the electronic control unit and thus transmit data wirelessly. The ECU is however wired to the airbag module.

SAW sensors also have applicability to various other sectors of the vehicle including the powertrain, chassis, and occupant comfort and convenience. For example, SAW sensors have applicability to sensors for the powertrain area including oxygen sensors, gear-tooth Hall effect sensors, variable reluctance sensors, digital speed and position sensors, oil condition sensors, rotary position sensors, low pressure sensors, manifold absolute pressure/manifold air temperature (MAP/MAT) sensors, medium pressure sensors, turbo pressure sensors, knock sensors, coolant/fluid temperature sensors, and transmission temperature sensors.

SAW sensors for chassis applications include gear-tooth Hall effect sensors, variable reluctance sensors, digital speed and position sensors, rotary position sensors, non-contact steering position sensors, and digital ABS (anti-lock braking system) sensors.

SAW sensors for the occupant comfort and convenience area include low-pressure sensors, HVAC temperature and humidity sensors, air temperature sensors, and oil condition sensors.

SAW sensors also have applicability such areas as controlling evaporative emissions, transmission shifting, mass air flow meters, oxygen, NOx and hydrocarbon sensors. SAW based sensors are particularly useful in high temperature environments where many other technologies fail.

SAW sensors can facilitate compliance with U.S. regulations concerning evaporative system monitoring in vehicles, through a SAW fuel vapor pressure and temperature sensors that measure fuel vapor pressure within the fuel tank as well as temperature. If vapors leak into the atmosphere, the pressure within the tank drops. The sensor notifies the system of a fuel vapor leak, resulting in a warning signal to the driver and/or notification to a repair facility. This application is particularly important since the condition within the furl tank can be ascertained wirelessly reducing the chance of a fuel fire in an accident. The same interrogator that monitors the tire pressure SAW sensors can also monitor the fuel vapor pressure and temperature sensors resulting in significant economies.

A SAW humidity sensor can be used for measuring the relative humidity and the resulting information can be input to the engine management system or the heating, ventilation, and air conditioning (HVAC) system for more efficient operation. The relative humidity of the air entering an automotive engine impacts the engine's combustion efficiency; i.e., the ability of the spark plugs to ignite the fuel/air mixture in the combustion chamber at the proper time. A SAW humidity sensor in this case can measure the humidity level of the incoming engine air, helping to calculate a more precise fuel/air ratio for improved fuel economy and reduced emissions.

Dew point conditions are reached when the air is fully saturated with water. When the cabin dew point temperature matches the windshield glass temperature, water from the air condenses quickly, creating frost or fog. A SAW humidity sensor with a temperature-sensing element and a window glass-temperature-sensing element can prevent the formation of visible fog formation by automatically controlling the HVAC system.

Among the inventions disclosed above is an arrangement for obtaining and conveying information about occupancy of a passenger compartment of a vehicle comprises at least one wave-receiving sensor for receiving waves from the passenger compartment, generating means coupled to the wave-receiving sensor(s) for generating information about the occupancy of the passenger compartment based on the waves received by the wave-receiving sensor(s) and communications means coupled to the generating means for transmitting the information about the occupancy of the passenger compartment. As such, response personnel can receive the information about the occupancy of the passenger compartment and respond appropriately, if necessary. There may be several wave-receiving sensors and they may be, e.g., ultrasonic wave-receiving sensors, electromagnetic wave-receiving sensors, capacitance or electric field sensors, or combinations thereof. The information about the occupancy of the passenger compartment can include the number of occupants in the passenger compartment, as well as whether each occupant is moving non-reflexively and breathing. A transmitter may be provided for transmitting waves into the passenger compartment such that each wave-receiving sensor receives waves transmitted from the transmitter and modified by passing into and at least partially through the passenger compartment. One or more memory units may be coupled to the generating means for storing the information about the occupancy of the passenger compartment and to the communications means. The communications means then can interrogate the memory unit(s) upon a crash of the vehicle to thereby obtain the information about the occupancy of the passenger compartment. In one particularly useful embodiment, means for determining the health state of at least one occupant are provided, e.g., a heartbeat sensor, a motion sensor such as a micropower impulse radar sensor for detecting motion of the at least one occupant and motion sensor for determining whether the occupant(s) is/are breathing, and coupled to the communications means. The communications means can interrogate the health state determining means upon a crash of the vehicle to thereby obtain and transmit the health state of the occupant(s). The health state determining means can also comprise a chemical sensor for analyzing the amount of carbon dioxide in the passenger compartment or around the at least one occupant or for detecting the presence of blood in the passenger compartment. Movement of the occupant can be determined by monitoring the weight distribution of the occupant(s), or an analysis of waves from the space occupied by the occupant(s). Each wave-receiving sensor generates a signal representative of the waves received thereby and the generating means may comprise a processor for receiving and analyzing the signal from the wave-receiving sensor in order to generate the information about the occupancy of the passenger compartment. The processor can comprise pattern recognition means for classifying an occupant of the seat so that the information about the occupancy of the passenger compartment includes the classification of the occupant. The wave-receiving sensor may be a micropower impulse radar sensor adapted to detect motion of an occupant whereby the motion of the occupant or absence of motion of the occupant is indicative of whether the occupant is breathing. As such, the information about the occupancy of the passenger compartment generated by the generating means is an indication of whether the occupant is breathing. Also, the wave-receiving sensor may generate a signal representative of the waves received thereby and the generating means receive this signal over time and determine whether any occupants in the passenger compartment are moving. As such, the information about the occupancy of the passenger compartment generated by the generating means includes the number of moving and non-moving occupants in the passenger compartment.

A related method for obtaining and conveying information about occupancy of a passenger compartment of a vehicle comprises the steps of receiving waves from the passenger compartment, generating information about the occupancy of the passenger compartment based on the received waves, and transmitting the information about the occupancy of the passenger compartment whereby response personnel can receive the information about the occupancy of the passenger compartment. Waves may be transmitted into the passenger compartment whereby the transmitted waves are modified by passing into and at least partially through the passenger compartment and then received. The information about the occupancy of the passenger compartment may be stored in at least one memory unit which is subsequently interrogated upon a crash of the vehicle to thereby obtain the information about the occupancy of the passenger compartment. A signal representative of the received waves can be generated by sensors and analyzed in order to generate the information about the state of health of at least one occupant of the passenger compartment and/or to generate the information about the occupancy of the passenger compartment (i.e., determine non-reflexive movement and/or breathing indicating life). Pattern recognition techniques, e.g., a trained neural network, can be applied to analyze the signal and thereby recognize and identify any occupants of the passenger compartment. In this case, the identification of the occupants of the passenger compartment can be included into the information about the occupancy of the passenger compartment.

All of the above-described methods and apparatus, as well as those further described below, may be used in conjunction with one another and in combination with the methods and apparatus for optimizing the driving conditions for the occupants of the vehicle described herein.

Also described above is an embodiment of a component diagnostic system for diagnosing the component in accordance with the invention which comprises a plurality of sensors not directly associated with the component, i.e., independent therefrom, such that the component does not directly affect the sensors, each sensor detecting a signal containing information as to whether the component is operating normally or abnormally and outputting a corresponding electrical signal, processor means coupled to the sensors for receiving and processing the electrical signals and for determining if the component is operating abnormally based on the electrical signals, and output means coupled to the processor means for affecting another system within the vehicle if the component is operating abnormally. The processor means preferably comprise pattern recognition means such as a trained pattern recognition algorithm, a neural network, modular neural networks, an ensemble of neural networks, a cellular neural network, or a support vector machine. In some cases, fuzzy logic will be used which can be combined with a neural network to form a neural fuzzy algorithm. The another system may be a display for indicating the abnormal state of operation of the component arranged in a position in the vehicle to enable a driver of the vehicle to view the display and thus the indicated abnormal operation of the component. At least one source of additional information, e.g., the time and date, may be provided and input means coupled to the vehicle for inputting the additional information into the processor means. The another system may also be a warning device including transmission means for transmitting information related to the component abnormal operating state to a site remote from the vehicle, e.g., a vehicle repair facility.

In another embodiment of the component diagnostic system discussed above, at least one sensor detects a signal containing information as to whether the component is operating normally or abnormally and outputs a corresponding electrical signal. A processor or other computing device is coupled to the sensor(s) for receiving and processing the electrical signal(s) and for determining if the component is operating abnormally based thereon. The processor preferably comprises or embodies a pattern recognition algorithm for analyzing a pattern within the signal detected by each sensor. An output device (or multiple output devices) is coupled to the processor for affecting another system within the vehicle if the component is operating abnormally. The other system may be a display as mentioned above or a warning device.

A method for automatically monitoring one or more components of a vehicle during operation of the vehicle on a roadway entails, as discussed above, the steps of monitoring operation of the component in order to detect abnormal operation of the component, e.g., in one or the ways described above, and if abnormal operation of the component is detected, automatically directing the vehicle off of the restricted roadway. For example, in order to automatically direct the vehicle off of the restricted roadway, a signal representative of the abnormal operation of the component may be generated and directed to a guidance system of the vehicle that guides the movement of the vehicle. Possibly the directing the vehicle off of the restricted roadway may entail applying satellite positioning techniques or ground-based positioning techniques to enable the current position of the vehicle to be determined and a location off of the restricted highway to be determined and thus a path for the movement of the vehicle. Re-entry of the vehicle onto the restricted roadway may be prevented until the abnormal operation of the component is satisfactorily addressed.

Although several preferred embodiments are illustrated and described above, there are possible combinations using other signals and sensors for the components and different forms of the neural network implementation or different pattern recognition technologies that perform the same functions which can be utilized in accordance with the invention. Also, although the neural network and modular neural networks have been described as an example of one means of pattern recognition, other pattern recognition means exist and still others are being developed which can be used to identify potential component failures by comparing the operation of a component over time with patterns characteristic of normal and abnormal component operation. In addition, with the pattern recognition system described above, the input data to the system may be data which has been pre-processed rather than the raw signal data either through a process called "feature extraction" or by various mathematical transformations. Also, any of the apparatus and methods disclosed herein may be used for diagnosing the state of operation or a plurality of discrete components.

In other embodiments disclosed above, the state of the entire vehicle is diagnosed whereby two or more sensors, preferably acceleration sensors and gyroscopes, detect the state of the vehicle and if the state is abnormal, output means are coupled to the processor means for affecting another system in the vehicle.

The another system may be the steering control system, the brake system, the accelerator or the frontal or side occupant protection system. An exemplifying control system for controlling a part of the vehicle in accordance with the invention thus comprises a plurality of sensor systems mounted at different locations on the vehicle, each sensor system providing a measurement related to a state of the sensor system or a measurement related to a state of the mounting location, and a processor coupled to the sensor systems and arranged to diagnose the state of the vehicle based on the measurements of the sensor system, e.g., by the application of a pattern recognition technique. The processor controls the part based at least in part on the diagnosed state of the vehicle. At least one of the sensor systems may be a high dynamic range accelerometer or a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope, and may optionally include an RFID response unit. The gyroscope may be a MEMS-IDT gyroscope including a surface acoustic wave resonator which applies standing waves on a piezoelectric substrate. If an RFID response unit is present, the control system would then comprise an RFID interrogator device which causes the RFID response unit(s) to transmit a signal representative of the measurement of the sensor system associated therewith to the processor.

The state of the vehicle diagnosed by the processor may be the vehicle's angular motion, angular acceleration and/or angular velocity. As such, the steering system, braking system or throttle system may be controlled by the processor in order to maintain the stability of the vehicle. The processor can also be arranged to control an occupant restraint or protection device in an attempt to minimize injury to an occupant.

The state of the vehicle diagnosed by the processor may also be a determination of a location of an impact between the vehicle and another object. In this case, the processor can forecast the severity of the impact using the force/crush properties of the vehicle at the impact location and control an occupant restraint or protection device based at least in part on the severity of the impact.

The system can also include a weight sensing system coupled to a seat in the vehicle for sensing the weight of an occupying item of the seat. The weight sensing system is coupled to the processor whereby the processor controls deployment or actuation of the occupant restraint or protection device based on the state of the vehicle and the weight of the occupying item of the seat sensed by the weight sensing system.

A display may be coupled to the processor for displaying an indication of the state of the vehicle as diagnosed by the processor. A warning device may be coupled to the processor for relaying a warning to an occupant of the vehicle relating to the state of the vehicle as diagnosed by the processor. Further, a transmission device may be coupled to the processor for transmitting a signal to a remote site relating to the state of the vehicle as diagnosed by the processor.

The state of the vehicle diagnosed by the processor may include angular acceleration of the vehicle whereby angular velocity and angular position or orientation are derivable from the angular acceleration. The processor can then be arranged to control the vehicle's navigation system based on the angular acceleration of the vehicle.

A method for controlling a part of the vehicle in accordance with the invention comprises the step of mounting a plurality of sensor systems at different locations on the vehicle, measuring a state of the sensor system or a state of the respective mounting location of the sensor system, diagnosing the state of the vehicle based on the measurements of the state of the sensor systems or the state of the mounting locations of the sensor systems, and controlling the part based at least in part on the diagnosed state of the vehicle. The state of the sensor system may be any one or more of the acceleration, angular acceleration, angular velocity or angular orientation of the sensor system. Diagnosis of the state of the vehicle may entail determining whether the vehicle is stable or is about to rollover or skid and/or determining a location of an impact between the vehicle and another object. Diagnosis of the state of the vehicle may also entail determining angular acceleration of the vehicle based on the acceleration measured by accelerometers if multiple accelerometers are present as the sensor systems.

Another control system for controlling a part of the vehicle in accordance with the invention comprises a plurality of sensor systems mounted on the vehicle, each providing a measurement of a state of the sensor system or a state of the mounting location of the sensor system and generating a signal representative of the measurement, and a pattern recognition system for receiving the signals from the sensor systems and diagnosing the state of the vehicle based on the measurements of the sensor systems. The pattern recognition system generates a control signal for controlling the part based at least in part on the diagnosed state of the vehicle. The pattern recognition system may comprise one or more neural networks. The features of the control system described above may also be incorporated into this control system to the extent feasible.

The state of the vehicle diagnosed by the pattern recognition system may include a state of an abnormally operating component whereby the pattern recognition system is designed to identify a potentially malfunctioning component based on the state of the component measured by the sensor systems and determine whether the identified component is operating abnormally based on the state of the component measured by the sensor systems.

In one preferred embodiment, the pattern recognition system may comprise a neural network system and the state of the vehicle diagnosed by the neural network system includes a state of an abnormally operating component. The neural network system includes a first neural network for identifying a potentially malfunctioning component based on the state of the component measured by the sensor systems and a second neural network for determining whether the identified component is operating abnormally based on the state of the component measured by the sensor systems.

Modular neural networks can also be used whereby the neural network system includes a first neural network arranged to identify a potentially malfunctioning component based on the state of the component measured by the sensor systems and a plurality of additional neural networks. Each of the additional neural networks is trained to determine whether a specific component is operating abnormally so that the measurements of the state of the component from the sensor systems are input into that one of the additional neural networks trained on a component which is substantially identical to the identified component.

Another method for controlling a part of the vehicle comprises the steps of mounting a plurality of sensor systems on the vehicle, measuring a state of the sensor system or a state of the respective mounting location of the sensor system, generating signals representative of the measurements of the sensor systems, inputting the signals into a pattern recognition system to obtain a diagnosis of the state of the vehicle and controlling the part based at least in part on the diagnosis of the state of the vehicle.

In one notable embodiment, a potentially malfunctioning component is identified by the pattern recognition system based on the states measured by the sensor systems and the pattern recognition system determine whether the identified component is operating abnormally based on the states measured by the sensor systems. If the pattern recognition system comprises a neural network system, identification of the component entails inputting the states measured by the sensor systems into a first neural network of the neural network system and the determination of whether the identified component is operating abnormally entails inputting the states measured by the sensor systems into a second neural network of the neural network system. A modular neural network system can also be applied in which the states measured by the sensor systems are input into a first neural network and a plurality of additional neural networks are provided, each being trained to determine whether a specific component is operating abnormally, whereby the states measured by the sensor systems are input into that one of the additional neural networks trained on a component which is substantially identical to the identified component.

Another control system for controlling a part of the vehicle based on occupancy of the seat in accordance with the invention comprises a plurality of strain gages mounted in connection with the seat, each measuring strain of a respective mounting location caused by occupancy of the seat, and a processor coupled to the strain gages and arranged to determine the weight of an occupying item based on the strain measurements from the strain gages over a period of time, i.e., dynamic measurements. The processor controls the part based at least in part on the determined weight of the occupying item of the seat. The processor can also determine motion of the occupying item of the seat based on the strain measurements from the strain gages over the period of time. One or more accelerometers may be mounted on the vehicle for measuring acceleration in which case, the processor may control the part based at least in part on the determined weight of the occupying item of the seat and the acceleration measured by the accelerometer(s). By comparing the output of various sensors in the vehicle, it is possible to determine activities that are affecting parts of the vehicle while not affecting other parts. For example, by monitoring the vertical accelerations of various parts of the vehicle and comparing these accelerations with the output of strain gage load cells placed on the seat support structure, a characterization can be made of the occupancy of the seat. Not only can the weight of an object occupying the seat be determined, but also the gross motion of such an object can be ascertained and thereby an assessment can be made as to whether the object is a life form such as a human being. Strain gage weight sensors are disclosed in U.S. patent application Ser. No. 09/193,209 filed Nov. 17, 1998 (corresponding to International Publication No. WO 00/29257), which is incorporated herein by reference its entirety as if the entire application were set forth herein. In particular, the inventors contemplate the combination of all of the ideas expressed in this patent application with those expressed in the current invention.

Although several preferred embodiments are illustrated and described above, there are possible combinations using other geometries, sensors, materials and different dimensions for the components that perform the same functions. This invention is not limited to the above embodiments and should be determined by the following claims.

CLAIMS:

I Claim:

Sub a2 1. A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system.

2. The vehicle of claim 1, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

3. The vehicle of claim 2, wherein said sensors are wirelessly coupled to said processor.

4. The vehicle of claim 2, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

5. The vehicle of claim 1, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

6. The vehicle of claim 1, wherein said communications device comprises a cellular telephone system including an antenna.

7. The vehicle of claim 1, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle.

8. The vehicle of claim 1, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle.

9. The vehicle of claim 1, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrogate said memory unit to obtain the stored diagnosis to enable transmission thereof.

10. The vehicle of claim 1, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

11. The vehicle of claim 10, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

12. The vehicle of claim 10, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing said RFID response units of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

13 The vehicle of claim 10, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

14. The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of temperature and pressure.

15. The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of the presence and concentration of a chemical.

16. The vehicle of claim 1, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

17. The vehicle of claim 1, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

18. The vehicle of claim 1, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

19 The vehicle of claim 1, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle.

20. The vehicle of claim 19, wherein said location determining system uses GPS technology.

21. A method for monitoring a vehicle, comprising the steps of:

diagnosing the state of the vehicle or the state of a component of the vehicle by means of a diagnostic system arranged on the vehicle;

generating an output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle; and

transmitting the output to a remote location.

22. The vehicle of claim 21, wherein the step of transmitting the output to a remote location comprises the step of arranging a communications device comprising a cellular telephone system including an antenna on the vehicle.

23. The method of claim 21, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor embodying a pattern recognition algorithm.

24. The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining whether the vehicle is stable or is about to rollover or skid.

25. The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining a location of an impact between the vehicle and another object.

26. The method of claim 21, further comprising the steps of:

arranging a display in the vehicle in a position to be visible from the passenger compartment; and

displaying the state of the vehicle or the state of a component of the vehicle on the display.

27. The method of claim 21, further comprising the step of relaying a warning to an occupant of the vehicle relating to the state of the vehicle.

28. The method of claim 21, further comprising the steps of:

determining at least one property or characteristic of occupancy of the vehicle; and

transmitting the determined property or characteristic of occupancy of the vehicle to a remote location.

29. The method of claim 28, wherein the step of determining at least one property or characteristic of occupancy of the vehicle comprises the step of determining the number of occupants in the passenger compartment.

30. The method of claim 21, further comprising the steps of:

sensing a state of the environment around the vehicle; and

transmitting information about the environment of the vehicle to a remote location.

31. The method of claim 21, further comprising the steps of:

providing a memory unit in the vehicle to receive the diagnosis of the state of the vehicle or the state of the component of the vehicle and store the diagnosis; and interrogating the memory unit to obtain the stored diagnosis to enable transmission thereof.

32. The method of claim 21, wherein the step of diagnosing the state of the vehicle or the state of the component of the vehicle comprises the steps of mounting a plurality of sensors on the vehicle, measuring a state of each sensor or a state of the mounting location of each sensor and diagnosing the state of the vehicle or the state of a component of the vehicle based on the measurements of the state of the sensors or the state of the mounting locations of the sensors.

33. The method of claim 32, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor, further comprising the step of wirelessly coupling the sensors to the processor.

34. The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the steps of:

providing at least one of the sensors with an RFID response unit;

mounting at least one RFID interrogator device on the vehicle; and

transmitting signals via the at least one RFID interrogator device to cause the RFID response units of the at least one sensor to transmit a signal representative of the measurements of the at least one sensor to the processor.

35. The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the step of providing at least one of the sensors as a SAW sensor capable of receiving a signal and returning a signal modified by virtue of the state of the SAW sensor or the state of the mounting location of the SAW sensor.

36. The method of claim 35, wherein the SAW sensor is arranged to measure at least one of temperature and pressure.

37. The method of claim 35, wherein the SAW sensor is arranged to measure at least one of concentration and presence of a chemical.

38. The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output to a satellite for transmission from the satellite to the remote location.

39. The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output via the Internet to a web site or host computer associated with the remote location.

40. The method of claim 21, further comprising the steps of:

determining the location of the vehicle; and

transmitting the determined location of the vehicle to the remote location in conjunction with the output.

41. A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system,

said communications device including a transmitter for transmitting a signal representative of the output of said diagnostic system to a satellite for transmission from the satellite to a remote site.

42. The vehicle of claim 41, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

43. The vehicle of claim 42, wherein said sensors are wirelessly coupled to said processor.

44. The vehicle of claim 42, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

45. The vehicle of claim 41, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

46. The vehicle of claim 41, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle.

47. The vehicle of claim 41, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle.

48. The vehicle of claim 41, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrogate said memory unit to obtain the stored diagnosis to enable transmission thereof.

49. The vehicle of claim 41, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

50. The vehicle of claim 49, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

51. The vehicle of claim 49, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing

said RFID response units of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

52. The vehicle of claim 49, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

53. The vehicle of claim 41, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

54. The vehicle of claim 41, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative of representative of the state of the vehicle or the state of a component of the vehicle.

55. The vehicle of claim 41, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

56. The vehicle of claim 41, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle.

ABSTRACT

Vehicle diagnostic system which diagnoses the state of the vehicle or the state of a component of the vehicle and generates an output indicative or representative thereof. A communications device transmits the output of the diagnostic system to a remote location, possibly via a satellite or the Internet. The diagnostic system can include sensors mounted on the vehicle, each providing a measurement related to a state of the sensor or a measurement related to a state of the mounting location, and a processor coupled to the sensors and arranged to receive data from the sensors and process the data to generate the output indicative or representative of the state of the vehicle or its component. The processor may embody a pattern recognition algorithm trained to generate the output from the data received from the sensors and be arranged to control parts of the vehicle based on the output.

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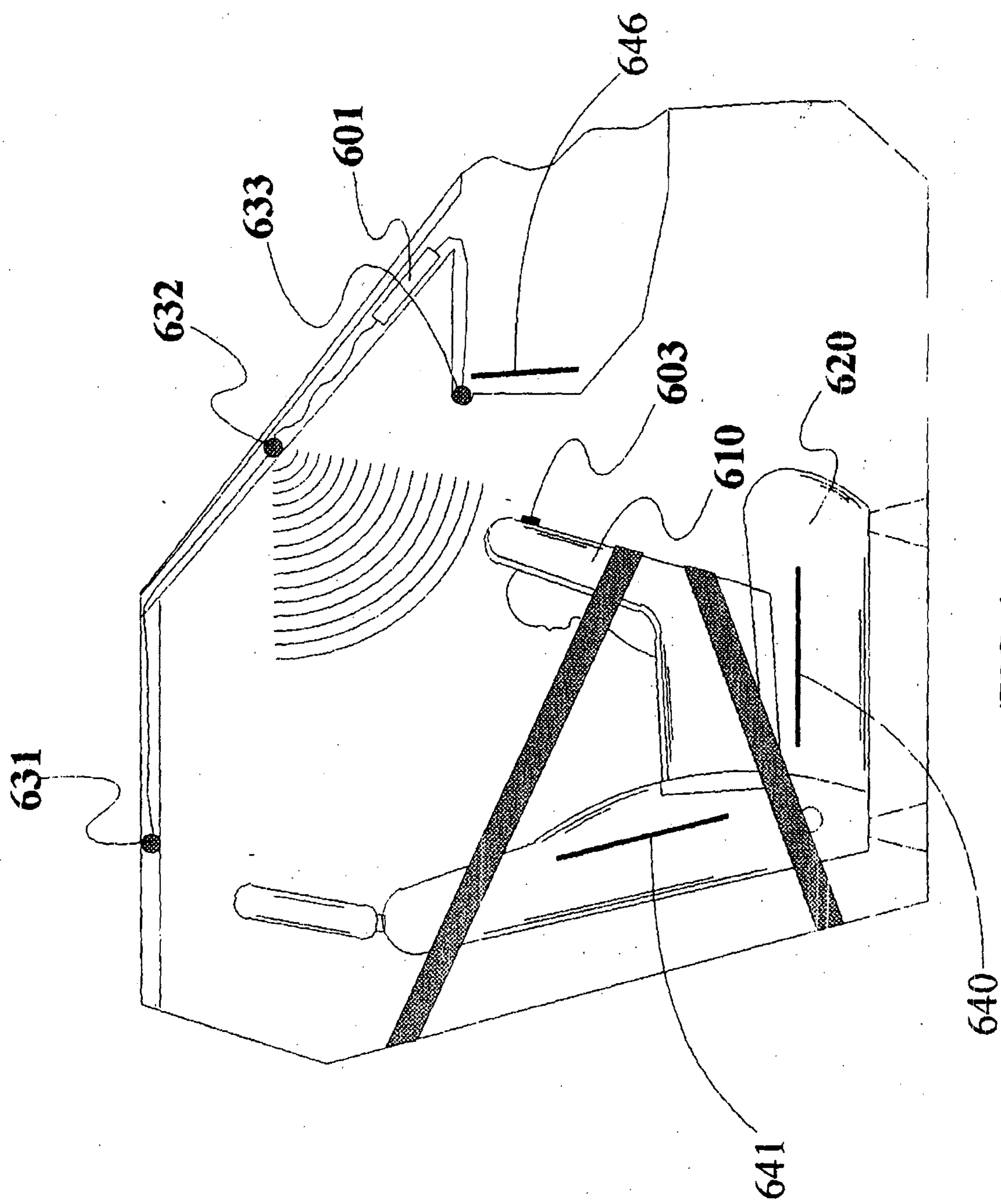

FIG. 1

38 sh.

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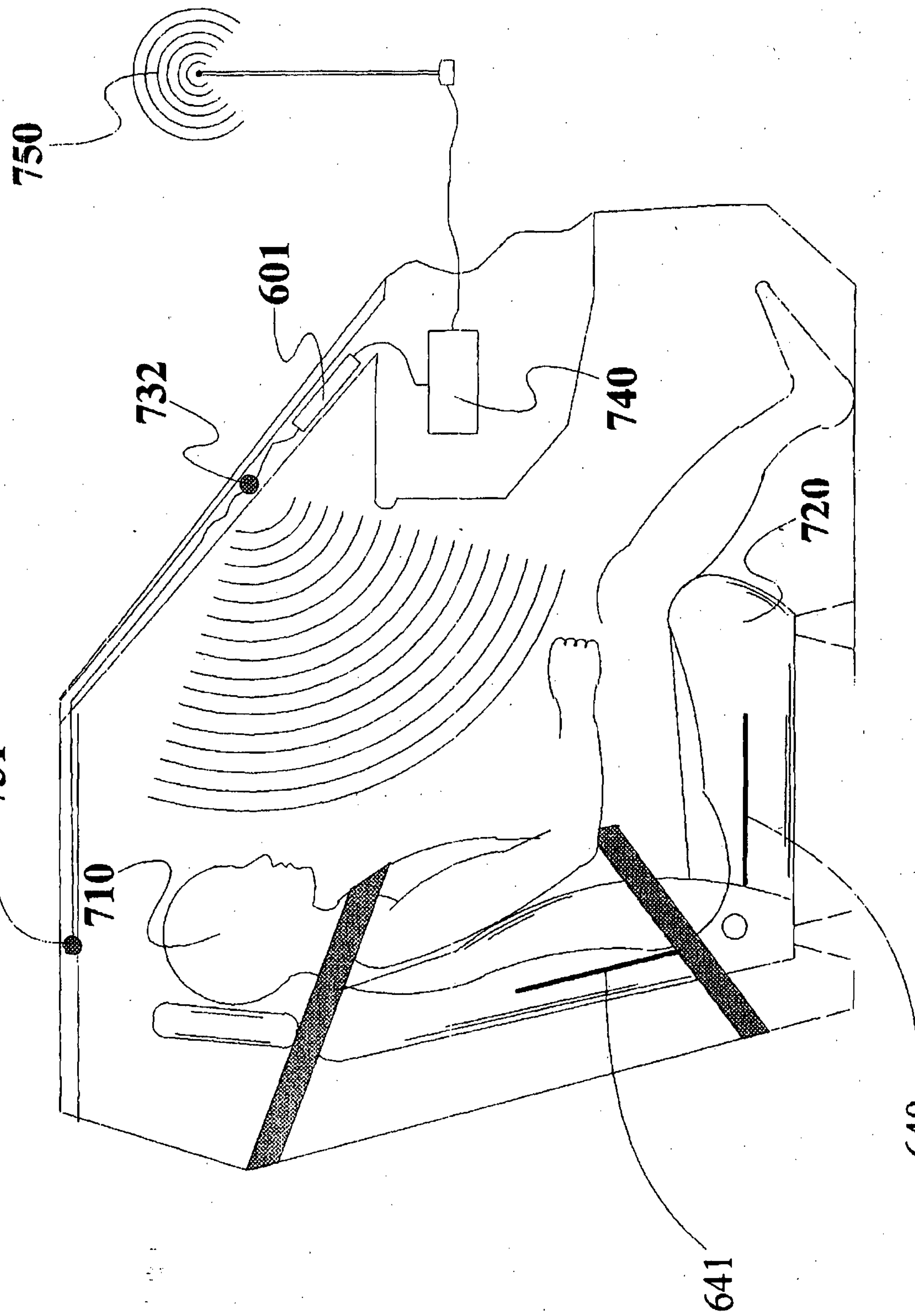

FIG. 2

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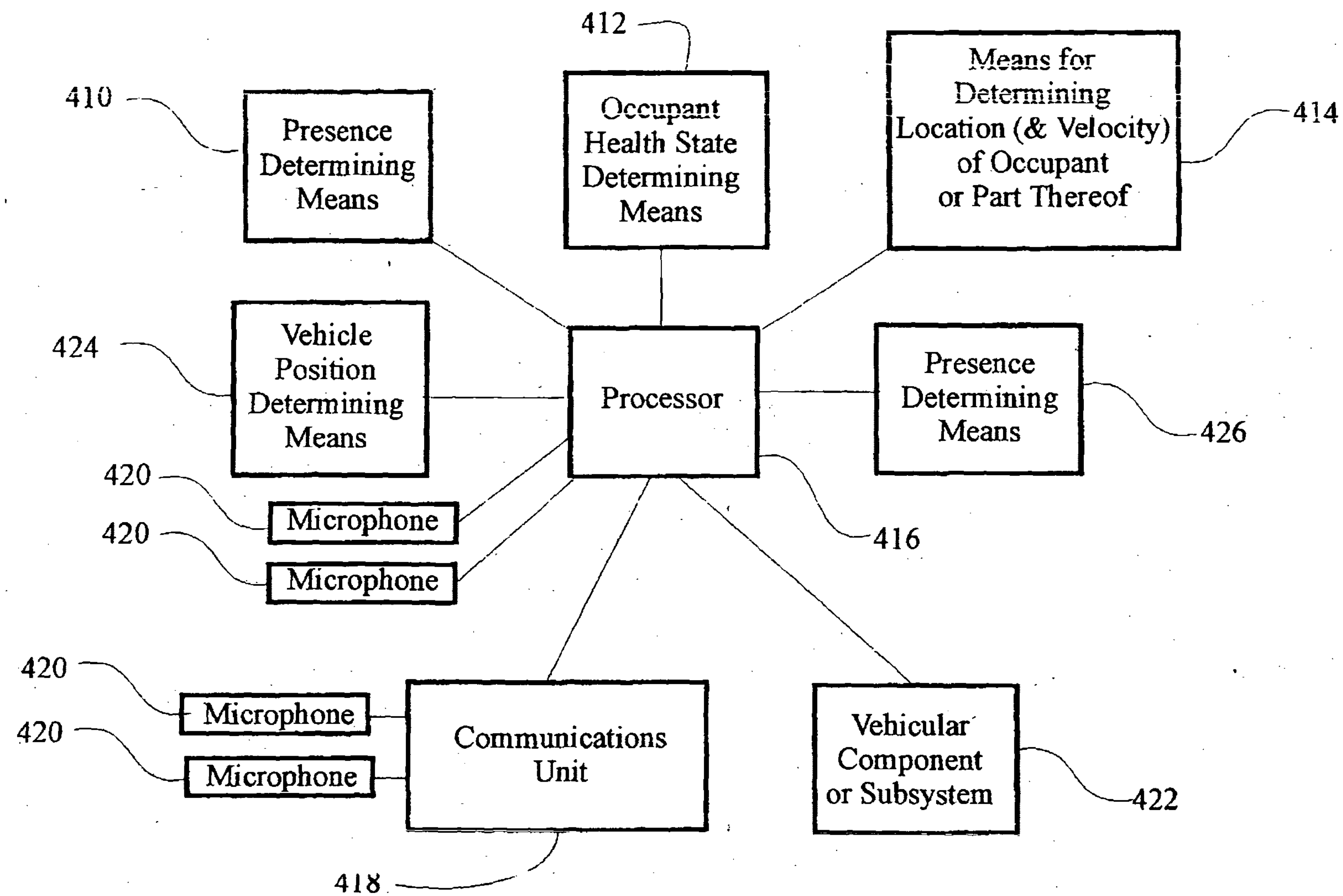

FIG. 3

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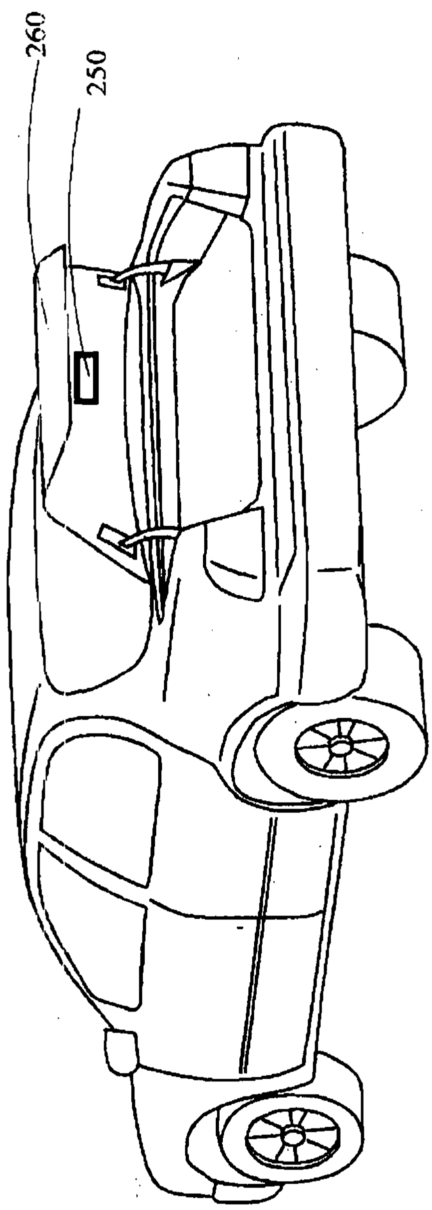

FIG. 4

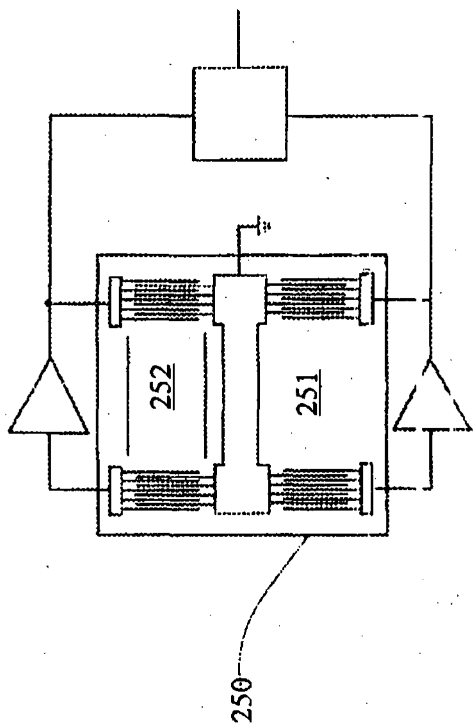

FIG. 4A

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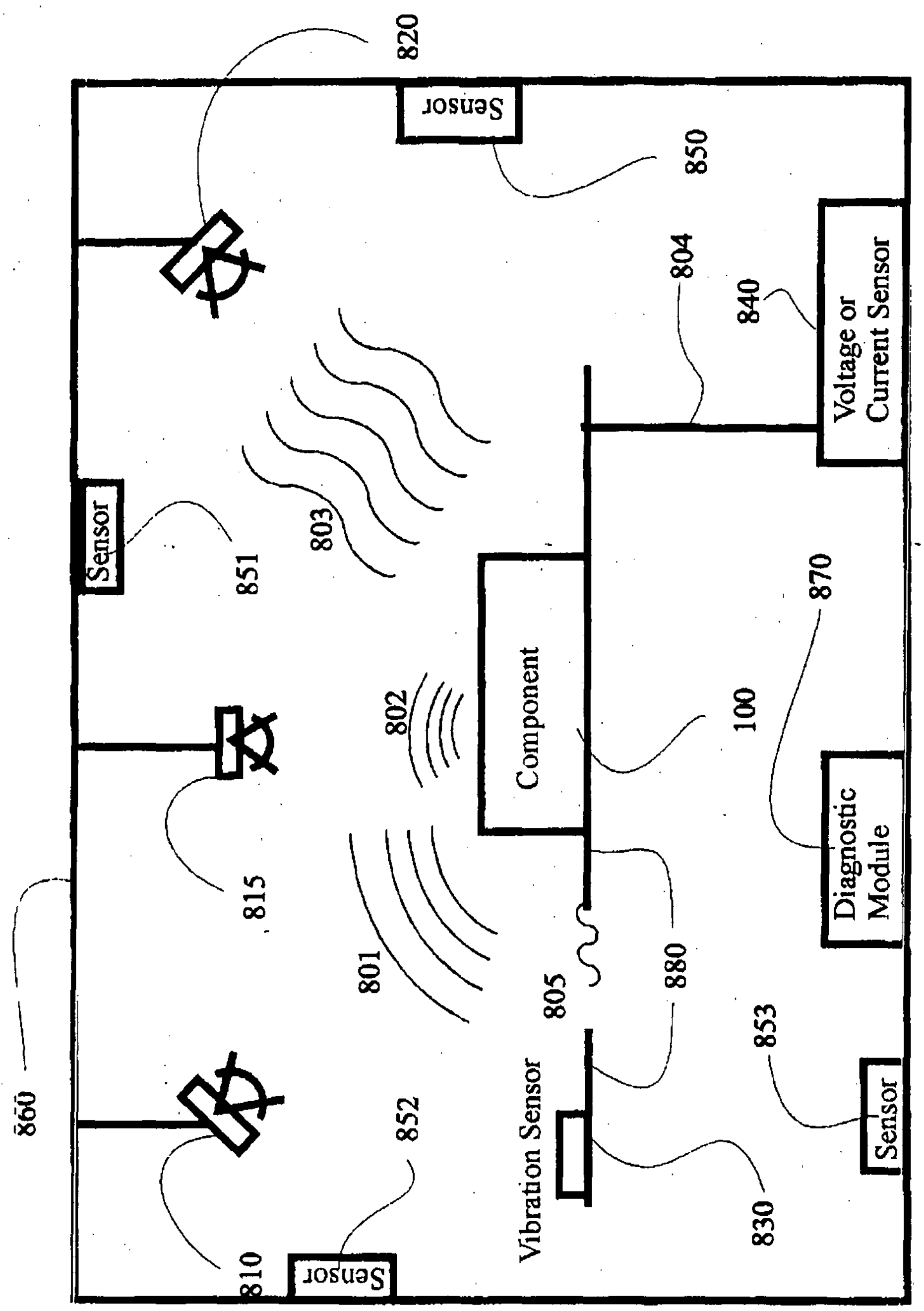

FIG. 5

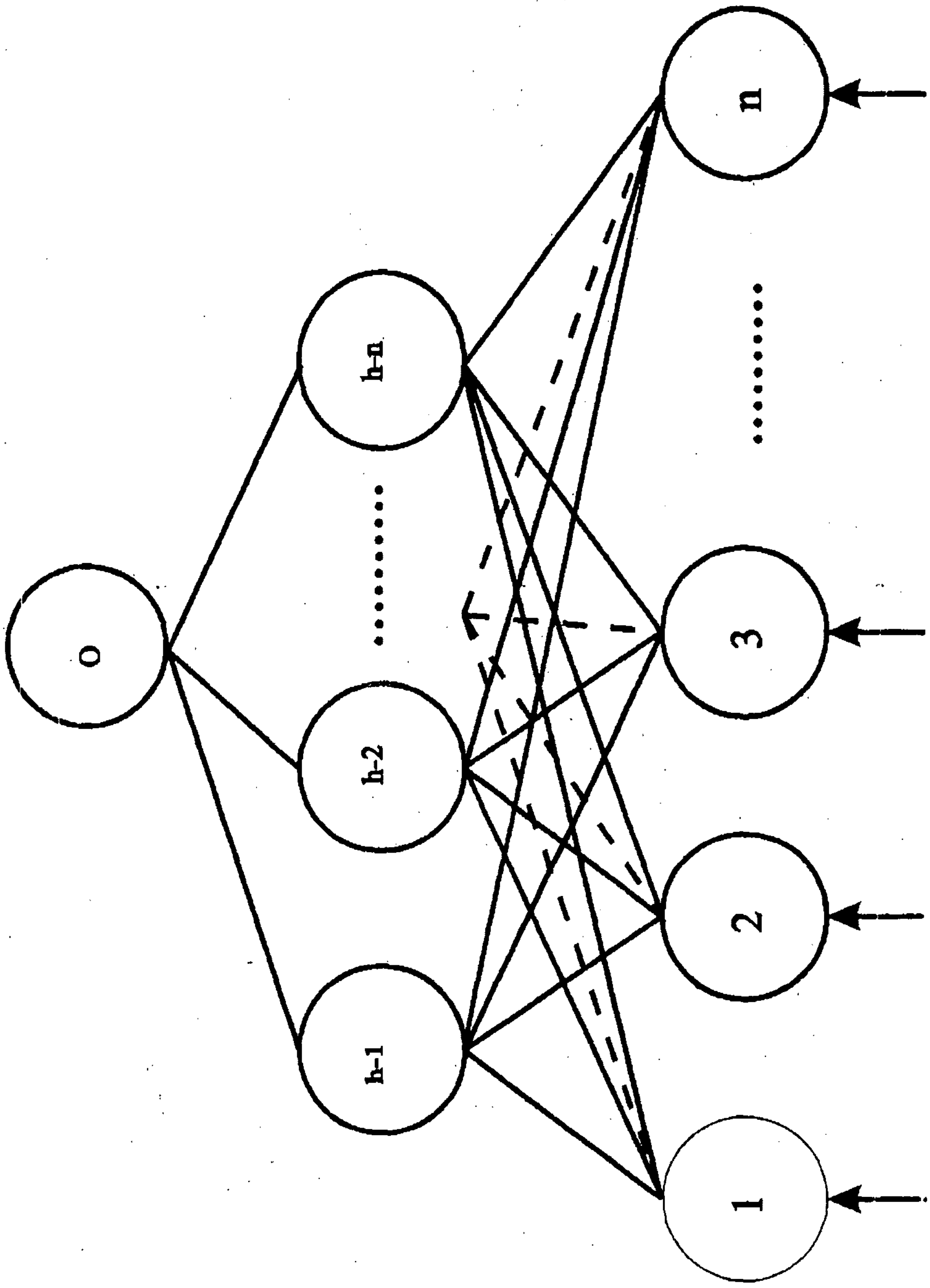

FIG. 6

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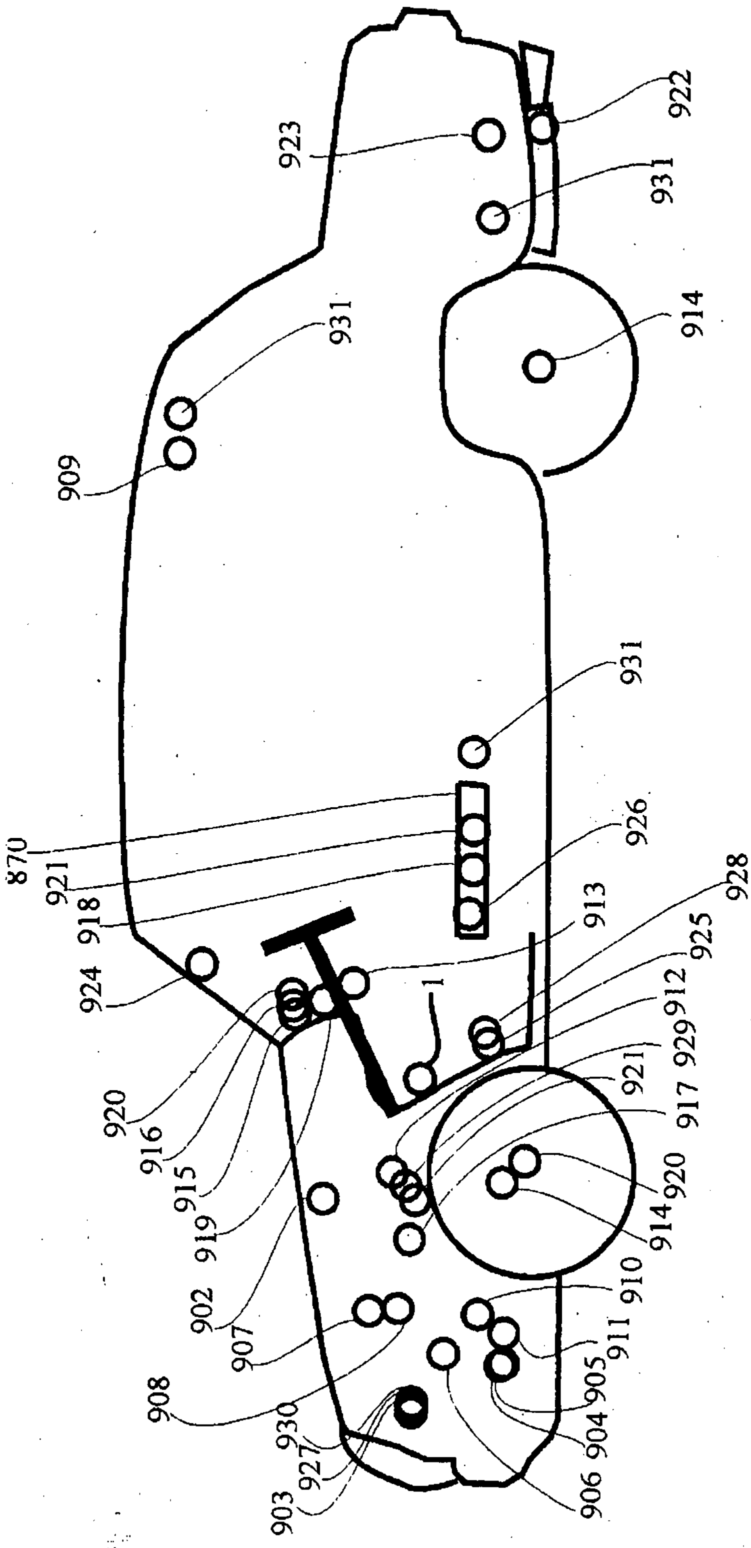

FIG. 7

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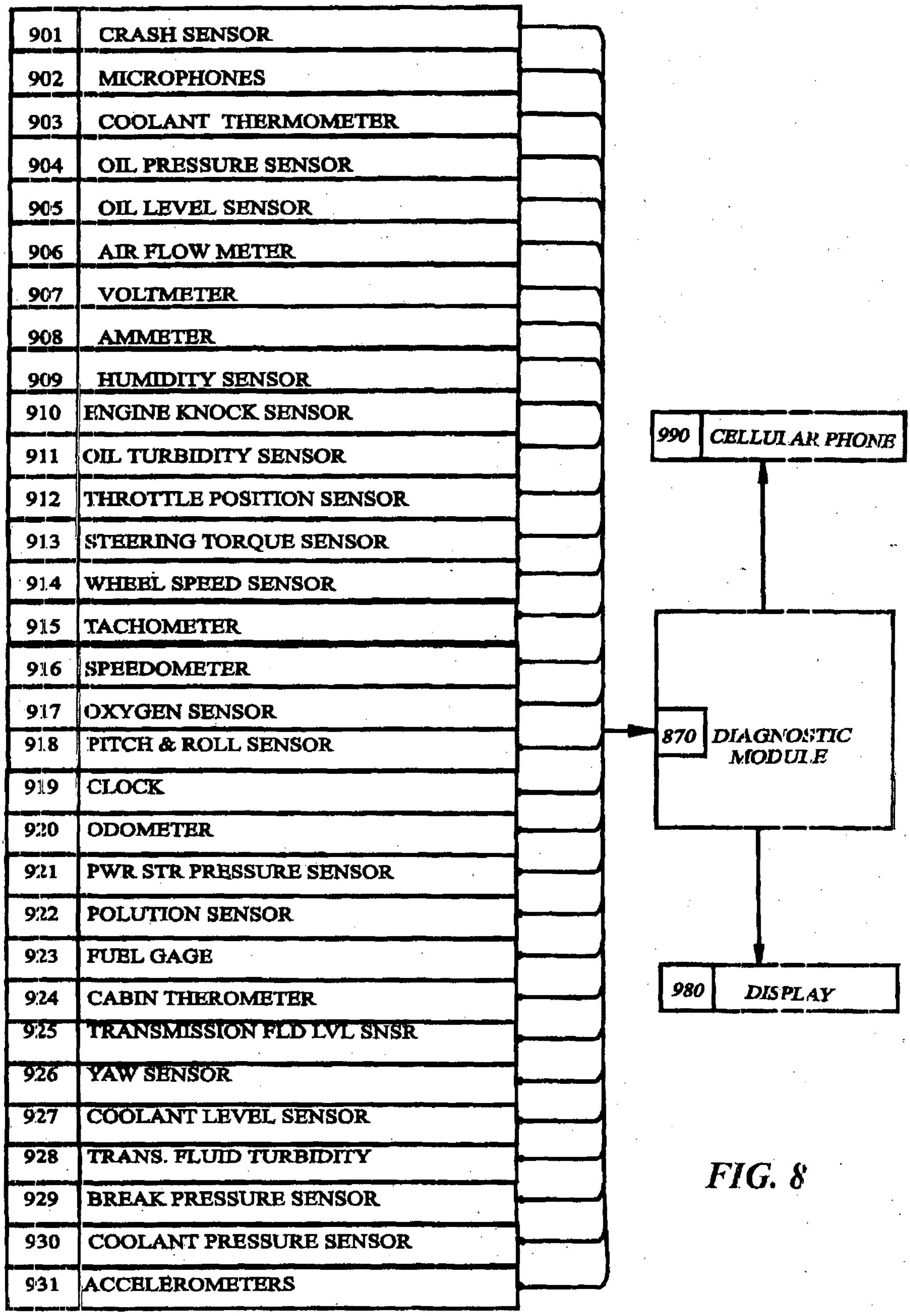

FIG. 8

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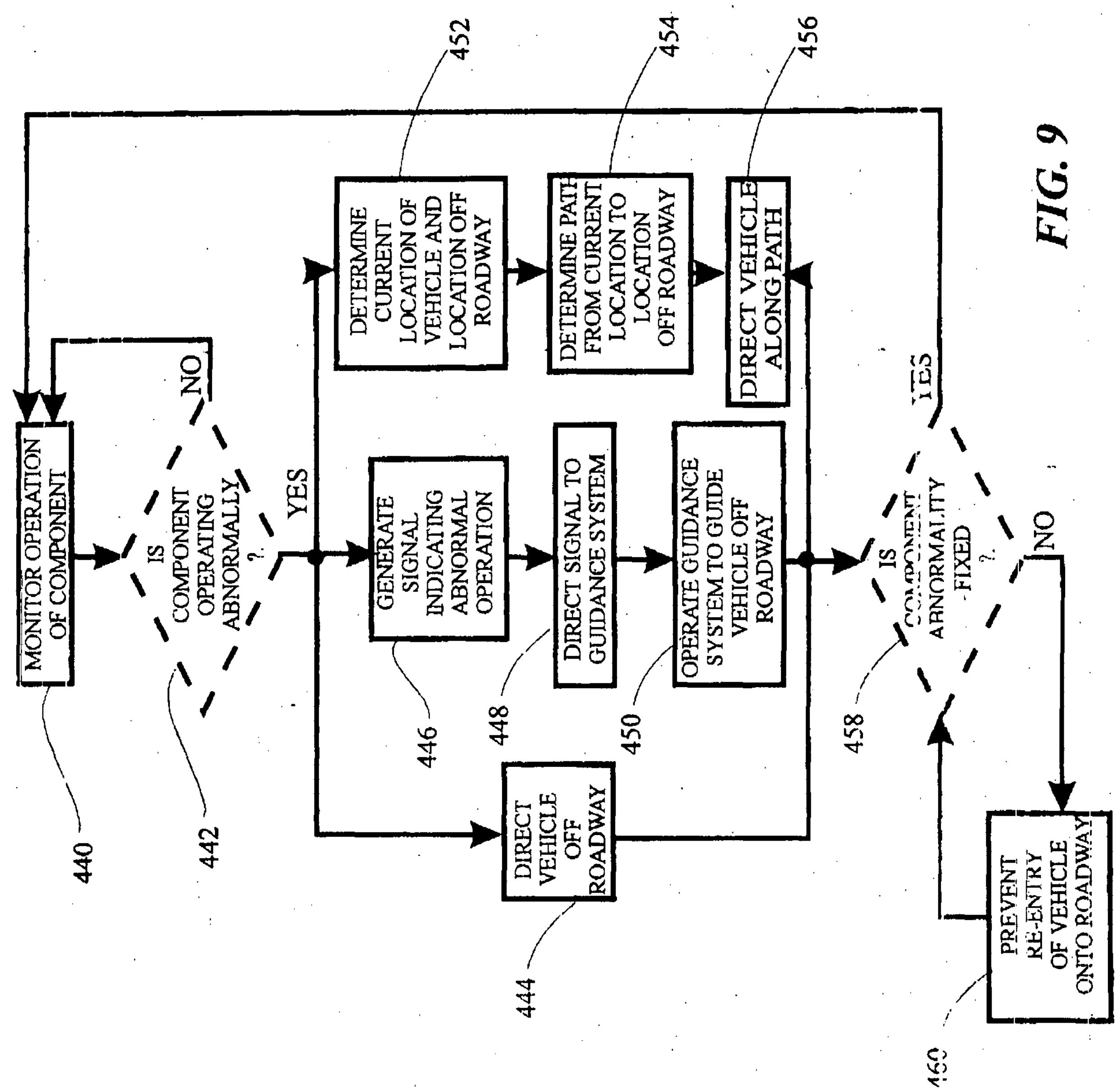

FIG. 9

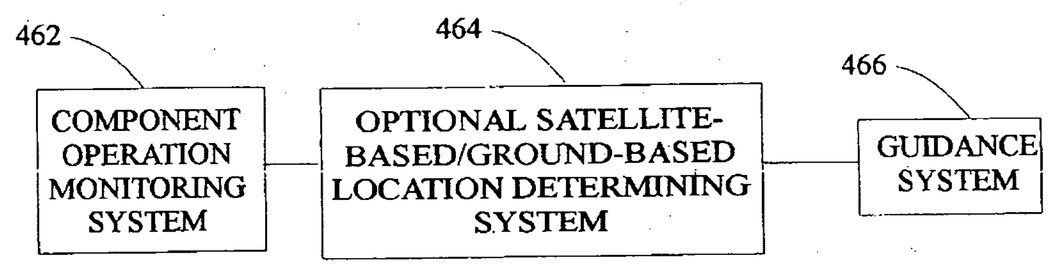
462
COMPONENT OPERATION MONITORING SYSTEM
464
OPTIONAL SATELLITE-BASED/GROUND-BASED LOCATION DETERMINING SYSTEM
466
GUIDANCE SYSTEM

FIG. 10

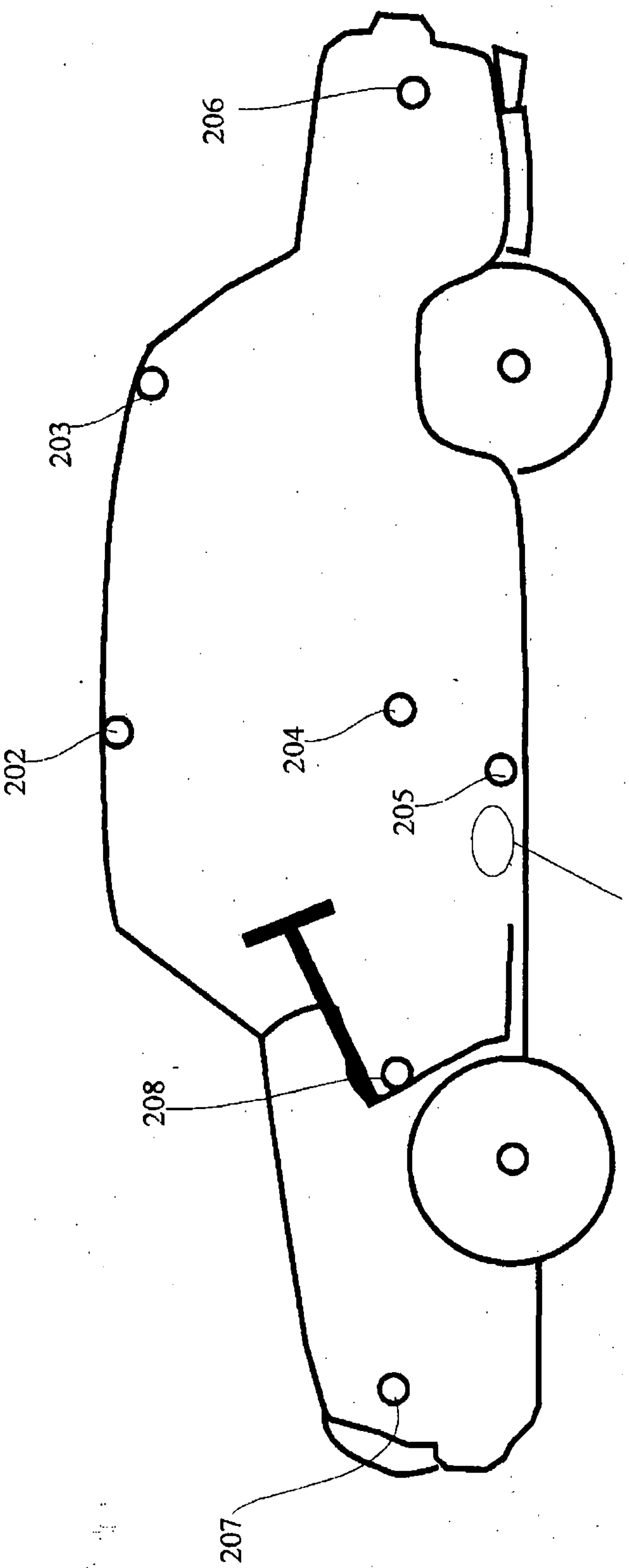

FIG. 11

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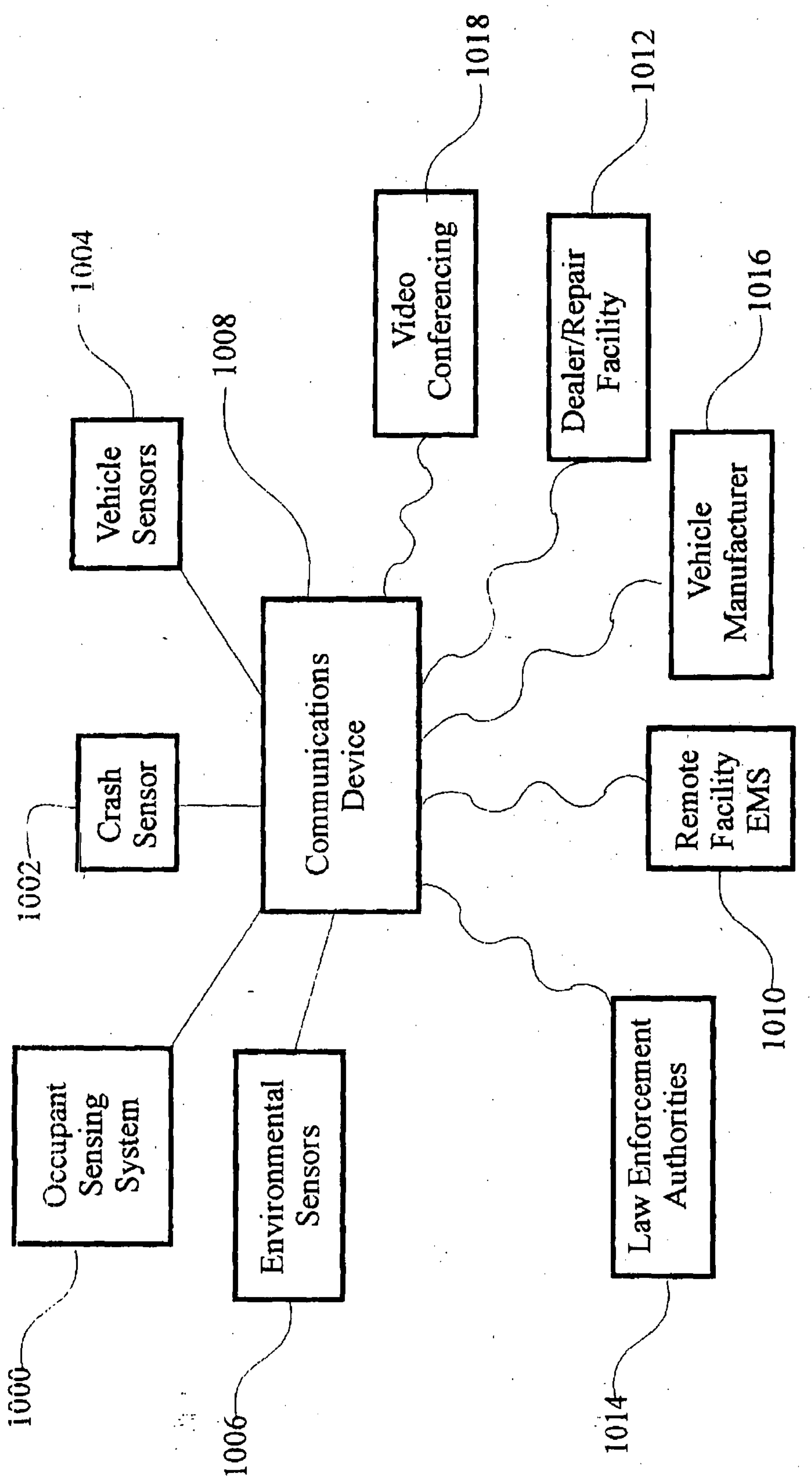

FIG. 12

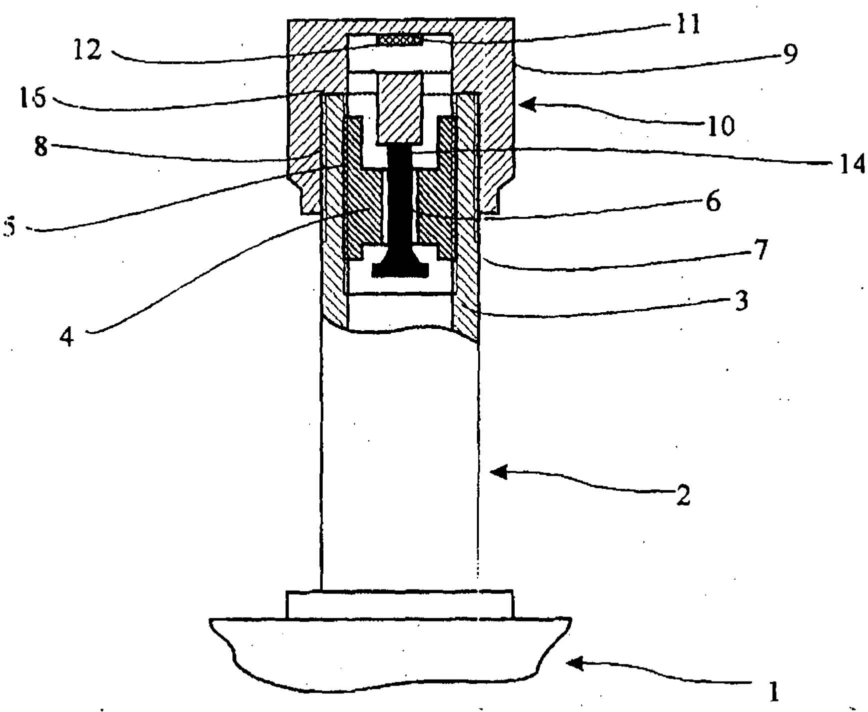

FIG. 13A

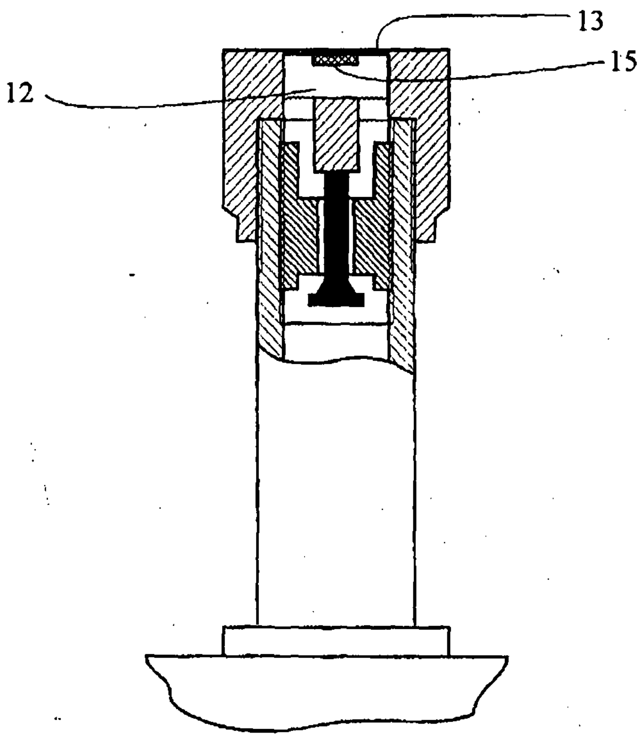

FIG. 13B

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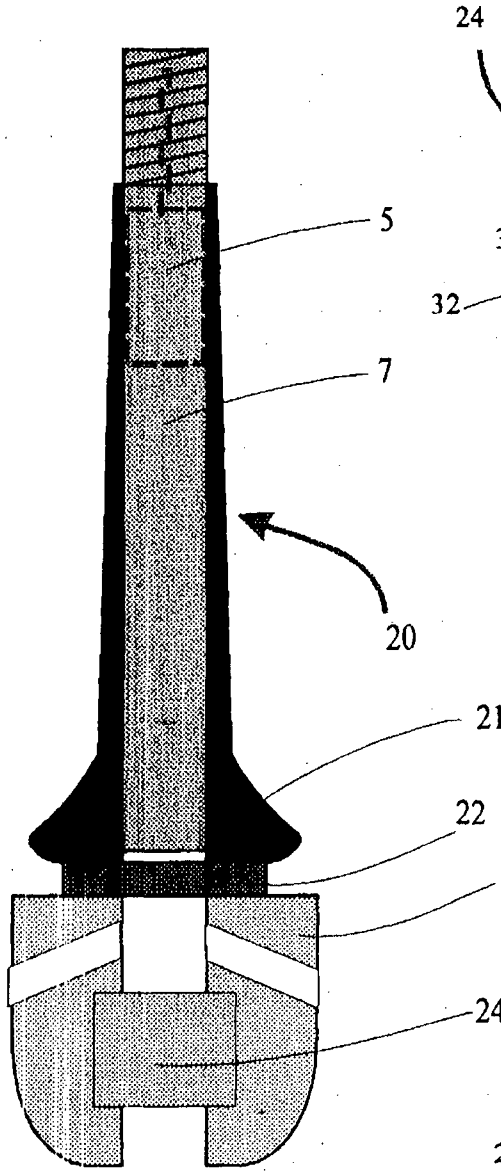

FIG. 14

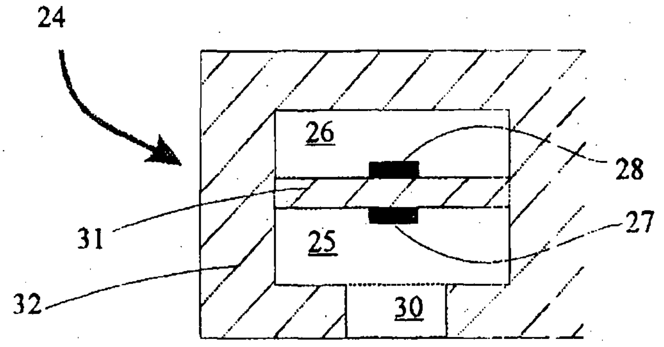

FIG. 14A

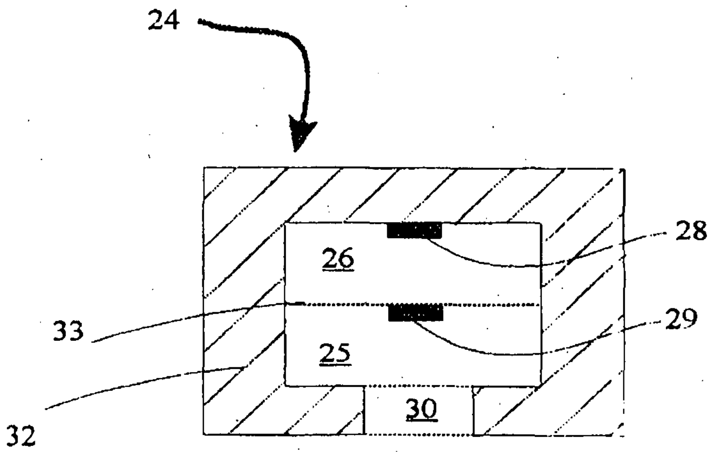

FIG. 14B

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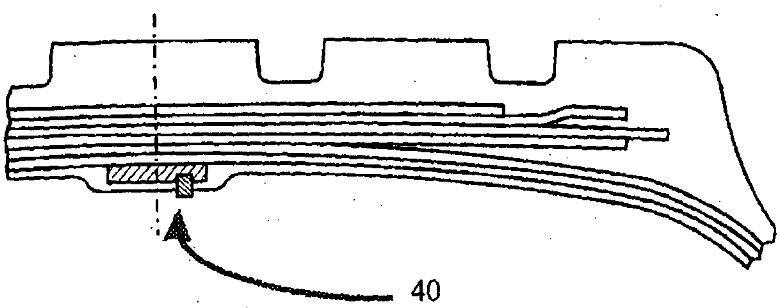

FIG. 15A

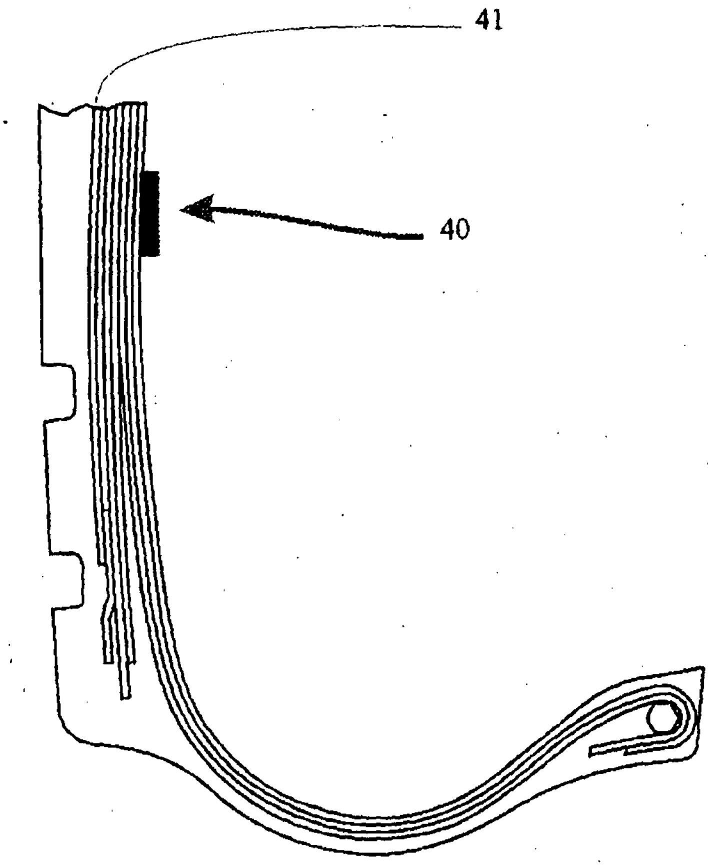

FIG. 15

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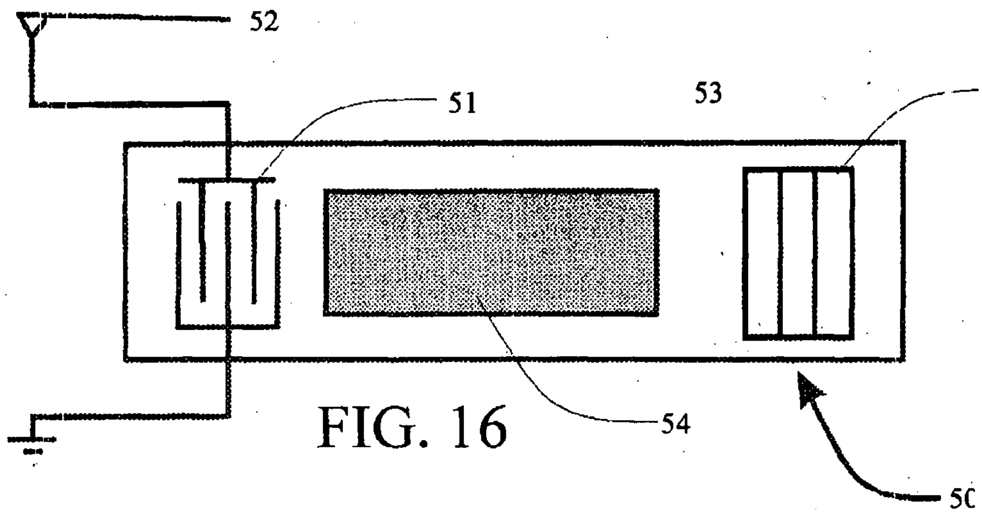

FIG. 16

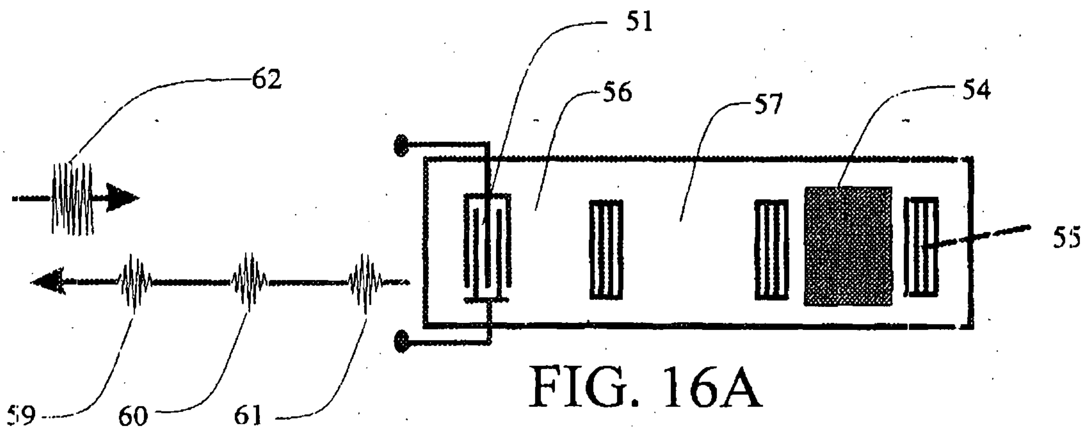

FIG. 16A

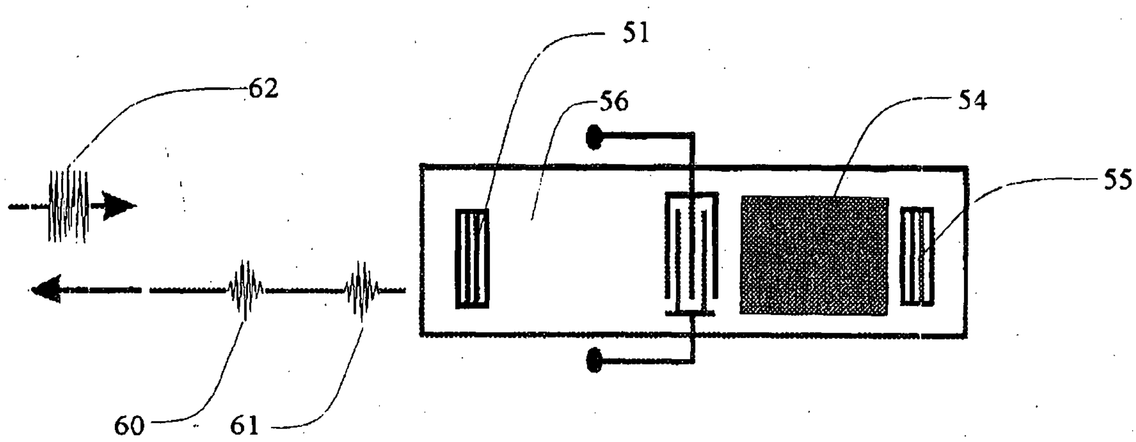

FIG. 16B

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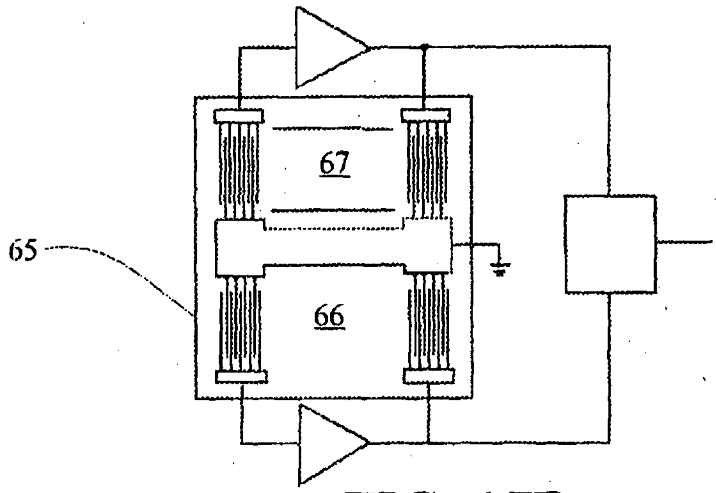

FIG. 17B

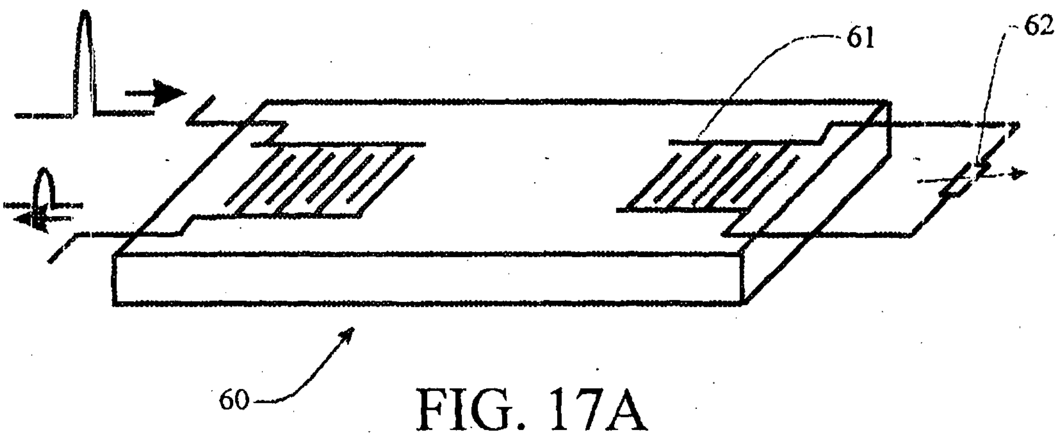

FIG. 17A

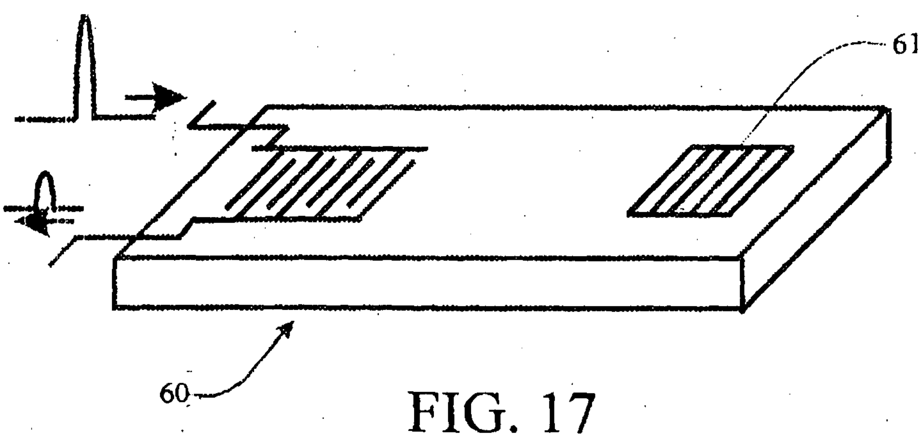

FIG. 17

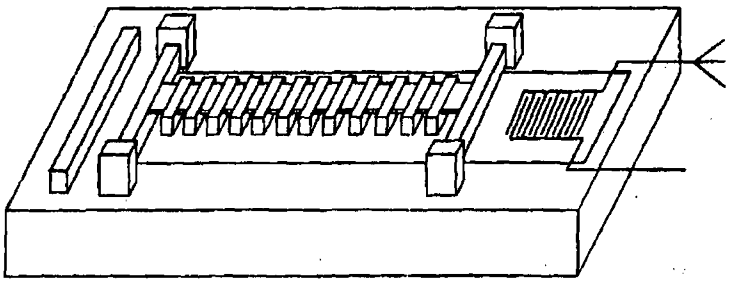

FIG. 18A

PRIOR ART

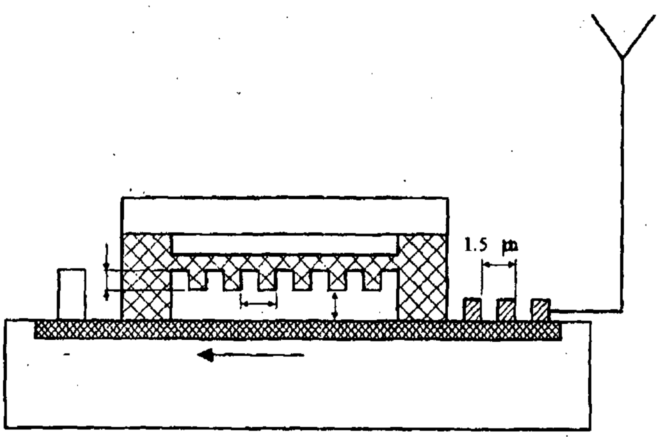

FIG. 18

PRIOR ART

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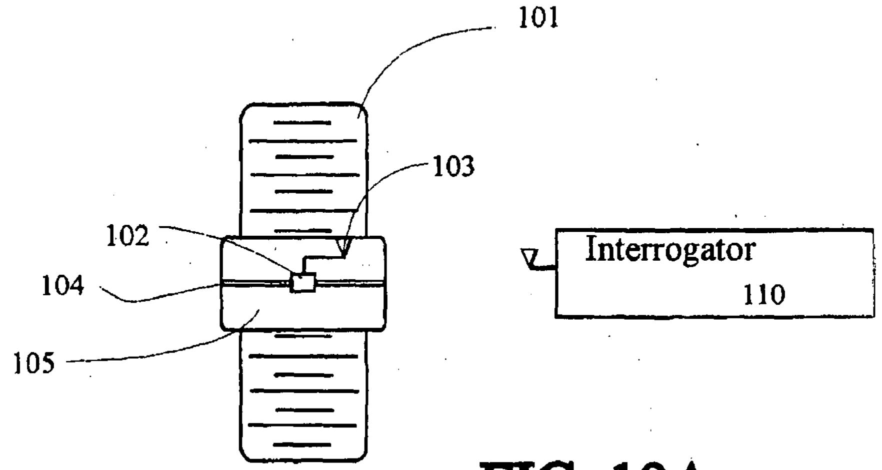


FIG. 19A

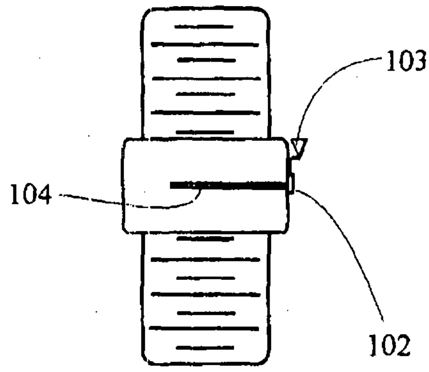


FIG. 19B

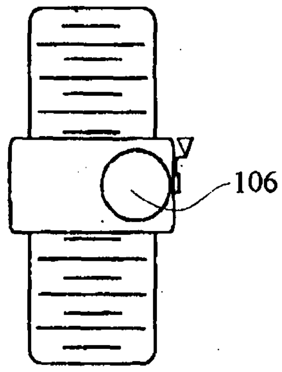


FIG. 19C

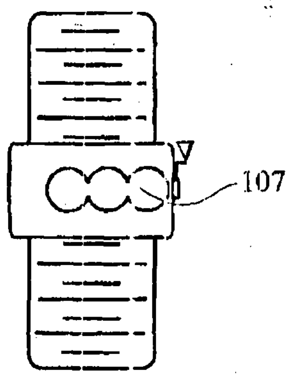


FIG. 19D

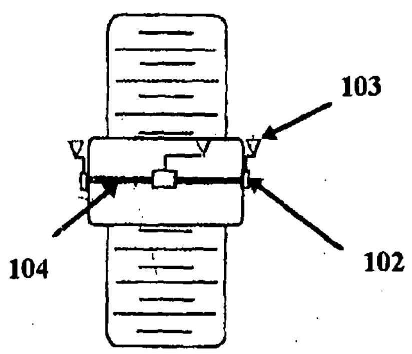


FIG. 19E

PRINT OF DRAWINGS
AS ORIGINALLY FIL[illegible]

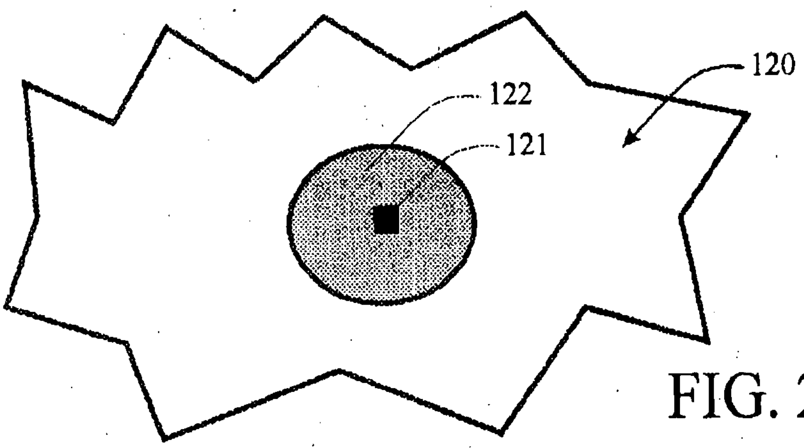


FIG. 20A

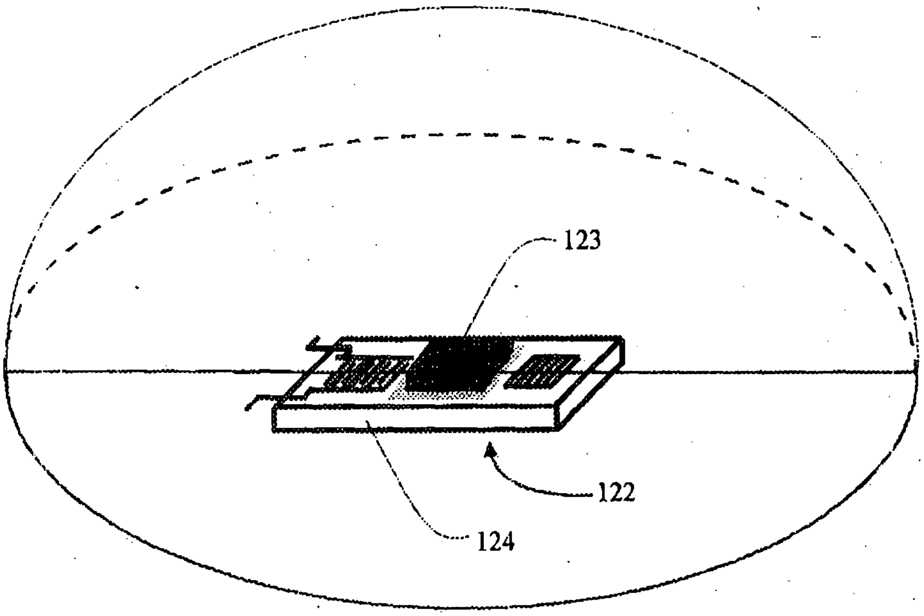


FIG. 20B

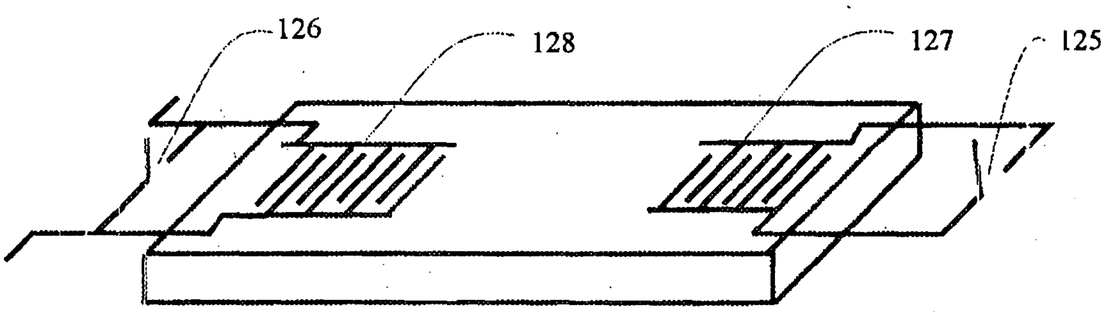


FIG. 20C

PRINT OF DRAWINGS
AS ORIGINALLY FIL[illegible]

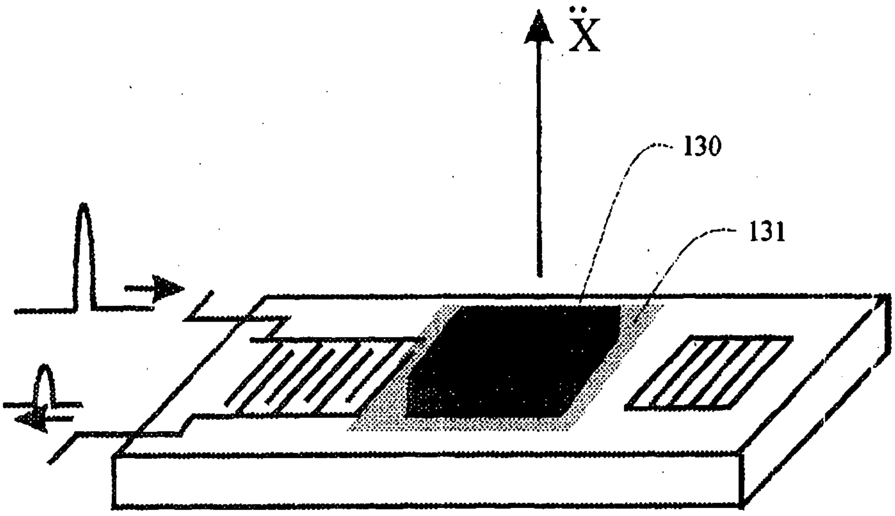


FIG. 21A

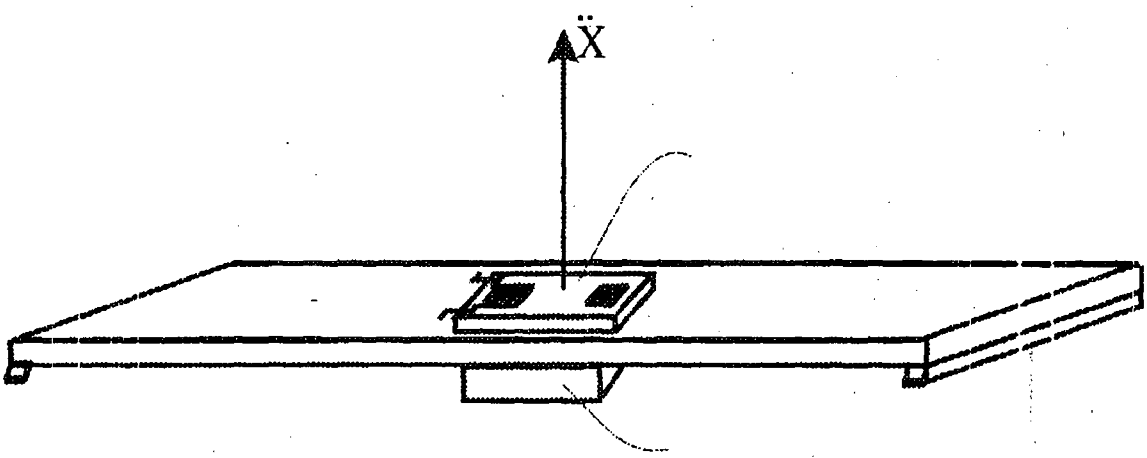


FIG. 21B

Prior Art

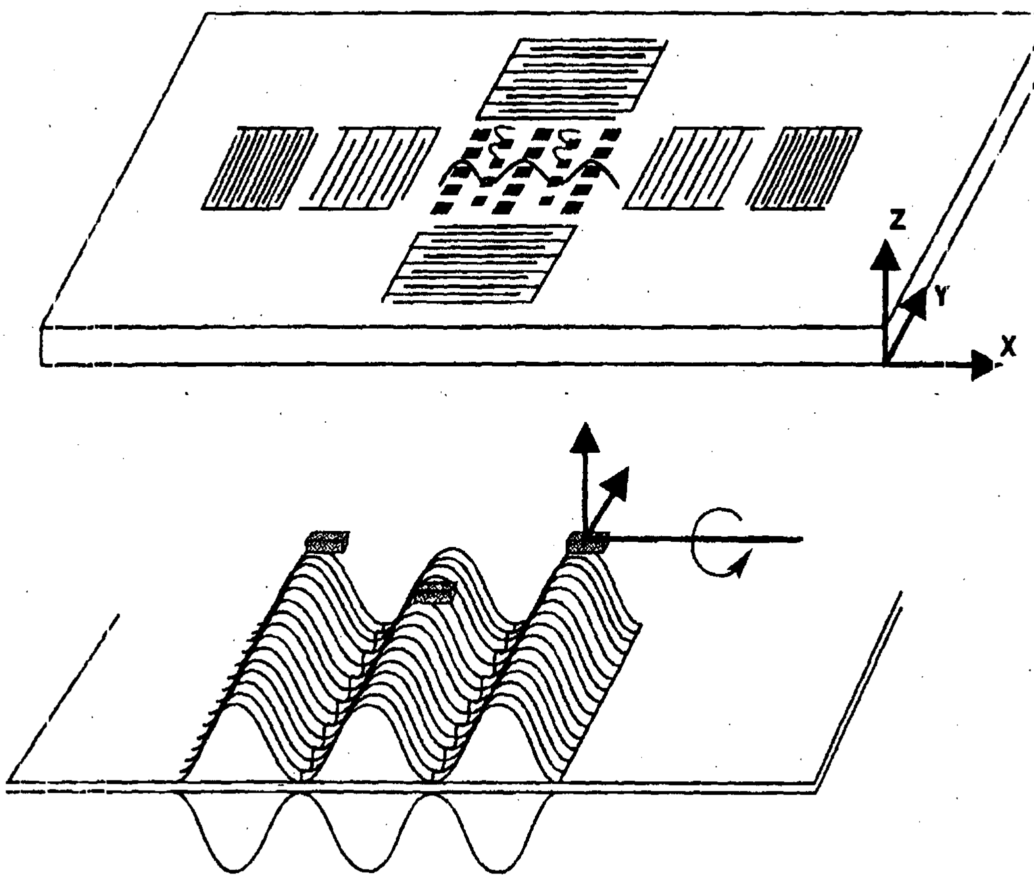


FIG. 22

PRINT OF DRAWINGS
AS ORIGINALLY FIL

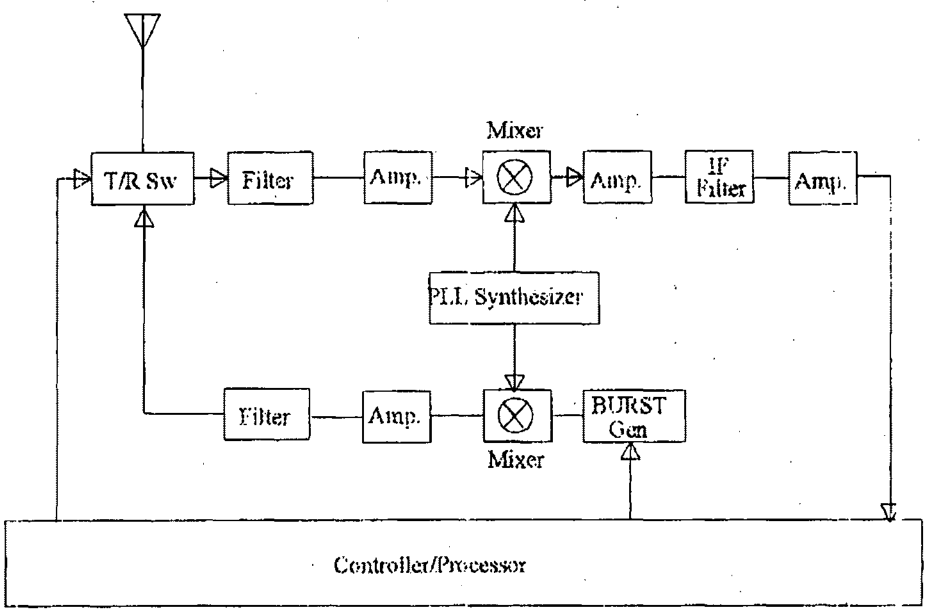


FIG. 23A

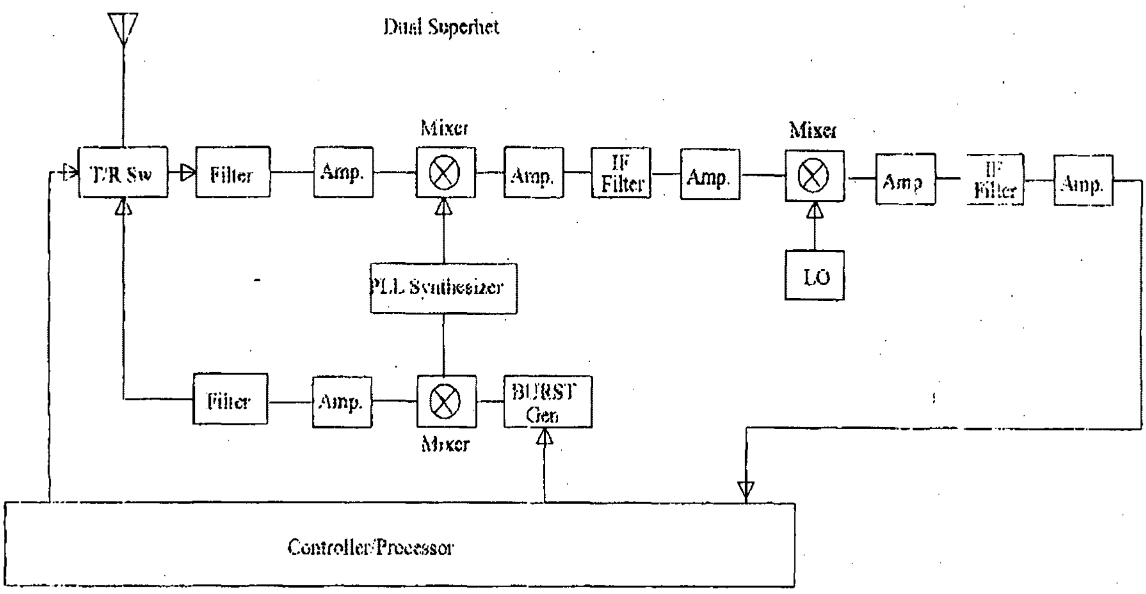
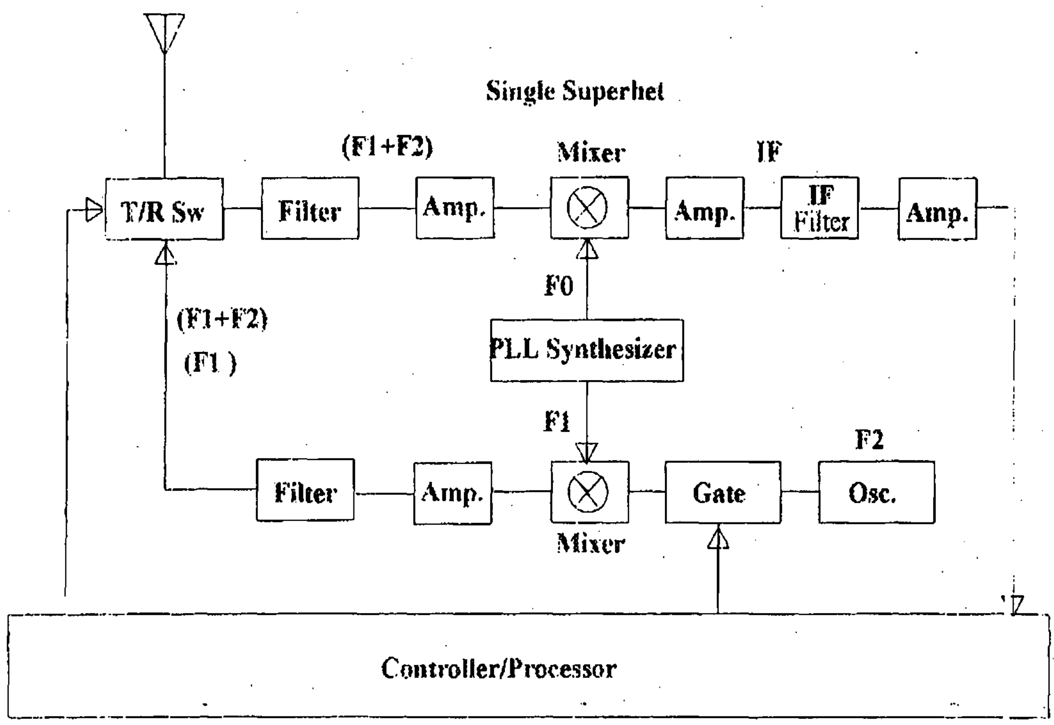


FIG. 23B

PRINT OF DRAWINGS
AS ORIGINALLY FILED



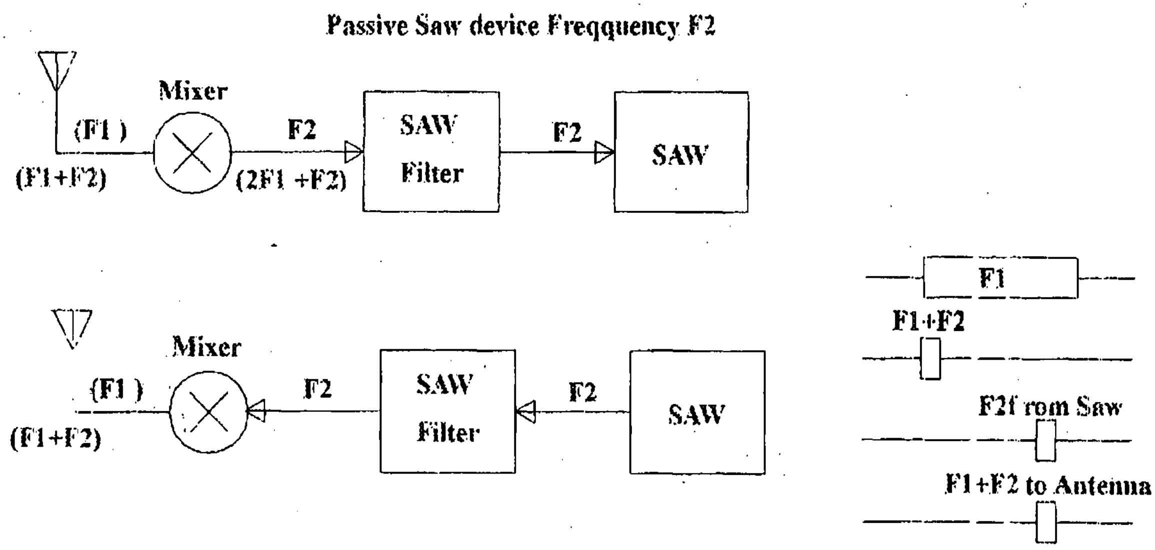


FIG. 23C

PRINT OF DRAWINGS
AS ORIGINALLY FIL.

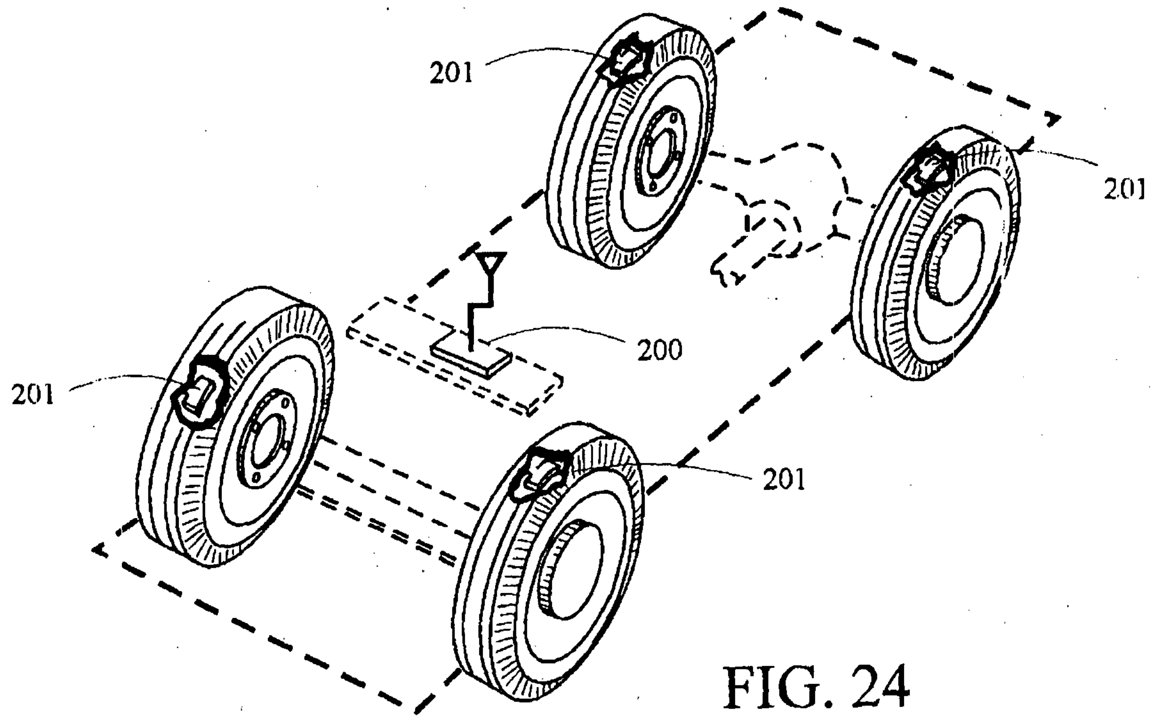


FIG. 24

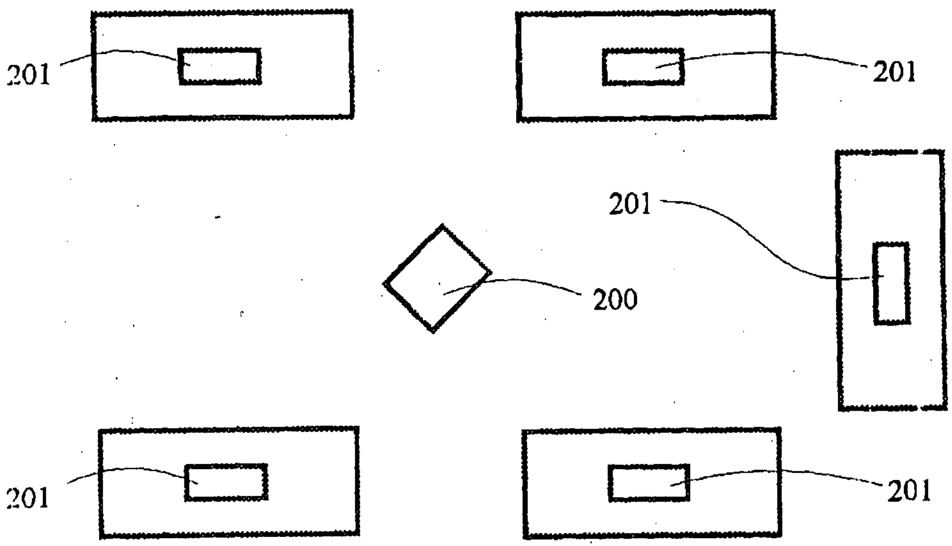


FIG. 24A

PRINT OF DRAWINGS
AS ORIGINALLY FILED

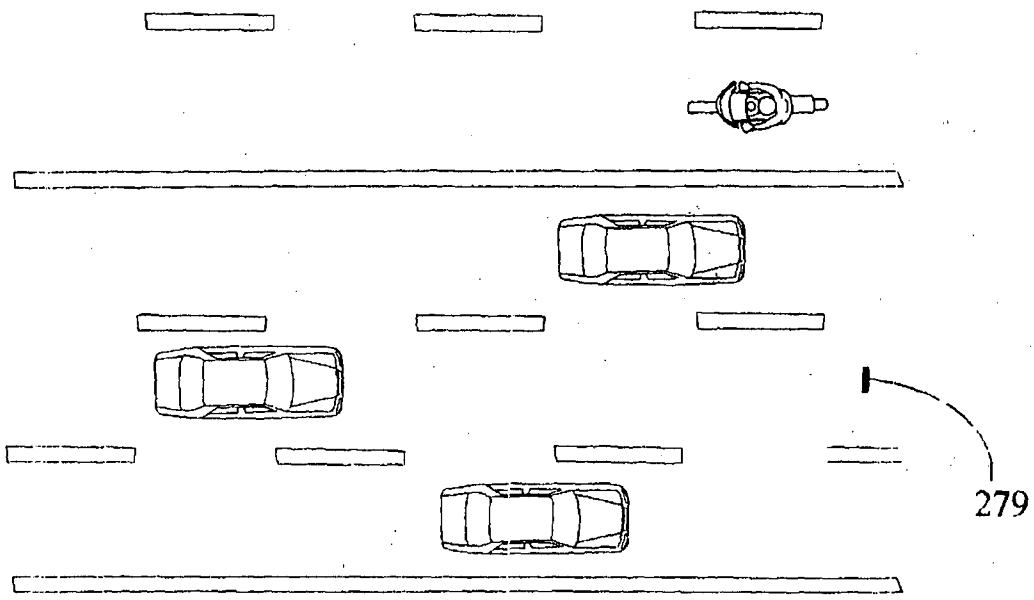


FIG. 25

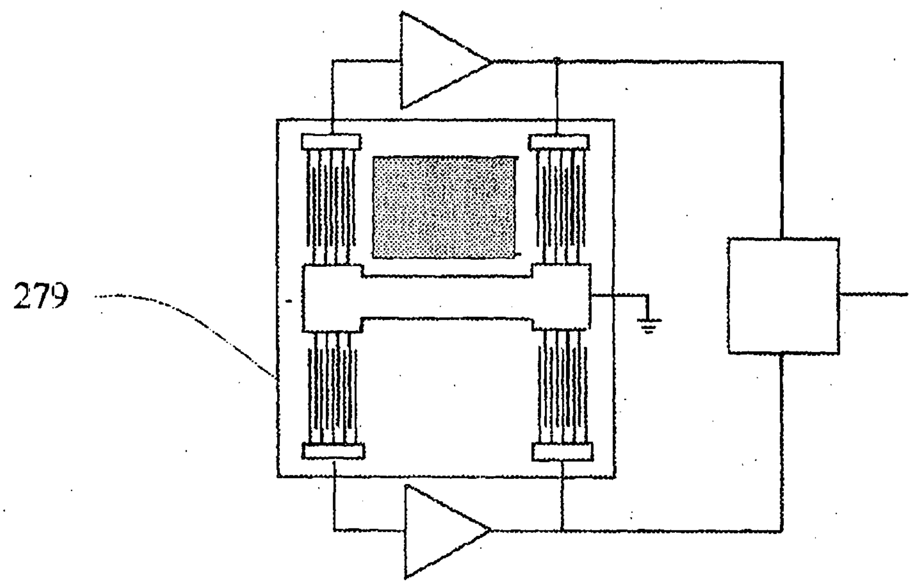


FIG. 25A

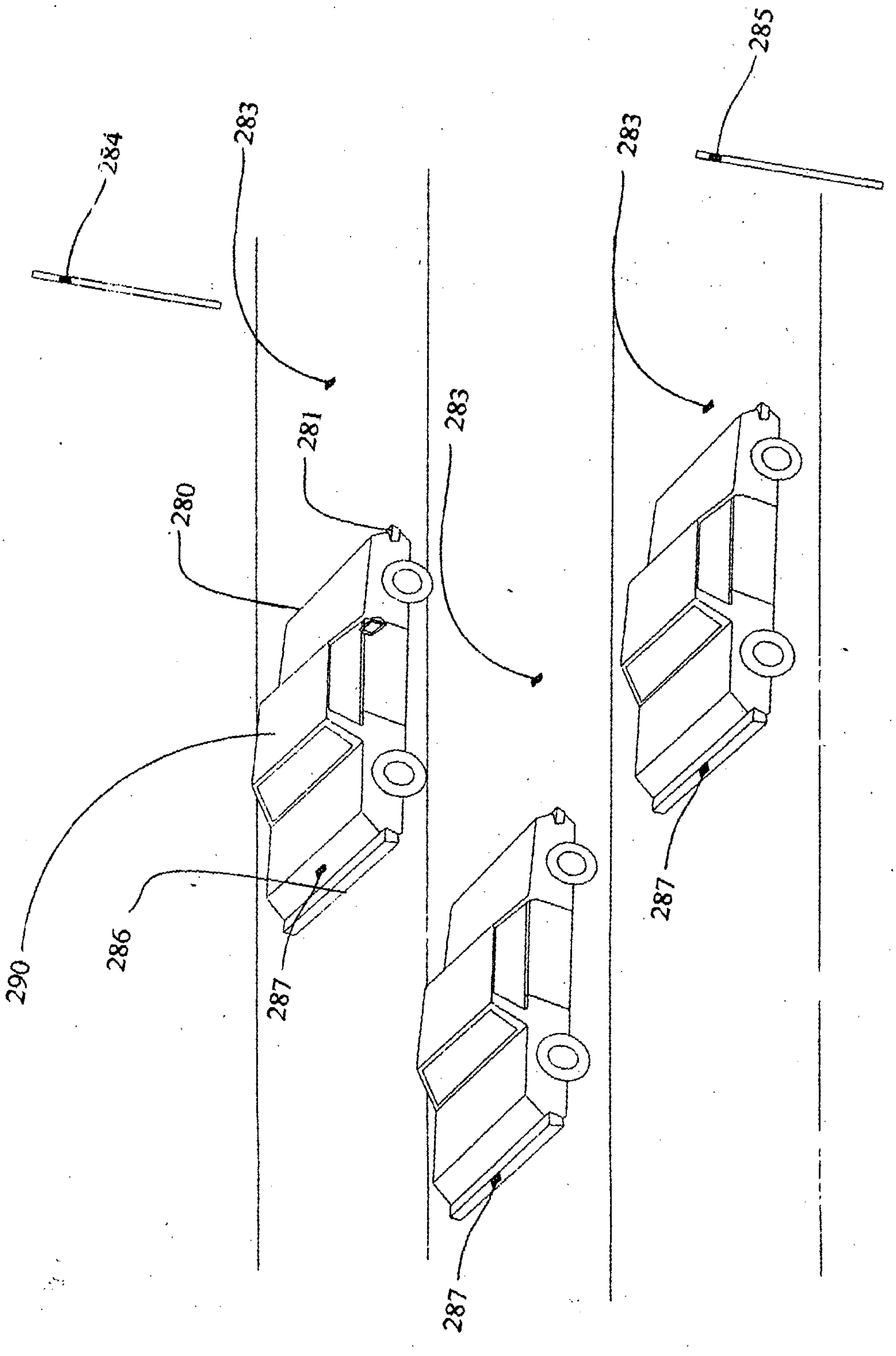


FIG. 26

PRINT OF DRAWINGS
AS ORIGINALLY FIL[illegible]

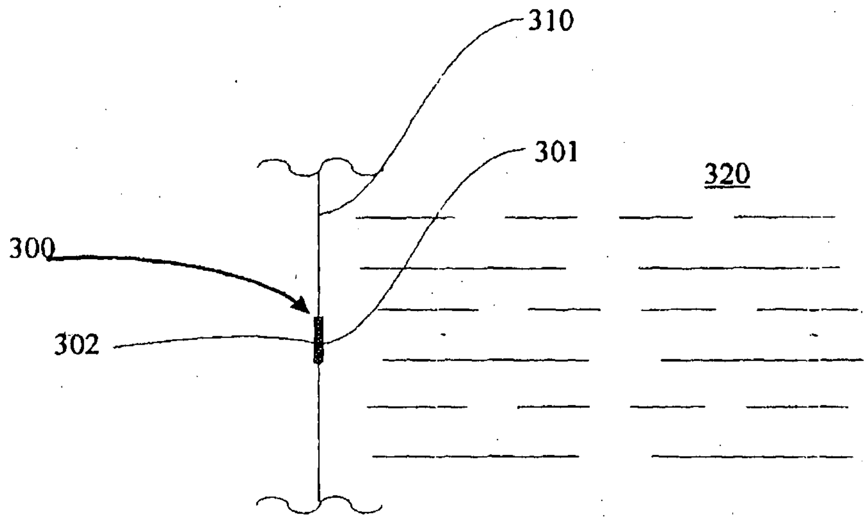


FIG. 27

PRINT OF DRAWINGS AS ORIGINALLY FIL...

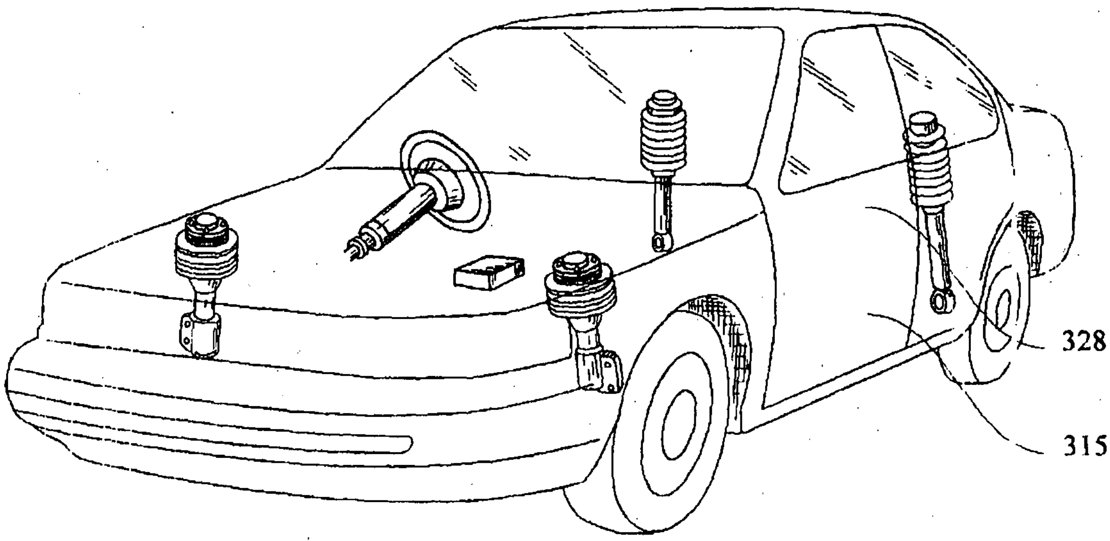


FIG. 28

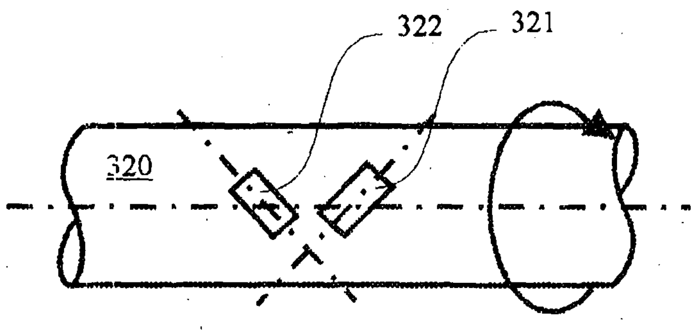


FIG. 28B

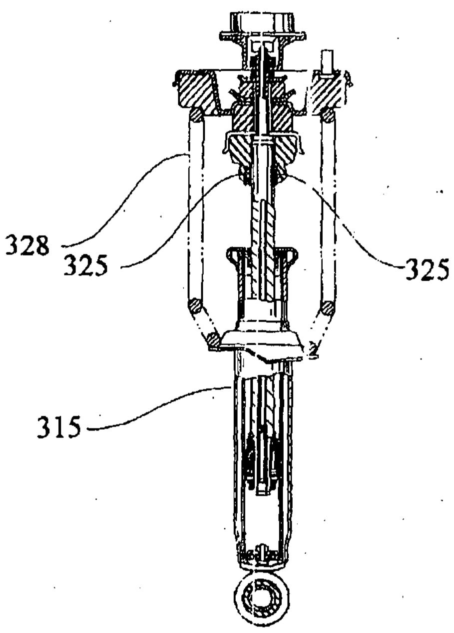


FIG. 28A

PRINT OF DRAWINGS
AS ORIGINALLY FILL

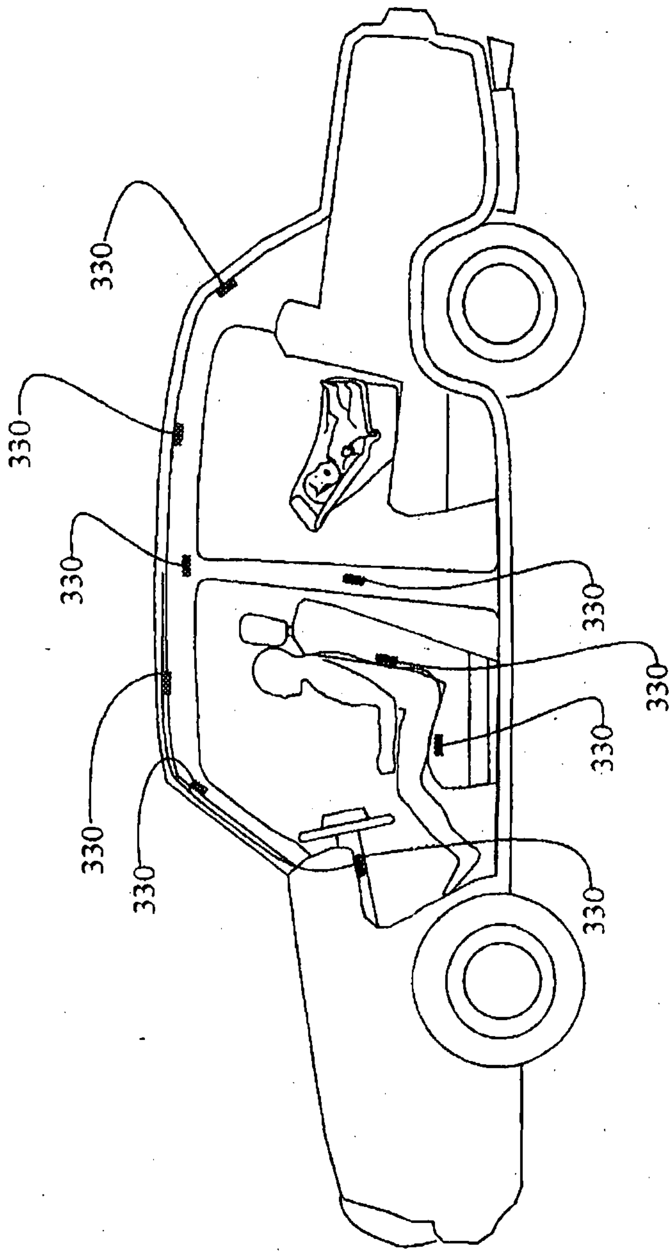


FIG. 29

PRINT OF DRAWINGS
AS ORIGINALLY FILED

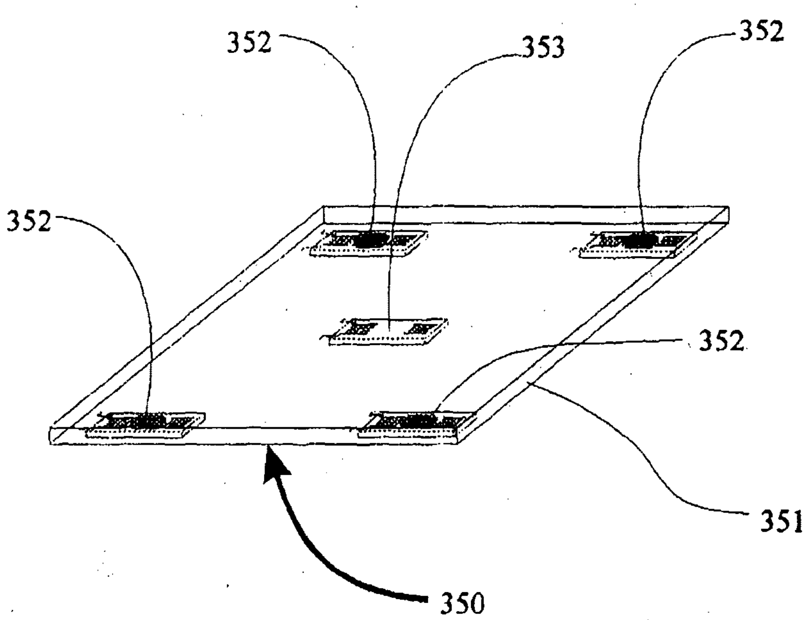


FIG. 30A

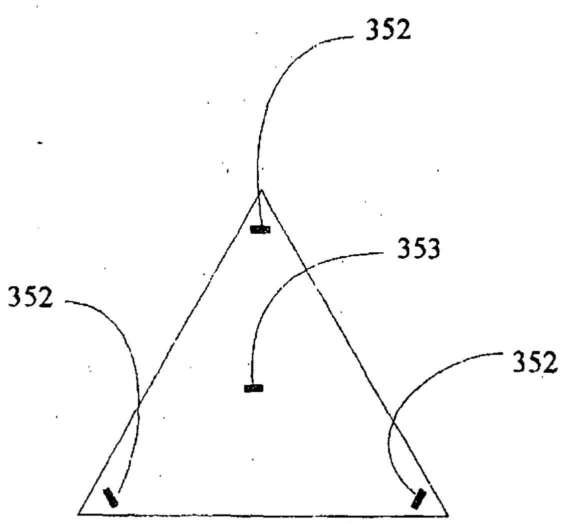


FIG. 30B

PRINT OF DRAWINGS
AS ORIGINALLY FILE

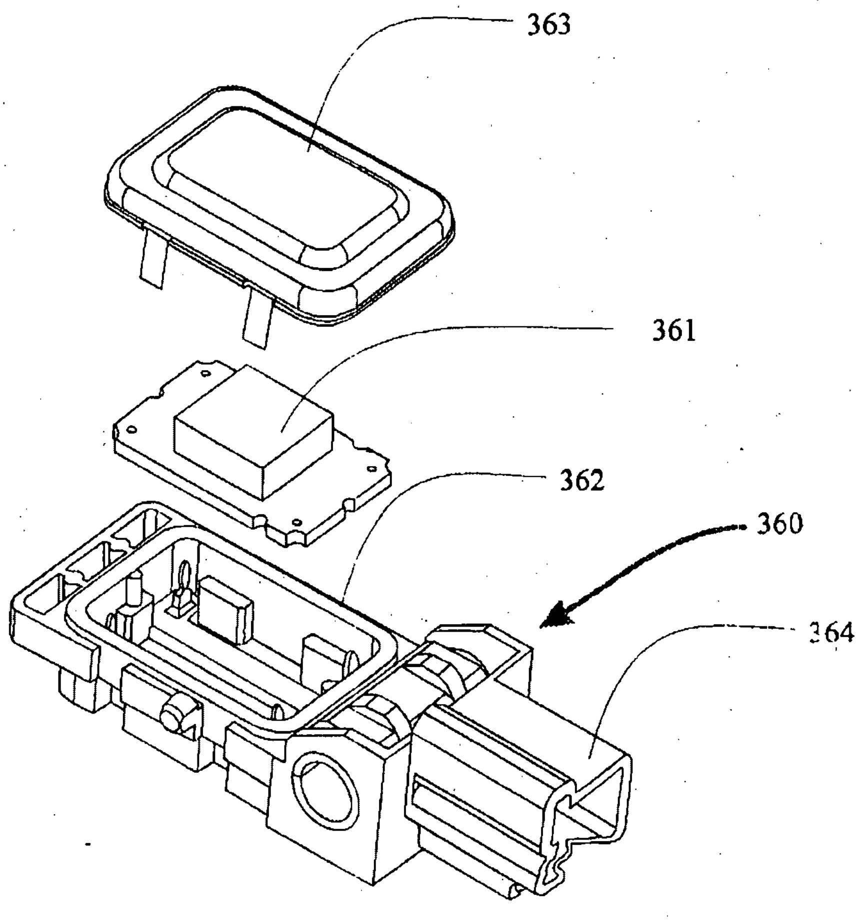


FIG. 31

PRINT OF DRAWINGS
AS ORIGINALLY FILED

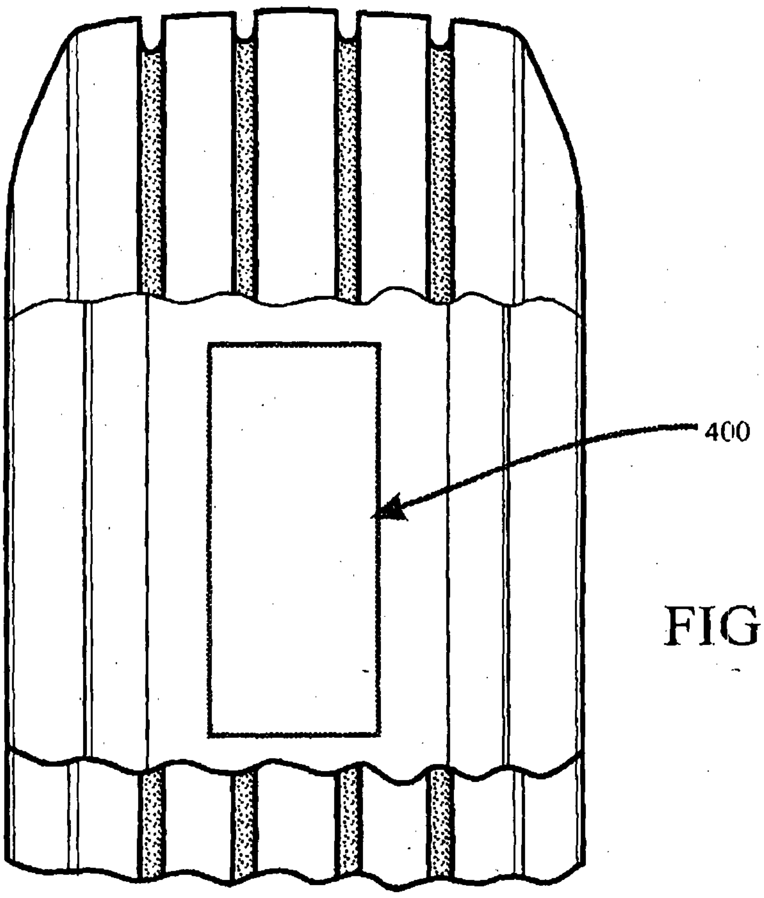
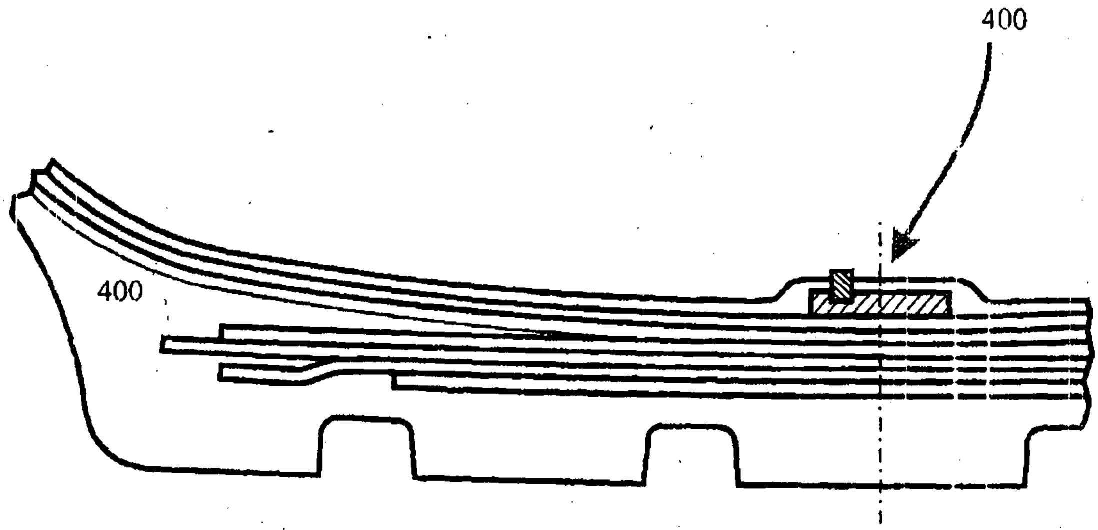


FIG. 32



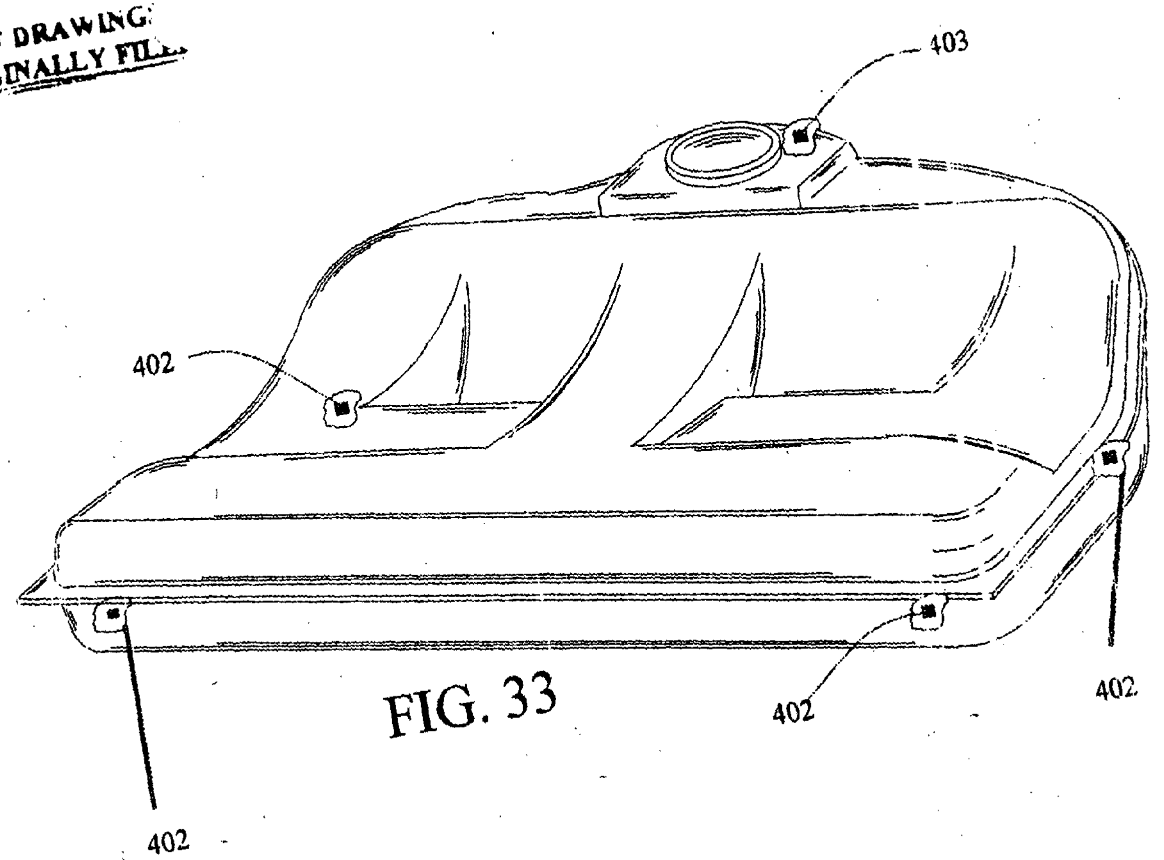


FIG. 33

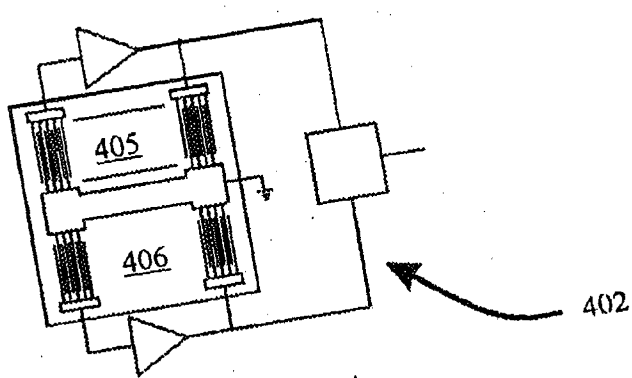


FIG. 33A

PRINT OF DRAWINGS
AS ORIGINALLY FILED

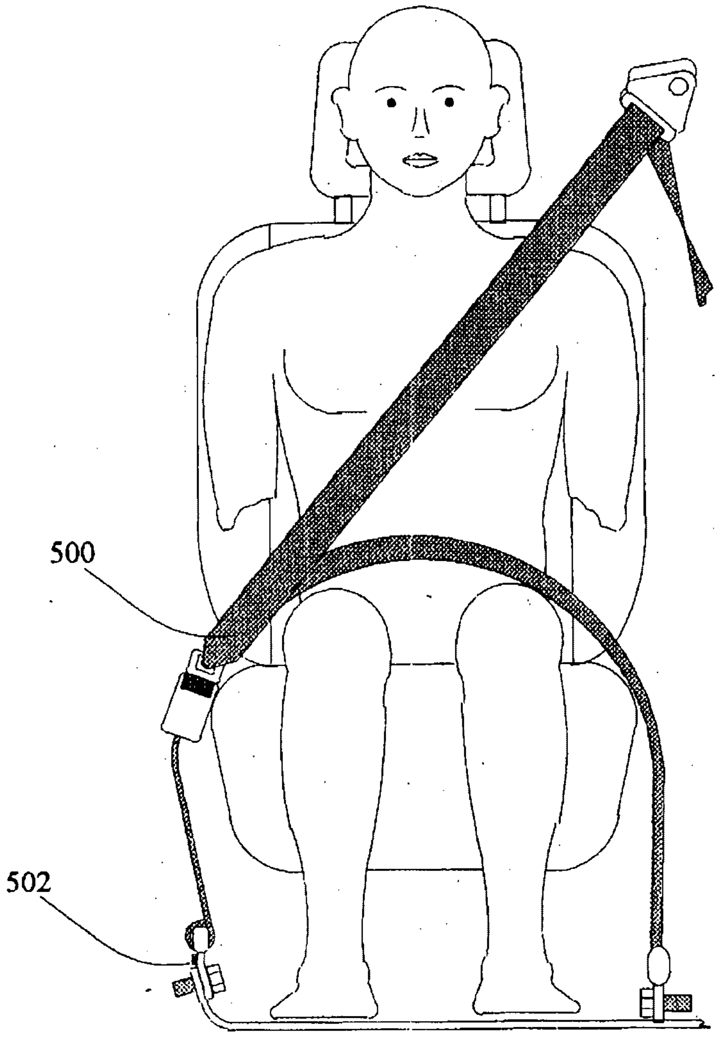


FIG. 34

PRINT OF DRAWINGS
AS ORIGINALLY FILED

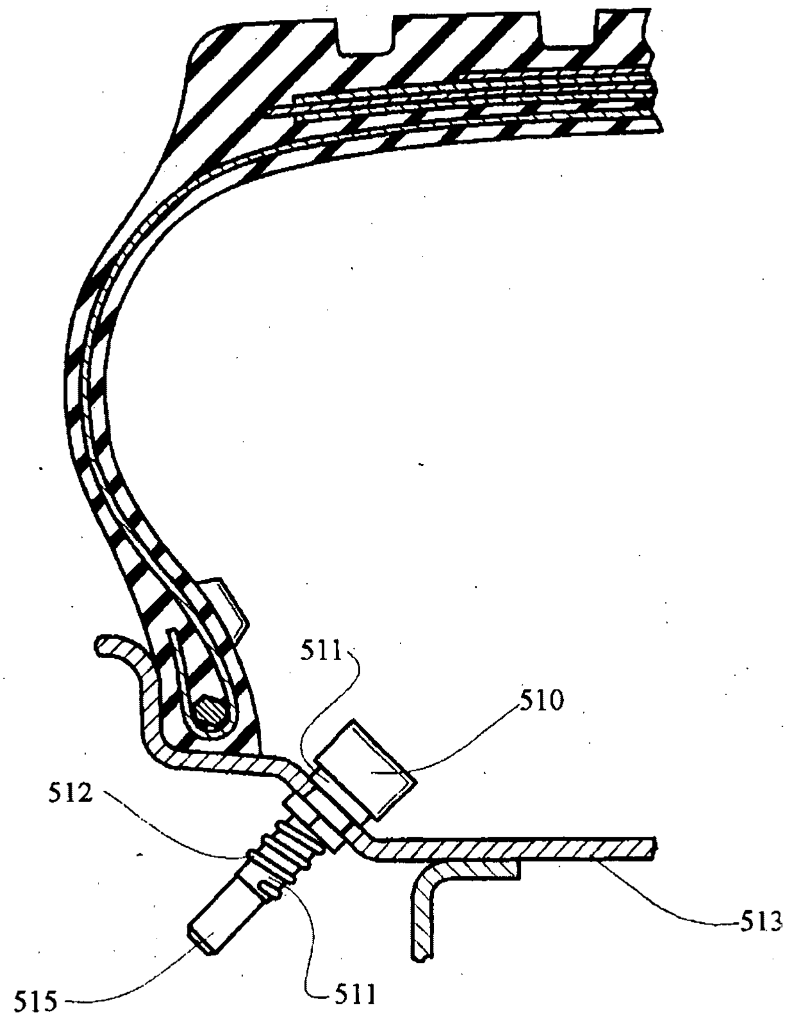


FIG. 35

Prior Art

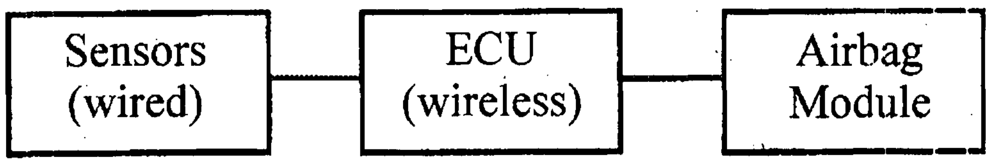


FIG. 36A

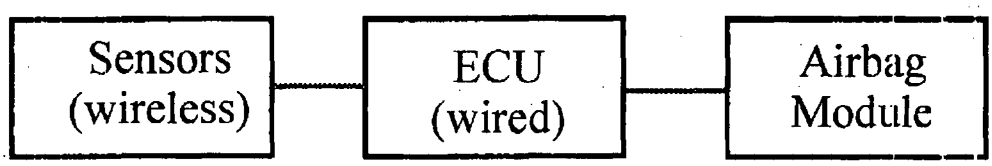


FIG. 36B

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6738697

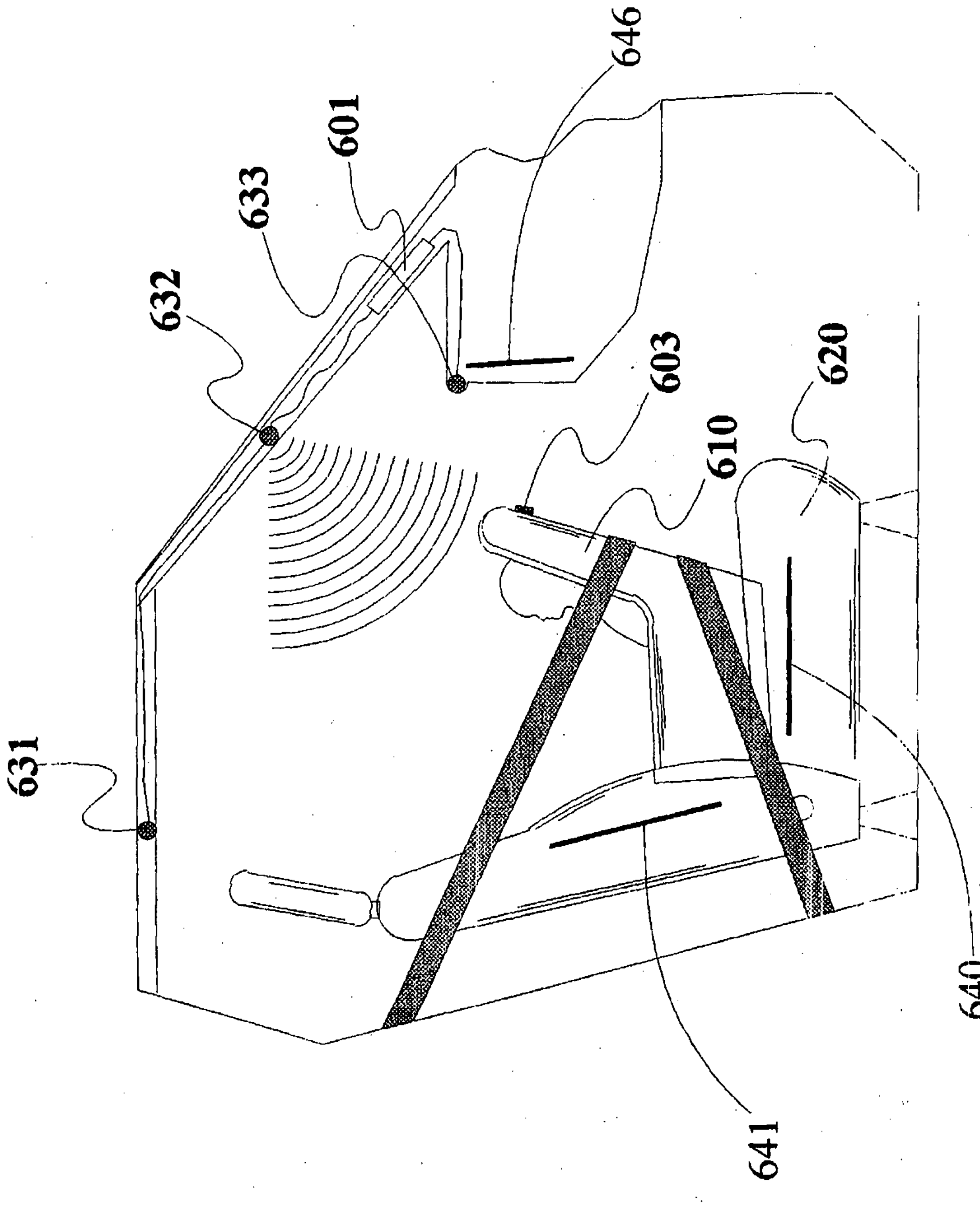


FIG. 1

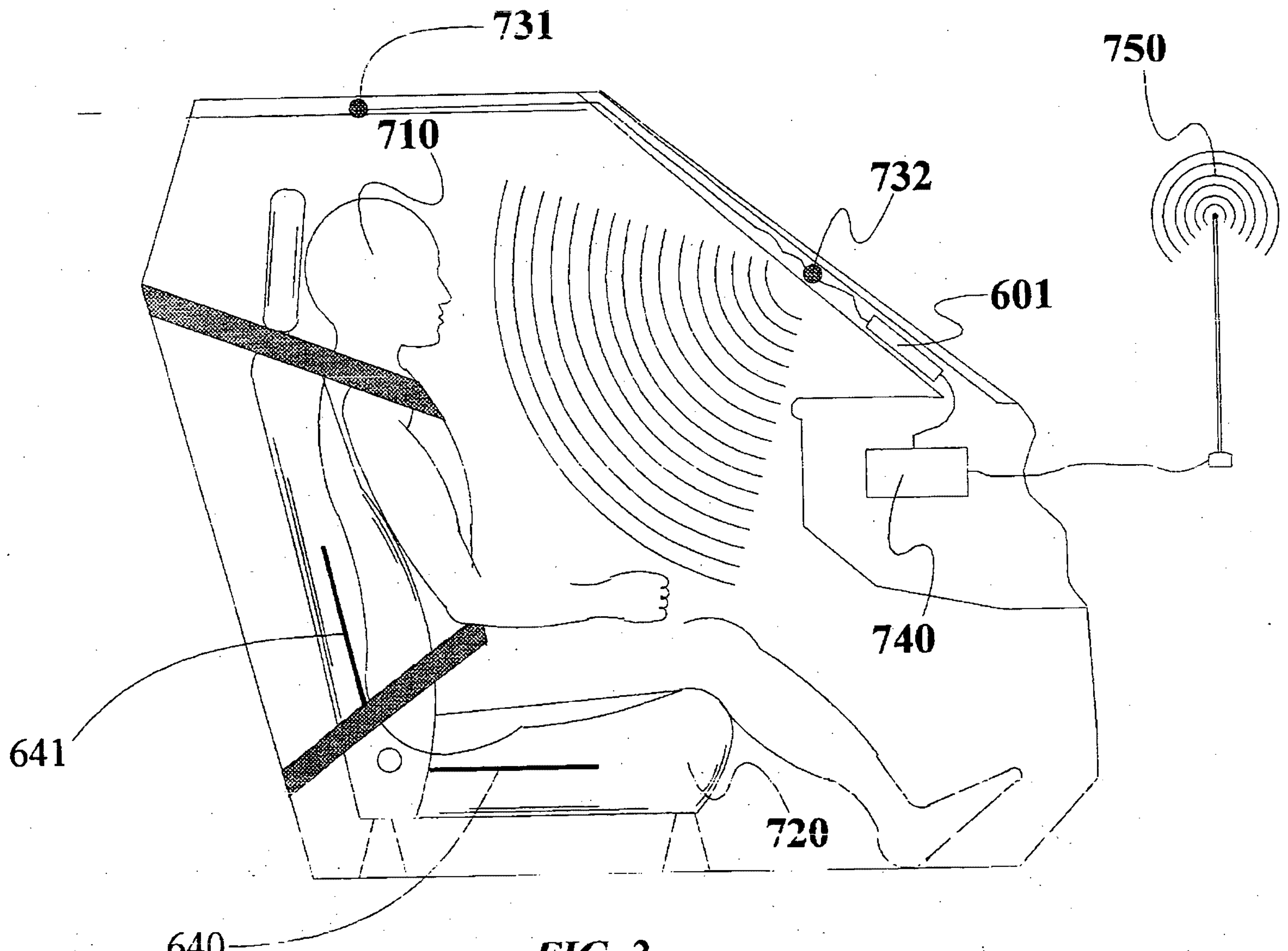
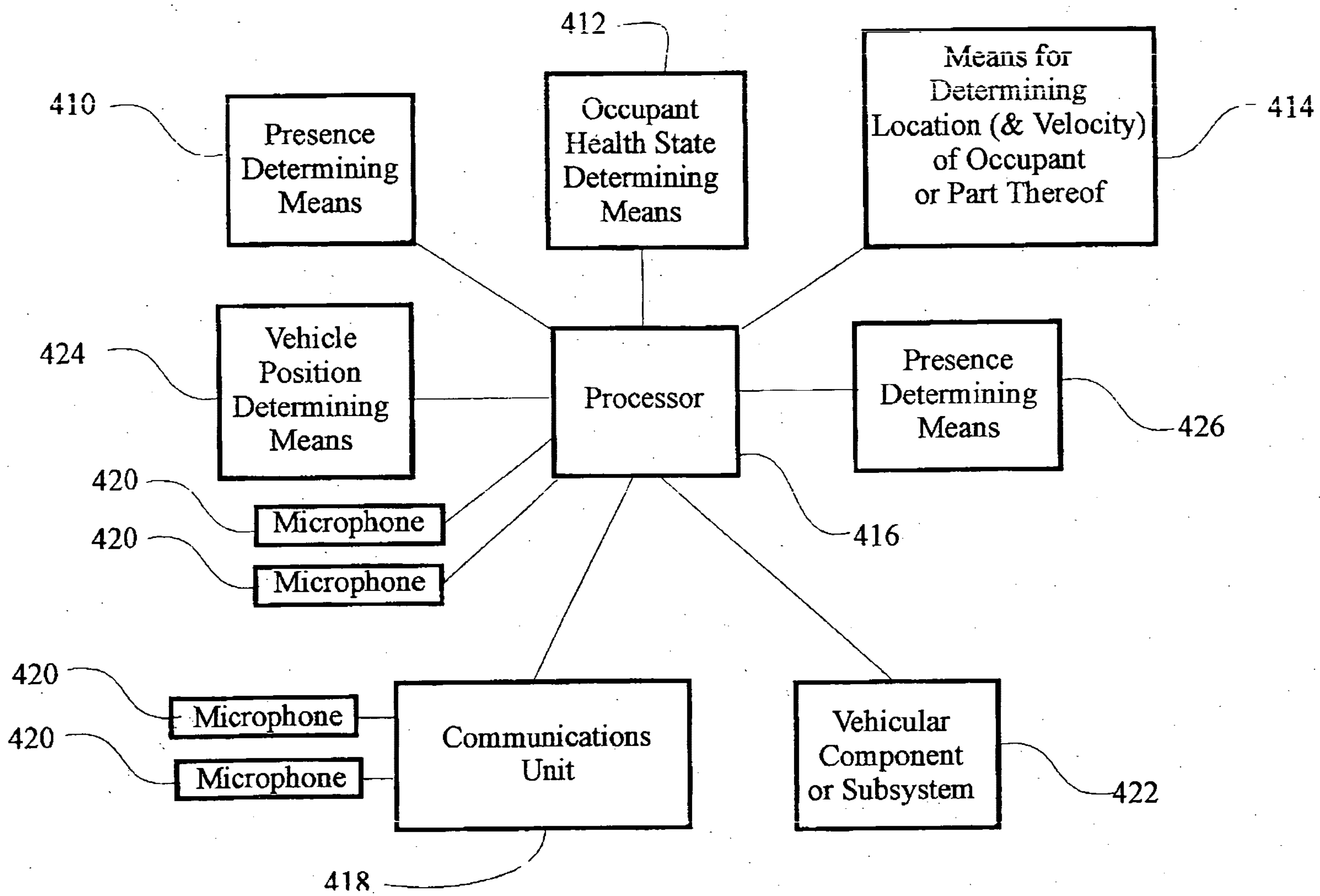


FIG. 2



412
410
Presence Determining Means
Occupant Health State Determining Means
Means for Determining Location (& Velocity) of Occupant or Part Thereof
414
424
Vehicle Position Determining Means
Processor
Presence Determining Means
426
420
Microphone
420
Microphone
416
420
Microphone
420
Microphone
Communications Unit
Vehicular Component or Subsystem
422
418

FIG. 3

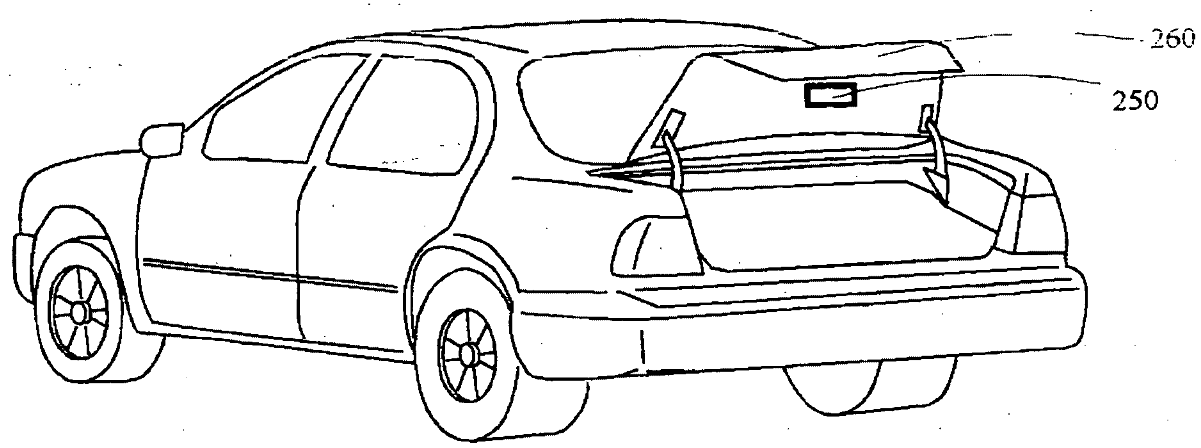


FIG. 4

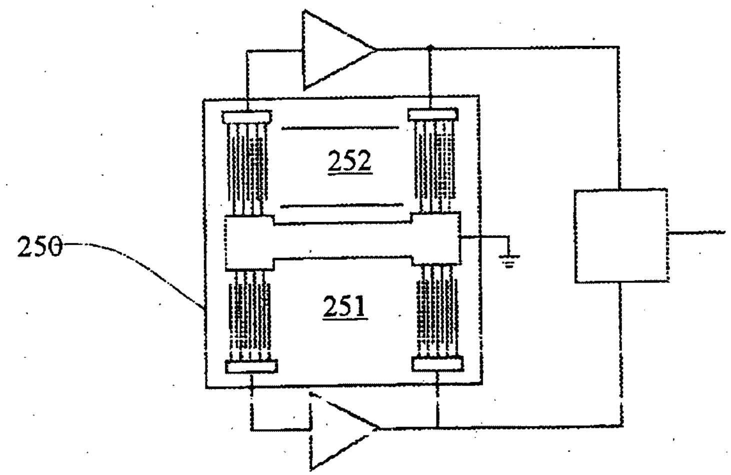


FIG. 4A

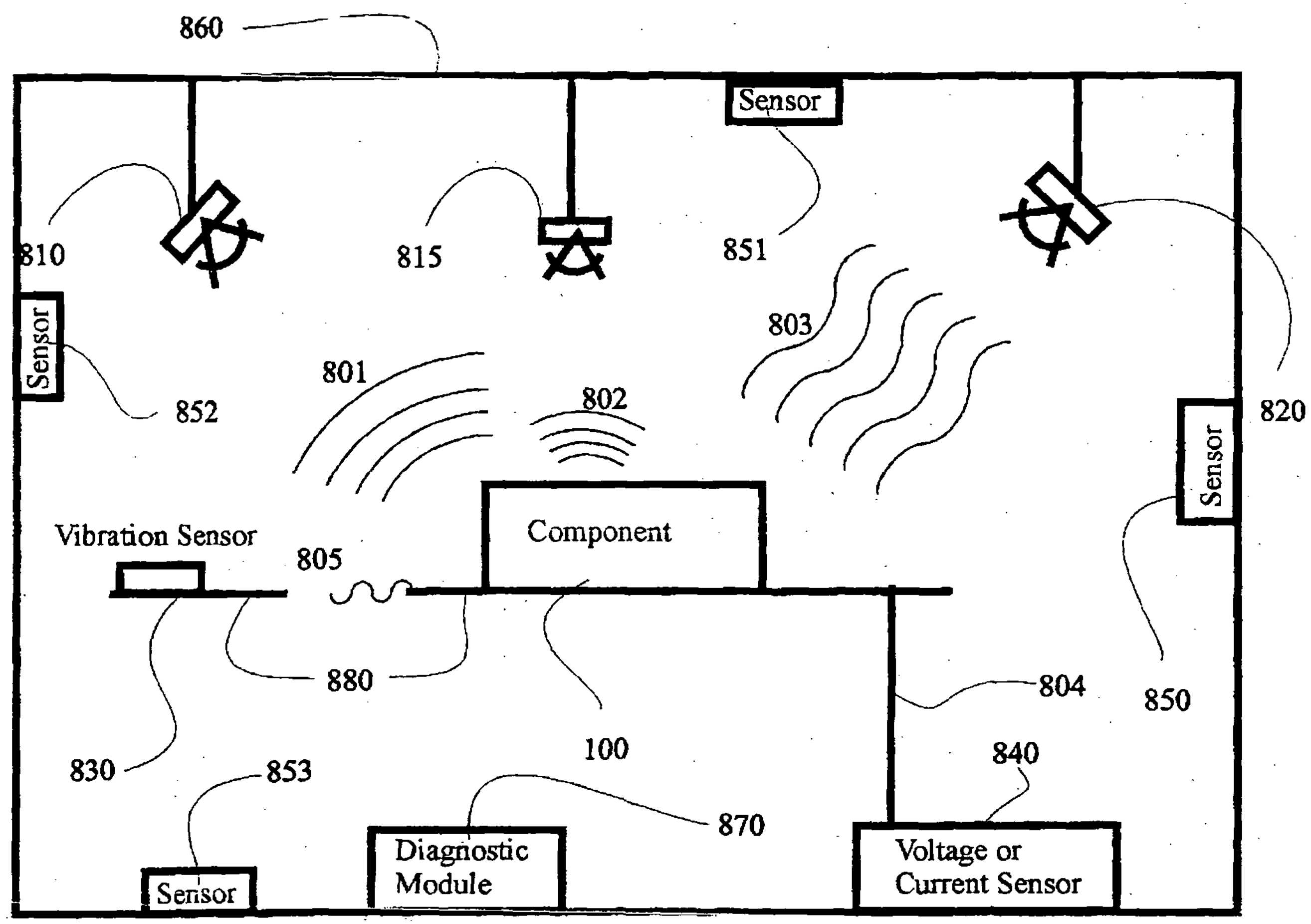


FIG. 5

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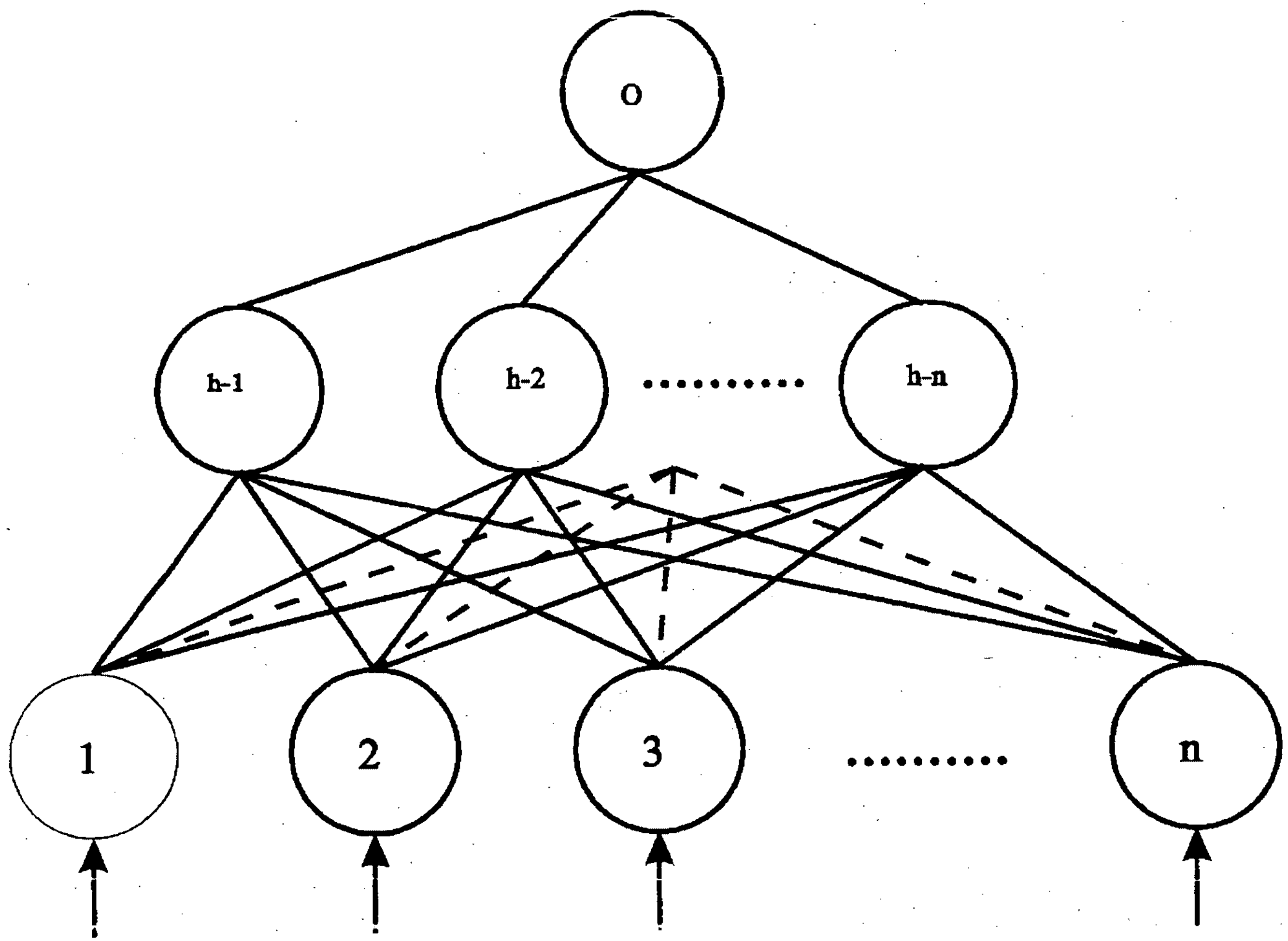

FIG. 6

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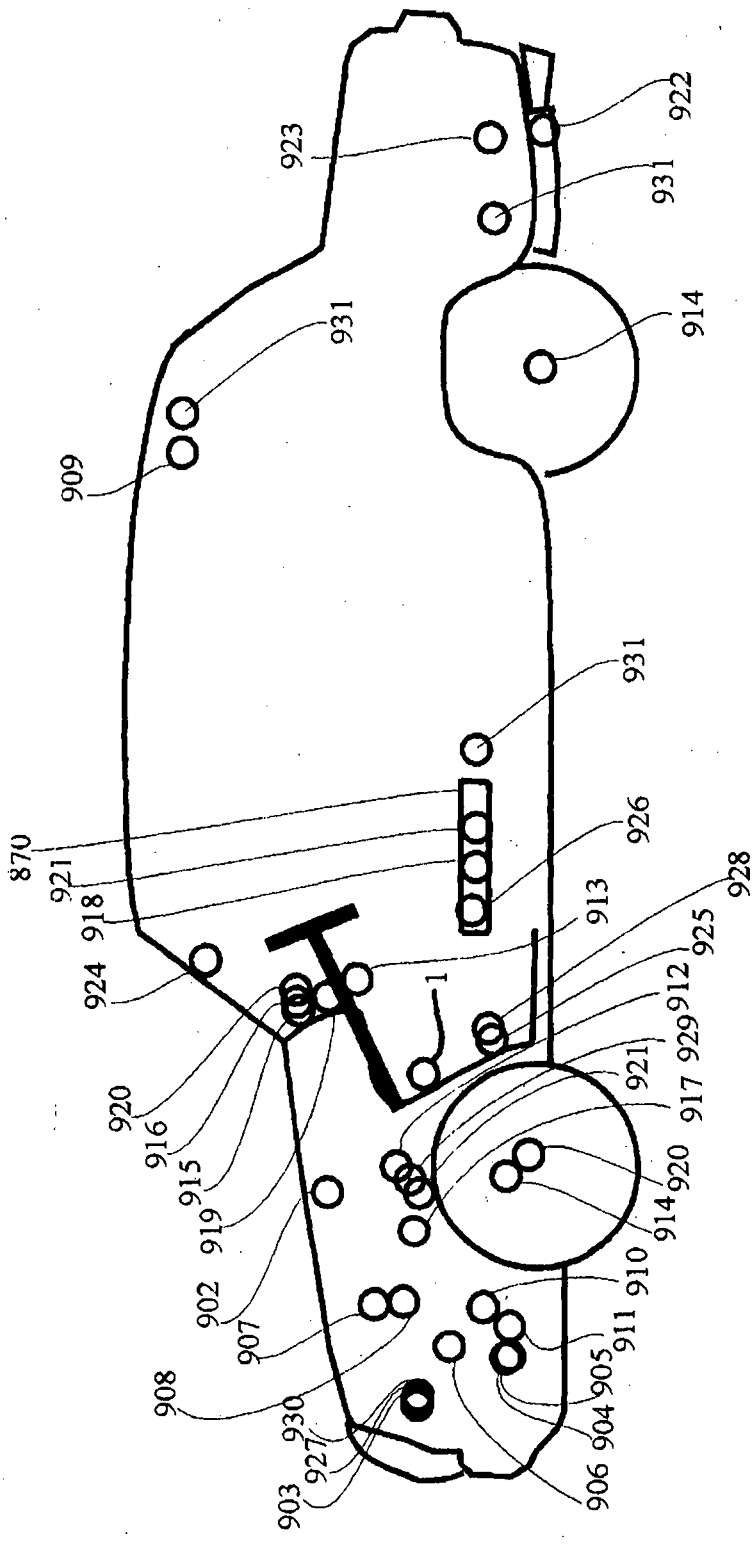

FIG. 7

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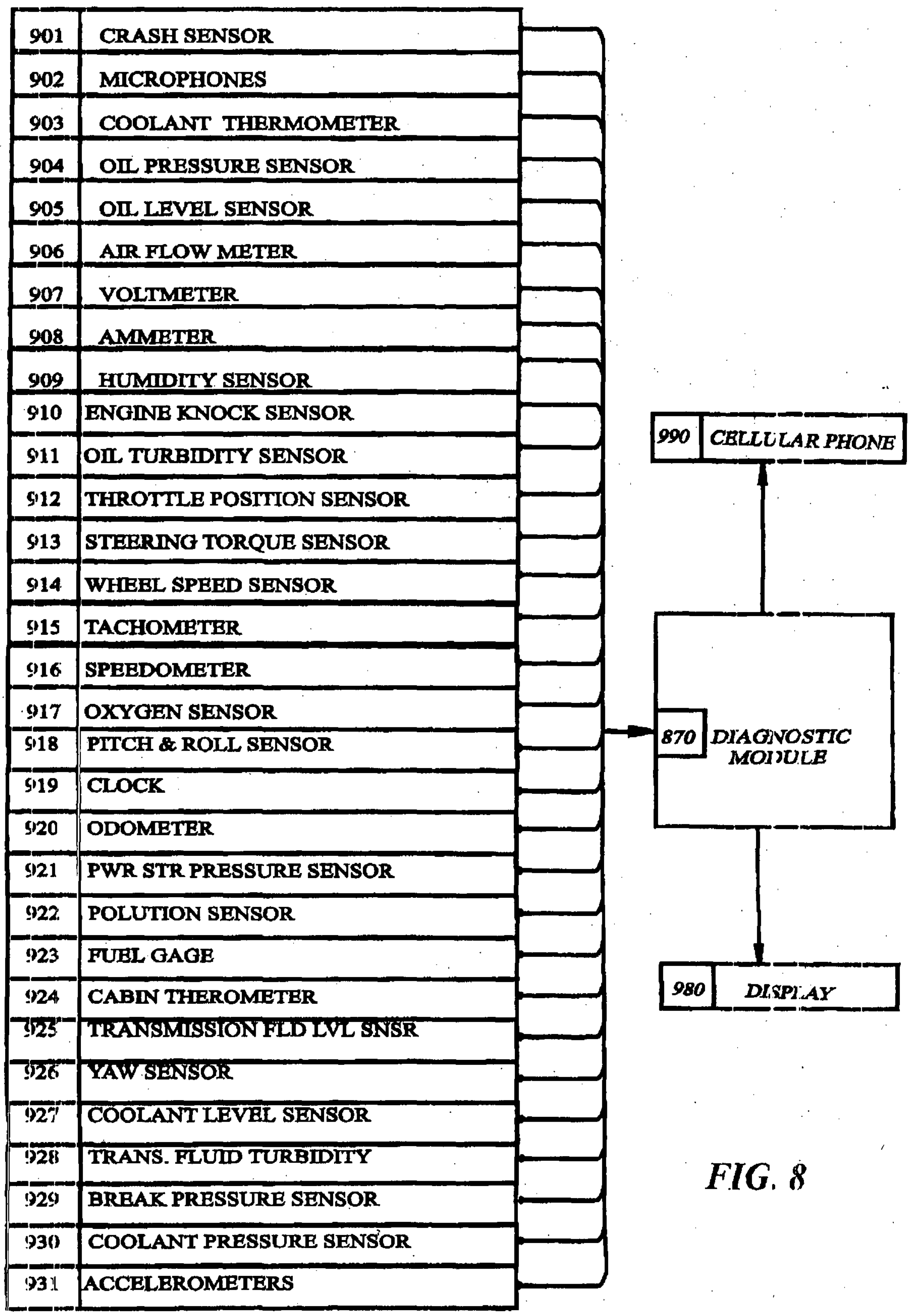

FIG. 8

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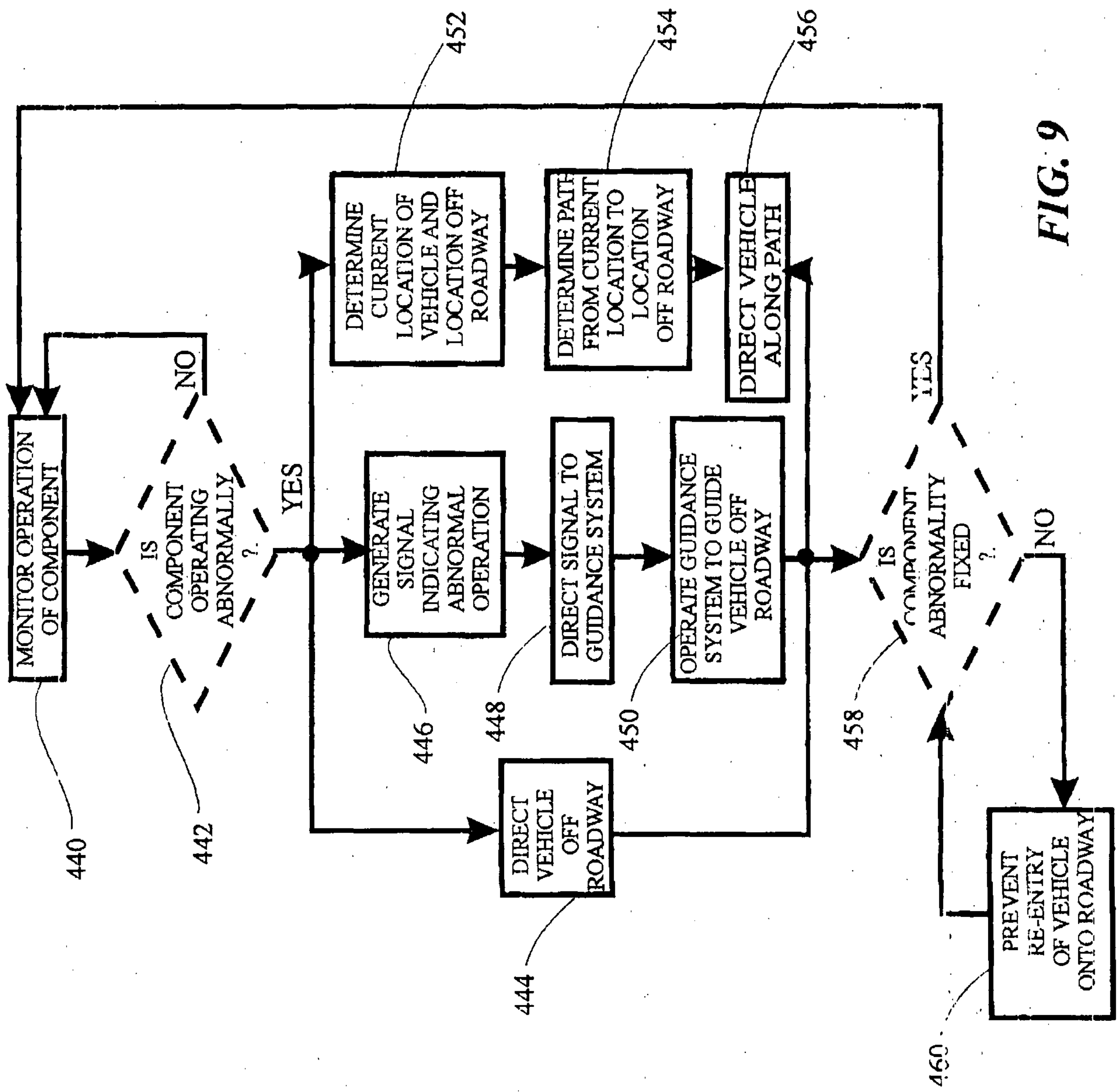

FIG. 9

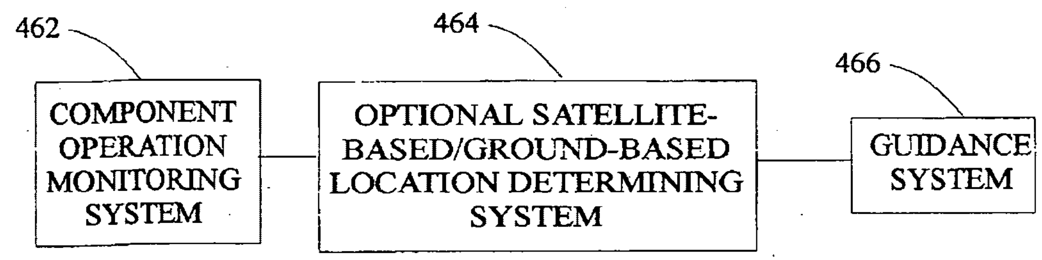
462
464
466
COMPONENT OPERATION MONITORING SYSTEM
OPTIONAL SATELLITE-BASED/GROUND-BASED LOCATION DETERMINING SYSTEM
GUIDANCE SYSTEM

FIG. 10

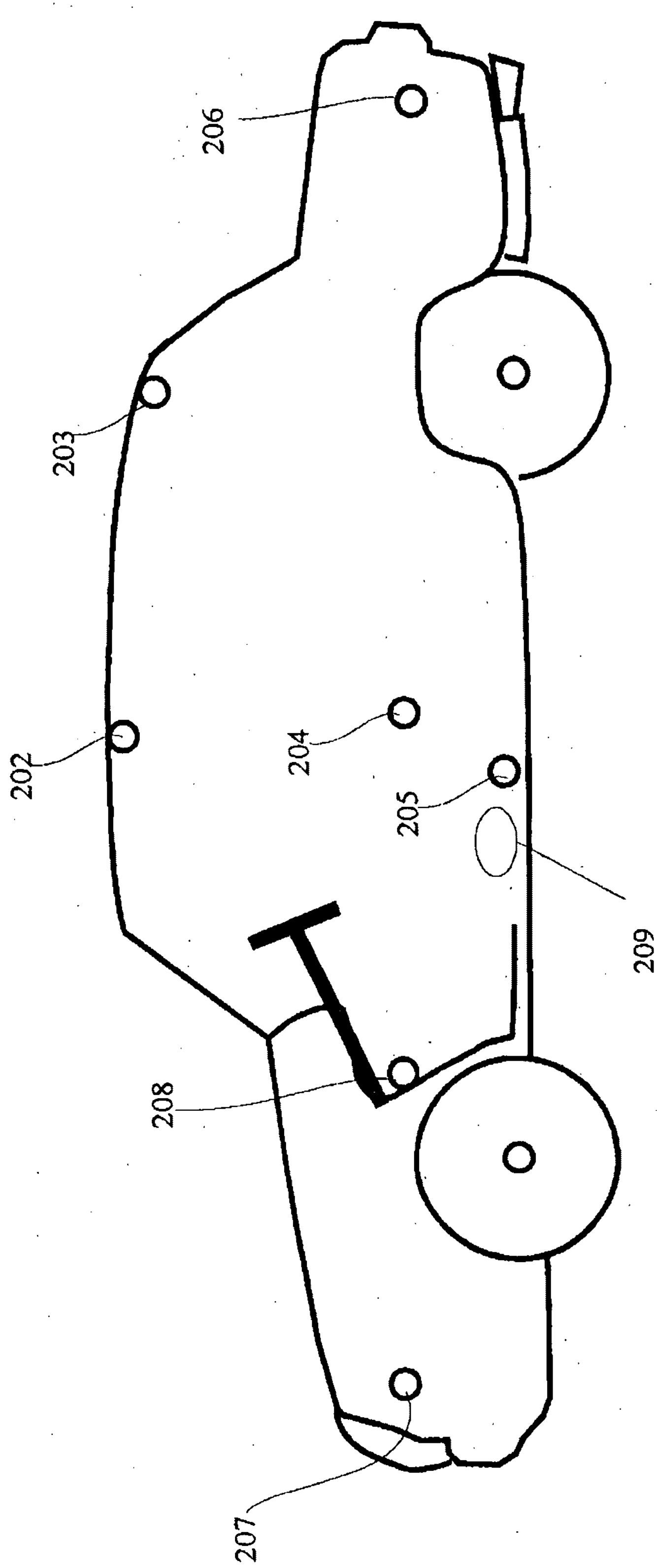

FIG. 11

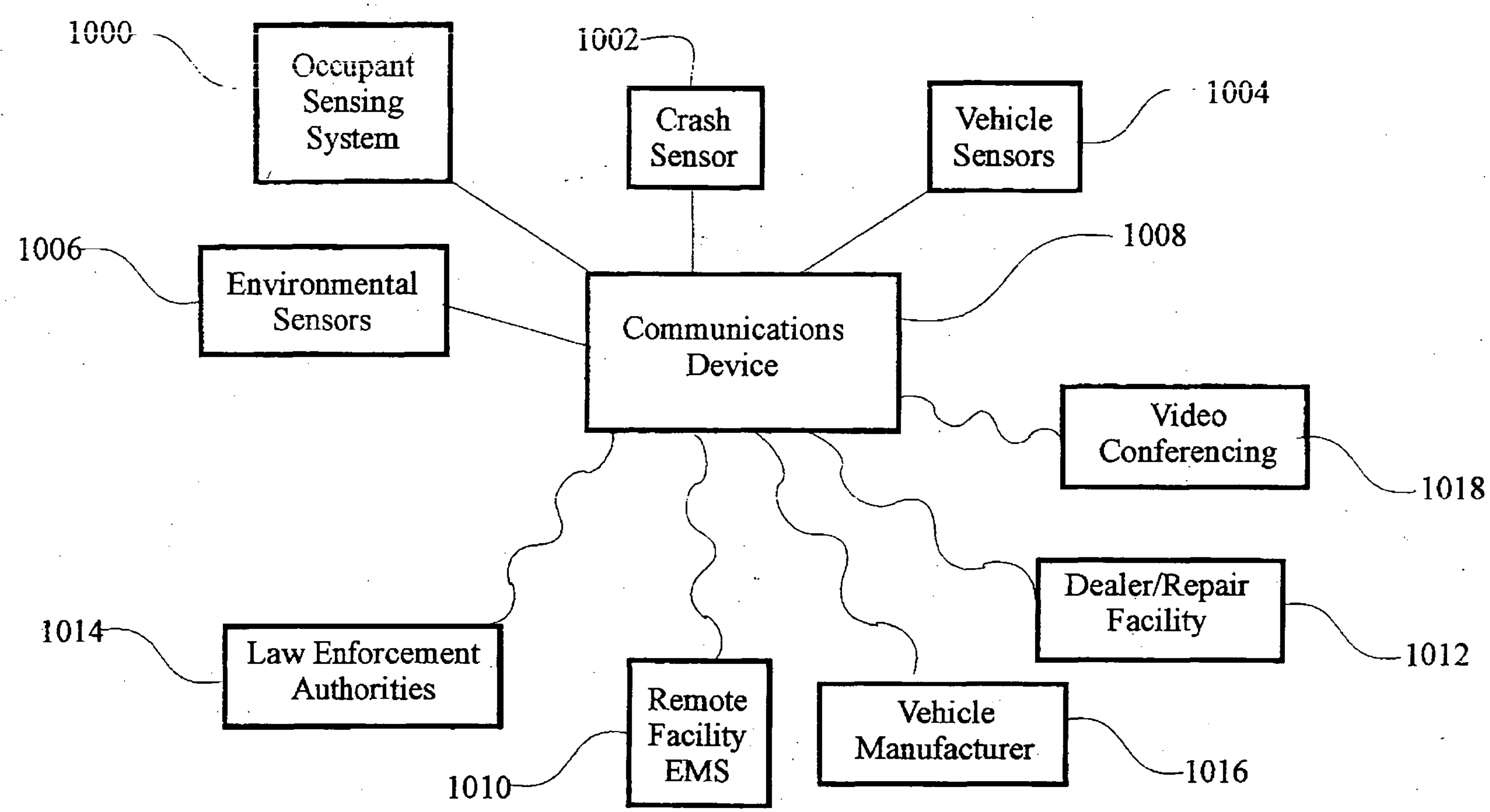

FIG. 12

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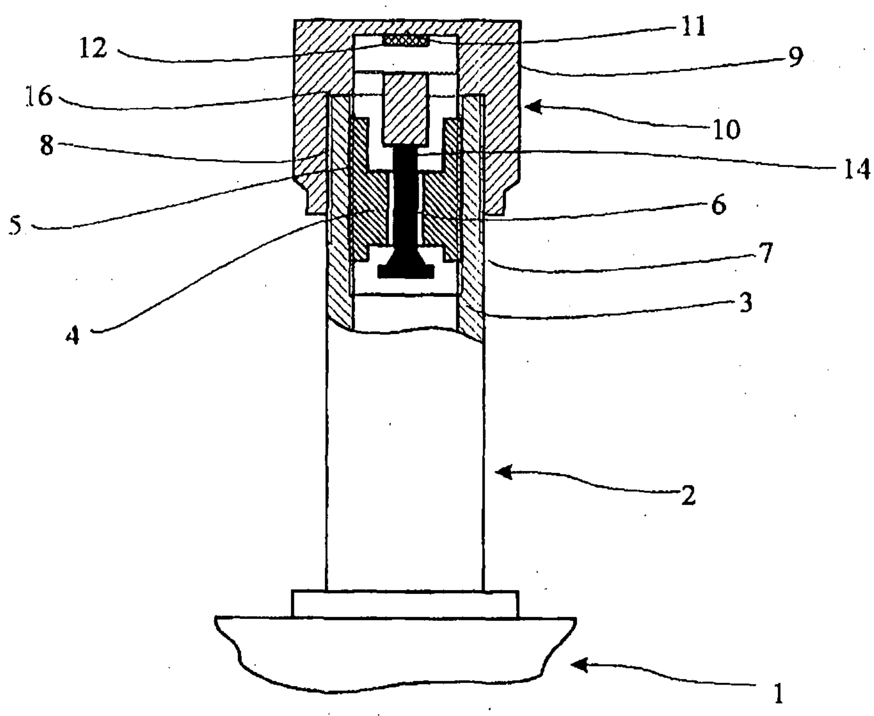

FIG. 13A

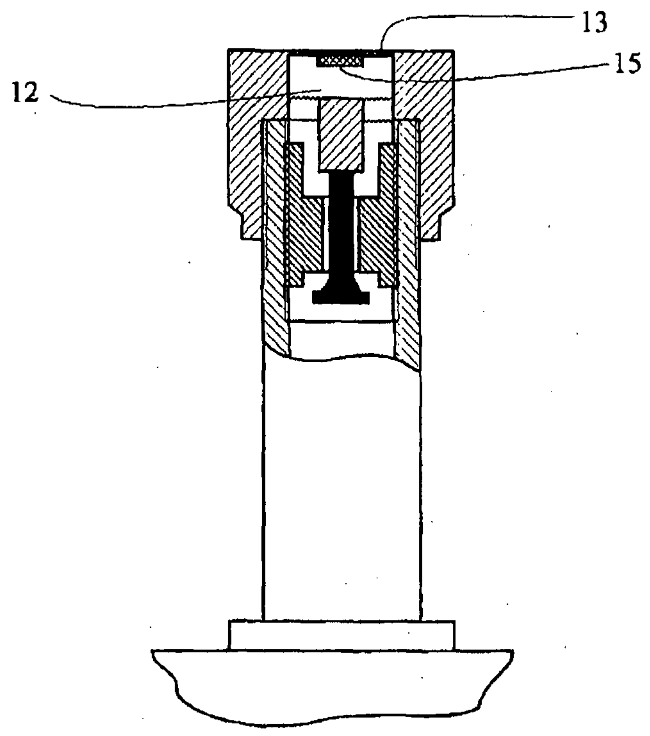

FIG. 13B

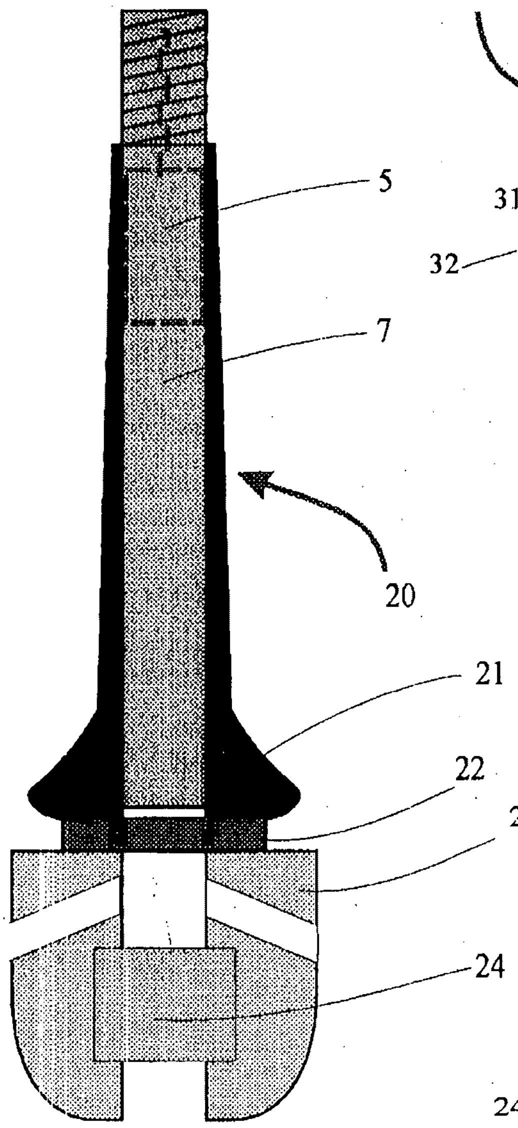

FIG. 14

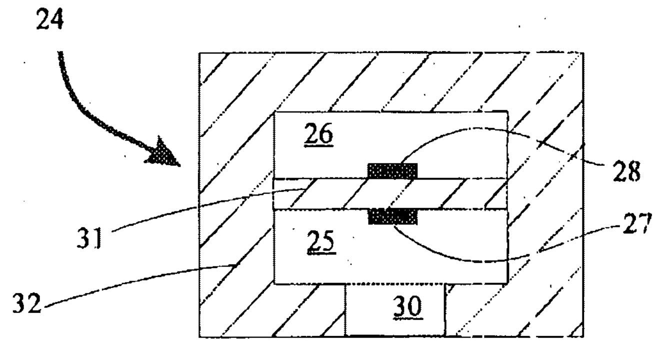

FIG. 14A

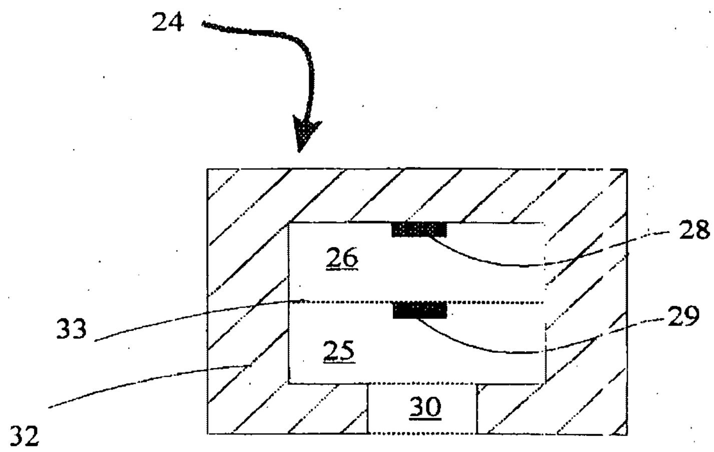

FIG. 14B

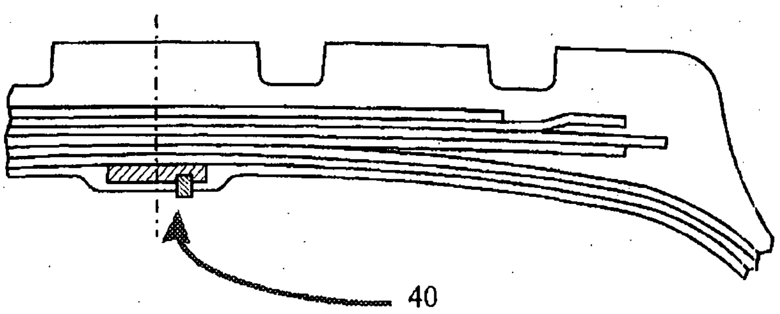

FIG. 15A

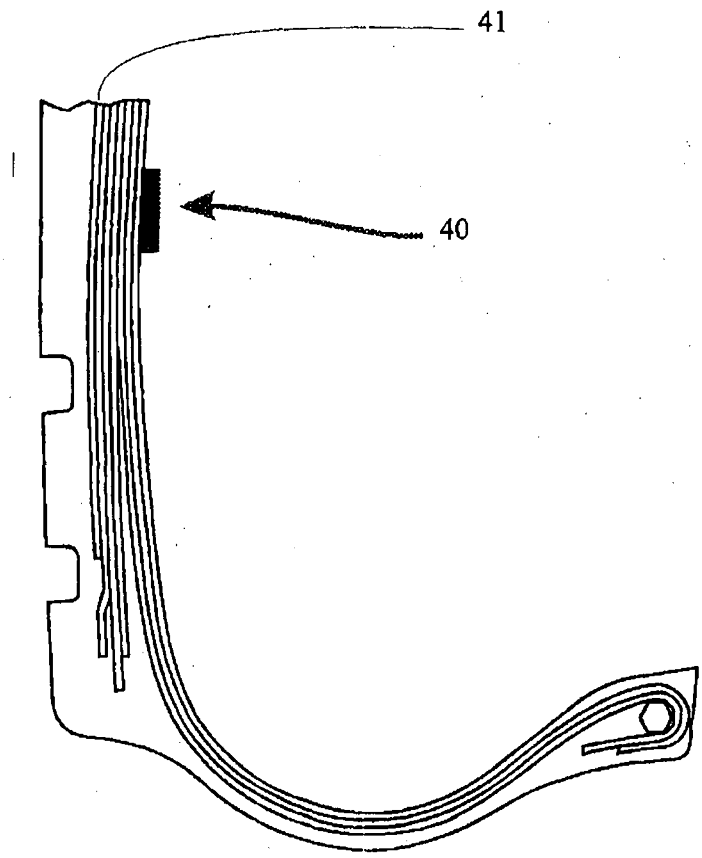

FIG. 15

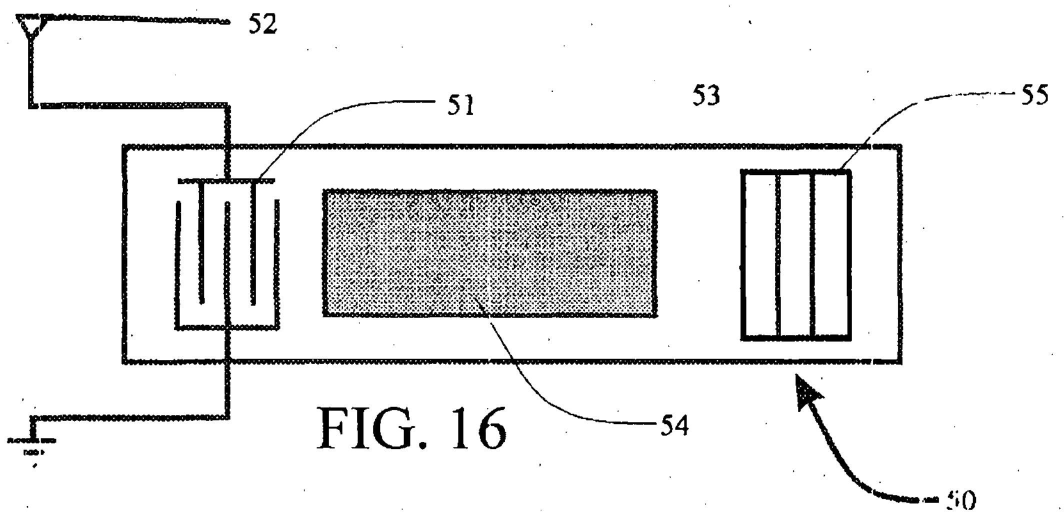

FIG. 16

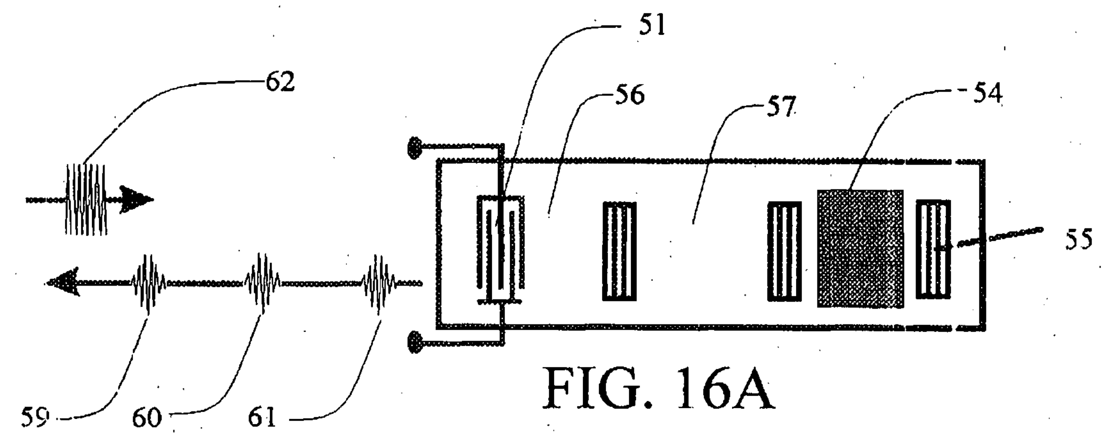

FIG. 16A

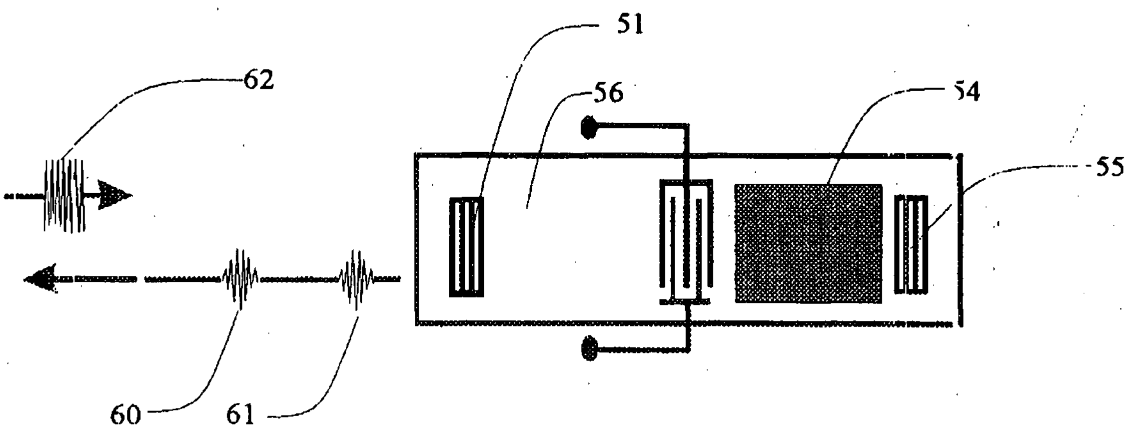

FIG. 16B

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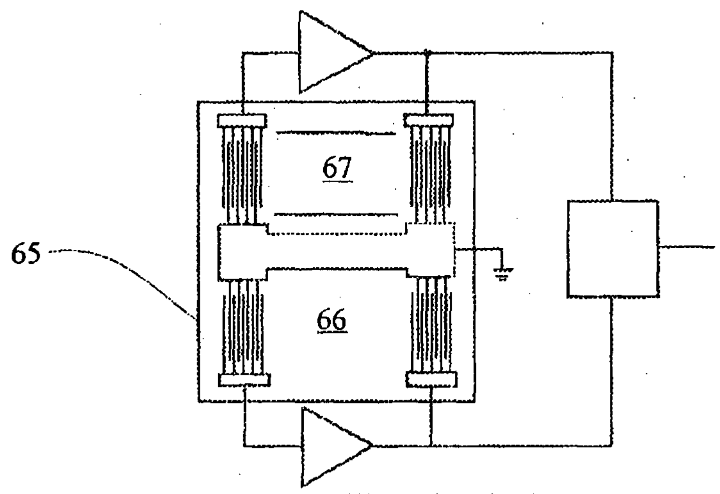

FIG. 17B

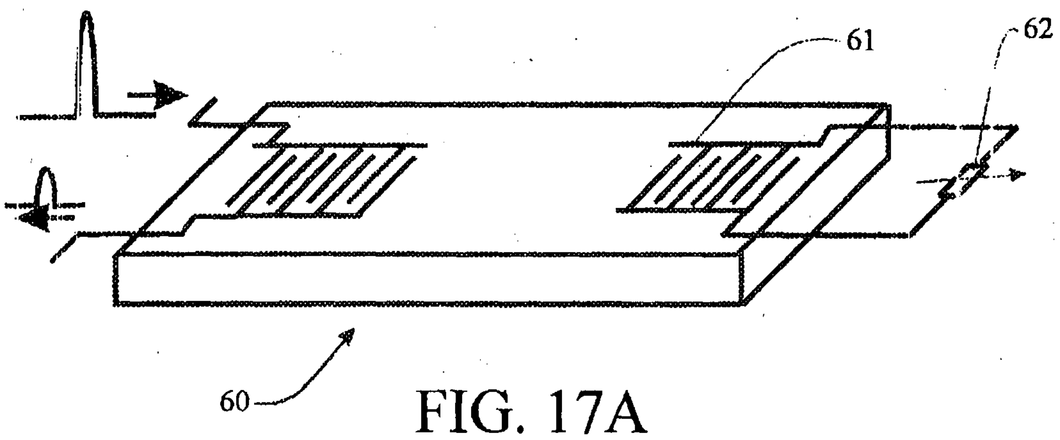

FIG. 17A

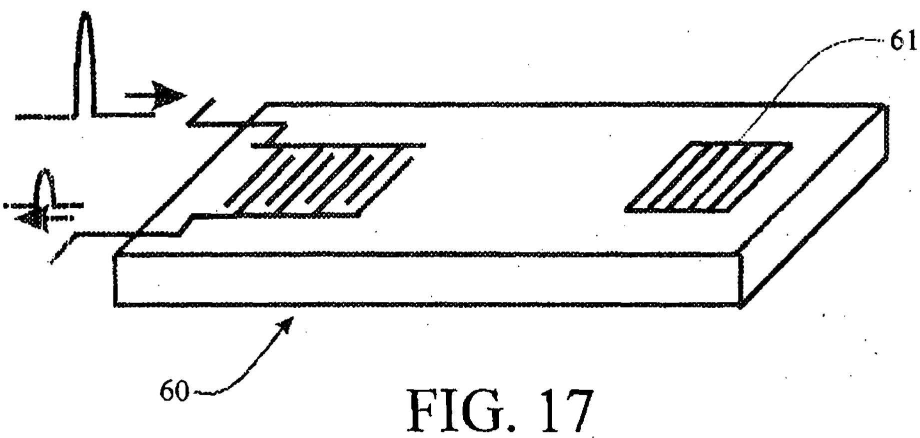

FIG. 17

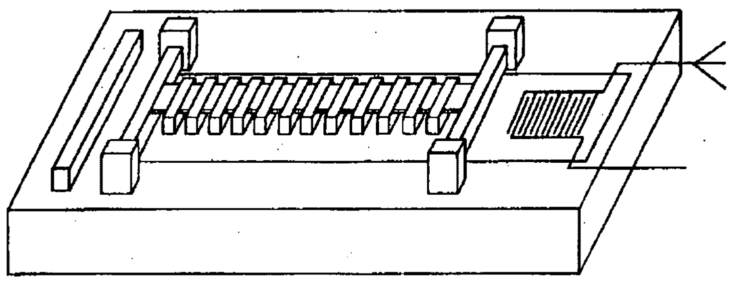

FIG. 18A

PRIOR ART

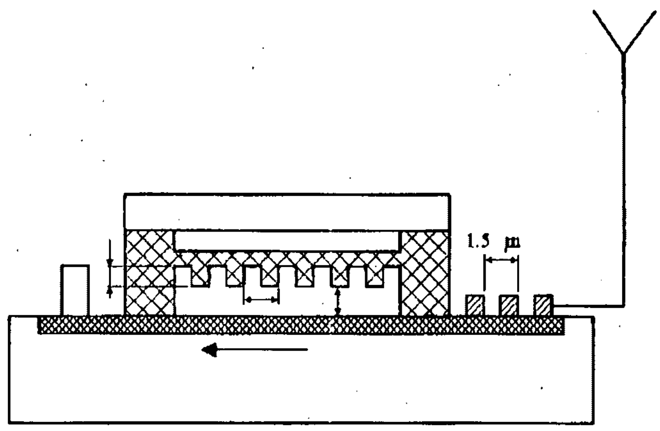

FIG. 18

PRIOR ART

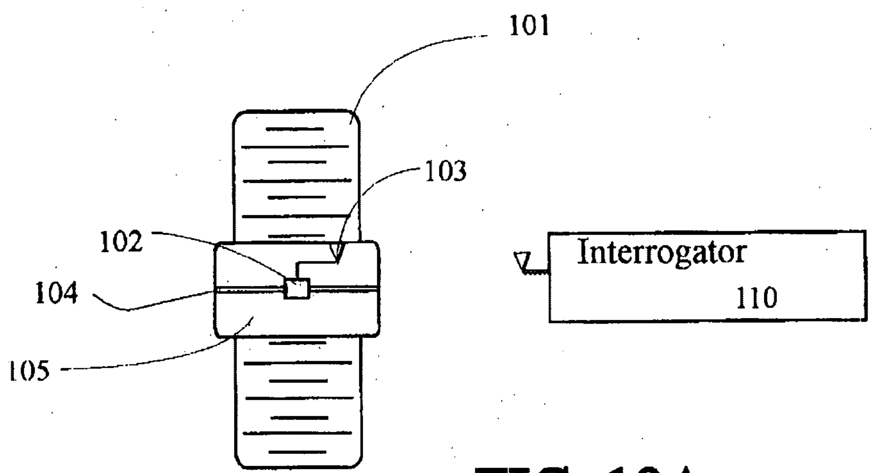

FIG. 19A

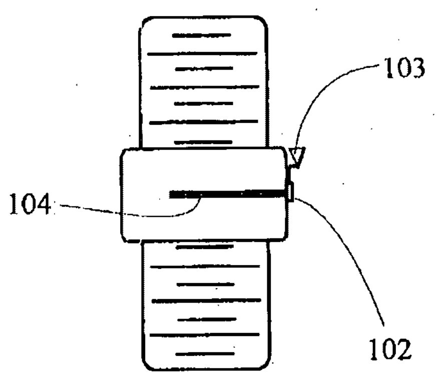

FIG. 19B

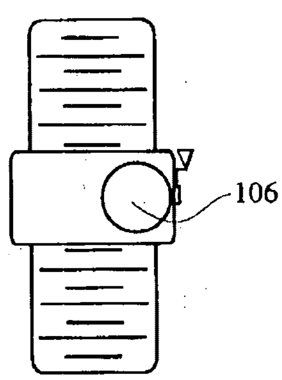

FIG. 19C

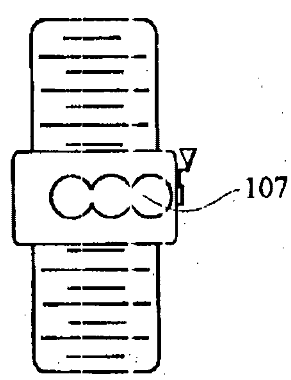

FIG. 19D

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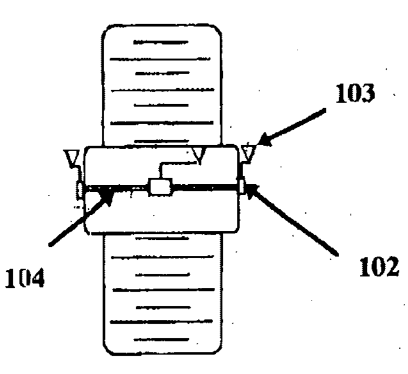

FIG. 19E

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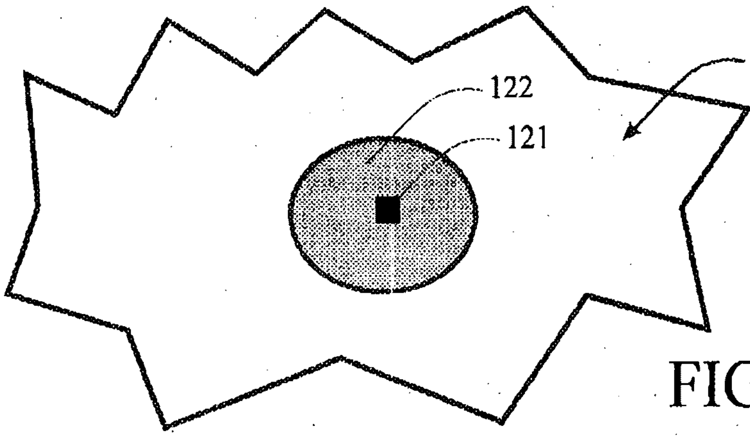

FIG. 20A

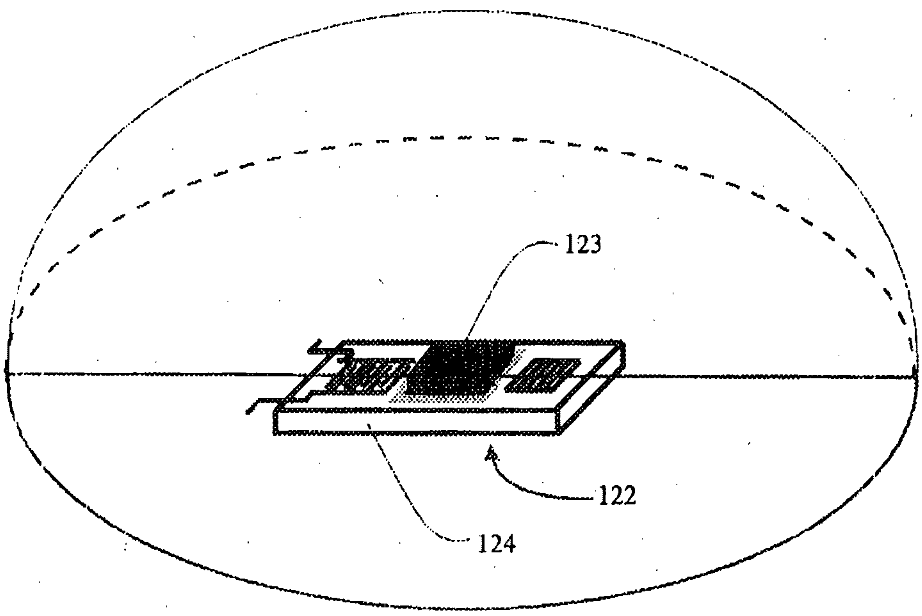

FIG. 20B

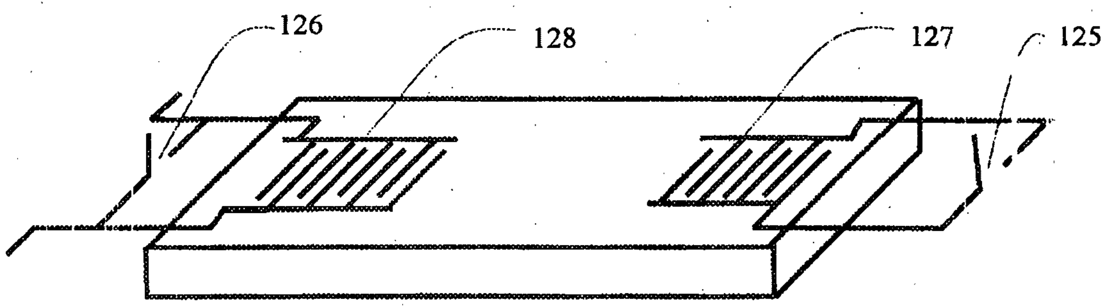

FIG. 20C

10188673.070302

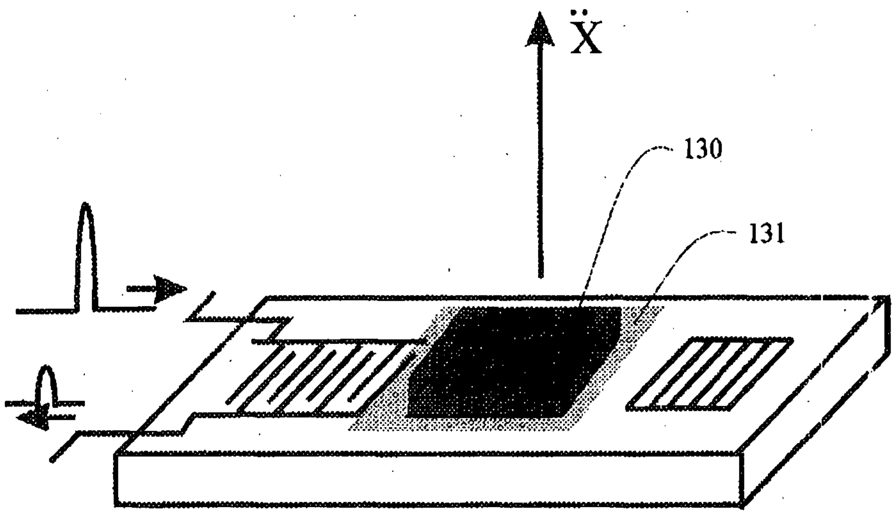

FIG. 21A

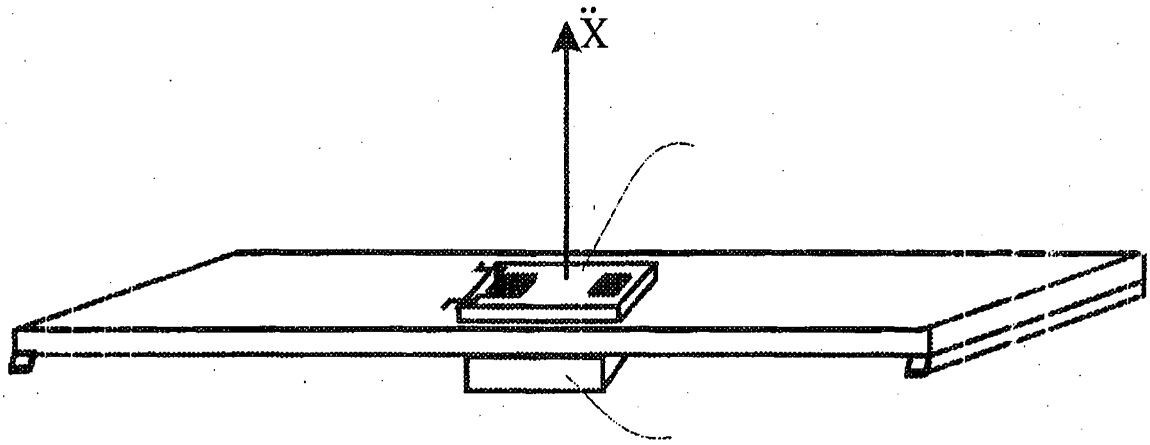

FIG. 21B

10188673.070302

Prior Art

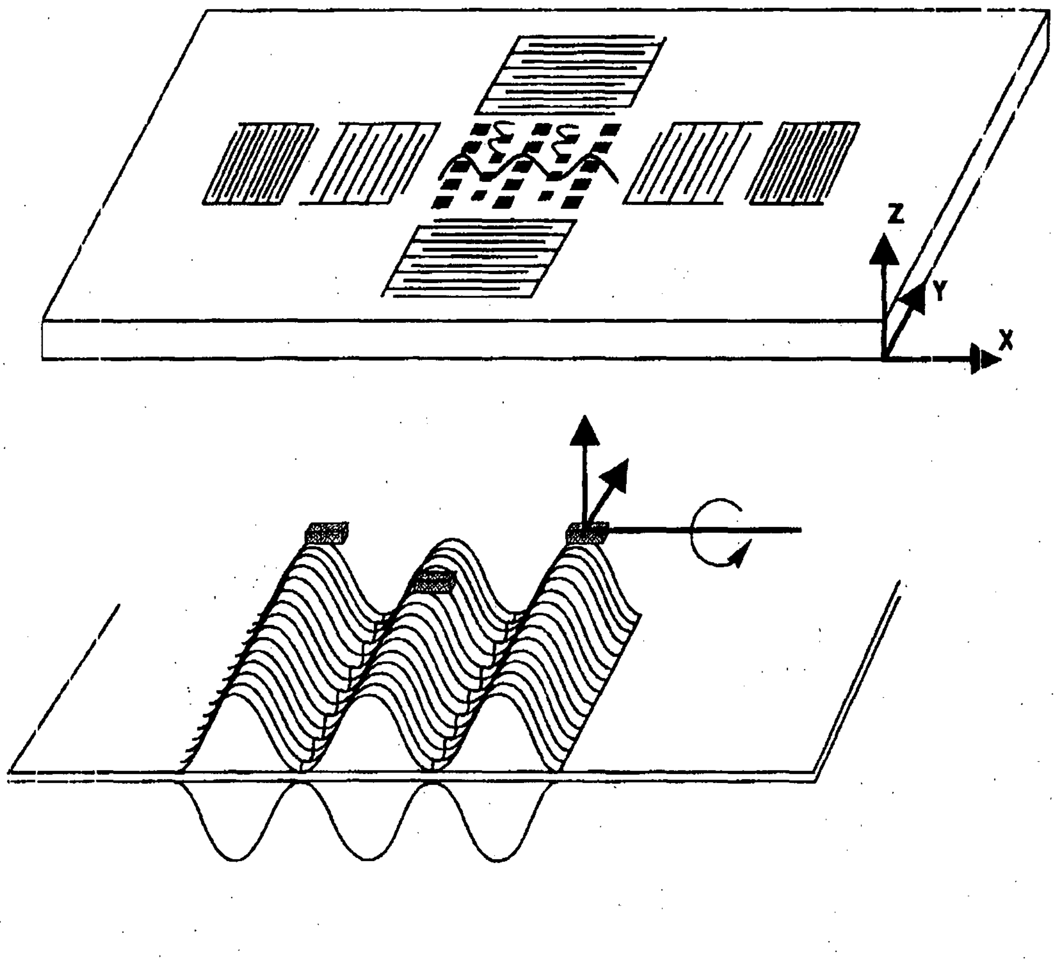

FIG. 22

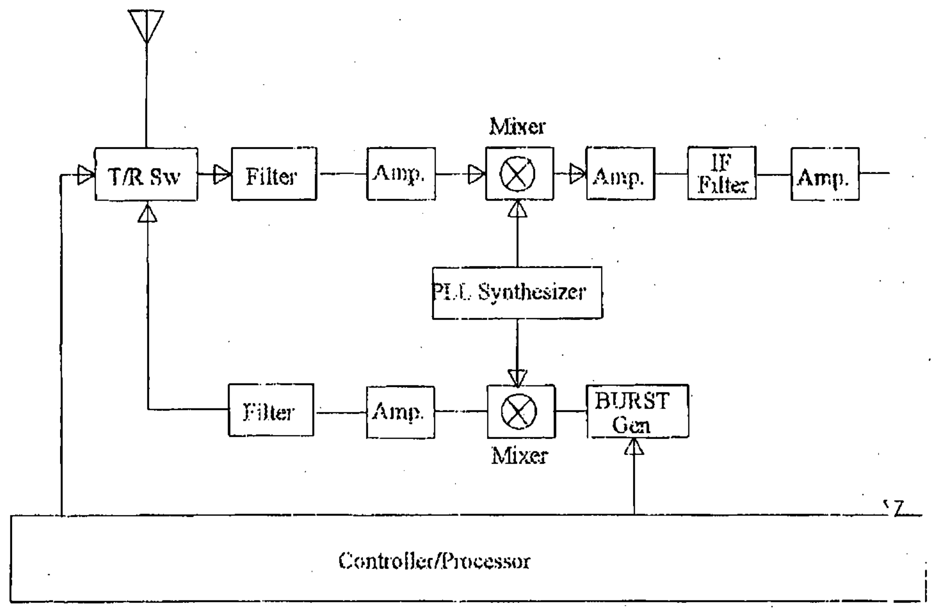

FIG. 23A

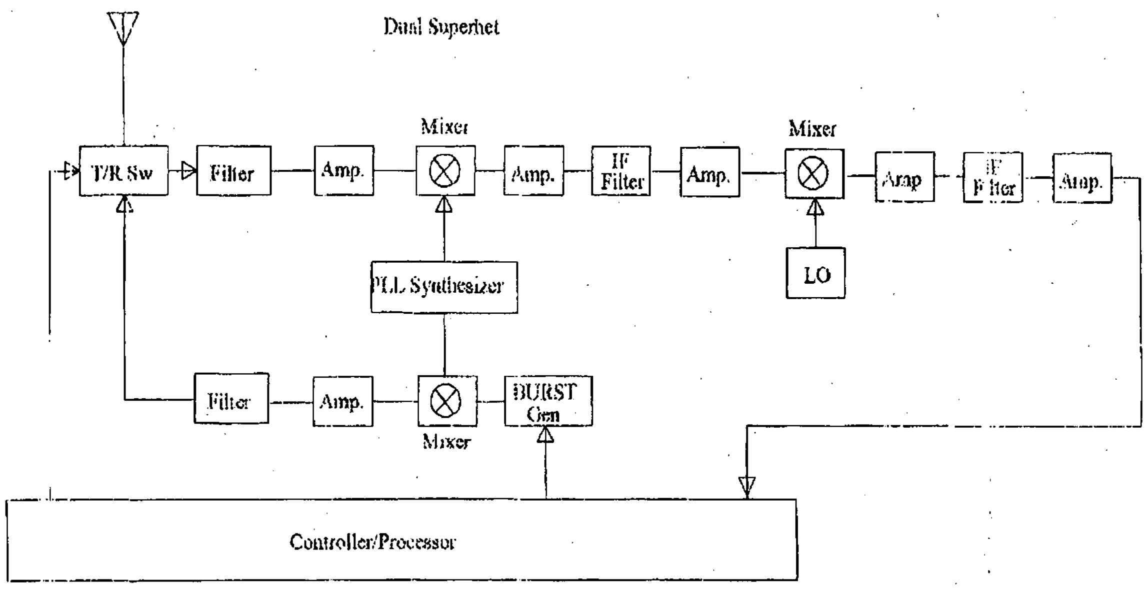

FIG. 23B

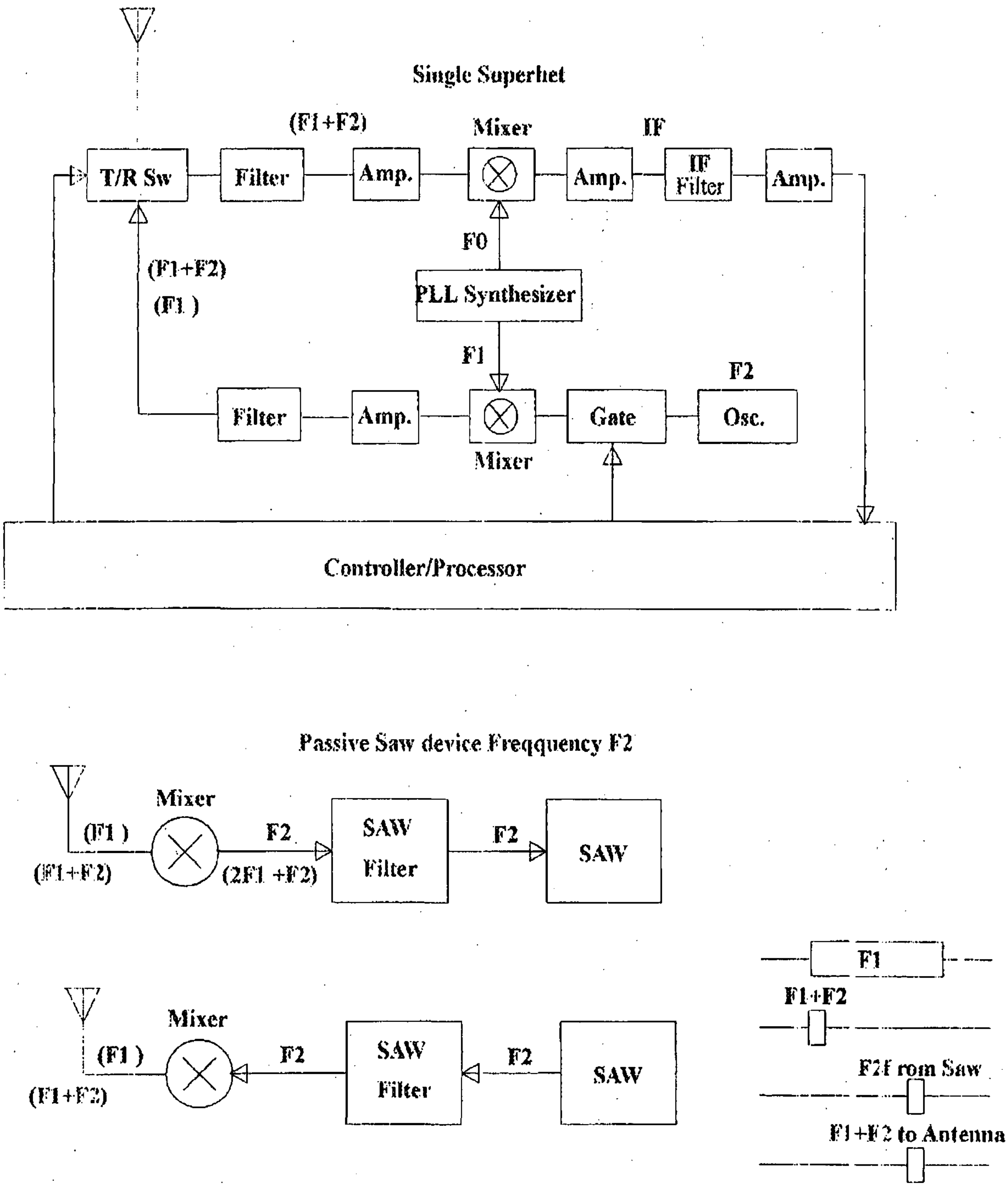
Single Superhet
(F1+F2)
Mixer
IF
T/R Sw
Filter
Amp.
Amp.
IF Filter
Amp.
F0
(F1+F2)
(F1)
PLL Synthesizer
F1
F2
Filter
Amp.
Gate
Osc.
Mixer
Controller/Processor
Passive Saw device Freqquency F2
Mixer
(F1)
F2
(F1+F2)
(2F1 +F2)
SAW Filter
F2
SAW
Mixer
(F1)
F2
(F1+F2)
SAW Filter
F2
SAW
F1
F1+F2
F2f rom Saw
F1+F2 to Antenna

FIG. 23C

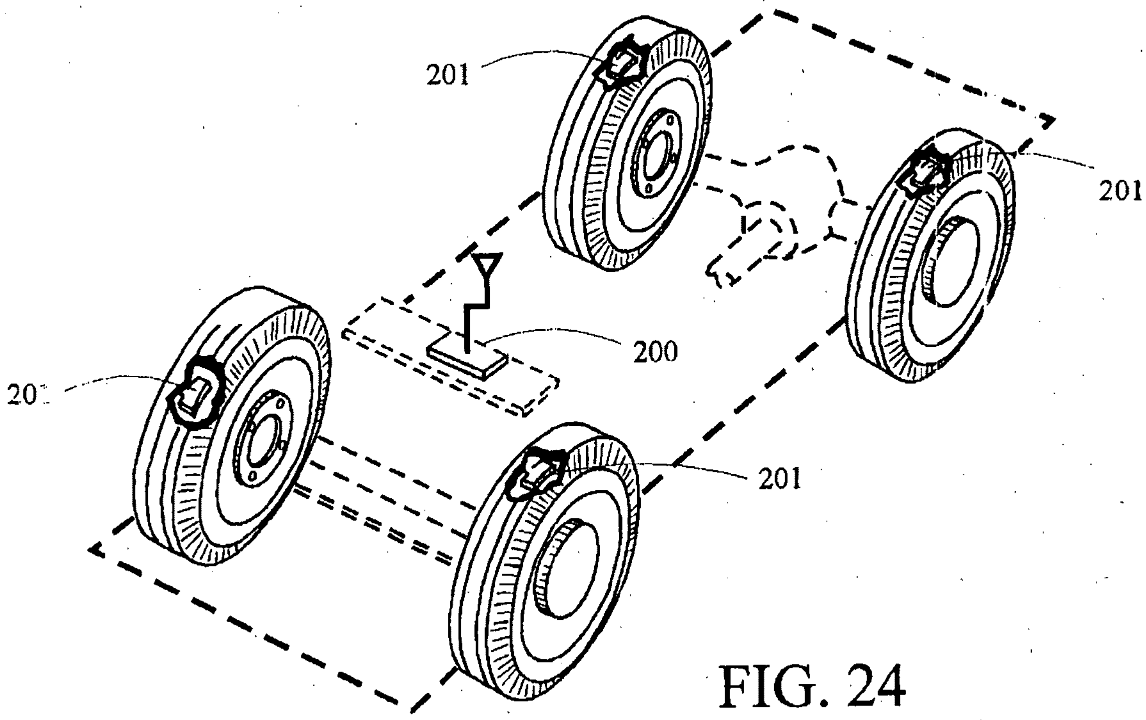

FIG. 24

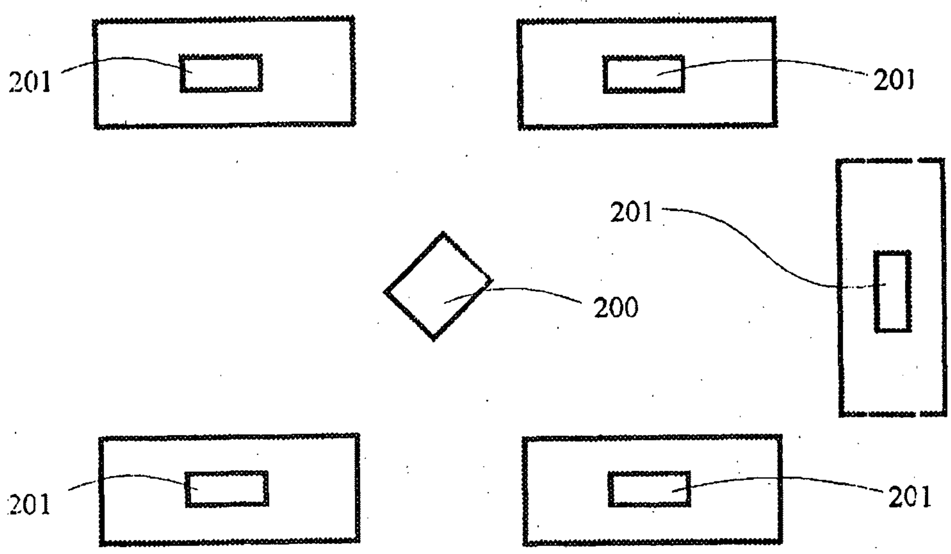

FIG. 24A

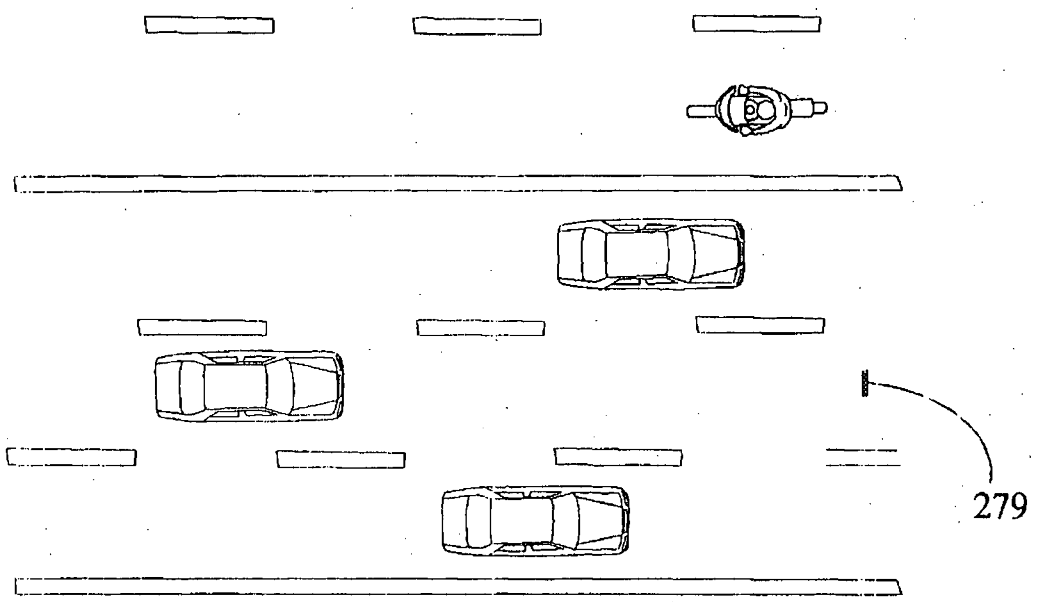

FIG. 25

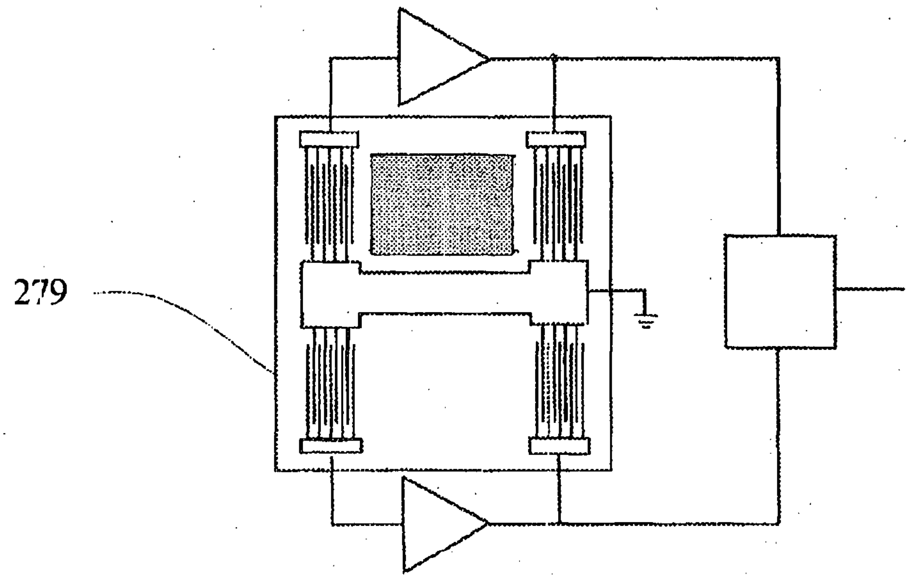

FIG. 25A

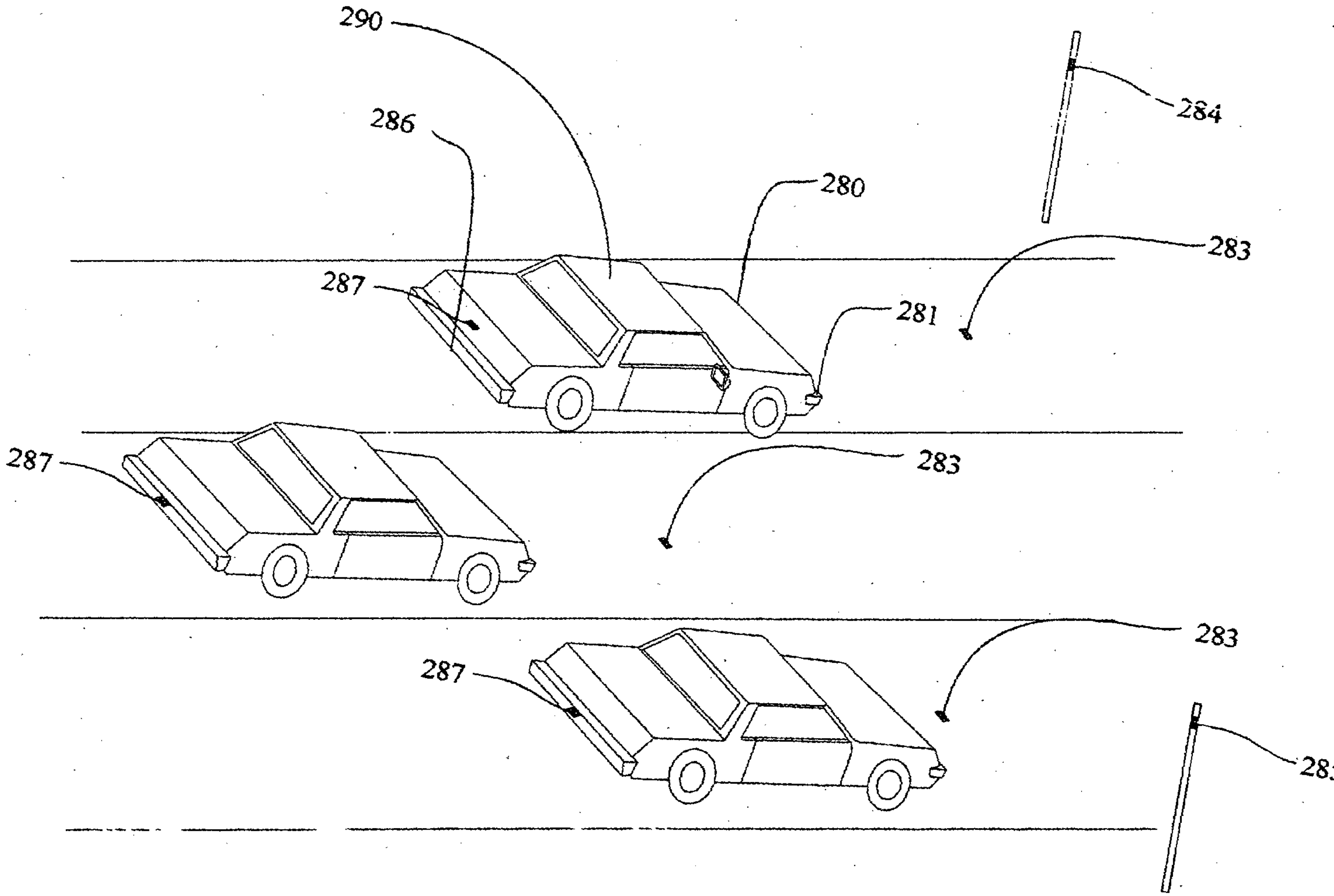

FIG. 26

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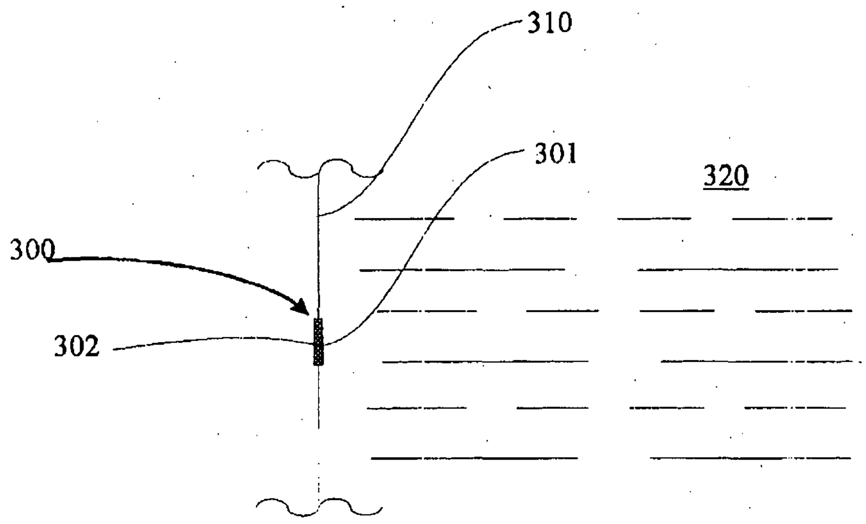

FIG. 27

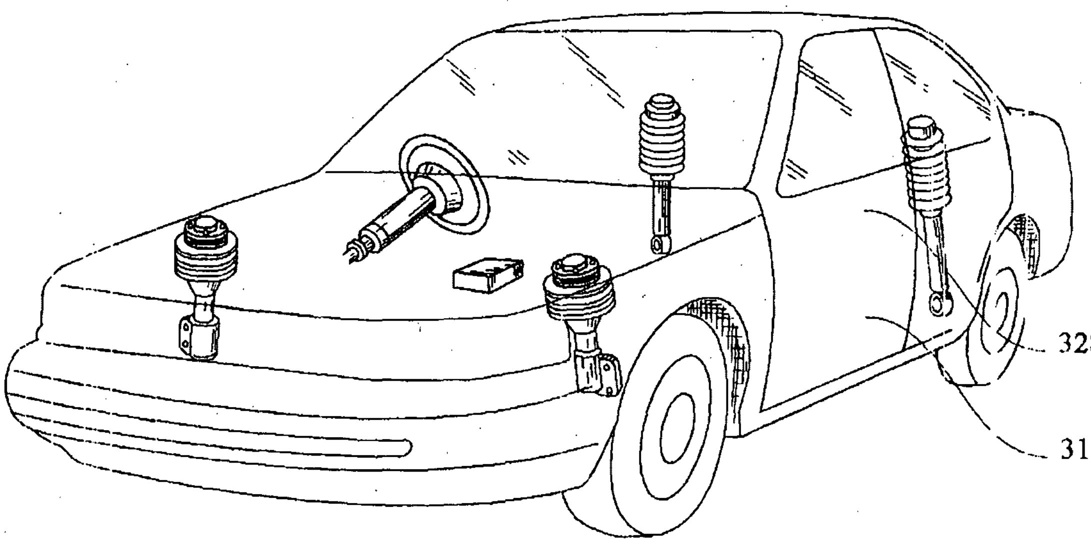

FIG. 28

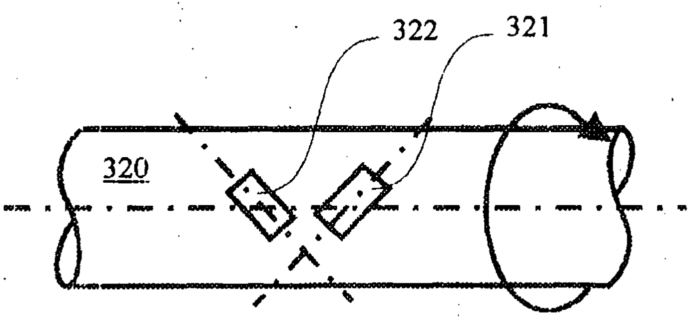

FIG. 28B

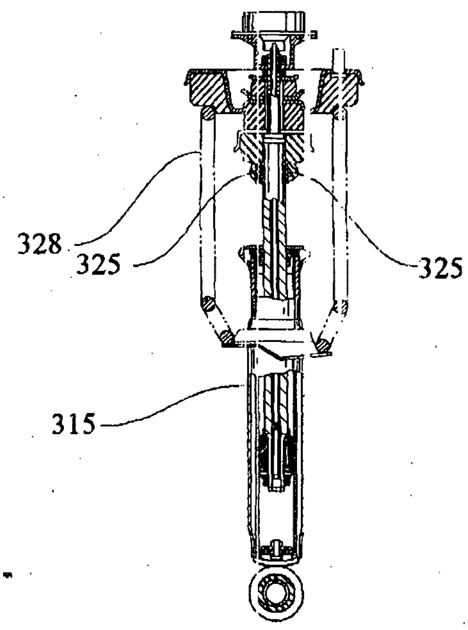

FIG. 28A

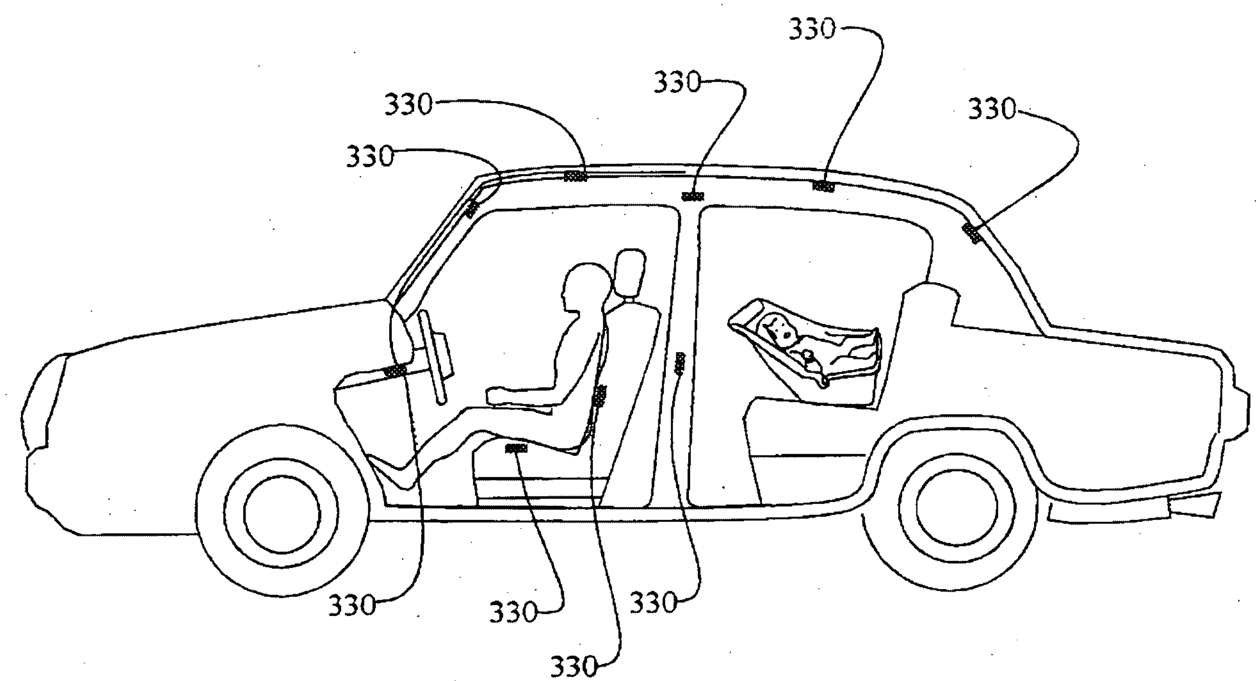

FIG. 29

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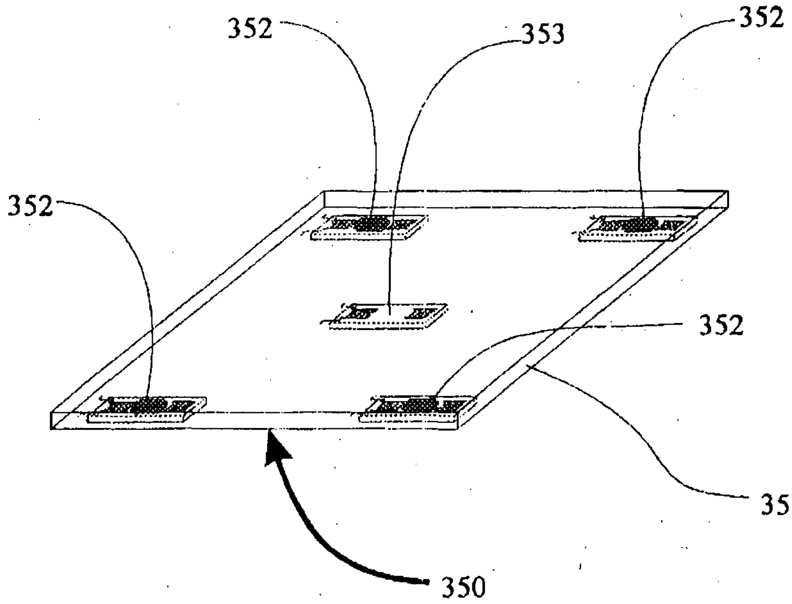

FIG. 30A

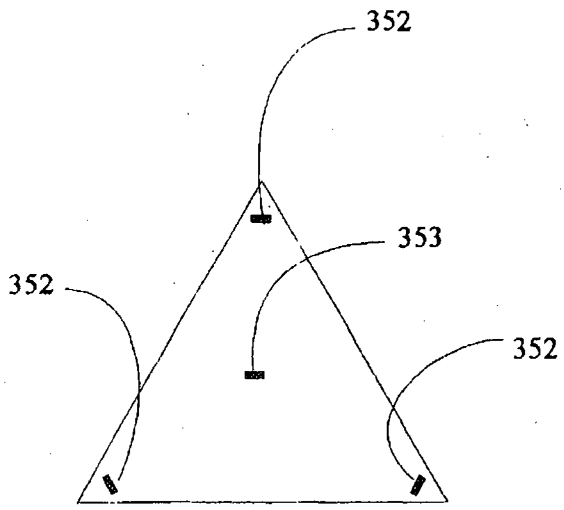

FIG. 30B

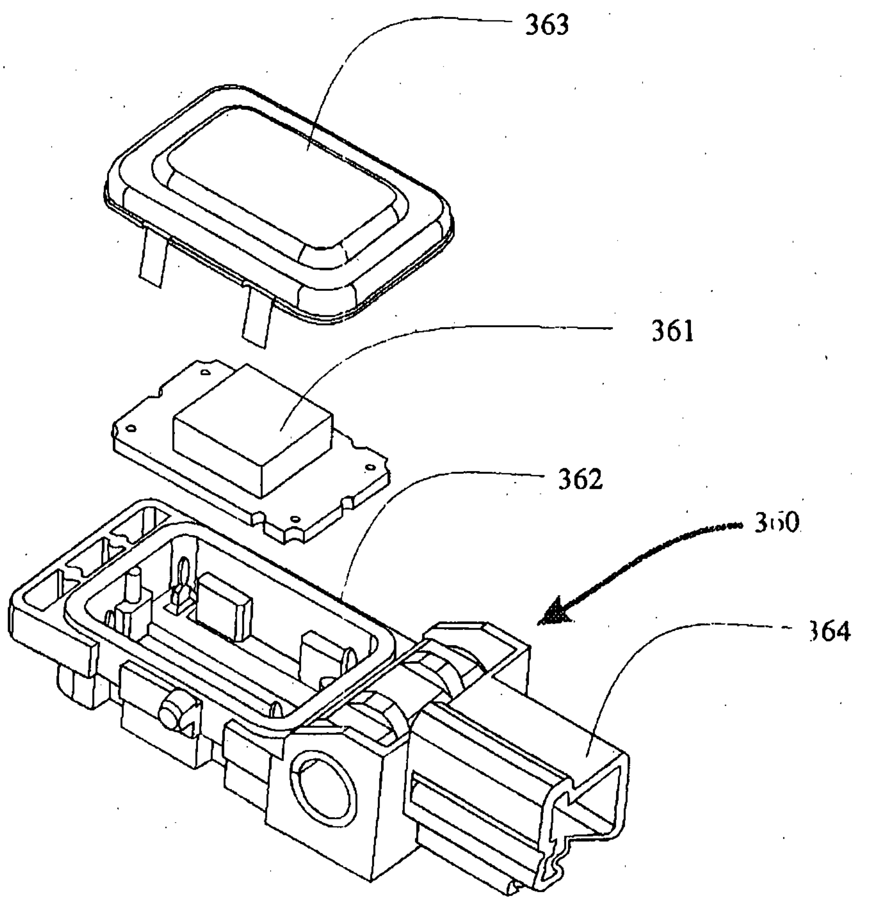

FIG. 31

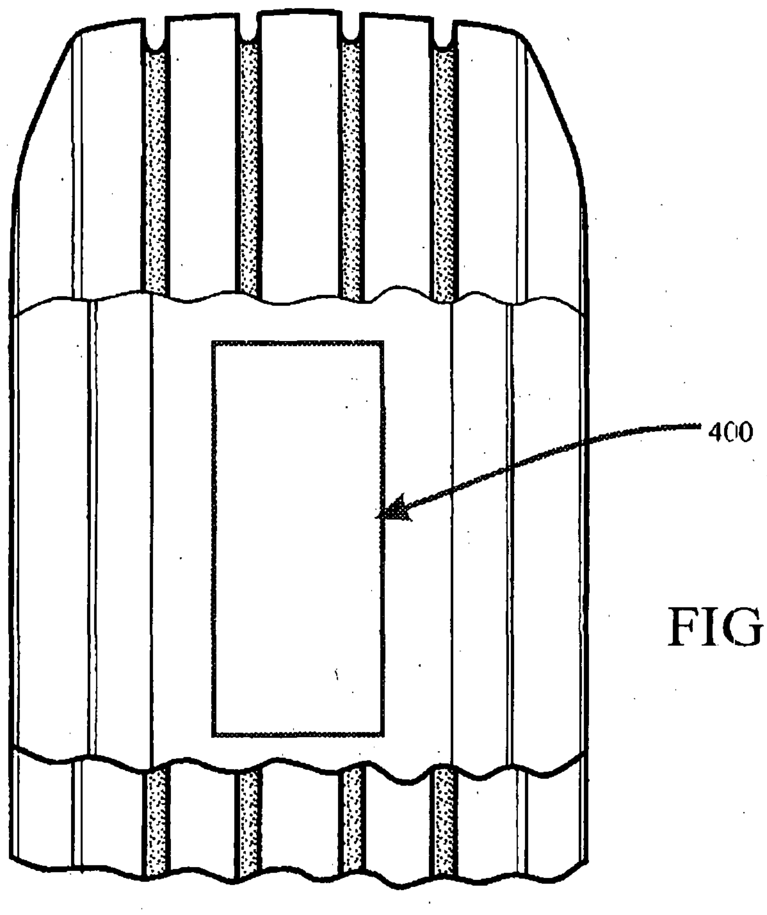

FIG. 32

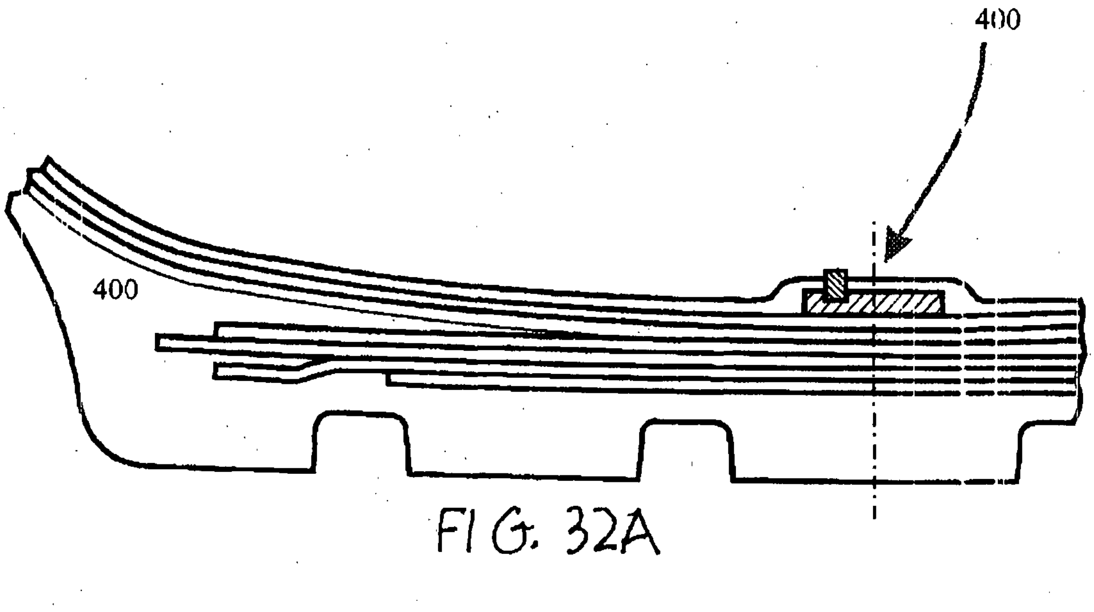

FIG. 32A

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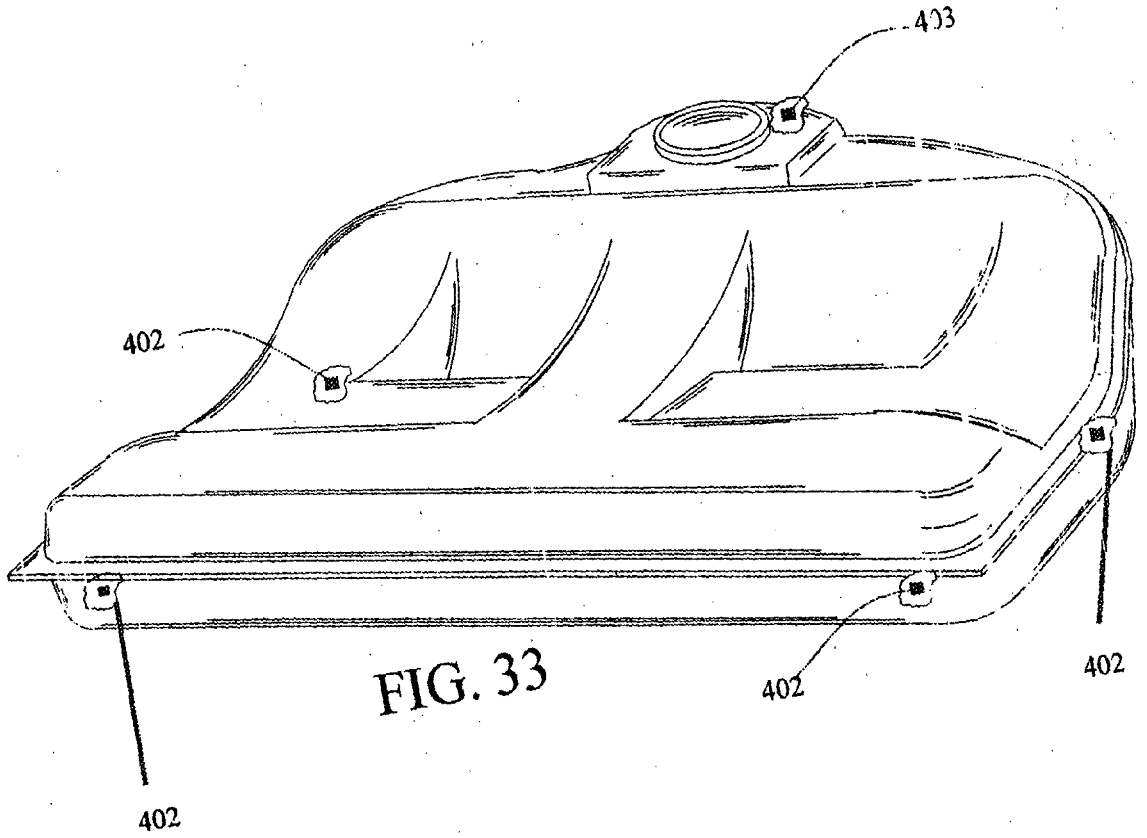

FIG. 33

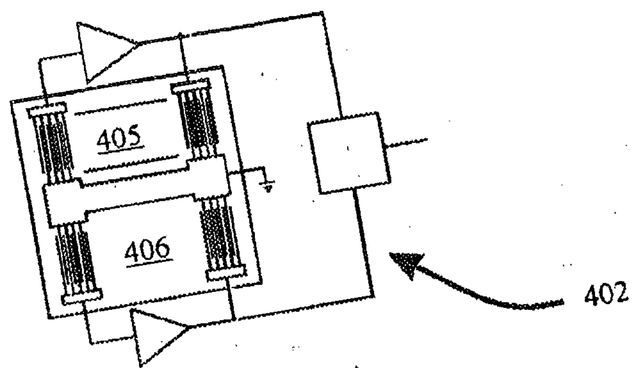

FIG. 33A

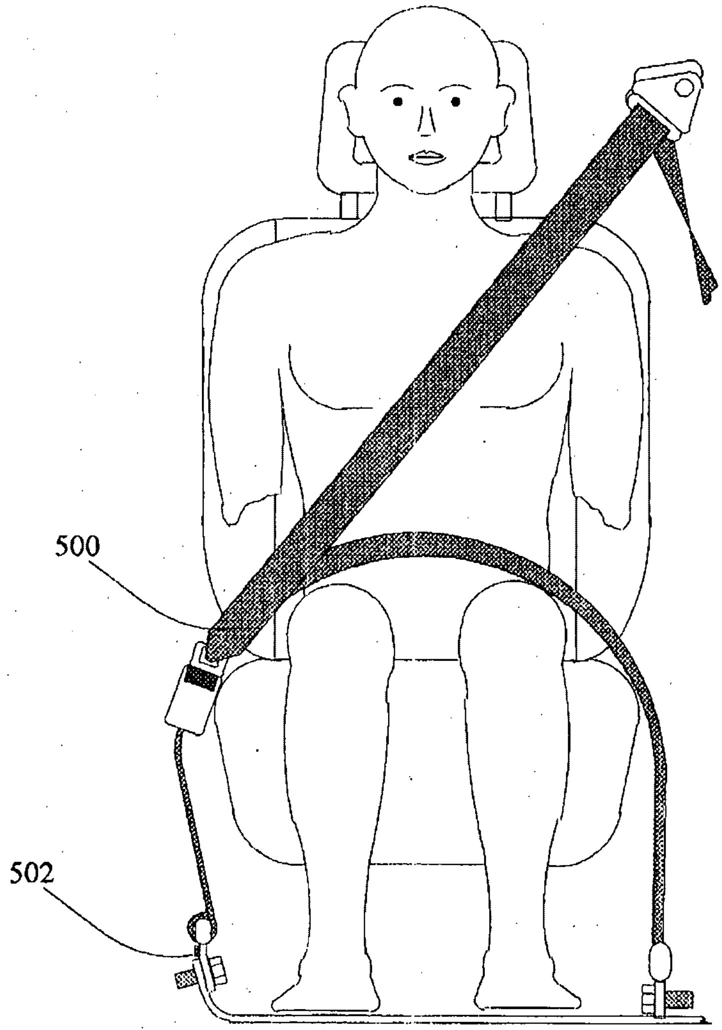

FIG. 34

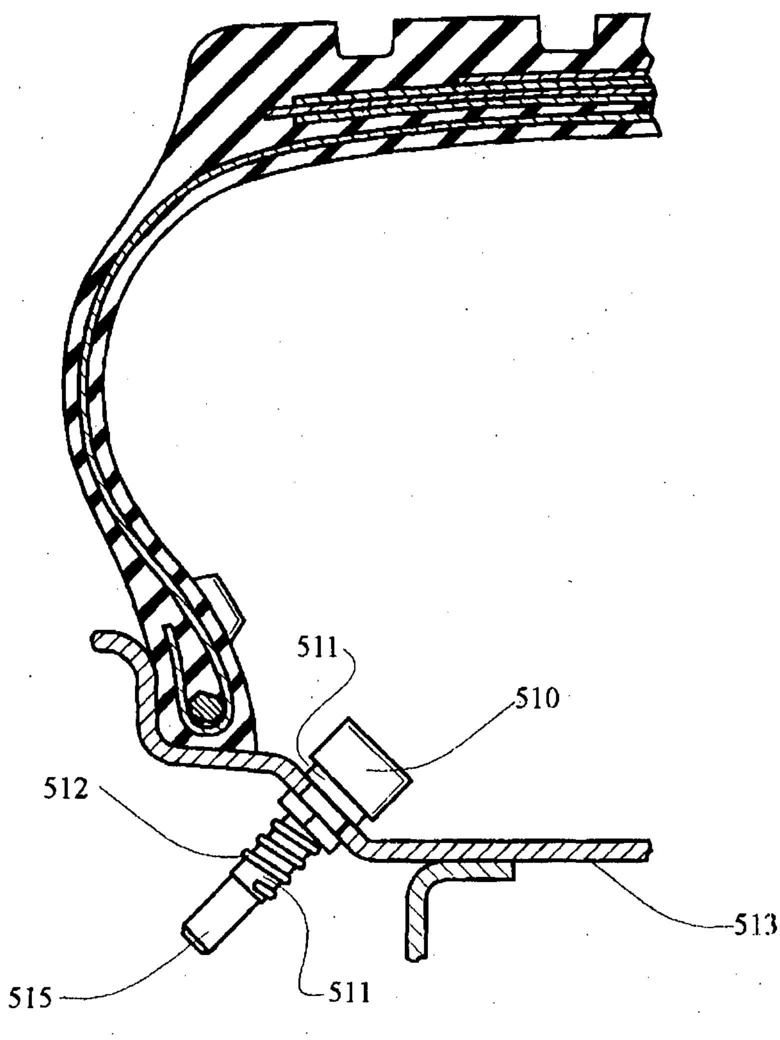

FIG. 35

Prior Art

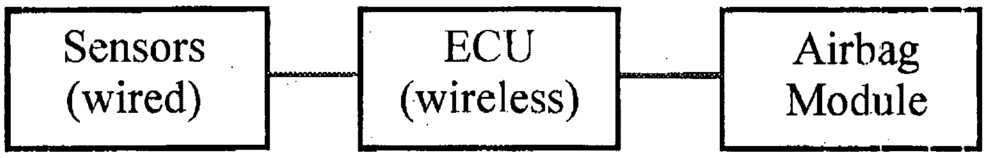

FIG. 36A

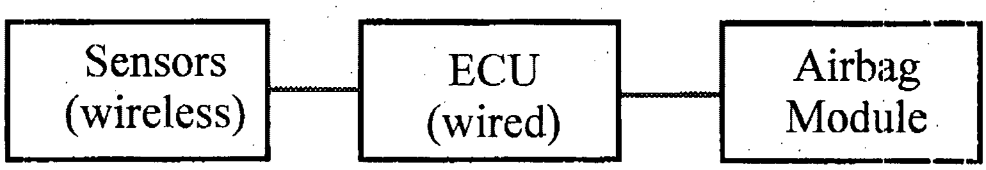

FIG. 36B

10188673.070302

DECLARATION FOR PATENT APPLICATION

Attorney Docket Number: ATI-296

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability as defined in 37 C.F.R. §1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.

I hereby claim foreign or domestic priority benefits under Title 35, United States Code, §119 of any foreign and/or provisional U.S. application(s) for patent or inventor's certificate listed below and have also identified below any foreign and provisional U.S. application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Application(s)			Priority Claimed	
60/231,378	U.S.	8 September 2000	X	
60/304,013	U.S.	9 July 2001	X	
60/291,511	U.S.	16 May 2001	X	
60/269,415	U.S.	16 February 2001	X	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112,I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

10/174,709	Jun. 19, 2002	Pending
10/079,065	Feb. 19, 2002	Pending
09/765,558	Jan. 19, 2001	Pending
09/753,186	Jan. 2, 2001	Pending
09/137,918	Aug. 20, 1998	Patented
08/476,077	Jun. 7, 1995	Patented
(Application Serial No.)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Brian Roffe, Reg. No. 35,336, Customer Number 22846

Telephone number: (516) 295-1394; Facsimile Number: (516) 295-0318

Address: Brian Roffe, Esq., 366 Longacre Avenue, Woodmere, New York 11598-2417

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first joint inventor, (given name, family name) David S. Breed

Inventor's signature ____________ Date July 2, 2002

Residence Boonton Township, Morris County, New Jersey Citizenship USA

Post Office Address 48 Hillcrest Road, Boonton Township, Morris County, New Jersey 07005

Application Assignment Record

According to the application transmittal letter, an assignment recording ownership was filed with this application; however, a copy of this record was not located in the original file history record obtained from the United States Patent and Trademark Office. Upon your request, we will attempt to obtain the assignment documents from the Assignment Recordation Branch of of the United States Patent and Trademark Office or from a related application case (if applicable). Please note that additional charges will apply for this service.

Attorney Docket No. ATI-296

10/188673

07/03/02

UNITED STATES PATENT AND TRADEMARK OFFICE

#2
7-14-03
DRS

Re:	Application of:	David S. Breed
	Serial No.:	Not yet known
	Filed:	July 3, 2002
	For:	TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

INFORMATION DISCLOSURE STATEMENT

Honorable Commissioner for Patents
Washington, D.C. 20231

July 3, 2002

Sir:

Applicant herewith submits a list of references including those cited during the prosecution of one or more of the parent applications and other preceding applications in the chain of priority under 35 U.S.C. §120, namely U.S. patent application Ser. Nos. 10/174,709, 10/079,065, 09/765,558, 09/753,186, 09/137,918 and 08/476,077, and additional references of which the applicant is aware. A copy of each of the references can be found in the file of the parent application or the preceding applications, or is enclosed herewith.

The cited references generally relate to vehicle diagnostics and/or telematics

This submission does not represent that a search has been made or that no better prior art exists. While the term "reference" is used in citing each of the publications called to the Examiner's attention herein, applicant does not make any admission that each or all of them are "prior art" references within the meaning of the statutory and case law.

Applicant reserves the right to contend, where appropriate, that a reference asserted against any claim of the present application is not prior art under the facts and the law.

Applicants also reserve the right to present appropriate arguments and/or evidence to establish patentability over the references, should one or more of the references be applied against the claims of the present application.

Applicant requests the Examiner independently determine those items that the Examiner would consider the most pertinent of all the references cited herein.

It is respectfully requested that these references be considered and made of record.

Respectfully submitted,

By: ______________________
Brian Roffe
Attorney for Applicant
Reg. No. 35,336

Brian Roffe, Esq.
366 Longacre Avenue
Woodmere, New York 11598-2417
Tel.: (516) 295-1394
Fax.: (516) 295-0318

Enclosures
PTO-1449 (2 pages)
9 References

Attorney Docket No.	ATI-296
U.S. Serial No.	
Inventor	David S. Breed
Filed	July 3, 2002
Art Unit	3661
Examiner	Beaulieu

-LIST OF REFERENCES CITED

U.S. PATENTS

		Number	Date	Inventor(s)	Class	Subclass
	AA	4,128,005	12/1978	Arnston et al.	73	117.3
	AB	4,418,388	11/1983	Allgor et al.	364	431.01
	AC	4,817,418	4/1989	Asami et al.	73	118.1
	AD	4,989,146	1/1991	Imajo	701	29
	AE	5,041,976	8/1991	Marko et al.	364	424.03
	AF	5,123,017	6/1992	Simpkins et al.	714	26
	AG	5,164,901	11/1992	Blackburn et al.	701	47
	AH	5,313,407	5/1994	Tiernan et al.	364	508
	AI	5,325,082	6/1994	Rodriguez	340	438
	AJ	5,333,240	7/1994	Matsumoto et al.	706	20
	AK	5,400,018	3/1995	Scholl et al.	340	825.54
	AL	5,406,502	4/1995	Haramaty et al.	364	551.01
	AM	5,420,794	5/1995	James	701	117
	AN	5,442,553	8/1995	Parrillo	364	424.04
	AO	5,481,906	1/1996	Nagayoshi et al.	73	116
	AP	5,594,740	1/1997	LaDue	379	59
	AQ	5,754,965	5/1998	Hagenbuch	701/35	
	AR	5,809,437	9/1998	Breed	701	29
	AS	5,829,782	11/1998	Breed et al.	280	735
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	AV	6,175,787	1/2001	Breed	701	29
	AW	6,263,268	7/2001	Nathanson	701	29
	AX	6,295,492	9/2001	Lang et al.	701	33
	AY	6,339,736	1/2002	Moskowitz et al.	701	29
	AZ	6,356,822	3/2002	Diaz et al.	701	33

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		Number	Date	Country	Class	Subclass
	BA	00/29257	5/2000	WIPO	—	—

Attorney Docket No.	ATI-296	PAGE 2 of 2
U.S. Serial No.		
Inventor	David S. Breed	
Filed	January 2, 2001	
Art Unit		

-LIST OF REFERENCES CITED

OTHER DOCUMENTS

BB Liubakka et al., "Failure Detection Algorithms Applied To Control System Design For Improved Diagnostics And Reliability", SAE Technical Paper Series, 02-29 To 04-04, 1988, Pages 1-7.

BC James et al., "Microprocessor Based Data Acquisition For Analysis Of Engine Performance", SAE Technical Paper Series, February 23-27, 1987, Pages 1-9.

BD Engine Monitoring Based on Normalized Vibration Spectra, NASA Tech Briefs, MFS-26529, 1994.

BE V.K. Varadan et al., "Conformal MEMS-IDT Gyroscopes and Their Comparison with Fiber Optic Gyro, Smart Structures and Materials 2000", Smart Electronics and MEMS, Proceedings of SPIE Vol. 3990 (2000), pages 335-344.

BF H.K. Tonshoff et al., "Using Acoustic Emission Signals for Monitoring of Production Processes", Ultrasonics 37 (2000), pages 681-686, 2000.

BG Design and Development of a MEMS-IDT Gyroscope, V.K. Varadan et al., Smart Mater. Struct. Vol. 9, July 21, 2000, pages 898-905.

BH Microsensors, Microelectromechanical Systems (MEMS), and Electronics for Smart Structures and Systems, V.K. Varadan et al., Smart Mater. Struct., Vol. 9, February, 1999, pages 953-972.

BI Abstract of Wireless Remote Accelerometer, V.K. Varadan et al., in Physics of Semiconductor Devices, Vol. 1: Proceedings of the 9th International Workshop on Physics of Semiconductor Devices (IWPSD), Delhi, India, Dec. 6-20, 1997.

BJ Using Remote Diagnostics and Prognostics in the R&D Environment, Maggy Blagrove, no earlier than January, 2002.

BK Vetronix Corporation, WirelessRoad System Description, no earlier than January 1, 2002.

BL Wingcast to Market Remote Vehicle Diagnostic and Prognostic Solutions with HP, Press Release dated May 15, 2002.

BM ATX Unveils Direct Telematics Link from Vehicle to Car Dealer Press Release, January 23, 2002.

BO Cosworth Technology, Inc. and North American Bus Industries (NABI) to Unveil the CompoBus ™ Suited with the Revolutionary i3000{R} Predictive Diagnostic System at APTA Conference in Ft. Worth, Texas, October 28-31, 2001., Press Release, October 28, 2001.

BP Telematics Integrated with Tire Pressure Monitoring, Press Release, October 3, 2001.

12 September 2003

Other Prior Art

According to the information contained in form PTO-1449 or PTO-892, there are one or more other prior art/non-patent literature documents missing from the original file history record obtained from the United States Patent and Trademark Office. Upon your request we will attempt to obtain these documents from alternative resources. Please note that additional charges will apply for this service.

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MAR 04 2003
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2632
Paper #3
IDS
Gm
3/27/03

Attorney Docket No. ATI-296

UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit: 2632

RECEIVED
MAR 06 2003
Technology Center 2600

Re: Application of:	David S. Breed	
Serial No.:	10/188,673	
Filed:	July 3, 2002	
For:	TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS	

INFORMATION DISCLOSURE STATEMENT

Honorable Commissioner for Patents
Washington, D.C. 20231

February 26, 2003

Sir:

Applicant herewith submits a list of references potentially material to the subject matter of the above-referenced application.

From the Abstract, German Patent No. 38 39 959, is relevant because it describes an emergency call system for vehicles which sends an automatic emergency call in the event of a crash. The call includes the transmission of the vehicle position and the number of people in the vehicle. The particular manner in which the number of people in the vehicle is obtained is not specified in the Abstract.

Suman et al. describes a vehicle communication and control system which provides for two-way communications between the vehicle and a remote facility. The information transmitted includes location-specific information, a request for roadside assistance, and an indication of deployment of an airbag among others. Buttons on a cellular telephone are provided for enabling a call to an emergency assistance facility, a 911 operator. Remote diagnostic functions are indicated as being available.

I hereby certify that this correspondence and/or fee is being deposited with the United States Postal Service as first class mail in an envelope addressed to the "Commissioner for Patents Washington, D.C. 20231" on February 26, 2003.

Brian Roffe, Esq.

This submission does not represent that a search has been made or that no better prior art exists. While the term "reference" is used in citing each of the publications called to the Examiner's attention herein, applicant does not make any admission that each or all of them are "prior art" references within the meaning of the statutory and case law.

Applicant reserves the right to contend, where appropriate, that a reference asserted against any claim of the present application is not prior art under the facts and the law.

Applicants also reserve the right to present appropriate arguments and/or evidence to establish patentability over the references, should one or more of the references be applied against the claims of the present application.

Applicant requests the Examiner independently determine those items that the Examiner would consider the most pertinent of all the references cited herein.

This Information Disclosure Statement is being submitted prior to issuance of a first Office Action on the merits. Therefore, no fee is due for the submission of this Information Disclosure Statement.

It is respectfully requested that these references be considered and made of record.

Respectfully submitted,

By: ______________________
Brian Roffe
Attorney for Applicant
Reg. No. 35,336

Brian Roffe, Esq.
366 Longacre Avenue
Woodmere, New York 11598-2417
Tel.: (516) 295-1394/Fax.: (516) 295-0318

Enclosures
PTO-1449 (1 page); 2 References

Attorney Docket No.	ATI-296	PAGE 1 of 1
U.S. Serial No.	10/188,673	
Inventor	David S. Breed	
Filed	July 3, 2002	
Art Unit 3661	2632	
Examiner Beaulieu		

OIPE JC97 MAR 0 4 2003 PATENT & TRADEMARK OFFICE

-LIST OF REFERENCES CITED

U.S. PATENTS

		Number	Date	Inventor(s)	Class	Subclass
YB	AA	6,028,537	2/2000	Suman et al.	340	988

FOREIGN PATENT LITERATURE

		Number	Date	Country	Class	Subclass
YB	AB	3839959	11/1988	Germany	—	—

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GROUP 3600

AB

No English title available.
Patent Number: DE3839959
Publication date: 1990-04-12
Inventor(s): TEMPELHOF ALFRED DIPL ING (DE); VOLLMER RUDOLPH DIPL ING DR (DE); ZURMUEHL UWE DR RER NAT (DE); MOEHRLE MICHAEL (DE); JOHANNKNECHT RAPHAEL (DE)
Applicant(s): BOSCH GMBH ROBERT (DE)
Requested Patent: DE3839959
Application Number: DE19883839959 19881126
Priority Number(s): DE19883839959 19881126; DE19883833952 19881006
IPC Classification: B60Q9/00; G08B25/00; G08G1/123; H04Q7/00
EC Classification: B60Q1/52, B60R25/10D2, G07C5/08R2, G08G1/127
Equivalents: WO9003899

Abstract

An emergency call system for vehicles sends an automatic emergency call in the event of danger, accident or breakdown, that can be clearly read at a signalling station, or announced by a loudspeaker. The simultaneous transmission of the vehicle position and number of persons in the vehicle allows important information to be immediately transmitted, for example in the case of an accident. Various vehicle systems, for example an air bag system, an anti-theft alarm system, temperature sensors and vehicle controllers can be used as signal generators. The location of the vehicle is given by a locating/navigating device on board the vehicle, making the taking of bearings unnecessary.

Transaction History Date: 2003 - 09-30
Date information retrieved from USPTO Patent
Application Information Retrieval (PAIR)
system records at www.uspto.gov

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-296	4201

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EXAMINER	
BEAULIEU, YONEL	
ART UNIT	**PAPER NUMBER**
3661	4

DATE MAILED: 09/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

SW

Office Action Summary	Application No.	Applicant(s)
	10/188,673	BREED, DAVID S.
	Examiner	Art Unit
	Yonel Beaulieu	3661

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 July 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-56* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11,16-33,38-50 and 53-56* is/are rejected.

7)☒ Claim(s) *12-15,34-37,51 and 52* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2,3* .

4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____ .

Information Disclosure Statement

The information disclosure statement filed 4 March 2003 fails to fully comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because at least one of the references has an earlier filing date when Applicant's related U.S. Application Serial No. 08/476,077 is considered. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

Claim Rejections - 35 USC § 112

Claim 17 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 17, "said processor" (line 1) lacks clear antecedent basis because such has not previously been established.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 4, 9, 10, and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Abe (US 5,056,023).

Regarding claims 1, 2, 4, 9, 10, and 17, Abe teaches a diagnostic system (25; figs. 1, 3B) arranged to diagnose the state of a vehicle and generate an output indicative thereof (col. 2: 27 – 29 at least); a communications device (56a) coupled to the system and arranged to transmit (via transmission line Tx) the output of the system (col. See figs. 1a, 1b, 3B at least); the system comprising a plurality of sensors (9 – 11, 13, 15, and 17 at least; see fig. 2A) – the sensors being mounted in various locations; a pattern recognition algorithm (figs. 4 and 5 at least); a memory unit (37/41) coupled to the system and the communication device, the unit storing the diagnosis (col. 3: 66 – col. 4: 28 at least).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 6, 7, 11, 16, 18 – 25, 27 - 29, 31 – 33, 38 – 44, 46, 48 – 50, 53 - 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abe ('023) in view of Burge (US 2002/0103622 A1).

As addressed above, Abe teaches all of the limitations except for the inclusion of a cellular telephone, sensing an occupant of the vehicle, selecting the sensor from a plurality of sensors, using GPS technology, transmission of the output to a remote location, whether the vehicle is stable or is about to rollover, wireless communication via a host computer.

However, Burge teaches, in the same field of endeavor of monitoring a vehicle, the inclusion of a cellular telephone (0188, 0213, 0241 at least), sensing an occupant of the vehicle and selecting the sensor from a plurality of sensors (0108 – 0185, 0286), using GPS technology (0188 at least), transmission of the output to a remote location (0021, 0101, 0191, 0302), whether the vehicle is stable or is about to rollover (0285, wireless communication via the Internet or a host computer (0105 at least).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Abe's teaching by including a cellular telephone, sensing an occupant of the vehicle, selecting the sensor from a plurality of sensors, using GPS technology, transmission of the output to a remote location, whether the vehicle is stable or is about to rollover, wireless communication via a host computer as evidenced by Burge in order to enhance safety.

Claims 5, 8, 26, 30, 45, and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abe and Burge and further in view Woll et al. (US 5,581,464).

As discussed above, Abe and Burge teach all of the limitations either individually or in combination except for the display arranged in the vehicle and sensing the environment around the vehicle.

However, Woll et al., teaches in the same environment, a display (item 4 in fig. 1) and arranged in a vehicle (col. 3: 60 – col. 4: 25 at least); and sensing the environment around the vehicle (col. 1: 57 – col. 2: 5 at least).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Abe and Burge system by including a display in the vehicle and sensing the environment around the vehicle as evidenced by Woll et al. in order to provide reliable vehicle diagnostics data.

Allowable Subject Matter

Claims 12 – 15, 34 – 37, 51, and 52 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The prior art of record fail to teach in combination a vehicle including sensors which include RFID response units and an interrogator device causing the RFID units to transmit a signal representative of signal measurement of at least one sensor in the processor, wherein the sensors include a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of the SAW sensor or the state of the mounting location of the SAW sensor – the SAW sensor being arranged to measure at least one of temperature and pressure and the presence of and concentration of a chemical.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yonel Beaulieu whose telephone number is (703) 305-4072. The examiner can normally be reached on M-R, from 0900-1600.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William A. CUCHLINSKI can be reached on (703) 308-3873. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1113.

Y. BEAULIEU
YONEL BEAULIEU
PRIMARY EXAMINER

Notice of References Cited	Application/Control No. 10/188,673	Applicant(s)/Patent Under Reexamination BREED, DAVID S.	
	Examiner Yonel Beaulieu	Art Unit 3661	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,056,023	10-1991	Abe, Kunihiro	701/32
	B	US-5,581,464	12-1996	Woll et al.	701/35
	C	US-2002/0103622	08-2002	Burge, John R.	702/183
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

OIPE JC109
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PATENT & TRADEMARK OFFICE

3661

Attorney Docket No. ATI-296

UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED
OCT 29 2003
GROUP 3600

Examiner: Yonel Beaulieu		Art Unit: 3661
Re:	Application of:	David S. Breed
	Serial No.:	10/188,673
	Filed:	July 3, 2002
	For:	Telematics System for Vehicle Diagnostics
	Confirmation No.:	4201
	Customer Number:	0022846

10/30/03

AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

October 24, 2003

Dear Sir:

In response to the Office Action dated September 30, 2003, which set a shortened three-month statutory term for response expiring on December 30, 2003, please amend the above-identified application as follows.

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Remarks/Arguments begin on page 12 of this paper.

I hereby certify that this amendment is being deposited as first class mail, postage paid, in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on October 24, 2003.

Brian Roffe

AMENDMENTS TO THE SPECIFICATION:

Please replace the paragraph beginning at page 1, line 6 with the following rewritten paragraph:

This application is a continuation-in-part of U.S. patent application Ser. No. 09/753,186 filed Jan. 2, 2001, now U.S. Pat. No. 6,484,080, which in turn is a continuation-in-part of U.S. patent application Ser. No. 09/137,918 filed Aug. 20, 1998, now U.S. Pat. No. 6,175,787, which in turn is a continuation-in-part of U.S. patent application Ser. No. 08/476,077 filed Jun. 7, 1995, now U.S. Pat. No. 5,809,437.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) A vehicle, comprising:

a diagnostic system arranged on the vehicle to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to automatically establish a communications channel between the vehicle and a remote facility without manual intervention and wirelessly transmit the output of said diagnostic system to the remote facility.

2. (Original) The vehicle of claim 1, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

3. (Original) The vehicle of claim 2, wherein said sensors are wirelessly coupled to said processor.

4. (Original) The vehicle of claim 2, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

5. (Original) The vehicle of claim 1, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

6. (Original) The vehicle of claim 1, wherein said communications device comprises a cellular telephone system including an antenna.

7. (Currently Amended) The vehicle of claim 1, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said

communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle to the remote facility.

8. (Currently Amended) The vehicle of claim 1, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle to the remote facility.

9. (Original) The vehicle of claim 1, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrógate said memory unit to obtain the stored diagnosis to enable transmission thereof.

10. (Original) The vehicle of claim 1, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

11. (Original) The vehicle of claim 10, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

12. (Currently Amended) The vehicle of claim 10, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing said RFID response ~~units~~ unit of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

13. (Original) The vehicle of claim 10, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

14. (Original) The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of temperature and pressure.

15. (Original) The vehicle of claim 13, wherein said SAW sensor is arranged to measure at least one of the presence and concentration of a chemical.

16. (Original) The vehicle of claim 1, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

17. (Currently Amended) The vehicle of claim [[1]] 2, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

18. (Original) The vehicle of claim 1, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

19. (Original) The vehicle of claim 1, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle to the remote facility.

20. (Original) The vehicle of claim 19, wherein said location determining system uses GPS technology.

21. (Currently Amended) A method for monitoring a vehicle, comprising the steps of:

diagnosing the state of the vehicle or the state of a component of the vehicle by means of a diagnostic system arranged on the vehicle;

generating an output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle; and

transmitting the output indicative or representative of the diagnosed state of the vehicle or the diagnosed state of the component of the vehicle from the vehicle to a remote location.

22. (Original) The vehicle of claim 21, wherein the step of transmitting the output to a remote location comprises the step of arranging a communications device comprising a cellular telephone system including an antenna on the vehicle.

23. (Original) The method of claim 21, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor embodying a pattern recognition algorithm.

24. (Original) The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining whether the vehicle is stable or is about to rollover or skid.

25. (Original) The method of claim 21, wherein the step of diagnosing the state of the vehicle comprises the step of determining a location of an impact between the vehicle and another object.

26. (Original) The method of claim 21, further comprising the steps of:

arranging a display in the vehicle in a position to be visible from the passenger compartment; and

displaying the state of the vehicle or the state of a component of the vehicle on the display.

27. (Original) The method of claim 21, further comprising the step of relaying a warning to an occupant of the vehicle relating to the state of the vehicle.

28. (Original) The method of claim 21, further comprising the steps of:

determining at least one property or characteristic of occupancy of the vehicle; and

transmitting the determined property or characteristic of occupancy of the vehicle to a remote location.

29. (Original) The method of claim 28, wherein the step of determining at least one property or characteristic of occupancy of the vehicle comprises the step of determining the number of occupants in the passenger compartment.

30. (Original) The method of claim 21, further comprising the steps of:

sensing a state of the environment around the vehicle; and

transmitting information about the environment of the vehicle to a remote location.

31. (Original) The method of claim 21, further comprising the steps of:

providing a memory unit in the vehicle to receive the diagnosis of the state of the vehicle or the state of the component of the vehicle and store the diagnosis; and

interrogating the memory unit to obtain the stored diagnosis to enable transmission thereof.

32. (Original) The method of claim 21, wherein the step of diagnosing the state of the vehicle or the state of the component of the vehicle comprises the steps of mounting a plurality of sensors on the vehicle, measuring a state of each sensor or a state of the mounting location of each sensor and diagnosing the state of the vehicle or the state of a component of the vehicle based on the measurements of the state of the sensors or the state of the mounting locations of the sensors.

33. (Original) The method of claim 32, wherein the state of the vehicle or the state of the component of the vehicle is diagnosed by a processor, further comprising the step of wirelessly coupling the sensors to the processor.

34. (Original) The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the steps of:

providing at least one of the sensors with an RFID response unit;

mounting at least one RFID interrogator device on the vehicle; and

transmitting signals via the at least one RFID interrogator device to cause the RFID response units of the at least one sensor to transmit a signal representative of the measurements of the at least one sensor to the processor.

35. (Original) The method of claim 21, wherein the state of the vehicle is diagnosed by a processor, further comprising the step of providing at least one of the sensors as a SAW sensor capable of receiving a signal and returning a signal modified by virtue of the state of the SAW sensor or the state of the mounting location of the SAW sensor.

36. (Original) The method of claim 35, wherein the SAW sensor is arranged to measure at least one of temperature and pressure.

37. (Original) The method of claim 35, wherein the SAW sensor is arranged to measure at least one of concentration and presence of a chemical.

38. (Original) The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output to a satellite for transmission from the satellite to the remote location.

39. (Original) The method of claim 21, wherein the step of transmitting the output to a remote location comprises the step of transmitting the output via the Internet to a web site or host computer associated with the remote location.

40. (Original) The method of claim 21, further comprising the steps of:

determining the location of the vehicle; and

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transmitting the determined location of the vehicle to the remote location in conjunction with the output.

41. (Currently Amended) A vehicle, comprising:

a diagnostic system arranged on the vehicle to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system,

said communications device including a transmitter for transmitting a signal representative of the output of said diagnostic system to a satellite for transmission from the satellite to a remote site.

42. (Original) The vehicle of claim 41, wherein said diagnostic system comprises a plurality of vehicle sensors mounted on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensors and arranged to receive data from said sensors and process the data to generate the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

43. (Original) The vehicle of claim 42, wherein said sensors are wirelessly coupled to said processor.

44. (Original) The vehicle of claim 42, wherein said processor embodies a pattern recognition algorithm trained to generate the output from the data received from said sensors.

45. (Original) The vehicle of claim 41, further comprising a display arranged in the vehicle in a position to be visible from the passenger compartment, said display being coupled to said diagnostic system and arranged to display the diagnosis of the state of the vehicle or the state of a component of the vehicle.

46. (Original) The vehicle of claim 41, further comprising an occupant sensing system arranged to determine at least one property or characteristic of occupancy of the vehicle, said communications device being coupled to said occupant sensing system and arranged to transmit the determined property or characteristic of occupancy of the vehicle.

47. (Original) The vehicle of claim 41, further comprising at least one environment sensor each sensing a state of the environment around the vehicle, said communications device being coupled to said at least one environment sensor and being arranged to transmit the sensed state of the environment around the vehicle.

48. (Original) The vehicle of claim 41, further comprising a memory unit coupled to said diagnostic system and said communications device, said memory unit being arranged to receive the diagnosis of the state of the vehicle or the state of a component of the vehicle from said diagnostic system and store the diagnosis, said communications device being arranged to interrogate said memory unit to obtain the stored diagnosis to enable transmission thereof.

49. (Original) The vehicle of claim 41, wherein said diagnostic system comprises a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors.

50. (Original) The vehicle of claim 49, wherein at least one of said sensors is a sensor selected from a group consisting of a single axis acceleration sensor, a double axis acceleration sensor, a triaxial acceleration sensor and a gyroscope.

51. (Original) The vehicle of claim 49, wherein at least one of said sensors includes an RFID response unit, further comprising at least one RFID interrogator device, said at least one interrogator device causing said RFID response units of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

52. (Original) The vehicle of claim 49, wherein at least one of said sensors includes a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor.

53. (Original) The vehicle of claim 41, wherein the state of the vehicle diagnosed by said diagnostic system includes angular motion of the vehicle.

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54. (Currently Amended) The vehicle of claim [[41]] 49, wherein said processor is arranged to control at least one part of the vehicle based on the output indicative or representative of the state of the vehicle or the state of a component of the vehicle.

55. (Original) The vehicle of claim 41, further comprising a warning device coupled to said diagnostic system for relaying a warning to an occupant of the vehicle relating to the state of the vehicle or the state of the component of the vehicle as diagnosed by said diagnostic system.

56. (Original) The vehicle of claim 41, further comprising a location determining system for determining the location of the vehicle, said communications device being coupled to said location determining system and arranged to transmit the determined location of the vehicle.

57. (New) A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof, said diagnostic system comprising a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors, at least one of said sensors including an RFID response unit;

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system; and

at least one RFID interrogator device, said at least one interrogator device causing said RFID response unit of said at least one sensor to transmit a signal representative of the measurement of said at least one sensor to said processor.

58. (New) A vehicle, comprising:

a diagnostic system arranged to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof, said diagnostic system comprising a plurality of sensors mounted at different locations on the vehicle, each of said sensors providing a measurement related to a state of said sensor or a measurement related to a state of the mounting location and a processor coupled to said sensor systems and arranged to diagnose the state of the vehicle or the state of the component of the vehicle based on the measurements of said sensors, at least one of said sensors including a SAW sensor arranged to receive a signal and return a signal modified by virtue of the state of said SAW sensor or the state of the mounting location of said SAW sensor; and

a communications device coupled to said diagnostic system and arranged to transmit the output of said diagnostic system.

59. (New) The vehicle of claim 58, wherein said SAW sensor is arranged to measure at least one of temperature and pressure.

60. (New) The vehicle of claim 58, wherein said SAW sensor is arranged to measure at least one of the presence and concentration of a chemical.

61. (New) The method of claim 21, wherein the step of transmitting the output to the remote facility comprises the step of automatically establishing a communications channel between the vehicle and the remote facility without manual intervention to thereby enable the output to be transmitted from the vehicle to the remote facility.

62. (New) The vehicle of claim 41, wherein said communications device is arranged to automatically establish a communications channel between the vehicle and the remote site without manual intervention and transmit the output of said diagnostic system to the remote site.

REMARKS/ARGUMENTS

Entry of this amendment and reconsideration of the present application, as amended, are respectfully requested.

Claims 1-56 and new claims 57-62 are presently active in this application. Claims 1, 7, 8, 12, 17, 21, 41 and 54 have been amended herein. Unless an argument is made below to distinguish a claimed embodiment over the cited prior art based on a particular change to the claim, the changes do not relate to patentability.

Information Disclosure Statement

In the Office Action, the Examiner indicated that the Suman et al. reference (US 6,028,537) was not considered because it has an earlier filing date than the applicant's parent application U.S. Serial No. 08/476,077. It is not understood why the reference was not considered as a copy of the reference and a concise explanation of its relevance was provided in the Information Disclosure Statement filed March 4, 2003 and it is in the English-language. An identification of that portion of the MPEP which discusses filing dates of references for submission in an IDS and allows an Examiner not to consider a reference based on analysis of filing dates is respectfully requested.

Claim Rejections-35 U.S.C. §112

Claim 17 has been amended to depend from claim 2 which sets forth a processor so that the recitation of "said processor" in line 1 of claim 17 now has antecedent basis.

In view of the change to claim 17, it is respectfully submitted that the Examiner's rejection of claim 17 under 35 U.S.C. §112, second paragraph, has been overcome and should be removed.

Claim Rejections-35 U.S.C. §102

Claims 1, 2, 4, 9, 10 and 17 were rejected under 35 U.S.C. §102(b) as being anticipated by Abe (U.S. Pat. No. 5,056,023).

The Examiner's rejection is respectfully traversed in view of amended claim 1. Claim 1 has been amended to specify that the communications device is arranged to automatically establish a communications channel between the vehicle and a remote facility without manual intervention and wirelessly transmit the output of the diagnostic system to the remote facility.

This embodiment of the invention is shown in Fig. 8, which is essentially identical to Fig. 4 of the parent applications, U.S. Ser. Nos. 08/476,077 and 09/137,918. The communications device may be a cellular phone which wirelessly transmits signals to a remote facility for the purpose of allowing a dealer or repair facility to take steps to begin correction of a diagnostic problem with the vehicle. An advantage of this transmission is discussed in the specification, for example, at page 50, line 28 to page 51, line 16.

Abe describes a diagnostic system for a vehicle in which electronic control units (ECUs) 501-504 are connected through a communication bus 24a to an external connector 24 mounted on the vehicle (see Fig. 1). A diagnosis unit 25 is provided at each dealer and is connectable to the external connector 24 on the vehicle via a harness 27 to receive data from the ECUs 501-504, but only when the vehicle is physically present at the dealer. The diagnosis of the components of the vehicle is not performed by the ECU's 501-504 on the vehicle but rather is performed by the diagnosis unit 25 which is not located on the vehicle.

Abe does not disclose, teach or suggest a "vehicle comprising a diagnostic system arranged on the vehicle to diagnose the state of the vehicle or the state of a component of the vehicle and generate an output indicative or representative thereof". Also, in Abe, there is no structure which establishes a communications channel between the vehicle and a remote facility to enable wireless transmission of output of such a diagnostic system to the remote facility. That is, in the invention, a diagnosis of the operating condition of the vehicle is made by a diagnostic system on the vehicle from data obtained from sensors on the vehicle and this output is wirelessly transmitted to a remote facility, e.g., a dealer. Thus, in the claimed embodiment, the output of the diagnostic system is transmitted to the remote facility (e.g., a flat tire, a clogged filter) not data directly from individual sensors.

By contrast, in Abe, the vehicle must be physically brought to the dealer to have the harness 27 of the diagnosis unit 25 connected to the external connector 24 on the vehicle. There is absolutely no disclosure of a communications channel between the vehicle and the remote facility to enable wireless transmission of an output from a diagnostic system on the vehicle.

Since there is no diagnosis of the problem with the vehicle before the owner brings the vehicle to the dealer using the Abe system, the driver and dealer have no idea what the problem with the vehicle is until the vehicle is brought to the dealer and the diagnosis unit is connected to the external connector 24. The dealer cannot prepare the material or order the parts to fix the problem beforehand and cannot provide the owner with any estimate as to the cost for fixing the problem until the diagnosis unit 25 is actually connected to the vehicle. This is extremely disadvantageous when compared to the claimed embodiment wherein the dealer can be notified of the diagnosis of the vehicle and can order any required parts, schedule an appointment, etc., well before the owner brings the vehicle to the dealer. Such an arrangement for diagnosing the operation of a vehicle and providing for maintenance of the vehicle is not taught or suggested by Abe.

In view of the changes to claim 1 and the arguments presented above, it is respectfully submitted that the Examiner's rejection of claims 1, 2, 4, 9, 10 and 17 as being anticipated by Abe has been overcome and should be removed.

Claim Rejection under 35 U.S.C. §103

Claims 3, 6, 7, 11, 16, 18-25, 27-29, 31-33, 38-44, 46, 48-50 and 53-56 were rejected under 35 U.S.C. §103(a) as being unpatentable over Abe in view of Burge (U.S. Patent Publication No. 2002/0103622).

The Examiner's rejection is respectfully traversed for two reasons: 1) at least some of the claims of the instant application are entitled to an earlier filing date than the effective filing date of the Burge reference; and 2) Burge does not disclose performing a diagnosis of a vehicle on the vehicle and transmitting the diagnosis to a remote facility.

With respect to the first issue, it is noted that the features of at least some of the rejected claims are adequately supported by the disclosure of the immediate parent application U.S. patent application Ser. No. 09/137,918 (now U.S. Pat. No. 6,175,787) which was filed prior to the effective filing date of Burge. Specifically, the '918 application was filed August 20, 1998 which is before the July 17, 2000 effective filing date of the Burge application. There is a common inventor in the '918 application and the instant application, i.e., David Breed, and reference is made thereto in the specification. Thus, the conditions for obtaining the benefit of the filing date of the '918 application under 35 U.S.C. §120 are satisfied.

It is respectfully submitted that the disclosure of the subject matter of rejected claims is substantially set forth in the '918 application. For example, the matter of claim 3 is one of the other coupling means for coupling the sensors to the diagnostic module discussed at col. 15, lines 7-15 of the '787 patent, the subject matter of claim 6 is mentioned at col. 14, lines 44-47, the subject matter of claim 16 is mentioned at col. 13, line 33, and the subject matter of claim 18 is mentioned at col. 14, lines 63-64.

The subject matter of independent claims 21 and 41, and claims dependent therefrom, is also adequately described in the '787 patent.

To the extent that the subject matter of the rejected claims is supported by the disclosure of the '918 application, Burge is not available as prior art against the patentability of these claims.

With respect to the second issue, it is respectfully submitted that Burge does not disclose, teach or suggest a communications device such as a cellular telephone which is arranged to transmit output from a diagnostic system to a remote facility. Rather, in Burge, the on-board data system 80 transmits data from on-board sensors 300 to the remote facility and there is no processing of the data to determine, for example, a diagnosis relating to the occupancy or condition of the vehicle.

Since Burge does not disclose processing sensor data on a vehicle to obtain a diagnosis of the vehicle and then transmitting the diagnosis via a communications device to a remote facility, one skilled in the art could not have combined Burge with Abe to arrive at the embodiments of the invention set forth in at least independent claims 21 and 41.

In view of the arguments presented above, it is respectfully submitted that the Examiner's rejection of claims 3, 6, 7, 11, 16, 18-25, 27-29, 31-33, 38-44, 46, 48-50 and 53-56 under 35 U.S.C. §103(a) as being unpatentable over Abe in view of Burge has been overcome and should be removed.

Claims 5, 8, 26, 30, 45 and 47 were rejected under 35 U.S.C. §103(a) as being unpatentable over Abe in view of Burge and furthering view of Woll et al. (U.S. Pat. No. 5,581,464).

Woll et al. does not disclose all of the features of independent claims 1, 21 and 41, upon which claims 5, 8, 26, 30, 45 and 47 depend, and therefore does not overcome the deficiencies of the combination of Abe and Burge.

In view of the foregoing, it is respectfully submitted that the Examiner's rejections of the claims have been overcome and should be removed and that the present application is now in condition for allowance. If there should be any remaining informalities which can be attend to by telephone, the Examiner is respectfully requested to contact the undersigned to discuss the case.

New Claims

Claims 57-62 are presented. Claim 57 is an independent claim corresponding to original claim 12 rewritten in independent form. Claim 58 is an independent claim corresponding to original claim 13 rewritten in independent form. Claims 59 and 60 correspond to original claims 14 and 15, respectively, but depend from claim 58. In view of the Examiner's indication of allowable subject matter in claims 12-15, claims 57-60 should be allowable over the prior art of record.

Claims 61 and 62 depend from claims 21 and 41, respectively, and are directed to the feature of a communications channel being automatically established between the vehicle and the remote facility without manual intervention to thereby enable the output to be transmitted from the vehicle to the remote facility.

Two independent claims in excess of three are presented and six further claims in excess of twenty are presented. The additional filing fee of $140.00 should be charged to Deposit Account No. 50-0266.

An early and favorable action on the merits upon entry and consideration of this amendment is earnestly solicited.

FOR THE APPLICANT
Respectfully submitted,

Brian Roffe
Reg. No. 35,336

Brian Roffe, Esq.
11 Sunrise Plaza, Suite 303
Valley Stream, New York 11580-6111
Tel.: (516) 256-5636
Fax: (516) 256-5638

Transaction History Date: 2003-12-09
Date information retrieved from USPTO Patent Application Information Retrieval (PAIR) system records at www.uspto.gov

Notice of Allowability	Application No.	Applicant(s)
	10/188,673	BREED, DAVID S.
	Examiner	Art Unit
	Yonel Beaulieu	3661

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--
All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendments/arguments filed 27 Oct. 2003.
2. ☒ The allowed claim(s) is/are 1-62.
3. ☒ The drawings filed on 03 July 2002 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____.
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.
5. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
   (a) ☐ The translation of the foreign language provisional application has been received.
6. ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE**

7. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
8. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No. ____.
   (b) ☐ including changes required by the proposed drawing correction filed _____, which has been approved by the Examiner.
   (c) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No. _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the margin according to 37 CFR 1.121(d).

9. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1☐ Notice of References Cited (PTO-892)
2☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No. 2
4☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5☐ Notice of Informal Patent Application (PTO-152)
6☐ Interview Summary (PTO-413), Paper No._____.
7☐ Examiner's Amendment/Comment
8☒ Examiner's Statement of Reasons for Allowance
9☐ Other

YONEL BEAULIEU
PRIMARY EXAMINER

U.S. Patent and Trademark Office
PTOL-37 (Rev. 11-03) Notice of Allowability Part of Paper No. 06

Allowable Subject Matter

Claims 1 – 62 are allowed. The following is a statement of reasons for such an indication.

The prior art of record fail to suggest arranging a diagnostic system comprising a plurality of sensors (including RFID interrogator device or SAW sensor arranged to receive a signal and a return signal) on a vehicle to diagnose the state of the vehicle or the state of a component of the vehicle provided by the respective sensor, wherein, through a communication device, the arrangement automatically establishes a communication channel between the vehicle and a remote facility without manual intervention and wirelessly transmits thereto – the output transmission being indicative or representative of the diagnosed state and the remote facility receiving the diagnosed state from a satellite.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yonel Beaulieu whose telephone number is (703) 305-4072. The examiner can normally be reached on M-R, from 0900-1600.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William A. CUCHLINSKI can be reached on (703) 308-3873. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-7687.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1113.

Y. BEAULIEU
AU 3661
703-305-4072

YONEL BEAULIEU
PRIMARY EXAMINER

UNITED STATES PATENT AND TRADEMARK OFFICE

#7

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NOTICE OF ALLOWANCE AND FEE(S) DUE

22846 7590 12/09/2003

BRIAN ROFFE, ESQ
11 SUNRISE PLAZA, SUITE 303
VALLEY STREAM, NY 11580-6170

EXAMINER	
BEAULIEU, YONEL	
ART UNIT	PAPER NUMBER
3661	

DATE MAILED: 12/09/2003

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-296	4201

TITLE OF INVENTION: TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$665	$300	$965	03/09/2004

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status is changed, pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above and notify the United States Patent and Trademark Office of the change in status, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

❑ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 10/03) Approved for use through 04/30/2004.

I T B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
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Alexandria, Virginia 22313-1450

or Fax (703) 746-4000

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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22846 7590 12/09/2003

BRIAN ROFFE, ESQ
11 SUNRISE PLAZA, SUITE 303
VALLEY STREAM, NY 11580-6170

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-296	4201

TITLE OF INVENTION: TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$665	$300	$965	03/09/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
BEAULIEU, YONEL	3661	701-029000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 __________
2 __________
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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

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Please check the appropriate assignee category or categories (will not be printed on the patent); ❑ individual ❑ corporation or other private group entity ❑ government

4a. The following fee(s) are enclosed:

❑ Issue Fee

❑ Publication Fee

❑ Advance Order - # of Copies __________

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❑ A check in the amount of the fee(s) is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number __________ (enclose an extra copy of this form).

Director for Patents is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.

(Authorized Signature) (Date)

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Alexandria, Virginia 22313-1450.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-256	4201

22846 7590 12/09/2003

BRIAN ROFFE, ESQ
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EXAMINER	
BEAULIEU, YONEL	
ART UNIT	**PAPER NUMBER**
3661	

DATE MAILED: 12/09/2003

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 27 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 27 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) system (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-296	4201

22846 7590 12/09/2003

BRIAN ROFFE, ESQ
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VALLEY STREAM, NY 11580-6170

EXAMINER	
BEAULIEU, YONEL	
ART UNIT	**PAPER NUMBER**
3661	

DATE MAILED: 12/09/2003

Notice of Fee Increase on October 1, 2003

If a reply to a "Notice of Allowance and Fee(s) Due" is filed in the Office on or after October 1, 2003, then the amount due will be higher than that set forth in the "Notice of Allowance and Fee(s) Due" since there will be an increase in fees effective on October 1, 2003. See Revision of Patent Fees for Fiscal Year 2004; Final Rule, 68 Fed. Reg. 41532, 41533, 41534 (July 14, 2003).

The current fee schedule is accessible from (http://www.uspto.gov/main/howtofees.htm).

If the fee paid is the amount shown on the "Notice of Allowance and Fee(s) Due" but not the correct amount in view of the fee increase, a "Notice of Pay Balance of Issue Fee" will be mailed to applicant. In order to avoid processing delays associated with mailing of a "Notice of Pay Balance of Issue Fee," if the response to the Notice of Allowance is to be filed on or after October 1, 2003 (or mailed with a certificate of mailing on or after October 1, 2003), the issue fee paid should be the fee that is required at the time the fee is paid. If the issue fee was previously paid, and the response to the "Notice of Allowance and Fee(s) Due" includes a request to apply a previously-paid issue fee to the issue fee now due, then the difference between the issue fee amount at the time the response is filed and the previously-paid issue fee should be paid. See Manual of Patent Examining Procedure, Section 1308.01 (Eighth Edition, August 2001).

Effective October 1, 2003, 37 CFR 1.18 is amended by revising paragraphs (a) through (c) to read as set forth below.

Section 1.18 Patent post allowance (including issue) fees.

(a) Issue fee for issuing each original or reissue patent, except a design or plant patent:
By a small entity (Sec. 1.27(a)).................... $665.00
By other than a small entity....................... $1,330.00

(b) Issue fee for issuing a design patent:
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a. Serial No.	f. Foreign Priority	k. Print Claim(s)	p. PTO-1449
b. Applicant(s)	g. Disclaimer	l. Print Fig.	q. PTOL-85b
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22846 7590 12/09/2003

BRIAN ROFFE, ESQ
11 SUNRISE PLAZA, SUITE 303
VALLEY STREAM, NY 11580-6170

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Brian Roffe	(Depositor's name)
[signature]	(Signature)
March 1, 2004	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/188,673	07/03/2002	David S. Breed	ATI-296	4201

TITLE OF INVENTION: TELEMATICS SYSTEM FOR VEHICLE DIAGNOSTICS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$665	$300	$965	03/09/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
BEAULIEU, YONEL	3661	701-029000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Brian Roffe
2 ______
3 ______

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC.

(B) RESIDENCE: (CITY and STATE OR COUNTRY) DENVILLE, NEW JERSEY

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ individual ☒ corporation or other private group entity ☐ government

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☒ Issue Fee
☒ Publication Fee
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(Authorized Signature) [signature] (Date) 3/1/2004

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03/05/2004 SFELEKE2 00000182 500266 10188673

01 FC:2501 665.00 DA
02 FC:1504 300.00 DA
03 FC:8001 3.00 DA

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Pat. Rev.

*RETURN TO FMF - LOCATION 7540

#9

QUERY CONTROL FORM		RTIS USE ONLY
Application No. 10/188,673	Prepared by BAB	Tracking Number
Examiner-GAU Beaulieu - 3661	Date 3-29-04	Week Date
	No. of queries 2	

JACKET			
a. Serial No.	f. Foreign Priority	k. Print Claim(s)	p. PTO-1449
b. Applicant(s)	g. Disclaimer	l. Print Fig.	q. PTOL-85b
c. Continuing Data	h. Microfiche Appendix	m. Searched Column	r. Abstract
d. PCT	i. Title	n. PTO-270/328	s. Sheets/Figs
e. Domestic Priority	j. Claims Allowed	o. PTO-892	t. Other

SPECIFICATION

a. Page Missing
b. Text Continuity
c. Holes through Data
d. Other Missing Text
e. Illegible Text
f. Duplicate Text
g. Brief Description
h. Sequence Listing
i. Appendix
j. Amendments
k. Other

CLAIMS

a. Claim(s) Missing
b. Improper Dependency
c. Duplicate Numbers
d. Incorrect Numbering
e. Index Disagrees
f. Punctuation
g. Amendments
h. Bracketing
i. Missing Text
j. Duplicate Text
k. Other

MESSAGE 1) Sheets/Figs: Fig. 32A has not been labeled, see yellow tab.

2) Brief Description: pg. 23 cites Fig. 35A, drwgs. show Fig. 36A, no figure 35A found in the drwgs.

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E-5 (Rev. 10/15/02) *LOCATION 7540

CODE SHEET FOR CONTINUING DATA

Line	Code	Serial No.	Filing Date	Status	Document No.	Issue Date
104	72	09/753186	1/2/01	01	6484080	
105	82	09/137918	8/20/98	01	6175787	
106	82	08/476077	6/17/95	01	5809437	
107	89	10/188673				
108	72	10/079,065	2/19/02			
109	82	09/765,558	1/19/00			
110	89	10/188,673				
111	82	10/174,709	6/19/02			
112	68	60/304,013	7/9/01			
113	68	60/291,511	5/16/01			
114	68	60/269,415	2/16/01			
115	68	60/231,378	9/08/00			
116						
117						

Condition and Status Codes for Continuing Data

CONDITION CODE

71	Continuation of application No.
81	which is a continuation of application No.
91	and a continuation of application No.
72	Continuation-in-part of application No.
82	which is a continuation-in-part of application No.
75	and a continuation-in-part of application No.
74	Division of application No.
84	which is a division of application No.
76	and a division of application No.
86	, said application No.
89	Application No.
90	and application No.
92	each
65	filed as application No.
66	Substitute for application No.
68	Provisional application No.

STATUS CODE

01	Patent No.
03	abandoned
04	SIR No.

NOTE I: When the codes 86 and 92 are used, they must be followed by 81, 82 or 84 – conditions beginning with "which is"

NOTE II: Codes 71, 72 and 74 may be used only on the first line; one of them must be used on the first line in regular continuing data. 66 or 68 may be used on the first line in Substitute or Provisional cases. Remember, however, that if there is a Provisional and other continuing data, the Provisional is always listed last.

E-6 (Re[illegible]ed 10/05/00)

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2001

Application or Docket Number: ATT - 296

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	56	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	56 minus 20=	* 36
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐ OR OTHER THAN SMALL ENTITY

SMALL ENTITY RATE	FEE	OR	OTHER THAN SMALL ENTITY RATE	FEE
BASIC FEE	370.00	OR	BASIC FEE	740.00
X$ 9=	324	OR	X$18=	
X42=	—	OR	X84=	
+140=	—	OR	+280=	
TOTAL	694	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 62	Minus	** 56	= 6
Independent	* 5	Minus	*** 3	= 2
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
X$ 9=	54	OR	X$18=	
~~X42=~~ X43	86	OR	X84=	
+140=	—	OR	+280=	
TOTAL ADDIT. FEE	146-	OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

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MPI Family Report (Family Bibliographic and Legal Status)

In the MPI Family report, all publication stages are collapsed into a single record, based on identical application data. The bibliographic information displayed in the collapsed record is taken from the latest publication.

Report Created Date: 2012-02-03

Name of Report:

Number of Families: 1

Comments:

Table of Contents

Family1

839 records in the family, collapsed to 541 records.

AR072139A1 20100811

[no drawing available]

(SPA) POLIMORFOS CRISTALINOS DE GEMCITABINA BASE

Assignee: SCINOPHARM TAIWAN LTD TW

Inventor(s): SHIEH CHIA-LIN CHARLENE TW ; CHEN SHU-PING TW

Application No: AR P090102153 A

Filing Date: 20090612

Issue/Publication Date: 20100811

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y;

IPC (International Class): C07H019073; A61K031522; A61K031513; A61P03500

ECLA (European Class): C07H019073

Publication Language: SPA

Legal Status: There is no Legal Status information available for this patent

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AT443946T 20091015

(GER) TASTATURSYSTEM MIT AUTOMATISCHER KORREKTUR

[no drawing available]

Assignee: TEGIC COMMUNICATIONS INC US

Inventor(s): ROBINSON B US ; LONGE MICHAEL US

Application No: AT 00937879 T

Filing Date: 20000526

Issue/Publication Date: 20091015

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F01722; H03K01794; G09G00500; B41J00514; G06F003041; B41J00512; H03M01104; G06F003048; B41J00510; B41J00516; B41J00508; H03M01100; G06F003033; G06F01727; G06F003023

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status:

Date	+/-	Code	Description
20100315	()	RER	

AU1526299A 19990607

(ENG) Apparatus and method for adjusting a vehicle component

Assignee: AUTOMOTIVE TECH INT

[no drawing available]

Inventor(s): BREED DAVID S ; DUVALL WILBUR E ; MORIN JEFFREY L

Application No: AU 1526299 D

Filing Date: 19981116

Issue/Publication Date: 19990607

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

Priority Data: US 97082297 19971114 A Y; US 12849098 19980804 A Y; US 9824487 19981116 W W N;

IPC (International Class): B60N00244; B60R02116; G01S01587; B60N00206; B60N00202; G01S01588; B60N00200; B60R02101; B60N00228; G01G019414; B60N00248; B60R021276; B60R021015; G01S01506; B60R02228; B60R02120; B60R02220; B60R02246; B60R021203

Legal Status:

Date	+/-	Code	Description
20000727	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU1820200A 20000605

(ENG) Apparatus and method for measuring weight of an occupying item of a seat

[no drawing available]

Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S ; DUVALL WILBUR E ; MORIN JEFFREY L

Application No: AU 1820200 D

Filing Date: 19991115

Issue/Publication Date: 20000605

Abstract: NotAvailable

Priority Data: US 19320998 19981117 A Y; US 9927098 19991115 W W N;

IPC (International Class): G01G01912; B60R02116; G01G01952; B60N00244; B60N00266; B60N00202; B60N002015; B60N00200; B60N00248; B60N00206; B60R02101; B60N00268; B60N00228; B60R021015

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206; B60N00206S; B60N00228B2; B60N00228P4; B60N00248C; B60N00248C2C; B60N00248C3C; B60N00266; B60N00268

Legal Status:

Date	+/-	Code	Description
20010809	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU1958801A 20010625

(ENG) Interactive vehicle display system

[no drawing available]

Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S

Application No: AU 1958801 D

Filing Date: 20001212

Issue/Publication Date: 20010625

Abstract: NotAvailable

Priority Data: US 17097399 19991215 P Y; US 64570900 20000824 A Y; US 0033566 20001212 W W N;

IPC (International Class): G02B02701; G02B02700

ECLA (European Class): G02B02701

Legal Status:

Date	+/-	Code	Description
20020815	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU2002321216A1 20030129

(ENG) Protease inhibitor conjugates and antibodies useful in immunoassay

[no drawing available]

Assignee: ROCHE DIAGNOSTICS GMBH

Inventor(s): METZ SIGRUN ; SIGLER GERALD F ; DERAS INA ; HUBER ERASMUS J ; GHOSHAL MITALI ; HUI RAYMOND ; ELTZ HERBERT W VON DER ; ROOT RICHARD TERRY

Application No: AU 2002321216 A

Filing Date: 20020715

Issue/Publication Date: 20030129

Abstract: NotAvailable

Priority Data: EP 0207843 20020715 W W; US 19205202 20020710 A; US 30519201 20010713 P;

IPC (International Class): C07K01638

ECLA (European Class): C07K01638

Legal Status:

Date	+/-	Code	Description
20040408	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU2002353311A1 20030709

(ENG) COMPLEXITY SCALABILITY FOR FINE GRANULAR VIDEO ENCODING (FGS)

[no drawing available]

Assignee: KONINKL PHILIPS ELECTRONICS NV

Inventor(s): CHEN RICHARD ; SCHAAR MIHAELA VAN DER

Application No: AU 2002353311 A

Filing Date: 20021209

Issue/Publication Date: 20030709

Abstract: NotAvailable

Priority Data: IB 0205320 20021209 W W; US 2838601 20011221 A;

IPC (International Class): H04N00730; H04N00750; H04N00726

Legal Status:

Date	+/-	Code	Description
20040909	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU2003252043A1 20040209

(ENG) DYNAMIC DATABASE REORDERING SYSTEM

[no drawing available]

Assignee: AMERICA ONLINE INC

Inventor(s): BRADFORD ETHAN R ; KAY DAVID JON

Application No: AU 2003252043 A

Filing Date: 20030717

Issue/Publication Date: 20040209

Abstract: (ENG) The invention provides a process for selecting and ordering one or more sets of linguistic objects. The invention orders a current list of items for selection that comprises a first list of one or more items of a first language and a second list of one or more items of a second language, the current list of items being displayed in an order based on the first language having a priority over the second language. In response to a user selection of one item from the second list, the invention changes a priority for ordering a subsequent list of items to order the subsequent list of items based on the second language having a priority over the first language.

Priority Data: US 62186403 20030716 A Y; US 39725302 20020718 P Y; US 0322525 20030717 W W N;

IPC (International Class): G06F01722; G06F01727

ECLA (European Class): G06F003023M6; G06F01727P

Legal Status: There is no Legal Status information available for this patent

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AU2003252091A1 20040216

(ENG) CHINESE CHARACTER HANDWRITING RECOGNITION SYSTEM

[no drawing available]

Assignee: AMERICA ONLINE INC

Inventor(s): PALMER BRIAN ; LONGE MICHAEL R

Application No: AU 2003252091 A

Filing Date: 20030717

Issue/Publication Date: 20040216

Abstract: NotAvailable

Priority Data: US 20595002 20020725 A Y; US 0322776 20030717 W W N;

IPC (International Class): G06F003033; G06F00301; G06F00300; G06F003048; G06K00922

ECLA (European Class): G06F00301M; G06F003048A3G; G06K00922H

Legal Status: There is no Legal Status information available for this patent

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AU2003302178A1 20040714

(ENG) METHOD AND SYSTEM FOR REAL TIME NAVIGATION USING SATELLITE TRANSMITTED THREE-CARRIER RADIO SIGNALS AND IONOSPHERIC CORRECTIONS

[no drawing available]

Assignee: AGENCE SPATIALE EUROPEENNE

Inventor(s): HERNANDEZ-PAJARES MANUEL ; JUAN-ZORNOZA JOSE MIGUEL ; SANZ-SUBIRANA JAUME ; GARCIA-RODRIGUEZ ALBERTO

Application No: AU 2003302178 A

Filing Date: 20031216

Issue/Publication Date: 20040714

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0216227 20021219 A Y; FR 0350176 20031216 W W N;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Legal Status:

Date	+/-	Code	Description
20050922	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU2009257344A2 20110421
AU2009257344A1 20091217

(ENG) Crystalline polymorphs of gemcitabine base

[no drawing available]

Assignee: SCINOPHARM TAIWAN LTD

Inventor(s): SHIEH CHIA-LIN ; CHEN SHU-PING

Application No: AU 2009257344 A

Filing Date: 20090612

Issue/Publication Date: 20110421

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y; US 2009047190 20090612 W W N;

IPC (International Class): C07H019073; A61K031522

ECLA (European Class): C07H019073

Legal Status: There is no Legal Status information available for this patent

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AU2323692A 19930211

(ENG) IMPROVED TAPE SWITCH CRUSH SENSOR

[no drawing available]

Inventor(s): DAVID S BREED

Application No: AU 2323692 D

Filing Date: 19920709

Issue/Publication Date: 19930211

Abstract: NotAvailable

Priority Data: US 72775691 19910709 A Y;

IPC (International Class): H01H03514; B60R02101; B60R01948

ECLA (European Class): B60R0210136; B60R01948D; H01H03514E

Legal Status: There is no Legal Status information available for this patent

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AU3522500A 20000928

(ENG) Methods and apparatus for preventing vehicle accidents

Assignee: INTELLIGENT TECH INT INC

[no drawing available]

Inventor(s): BREED DAVID S ; DUVALL WILBUR E ; JOHNSON WENDELL C

Application No: AU 3522500 D

Filing Date: 20000310

Issue/Publication Date: 20000928

Abstract: (ENG) System and method for preventing vehicle accidents in which the absolute position of the vehicle is determined, e.g., using a satellite-based positioning system (44) such as GPS, and the location of the vehicle relative to the edges of the roadway is then determined based on the absolute position of the vehicle and stored data (46) relating to edges of roadways on which the vehicle may travel. A system or component within the vehicle is initiated, e.g., an alarm or warning system (50), or the operation of a system or component is affected, e.g., an automatic guidance system (60), if the location of the vehicle approaches close to an edge of the roadway or intersects with an edge of the roadway.

Priority Data: US 12388299 19990311 P Y; US 0006236 20000310 W W N;

IPC (International Class): G08G001133; G01C02126; B60N00228; G08G00116

Legal Status:

Date	+/-	Code	Description
20020207	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

AU5299700A 20001218

(ENG) Keyboard system with automatic correction

Assignee: AMERICA ONLINE

[no drawing available]

Inventor(s): ROBINSON B ALEX ; LONGE MICHAEL R

Application No: AU 5299700 D

Filing Date: 20000526

Issue/Publication Date: 20001218

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F01722; G06F003041; G06F003048; H03M01104; H03K01794; G06F003033; G06F003023; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status:

Date	+/-	Code	Description
20020411	(-)	MK6	APPLICATION LAPSED SECTION 142(2)(F)/REG. 8.3(3) - PCT APPLIC. NOT ENTERING NATIONAL PHASE

BR0317446A 20051116

(POR) Processo e sistema de navegação em tempo real, com o auxìlio de sinais radioelétricos com três portadoras emitidos por satélites e de correções ionosféricas

[no drawing available]

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ-PAJARES MANUEL ;
JUAN-ZORNOZA JOSE MIGUEL ;
SANZ-SUBIRANA JAUME ;
GARCIA-RODRIGUEZ ALBERTO

Application No: BR 0317446 A

Filing Date: 20031216

Issue/Publication Date: 20051116

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0216227 20021219 A Y; FR 0350176 20031216 W W N;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Legal Status: There is no Legal Status information available for this patent

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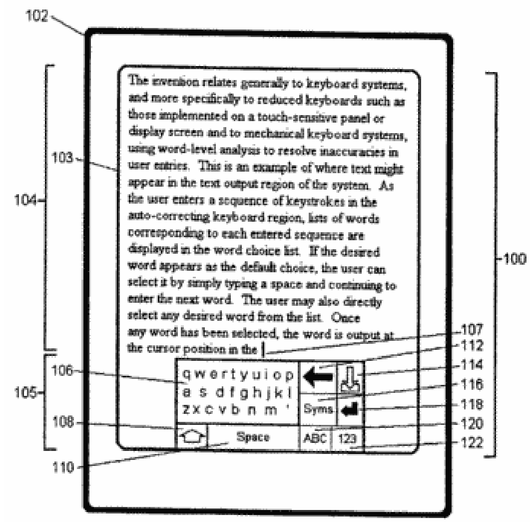
CA2392446C 20090714
CA2392446A1 20001207



(ENG) KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

Assignee: AMERICA ONLINE INC US

Inventor(s): ROBINSON B ALEX US ; LONGE MICHAEL R US

Application No: CA 2392446 A

Filing Date: 20000526

Issue/Publication Date: 20090714

Abstract: (ENG) An enhanced text entry system using word-level analysis to auto-matically correct inaccuracies in user keystroke entries on reduced keyboards. The keyboard (105) may be a part of a touch-sensitive panel or display screen (100) or on a mechanical keyboard system. A method and system are defined which determine one or more alternative textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region (106). The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. The user can easily select the intended word from among the generated interpretations.

Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F003041; G06F01722; G06F003048; H03M01104; G06F01727; H03K01794; G06F003033; G06F003023; G09G00500

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent

CA2449243A1 20030123

(ENG) PROTEASE INHIBITOR CONJUGATES AND ANTIBODIES USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: HOFFMANN LA ROCHE CH

Inventor(s): METZ SIGRUN DE ; HUBER ERASMUS J DE ; VON DER ELTZ HERBERT W DE ; DERAS INA US ; HUI RAYMOND US ; GHOSHAL MITALI US ; SIGLER GERALD F US ; ROOT RICHARD TERRY US

Application No: CA 2449243 A

Filing Date: 20020715

Issue/Publication Date: 20030123

Priority Data: EP 0207843 20020715 W V; US 30519201 20010713 P X; US 19205202 20020710 A X;

IPC (International Class): C12N00518; C07K01600; C12N00512; A61P03112; C07D40114; C07D41714; C07D27728; A61K031341; A61K03838; A61K039385; A61K03842; A61K031427; A61K031435; C07K01644; A61K031472; A61K0314725; A61K04748; A61K031496; A61K031513; C07K014765; C07K014805

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent

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CA2452157A1 20040118

(ENG) DYNAMIC DATABASE REORDERING SYSTEM

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): BRADFORD ETHAN R US ; KAY DAVID JON US

Application No: CA 2452157 A

Filing Date: 20030717

Issue/Publication Date: 20040118

Abstract: (ENG) A dynamic database reordering system provides a linguistics database that contains words that are ordered according to a linguistics model that dictates the order in which words are presented to a user. While a user enters keystrokes on a keypad of a communications device is pressing keys, the invention predicts the word s, letters, numbers, or word stubs that the user is trying to enter. The invention reorders the linguistics model order based on the user's usage of the system by tracking the user's word selections. Once a word has been selected as a resu lt of a next key selection (the nexted word), a frequency value is applied to the selected word and the word ordered first by the linguistics model in the linguistics database for that key sequence. The frequency value of the nexted word will become greater than the frequency value of the first displayed word upon repeated nexting t o the same word. Subsequent user entries of the key sequence for the nexted word a nd the first ordered word will result in displaying the nexted word before the word ordered first by the linguistics model.

Priority Data: US 62186403 20030716 A Y; US 39725302 20020718 P Y; US 0322525 20030717 W W N;

IPC (International Class): G06F01722; G06F01727

ECLA (European Class): G06F003023M6; G06F01727P

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20040109	(+)	AFNE	NATIONAL PHASE ENTRY
20040226	(+)	AFNE	NATIONAL PHASE ENTRY Effective date: 20040109;
20040226	(+)	AFNE	NATIONAL PHASE ENTRY Effective date: 20040109;
20050721	(+)	EEER	EXAMINATION REQUEST
20100913	()	FZDE	Effective date: 20100719;

CA2482232A1 20050324

(ENG) PROTEASE INHIBITOR CONJUGATES AND ANTIBODIES USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: HOFFMANN LA ROCHE CH

Inventor(s): KERN PETER DE ; HUI RAYMOND A US ; GHOSHAL MITALI US ; SIGLER GERALD F US ; DERAS INA US ; HUBER ERASMUS DE ; ROOT RICHARD TERRY US ; VON DER ELTZ HERBERT US ; METZ SIGRUN DE

Application No: CA 2482232 A

Filing Date: 20040920

Issue/Publication Date: 20050324

Priority Data: US 66983103 20030924 A;

IPC (International Class): C12N00518; C07D49504; C07D41712; C07D40114; C07K01638

ECLA (European Class): C07K01644

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20040920	(+)	EEER	EXAMINATION REQUEST
20050407	(+)	EEER	EXAMINATION REQUEST Effective date: 20040920;
20050407	(+)	EEER	EXAMINATION REQUEST Effective date: 20040920;
20070920	(-)	FZDE	DEAD

CA2521362A1 20041028

(ENG) DIRECTIONAL INPUT SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; PALMER BRIAN US

Application No: CA 2521362 A

Filing Date: 20040409

Issue/Publication Date: 20041028

Abstract: (ENG) A system associated with a text entry application, such as email or instant messaging, comprises an optional onscreen representation of a circular keyboard, a list of potential linguistic object matches, and a message area where the selected words are entered. The circular keyboard is manipulated v ia a hardware joystick or game-pad with analog joystick or omni-directional rocker switch built therein. The user points the joystick in the general direction of the desired letter, and then continues pointing roughly to each letter in the desired word. Once all letters have been roughly selected, buttons are used to select a specific word from the list of potential matche s and send the selected word to the message area.

Priority Data: US 46173503 20030409 P Y; US 67789003 20031001 A Y; US 2004011343 20040409 W W N;

IPC (International Class): G06F003048; G06F003033; G06F003023

ECLA (European Class): G06F003048A1M; G06F003023M6; G06F003023M8

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20051003	(+)	AFNE	NATIONAL PHASE ENTRY
20051003	(+)	EEER	EXAMINATION REQUEST
20100606	()	FZDE	Effective date: 20100409;

CA2550669A1 20050714

(ENG) VIRTUAL KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): VAN MEURS PIM US ; LONGE MICHAEL R US

Application No: CA 2550669 A

Filing Date: 20041222

Issue/Publication Date: 20050714

Abstract: (ENG) An enhanced text entry system (100) which uses word-level analysis to correc t inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards (105). A method and system determine alternate textual interpretations of each sequence of inputs detected within a designated auto - correcting region (106). The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed, where the distance from each interaction location to each corresponding intended character may increase with the expected frequency of the intended word in the language. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of th e word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 53213103 20031222 P Y; US 1951704 20041220 A Y; US 2004043329 20041222 W W N;

IPC (International Class): G09G00500; G06K00918; G06F01727; G06F003048; G06K00934; G06K00948; G06K00972

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20060619	(+)	AFNE	NATIONAL PHASE ENTRY
20060620	(+)	AFNE	NATIONAL PHASE ENTRY
20060620	(+)	EEER	EXAMINATION REQUEST

CA2578154A1 20070709

(ENG) ASSET PERFORMANCE OPTIMIZATION

Assignee: PRENOVA US

[no drawing available]

Inventor(s): CHAMBERS GREGORY L US ; GOLDEN PATRICK T US ; VAN METER KENNETH US ; SMITH EDWARD M US

Application No: CA 2578154 A

Filing Date: 20070109

Issue/Publication Date: 20070709

Abstract: (ENG) Included are embodiments for asset management. At least one embodiment of a method includes receiving, at a performance assessment and optimization center, data from at least one asset, the asset being configured to service an environment and performing at least one calculation, from the received data, to determine whether the asset is operating properly. Some embodiments include in response to a determination that the at least one asset is not operating properly, providing an indication related to operation of the asset.

Priority Data: US 75744606 20060109 P Y; US 61983807 20070104 A Y; US 2007060271 20070109 W W N;

IPC (International Class): G06Q04000; G06Q05000

ECLA (European Class): G05B01502; G06Q01000C

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20070227	(+)	AFNE	NATIONAL PHASE ENTRY
20111123	()	EEER	Effective date: 20111114;

CA2727813A1 20091217

(ENG) CRYSTALLINE POLYMORPHS OF GEMCITABINE BASE

Assignee: SCINOPHARM TAIWAN LTD TW

[no drawing available]

Inventor(s): CHEN SHU-PING TW ; SHIEH CHIA-LIN TW

Application No: CA 2727813 A

Filing Date: 20090612

Issue/Publication Date: 20091217

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y; US 2009047190 20090612 W W N;

IPC (International Class): C07H019073; C07H01906; A61K0317068; A61K00914

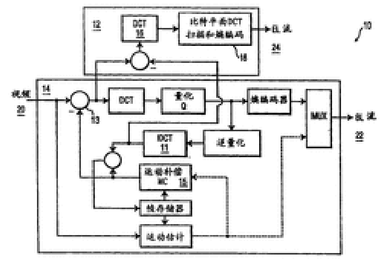
ECLA (European Class): C07H019073

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20110210	()	EEER	Effective date: 20101213;

CN1310518C 20070411
CN1623332A 20050601



(ENG) Delamination video frequency coding system, decoding system and its coding method and decoding method

Assignee: KONINKL PHILIPS ELECTRONICS NV NL

Inventor(s): MIHAELA CHEN RICHARD VAN DER S NL

Application No: CN 02825368 A

Filing Date: 20021209

Issue/Publication Date: 20070411

Abstract: (ENG) An encoder and decoder system for realization of complexity scalability in a layered video-coding framework. The layered video encoder comprises a base layer encoder for receiving a video signal and outputting a base layer stream; and an enhancement layer encoder that includes a plurality of discrete cosine transform (DCT) modules and a selection system for selecting one of the DCT modules. The layered video decoding system comprises a base layer decoder for receiving and decoding a base layer video stream; and an enhancement layer decoder for receiving an enhancement layer video stream and the decoded base layer stream, and generating a decoded enhanced video output, wherein the enhancement layer decoder includes: a plurality of inverse discrete cosine transform (IDCT) modules; and a selection system for selecting one of the IDCT modules.

Priority Data: US 2838601 20011221 A Y;

IPC (International Class): H04N00730; H04N00750; H04N00726

ECLA (European Class): H04N00726E2; H04N00730H; H04N00750

Legal Status:

Date	+/-	Code	Description
[illegible]	()	[illegible]	

CN100428224C 20081022
CN1703693A 20051130

(ENG) Dynamic database reordering system

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): JON KAY DAVID US

Application No: CN 03800789 A

Filing Date: 20030717

Issue/Publication Date: 20081022

Abstract: NotAvailable

Priority Data: US 39725302 20020718 P Y;

IPC (International Class): G06F01728; G06F01721; G06F01500; G06F00302; G09G00500

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
[illegible]	()	[illegible]	

CN100550036C 20091014
CN1606753A 20050413

(ENG) Chinese character handwriting recognition system

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): BRIAN PALMER US

Application No: CN 03801752 A

Filing Date: 20030717

Issue/Publication Date: 20091014

Abstract: (ENG) A handwritten Chinese character input method and system is provided to allow users to enter Chinese characters to a data processor by adding less than three strokes and one selection movement such as mouse clicking or stylus or finger tapping. The system is interactive, predictive, and intuitive to use. By adding one or two strokes which are used to start writing a Chinese character, or in some case even no strokes are needed, users can find a desired character from a list of characters. The list is context sensitive. It varies depending on the prior character entered. Compared to other existing systems, this system can save users considerable time and efforts to entering handwritten characters.

Priority Data: US 20595002 20020725 A Y;

IPC (International Class): G06K00900; G09B01104; H03K01794; G06K00918; G09B00100; G09B01900; G06K00962; G06F01500; G09B01100; G06K00922; G06F003033; G06F00301; G06F00300; G06F003048

ECLA (European Class): G06F00301M; G06F003048A3G; G06K00922H

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description

20091014	()	C14	

CN1726406B 20110817
CN1726406A 20060125

(ENG) Method and system for real time navigation using satellite transmitted three-carrier radio signals and ionospheric corrections

[no drawing available]

Assignee: EUROP AGENCE SPATIALE

Inventor(s): MANUEL HERNANDEZ-PAJARES ; JAUME SANZ-SUBIRANA ; MIGUEL JUAN-ZORNOZA JOSE ; ALBERTO GARCIA-RODRIGUEZ

Application No: CN 200380106136 A

Filing Date: 20031216

Issue/Publication Date: 20110817

Abstract: (ENG) The invention concerns a real-time navigation method for locating a rover using three-carrier radio signals of three different frequencies to determine the position of a user, transmitted by satellites. The method comprises a first step for determining "extra-wide lane" carrier phase ambiguity, a second step for estimating "wide-lane" phase ambiguity, and a third step for resolving the phase ambiguity of one of the frequencies. An additional step consists in the application of real-time ionospheric corrections during the third step, these ionospheric corrections being based on a continuously updated ionospheric model of said ionospheric layer calculated by a fixed ground reference station combined with geodetic data calculated by a so-called master fixed ground reference station. The invention also concerns a system for implementing the method.

Priority Data: FR 0350176 20031216 W W N; FR 0216227 20021219 A Y;

IPC (International Class): G01S00514; G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00100

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
20110817	()	C14	

CN100419651C 20080917
CN1624641A 20050608

(ENG) Directional input system with automatic correction

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): BRIAN PALMER US ; CHARLES HULLFISH KEITH US ; DOUG BRAMS US

Application No: CN 200410030896 A

Filing Date: 20040409

Issue/Publication Date: 20080917

Abstract: (ENG) A system associated with a text entry application, such as email or instant messaging, comprises an optional onscreen representation of a circular keyboard, a list of potential linguistic object matches, and a message area where the selected words are entered. The circular keyboard is manipulated via a hardware joystick or game-pad with analog joystick or omni-directional rocker switch built therein. The user points the joystick in the general direction of the desired letter, and then continues pointing roughly to each letter in the desired word. Once all letters have been roughly selected, buttons are used to select a specific word from the list of potential matches and send the selected word to the message area.

Priority Data: US 46173503 20030409 P Y; US 67789003 20031001 A Y;

IPC (International Class): G06F003033; G06F003048; G06F003023

ECLA (European Class): G06F003048A1M; G06F003023M6; G06F003023M8

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
[illegible]	()	[illegible]	

CN1655107A 20050817

(ENG) Keyboard system with automatic correction

[no drawing available]

Assignee: AMERICA ONLINE SERVICE INC US

Inventor(s): ALEX ROBINSON B US ; LONGE MICHAEL R US

Application No: CN 200410050006 A

Filing Date: 20040625

Issue/Publication Date: 20050817

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 77548304 20040209 A N; US 13661399 19990527 P Y;

IPC (International Class): G06F01722; G06F003041; G06F003048; H03M01104; H03K01794; G06F003033; G06F003023; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status:

Date	+/-	Code	Description
20050817	()	C02	

CN1648837A 20050803

(ENG) Selective input system based on tracking of motion parameters of an input device

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): JAMES STEPHANICK US ; CHRISTINA JAMES US ; BRADFORD ETHAN R US ; LONGE MICHAEL R US

Application No: CN 200410069379 A

Filing Date: 20040721

Issue/Publication Date: 20050803

Abstract: (ENG) A selective input system and associated method is provided which tracks the motion of a pointing device over a region or area. The pointing device can be a touchpad, a mouse, a pen, or any device capable of providing two or three-dimensional location. The region or area is preferably augmented with a printed or actual keyboard/pad. Alternatively, a representation of the location of the pointing device over a virtual keyboard/pad can be dynamically shown on an associated display. The system identifies selections of items or characters by detecting parameters of motion of the pointing device, such as length of motion, a change in direction, a change in velocity, and or a lack of motion at locations that correspond to features on the keyboard/pad. The input system is preferably coupled to a text disambiguation system such as a T9® or Sloppytype™ system, to improve the accuracy and usability of the input system.

Priority Data: US 50455203 20030919 P Y; US 67789003 20031001 A Y; US 88181904 20040628 A Y;

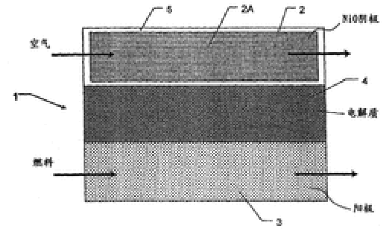
IPC (International Class): G06F003048; G06F003033; G06F003023; G09G00500

ECLA (European Class): G06F003048A3G; G06F003023M6; G06F003048A3T

Legal Status:

Date	+/-	Code	Description
20060818	()	REG	Corresponding country code for PRS Code (EP REG): HK; Corresponding EP Code 1 for PRS Code (EP REG): DE; Corresponding patent document: 1078356; Country code of corresponding patent document: HK;

CN101076913A 20071121



(ENG) Fused carbonate fuel battery cathode with mixed oxide coatings

Assignee: FUELCELL ENERGY INC US

Inventor(s): ZHAOYI HILMY A YU US

Application No: CN 200480040319 A

Filing Date: 20041201

Issue/Publication Date: 20071121

Abstract: (ENG) A molten carbonate fuel cell cathode having a cathode body and a coating of a mixed oxygen ion conductor materials. The mixed oxygen ion conductor materials are formed from ceria or doped ceria, such as gadolinium doped ceria or yttrium doped ceria. The coating is deposited on the cathode body using a sol-gel process, which utilizes as precursors organometallic compounds, organic and inorganic salts, hydroxides and alkoxides and which uses as the solvent water, organic solvent or a mixture of same.

Priority Data: US 75548304 20040112 A Y;

IPC (International Class): H01M00810; H01M00486; B05D00512; H01M00490; H01M00496; H01M00488; H01M00814

Legal Status:

Date	+/-	Code	Description
[illegible]	()	[illegible]	

CN100472600C 20090325
CN1954355A 20070425

(ENG) Virtual keyboard system with automatic text input correction

[no drawing available]

Assignee: AMERICA ONLINE SERVICE INC US

Inventor(s): PIM MEURS VAN US

Application No: CN 200480041535 A

Filing Date: 20041222

Issue/Publication Date: 20090325

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a

virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 53213103 20031222 P Y; US 1951704 20041220 A Y;

IPC (International Class): G09G00500; G06K00918; G06F01727; G06F003048; G06K00934; G06K00948; G06K00972

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description
[illegible]	()	[illegible]	

CN102216314A 20111012

NotAvailable

Application No: CN 200980131290 A

[no drawing available]

Filing Date: 20090612

Issue/Publication Date: 20111012

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 2009047190 20090612 W W N; US 13183508 20080612 P Y;

IPC (International Class): C07H019073; A61K031522

Legal Status:

Date	+/-	Code	Description
20111012	()	C06	

DE10084638T1 20020502

(GER) Methode fuer die Entwicklung des Systems von Identifizierung der Anwesenheit und Lage des Objekts im Fahrzeug

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US ; MORIN JEFFREY L US ; XU KUNHONG US ; VARGA ANDREW J US

Application No: DE 10084638 T

Filing Date: 20000530

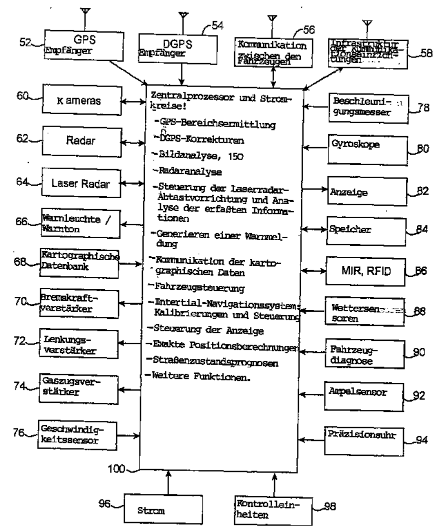
Issue/Publication Date: 20020502

Abstract: (ENG) Method for developing a system for determining the occupancy of a seat in a vehicle using a variety of transducers and pattern recognition technologies and techniques that applies to any combination of transducers that provide information about seat occupancy. These include weight sensors, capacitive sensors, inductive sensors, ultrasonic, optical, electromagnetic, motion, infrared, and radar among others. A processor coupled to the transducers for receiving the data from the transducers and processing the data to obtain an output indicative of the current occupancy state of the seat. An algorithm is resident in the processor and is created from a plurality of data sets, each representing a different occupancy state of the seat and being formed from data from the transducers while the seat is in that occupancy state. The algorithm produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from the transducers. The algorithm may be a neural network or neural fuzzy algorithm generated by an appropriate algorithm-generating program.

Priority Data: US 13616399 19990527 P Y; US 38240699 19990824 A Y; US 47414799 19991229 A Y; US 0014903 20000530 W W N;

IPC (International Class): G01V00100; G01V00312; B60N00244; G01V00308; B60R02116; G01S01508; B60R02101; G06K00900; B60R021015

Legal Status: There is no Legal Status information available for this patent



DE10149206A1 20030206

(GER) Verfahren und Vorrichtung zum Kartographieren einer Strasse sowie Unfallverhuetungssystem

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): CASTELLI VITTORIO US ; SEITZ WILLIAM E US ; DUVALL WILBUR E US ; BREED DAVID SCRANTON US ; JOHNSON WENDELL C US

Application No: DE 10149206 A

Filing Date: 20011002

Issue/Publication Date: 20030206

Abstract: (ENG) To map a road during travel, a vehicle has two data acquisition modules arranged on sides of the vehicle. Each includes a differential GPS (DGPS) receiver and antenna for enabling the vehicle's position to be determined and a linear camera which provides vertical one-dimensional images of an area on the respective side in a vertical plane perpendicular to the road such that information about the road is obtained from a view in a direction perpendicular to the road. A processor unit forms a map database of the road by correlating the vehicle's position and the information about the road. Instead of or in addition to the linear cameras, scanning laser radars are provided and transmit waves downward in a plane perpendicular to the road and receive reflected waves to provide information about distance between the laser radars and the ground for use in forming the database. The database is then used in a collision avoidance system. Equipped vehicles use the database in combination with a DGPS receiver to determine their position and velocity relative to the road. This is broadcast to other vehicles in the area, which compare the received position with their own position and velocity to give a warning of an imminent collision. The database may also include lane markings and road intersection information such as the edges of intersecting roads; this is used to prevent collisions at junctions. Traffic lights may transmit a signal warning of red lights. The GPS system may be supplemented by INS, video cameras, multiple local impulse transmitters, radar reflectors etc. A fully automated traffic control system is also envisaged.

Priority Data: US 90946601 20010719 A Y; US 67931700 20001004 A Y;

IPC (International Class): G05D00102; G01S00100; G01C02126; B60N00228; G01S01907; G01S01393; G08G00116; G01S01702; G01S01789

Legal Status:

Date	+/-	Code	Description
20090604	()	8170	Corresponding patent document: 10165057; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20090604	()	Q171	Corresponding patent document: 10165057; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20090604	()	R171	Corresponding patent document: 10165057; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20090604	()	R171	Corresponding patent document: 10165057; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;

DE19882381T1 20000713

(GER) Mustererkennungssystem

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: DE 19882381 T

Filing Date: 19980529

Issue/Publication Date: 20000713

Abstract: (ENG) A smart airbag system including a sensor mechanism for controlling the deployment of an occupant protection apparatus in a motor vehicle, such as a gas-inflatable airbag, to protect an occupant of the vehicle in a crash. The system includes a sensor mounted to the vehicle for sensing accelerations of the vehicle and producing an analog signal representative thereof; an electronic converter for receiving the analog signal from the sensor and for converting the analog signal into a digital signal, and a processor which receives the digital signal. The processor includes a pattern recognition system and produces a deployment control signal to a gas control module which controls the flow of gas into or out of the airbag to optimize the injury protection capability of the airbag. The system also accepts inputs from occupant position, velocity and weight sensors and/or anticipatory crash sensors, when such are available, and may affect the deployment control signal based on these inputs.

Priority Data: US 86552597 19970529 A Y; US 9810943 19980529 W W N;

IPC (International Class): B60R02116; G06G00760; G05B01302; G06N00300; B60R02101; B60R0210132; B60R02100; B60R0210134; B60R021015

Legal Status: There is no Legal Status information available for this patent

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DE19983715T1 20020307

(GER) Vorrichtung und Verfahren zum Messen des Gewichts eines Insassen bzw. Gegenstands auf einem Sitz

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: DE 19983715 T

Filing Date: 19991115

Issue/Publication Date: 20020307

Abstract: (ENG) An apparatus for measuring the weight of an occupying item of a seat (1056) including a support structure (1058, 1060, 1062) for mounting the seat (1056) to a substrate. The apparatus includes a strain gage transducer (1065, 1066) mounted on the support structure (1058, 1060, 1062) and arranged to provide a measurement of the stain of the support structure (1058, 1060, 1062) at the location at which it is mounted. A control system (1030) is coupled to the strain gage transducer (1065, 1066) for determining the weight of the occupying item of the seat (1056) based on the strain of the support structure (1058, 1060, 1062) measured by the strain gage transducer (1065, 1066). The weight measuring apparatus is used in a seat adjustment apparatus for adjusting a seat (1) in a passenger compartment of a vehicle including wave sensors (11, 12, 13, 14) for transmitting waves into the

passenger compartment toward the seat (1), receiving waves from the passenger compartment and generating an output representative of the waves received by the wave sensors (11, 12, 13, 14), and a processor (19, 20, 21, 22, 23, 24, 25, 26, 28, 29) for receiving the outputs from the wave sensors (11, 12, 13, 14) and the weight measuring apparatus and evaluating the seated-state of the seat (1) based thereon. The processor, e.g., directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat or to affect the deployment of an airbag.

Priority Data: US 19320998 19981117 A Y; US 9927098 19991115 W W N;

IPC (International Class): G01G01912; B60R02116; G01G01952; B60N00244; B60N00266; B60N00202; B60N002015; B60N00200; B60N00248; B60N00206; B60R02101; B60N00268; B60N00228; B60R021015

Legal Status: There is no Legal Status information available for this patent

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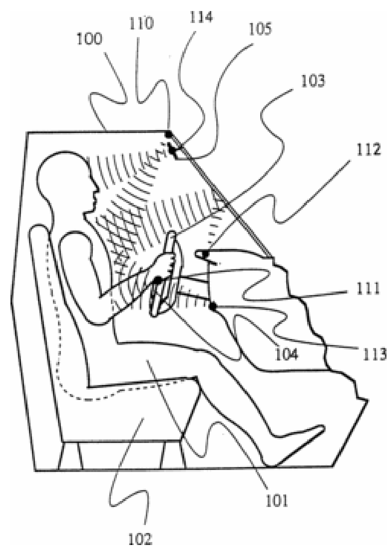


DE4447960B4 20070927

(ENG) Vehicle occupant position and velocity sensor for use in occupant restraint system - transmits ultrasonic waves to occupant and back using time period and frequency shift to determine position and velocity of occupant

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; CASTELLI VITTORIO US ; JOHNSON WENDELL C US ; DU VALL WILBUR E US ; PATEL RASHIK US

Application No: DE 4447960 A

Filing Date: 19940330

Issue/Publication Date: 20070927

Abstract: (ENG) The occupant position sensor determines the position of a vehicle occupant relative to a protective device such as an inflatable airbag, when the vehicle is subjected to a crash of sufficient magnitude to require the airbag. An ultrasonic generator transmits a burst of waves which travel to the occupant and back to a receiver. The time period required for the journey determines occupant position and the frequency shift determines the velocity of the occupant relative to the airbag. The airbag is then disabled if the occupant may be injured by its use.

Priority Data: US 4097893 19930331 A Y; DE 4492128 19940330 A 3 Y; DE 4448039 19940330 A Y;

IPC (International Class): B60R021015; B60R02101

ECLA (European Class): B60R021015

Legal Status:

Date	+/-	Code	Description
20061228	()	Q171	Corresponding patent document: 4448039; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20061228	()	R171	Corresponding patent document: 4448039; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20070927	( )	AC	DIVIDED OUT OF Corresponding patent document: 4492128; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;

20070927	( )	AH	DIVISION IN Corresponding patent document: 4448039; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20080327	(+)	8364	NO OPPOSITION DURING TERM OF OPPOSITION
20100121	()	8339	

DE4492128C2 20030102

(GER) Positions- und Geschwindigkeitssensor fuer Fahrzeuginsassen

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: DE 4492128 A

Filing Date: 19940330

Issue/Publication Date: 20030102

Abstract: (ENG) An occupant position sensor (110-114, 215) using either ultrasonic, microwave or optical technologies, or seat belt spool out (501) and seat position sensors (601), are used as inputs to the primary vehicle crash sensor circuit to permit the longest possible sensing time before the occupant gets proximate to the airbag (104) and is in danger of being injured by the deploying airbag. The sensor further disables the inflatable restraint system (104) if the occupant is in danger of being injured by the system deployment. Separate systems are used for the driver and passenger to permit the optimum decision to be made for each occupant.

Priority Data: US 4097893 19930331 A Y; US 9403455 19940330 W W N;

IPC (International Class): G01P003486; G01B01100; G01S01789; G01S01510; B60R02116; G01S007539; G01S01588; B60N00228; B60N00202; B60N00200; G06K00900; G01S01788; G01S01587; B60R02101; B60N00248; G01S00748; B60R02220; B60R00108; G01S00741; B60R0212165; B60R0210132; G01S01304; G01S01506; B60R02248; B60R021276; B60R021015; B60R02126; B60R02228; B60R0210134; B60R00112

ECLA (European Class): B60R021015; B60N00200C; B60N00202B; B60N00202B4; B60N00202B6B; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; B60R00108G5; B60R02220; G01S00741D; G01S00748A; G01S007539; G01S01587; G01S01588; G01S01788; G06K00900H

Legal Status:

Date	+/-	Code	Description
19970605	(+)	8110	REQUEST FOR EXAMINATION PARAGRAPH 44
20020919	( )	8607	NOTIFICATION OF SEARCH RESULTS AFTER PUBLICATION
20030102	(+)	D2	GRANT AFTER EXAMINATION
20030206	( )	8369	PARTITION IN: Corresponding patent document: 4447960; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20030206	()	R171	Corresponding patent document: 4447960; Country code of corresponding patent document: DE; Kind code of corresponding patent document: P;
20030626	(+)	8364	NO OPPOSITION DURING TERM OF OPPOSITION
20070301	( )	8381	INVENTOR (NEW SITUATION) Inventor name: PATEL, RASHIK, RIVERSIDE, CALIF., US;

20070301	( )	8381	INVENTOR (NEW SITUATION) Inventor name: DU VALL, WILBUR E., KIMBERLING, MO., US;
20070301	( )	8381	INVENTOR (NEW SITUATION) Inventor name: JOHNSON, WENDELL C., TORRANCE, CALIF., US;
20070301	( )	8381	INVENTOR (NEW SITUATION) Inventor name: CASTELLI, VITTORIO, YORKTOWN HEIGHTS, N.Y., US;
20070301	( )	8381	INVENTOR (NEW SITUATION) Inventor name: BREED, DAVID S., BOONTON, N.J., US;
20100121	()	8339	

DE4492128T1 19960627

(GER) Positions- und Geschwindigkeitssensor fuer Fahrzeuginsassen

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: DE 4492128 T

Filing Date: 19940330

Issue/Publication Date: 19960627

Abstract: (ENG) An occupant position sensor (110-114, 215) using either ultrasonic, microwave or optical technologies, or seat belt spool out (501) and seat position sensors (601), are used as inputs to the primary vehicle crash sensor circuit to permit the longest possible sensing time before the occupant gets proximate to the airbag (104) and is in danger of being injured by the deploying airbag. The sensor further disables the inflatable restraint system (104) if the occupant is in danger of being injured by the system deployment. Separate systems are used for the driver and passenger to permit the optimum decision to be made for each occupant.

Priority Data: US 4097893 19930331 A Y; US 9403455 19940330 W W N;

IPC (International Class): G01P003486; G01B01100; G01S01789; G01S01510; B60R02116; G01S007539; G01S01588; B60N00228; B60N00202; B60N00200; G06K00900; G01S01788; G01S01587; B60R02101; B60N00248; G01S00748; B60R02220; B60R00108; G01S00741; B60R0212165; B60R0210132; G01S01304; G01S01506; B60R02248; B60R021276; B60R021015; B60R02126; B60R02228; B60R0210134; B60R00112

Legal Status: There is no Legal Status information available for this patent

DE60043008D1 20091105

(GER) TASTATURSYSTEM MIT AUTOMATISCHER KORREKTUR

[no drawing available]

Assignee: TEGIC COMM INC US

Inventor(s): ROBINSON ALEX B US ; LONGE MICHAEL R US

Application No: DE 60043008 A

Filing Date: 20000526

Issue/Publication Date: 20091105

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

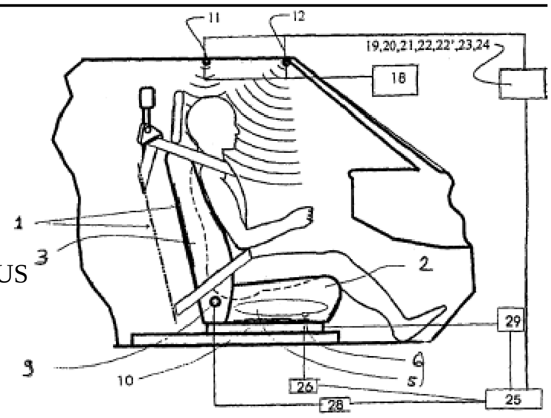
Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F01722; H03K01794; G09G00500; G06F003041; B41J00512; B41J00510; B41J00508; H03M01100; G06F003033; B41J00514; H03M01104; G06F003048; B41J00516; G06F003023; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status:

Date	+/-	Code	Description
20101014	()	R082	Corresponding patent document: 1192716; Country code of corresponding patent document: EP; Representative's name: TBK, 80336 MUENCHEN, DE;



DE69828585D1 20050217

(GER) GERAET UND VERFAHREN ZUM VERSTELLEN EINER FAHRZEUGKOMPONENTE

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED S US ; DUVALL E US ; MORIN L US

Application No: DE 69828585 A

Filing Date: 19981116

Issue/Publication Date: 20050217

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

Priority Data: US 97082297 19971114 A Y; US 12849098 19980804 A Y; US 9824487 19981116 W W N;

IPC (International Class): B60N00244; B60R02116; G01S01587; B60N00206; B60N00202; G01S01588; B60N00200; B60R02101; B60N00228; G01G019414; B60N00248; B60R021276; B60R021015; G01S01506; B60R02228; B60R02120; B60R02220; B60R02246; B60R021203

Legal Status:

Date	+/-	Code	Description
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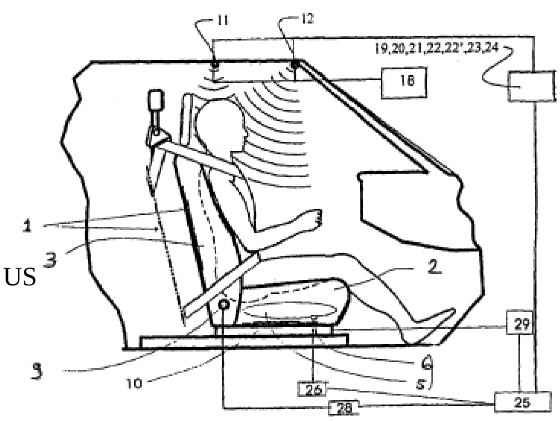
20100916	()	8339	



DE69828585T2 20060119

(GER) GERAET UND VERFAHREN ZUM VERSTELLEN EINER FAHRZEUGKOMPONENTE

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED S US ; DUVALL E US ; MORIN L US

Application No: DE 69828585 T

Filing Date: 19981116

Issue/Publication Date: 20060119

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

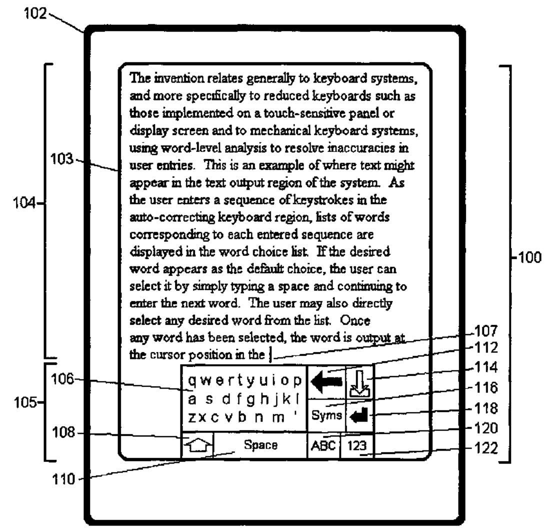
Priority Data: US 97082297 19971114 A Y; US 12849098 19980804 A Y; US 9824487 19981116 W W N;

IPC (International Class): B60N00244; B60R02116; B60R02101; B60N00204; B60N00202; G01S01587; B60N00200; G01G019414; B60N00248; B60N00206; B60N00228; G01S01588; B60R021203; G01S01506; B60R02220; B60R021276; B60R02246; B60R02228; B60R021015; B60R02120

Legal Status:

Date	+/-	Code	Description
20060330	(+)	8364	NO OPPOSITION DURING TERM OF OPPOSITION
20100916	()	8339	

EP1192716A1 20020403



(ENG) KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

Assignee: AMERICA ONLINE INC US

Inventor(s): ROBINSON B ALEX US ; LONGE MICHAEL R US

Application No: EP 00937879 A

Filing Date: 20000526

Issue/Publication Date: 20020403

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 0014684 20000526 W W N; US 13661399 19990527 P Y;

IPC (International Class): G06F01722; G06F003041; G06F003048; H03M01104; H03K01794; G06F003033; G06F003023; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Agent(s): Leeming, John Gerard J.A. Kemp & Co., 14 South Square, Gray's Inn, London WC1R 5JJ, GB GB

Legal Status:

Date	+/-	Code	Description

20020403	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20011105;
20020403	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A1; List of designated states: AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE;
20020403	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO : AL;LT;LV;MK;RO;SI;
20050309	(+)	A4	SUPPLEMENTARY SEARCH REPORT Effective date: 20050125;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7H 03K 17/94 A;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7H 03M 11/00 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7G 09G 5/00 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7B 41J 5/08 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7B 41J 5/10 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7B 41J 5/12 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7B 41J 5/14 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7B 41J 5/16 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7G 06F 3/033 B;
20050309	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: 7G 06F 3/023 B;
20070228	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20050706;
20070912	( )	RAP1	TRANSFER OF RIGHTS OF AN EP APPLICATION New owner name: TEGIC COMMUNICATIONS, INC.;
20090916	()	RIN1	Inventor name: ROBINSON, B., ALEX;
20090916	()	RIN1	Inventor name: LONGE , MICHAEL, R.;
20090923	()	AK	Kind code of corresponding patent document: B1; List of designated states: AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE;
20090923	()	REG	Corresponding country code for PRS Code (EP REG): GB; Corresponding EP Code 1 for PRS Code (EP REG): FG4D;
20090930	()	REG	Corresponding country code for PRS Code (EP REG): CH; Corresponding EP Code 1 for PRS Code (EP REG): EP;
20091028	()	REG	Corresponding country code for PRS Code (EP REG): IE; Corresponding EP Code 1 for PRS Code (EP REG): FG4D;
20091105	()	REF	Corresponding patent document: 60043008; Country code of corresponding patent document: DE; Publication date of corresponding patent document: 20091105; Kind code of corresponding patent document: P;
20091231	()	REG	Corresponding country code for PRS Code (EP REG): HK; Corresponding EP Code 1 for PRS Code (EP REG): WD; Corresponding patent document: 1046786; Country code of corresponding patent document: HK;
20100129	()	PG25	Corresponding country code for PRS Code (EP REG): FI; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20090923;
20100129	()	PG25	Corresponding country code for PRS Code (EP REG): SE; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20090923;
20100301	()	PG25	Corresponding country code for PRS Code (EP REG): CY; : LAPSE BECAUSE OF FAILURE TO SUBMIT A

			TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20090923;
20100430	()	PG25	Corresponding country code for PRS Code (EP REG): ES; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20100103;
20100430	()	PG25	Corresponding country code for PRS Code (EP REG): PT; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20100125;
20100630	()	PG25	Corresponding country code for PRS Code (EP REG): AT; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20090923;
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20100901	()	26N	Effective date: 20100624;
20101029	()	PG25	Corresponding country code for PRS Code (EP REG): GR; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20091224;
20101130	()	PGFP	Corresponding country code for PRS Code (EP REG): DE; Payment date: 20100630; Year of fee payment: 11;
20101130	()	PGFP	Corresponding country code for PRS Code (EP REG): GB; Payment date: 20100616; Year of fee payment: 11;
20101231	()	PG25	Corresponding country code for PRS Code (EP REG): MC; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20100531;
20101231	()	REG	Corresponding country code for PRS Code (EP REG): CH; Corresponding EP Code 1 for PRS Code (EP REG): PL;
20110228	()	PG25	Corresponding country code for PRS Code (EP REG): CH; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20100531;

20110228	()	PG25	Corresponding country code for PRS Code (EP REG): LI; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20100531;
20110331	()	PG25	Corresponding country code for PRS Code (EP REG): IT; : LAPSE BECAUSE OF FAILURE TO SUBMIT A TRANSLATION OF THE DESCRIPTION OR TO PAY THE FEE WITHIN THE PRESCRIBED TIME-LIMIT; Effective date: 20090923;
20110429	()	PG25	Corresponding country code for PRS Code (EP REG): IE; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20100526;

WO2003006506A3 20031106
WO2003006506A2 20030123

(ENG) PROTEASE INHIBITOR CONJUGATES AND ANTIBODIES USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: HOFFMANN LA ROCHE CH

Inventor(s): DERAS INA ; HUI RAYMOND ; METZ SIGRUN ; GHOSHAL MITALI ; HUBER ERASMUS J ; SIGLER GERALD F ; ROOT RICHARD TERRY ; VON DER ELTZ HERBERT W

Application No: EP 0207843 W

Filing Date: 20020715

Issue/Publication Date: 20031106

Abstract: Activated haptens useful for generating immunogens to HIV protease inhibitors, immunogens useful for producing antibodies to HIV protease inhibitors, and antibodies and labeled conjugates useful in immunoassays for HIV protease inhibitors. The novel haptens feature an activated functionality at the central, non-terminal hydroxyl group common to all HIV protease inhibitors, e.g., saquinavir, nelfinavir, indinavir, amprenavir, ritonavir and lopinavir.

Priority Data: US 30519201 20010713 P I; US 19205202 20020710 A I;

IPC (International Class): C12N00999; C07D40312; C07D40114; A61K03900; C07K01600; C07D40512; C12N00510; C07D41714; C12P02108; C07K01400; C07K01638

ECLA (European Class): C07K01638

Designated Countries:

----Designated States: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG UZ VN YU ZA ZM ZW

----Regional Treaties: AM AT AZ BE BF BG BJ BY CF CG CH CI CM CY CZ DE DK EE ES FI FR GA GB GH GM GN GQ GR GW IE IT KE KG KZ LS LU MC MD ML MR MW MZ NE NL PT RU SD SE SK SL SN SZ TD TG TJ TM TR TZ UG ZM ZW

Publication Language: ENG

Legal Status:

Date	+/-	Code	Description

20030123	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A2; List of designated states: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG UZ VN YU ZA ZM ZW;
20030123	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A2; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW AM AZ BY KG KZ MD RU TJ TM AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LU MC NL PT SE SK TR BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG;
20030319	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20031115	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2002754883; Country code of corresponding patent document: EP;
20031201	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2449243; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20031201	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2449243; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20031201	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2449243; Country code of corresponding patent document: CA;
20040108	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2003512276; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040108	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2003512276; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040108	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2003512276; Country code of corresponding patent document: JP;
20040226	( )	DFPE	REQUEST FOR PRELIMINARY EXAMINATION FILED PRIOR TO EXPIRATION OF 19TH MONTH FROM PRIORITY DATE (PCT APPLICATION FILED BEFORE 20040101)
20040421	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 2002754883; Country code of corresponding patent document: EP;
20040527	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;

EP1409546A2 20040421

(ENG) PROTEASE INHIBITOR CONJUGATES AND ANTIBODIES USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: HOFFMANN LA ROCHE CH

Inventor(s): METZ SIGRUN DE ; HUBER ERASMUS J DE ; VON DER ELTZ HERBERT W DE ; DERAS INA US ; HUI RAYMOND US ; GHOSHAL MITALI US ; SIGLER GERALD F US ; ROOT RICHARD TERRY US

Application No: EP 02754883 A

Filing Date: 20020715

Issue/Publication Date: 20040421

Abstract: (ENG) NotAvailable

Priority Data: EP 0207843 20020715 W V; US 30519201 20010713 P X; US 19205202 20020710 A X;

IPC (International Class): 19950101

Designated Countries:
----Designated States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR

Publication Language: ENG

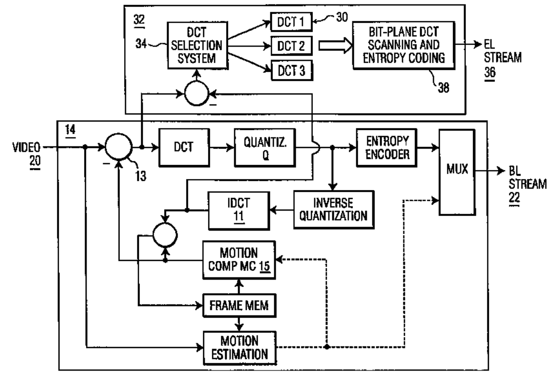
Filing Language: ENG

Agent(s): Schwarz, Ralf 00076354 Roche Diagnostics GmbH Patentabteilung 68298 Mannheim D

Date of Deferred Publication of Search Report:
--20031106

Legal Status:

Date	+/-	Code	Description
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: DERAS, INA;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: HUI, RAYMOND;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: SIGLER, GERALD, F.;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: HUBER, ERASMUS, J.;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: VON DER ELTZ, HERBERT, W.;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: GHOSHAL, MITALI;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: ROOT, RICHARD, TERRY;
20040519	( )	RIN1	INVENTOR (CORRECTION) Inventor name: METZ, SIGRUN;
20040707	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20040506;
20070124	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20061227;
20070124	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20061227;
20110309	()	18D	Effective date: 20100915;



EP1459560A1 20040922

(ENG) COMPLEXITY SCALABILITY FOR FINE GRANULAR VIDEO ENCODING (FGS)

Assignee: KONINKL PHILIPS ELECTRONICS NV NL

Inventor(s): CHEN RICHARD NL ; VAN DER SCHAAR MIHAELA NL

Application No: EP 02788332 A

Filing Date: 20021209

Issue/Publication Date: 20040922

Abstract: (ENG) NotAvailable

Priority Data: IB 0205320 20021209 W W; US 2838601 20011221 A;

IPC (International Class): H04N00730; H04N00750; H04N00726

Designated Countries:
----Designated States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK TR

Publication Language: ENG

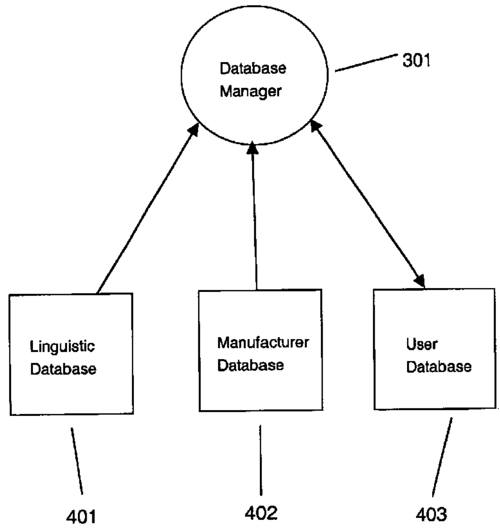
Filing Language: ENG

Agent(s): Landousy, Christian 00044385 Philips Intellectual Property & Standards, 156 Boulevard Haussmann 75008 Paris FR

Legal Status:

Date	+/-	Code	Description
20040922	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20040721;
20040922	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A1; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK TR;
20040922	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL LT LV MK RO;
20070905	(-)	18W	WITHDRAWN Effective date: 20070723;

EP1540513A4 20080924
EP1540513A1 20050615



(ENG) DYNAMIC DATABASE REORDERING SYSTEM

Assignee: AMERICA ONLINE INC US

Inventor(s): BRADFORD ETHAN R US ; KAY DAVID JON US

Application No: EP 03765738 A

Filing Date: 20030717

Issue/Publication Date: 20080924

Abstract: (ENG) The invention provides a process for selecting and ordering one or more sets of linguistic objects. The invention orders a current list of items for selection that comprises a first list of one or more items of a first language and a second list of one or more items of a second language, the current list of items being displayed in an order based on the first language having a priority over the second language. In response to a user selection of one item from the second list, the invention changes a priority for ordering a subsequent list of items to order the subsequent list of items based on the second language having a priority over the first language.

Priority Data: US 0322525 20030717 W W N; US 39725302 20020718 P Y; US 62186403 20030716 A Y;

IPC (International Class): G06F01722; G06F01727

ECLA (European Class): G06F003023M6; G06F01727P

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20050615	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20040115;
20050615	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A1; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR;
20050615	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL LT LV MK;
20060421	()	REG	Corresponding country code for PRS Code (EP REG): HK; Corresponding EP Code 1 for PRS Code (EP REG): DE; Corresponding patent document: 1078945; Country code of corresponding patent document: HK;
20080924	(+)	A4	SUPPLEMENTARY SEARCH REPORT Effective date: 20080821;
20081126	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20081024;

EP1576387A2 20050921

(ENG) METHOD AND SYSTEM FOR REAL TIME NAVIGATION USING SATELLITE TRANSMITTED THREE-CARRIER RADIO SIGNALS AND IONOSPHERIC CORRECTIONS

[no drawing available]

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ-PAJARES MANUEL ES ;
JUAN-ZORNOZA JOSE MIGUEL ES ;
SANZ-SUBIRANA JAUME ES ;
GARCIA-RODRIGUEZ ALBERTO NL

Application No: EP 03809988 A

Filing Date: 20031216

Issue/Publication Date: 20050921

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0350176 20031216 W W N; FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Designated Countries:

Publication Language: FRE

Filing Language: FRE

Agent(s): Grynwald, Albert 09223571 Cabinet GRYNWALD 16, Rue de la Paix 75002 Paris FR

Date of Deferred Publication of Search Report:
--20040812

Legal Status:

Date	+/-	Code	Description
20050921	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20050719;
20050921	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A2; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR;
20050921	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL LT LV MK;
20060412	( )	DAX	EXTENSION OF THE EUROPEAN PATENT TO (DELETED)

20061108	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20061006;

EP1576387A2 20050921

(ENG) METHOD AND SYSTEM FOR REAL TIME NAVIGATION USING SATELLITE TRANSMITTED THREE-CARRIER RADIO SIGNALS AND IONOSPHERIC CORRECTIONS

[no drawing available]

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ-PAJARES MANUEL ES ;
JUAN-ZORNOZA JOSE MIGUEL ES ;
SANZ-SUBIRANA JAUME ES ;
GARCIA-RODRIGUEZ ALBERTO NL

Application No: EP 03809988 A

Filing Date: 20031216

Issue/Publication Date: 20050921

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0350176 20031216 W W N; FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Designated Countries:

Publication Language: FRE

Filing Language: FRE

Agent(s): Grynwald, Albert 09223571 Cabinet GRYNWALD 16, Rue de la Paix 75002 Paris FR

Date of Deferred Publication of Search Report:
--20040812

Legal Status:

Date	+/-	Code	Description
20050921	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20050719;
20050921	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A2; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR;

20050921	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL LT LV MK;
20060412	( )	DAX	EXTENSION OF THE EUROPEAN PATENT TO (DELETED)
20061108	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20061006;

EP1576387A2 20050921

(ENG) METHOD AND SYSTEM FOR REAL TIME NAVIGATION USING SATELLITE TRANSMITTED THREE-CARRIER RADIO SIGNALS AND IONOSPHERIC CORRECTIONS

[no drawing available]

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ-PAJARES MANUEL ES ;
JUAN-ZORNOZA JOSE MIGUEL ES ;
SANZ-SUBIRANA JAUME ES ;
GARCIA-RODRIGUEZ ALBERTO NL

Application No: EP 03809988 A

Filing Date: 20031216

Issue/Publication Date: 20050921

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0350176 20031216 W W N; FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Designated Countries:

Publication Language: FRE

Filing Language: FRE

Agent(s): Grynwald, Albert 09223571 Cabinet GRYNWALD 16, Rue de la Paix 75002 Paris FR

Date of Deferred Publication of Search Report:
--20040812

Legal Status:

Date	+/-	Code	Description
20050921	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20050719;

20050921	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A2; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR;
20050921	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL LT LV MK;
20060412	( )	DAX	EXTENSION OF THE EUROPEAN PATENT TO (DELETED)
20061108	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20061006;

EP1519192A3 20050608
EP1519192A2 20050330

(ENG) HIV PROTEASE INHIBITOR CONJUGATES AND ANTIBODIES USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: ROCHE DIAGNOSTICS GMBH DE

Inventor(s): SIGLER GERALD F US ; HUI RAYMOND A US ; DERAS INA US ; ROOT RICHARD TERRY US ; GHOSHAL MITALI US ; HUBER ERASMUS DE ; VON DER ELTZ HERBERT DE ; METZ SIGRUN DE ; KERN PETER DE

Application No: EP 04022393 A

Filing Date: 20040921

Issue/Publication Date: 20050608

Abstract: (ENG) <p>Activated haptens useful for generating immunogens to HIV protease inhibitors, immunogens useful for producing antibodies to HIV protease inhibitors, and antibodies and labeled conjugates useful in immunoassays for HIV proteaseinhibitors. The novel haptens feature an activated functionality at the central, non-terminal hydroxyl group common to all HIV protease inhibitors, e.g., saquinavir, nelfinavir, indinavir, amprenavir, ritonavir, lopinavir, and atazanavir.</p>

Priority Data: US 66983103 20030924 A;

IPC (International Class): G01N03353; C07K01638; C07D40112; C07D49304; C12N00516

ECLA (European Class): C07K01644

Designated Countries:
----Designated States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR

Publication Language: ENG

Filing Language: ENG

Date of Deferred Publication of Search Report:
--20050608

Legal Status:

Date	+/-	Code	Description
20050608	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A3; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR;

20050608	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL HR LT LV MK;
20060301	(+)	AKX	PAYMENT OF DESIGNATION FEES
20060906	(-)	18D	DEEMED TO BE WITHDRAWN Effective date: 20051209;
20061019	( )	REG	REFERENCE TO A NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8566;

EP1629345A4 20090114
EP1629345A2 20060301

(ENG) DIRECTIONAL INPUT SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; PALMER BRIAN US

Application No: EP 04750057 A

Filing Date: 20040409

Issue/Publication Date: 20090114

Abstract: (ENG) A system associated with a text entry application, such as email or instant messaging, comprises an optional onscreen representation of a circular keyboard, a list of potential linguistic object matches, and a message area where the selected words are entered. The circular keyboard is manipulated via a hardware joystick or game-pad with analog joystick or omni-directional rocker switch built therein. The user points the joystick in the general direction of the desired letter, and then continues pointing roughly to each letter in the desired word. Once all letters have been roughly selected, buttons are used to select a specific word from the list of potential matches and send the selected word to the message area.

Priority Data: US 2004011343 20040409 W W N; US 46173503 20030409 P Y; US 67789003 20031001 A Y;

IPC (International Class): G09G00508; G06F00300; G06F003033; G06F003023; G06F003048

ECLA (European Class): G06F003048A1M; G06F003023M6; G06F003023M8

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20090114	()	A4	Effective date: 20081212;
20090318	()	17Q	Effective date: 20090216;
20091223	()	18D	Effective date: 20090627;

EP1629345A2 20060301

(ENG) DIRECTIONAL INPUT SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; PALMER BRIAN US

Application No: EP 04750057 A

Filing Date: 20040409

Issue/Publication Date: 20090114

Abstract: (ENG) A system associated with a text entry application, such as email or instant messaging, comprises an optional onscreen representation of a circular keyboard, a list of potential linguistic object matches, and a message area where the selected words are entered. The circular keyboard is manipulated via a hardware joystick or game-pad with analog joystick or omni-directional rocker switch built therein. The user points the joystick in the general direction of the desired letter, and then continues pointing roughly to each letter in the desired word. Once all letters have been roughly selected, buttons are used to select a specific word from the list of potential matches and send the selected word to the message area.

Priority Data: US 2004011343 20040409 W W N; US 46173503 20030409 P Y; US 67789003 20031001 A Y;

IPC (International Class): G09G00508; G06F00300; G06F003033; G06F003023; G06F003048

ECLA (European Class): G06F003048A1M; G06F003023M6; G06F003023M8

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20090114	()	A4	Effective date: 20081212;
20090318	()	17Q	Effective date: 20090216;
20091223	()	18D	Effective date: 20090627;

EP1766707A4 20090819
EP1766707A2 20070328

(ENG) MOLTEN CARBONATE FUEL CELL CATHODE WITH MIXED OXIDE COATING

[no drawing available]

Assignee: FUELCELL ENERGY INC US

Inventor(s): HILMI ABDELKADER US ; YUH CHAO-YI US

Application No: EP 04812583 A

Filing Date: 20041201

Issue/Publication Date: 20090819

Abstract: (ENG) A molten carbonate fuel cell cathode having a cathode body and a coating of a mixed oxygen ion conductor materials. The mixed oxygen ion conductor materials are formed from ceria or doped ceria, such as gadolinium doped ceria or yttrium doped ceria. The coating is deposited on the cathode body using a sol-gel process, which utilizes as precursors organometallic compounds, organic and inorganic salts, hydroxides or alkoxides and which uses as the solvent water, organic solvent or a mixture of same.

Priority Data: US 2004040099 20041201 W W N; US 75548304 20040112 A Y;

IPC (International Class): H01M00810; H01M00488; H01M00486; B05D00512; H01M00814; H01M00490; H01M00496

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Agent(s): Gritschneder, Martin et al 09224501 Abitz & Partner Patentanwaelte Postfach 86 01 09 81628 Muenchen DE

Date of Deferred Publication of Search Report:
--20070104

Legal Status:

Date	+/-	Code	Description
20090819	()	A4	Effective date: 20090722;
20090819	()	RIC1	IPC: H01M 8/10 20060101AFI20070515BHEP;
20090819	()	RIC1	IPC: H01M 4/86 20060101ALI20090716BHEP;
20090819	()	RIC1	IPC: H01M 4/96 20060101ALI20090716BHEP;
20090819	()	RIC1	IPC: H01M 4/90 20060101ALI20090716BHEP;
20090819	()	RIC1	IPC: B05D 5/12 20060101ALI20090716BHEP;
20090819	()	RIC1	IPC: H01M 4/88 20060101ALI20090716BHEP;
20090819	()	RIC1	IPC: H01M 8/14 20060101ALI20090716BHEP;

EP1700291A4 20070822
EP1700291A2 20060913

(ENG) VIRTUAL KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; VAN MEURS PIM US

Application No: EP 04815408 A

Filing Date: 20041222

Issue/Publication Date: 20070822

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 2004043329 20041222 W W N; US 53213103 20031222 P Y; US 1951704 20041220 A Y;

IPC (International Class): G06F003023; G09G00500; G06F01727; G06F003048; G06K00972; G06K00918; G06K00934; G06K00948

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20070822	(+)	A4	SUPPLEMENTARY SEARCH REPORT Effective date: 20070723;
20070822	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: G06F 3/023 20060101AFI20070717BHEP;
20070912	( )	RAP1	TRANSFER OF RIGHTS OF AN EP APPLICATION New owner name: TEGIC COMMUNICATIONS, INC.;
20070926	( )	R17D	SEARCH REPORT (CORRECTION) Effective date: 20070816;
20071107	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20071004;

EP1700291A2 20060913

(ENG) VIRTUAL KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; VAN MEURS PIM US

Application No: EP 04815408 A

Filing Date: 20041222

Issue/Publication Date: 20070822

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 2004043329 20041222 W W N; US 53213103 20031222 P Y; US 1951704 20041220 A Y;

IPC (International Class): G06F003023; G09G00500; G06F01727; G06F003048; G06K00972; G06K00918; G06K00934; G06K00948

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Designated Countries:

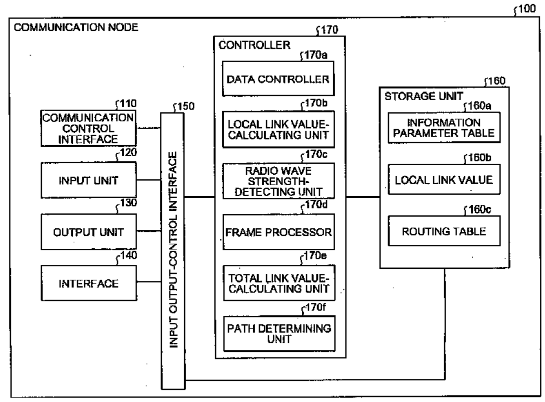
Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20070822	(+)	A4	SUPPLEMENTARY SEARCH REPORT Effective date: 20070723;
20070822	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: G06F 3/023 20060101AFI20070717BHEP;
20070912	( )	RAP1	TRANSFER OF RIGHTS OF AN EP APPLICATION New owner name: TEGIC COMMUNICATIONS, INC.;
20070926	( )	R17D	SEARCH REPORT (CORRECTION) Effective date: 20070816;
20071107	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20071004;

FIG.3



EP1940088A1 20080702

(ENG) Network system and data transfer method

Assignee: FUJITSU LTD JP

Inventor(s): YAMADA KENJI JP

Application No: EP 07020826 A

Filing Date: 20071024

Issue/Publication Date: 20080702

Abstract: (ENG) Upon communication nodes receiving data that is a transfer target, based on a link value corresponding to a communication quality of each communication node that has transferred the data and radio wave strength among the communication nodes, a network system calculates a total link value that indicates a quality of a communication path that is used to transfer the data. The network system determines whether the calculated total link value is greater than or equal to a threshold value and based on a determination result, transfers the data to a destination communication node.

Priority Data: JP 2006348344 20061225 A Y;

IPC (International Class): H04L01256

ECLA (European Class): H04L01256C; H04L01256C11D; H04W04004

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Agent(s): HOFFMANN EITLE Patent- und Rechtsanwaelte, Arabellastrasse 4, 81925 Muenchen, DE DE

Legal Status:

Date	+/-	Code	Description
20080702	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A1; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR;
20080702	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO List of countries concerned with an event: AL BA HR MK RS;
20090211	()	17P	Effective date: 20081223;
20090311	()	AKX	List of designated states: DE FR GB;
20091111	()	17Q	Effective date: 20091008;

EP1894160A4 20081112
EP1894160A2 20080305

(ENG) ASSET PERFORMANCE OPTIMIZATION

[no drawing available]

Assignee: PRENOVA US

Inventor(s): CHAMBERS GREGORY L US ; VAN METER KENNETH US ; SMITH EDWARD M US ; GOLDEN PATRICK T US

Application No: EP 07717262 A

Filing Date: 20070109

Issue/Publication Date: 20081112

Abstract: (ENG) Included are embodiments for asset management. At least one embodiment of a method includes receiving, at a performance assessment and optimization center, data from at least one asset, the asset being configured to service an environment and performing at least one calculation, from the received data, to determine whether the asset is operating properly. Some embodiments include in response to a determination that the at least one asset is not operating properly, providing an indication related to operation of the asset.

Priority Data: US 2007060271 20070109 W W N; US 75744606 20060109 P Y; US 61983807 20070104 A Y;

IPC (International Class): G06Q01000

ECLA (European Class): G05B01502; G06Q01000C

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20081112	(+)	A4	SUPPLEMENTARY SEARCH REPORT Effective date: 20081013;
20081112	( )	RIC1	CLASSIFICATION (CORRECTION) IPC: G06Q 10/00 20060101AFI20081007BHEP;
20090211	()	17Q	Effective date: 20090112;

EP2303906A1 20110406

(ENG) CRYSTALLINE POLYMORPHS OF GEMCITABINE BASE

[no drawing available]

Assignee: SCINOPHARM TAIWAN LTD TW

Inventor(s): CHEN SHU-PING TW ; SHIEH CHIA-LIN TW

Application No: EP 09763709 A

Filing Date: 20090612

Issue/Publication Date: 20110406

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 2009047190 20090612 W W N; US 13183508 20080612 P Y;

IPC (International Class): C07H019073; A61K031522

ECLA (European Class): C07H019073

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Agent(s): Gulde Hengelhaupt Ziebig & Schneider Patentanwaelte - Rechtsanwaelte, Wallstrasse 58/59, 10179 Berlin, DE DE

Legal Status:

Date	+/-	Code	Description
20110406	()	17P	Effective date: 20110112;
20110406	()	AK	Kind code of corresponding patent document: A1; List of designated states: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR;
20110406	()	AX	List of countries concerned with an event: AL BA RS;

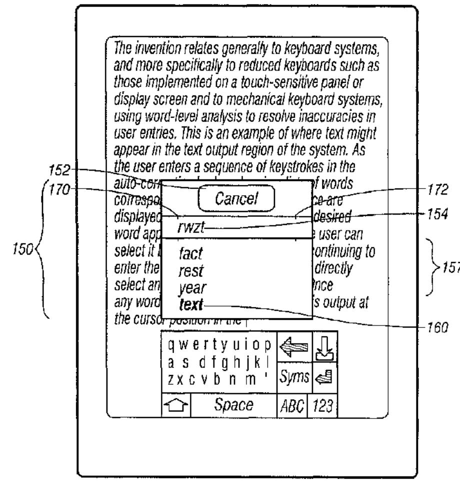


FIG. 1B

EP2264563A1 20101222

(ENG) Virtual keyboard system with automatic correction

Assignee: TEGIC COMMUNICATIONS INC US

Inventor(s): LONGE MICHAEL R US ; VAN MEURS PIM US

Application No: EP 10166323 A

Filing Date: 20100617

Issue/Publication Date: 20101222

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 48837509 20090619 A Y;

IPC (International Class): G06F003023

ECLA (European Class): G06F003023M8; G06F003048A3T

Designated Countries:

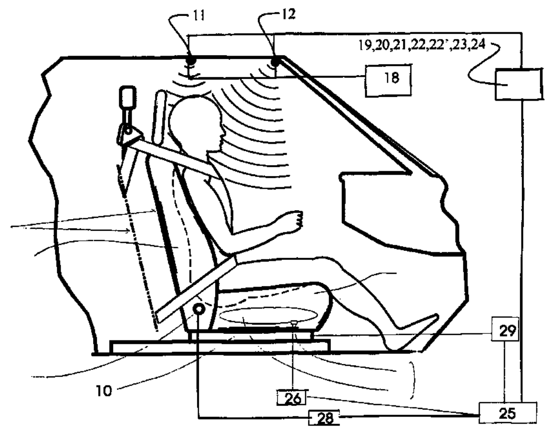
Publication Language: ENG

Filing Language: ENG

Agent(s): Zimmermann, Tankred Klaus Schoppe, Zimmermann, Stoeckeler & Zinkler, Patentanwaelte, Postfach 246, 82043 Pullach beiMuenchen, DE DE

Legal Status:

Date	+/-	Code	Description
20101222	()	AK	Kind code of corresponding patent document: A1; List of designated states: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR;
20101222	()	AX	List of countries concerned with an event: BA ME RS;



EP0952933B1 20050112
EP0952933A4 20000202
EP0952933A1 19991103

(ENG) APPARATUS AND METHOD FOR ADJUSTING A VEHICLE COMPONENT

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: EP 98959474 A

Filing Date: 19981116

Issue/Publication Date: 20050112

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

Priority Data: US 9824487 19981116 W W N; US 97082297 19971114 A Y; US 12849098 19980804 A Y;

IPC (International Class): B60N00244; B60R02116; G01S01587; B60N00206; B60N00202; G01S01588; B60N00200; B60R02101; B60N00228; G01G019414; B60N00248; B60R021276; B60R021015; G01S01506; B60R02228; B60R02120; B60R02220; B60R02246; B60R021203

ECLA (European Class): B60R021015; B60N00200C; B60N00202B4; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206S; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; G01G019414A; G01S01587; G01S01588

Designated Countries:

Publication Language: ENG

Filing Language: ENG

Agent(s): Watts, Peter Graham Anthony Cundy & Co., 1 Olton Bridge, 245 Warwick Road, Solihull, West Midlands B92 7AH, GB GB

Legal Status:

Date	+/-	Code	Description
20050112	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: B1; List of designated states: DE GB;
20050112	( )	REG	REFERENCE TO A NATIONAL CODE Corresponding country code for PRS Code (EP REG): GB; Corresponding EP Code 1 for PRS Code (EP REG): FG4D;
20050217	( )	REF	CORRESPONDS TO: Corresponding patent document: 69828585; Country code of corresponding patent document: DE; Publication date of corresponding patent document: 20050217; Kind code of corresponding patent document: P;

20060104	(+)	26N	NO OPPOSITION FILED Effective date: 20051013;
20061117	(+)	PGFP	POSTGRANT: ANNUAL FEES PAID TO NATIONAL OFFICE Corresponding country code for PRS Code (EP REG): GB; Payment date: 20061117; Year of fee payment: 09;
20061117	()	PGFP	Corresponding country code for PRS Code (EP REG): GB; Payment date: 20061117; Year of fee payment: 09;
20070124	(+)	PGFP	POSTGRANT: ANNUAL FEES PAID TO NATIONAL OFFICE Corresponding country code for PRS Code (EP REG): DE; Payment date: 20070124; Year of fee payment: 09;
20070124	()	PGFP	Corresponding country code for PRS Code (EP REG): DE; Payment date: 20070124; Year of fee payment: 09;
20080430	(+)	PGFP	POSTGRANT: ANNUAL FEES PAID TO NATIONAL OFFICE Corresponding country code for PRS Code (EP REG): GB; Payment date: 20071108; Year of fee payment: 10;
20080430	()	PGFP	Corresponding country code for PRS Code (EP REG): GB; Payment date: 20071108; Year of fee payment: 10;
20080530	(+)	PGFP	POSTGRANT: ANNUAL FEES PAID TO NATIONAL OFFICE Corresponding country code for PRS Code (EP REG): DE; Payment date: 20080129; Year of fee payment: 10;
20080530	()	PGFP	Corresponding country code for PRS Code (EP REG): DE; Payment date: 20080129; Year of fee payment: 10;
20081031	(+)	PGFP	POSTGRANT: ANNUAL FEES PAID TO NATIONAL OFFICE Corresponding country code for PRS Code (EP REG): GB; Payment date: 20051109; Year of fee payment: 08;
20081031	()	PGFP	Corresponding country code for PRS Code (EP REG): GB; Payment date: 20051109; Year of fee payment: 08;
20090529	()	PGFP	Corresponding country code for PRS Code (EP REG): DE; Payment date: 20090128; Year of fee payment: 11;
20090630	()	PGFP	Corresponding country code for PRS Code (EP REG): GB; Payment date: 20081112; Year of fee payment: 11;
20100728	()	GBPC	Effective date: 20091116;
20101130	()	PG25	Corresponding country code for PRS Code (EP REG): DE; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20100601;
20101231	()	PG25	Corresponding country code for PRS Code (EP REG): GB; : LAPSE BECAUSE OF NON-PAYMENT OF DUE FEES; Effective date: 20091116;

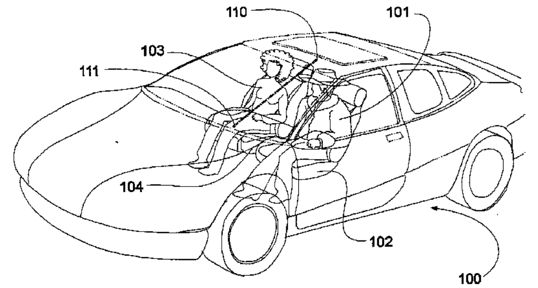


FIG. 1

EP1069000A1 20010117

(ENG) Method for identifying the presence and orientation of an object in a vehicle

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): VARGA ANDREW J US ; BREED DAVID S US ; DUVALL WILBUR E US

Application No: EP 99305623 A

Filing Date: 19990715

Issue/Publication Date: 20010117

Abstract: (ENG) A method for determining the location of an object in a passenger compartment of a vehicle in which ultrasonic waves are transmitted from a first transducer into the passenger compartment, waves reflected off an object in the passenger compartment are received by the first transducer and a first distance from the first transducer to the object is calculated based on the time difference between the transmitted waves and reflected waves when received by the first transducer. Further, different ultrasonic waves are transmitted from a second transducer into the passenger compartment which then receives reflected waves off the object and a second distance from the second transducer to the object is calculated based on the time difference between the transmitted waves and reflected waves when received by the second transducer. The approximate location of the object in the passenger compartment is determined based on the first distance and the second distance.

Priority Data: EP 99305623 19990715 A N; US 91982397 19970828 A T Y; US 79802997 19970206 A T Y;

IPC (International Class): G01S01504; B60R02101; G01S01542; G06K00900; B60R021015; G01S01588

ECLA (European Class): B60R021015; G01S01504; G01S01542; G06K00900H

Designated Countries:

Publication Language: ENG

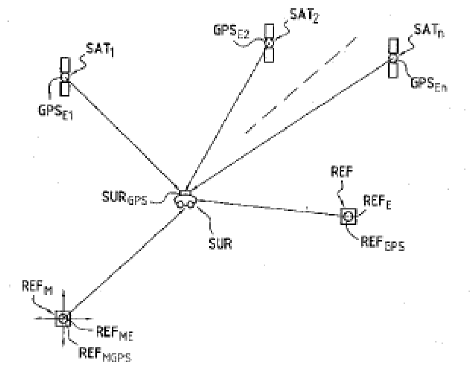
Filing Language: ENG

Agent(s): Watts, Peter Graham 00043101 Anthony Cundy & Co., 1 Olton Bridge, 245 Warwick Road Solihull, West Midlands B92 7AH GB

Legal Status:

Date	+/-	Code	Description
20010117	(+)	AK	DESIGNATED CONTRACTING STATES: Kind code of corresponding patent document: A1; List of designated states: DE GB SE;
20010117	(+)	AX	EXTENSION OF THE EUROPEAN PATENT TO : AL;LT;LV;MK;RO;SI;
20010523	(+)	17P	REQUEST FOR EXAMINATION FILED Effective date: 20010323;
20010801	(+)	17Q	FIRST EXAMINATION REPORT Effective date: 20010613;
20011004	(+)	AKX	PAYMENT OF DESIGNATION FEES : DE GB SE;
20030723	(-)	18R	REFUSED Effective date: 20030304;

FR2849209B1 20070406
FR2849209A1 20040625



(FRE) PROCEDE ET SYSTEME DE NAVIGATION EN TEMPS REEL A L'AIDE DE SIGNAUX RADIOELECTRIQUES A TROIS PORTEUSES EMIS PAR DES SATELLITES ET DE CORRECTIONS IONOSPHERIQUES

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ PAJARES MANUEL ; JUAN ZORNOZA JOSE MIGUEL ; SANZ SUBIRANA JAUME ; GARCIA RODRIGUEZ ALBERTO

Application No: FR 0216227 A

Filing Date: 20021219

Issue/Publication Date: 20070406

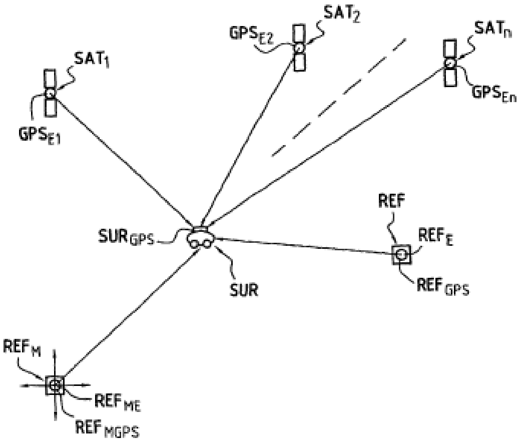
Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Legal Status: There is no Legal Status information available for this patent



WO2004057364A3 20040812
WO2004057364A2 20040708

(ENG) METHOD AND SYSTEM FOR REAL TIME NAVIGATION USING SATELLITE TRANSMITTED THREE-CARRIER RADIO SIGNALS AND IONOSPHERIC CORRECTIONS

Assignee: AGENCE SPATIALE EUROPEENNE FR

Inventor(s): HERNANDEZ-PAJARES MANUEL ES ;
JUAN-ZORNOZA JOSE MIGUEL ES ;
SANZ-SUBIRANA JAUME ES ;
GARCIA-RODRIGUEZ ALBERTO NL

Application No: FR 0350176 W

Filing Date: 20031216

Issue/Publication Date: 20040812

Abstract: (ENG) The invention concerns a method for real time navigation for locating a nomad (SUR) using radio signals with three carriers of three different frequencies, to determine the position of a user, transmitted by satellites (SAT1-GPSEE1 A SATn-GPSEEn). The method comprises a first step which consists in determining extra-long-path carrier phase ambiguity, a second step which consists in estimating long-path phase ambiguity, and a third step which consists in resolving the phase ambiguity of one of the frequencies. One additional step consists in real time application of ionospheric corrections during the third step, said ionospheric corrections being based on a constantly updated ionospheric model of said ionospheric layer calculated by a reference fixed earth station (REF-REFE), combined with geodesic data calculated by a so-called master reference fixed earth station (REFM-REFME). The invention also concerns a system for implementing said method.

Priority Data: FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Designated Countries:
----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: FRE

Agent(s): LEPERCQUE, Jean 94, rue Saint Lazare, F 75442 PARIS, FR FR

Legal Status:

Date	+/-	Code	Description
20050527	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2003809988; Country code of corresponding patent document: EP;

20050615	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 20038A61360; Country code of corresponding patent document: CN;
20050616	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2004561578; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20050616	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2004561578; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20050616	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2004561578; Country code of corresponding patent document: JP;
20050719	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2005118999; Country code of corresponding patent document: RU; Kind code of corresponding patent document: A;
20050921	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 2003809988; Country code of corresponding patent document: EP;
20060316	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2006164297; Country code of corresponding patent document: US; Kind code of corresponding patent document: A1;
20060316	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 10539826; Country code of corresponding patent document: US;
20060727	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 10539826; Country code of corresponding patent document: US;

GB2360097B 20030423
GB2360097A 20010912
GB0111362D0 20010704

(ENG) Apparatus and method for measuring weight of an occupying item of a seat

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: GB 0111362 A

Filing Date: 19991115

Issue/Publication Date: 20030423

Abstract: NotAvailable

Priority Data: US 9927098 19991115 W W N; US 19320998 19981117 A Y;

IPC (International Class): G01G01912; B60R02116; G01G01952; B60N00244; B60N00266; B60N00202; B60N002015; B60N00200; B60N00248; B60N00206; B60R02101; B60N00268; B60N00228; B60R021015

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206; B60N00206S; B60N00228B2; B60N00228P4; B60N00248C; B60N00248C2C; B60N00248C3C; B60N00266; B60N00268

National Classification:
--B7H H305 HXGREM; B7H H30X HXGREM; B7H H201 HXGREM; B7H H316 HXGREM; B7H H23X HXGREM; B7H H222 HXGREM; B7H H220 HXGREM; B7H H322 HXGREM; B7H HXG HXGREM; G1W WB1B WB1B; B7H H304 HXGREM

Legal Status:

Date	+/-	Code	Description
20100728	()	PCNP	Effective date: 20091115;

GB2363638B 20040310
GB2363638A 20020102
GB0116062D0 20010822

(ENG) Methods for determining the identification and position of and monitoring objects in a vehicle

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: GB 0116062 A

Filing Date: 19991231

Issue/Publication Date: 20040310

Abstract: NotAvailable

Priority Data: US 9931184 19991231 W W N; US 11450798 19981231 P Y; US 47625599 19991230 A Y;

IPC (International Class): B60R02101; B60N00228; B60N00202; G06K00900; B60R021015

ECLA (European Class): B60R021015; B60N00202B4; B60N00202B6; B60N00202B6W; B60N00228B2; B60N00228P4; G06K00900H

National Classification:
--G1A AR6 AJL; G1A AT3 AJL; G1A AAJL AJL; G1A AG9 AJL; G1A AG6 AJP; G1A AG9 AJP; G1A AG17 AJP; G1A AR7 AJP; G1A AT3 AJP; G1A AG6 AJL; G1A AT26 AJP; G1A AAJP AJP; G1A AR7 AJL; G1A AA3 AJP; G1A AT26 AJL; G1A AA3 AJL; G1A AG17 AJL; G1A AR6 AJP

Legal Status: There is no Legal Status information available for this patent

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GB2363769B 20030618
GB2363769A 20020109
GB0117003D0 20010905

(ENG) Interactive vehicle display system

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US

Application No: GB 0117003 A

Filing Date: 20001212

Issue/Publication Date: 20030618

Abstract: NotAvailable

Priority Data: US 0033566 20001212 W W N; US 17097399 19991215 P Y; US 64570900 20000824 A Y;

IPC (International Class): G02B02701; G02B02700

ECLA (European Class): G02B02701

National Classification:
--H4D D773 LAB; H4D D752 LAB; H4D D747 LAB; H4D D748 LAB; H4D D730 LAB; H4D D714 LAB; H4D D781 LAB; B7H HNR HNR; H4D DLAB LAB; G1G GRA GRA; H4D D775 LAB; G1G G9X GRA

Legal Status:

Date	+/-	Code	Description
20100825	()	PCNP	Effective date: 20091212;

GB2373117B 20050216
GB2373117A 20020911
GB0123688D0 20011121

(ENG) Method and arrangement for mapping a road and accident avoidance system

[no drawing available]

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US ; DUVALL WILBUR E US

Application No: GB 0123688 A

Filing Date: 20011002

Issue/Publication Date: 20050216

Abstract: (ENG) To map a road during travel, a vehicle has two data acquisition modules arranged on sides of the vehicle. Each includes a differential GPS (DGPS) receiver and antenna for enabling the vehicle's position to be determined and a linear camera which provides vertical one-dimensional images of an area on the respective side in a vertical plane perpendicular to the road such that information about the road is obtained from a view in a direction perpendicular to the road. A processor unit forms a map database of the road by correlating the vehicle's position and the information about the road. Instead of or in addition to the linear cameras, scanning laser radars are provided and transmit waves downward in a plane perpendicular to the road and receive reflected waves to provide information about distance between the laser radars and the ground for use in forming the database. The database is then used in a collision avoidance system. Equipped vehicles use the database in combination with a DGPS receiver to determine their position and velocity relative to the road. This is broadcast to other vehicles in the area, which compare the received position with their own position and velocity to give a warning of an imminent collision. The database may also include lane markings and road intersection information such as the edges of intersecting roads; this is used to prevent collisions at junctions. Traffic lights may transmit a signal warning of red lights. The GPS system may be supplemented by INS, video cameras, multiple local impulse transmitters, radar reflectors etc. A fully automated traffic control system is also envisaged.

Priority Data: US 67931700 20001004 A Y; US 90946601 20010719 A Y;

IPC (International Class): G05D00102; G01S00100; G01C02126; B60N00228; G01S01907; G01S01393; G08G00116; G01S01702; G01S01789

National Classification:
--H4D DAA AA; H4D D549 AA; H4D D714 AA; H4D D745 AA; H4D D749 AA; H4D D751 AA; H4D D783 AA; U1S S1819

Legal Status: There is no Legal Status information available for this patent

GB2383415B 20050223
GB2383415A 20030625
GB0307874D0 20030514

(ENG) Vehicle wireless sensing and communication system

Assignee: AUTOMOTIVE TECH INT US

[no drawing available]

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US

Application No: GB 0307874 A

Filing Date: 20010907

Issue/Publication Date: 20050223

Abstract: (ENG) Valve cap (10) for monitoring pressure and/or temperature of a tire (1) having a valve stem (2) including a valve assembly (5) having a valve pin (6). A body (9) of the valve cap (10) mates with the valve stem (2) and defines a chamber (12) upon such mating. A valve pin depressor (14) is arranged in the body (9) and depresses the valve pin (6) upon mating of the body (9) with the valve stem (2) to open the valve assembly (5) and enable flow communication between an interior of the tire (1) and the chamber (12). At least one SAW sensor (11) is arranged in the chamber (12) for receiving a signal and returning a signal modified by virtue of the temperature and/or pressure of the tire (1).

Priority Data: US 0128010 20010907 W W N; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; B60N00202; B60N00228

National Classification:
--E2A ABC ABC; E2A A401 ABC; G1G GPGB PGB; G1G GPP PP; G1G GPR PR; G1G GPU PU; G1G GPW PW; G1G GPX PX; G1G G6S PGB; G1G G6S PP; G1G G6S PR; G1G G6S PU; G1G G6S PW; G1G G6S PX; G4N NHVSC NHVSC; G4N N5C2 NHVSC; G4N N7X NHVSC; U1S S1820; U1S S1845

Legal Status:

Date	+/-	Code	Description
20100526	()	PCNP	Effective date: 20090907;

GB2405279B 20050427
GB2405279A 20050223
GB0422015D0 20041103

(ENG) Method and arrangement for mapping a road and accident avoidance system

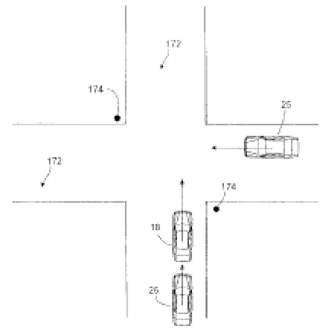


Fig. 13

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US ; DUVALL WILBUR E US

Application No: GB 0422015 A

Filing Date: 20011002

Issue/Publication Date: 20050427

Abstract: (ENG) Arrangement and method for mapping a road during travel of a vehicle having two data acquisition modules arranged on sides of the vehicle, each including a GPS receiver and antenna for enabling the vehicle's position to be determined and a linear camera which provides one-dimensional images of an area on the respective side in a vertical plane perpendicular to the road such that information about the road is obtained from a view in a direction perpendicular to the road. A processor unit forms a map database of the road by correlating the vehicle's position and the information about the road. Instead of or in addition to the linear cameras, scanning laser radars are provided and transmit waves downward in a plane perpendicular to the road and receive reflected waves to provide information about distance between the laser radars and the ground for use in forming the database.

Priority Data: GB 0123688 20011002 A 3 N; US 67931700 20001004 A N; US 90946601 20010719 A Y;

IPC (International Class): G01S01948; G01S01941; G01S00514; G01S00100; G01C02126; G01S01907; G01S01393; G05D00102; G01S01702; G08G00116; G01S01789

National Classification:
--H4D DAB AB; H4D D260 AB; H4D D267 AB; H4D D268 AB; H4D D549 AB; H4D D714 AB; H4D D749 AB; H4D D751 AB; H4D D783 AB; U1S S1819

Legal Status: There is no Legal Status information available for this patent

GB2406170B 20050504
GB2406170A 20050323
GB0426923D0 20050112

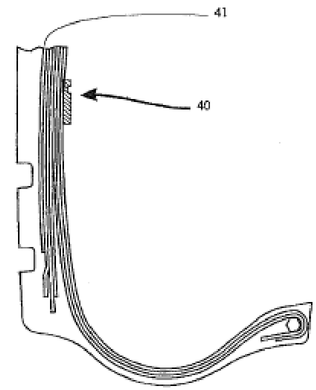


Fig 1A

(ENG) Vehicle wireless sensing and communication system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US

Application No: GB 0426923 A

Filing Date: 20010907

Issue/Publication Date: 20050504

Abstract: (ENG) A valve stem assembly for a tyre has an elongate metallic (eg brass) valve stem 7, a rubber body 23 attached to the end of the stem 7 within the interior space of the tyre and a sensor capsule 24 within the rubber body 23 which includes a SAW absolute pressure sensor 27,29' in a chamber 25 in flow communication with the inside of the tyre and also a SAW temperature sensor 28,28' in another chamber 26 isolated from the inside of the tyre by a flexible or rigid membrane 31,33.

Priority Data: GB 0426923 20010907 A N; GB 0307874 20010907 A 3 Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; H01Q00122

National Classification:
--G1G GPGB PGB

Legal Status:

Date	+/-	Code	Description
20100526	()	PCNP	Effective date: 20090907;

GB2406646B 20050518
GB2406646A 20050406
GB0426924D0 20050112

(ENG) Vehicle wireless sensing and communication system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US

Application No: GB 0426924 A

Filing Date: 20010907

Issue/Publication Date: 20050518

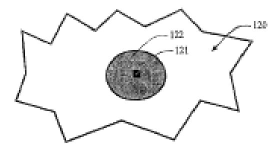


Fig 1A

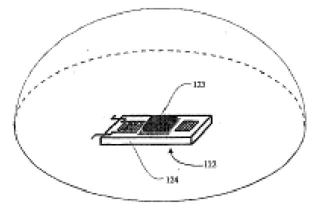


Fig 1B

Abstract: (ENG) A valve stem assembly for a tyre has an elongate metallic (eg brass) valve stem 7, a rubber body 23 attached to the end of the stem 7 within the interior space of the tyre and a sensor capsule 24 within the rubber body 23 which includes a SAW absolute pressure sensor 27,29' in a chamber 25 in flow communication with the inside of the tyre and also a SAW temperature sensor 28,28' in another chamber 26 isolated from the inside of the tyre by a flexible or rigid membrane 31,33.

Priority Data: GB 0426924 20010907 A N; GB 0307874 20010907 A 3 Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; H01Q00122

National Classification:
--G1G GPU PU

Legal Status:

Date	+/-	Code	Description
20100526	()	PCNP	Effective date: 20090907;

GB2405931B 20050427
GB2405931A 20050316
GB0426925D0 20050112

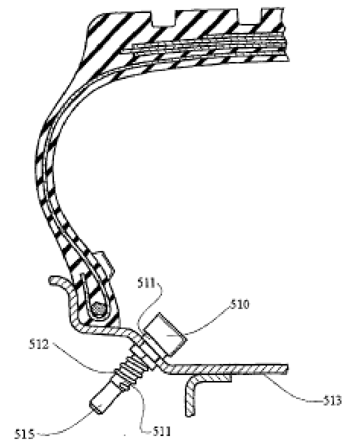


Fig 1

(ENG) Vehicle wireless sensing and communication system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US ; CASTELLI VITTORIO US ; SEITZ WILLIAM E US

Application No: GB 0426925 A

Filing Date: 20010907

Issue/Publication Date: 20050427

Abstract: (ENG) A valve stem assembly for a tyre has an elongate metallic (eg brass) valve stem 7, a rubber body 23 attached to the end of the stem 7 within the interior space of the tyre and a sensor capsule 24 within the rubber body 23 which includes a SAW absolute pressure sensor 27,29' in a chamber 25 in flow communication with the inside of the tyre and also a SAW temperature sensor 28,28' in another chamber 26 isolated from the inside of the tyre by a flexible or rigid membrane 31,33.

Priority Data: GB 0426925 20010907 A N; GB 0307874 20010907 A 3 Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

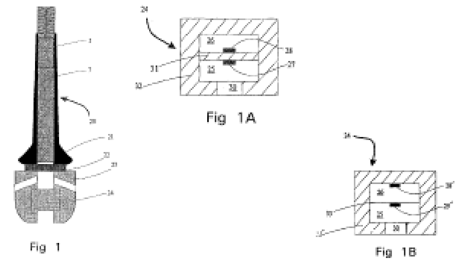
IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; H01Q00122

National Classification:
--G1G GPR PR; G1G GPW PW

Legal Status:

Date	+/-	Code	Description
20100526	()	PCNP	Effective date: 20090907;

GB2406171B 20050504
GB2406171A 20050323
GB0426926D0 20050112



(ENG) Vehicle wireless sensing and communication system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): CASTELLI VITTORIO US ; SEITZ WILLIAM E US ; BREED DAVID SCRANTON US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: GB 0426926 A

Filing Date: 20010907

Issue/Publication Date: 20050504

Abstract: (ENG) A valve stem assembly for a tyre has an elongate metallic (eg brass) valve stem 7, a rubber body 23 attached to the end of the stem 7 within the interior space of the tyre and a sensor capsule 24 within the rubber body 23 which includes a SAW absolute pressure sensor 27,29' in a chamber 25 in flow communication with the inside of the tyre and also a SAW temperature sensor 28,28' in another chamber 26 isolated from the inside of the tyre by a flexible or rigid membrane 31,33.

Priority Data: GB 0426926 20010907 A N; GB 0307874 20010907 A 3 Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

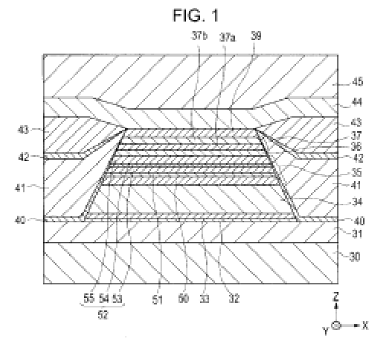
IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; H01Q00122

National Classification:
--G1G GPR PR; G1G GPW PW

Legal Status:

Date	+/-	Code	Description
20100526	()	PCNP	Effective date: 20090907;

GB2410121B 20080102
GB2410121A 20050720
GB0427311D0 20050119



(ENG) A magnetic sensor

Assignee: ALPS ELECTRIC CO LTD JP

Inventor(s): IKARASHI KAZUAKI JP ; HASEGAWA NAOYA JP ; KOIKE FUMIHITO JP ; UMETSU EIJI JP

Application No: GB 0427311 A

Filing Date: 20041214

Issue/Publication Date: 20080102

Abstract: (ENG) A nonmagnetic material-noncontact layer forming a fixed magnetic layer is formed using CoFe, a nonmagnetic material-contact layer is formed using Co, and an NOL (Nano-Oxide Layer) is provided between the nonmagnetic material-noncontact layer and the nonmagnetic material-contact layer. In addition, the average film thickness of the nonmagnetic material-contact layer is set in the range of 16 to 19 Å. Accordingly, compared to a three-layered structure composed of CoFe, an NOL, and CoFe or a three-layered structure composed of Co, an NOL, and Co, which has been conventionally used, the rate (DeltaR/R) of change in resistance and the unidirectional exchange bias magnetic field (Hex*) can both be improved.

Priority Data: JP 2004008492 20040115 A Y;

IPC (International Class): G11B00539; H01F01030; H01L04308; G11B00533; G11B005127; G01R03309

ECLA (European Class): B82Y02500; B82Y01000; G01R03309B

National Classification:
--N0T CLASSIFIED NONE

Legal Status: There is no Legal Status information available for this patent

GB2435346B 20080102
GB2435346A 20070822
GB0707614D0 20070530

(ENG) A magnetic sensor

Assignee: ALPS ELECTRIC CO LTD JP

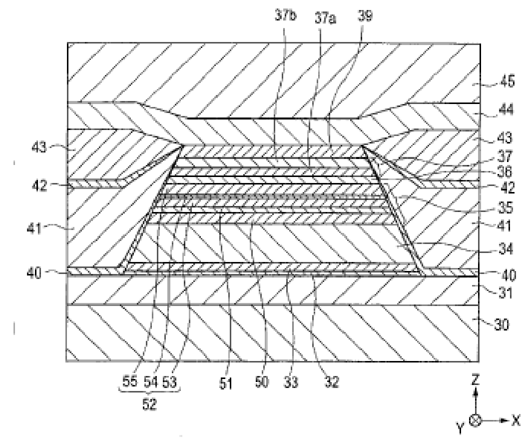
Inventor(s): IKARASHI KAZUAKI JP ; HASEGAWA NAOYA JP ; KOIKE FUMIHITO JP

Application No: GB 0707614 A

Filing Date: 20041214

Issue/Publication Date: 20080102

FIG. 1



Abstract: (ENG) A nonmagnetic material-noncontact layer forming a fixed magnetic layer 35 is formed using CoFe, a nonmagnetic material-contact layer 55 is formed using Co, and an NOL 54 is provided between the nonmagnetic material-noncontact layer 53 and the nonmagnetic material-contact layer. In addition, the average film thickness of the nonmagnetic material-contact layer is set in the range of 16 to 19 Ñ. Accordingly, compared to a three-layered structure composed of CoFe, an NOL, and CoFe or a three-layered structure composed of Co, an NOL, and Co, which has been conventionally used, the rate (W R/R) of change in resistance and the unidirectional exchange bias magnetic field (Hex*) can both be improved to a satisfactory level. The NOL is formed by oxidation of layer 53 and has a mirror reflection effect. In one embodiment the NOL has intermittent portions and Cr oxide layers.

Priority Data: JP 2004008492 20040115 A Y; GB 0427311 20041214 A 3 Y; GB 0707614 20041214 A Y;

IPC (International Class): G11B00539; G01R03309; H01F01030; H01L04308; G11B00533; G11B005127

ECLA (European Class): G01R03309B; B82Y01000; B82Y02500; G01R03309B; G11B00539; S11B00539W; Y01N00400; Y01N01200

National Classification:
--N0T CLASSIFIED NONE

Legal Status: There is no Legal Status information available for this patent

GB2289542B 19980826
GB2289542A 19951122
GB9509088D0 19950802

(ENG) Method and apparatus for measuring the quantity of fuel in a land vehicle fuel tank subject to external forces

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON ; JOHNSON WENDELL C ; DUVALL WILBUR E ; SANDERS WILLIAM THOMAS

Application No: GB 9509088 A

Filing Date: 19950504

Issue/Publication Date: 19980826

Abstract: NotAvailable

Priority Data: US 23997794 19940509 A Y;

IPC (International Class): G01F023296; B60N00228; B60N00200; B60J01000; G01F02326; B60R02101; G01F02336; G01F02300; G01F02320

ECLA (European Class): B60R0210136; B60J01000; B60N00200C; B60N00228P4; G01F02300G1A; G01F02320; G01F02326B; G01F023296D; G01F02336

National Classification:
--U1S S1820; G1N N3S2 AHT; G1N NAHT AHT; G1N N7F AHT; G1N N1B3 AHT; G1N N1D2B AHT; G1N N7F AHR; G1N N7H1 AHR; G1N N1B3 AHR; G1N N1D2B AHR; U1S S1359; G1N NAHR AHR; U1S S1807; G1N N3S1B AHR; G1N N19B2B CFG; G1G GPL PL; G1N N7H1 AHT; G1N N19D10 CFG; G1N N4D AHR; G1N NCFG CFG; G1N N3S2 AHR; G1N N7G AHR; G1N N7L1B AHR; G1N N1D8 AHR; G1N N4D AHT

Legal Status:

Date	+/-	Code	Description
20031224	(-)	PCNP	PATENT CEASED THROUGH NON-PAYMENT OF RENEWAL FEE Effective date: 20030504;

GB2289332B 19990106
GB2289332A 19951115
GB9509090D0 19950802

(ENG) Vehicle interior identification and monitoring system

Assignee: AUTOMOTIVE TECH INT US

[no drawing available]

Inventor(s): BREED DAVID SCRANTON ; JOHNSON WENDELL CLAYTON ; DUVALL WILBUR E

Application No: GB 9509090 A

Filing Date: 19950504

Issue/Publication Date: 19990106

Abstract: (ENG) A system to identity and monitor contents and/or parts of the passenger compartment of a motor vehicle, by processing the signal received from the contents or parts using one or more techniques, includes neural networks or other pattern recognition systems and technologies including ultrasonic and electromagnetic radiation. The received signal is a combination of the reflection of a transmitted signal, the reflection of some natural signal within the vehicle, and also some signal emitted naturally by the object. A signal is emitted by transducer 132 and characteristic signals received by multiple transducers 131, 133. A neural network is trained to distinguish between adults, children, children in seats, plants, groceries and the like on the basis of these signals. Information obtained by the identification and monitoring system is then used to affect the operation of some other system in the vehicle such as the airbag, entertainment system, heating and air conditioning system, or the system to darken portions of the mirrors or windscreen. The system will automatically inform the emergency services of the number of people involved and the position of the car (by use of the GPS) in the event of a collision.

Priority Data: US 23997894 19940509 A Y;

IPC (International Class): B60R02220; G01S00748; B60N00202; G01S01587; B60N00200; G01S007539; B60J01000; G01S01588; G01S00741; G01F02300; G06K00900; G01S01788; G10K011178; B60N00228; E05F01500; G01S01504; G01F023296; G01F02320; B60N00248; B60R02101; G01S01506; B60R0210132; G01S01789; B60R021013; B60R021015; B60R0210134; G01S01593; G01S01304; B60R021276

National Classification:
--B7B BPD BPD; B7B BSBCR BSBCR; B7B BVRJ BVRJ; E1R RPX RPX; G1A AAJC AJC; G1A AAJL AJL; G1A AA3 AJC; G1A AA3 AJL; G1A AR6 AJC; G1A AT21 AJC; G1A AT21 AJL; G1A AT27 AJC; G1A AT27 AJL; G1A AT3 AJC; G1A AT3 AJL; G1G GMD MD; G1G G9X MD; G3N NGA4 GA4; G3N N262 GA4; G3N N275 GA4; G3N N286C GA4; G3N N397 GA4; G3N N404 GA4; G3N N410 GA4; G4N NHVSC NHVSC; G4N N5C2 NHVSC; H4D DLAB LAB; H4D D714 LAB; H4D D747 LAB; H4D D748 LAB; H4D D752 LAB; H4D D773 LAB; H4D D775 LAB; H4D D781 LAB; H4D D783 LAB; H4J JGP JGP; U1S S1820; U1S S2139

Legal Status:

Date	+/-	Code	Description
20100127	()	PCNP	Effective date: 20090504;

GB2289653B 19980826
GB2289653A 19951129
GB9510402D0 19950719

(ENG) Film airbag

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON

Application No: GB 9510402 A

Filing Date: 19950523

Issue/Publication Date: 19980826

Abstract: (ENG) A thin plastic film is used to make the airbag of this invention. A preferred embodiment uses multiple thin film airbags which are inflated and confined to act together through the use of a surrounding net. In another embodiment, multiple layers of anisotropic film are joined together to form an airbag which is resistant to tearing. The inflator, which is typically of the aspirated type, fills the airbags through a manifold in a controlled sequence until each bag is filled to a specific pressure indicative of either being fully inflated or of interaction with an occupant.

Priority Data: US 24776394 19940523 A Y;

IPC (International Class): B60R02120; B29D02200; B60R021233; B60R021276; B60R02116; B60R02126; B60R021235; B60R021231

ECLA (European Class): B60R02123; B32B00324; B32B00702; B60R021233; B60R021235; B60R02126; B60R021261; B60R021276

National Classification:
--B7B BSBCR BSBCR

Legal Status:

Date	+/-	Code	Description
20100127	()	PCNP	Effective date: 20090523;

GB2289786B 19980916
GB2289786A 19951129
GB9510408D0 19950719

(ENG) Side impact airbag system with anticipatory sensor

Assignee: AUTOMOTIVE TECH INT US

[no drawing available]

Inventor(s): BREED DAVID SCRANTON

Application No: GB 9510408 A

Filing Date: 19950523

Issue/Publication Date: 19980916

Abstract: (ENG) A variable inflation rate inflator system for inflating one or more airbags including an inflator for releasing a gas into the airbag(s), a first anticipatory crash sensor for determining that a crash requiring an airbag will occur based on data obtained prior to the crash and, upon the making of such a determination, triggering the inflator means to release gas into the airbag(s) to thereby inflate the same at a first inflation rate, and a second crash sensor for determining that a crash requiring an airbag will occur or is occurring and, upon the making of such a determination, affecting the inflator such that an additional quantity of gas is released thereby into the airbag(s) to thereby inflate the airbag(s) at a second inflation rate greater than the first inflation rate. Also, an airbag passive restraint system for protecting an occupant sitting in the seat adjacent the side door is disclosed including at least one airbag arranged to be inflated between the occupant and the side door, a sensor for detecting that a crash requiring deployment of the airbag(s) is required, an inflator for releasing a gas into the airbag(s) to inflate the same and which is triggered by the sensor to release gas into the airbag(s) in response to the detection by the sensor of a crash requiring deployment of the airbag(s), and a system for permitting the occupant to be displaced away from the side door upon inflation of the airbag(s) and thereby increase the space between the occupant and the side door.

Priority Data: US 24776094 19940523 A Y;

IPC (International Class): B60R02100; B60R02120; G01S01388; G08G00116; G01S00741; B60N00228; G01S01587; B60N00202; G01S00748; B60N00200; G01S01588; B60R02232; B60R021233; B60R02101; B60R01920; B60R021231; B60R02226; B60R01942; G01S01788; B60R02116; B60R0210132; G01S01789; B60R021015; G01S007539; B60R02126; B60R0210134; G01S007487

ECLA (European Class): B60R021013; B60N00200C; B60N00202B4; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60R01920C; B60R01942; B60R021015; B60R021231L; B60R021233; B60R02226; B60R02232B; G01S00741D; G01S00748A; G01S01388; G01S01587; G01S01588; G01S01788; G08G00116A; G08G00116A2; G08G00116B

National Classification:
--U1S S1820; G4N N5C2 NHVSC; G4Q QCJ QCJ; G4N NHVSC NHVSC; U1S S1142; G4N N7P NHVSC; G4N N2A1 NHVSC

Legal Status:

Date	+/-	Code	Description
20100127	()	PCNP	Effective date: 20090523;

GB2301906B 19990929
GB2301906A 19961218
GB9611795D0 19960807

(ENG) Rear impact occupant protection apparatus

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US

Application No: GB 9611795 A

Filing Date: 19960606

Issue/Publication Date: 19990929

Abstract: NotAvailable

Priority Data: US 47688295 19950607 A Y;

IPC (International Class): B60N00228; B60N00202; B60N00200; B60N002427; G01S01587; B60N00248; G01S01588; B60R02101; B60R021276; B60R021015; G01S01506

ECLA (European Class): B60R021015; B60N00200C; B60N00202B4; B60N00202B6B; B60N00228; B60N00228P4; B60N002427T4; B60N00248C2C; B60N00248C3C; B60N00248W; G01S01587; G01S01588

National Classification:
--G3N N286C GA4; U1S S1857; G3N NGA4 GA4

Legal Status:

Date	+/-	Code	Description
20100224	()	PCNP	Effective date: 20090606;

GB2301922B 19991222
GB2301922A 19961218
GB9611810D0 19960807

(ENG) Optical identification and monitoring system using pattern recognition for use with vehicles

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US ; JOHNSON WENDELL CLAYTON US ; DUVALL WILBUR E US

Application No: GB 9611810 A

Filing Date: 19960606

Issue/Publication Date: 19991222

Abstract: (ENG) A vehicle monitoring system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD

arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle. When system is installed in the passenger compartment of an automotive vehicle equipped with an airbag, the system determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag. The exterior monitoring system may be used to initiate side airbags or to control dipping of headlights.

Priority Data: US 47478695 19950607 A Y;

IPC (International Class): G06K00900; B60N00228; B60N00202; B60N00200; B60Q00114; G01S01588; G01S01587; B60R02101; G01S01788; B60R02220; B60R021015; B60R0210134

ECLA (European Class): B60R021013; B60N00200C; B60N00202B4; B60N00202B6; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60Q00114C1B; B60R021015; G01S01587; G01S01588; G01S01788; G06K00900H

National Classification:
--G1A AAJL AJL; H4D D749 LRE; G1A AT3 AJC; G1A AA3 AJC; H4D D781 LRE; H4D D78X LRE; H4D D714 LRE; H4D D730 LPC; H4D D773 LRE; H4D D773 LPC; G1A AT21 AJC; G1A AAJC AJC; H4D D775 LPC; G1A AT27 AJL; G1A AR6 AJL; H4D D755 LRE; G1A AT3 AJL; H4D DLPC LPC; H4D D762 LRE; G1A AR6 AJC; H4D D753 LPC; H4D D782 LPC; G4N NHVSC NHVSC; G1A AT21 AJL; G4N N5C2 NHVSC; H4D DLRE LRE; G1A AT27 AJC; H4D D776 LRE; H4D D251 LRE; G1A AA3 AJL; H4D D714 LPC; H4D D747 LRE

Legal Status:

Date	+/-	Code	Description
20100224	()	PCNP	Effective date: 20090606;

GB2308102B 19991110
GB2308102A 19970618
GB9624734D0 19970115

(ENG) An efficient airbag module

Assignee: AUTOMOTIVE TECH INT US

[no drawing available]

Inventor(s): BREED DAVID SCRANTON US ; SANDERS WILLIAM THOMAS US

Application No: GB 9624734 A

Filing Date: 19961128

Issue/Publication Date: 19991110

Abstract: (ENG) An airbag module to protect an occupant in the passenger compartment in the event of a crash of the vehicle. In a most basic embodiment, the module includes an elongate housing having a length in the longitudinal direction which is substantially larger than its width or thickness in a direction transverse to the longitudinal direction, an airbag situated within the housing, an inflator arranged in the housing to produce pressurized gas to inflate the airbag, mounting members for mounting the module in the passenger compartment and an initiator for initiating the inflator to produce the pressurized gas in response to the crash of the vehicle. The housing includes a cover for releasably retaining the airbag so that it can deploy upon inflation of the airbag.

Priority Data: US 57124795 19951212 A Y;

IPC (International Class): B60R02126; B60R02120; B60R02116; B60R021235; B60R021213; B60R02130; B60R021231; B60R021233; B60R02100

ECLA (European Class): B60R021233; B60R02120; B60R021213; B60R021232; B60R021235; B60R02130

National Classification:
--B7B BSBCR BSBCR

Legal Status:

Date	+/-	Code	Description
20100728	()	PCNP	Effective date: 20091128;

GB2323340B 20010718
GB2323340A 19980923
GB9802263D0 19980401

(ENG) Plastic film airbag

Assignee: AUTOMOTIVE TECH INT US

[no drawing available]

Inventor(s): BREED DAVID SCRANTON US

Application No: GB 9802263 A

Filing Date: 19980204

Issue/Publication Date: 20010718

Abstract: (ENG) A vehicle occupant protection system is characterised by an airbag made from non-perforated film sheet with elastomeric material, preferably thermoplastic, such as polyurethane, arranged over at least part of the sheet as tear propagation arresting means. The elastomeric material may be arranged at specific locations such that those locations are thicker than the average thickness of the sheet, eg in a predetermined pattern of ribs 320 and circular rings 318. The specific locations may be chosen to take into account the stresses in the sheet. Alternatively the tear propagation arresting means may be a network of material strips, a net, a second sheet of film or a fabric layer. Also disclosed is a side impact airbag arrangement with the airbag 800 stored in a lateral housing 810 above the side windows of a vehicle, deployable downwardly to cover the side windows of the vehicle.

Priority Data: US 79541897 19970204 A Y;

IPC (International Class): B60R02133; B60R02120; B60R02116; B60R021268; B60R021232; B60R021235; B60R02100; B60R021231

ECLA (European Class): B60R02120; B60R021232; B60R021235; B60R021268; B60R02133

National Classification:
--B7B BSBCC BSBCC; B7B BSBCR BSBCR; B7B B601 BSBCC; B7B B601 BSBCR

Legal Status: There is no Legal Status information available for this patent

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GB2324864B 19990106
GB2324864A 19981104
GB9816593D0 19980930

(ENG) Vehicle interior identification and monitoring system

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON ; JOHNSON WENDELL CLAYTON ; DUVALL WILBUR E

Application No: GB 9816593 A

Filing Date: 19950504

Issue/Publication Date: 19990106

Abstract: NotAvailable

Priority Data: GB 9509090 19950504 A 3 Y; US 23997894 19940509 A Y;

IPC (International Class): E05F01500; G01S01788; B60N00228; B60N00202; G01S01587; B60N00200; G06K00900; G01S01504; G01S00748; B60N00248; G01S00741; G01S007539; B60R02101; G01S01588; B60R02220; B60R0210134; G01S01506; G01S01789; B60R0210132; B60R021276; G01S01593; G01S01304; B60R021015; B60R021013

ECLA (European Class): B60R021015; B60N00200C; B60N00202B4; B60N00202B6B; B60N00202B6W; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; B60R02220; E05F01500B6B; G01S00741D; G01S00748A; G01S007539; G01S01504; G01S01587; G01S01588; G01S01788; G06K00900H

National Classification:
--H4D D752 LAB; H4D D747 LAB; U1S S1865; B7B BPD BPD; G1A AAJL AJL; G1A AT3 AJC; G1A AA3 AJC; U1S S1887; H4D D775 LAB; G1A AA1 AJC; G3N N275 GA4; G1A AG9 AJC; H4D D773 LAB; U1S S1917; G1A AA1 AJL; H4D DLAB LAB; B7B BVRJ BVRJ; G1A AR7 AJL; G1A AT21 AJC; G3N N262 GA4; G1A AAJC AJC; G3N N410 GA4; G1A AR6 AJL; G1A AT27 AJL; G1A AT3 AJL; G3N N286C GA4; H4D D783 LAB; G3N N404 GA4; G1A AR6 AJC; G1A AG9 AJL; B7B BSBCR BSBCR; H4J JGP JGP; G1A AT21 AJL; H4D D748 LAB; H4D D714 LAB; H4D D781 LAB; G3N N397 GA4; E1R RPX RPX; G1A AT27 AJC; U1S S1142; G1A AR7 AJC; G3N NGA4 GA4; G1A AA3 AJL

Legal Status:

Date	+/-	Code	Description
20100127	()	PCNP	Effective date: 20090504;

GB2340978B 20001227
GB2340978A 20000301
GB9927633D0 20000119

(ENG) Smart airbag system

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID SCRANTON US

Application No: GB 9927633 A

Filing Date: 19980529

Issue/Publication Date: 20001227

Abstract: NotAvailable

Priority Data: US 9810943 19980529 W W N; US 86552597 19970529 A Y;

IPC (International Class): B60R02116; G06G00760; G05B01302; G06N00300; B60R02101; B60R0210132; B60R02100; B60R0210134; B60R021015

ECLA (European Class): B60R021013; B60R021015

National Classification:
--G4N N5C2 NHVSC; G4N NHVSC NHVSC

Legal Status:

Date	+/-	Code	Description
20100127	()	PCNP	Effective date: 20090529;

HK1082310A1 20100416

(ENG) CHINESE CHARACTER HANDWRITING SYSTEM

[no drawing available]

Assignee: TEGI COMM INC US

Inventor(s): LONGE MICHAEL R ; PALMER BRIAN

Application No: HK 05109060 A

Filing Date: 20051013

Issue/Publication Date: 20100416

Abstract: (ENG) A handwritten Chinese character input method and system is provided to allow users to enter Chinese characters to a data processor by adding less than three strokes and one selection movement such as mouse clicking or stylus or finger tapping. The system is interactive, predictive, and intuitive to use. By adding one or two strokes which are used to start writing a Chinese character, or in some case even no strokes are needed, users can find a desired character from a list of characters. The list is context sensitive. It varies depending on the prior character entered. Compared to other existing systems, this system can save users considerable time and efforts to entering handwritten characters.

Priority Data: US 0322776 20030717 W W N; US 20595002 20020725 A Y;

IPC (International Class): G06F003033; G06F00301; G06F00300; G06F003048; G06K00922

ECLA (European Class): G06F00301M; G06F003048A3G; G06K00922H

Legal Status: There is no Legal Status information available for this patent

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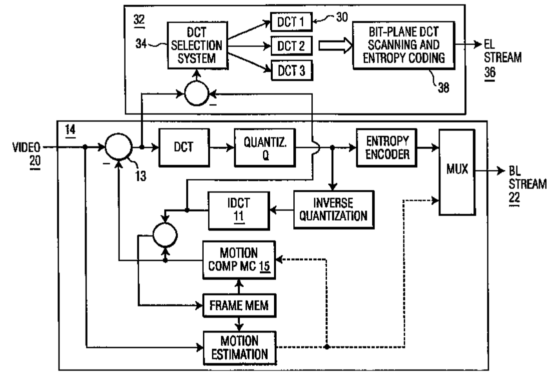

WO2003055227A1 20030703

(ENG) COMPLEXITY SCALABILITY FOR FINE GRANULAR VIDEO ENCODING (FGS)

Assignee: KONINKL PHILIPS ELECTRONICS NV NL

Inventor(s): CHEN RICHARD ; VAN DER SCHAAR MIHAELA

Application No: IB 0205320 W

Filing Date: 20021209

Issue/Publication Date: 20030703

Abstract: An encoder and decoder system for realization of complexity scalability in a layered video-coding framework. The layered video encoder comprises a base layer encoder for receiving a video signal and outputting a base layer stream; and an enhancement layer encoder that includes a plurality of discrete cosine transform (DCT) modules and a selection system for selecting one of the DCT modules. The layered video decoding system comprises a base layer decoder for receiving and decoding a base layer video stream; and an enhancement layer decoder for receiving an enhancement layer video stream and the decoded base layer stream, and generating a decoded enhanced video output, wherein the enhancement layer decoder includes: a plurality of inverse discrete cosine transform /IDCT) modules; and a selection system for selecting one of the IDCT modules.

Priority Data: US 2838601 20011221 A A;

IPC (International Class): H04N00730; H04N00750; H04N00726

ECLA (European Class): H04N00726E2; H04N00730H; H04N00750

Designated Countries:

----Designated States: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SC SD SE SG SK SL TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW

----Regional Treaties: AM AT AZ BE BF BG BJ BY CF CG CH CI CM CY CZ DE DK EE ES FI FR GA GB GH GM GN GQ GR GW IE IT KE KG KZ LS LU MC MD ML MR MW MZ NE NL PT RU SD SE SI SK SL SN SZ TD TG TJ TM TR TZ UG ZM ZW

Publication Language: ENG

Agent(s): LANDOUSY, Christian Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven NL

Legal Status:

Date	+/-	Code	Description
20030703	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SC SD SE SG SK SL TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW;
20030703	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW AM

			AZ BY KG KZ MD RU TJ TM AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LU MC NL PT SE SI SK TR BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG;
20030827	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20040524	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2002788332; Country code of corresponding patent document: EP;
20040618	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2003555817; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040618	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2003555817; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040618	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2002825368X; Country code of corresponding patent document: CN;
20040618	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2003555817; Country code of corresponding patent document: JP;
20040922	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 2002788332; Country code of corresponding patent document: EP;
20070723	(-)	WWW	WIPO INFORMATION: WITHDRAWN IN NATIONAL OFFICE Corresponding patent document: 2002788332; Country code of corresponding patent document: EP;

JP3960394B2 20070815
JP8175305A 19960709

NotAvailable

Application No: JP 14821795 A

[no drawing available]

Filing Date: 19950522

Issue/Publication Date: 20070815

Abstract: (ENG) A thin plastic film is used to make the airbag of this invention. A preferred embodiment uses multiple thin film airbags which are inflated and confined to act together through the use of a surrounding net. In another embodiment, multiple layers of anisotropic film are joined together to form an airbag which is resistant to tearing. The inflator, which is typically of the aspirated type, fills the airbags through a manifold in a controlled sequence until each bag is filled to a specific pressure indicative of either being fully inflated or of interaction with an occupant.

Priority Data: US 24776394 19940523 A Y;

IPC (International Class): B60R02116; B60R02120; B29D02200; B60R021233; B60R021276; B60R02126; B60R021235; B60R021231

ECLA (European Class): B60R02123; B32B00324; B32B00702; B60R021233; B60R021235; B60R02126; B60R021261; B60R021276

Legal Status: There is no Legal Status information available for this patent

JP3993253B2 20071017
JP8198044A 19960806

NotAvailable

Application No: JP 14955295 A

[no drawing available]

Filing Date: 19950523

Issue/Publication Date: 20071017

Abstract: (ENG) A variable inflation rate inflator system for inflating one or more airbags including an inflator for releasing a gas into the airbag(s), a first anticipatory crash sensor for determining that a crash requiring an airbag will occur based on data obtained prior to the crash and, upon the making of such a determination, triggering the inflator means to release gas into the airbag(s) to thereby inflate the same at a first inflation rate, and a second crash sensor for determining that a crash requiring an airbag will occur or is occurring and, upon the making of such a determination, affecting the inflator such that an additional quantity of gas is released thereby into the airbag(s) to thereby inflate the airbag(s) at a second inflation rate greater than the first inflation rate. Also, an airbag passive restraint system for protecting an occupant sitting in the seat adjacent the side door is disclosed including at least one airbag arranged to be inflated between the occupant and the side door, a sensor for detecting that a crash requiring deployment of the airbag(s) is required, an inflator for releasing a gas into the airbag(s) to inflate the same and which is triggered by the sensor to release gas into the airbag(s) in response to the detection by the sensor of a crash requiring deployment of the airbag(s), and a system for permitting the occupant to be displaced away from the side door upon inflation of the airbag(s) and thereby increase the space between the occupant and the side door.

Priority Data: US 24776094 19940523 A Y;

IPC (International Class): B60R02116; B60R02100; B60R02120; G01S01388; G08G00116; G01S00741; B60N00228; G01S01587; B60N00202; G01S00748; B60N00200; G01S01588; B60R02232; B60R021233; B60R02101; B60R01920; B60R021231; B60R02226; B60R01942; G01S01788; B60R0210132; G01S01789; B60R021015; G01S007539; B60R02126; B60R0210134; G01S007487

ECLA (European Class): B60R021013; B60N00200C; B60N00202B4; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60R01920C; B60R01942; B60R021015; B60R021231L; B60R021233; B60R02226; B60R02232B; G01S00741D; G01S00748A; G01S01388; G01S01587; G01S01588; G01S01788; G08G00116A; G08G00116A2; G08G00116B

Legal Status: There is no Legal Status information available for this patent

JP2004518104A 20040617

NotAvailable

Application No: JP 2000582267 T

[no drawing available]

Filing Date: 19991115

Issue/Publication Date: 20040617

Abstract: (ENG) An apparatus for measuring the weight of an occupying item of a seat (1056) including a support structure (1058, 1060, 1062) for mounting the seat (1056) to a substrate. The apparatus includes a strain gage transducer (1065, 1066) mounted on the support structure (1058, 1060, 1062) and arranged to provide a measurement of the stain of the support structure (1058, 1060, 1062) at the location at which it is mounted. A control system (1030) is coupled to the strain gage transducer (1065, 1066) for determining the weight of the occupying item of the seat (1056) based on the strain of the support structure (1058, 1060, 1062) measured by the strain gage transducer (1065, 1066). The weight measuring apparatus is used in a seat adjustment apparatus for adjusting a seat (1) in a passenger compartment of a vehicle including wave sensors (11, 12, 13, 14) for transmitting waves into the passenger compartment toward the seat (1), receiving waves from the passenger compartment and generating an output representative of the waves received by the wave sensors (11, 12, 13, 14), and a processor (19, 20, 21, 22, 23, 24, 25, 26, 28, 29) for receiving the outputs from the wave sensors (11, 12, 13, 14) and the weight measuring apparatus and evaluating the seated-state of the seat (1) based thereon. The processor, e.g., directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat or to affect the deployment of an airbag.

Priority Data: US 19320998 19981117 A Y; US 9927098 19991115 W W N;

IPC (International Class): G01G01912; B60R02116; G01G01952; B60N00244; B60N00266; B60N00202; B60N002015; B60N00200; B60N00248; B60N00206; B60R02101; B60N00268; B60N00228; B60R021015

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206; B60N00206S; B60N00228B2; B60N00228P4; B60N00248C; B60N00248C2C; B60N00248C3C; B60N00266; B60N00268

Legal Status: There is no Legal Status information available for this patent

JP4519381B2 20100804
JP2003501711A 20030114

NotAvailable

Application No: JP 2001500435 T

[no drawing available]

Filing Date: 20000526

Issue/Publication Date: 20100804

Abstract: (ENG) A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region. The actual contact locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a mechanical keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F003041; G06F01722; G06F003023; G06F003048; H03M01104; H03K01794; G06F003033; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status: There is no Legal Status information available for this patent

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JP2004522932A 20040729

NotAvailable

Application No: JP 2001519213 T

[no drawing available]

Filing Date: 20000530

Issue/Publication Date: 20040729

Abstract: (ENG) Method for developing a system for determining the occupancy of a seat in a vehicle using a variety of transducers and pattern recognition technologies and techniques that applies to any combination of transducers that provide information about seat occupancy. These include weight sensors, capacitive sensors, inductive sensors, ultrasonic, optical, electromagnetic, motion, infrared, and radar among others. A processor coupled to the transducers for receiving the data from the transducers and processing the data to obtain an output indicative of the current occupancy state of the seat. An algorithm is resident in the processor and is created from a plurality of data sets, each representing a different occupancy state of the seat and being formed from data from the transducers while the seat is in that occupancy state. The algorithm produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from the transducers. The algorithm may be a neural network or neural fuzzy algorithm generated by an appropriate algorithm-generating program.

Priority Data: US 13616399 19990527 P Y; US 38240699 19990824 A Y; US 47414799 19991229 A Y; US 0014903 20000530 W W N;

IPC (International Class): G01V00100; G01V00312; B60N00244; G01V00308; B60R02116; G01S01508; B60R02101; G06K00900; B60R021015

ECLA (European Class): B60R021015; G06K00900H

Legal Status: There is no Legal Status information available for this patent

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JP4307252B2 20090805
JP2005508877A 20050407

NotAvailable

Application No: JP 2003512276 T

[no drawing available]

Filing Date: 20020715

Issue/Publication Date: 20090805

Abstract: (ENG) Activated haptens useful for generating immunogens to HIV protease inhibitors, immunogens useful for producing antibodies to HIV protease inhibitors, and antibodies and labeled conjugates useful in immunoassays for HIV protease inhibitors. The novel haptens feature an activated functionality at the central, non-terminal hydroxyl group common to all HIV protease inhibitors, e.g., saquinavir, nelfinavir, indinavir, amprenavir, ritonavir and lopinavir.

Priority Data: EP 0207843 20020715 W W N; US 30519201 20010713 P Y; US 19205202 20020710 A Y;

IPC (International Class): C07D40114; C12N00999; C07D40312; A61K03900; C07K01600; C07D40512; C12N00510; C07D41714; C12P02108; C07K01400; C07K01638

ECLA (European Class): C07K01638

Legal Status: There is no Legal Status information available for this patent

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JP2005513928A 20050512

NotAvailable

Application No: JP 2003555817 T

[no drawing available]

Filing Date: 20021209

Issue/Publication Date: 20050512

Abstract: (ENG) An encoder and decoder system for realization of complexity scalability in a layered video-coding framework. The layered video encoder comprises a base layer encoder for receiving a video signal and outputting a base layer stream; and an enhancement layer encoder that includes a plurality of discrete cosine transform (DCT) modules and a selection system for selecting one of the DCT modules. The layered video decoding system comprises a base layer decoder for receiving and decoding a base layer video stream; and an enhancement layer decoder for receiving an enhancement layer video stream and the decoded base layer stream, and generating a decoded enhanced video output, wherein the enhancement layer decoder includes: a plurality of inverse discrete cosine transform (IDCT) modules; and a selection system for selecting one of the IDCT modules.

Priority Data: IB 0205320 20021209 W W N; US 2838601 20011221 A Y;

IPC (International Class): H04N00750; H04N00730; H04N00726

ECLA (European Class): H04N00726E2; H04N00730H; H04N00750

Legal Status: There is no Legal Status information available for this patent

JP4309772B2 20090805
JP2005203572A 20050728

NotAvailable

Application No: JP 2004008492 A

[no drawing available]

Filing Date: 20040115

Issue/Publication Date: 20090805

Abstract: (ENG) A nonmagnetic material-noncontact layer forming a fixed magnetic layer is formed using CoFe, a nonmagnetic material-contact layer is formed using Co, and an NOL (Nano-Oxide Layer) is provided between the nonmagnetic material-noncontact layer and the nonmagnetic material-contact layer. In addition, the average film thickness of the nonmagnetic material-contact layer is set in the range of 16 to 19 Å. Accordingly, compared to a three-layered structure composed of CoFe, an NOL, and CoFe or a three-layered structure composed of Co, an NOL, and Co, which has been conventionally used, the rate (DeltaR/R) of change in resistance and the unidirectional exchange bias magnetic field (Hex*) can both be improved.

Priority Data: JP 2004008492 20040115 A Y;

IPC (International Class): H01L04308; G01R03309; G11B00539; H01F01030; G11B00533; G11B005127

ECLA (European Class): B82Y02500; B82Y01000; G01R03309B

Legal Status: There is no Legal Status information available for this patent

JP2005097307A 20050414

(ENG) PROTEASE INHIBITOR CONJUGATE AND ANTIBODY USEFUL IN IMMUNOASSAY

[no drawing available]

Assignee: HOFFMANN LA ROCHE

Inventor(s): SIGLER GERALD F ; HUI RAYMOND A ; DERAS INA ; ROOT RICHARD TERRY ; GHOSHAL MITALI ; HUBER ERASMUS ; DER ELTZ HERBERT VON ; METZ SIGRUN ; KERN PETER

Application No: JP 2004277754 A

Filing Date: 20040924

Issue/Publication Date: 20050414

Abstract: (ENG) <sec><p>PROBLEM TO BE SOLVED: To provide activated haptens useful for generating immunogens to HIV protease inhibitors, and antibodies and labeled conjugates useful in immunoassays for HIV protease inhibitors.</p> <p>SOLUTION: Theinvention relates to a compound represented by the structural formula: I-X-(C=Y)<sb pos="post">m</sb>-L-A. In the formula is an HIV protease

inhibitor group of an HIV protease inhibitor atazanavir, X is O or NH, Y is O, S or NH, m is 0 or 1, L is alinker consisting of from 0 to 40 carbon atoms arranged in a saturated or unsaturated straight chain or a branched chain, and containing up to two ring structures and 0- 20 heteroatoms, with the proviso that not more than three heteroatoms may belinked in sequence, and A is an activated functional group chosen from a group consisting of active esters, isocyanates, isothiocyanates, thiols, imidoesters, acid anhydrides, maleimides, thiolactones, diazonium groups andaldehydes.</p><p></p></sec>

Priority Data: US 66983103 20030924 A;

IPC (International Class): C07D21726; C07D23910; C07D27728; C07D30720; C07D40112; C07D40114; C07D40512; C07D41714; C07D49504; C07K014765; C07K014795; C07K01638; C12N00510; A61K03900; A61P03118; A61P04300; C12P02108

ECLA (European Class): C07K01644

Legal Status: There is no Legal Status information available for this patent

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JP2005520268A 20050707

NotAvailable

Application No: JP 2004523577 T

[no drawing available]

Filing Date: 20030717

Issue/Publication Date: 20050707

Abstract: (ENG) The invention provides a process for selecting and ordering one or more sets of linguistic objects. The invention orders a current list of items for selection that comprises a first list of one or more items of a first language and a second list of one or more items of a second language, the current list of items being displayed in an order based on the first language having a priority over the second language. In response to a user selection of one item from the second list, the invention changes a priority for ordering a subsequent list of items to order the subsequent list of items based on the second language having a priority over the first language.

Priority Data: US 39725302 20020718 P Y; US 62186403 20030716 A Y; US 0322525 20030717 W W N;

IPC (International Class): G06F01722; G06F01727

ECLA (European Class): G06F003023M6; G06F01727P

Legal Status: There is no Legal Status information available for this patent

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JP4230458B2 20090225
JP2006510893A 20060330

NotAvailable

Application No: JP 2004561578 T

[no drawing available]

Filing Date: 20031216

Issue/Publication Date: 20090225

Abstract: (ENG) Phase difference ambiguity is first determined between third and second extra-long path carriers. Phase difference ambiguity is then estimated between third and second long path carriers from ambiguity for extra-long path determined in first step. Next step involves resolving ambiguity of one frequency from long path ambiguity estimated in second step. Additional step involves applying real-time ionospheric corrections during third step. Corrections are based on permanently updated ionospheric model of ionospheric layer calculated by a fixed terrestrial reference station linked with geodesic data calculated by a master fixed terrestrial reference station (REFM-REFME). An Independent claim is also included for a navigation system for locating position of a nomad e.g. land vehicle.

Priority Data: FR 0216227 20021219 A Y; FR 0350176 20031216 W W N;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Legal Status: There is no Legal Status information available for this patent

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JP2005306376A 20051104

(ENG) THIN FILM AIR BAG

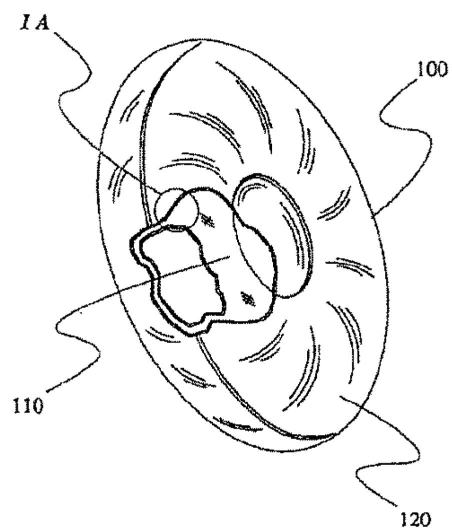
Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S

Application No: JP 2005150118 A

Filing Date: 20050419

Issue/Publication Date: 20051104



Abstract: (ENG) <P>PROBLEM TO BE SOLVED: To eliminate an air bag from being suddenly damaged by easily spreading tear in a thin film in its generation, to use a plastic thin film for the air bag and to realize great reduction of cost and space. <P>SOLUTION: In the thin film air bag, two air bags having one placed in the other are used and are mounted to each other by an adhesive. The adhesive is strong as it can closely retain two bags each other but it is not strong as tear is spread to the other bag in one bag. For example, if tear is generated in the outside air bag, since considerable tensile stress in a material near the tear position cannot be supported, the internal air bag must receive the increased tensile stress until the stress can be transmitted to the outside air bag positioned at a position apart from the tear

position with a slight distance. If the tear is generated by a small hole, the stress in the internal air bag is only generated at the position of a few hole diameters away from the hole. <P>COPYRIGHT: (C)2006,JPO&NCIPI

Priority Data: US 24776394 19940523 A Y;

Related Application(s): JP07148217

IPC (International Class): B60R02120; B29D02200; B60R021233; B60R021276; B60R02116; B60R02126; B60R021235; B60R021231

Legal Status: There is no Legal Status information available for this patent

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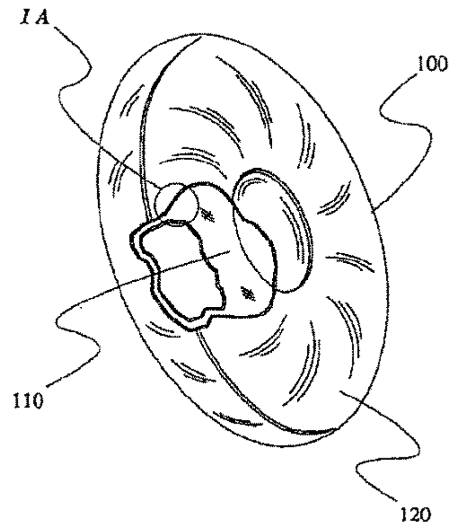
JP2005306376A 20051104



(ENG) THIN FILM AIR BAG

Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S

Application No: JP 2005150118 A

Filing Date: 20050419

Issue/Publication Date: 20051104

Abstract: (ENG) <P>PROBLEM TO BE SOLVED: To eliminate an air bag from being suddenly damaged by easily spreading tear in a thin film in its generation, to use a plastic thin film for the air bag and to realize great reduction of cost and space. <P>SOLUTION: In the thin film air bag, two air bags having one placed in the other are used and are mounted to each other by an adhesive. The adhesive is strong as it can closely retain two bags each other but it is not strong as tear is spread to the other bag in one bag. For example, if tear is generated in the outside air bag, since considerable tensile stress in a material near the tear position cannot be supported, the internal air bag must receive the increased tensile stress until the stress can be transmitted to the outside air bag positioned at a position apart from the tear position with a slight distance. If the tear is generated by a small hole, the stress in the internal air bag is only generated at the position of a few hole diameters away from the hole. <P>COPYRIGHT: (C)2006,JPO&NCIPI

Priority Data: US 24776394 19940523 A Y;

Related Application(s): JP07148217

IPC (International Class): B60R02120; B29D02200; B60R021233; B60R021276; B60R02116; B60R02126; B60R021235; B60R021231

Legal Status: There is no Legal Status information available for this patent

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本実施例にかかるネットワークシステムの構成を示す図

JP2008160584A 20080710

(ENG) NETWORK SYSTEM AND DATA TRANSFER METHOD

Assignee: FUJITSU LTD

Inventor(s): YAMADA KENJI

Application No: JP 2006348344 A

Filing Date: 20061225

Issue/Publication Date: 20080710

Abstract: (ENG) Upon communication nodes receiving data that is a transfer target, based on a link value corresponding to a communication quality of each communication node that has transferred the data and radio wave strength among the communication nodes, a network system calculates a total link value that indicates a quality of a communication path that is used to transfer the data. The network system determines whether the calculated total link value is greater than or equal to a threshold value and based on a determination result, transfers the data to a destination communication node.

Priority Data: JP 2006348344 20061225 A Y;

IPC (International Class): H04L01228; H04B00726; H04B00715

ECLA (European Class): H04L01256C; H04L01256C11D; H04W04004

Publication Language: JAP

Filing Language: JAP

Legal Status: There is no Legal Status information available for this patent

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JP4527731B2 20100818
JP2007538299A 20071227

NotAvailable

Application No: JP 2006545610 T

[no drawing available]

Filing Date: 20041222

Issue/Publication Date: 20100818

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 53213103 20031222 P Y; US 1951704 20041220 A Y; US 2004043329 20041222 W W N;

IPC (International Class): G06F003023; G06F003041; H03M01104; G06K00972; G06F003048; G06K00948; G06F01727; G09G00500; G06K00918; G06K00934

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Legal Status: There is no Legal Status information available for this patent

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JP2007518238A 20070705

NotAvailable

Application No: JP 2006549258 T

[no drawing available]

Filing Date: 20041201

Issue/Publication Date: 20070705

Abstract: (ENG) A molten carbonate fuel cell cathode having a cathode body and a coating of a mixed oxygen ion conductor materials. The mixed oxygen ion conductor materials are formed from ceria or doped ceria, such as gadolinium doped ceria or yttrium doped ceria. The coating is deposited on the cathode body using a sol-gel process, which utilizes as precursors organometallic compounds, organic and inorganic salts, hydroxides or alkoxides and which uses as the solvent water, organic solvent or a mixture of same.

Priority Data: US 75548304 20040112 A Y; US 2004040099 20041201 W W N;

IPC (International Class): H01M00486; H01M00488; H01M00814; H01M00490

Legal Status: There is no Legal Status information available for this patent

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JP2011524369A 20110901

NotAvailable

Application No: JP 2011513726 A

[no drawing available]

Filing Date: 20090612

Issue/Publication Date: 20110901

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y; US 2009047190 20090612 W W N;

IPC (International Class): C07H019067; A61P03500; A61K0317068

Legal Status: There is no Legal Status information available for this patent

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JP9189710A 19970722

(ENG) IMPROVED VEHICLE COLLISION SENSOR FOR DESTRUCTION SENSING

[no drawing available]

Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S US

Application No: JP 22736196 A

Filing Date: 19960812

Issue/Publication Date: 19970722

Abstract: (ENG) PROBLEM TO BE SOLVED: To detect collision needing an air-bag on the front part, rear part or the side of a vehicle with a single sensor. SOLUTION: This sensor comprises a destruction detecting device for vehicle having a conductive tube 105, a conductive rod 104 assigned in the tube in coaxial manner and insulating means 106 disposed at least at two points between the rod and the tube so as to insulate the rod from the tube, and the conductive tube is deformed by the force beyond the specified magnitude when the vehicle collides, and the tube is brought into contact with the rod according to the destruction of the vehicle. Destruction sensors for this are attached to a rear part boundary of a destruction sensor zone(CSZ) for a front part and a rear part collision, and to a door or other proper position for side collision, respectively. The sensor is used for collision sensing for expanding a passive people protecting device for the vehicle such as an air bag, etc.

Priority Data: US 51498695 19950814 A Y;

IPC (International Class): G01P01500; B60R02116

Legal Status: There is no Legal Status information available for this patent

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JP9240407A 19970916

(ENG) AIR BAG SYSTEM FURNISHING SELF-FORMING TYPE AIR BAG

[no drawing available]

Assignee: AUTOMOTIVE TECH INT

Inventor(s): BREED DAVID S US

Application No: JP 27862496 A

Filing Date: 19961001

Issue/Publication Date: 19970916

Abstract: (ENG) PROBLEM TO BE SOLVED: To provide an air bag which can be manufactured without sewing, has a very light weight, and can be made in a small form smaller than a conventional cloth bag in the folding condition in a nonoperating condition. SOLUTION: An expansion type occupant restricting device in an occupant protective system of a vehicle has a peripheral end, and it includes at least two sheets of inelastic plastic films 210 and 212, which are jointed only by the peripheral end, and plain practically; an inflator connected to the air bag 200 and the vehicle, in order to inflate the air bag 200 through at least one port of the inelastic plastic films 210 and 212; and an initiator to start the inflator by reacting to the collision of the vehicle. When the air bag 200 is inflated, at least two sheets of inelastic plastic films 210 and 212 are deformed without being extended practically, and practically, the thickness of the air bag 200 is made smaller than its width or the height, or the air bag 200 is made in an elliptical form.

Priority Data: US 53967695 19951005 A Y;

IPC (International Class): B60R02120; B60R021231; B60R02116; B60R021235; B60R021239

Legal Status: There is no Legal Status information available for this patent

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JP9175316A 19970708

(ENG) EFFICIENT AIR BAG MODULE

Assignee: AUTOMOTIVE TECH INT

[no drawing available]

Inventor(s): BREED DAVID S US

Application No: JP 34657696 A

Filing Date: 19961211

Issue/Publication Date: 19970708

Abstract: (ENG) PROBLEM TO BE SOLVED: To efficiently utilize a gas generating agent by providing a housing with an inflator which generates pressure gas to expand an air bag, and starting the inflator, in response to the collision of a vehicle, and keeping the air bag capably of opening at the housing. SOLUTION: An air bag module 110 attached to the ceiling of the cabin 195 of an automobile includes an inflator module 120 and an air bag 110. The air bag 110 is coupled with the inflator module 120, and is attached to the ceiling. In the case that the unfolding of the air bag 110 is judged to be necessary, a sensor/diagnosing module sends a signal to the inflator module 120, and starts combustion of the gas generating agent. The inflator module 120 consists of a gas generator composed of a housing which lets produced gas flow out. The gas generating agent 127 is attached to a tube 121. By the above, the consumption of the generated energy can be made small.

Priority Data: US 57124795 19951212 A Y;

IPC (International Class): B60R02126; B60R02120; B60R02116; B60R021235; B60R021213; B60R02130; B60R021231; B60R021233; B60R02100

Legal Status: There is no Legal Status information available for this patent

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JP2002501459A 20020115

NotAvailable

Application No: JP 50093699 T

[no drawing available]

Filing Date: 19980529

Issue/Publication Date: 20020115

Abstract: (ENG) A smart airbag system including a sensor mechanism for controlling the deployment of an occupant protection apparatus in a motor vehicle, such as a gas-inflatable airbag, to protect an occupant of the vehicle in a crash. The system includes a sensor mounted to the vehicle for sensing accelerations of the vehicle and producing an analog signal representative thereof; an electronic converter for receiving the analog signal from the sensor and for converting the analog signal into a digital signal, and a processor which receives the digital signal. The processor includes a pattern recognition system and produces a deployment control signal to a gas control module which controls the flow of gas into or out of the airbag to optimize the injury protection capability of the airbag. The system also accepts inputs from occupant position, velocity and weight sensors and/or anticipatory crash sensors, when such are available, and may affect the deployment control signal based on these inputs.

Priority Data: US 86552597 19970529 A Y; US 9810943 19980529 W W N;

IPC (International Class): B60R02116; G06G00760; G05B01302; G06N00300; B60R02101; B60R0210132; B60R02100; B60R0210134; B60R021015

ECLA (European Class): B60R021013; B60R021015

Legal Status: There is no Legal Status information available for this patent

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JPH09501120A 19970204

NotAvailable

Application No: JP 52231894 T

[no drawing available]

Filing Date: 19940330

Issue/Publication Date: 19970204

Abstract: (ENG) An occupant position sensor (110-114, 215) using either ultrasonic, microwave or optical technologies, or seat belt spool out (501) and seat position sensors (601), are used as inputs to the primary vehicle crash sensor circuit to permit the longest possible sensing time before the occupant gets proximate to the airbag (104) and is in danger of being injured by the deploying airbag. The sensor further disables the inflatable restraint system (104) if the occupant is in danger of being injured by the system deployment. Separate systems are used for the driver and passenger to permit the optimum decision to be made for each occupant.

Priority Data: US 9403455 19940330 W W N; US 4097893 19930331 A Y;

IPC (International Class): G01P003486; G01B01100; G01S01789; G01S01510; B60R02116; G01S007539; G01S01588; B60N00228; B60N00202; B60N00200; G06K00900; G01S01788; G01S01587; B60R02101; B60N00248; G01S00748; B60R02220; B60R00108; G01S00741; B60R0212165; B60R0210132; G01S01304; G01S01506; B60R02248; B60R021276; B60R021015; B60R02126; B60R02228; B60R0210134; B60R00112

Legal Status: There is no Legal Status information available for this patent

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JP2001508732A 20010703

NotAvailable

Application No: JP 52895499 T

[no drawing available]

Filing Date: 19981116

Issue/Publication Date: 20010703

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

Priority Data: US 97082297 19971114 A Y; US 12849098 19980804 A Y; US 9824487 19981116 W W N;

IPC (International Class): B60N00244; B60R02116; G01S01587; B60N00206; B60N00202; G01S01588; B60N00200; B60R02101; B60N00228; G01G019414; B60N00248; B60R021276; B60R021015; G01S01506; B60R02228; B60R02120; B60R02220; B60R02246; B60R021203

Legal Status: There is no Legal Status information available for this patent

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KR101003879B1 20101230
KR20070114329A 20071203

(ENG) VIRTUAL KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

[no drawing available]

Application No: KR 20067014590 A

Filing Date: 20041222

Issue/Publication Date: 20101230

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 1951704 20041220 A Y; US 53213103 20031222 P Y;

IPC (International Class): G06F003048; G06K00918; G06F01727; G09G00500; G06K00934; G06K00948; G06K00972

Publication Language: KOR

Legal Status: There is no Legal Status information available for this patent

KR100772237B1 20071101
KR20060108765A 20061018

(ENG) MOLTEN CARBONATE FUEL CELL CATHODE WITH MIXED OXIDE COATING

[no drawing available]

Application No: KR 20067015822 A

Filing Date: 20060804

Issue/Publication Date: 20071101

Abstract: (ENG) A molten carbonate fuel cell cathode having a cathode body and a coating of a mixed oxygen ion conductor materials. The mixed oxygen ion conductor materials are formed from ceria or doped ceria, such as gadolinium doped ceria or yttrium doped ceria. The coating is deposited on the cathode body using a sol-gel process, which utilizes as precursors organometallic compounds, organic and inorganic salts, hydroxides or alkoxides and which uses as the solvent water, organic solvent or a mixture of same.

Priority Data: US 75548304 20040112 A Y;

IPC (International Class): H01M00486; H01M00490; H01M00488; H01M00814

Publication Language: KOR

Legal Status: There is no Legal Status information available for this patent

KR20110036735A 20110408

(ENG) CRYSTALLINE POLYMORPHS OF GEMCITABINE BASE

[no drawing available]

Assignee: SCINOPHARM TAIWAN LTD TW

Inventor(s): CHEN SHU PING TW ; SHIEH CHIA LIN TW

Application No: KR 20117000722 A

Filing Date: 20090612

Issue/Publication Date: 20110408

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y;

IPC (International Class): C07H019073; A61K031522

ECLA (European Class): C07H019073

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent

NZ519928A 20040730

(ENG) Keyboard system with automatic correction

Assignee: AMERICA ONLINE INC

[no drawing available]

Inventor(s): ROBINSON ALEX B ; LONGE MICHAEL R

Application No: NZ 51992800 A

Filing Date: 20000526

Issue/Publication Date: 20040730

Abstract: (ENG) A text entry system comprises: (a) a user input device comprising a touch sensitive surface including an auto correcting keyboard region (106) comprising a plurality of the characters of an alphabet, wherein each of the plurality of characters corresponds to a location with known coordinates in the auto-correcting keyboard region, wherein each time a user contacts the user input device within the auto-correcting keyboard region, a location associated with the user contact is determined and the determined contact location is added to a current input sequence of contact locations; (b) a memory containing a plurality of objects, wherein each object is further associated with a frequency of use; (c) an output device with a text display area; and (d) a processor coupled to the user input device, memory, and output device, the processor comprising: (i) a distance value calculation component which, for each determined contact location in the input sequence of contacts, calculates a set of distance values between the contact locations and the known coordinate locations corresponding to one or a plurality of characters within the auto-correcting keyboard region; (ii) a word evaluation component which, for each generated input sequence, identifies one or a plurality of candidate objects in memory, and for each of the one or a plurality of identified candidate objects, evaluates each identified candidate object by calculating a matching metric based on the calculated distance values and the frequency of use associated with the object, and ranks the evaluated candidate objects based on the calculated matching metric values; and (iii) a selection component for identifying one or a plurality of candidate objects according to their evaluated ranking, presenting the identified objects to the user, and enabling the user to select one of the presented objects for output to the text display area on the output device.

Priority Data: US 13661399 19990527 P Y; US 0014684 20000526 W W N;

IPC (International Class): G06F01722; G06F003041; G06F003048; H03M01104; H03K01794; G06F003033; G06F003023; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Legal Status:

Date	+/-	Code	Description
20020830	(+)	RENP	PCT: LATE ENTRY INTO NATIONAL PHASE REQUESTED Effective date: 20020701;
20040430	(+)	RENW	RENEWAL (RENEWAL FEES ACCEPTED)
20041126	(+)	PSEA	PATENT SEALED
20070427	(+)	RENW	RENEWAL (RENEWAL FEES ACCEPTED)
20081031	( )	ASS	CHANGE OF OWNERSHIP New owner name: TEGIC COMMUNICATIONS, US; : OLD OWNER(S): AOL, LLC;

RU2318222C2 20080227
RU2005118999A 20060127

(ENG) METHOD AND SYSTEM FOR NAVIGATION IN REAL TIME SCALE WHICH USE THREE CARRIER RADIO SIGNALS, TRANSMITTED BY SATELLITE, AND IONOSPHERE CORRECTIONS

[no drawing available]

Assignee: ORGANIZAS ON EHNTERGUVERNMANTA FR

Inventor(s): EHRNANDES-PAKHARES MANUEHL ES ;
KHUAN-SORNOSA KHOSE MIGEL ES ;
SANS-SUBIRANA KHAUME ES ;
GARSIA-RODRIGES AL BERTO NL

Application No: RU 2005118999 A

Filing Date: 20031216

Issue/Publication Date: 20080227

Abstract: (ENG) FIELD: real time scale navigation with the goal of detecting position of mobile device. ^ SUBSTANCE: in the invention, radio-signals of three different carrier frequencies are used, transmitted by satellites. Method includes a stage for determining indeterminacy of carrier frequency phase of "especially wide phase track", stage for estimating indeterminacy of phase of "wide phase track" and stage for resolving phase indeterminacy of one of frequencies. Additional stage includes utilizing ionosphere corrections in real time scale during third stage, where these ionosphere corrections are based on continuously updated ionosphere model of aforementioned ionosphere layer, computed by stationary ground-based support station, combined with geodesic data, computed by the so-called leading stationary ground-based support station. ^ EFFECT: ensured capability for precise navigation at distances exceeding 100 kilometers from supporting satellite communication stations. ^ 2 cl, 17 dwg, 6 tbl

Priority Data: FR 0216227 20021219 A Y;

IPC (International Class): G01S01910; G01S01944; G01S01907; G01S01932; G01S01913; G01S01929; G01S00514; G01S00100

ECLA (European Class): B60R021015; B60R021239; G01S01932; G01S01944

Publication Language: RUS

Legal Status: There is no Legal Status information available for this patent

SE523753C2 20040511

(SWE) Metod foer att utveckla ett system foer att identi fiera ett objekts naervaro och position i ett fordon

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S ; JOHNSON WENDELL C ; VALL WILBUR E DU ; MORIN JEFFREY L ; XU KUNHONG

Application No: SE 0100186 A

Filing Date: 20010124

Issue/Publication Date: 20040511

Abstract: (ENG) Method for developing a system for determining the occupancy of a seat in a vehicle using a variety of transducers and pattern recognition technologies and techniques that applies to any combination of transducers that provide information about seat occupancy. These include weight sensors, capacitive sensors, inductive sensors, ultrasonic, optical, electromagnetic, motion, infrared, and radar among others. A processor coupled to the transducers for receiving the data from the transducers and processing the data to obtain an output indicative of the current occupancy state of the seat. An algorithm is resident in the processor and is created from a plurality of data sets, each representing a different occupancy state of the seat and being formed from data from the transducers while the seat is in that occupancy state. The algorithm produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from the transducers. The algorithm may be a neural network or neural fuzzy algorithm generated by an appropriate algorithm-generating program.

Priority Data: US 13616399 19990527 P Y; US 38240699 19990824 A Y; US 47414799 19991229 A Y; US 0014903 20000530 W W N;

IPC (International Class): G01V00100; G01V00312; B60N00244; G01V00308; B60R02116; G01S01508; B60R02101; G06K00900; B60R021015

Legal Status: There is no Legal Status information available for this patent

SE0100186A 20010327
SE0100186D0 20010124

(SWE) Metod foer att utveckla ett system foer att identi fiera ett objekts naervaro och position i ett fordon

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S ; JOHNSON WENDELL C ; DU VALL WILBUR E ; MORIN JEFFREY L ; XU KUNHONG

Application No: SE 0100186 D

Filing Date: 20010124

Issue/Publication Date: 20010327

Abstract: (ENG) Method for developing a system for determining the occupancy of a seat in a vehicle using a variety of transducers and pattern recognition technologies and techniques that applies to any combination of transducers that provide information about seat occupancy. These include weight sensors, capacitive sensors, inductive sensors, ultrasonic, optical, electromagnetic, motion, infrared, and radar among others. A processor coupled to the transducers for receiving the data from the transducers and processing the data to obtain an output indicative of the current occupancy state of the seat. An algorithm is resident in the processor and is created from a plurality of data sets, each representing a different occupancy state of the seat and being formed from data from the transducers while the seat is in that occupancy state. The algorithm produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from the transducers. The algorithm may be a neural network or neural fuzzy algorithm generated by an appropriate algorithm-generating program.

Priority Data: US 13616399 19990527 P Y; US 38240699 19990824 A Y; US 47414799 19991229 A Y; US 0014903 20000530 W W N;

IPC (International Class): G01V00100; G01V00312; B60N00244; G01V00308; B60R02116; G01S01508; B60R02101; G06K00900; B60R021015

ECLA (European Class): B60R021015; G06K00900H

Legal Status: There is no Legal Status information available for this patent

TW541255B 20030711

(ENG) Interactive vehicle display system

[no drawing available]

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: TW 89126967 A

Filing Date: 20001218

Issue/Publication Date: 20030711

Abstract: (ENG) An interactive display system for a vehicle including a heads up display system (130) for projecting text and/or graphics into a field of view of an occupant (101) of the vehicle and an occupant-controllable device (114, 162) enabling the occupant to interact with the heads up display system (130) to change the text and/or graphics projected by the heads up display system (130) or direct another vehicular system to perform an operation. The device may be a touch pad (162) arranged on a steering wheel (103) (possibly over a cover of an airbag module (104) in the steering wheel (103)) or at another location accessible to the occupant (101). A processor (180) and associated electrical architecture are provided for correlating a location on the touch pad (162) which has been touched by the occupant to the projected text and/or graphics. The device may also be a microphone.

Priority Data: US 17097399 19991215 P Y; US 64570900 20000824 A Y;

IPC (International Class): G02B02701; G02B02700

ECLA (European Class): G02B02701

Legal Status:

Date	+/-	Code	Description
20031128	(+)	GD4A	ISSUE OF PATENT CERTIFICATE FOR GRANTED INVENTION PATENT

TWI290690B 20071201

(ENG) Selective input system based on tracking of motion parameters of an input device

[no drawing available]

Assignee: AMERICA ONLINE INC US

Inventor(s): STEPHANICK JAMES US ; JAMES CHRISTINA US ; BRADFORD ETHAN R US ; LONGE MICHAEL R US

Application No: TW 93121631 A

Filing Date: 20040720

Issue/Publication Date: 20071201

Abstract: (ENG) A selective input system and associated method is provided which tracks the motion of a pointing device over a region or area. The pointing device can be a touchpad, a mouse, a pen, or any device capable of providing two or three-dimensional location. The region or area is preferably augmented with a printed or actual keyboard/pad. Alternatively, a representation of the location of the pointing device over a virtual keyboard/pad can be dynamically shown on an associated display. The system identifies selections of items or characters by detecting parameters of motion of the pointing

device, such as length of motion, a change in direction, a change in velocity, and or a lack of motion at locations that correspond to features on the keyboard/pad. The input system is preferably coupled to a text disambiguation system such as a T9(R) or Sloppytype(TM) system, to improve the accuracy and usability of the input system.

Priority Data: US 50455203 20030919 P Y; US 67789003 20031001 A Y; US 88181904 20040628 A Y;

IPC (International Class): G06F00300; G06F003033; G06F003023; G06F003048; G09G00500

ECLA (European Class): G06F003048A3G; G06F003023M6; G06F003048A3T

Legal Status: There is no Legal Status information available for this patent

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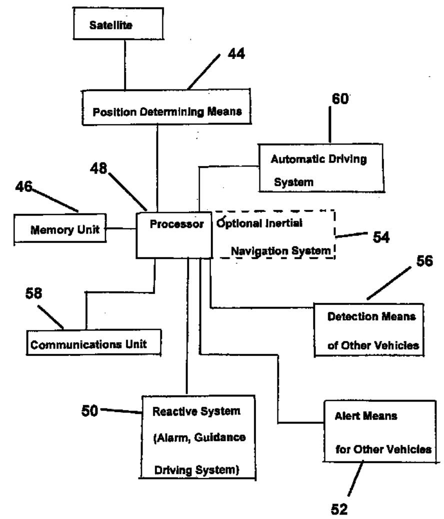
WO2000054008A1 20000914



(ENG) METHODS AND APPARATUS FOR PREVENTING VEHICLE ACCIDENTS

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 0006236 W

Filing Date: 20000310

Issue/Publication Date: 20000914

Abstract: (ENG) System and method for preventing vehicle accidents in which the absolute position of the vehicle is determined, e.g., using a satellite-based positioning system (44) such as GPS, and the location of the vehicle relative to the edges of the roadway is then determined based on the absolute position of the vehicle and stored data (46) relating to edges of roadways on which the vehicle may travel. A system or component within the vehicle is initiated, e.g., an alarm or warning system (50), or the operation of a system or component is affected, e.g., an automatic guidance system (60), if the location of the vehicle approaches close to an edge of the roadway or intersects with an edge of the roadway.

Priority Data: US 12388299 19990311 P Y;

IPC (International Class): G08G001133; G01C02126; B60N00228; G08G00116

Designated Countries:
----Designated States: (national) AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW ::: (ARIPO) AP GH GM KE LS MW SD SL SZ TZ UG ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): ROFFE, Brian 366 Longacre Avenue, Woodmere, NY 11598-2417 US

Legal Status:

Date	+/-	Code	Description
20000914	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW;
20000914	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW SD SL SZ TZ UG ZW AM AZ BY KG KZ MD RU TJ TM AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG;
20001108	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20010201	( )	DFPE	REQUEST FOR PRELIMINARY EXAMINATION FILED PRIOR TO EXPIRATION OF 19TH MONTH FROM PRIORITY DATE (PCT APPLICATION FILED BEFORE 20040101)
20011011	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20011011	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20020110	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;
20020717	(-)	122	EP: PCT APP. NOT ENT. EUROP. PHASE

WO2000074240A1 20001207

(ENG) KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

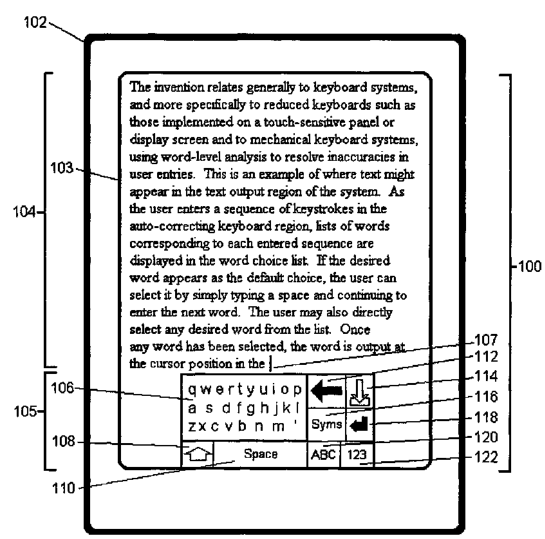
Assignee: AMERICA ONLINE US

Inventor(s): ROBINSON B ALEX ; LONGE MICHAEL R

Application No: US 0014684 W

Filing Date: 20000526

Issue/Publication Date: 20001207



Abstract: (ENG) An enhanced text entry system using word-level analysis to automatically correct inaccuracies in user keystroke entries on reduced keyboards. The keyboard (105) may be a part of a touch-sensitive panel or display screen (100) or on a mechanical keyboard system. A method and system are defined which determine one or more alternative textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region (106). The actual contact locations for the

keystrokes may occur outside the boundaries of the specific keyboard key regions, where the distance from each contact location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. The user can easily select the intended word from among the generated interpretations.

Priority Data: US 13661399 19990527 P Y;

IPC (International Class): G06F01722; G06F003041; G06F003048; H03M01104; H03K01794; G06F003033; G06F003023; G09G00500; G06F01727

ECLA (European Class): G06F00302A5; G06F003023M; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C

Designated Countries:
----Designated States: (national) AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW ::: (ARIPO) AP GH GM KE LS MW MZ SD SL SZ TZ UG ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG

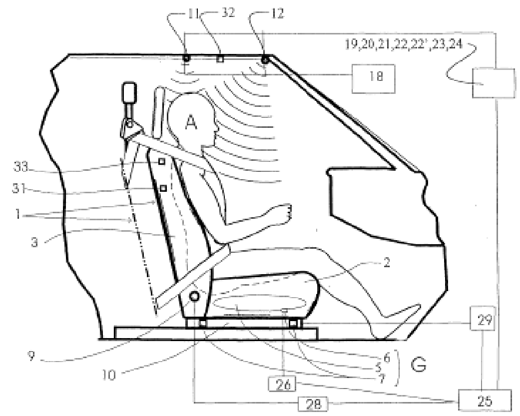
Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	**+/-**	**Code**	**Description**
20001207	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW;
20001207	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZW AM AZ BY KG KZ MD RU TJ TM AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG;
20010131	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20010412	( )	DFPE	REQUEST FOR PRELIMINARY EXAMINATION FILED PRIOR TO EXPIRATION OF 19TH MONTH FROM PRIORITY DATE (PCT APPLICATION FILED BEFORE 20040101)
20011105	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2000937879; Country code of corresponding patent document: EP;
20011123	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 1020017014956; Country code of corresponding patent document: KR;
20011126	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): JP; Corresponding patent document: 2001 500435; Kind code of corresponding patent document: A;

20011227	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20011227	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20020202	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 1020017014956; Country code of corresponding patent document: KR;
20020328	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;
20020403	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 2000937879; Country code of corresponding patent document: EP;
20020523	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2392446; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20020523	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2392446; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20020523	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2392446; Country code of corresponding patent document: CA;
20020701	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 519928; Country code of corresponding patent document: NZ;
20040730	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 519928; Country code of corresponding patent document: NZ;
20041111	(+)	WWG	WIPO INFORMATION: GRANT IN NATIONAL OFFICE Corresponding patent document: 519928; Country code of corresponding patent document: NZ;
20070309	(+)	WWG	WIPO INFORMATION: GRANT IN NATIONAL OFFICE Corresponding patent document: 1020017014956; Country code of corresponding patent document: KR;



WO2001014910A3 20010927
WO2001014910A2 20010301

(ENG) METHOD FOR DEVELOPING A SYSTEM FOR IDENTIFYING THE PRESENCE AND ORIENTATION OF AN OBJECT IN A VEHICLE

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S ; JOHNSON WENDELL C ; DUVALL WILBUR E ; MORIN JEFFREY L ; XU KUNHONG ; VARGA ANDREW J

Application No: US 0014903 W

Filing Date: 20000530

Issue/Publication Date: 20010927

Abstract: (ENG) Method for developing a system for determining the occupancy of a seat (1) in a vehicle using a variety of transducers and pattern recognition technologies and techniques that applies to any combination of transducers that provide information about seat occupancy. These include weight sensors (6,7) capacitive sensors, inductive sensors, ultrasonic (12), optical (12), electromagnetic, motion, infrared, and radar among others. A processor coupled to the transducers for receiving the data from the transducers and processing the data to obtain an output indicative of the current occupancy state of the seat. An algorithm is resident in the processor and is created from a plurality of data sets, each representing a different occupancy state of the seat and being formed from data from the transducers while the seat is in that occupancy state. The algorithm produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from the transducers. The algorithm may be a neural network (25) or neural fuzzy algorithm generated by an appropriate algorithmgenerating program.

Priority Data: US 13616399 19990527 P Y; US 38240699 19990824 A Y; US 47414799 19991229 A Y;

Related Application(s): 20010927 200139 3 R4

IPC (International Class): G01V00100; G01V00312; B60N00244; G01V00308; B60R02116; G01S01508; B60R02101; G06K00900; B60R021015

ECLA (European Class): B60R021015; G06K00900H

Designated Countries:

Publication Language: ENG

Filing Language: ENG

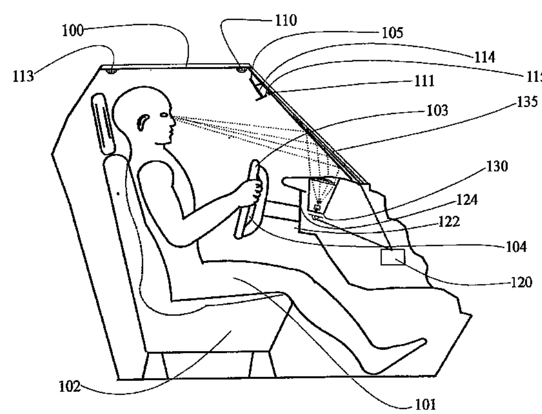
Date of Deferred Publication of Search Report:
--20010927

Legal Status:

Date	+/-	Code	Description
20010124	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 01001866; Country code of corresponding patent document: SE;
20010301	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A2; List of designated states: DE GB JP SE;
20010301	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A2; List of designated states: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE;

20010327	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 01001866; Country code of corresponding patent document: SE;
20010425	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20010927	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A3; List of designated states: DE GB JP SE;
20010927	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A3; List of designated states: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE;
20011011	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;
20011127	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): JP; Corresponding patent document: 2001 519213; Kind code of corresponding patent document: A;
20020502	(+)	RET	DE TRANSLATION (DE OG PART 6B) Corresponding country code for PRS Code (EP REG): DE; Corresponding patent document: 10084638; Publication date of corresponding patent document: 20020502;
20021016	(-)	122	EP: PCT APP. NOT ENT. EUROP. PHASE

WO2001045080A1 20010621



(ENG) INTERACTIVE VEHICLE DISPLAY SYSTEM

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S

Application No: US 0033566 W

Filing Date: 20001212

Issue/Publication Date: 20010621

Abstract: (ENG) An interactive display system for a vehicle including a heads up display system (130) for projecting text and/or graphics into a field of view of an occupant (101) of the vehicle and an occupant-controllable device (114, 162) enabling the occupant to interact with the heads up display system (130) to change the text and /or graphics projected by the heads up display system (130) or direct another vehicular system to perform an operation. The device may be a touch pad (162) arranged on a steering wheel (103) (possibly over a cover of an airbag module (104) in the steering wheel (103)) or at another location accessible to the occupant (101). A processor (180) and associated electrical architecture are provided for correlating a location on the touch pad (162) which has been touched by the occupant to the projected text and/or graphics. The device may also be a microphone.

Priority Data: US 17097399 19991215 P Y; US 64570900 20000824 A Y;

IPC (International Class): G02B02701; G02B02700

ECLA (European Class): G02B02701

Designated Countries:

----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW ::: (ARIPO) AP GH GM KE LS MW MZ SD SL SZ TZ UG ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG

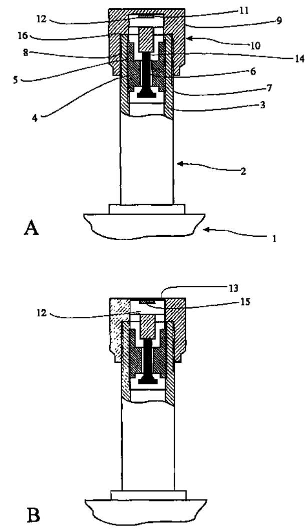
Publication Language: ENG

Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20010621	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW;
20010621	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZW AM AZ BY KG KZ MD RU TJ TM AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG;
20010712	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): GB; Corresponding patent document: 200117003; Kind code of corresponding patent document: A;
20010816	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20020418	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;
20020715	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20020715	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20021211	(-)	122	EP: PCT APP. NOT ENT. EUROP. PHASE
20040915	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): JP;

WO2002020287A1 20020314



(ENG) VEHICLE WIRELESS SENSING AND COMMUNICATION SYSTEM

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S ; JOHNSON WENDELL C ; DUVALL WILBUR E ; CASTELLI VITTORIO ; SEITZ WILLIAM E

Application No: US 0128010 W

Filing Date: 20010907

Issue/Publication Date: 20020314

Abstract: (ENG) Valve cap (10) for monitoring pressure and/or temperature of a tire (1) having a valve stem (2) including a valve assembly (5) having a valve pin (6). A body (9) of the valve cap (10) mates with the valve stem (2) and defines a chamber (12) upon such mating. A valve pin depressor (14) is arranged in the body (9) and depresses the valve pin (6) upon mating of the body (9) with the valve stem (2) to open the valve assembly (5) and enable flow communication between an interior of the tire (1) and the chamber (12). At least one SAW sensor (11) is arranged in the chamber (12) for receiving a signal and returning a signal modified by virtue of the temperature and/or pressure of the tire (1).

Priority Data: US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

IPC (International Class): B60C02304; B60C01900; B60C01124; B60C02306; B60N00202; B60N00228

Designated Countries:

Publication Language: ENG

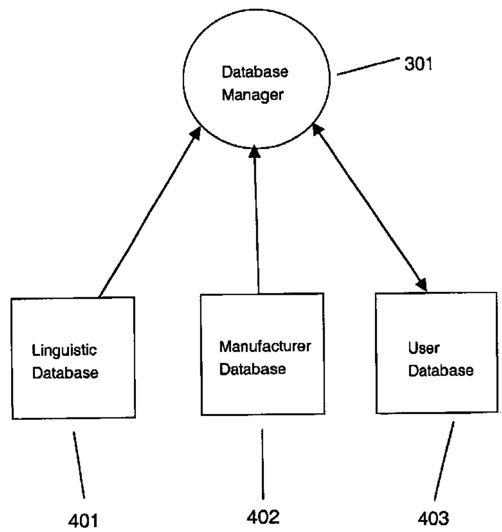
Filing Language: ENG

Legal Status:

Date	+/-	Code	Description
20020314	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: DE GB JP;
20020314	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 0307874; Country code of corresponding patent document: GB; Kind code of corresponding patent document: A; : PCT FILING DATE = 20010907;
20030204	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20030204	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20030205	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20030205	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20030206	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;
20030206	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): RU;

20030717	( )	REG	REFERENCE TO NATIONAL CODE Corresponding country code for PRS Code (EP REG): DE; Corresponding EP Code 1 for PRS Code (EP REG): 8642;
20050913	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): JP;

WO2004010326A1 20040129



(ENG) DYNAMIC DATABASE REORDERING SYSTEM

Assignee: AMERICA ONLINE INC US

Inventor(s): BRADFORD ETHAN R ; KAY DAVID JON

Application No: US 0322525 W

Filing Date: 20030717

Issue/Publication Date: 20040129

Abstract: (ENG) A dynamic database reordering system (301) provides a linguistics database (401) that contains words that are ordered according to a linguistics model that dictates the order in which words are presented to a user. While a user enters keystrokes on a keypad of a communications device is pressing keys (102), the invention predicts the words, letters, numbers, or word stubs that the user is trying to enter. The invention reorders the linguistics model order based on the user's usage of the system by tracking the user's word selection. Once a word has been selected as a result of a next key selection, a frequency value is applied to the selected word and the word ordered first by the linguistics model in the linguistics database (401) for that key sequence.

Priority Data: US 39725302 20020718 P Y; US 62186403 20030716 A Y;

IPC (International Class): G06F01722; G06F01727

ECLA (European Class): G06F003023M6; G06F01727P

Designated Countries:

----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW

----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM

----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT RO SE SI SK TR

----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

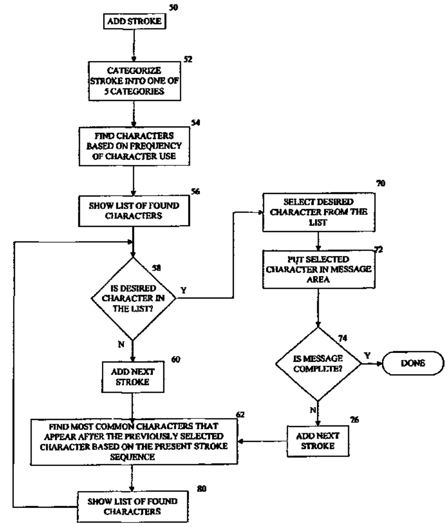
Filing Language: ENG

Agent(s): GLENN, Michael A. Glenn Patent Group, 3475 Edison Way, Suite L., Menlo Park, CA 94025, US US

Legal Status:

Date	**+/-**	**Code**	**Description**
20040109	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2452157; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20040109	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2452157; Country code of corresponding patent document: CA; Kind code of corresponding patent document: A;
20040109	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2452157; Country code of corresponding patent document: CA;
20040115	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2003765738; Country code of corresponding patent document: EP;
20040129	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW;
20040129	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW AM AZ BY KG KZ MD RU TJ TM AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT RO SE SI SK TR BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG;
20040205	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 20038007894; Country code of corresponding patent document: CN;
20040216	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2004523577; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040216	( )	ENP	ENTRY INTO THE NATIONAL PHASE IN: Corresponding patent document: 2004523577; Country code of corresponding patent document: JP; Kind code of corresponding patent document: A;
20040216	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 2004523577; Country code of corresponding patent document: JP;
20040331	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20050615	(+)	WWP	WIPO INFORMATION: PUBLISHED IN NATIONAL OFFICE Corresponding patent document: 2003765738; Country code of corresponding patent document: EP;

WO2004012135A1 20040205



(ENG) CHINESE CHARACTER HANDWRITING RECOGNITION SYSTEM

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R ; PALMER BRIAN

Application No: US 0322776 W

Filing Date: 20030717

Issue/Publication Date: 20040205

Abstract: (ENG) A handwritten Chinese character input method and system is provided to allow users to enter Chinese characters to a data processor by adding less than three strokes (50) and one selection movement such as mouse clicking or stylus or finger tapping. The system is interactive, predictive, and intuitive to use. By adding one or two strokes which are used to start writing a Chinese character, or in some case even no strokes are needed, users can find a desired character from a list of characters (56). The list is context sensitive. It varies depending on the prior character entered. Compared to other existing systems, this system can save users considerable time and efforts to entering handwritten characters.

Priority Data: US 20595002 20020725 A Y;

IPC (International Class): G06F003033; G06F00301; G06F00300; G06F003048; G06K00922

ECLA (European Class): G06F00301M; G06F003048A3G; G06K00922H

Designated Countries:

----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

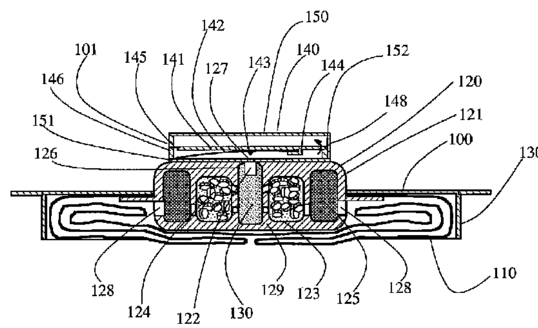
Agent(s): GLENN, Michael Glenn Patent Group, Suite L, 3475 Edison Way, Menlo Park, CA 94025 US

Legal Status:

Date	+/-	Code	Description
20040205	(+)	AK	DESIGNATED STATES Kind code of corresponding patent document: A1; List of designated states: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG UZ VC VN YU ZA ZM ZW;

20040205	(+)	AL	DESIGNATED COUNTRIES FOR REGIONAL PATENTS Kind code of corresponding patent document: A1; List of designated states: GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW AM AZ BY KG KZ MD RU TJ TM AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT RO SE SI SK TR BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG;
20040407	( )	121	EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS DESIGNATED IN THIS APPLICATION
20040611	(+)	WWE	WIPO INFORMATION: ENTRY INTO NATIONAL PHASE Corresponding patent document: 20038017520; Country code of corresponding patent document: CN;
20050907	(-)	122	EP: PCT APP. NOT ENT. EUROP. PHASE
20060721	( )	NENP	NON-ENTRY INTO THE NATIONAL PHASE IN: Corresponding country code for PRS Code (EP REG): JP;
20060721	(-)	WWW	WIPO INFORMATION: WITHDRAWN IN NATIONAL OFFICE Country code of corresponding patent document: JP;

US5842716A 19981201



(ENG) Self contained side impact airbag system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 10101793 A

Filing Date: 19930916

Issue/Publication Date: 19981201

Abstract: (ENG) This invention is primarily related to a side impact self contained airbag system for a vehicle including a sensor, an inflator, an airbag and, when appropriate, a diagnostic and energy reserve module all within one package. In some implementations, a non-sodium azide propellant is used and the gas in exhausted from the airbag into the door during the accident rather than into the passenger compartment. The preferred implementation uses an all mechanical system but electro-mechanical and electronic sensors can also be used. Several of the improvements disclosed are also applicable for frontal impact airbag systems. A combination of crush sensing and velocity sensing is also disclosed for the all mechanical system.

Priority Data: US 10101793 19930916 A Y; US 72775791 19910709 A 2 Y; US 89649692 19920602 A 2 Y; US 48027390 19900215 A 2 Y; US 31460389 19890223 A C Y; US 68671791 19910417 A C Y;

Related Application(s): 07/727757 19910709 5233141 US GRANTED; 07/896496 19920602 5231253 US GRANTED; 07/480273 19900215 US PENDING; 31/460389 19890223 US ABANDONED; 00/727757 00010101 US PENDING; 1991US-000686717 19910417 US ABANDONED; 00/314603 00010101 US PENDING

IPC (International Class): B60R02120; B60R02116; B60R02101; B60R02133; B60R02121

ECLA (European Class): B60R02133; B60R02101; B60R02120

US Class: 280734; 2807302; 280731

Publication Language: ENG

Filing Language: ENG

Agent(s): Shipkovit, Samuel

Examiner Primary: Culbreth, Eric D.

US Post Issuance:

--US Certificate of Correction: 20020924 20021015 a Certificate of Correction was issued for this patent

Assignments Reported to USPTO:

Reel/Frame: 08312/0665 **Date Signed:** 19930802 **Date Recorded:** 19970121

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 1028 DENVILLE NEW JERSEY 07834

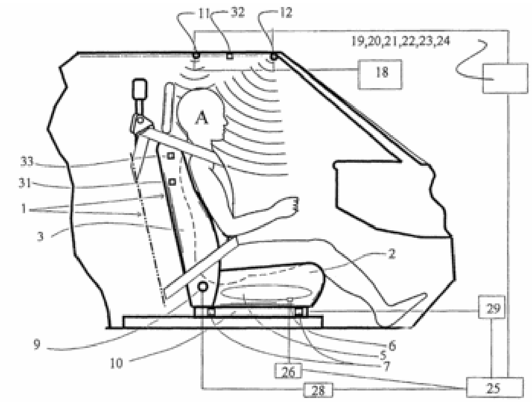
Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NY 11598

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19970121	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:008312/0665; Effective date: 19930802;
19970121	( )	AS02	ASSIGNMENT OF ASSIGNOR'S INTEREST New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; Effective date: 19930802;
19970121	( )	AS02	ASSIGNMENT OF ASSIGNOR'S INTEREST New owner name: BREED, DAVID S.; Effective date: 19930802;
19970121	()	AS02	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; Effective date: 19930802;
19970121	()	AS02	New owner name: BREED, DAVID S.; Effective date: 19930802;
20020522	()	FPAY	Year of fee payment: 4;
20020924	( )	CC	CERTIFICATE OF CORRECTION
20060531	()	FPAY	Year of fee payment: 8;
20100108 / 20101201	()	REMI / LAPS	Effective date: 20101201;



US7387183B2 20080617
US2005156457A1 20050721

(ENG) Weight measuring systems and methods for vehicles

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 1081904 A

Filing Date: 20041213

Issue/Publication Date: 20080617

Abstract: (ENG) Method for determining the position of the occupant in a seat having a bottom portion on which the occupant sits and a back portion situated at an angle to the bottom portion including arranging a bladder having at least one chamber in the bottom portion, measuring the pressure in each chamber, and determining the position of the occupant based at least on part on the measured pressure. Pressure may be measured by arranging at least one transducer in association with each chamber. If the bladder comprises a plurality of chambers, each chamber can be arranged at a different location in the bottom portion and the weight distribution of the occupant determined based on the measured pressure in the chambers. In this case, a respective transducer may be arranged in association with each chamber.

Priority Data: US 1081904 20041213 A N; US 73395703 20031211 A 3 Y; US 84955901 20010504 A 1 Y; US 19320998 19981117 A 2 Y; US 12849098 19980804 A 2 Y; US 47478395 19950607 A 2 Y; US 97082297 19971114 A 2 Y; US 6101602 20020130 A 2 Y; US 90187901 20010709 A 2 Y; US 22778102 20020826 A 2 Y; US 50034600 20000208 A 2 Y;

Related Application(s): 11/010819 20041213 20050156457 20050721 US; 10/733957 20031211 7243945 US; 10/227781 20020826 6792342 US; 10/061016 20020130 6833516 US; 09/901879 20010709 6555766 US; 09/849559 20010504 6689962 US; 09/500346 20000208 6442504 US; 09/193209 19981117 6242701 US; 09/128490 19980804 6078854 US; 08/970822 19971114 6081757 US; 08/474783 19950607 5822707 US

IPC (International Class): B60D00128; B60K02800; B60R02100; G01S01587; B60N00248; B60N00200; G01S01588; B60N00228; B60N002015; B60N00266; B60N00202; G01G019414; B60R02101; B60N00206; B60R021015; B60R02228; B60R02246; B60R02220; B60R021203; B60R02120; G01S01506; B60R021276; B60R02126

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206S; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; B60N00266; G01G019414A; G01S01587; G01S01588

US Class: 180271; 180273; 280735; 701045

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: To, Toan C

Assignments Reported to USPTO:
Reel/Frame: 22990/0463 **Date Signed:** 20031210 **Date Recorded:** 20090723
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

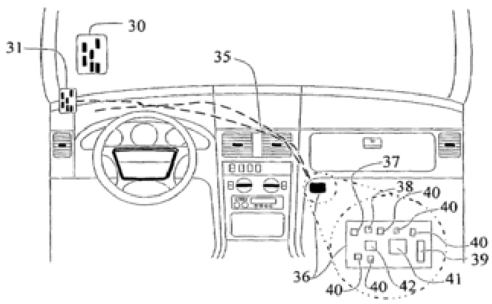
Assignor: BREEDM DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL C.

Corres. Addr: BRIAN ROFFE ATI-375 11 SUNRISE PLAZA, SUITE 303 VALLEY STREAM, NY 11580
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20090723	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREEDM DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:022990/0463; Effective date: 20031210;

US7209221B2 20070424
US2005195383A1 20050908



(ENG) Method for obtaining and displaying information about objects in a vehicular blind spot

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 11147405 A

Filing Date: 20050421

Issue/Publication Date: 20070424

Abstract: (ENG) Method for obtaining information about objects in an environment around a vehicle in which infrared light is emitted into a portion of the environment and received and the distance between the vehicle and objects from which the infrared light is reflected is measured. An identification of each object from which light is reflected is determined and a three-dimensional representation of the portion of the environment is created based on the measured distance and the determined identification of the object. Icons representative of the objects and their position relative to the vehicle are displayed on a display visible to the driver based on the three-dimensional representation. Additionally or alternatively to the display of icons, a vehicular system can be controlled or adjusted based on the relative position and optionally velocity of the vehicle and objects in the environment around the vehicle to avoid collisions.

Priority Data: US 11147405 20050421 A N; US 75401404 20040108 A 2 Y; US 85136201 20010508 A 2 Y; US 18046602 20020626 A 2 Y; US 9708202 20020313 A 2 Y; US 82517301 20010403 A 2 Y; US 2408598 19980217 A 2 Y; US 24776094 19940523 A C Y; US 30788399 19990510 A 2 Y; US 44220403 20030124 P Y; US 20242400 20000508 P Y;

Related Application(s): 11/111474 20050421 20050195383 20050908 US; 60/442204 20030124 US; 60/202424 20000508 US; 10/754014 20040108 6885968 US; 09/851362 20010508 7049945 US

IPC (International Class): G01C00308; G01P00336; G06T01500; G02B01300; B60R02101; G01S01587; G01S00741; B60N00228; B60N00202; G01S00748; G01S01789; G01S01588; G01S01787; B60R02232; B60R02116; G01S01793; B60R021233; B60N00200; B60R02226; G01S01388; G01S01788; B60Q00152; B60R01920; G01S007481; B60R01942; G01S007539; G01S01560; G01S007487; G01S01393; G01S01360; B60R02100; B60R0210134; B60R02126; B60R0210132

US Class: 35600502; 35600401; 35600501; 356028

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Tarcza, Thomas H.

Examiner Assistant: Alsomiri, Isam

Assignments Reported to USPTO:

Reel/Frame: 16596/0877 **Date Signed:** 20050501 **Date Recorded:** 20050525

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: DUVALL, WILBUR E.; BREED, DAVID S.; JOHNSON, WENDELL C.

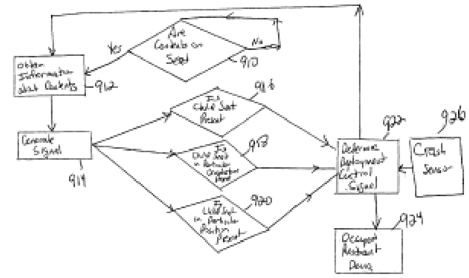
Corres. Addr: BRIAN ROFFE ATI-282 11 SUNRISE PLAZA SUITE 303 VALLEY STREAM, NEW YORK 11580-6111

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20050525	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:016596/0877;SIGNING DATES FROM 20050421 TO 20050501;
20050525	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:016596/0877;SIGNING DATES FROM 20050421 TO 20050501;
20050525	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:016596/0877;SIGNING DATES FROM 20050421 TO 20050501;
20101022	()	FPAY	Year of fee payment: 4;

US6942248B2 20050913
US2002140214A1 20021003



(ENG) Occupant restraint device control system and method

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 11453302 A

Filing Date: 20020402

Issue/Publication Date: 20050913

Abstract: (ENG) Control system for controlling an occupant restraint device effective for protection of an occupant of the seat including a receiving device arranged in the vehicle for obtaining information about contents of the seat and generating a signal based on any contents of the seat, a different signal being generated for different contents of the seat when such contents are present on the seat, an analysis unit such as a microprocessor coupled to the receiving device for analyzing the signal in order to determine whether the contents of the seat include a child seat, whether the contents of the seat include a child seat in a particular orientation and/or whether the contents of the seat include a child seat in a particular position, and a deployment unit coupled to the analysis unit for controlling deployment of the occupant restraint device based on the determination by the analysis unit. The analysis unit can be programmed to determine whether the contents of the seat include a child seat in a rear-facing position, in a forward-facing position, a rear-facing child seat in an improper orientation, a forward-facing child seat in an improper orientation, and the position of the child seat relative to one or more of the occupant restraint devices.

Priority Data: US 11453302 20020402 A N; US 5870602 20020128 A 2 Y; US 89143201 20010626 A 2 Y; US 83892001 20010420 A 2 Y; US 56355600 20000503 A 2 Y; US 43753599 19991110 A 2 Y; US 4770398 19980325 A 2 Y; US 64006896 19960430 A 2 Y; US 23997894 19940509 A B Y; US 4097893 19930331 A B Y; US 87857192 19920505 A C Y; US 90587697 19970804 A 2 Y; US 50503695 19950721 A 1 Y; US 63929900 20000815 A 2 Y; US 40962599 19991001 A 2 Y; US 44833799 19991123 A 2 Y; US 44833899 19991123 A 2 Y; US 54367800 20000407 A 2 Y;

Related Application(s): 08/640068 19960430 5829782 US; 1994US-000239978 19940509 US ABANDONED; 08/505036 19950721 5653462 US; 1993US-000040978 19930331 US ABANDONED; 08/505036 00010101 US PENDING; 10/058706 20020128 US PENDING; 09/891432 20010626 6513833 US; 09/838920 20010420 6778672 US; 09/563556 20000503 6474683 US; 09/437535 19991110 6712387 US; 09/047703 19980325 6039139 US; 1993US-000040978 19930331 US ABANDONED; 1992US-000878571 19920505 US ABANDONED; 08/905876 19970804 5848802 US; 1992US-000878571 19920505 US ABANDONED; 09/639299 20000815 US PENDING; 08/905877 19970804 6186537 US; 09/409625 19991001 6270116 US; 08/905877 00010101 US PENDING; 09/448337 19991123 6283503 US; 08/905877 00010101 US PENDING; 09/448338 19991123 6168186 US; 08/905877 00010101 US PENDING; 09/543678 20000407 US PENDING; 09/047704 19980325 6116638 US; 00/640068 00010101 US PENDING; 08/905876 19970804 5848802 US; 08/505036 00010101 US PENDING

IPC (International Class): G01S01587; B60R02220; B60R01102; G01F023296; B60N00202; B60N00200; G01S00741; G01F02320; G01S00748; G01F02300; B60R02101; G01S01788; B60J01000; E05F01500; G01S007539; B60N00228; B60R016037; B60R01602; B60N00248; G01S01588; G06K00900; B60R00108; G01S01506; B60R021215; B60R021231; G01S01304; B60R02120; B60R021276; B60R021015; G01S01504; B60R021013; B60R02248; B60R0210134; B60R00112; G01S01789; B60R0210132; B60R02116; B60R02126

ECLA (European Class): B60R021015; B60J01000; B60M00100Y5A; B60N00200C; B60N00202B4; B60N00202B6B; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60N00248C3C; B60N00248W; B60R00108G5; B60R01102G; B60R016037; B60R0210136; B60R02220; E05F01500B6B; E05F01500B6B2; G01F02300G1A; G01F02320; G01F023296D; G01S00741D; G01S00748A; G01S007539; G01S01587; G01S01588; G01S01788; G06K00900H

US Class: 280735; 180272; 701045

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Dickson, Paul N.

Examiner Assistant: To, Toan C

US Post Issuance:
--US Request for Examinations: 20071127 Elesys North America, Inc., (Att'y, Is: Richard K. DeMille, Brinks Hofer Gilson & Lione)
--US Certificate of Correction: 20051101 20051122 a Certificate of Correction was issued for this patent
--US Litigations: Automotive Technologies International Inc Automotive Technologies International Inc 20060317 Delaware 1:06cv187
; Automotive Technologies International Inc Automotive Technologies International Inc 20060616 Delaware 1:06cv391

Assignments Reported to USPTO:
Reel/Frame: 12774/0733 **Date Signed:** 20020326 **Date Recorded:** 20020402
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL C.

Corres. Addr: BRIAN ROFFE 366 LONGACRE AVENUE WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020402	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:012774/0733;SIGNING DATES FROM 20020326 TO 20020327;
20051101	( )	CC	CERTIFICATE OF CORRECTION
20071127	(+)	RR	REQUEST FOR REEXAMINATION FILED Effective date: 20071011;
20090312	()	FPAY	Year of fee payment: 4;

US6419265B1 20020716

(ENG) Self-contained airbag system

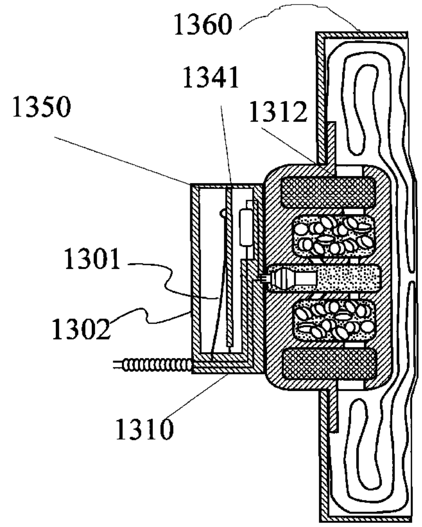
Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 11496298 A

Filing Date: 19980714

Issue/Publication Date: 20020716



Abstract: (ENG) A side impact airbag system for a vehicle including a system housing defining an interior space and arranged on a side of the vehicle alongside at least a portion of a passenger compartment of the vehicle. One or more airbags are arranged in the interior space of the system housing such that when inflating, the airbag(s) is/are expelled from the system housing into the passenger compartment. An inflator is arranged at least partially within the interior space of the system housing for inflating the airbag(s). A crash sensor, preferably an electronic crash sensor, initiates inflation of the airbag(s) via the inflator upon a determination of a crash requiring inflation of the airbag(s). The crash sensor includes a sensor housing arranged within and/or proximate to the system housing, and a sensing mass arranged in the sensor housing to move relative to the sensor housing in response to accelerations of the sensor housing resulting from the crash into the first side of the vehicle. Upon movement of the sensing mass in excess of a threshold value, the crash sensor initiates the inflator means to inflate the airbag(s).

Priority Data: US 11496298 19980714 A Y; US 10101793 19930916 A 2 Y;

Related Application(s): 08/101017 19930916 5842716 US GRANTED

IPC (International Class): B60R02120; B60R02116; B60R02133; B60R02121

ECLA (European Class): B60R02133; B60R02120

US Class: 280735; 2807302; 280731

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Culbreth, Eric

US Post Issuance:
--US Reissue Data: 20021227 20030401 Re. S.N. 10/330,955 Ex. Gp.: 3616; 20071009 RE039868
--US Certificate of Correction: 20030318 20030408 a Certificate of Correction was issued for this patent

Assignments Reported to USPTO:
Reel/Frame: 09315/0050 **Date Signed:** 19980713 **Date Recorded:** 19980714
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.

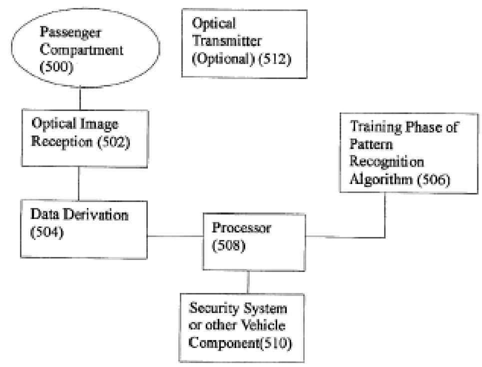
Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NY 11598-2051

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19980714	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:009315/0050; Effective date: 19980713;
20030318	( )	CC	CERTIFICATE OF CORRECTION
20030401	( )	RF	REISSUE APPLICATION FILED Effective date: 20021227;
20060113	()	FPAY	Year of fee payment: 4;

US6856873B2 20050215
US2002116106A1 20020822



(ENG) Vehicular monitoring systems using image processing

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 11680802 A

Filing Date: 20020405

Issue/Publication Date: 20050215

Abstract: (ENG) Vehicular monitoring arrangement for monitoring an environment of the vehicle including at least one active pixel camera for obtaining images of the environment of the vehicle and a processor coupled to the active pixel camera(s) for determining at least one characteristic of an object in the environment based on the images obtained by the active pixel camera(s). The active pixel camera can be arranged in a headliner, roof or ceiling of the vehicle to obtain images of an interior environment of the vehicle, in an A-pillar or B-pillar of the vehicle to obtain images of an interior environment of the vehicle, or in a roof, ceiling, B-pillar or C-pillar of the vehicle to obtain images of an interior environment of the vehicle behind a front seat of the vehicle. The determined characteristic can be used to enable optimal control of a reactive component, system or subsystem coupled to the processor. When the reactive component is an airbag assembly including at least one airbag, the processor can be designed to control at least one deployment parameter of the airbag(s).

Priority Data: US 11680802 20020405 A N; US 92504301 20010808 A 2 Y; US 76555901 20010119 A 2 Y; US 38994799 19990903 A 2 Y; US 83891901 20010420 A 2 Y; US 47625599 19991230 A 2 Y; US 20061498 19981130 A 2 Y; US 47478695 19950607 A 1 Y; US 11450798 19981231 P Y;

Related Application(s): 60/114507 19981231 00; 08/474786 19950607 5845000 US A GRANTED (PATENT); 09/838919 20010420 6442465 US A GRANTED (PATENT) 09/765559 20010119 6553296 US A GRANTED (PATENT)<RDA continuation-in-part> 09/476255 19991230 6324453 US A GRANTED (PATENT) 09/389947 19990903 6393133 US A GRANTED (PATENT)<RDA continuation-in-part> 09/200614 19981130 6141432 US A GRANTED (PATENT) 09/925043 20010808 6507779 US A GRANTED (PATENT)<RDA continuation-in-part> 09/765559 PENDING

IPC (International Class): B60N00228; B60N00202; G01S01788; G06K00900; B60N00200; B60Q00114; G01S01588; G01S01587; B60R02101; B60R02220; B60R021015; B60R0210134

ECLA (European Class): B60R021013; B60N00200C; B60N00202B4; B60N00202B6; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60Q00114C1B; B60R021015; G01S01587; G01S01588; G01S01788; G06K00900H

US Class: 701045; 180271; 382154

Agent(s): Roffe Brian

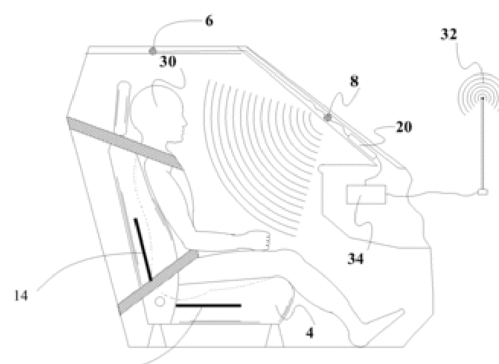
Examiner Primary: Black, Thomas G.

Examiner Assistant: To, Tuan C

Legal Status:

Date	+/-	Code	Description
20020405	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012793/0420;SIGNING DATESFROM 20020323 TO 20020326;
20020405	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:012793/0420;SIGNING DATES FROM 20020323 TO 20020326;
20020405	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012793/0420;SIGNING DATESFROM 20020323 TO 20020326;
20080814	()	FPAY	Year of fee payment: 4;

US2008234899A1 20080925



(ENG) Vehicular Occupant Sensing and Component Control Techniques

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: US 11703808 A

Filing Date: 20080508

Issue/Publication Date: 20080925

Abstract: (ENG) Method and system for obtaining information about a category of an occupying item in a volume of a passenger compartment of a vehicle in which the occupying item is situated during use of the vehicle and controlling one or more vehicular components. A time-varying signal is directed into the volume from at least one location. A modification of the directed signal arising from a property of any occupying items in the volume is detected, different occupying items causing different modifications of the same directed signal. A distinction is made between different occupying items of

the volume or between parts of an occupying item based on the detected modification to the directed signal and each component, e.g., an inflatable airbag, is controlled based on the distinction between the occupying items or parts thereof.

Priority Data: US 11703808 20080508 A Y; US 5870602 20020128 A 2 N; US 54367800 20000407 A 2 N; US 4770498 19980325 A 2 N; US 64006896 19960430 A 2 N; US 23997894 19940509 A B Y; US 63929900 20000815 A 2 N; US 90587797 19970804 A 2 N; US 50503695 19950721 A 1 N; US 4097893 19930331 A B Y; US 87857192 19920505 A C Y; US 40962599 19991001 A 2 N; US 44833799 19991123 A 2 N; US 44833899 19991123 A 2 N; US 89143201 20010626 A 2 N; US 83892001 20010420 A 2 N; US 56355600 20000503 A 2 N; US 43753599 19991110 A 2 N; US 4770398 19980325 A 2 N; US 90587697 19970804 A 2 N; US 41342603 20030414 A 2 N; US 76555901 20010119 A 2 N; US 47625599 19991230 A 2 Y; US 38994799 19990903 A 2 N; US 20061498 19981130 A 2 N; US 47478695 19950607 A 1 N; US 92504301 20010808 A 2 N; US 11453302 20020402 A 2 N; US 11680802 20020405 A 2 N; US 83891901 20010420 A 2 N; US 15161502 20020520 A 2 N; US 30210502 20021122 A 2 N; US 89512104 20040721 A 2 N; US 73395703 20031211 A 1 N; US 36512903 20030212 A 2 N; US 94088104 20040913 A 2 N; US 63930300 20000816 A 2 N; US 22778002 20020826 A 2 N; US 23406702 20020903 A 2 N; US 77813701 20010207 A 2 N; US 80590304 20040322 A 2 N; US 17470902 20020619 A 2 N; US 93128804 20040831 A 2 Y; US 2550105 20050103 A 2 N; US 53605406 20060928 A 2 N; US 83962207 20070816 A 2 N; US 11450798 19981231 P Y;

Related Application(s): 60/114507 19981231 US; 10/058706 20020128 US PENDING; 09/543678 20000407 6412813 US; 09/047704 19980325 6116639 US; 08/640068 19960430 5829782 US; 08/239978 19940509 US ABANDONED; 09/639299 20000815 6422595 US; 08/905877 19970804 6186537 US; 08/505036 19950721 5653462 US; 08/040978 19930331 US ABANDONED; 07/878571 19920505 US ABANDONED; 09/409625 19991001 6270116 US; 09/448337 19991123 6283503 US; 09/448338 19991123 6168198 US; 09/891432 20010626 6513833 US; 09/838920 20010420 6778672 US; 09/563556 20000503 6474683 US; 09/437535 19991110 6712387 US; 09/047703 19980325 6039139 US; 08/640068 19960430 5829782 US; 08/905876 19970804 5848802 US; 08/505036 19950721 5653462 US; 10/413426 20030414 US PENDING; 09/437535 19991110 6712387 US; 09/765559 20010119 6553296 US; 09/476255 19991230 6324453 US; 09/389947 19990903 6393133 US; 09/200614 19981130 6141432 US; 08/474786 19950607 5845000 US; 09/838920 20010420 6778672 US; 09/925043 20010808 6507779 US; 09/765559 20010119 6553296 US; 09/389947 19990903 6393133 US; 10/114533 20020402 6942248 US; 10/116808 20020405 6856873 US; 09/838919 20010420 6442465 US; 09/389947 19990903 6393133 US; 10/151615 20020520 6820897 US; 09/543678 20000407 6412813 US; 09/891432 20010626 6513833 US; 10/302105 20021122 6772057 US; 10/895121 20040721 7407029 US; 10/733957 20031211 7243945 US; 09/437535 19991110 6712387 US; 09/838920 20010420 6778672 US; 10/114533 20020402 6942248 US; 10/116808 20020405 6856873 US; 10/151615 20020520 6820897 US; 10/302105 20021122 6772057 US; 10/365129 20030212 7134687 US; 10/940881 20040913 US PENDING; 09/639303 20000816 6910711 US; 08/905877 19970804 6186537 US; 09/409625 19991001 6270116 US; 09/448337 19991123 6283503 US; 09/448338 19991123 6168198 US; 10/114533 20020402 6942248 US; 10/116808 20020405 6856873 US; 10/151615 20020520 6820897 US; 10/227780 20020826 6950022 US; 09/838920 20010420 6778672 US; 10/234067 20020903 6869100 US; 09/778137 20010207 6513830 US; 08/905877 19970804 6186537 US; 10/365129 20030212 7134687 US; 10/805903 20040322 7050897 US; 10/174709 20020619 6735506 US; 10/114533 20020402 6942248 US; 10/931288 20040831 7164117 US; 11/025501 20050103 US PENDING; 10/116808 20020405 6856873 US; 10/536054 20060119 US PENDING; 11/839622 20070816 US PENDING

IPC (International Class): B60R021015; G05B01900

ECLA (European Class): B60R01104; B60M00100Y5A; B60N00200C; B60N00202B4; B60N00202B6B; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60N00248C3C; B60N00248W; B60R00108G5; B60R01102G; B60R016037; B60R0210136; B60R021015; B60R02220; E05F01500B6B; E05F01500B6B2; G01F02300G1A; G01F02320; G01F023296D; G01S00741D; G01S00748A; G01S007539; G01S01587; G01S01588; G01S01788; G06K00900H

US Class: 701047; 701001

Publication Language: ENG

Filing Language: ENG

Assignments Reported to USPTO:

Reel/Frame: 21100/0556 **Date Signed:** 20080501 **Date Recorded:** 20080616
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 11580

Assignor: BREED, DAVID S.; JOHNSON, WENDELL C.; DUVALL, WILBUR E.

Corres. Addr: BRIAN ROFFE ATI-422 11 SUNRISE PLAZA SUITE 303 VALLEY STREAM, NY 11580
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20080616	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:021100/0556;SIGNING DATES FROM 20080501 TO 20080505;

US6720920B2 20040413

US2002198632A1 20021226

(ENG) Method and arrangement for communicating between vehicles

[no drawing available]

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US ; LUKIN KOSTYANTYN ALEXANDROVICH UA ; KONOVALOV VLADYMYR MICHAILOVIC UA

Application No: US 11885802 A

Filing Date: 20020409

Issue/Publication Date: 20040413

Abstract: (ENG) Method for transferring information between a vehicle and a transmitter in which a unique pseudorandom noise signal is transmitted by the transmitter in a carrier-less fashion composed of frequencies within a pre-selected band. Information is encoded in the noise signal relating to an identification of the transmitter and a position of the transmitter and the vehicle is provided with a device for extracting the information from the noise signal. The code to use for encoding the noise signal may be selected based on the position of the transmitter so that analysis of the code, or a portion thereof, provides an indication of the position of the transmitter. Information about accidents, weather conditions, road conditions, map data and traffic control devices and about errors in a GPS signal can also be encoded in the noise signals. The transmitter may be at a fixed location or in another vehicle to thereby enable vehicle-to-vehicle communications for the purposes of collision avoidance, intelligent highway applications and the like.

Priority Data: US 11885802 20020409 A N; US 17704198 19981022 A 2 Y; US 67931700 20001004 A 2 Y; US 52355900 20000310 A C Y; US 90946601 20010719 A 2 Y; US 6272997 19971022 P Y;

Related Application(s): 60/062729 19971022 00; 09/909466 20010719 6526352 US A GRANTED (PATENT) 09/679317 20001004 6405132 US A GRANTED (PATENT)<RDA continuation-in-part> 09/523559 20000310 ABANDONED 09/177041 19981022 6370475 US A GRANTED (PATENT)

IPC (International Class): G01S01948; G05D00102; G01S00514; G01S00100; B60N00228; G01S01393; G08G00116; G01S01702; G01S01789

US Class: 342386; 34235706

Agent(s): Roffe Brian

Examiner Primary: Phan, Dao

Assignments Reported to USPTO:

Reel/Frame: 12963/0122 **Date Signed:** 20020515 **Date Recorded:** 20020607
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

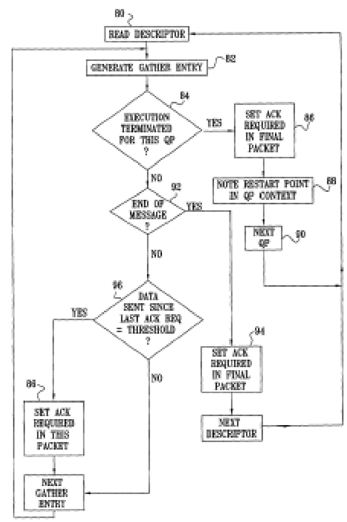
Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL C.; KONOVALOV, VLADYMYR MICHAILOV VLADYMYR MICHAILOVICH; LUKIN, KOSTYANTYN ALEXANDROVICH

Corres. Addr: BRIAN ROFFE 366 LONGACRE AVE. WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020607	( )	AS	ASSIGNMENT New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O.; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012963/0122;SIGNING DATESFROM 20020515 TO 20020529;
20020607	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;AND OTHERS;REEL/FRAME:012963/0122;SIGNING DATES FROM 20020515 TO 20020529;
20020607	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O.; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012963/0122;SIGNING DATESFROM 20020515 TO 20020529;
20071011	()	FPAY	Year of fee payment: 4;
20111128	()	REMI	

US7013419B2 20060314
US2002152315A1 20021017



(ENG) Reliable message transmission with packet-level resend

Assignee: MELLANOX TECHNOLOGIES LTD IL

Inventor(s): KAGAN MICHAEL IL ; CRUPNICOFF DIEGO AR ; SHACHAR ARIEL IL ; BLOCH GIL IL ; LEVENVIRTH DAFNA IL

Application No: US 11980802 A

Filing Date: 20020411

Issue/Publication Date: 20060314

Abstract: (ENG) A method for communication over a network includes receiving from a host processor a descriptor defining a message including message data to be sent over the network, and responsive to the descriptor, generating a sequence of packets each containing a respective portion of the message data. An indication is entered in a selected packet among the packets in the sequence, other than the final packet, requesting that a recipient of the packets acknowledge the selected packet. Following an interruption in the sequence of the packets subsequent to the selected packet, sending of the packets in the sequence resumes beginning after the selected packet.

Priority Data: US 11980802 20020411 A; US 28301801 20010411 P;

Related Application(s): 60/283018 20010411 00

IPC (International Class): G06F01516

US Class: 714749

Publication Language: ENG

Agent(s): Friedman Mark M.

Examiner Primary: Eng, David Y.

Assignments Reported to USPTO:

Reel/Frame: 17409/0893 **Date Signed:** 20020212 **Date Recorded:** 20051216
Assignee: MELLANOX TECHNOLOGIES LTD. P.O. BOX 83 YOKNEAM 20692 ISRAEL

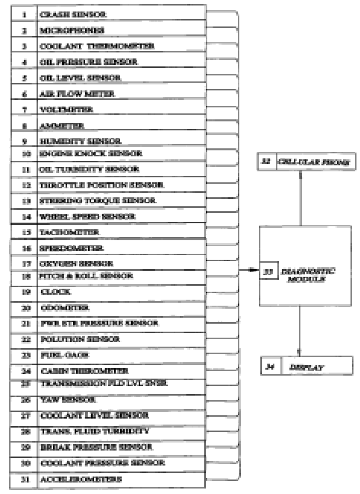
Assignor: KAGAN, MICHAEL

Corres. Addr: MARK M. FRIEDMAN C/O BILL POLKINGHORN DISCOVERY DISCOVERY DISPATCH, FLORIN WAY 9003 UPPER MARLBORO, MD 20772
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEEDOCUMENT FOR DETAILS).

Legal Status:

Date	**+/-**	**Code**	**Description**
20051216	( )	AS	ASSIGNMENT New owner name: MELLANOX TECHNOLOGIES LTD., ISRAEL; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:KAGAN, MICHAEL;CRUPNIKOFF, DIEGO;SHACHAR, ARIEL;AND OTHERS;REEL/FRAME:017409/0893;SIGNING DATES FROM 20020212 TO 20020214;
20051216	()	AS	New owner name: MELLANOX TECHNOLOGIES LTD., ISRAEL; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:KAGAN, MICHAEL;CRUPNIKOFF, DIEGO;SHACHAR, ARIEL;AND OTHERS;REEL/FRAME:017409/0893;SIGNING DATES FROM 20020212 TO 20020214;
20051216	()	AS	New owner name: MELLANOX TECHNOLOGIES LTD., ISRAEL; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:KAGAN, MICHAEL;CRUPNIKOFF, DIEGO;SHACHAR, ARIEL;AND OTHERS;REEL/FRAME:017409/0893;SIGNING DATES FROM 20020212 TO 20020214;
20090830	()	FPAY	Year of fee payment: 4;

US2005192727A1 20050901



(ENG) Sensor Assemblies

Assignee: AUTOMOTIVE TECH INT

Inventor(s): SHOSTAK OLEKSANDR T UA ; KOLOMEYKO ANATOLIY V UA ; BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 12006505 A

Filing Date: 20050502

Issue/Publication Date: 20050901

Abstract: (ENG) Sensor assembly capable of obtaining and providing a measurement of a physical quantity, e.g., measurement of temperature and/or pressure of a vehicular tire, includes an antenna capable of receiving a radio frequency signal, a radio frequency identification (RFID) device coupled to the antenna, a sensor coupled to the RFID device arranged to generate a measurement of the physical quantity or quantities, and a switch coupled to the RFID device and arranged to connect or disconnect the sensor from a circuit with the antenna dependent on whether the antenna receives a particular signal associated with the RFID device. When the antenna receives the particular signal associated with the RFID device, the RFID device causes the switch to close and connect the sensor in the circuit with the antenna to enable the measurement generated by the sensor to be directed to and transmitted by the antenna.

Priority Data: US 12006505 20050502 A N; US 8273905 20050317 A 2 Y; US 70136103 20031104 A 2 Y; US 18867302 20020703 A 1 Y; US 75318601 20010102 A 2 Y; US 13791898 19980820 A 2 Y; US 47607795 19950607 A 2 Y; US 17470902 20020619 A 2 Y; US 33093802 20021227 A 2 Y; US 61345303 20030703 A 2 Y; US 92506201 20010808 A 2 Y; US 76702001 20010123 A 2 Y; US 7340398 19980506 A 2 Y; US 57124795 19951212 A 2 Y; US 55021795 19951030 A C Y; US 35631499 19990716 A 2 Y; US 94766197 19971009 A C Y; US 76555801 20010119 A 2 Y; US 7906502 20020219 A 2 Y; US 64202803 20030815 A 2 Y; US 63874303 20030811 A 2 Y; US 4355702 20020111 A 2 Y; US 64570900 20000824 A 2 Y; US 3912905 20050119 A 2 Y; US 65875003 20030909 A 2 Y; US 81960997 19970317 A 2 Y; US 23997794 19940509 A C Y; US 59283804 20040730 P Y; US 42361302 20021104 P Y; US 46164803 20030408 P Y; US 2804696 19961009 P Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y; US 41586202 20021003 P Y; US 17097399 19991215 P Y;

Related Application(s): 60/592838 20040730 60/423613 20021104 60/461648 20030408 60/028046 19961009 60/231378 20000908 60/269415 20010216 60/291511 20010516 60/304013 20010709 60/415862 20021003 60/170973 19991215; 11/120065 20050502 10/188673 20020703 6738697 US GRANTED; 11/120065 20050502 11/082739 20050317 PENDING<RDA continuation-in-part> 11/120065 20050502 10/701361 20031104 PENDING 10/188673 20020703 09/753186 20010102 6484080 US GRANTED 09/753186 20010102 09/137918 19980820 6175787 US GRANTED 09/137918 19980820 08/476077 19950607 5809437 US GRANTED<RDA continuation-in-part> 10/701361 10/174709 20020619 6735506 US GRANTED 10/701361 10/330938 20021227 6823244 US GRANTED 10/701361 10/613453 20030703 6850824 US GRANTED<RDA continuation-in-part> 10/701361 09/925062 20010808 6733036 US GRANTED 09/925062 20010808 09/767020 20010123 6533316 US GRANTED 09/767020

20010123 09/073403 19980506 6179326 US GRANTED 09/073403 19980506 08/571247 19951212 5772238 US GRANTED<RDA continuation-in-part> 09/073403 19980506 08/550217 19951030 ABANDONED 09/767020 09/356314 19990716 6326704 US GRANTED 09/356314 19990716 08/947661 19971009 ABANDONED<RDA continuation-in-part> 09/356314 09/137918 19980820 6175787 US GRANTED 09/137918 19980820 08/476077 19950607 5809437 US GRANTED 10/701361 09/765558 20010119 6748797 US GRANTED<RDA continuation-in-part> 10/701361 10/079065 20020219 6662642 US GRANTED 10/701361 10/642028 20030815 PENDING 10/701361 10/638743 20030811 PENDING<RDA continuation-in-part> 10/701361 10/043557 20020111 6905135 US GRANTED 10/701361 09/645709 20000824 PENDING 11/082739 11/039129 20050119 PENDING<RDA continuation-in-part> 11/039129 20050119 10/658750 20030909 6892572 US GRANTED 10/658750 20030909 08/819609 19970317 6615656 US GRANTED 08/819609 19970317 08/239977 19940509 ABANDONED

IPC (International Class): G02B02701; B60R02101; G01F02326; B60C02304; B60C01900; G01F023296; G01F02320; B60R02130; H01Q00122; B60R021213; B60R021231; G07C00500; B60C01124; G07C00508; B60R021235; B60C02306; B60R02120; B60R021233; G01F02300; B60R02116; B60J01000; G01F02336; B60N00200; G02B02700; B60R02100

US Class: 701037; 701001

Publication Language: ENG

Assignments Reported to USPTO:

Reel/Frame: 16530/0669 **Date Signed:** 20050418 **Date Recorded:** 20050502

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE, ESQ. ATI-390 Q 11 SUNRISE PLAZA, SUITE 303 VALLEY STREAM, NY 11580-6111

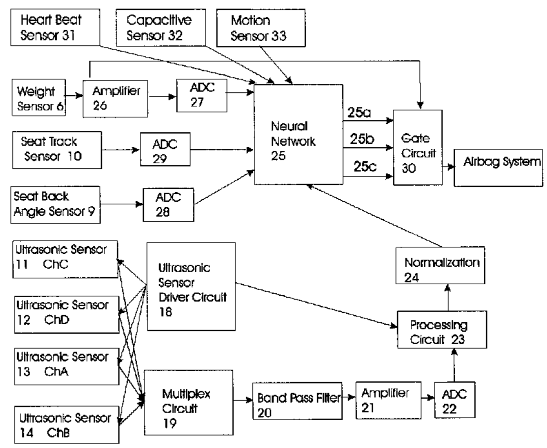
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEEDOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20050502	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:SHOSTAK, OLEKSANDR T.;KOLOMEYKO, ANATOLIY V.;BREED, DAVID S.;AND OTHERS;REEL/FRAME:016530/0669;SIGNING DATES FROM 20050418 TO 20050501;
20050502	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:SHOSTAK, OLEKSANDR T.;KOLOMEYKO, ANATOLIY V.;BREED, DAVID S.;AND OTHERS;REEL/FRAME:016530/0669;SIGNING DATES FROM 20050418 TO 20050501;
20050502	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF

ASSIGNORS INTEREST;ASSIGNORS:SHOSTAK, OLEKSANDR T.;KOLOMEYKO, ANATOLIY V.;BREED, DAVID S.;AND OTHERS;REEL/FRAME:016530/0669;SIGNING DATES FROM 20050418 TO 20050501;

US6078854A 20000620



(ENG) Apparatus and method for adjusting a vehicle component

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: US 12849098 A

Filing Date: 19980804

Issue/Publication Date: 20000620

Abstract: (ENG) A seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the wave sensors, weight sensors associated with the seat for measuring the weight applied onto the seat and generating an output representative of the measured weight applied onto the seat and a processor for receiving the outputs from the wave sensors and the weight sensors and evaluating the seated-state of the seat based thereon. The processor directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat.

Priority Data: US 12849098 19980804 A Y; US 47478395 19950607 A 2 N; US 97082297 19971114 A 2 Y;

Related Application(s): 08/474783 19950607 5822707 GRANTED 08/970822 19971114 PENDING

IPC (International Class): B60N00244; B60R02116; G01S01587; B60N00206; B60N00202; G01S01588; B60N00200; B60R02101; B60N00228; G01G019414; B60N00248; B60R021015; G01S01506; B60R02246; B60R021203; B60R021276; B60R02228; B60R02120; B60R02220

US Class: 701049; 180273; 280735; 318467; 701045

Agent(s): Roffe Brian

Examiner Primary: Chin, Gary

US Post Issuance:

--US Expiration Date: 20040620 20040817 DUE TO FAILURE TO PAY MAINTENANCE FEES
--US Certificate of Correction: 20011225 20020115 a Certificate of Correction was issued for this patent

Assignments Reported to USPTO:

Reel/Frame: 09377/0180 **Date Signed:** 19980722 **Date Recorded:** 19980804
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

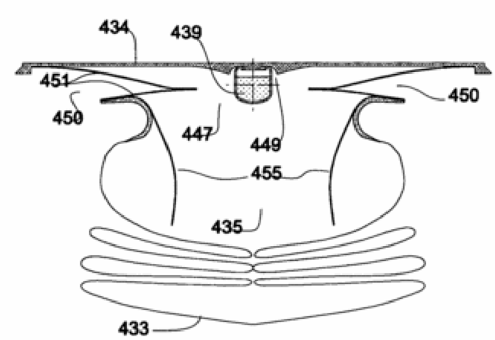
Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; MORIN, JEFFREY L.

Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NY 11598-2051
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19980804	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;MORIN, JEFFREY L.;REEL/FRAME:009377/0180;SIGNING DATES FROM 19980722 TO 19980729;
20011225	( )	CC	CERTIFICATE OF CORRECTION
20031217	()	FPAY	Year of fee payment: 4;
20040817	(-)	FP	EXPIRED DUE TO FAILURE TO PAY MAINTENANCE FEE Effective date: 20040620;
20070731	( )	ERR	ERRATUM : IN THE NOTICE OF "PATENTS WHICH EXPIRED ON 20040620 DUE TO FALLURE TO PAY MAINTENANCE FEES" APPEARING IN THE OFFICIAL GAZETTE OF 20040817, ALL REFERENCE TO PATENT NO. 6078854 WHICH ISSUED FROM APPLICATION NO. 09/128490 SHOULD BE DELETED SINCE THE RELEVANT MAINTENANCE FEE WAS TIMELY PAID IN THAT PATENT.;
20071220	()	FPAY	Year of fee payment: 8;

US7481453B2 20090127
US2007228703A1 20071004



(ENG) Inflator system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 13162305 A

Filing Date: 20050518

Issue/Publication Date: 20090127

Abstract: (ENG) Method for inflating an airbag in a vehicle to protect an occupant in the event of a crash involving the vehicle in which an inflator having a propellant is arranged in the vehicle, the propellant is ignited after determination of a crash involving the vehicle to generate gas therefrom, the gas is directed into an airbag and pressure in the airbag is controlled based on the occupant by varying the flow of gas into the airbag. Variation in the flow of gas into the airbag may be obtained by varying a flow of aspirating gas into a mixing chamber in which the aspirating gas mixes with gas generated from the propellant.

Priority Data: US 13162305 20050518 A Y; US 4355702 20020111 A 2 N; US 92506201 20010808 A 2 N; US 76702001 20010123 A 2 N; US 7340398 19980506 A 2 N; US 57124795 19951212 A 2 Y; US 55021795 19951030 A C N; US 35631499 19990716 A 2 N; US 94766197 19971009 A C N; US 13791898 19980820 A 2 N; US 47607795 19950607 A 2 N; US 27872102 20021023 A 2 N; US 63874303 20030811 A 2 N; US 96282797 19971103 A 2 N; US 47607695 19950607 A 2 N; US

33106002 20021227 A 2 N; US 86253001 20010522 A 2 N; US 45273599 19991201 A 2 N; US 35897694 19941219 A 2 N; US 10424693 19930809 A B N; US 72775691 19910709 A C N; US 74848900 20001226 A 2 N; US 51498695 19950814 A 1 N; US 2407693 19930301 A 2 N; US 86552597 19970529 A 2 N; US 43504599 19991108 A 2 N; US 11496298 19980714 A 2 N; US 10101793 19930916 A 2 N; US 18867302 20020703 A 2 N; US 75318601 20010102 A 2 N; US 33093802 20021227 A 2 N; US 81737904 20040402 A C N; US 88857501 20010625 A 2 N; US 53519800 20000327 A 2 N; US 7180198 19980504 A 2 N; US 62649396 19960402 A 2 N; US 53967695 19951005 A 2 N; US 24776394 19940523 A 2 N; US 79541897 19970204 A 2 N; US 41331803 20030414 A C N; US 97491904 20041027 A 2 Y; US 5833705 20050215 A 2 N; US 96339004 20041012 A 1 N; US 76879104 20040130 A 1 N; US 2804696 19961009 P N; US 34872001 20011023 P N; US 37428202 20020419 P N;

Related Application(s): 11/131623 20050518 20070228703 20071004 US; 10/974919 20041027 7040653 US; 10/817379 20040402 US ABANDONED; 10/638743 20030811 US PENDING; 10/278721 20021023 US PENDING; 10/043557 20020111 6905135 US

IPC (International Class): B60R02116; B60R02130

ECLA (European Class): B60R02130; B60R0210132; B60R021264

US Class: 280738; 280740

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Culbreth, Eric

Examiner Assistant: Rocca, Joseph

US Post Issuance:
--US Certificate of Correction: 20090317 20090407 A Certificate of Correction was issued for this patent

Assignments Reported to USPTO:
Reel/Frame: 16582/0883 **Date Signed:** 20050517 **Date Recorded:** 20050518
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

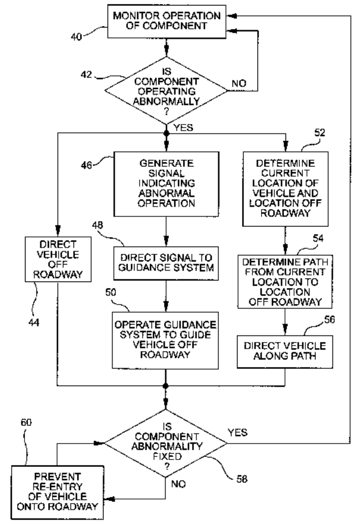
Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE, ESQ. ATI-367 11 SUNRISE PLAZA, SUITE 303 VALLEY STREAM, NEW YORK 11580-6111
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20050518	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:016582/0883; Effective date: 20050517;
20090317	()	CC	

US6175787B1 20010116



(ENG) On board vehicle diagnostic module using pattern recognition

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 13791898 A

Filing Date: 19980820

Issue/Publication Date: 20010116

Abstract: (ENG) A component diagnostic system for a motor vehicle including sensors not directly associated with the component such that the component does not directly affect the sensors, each sensors being arranged to detect a signal containing information as to whether the component is operating normally or abnormally and outputting a corresponding electrical signal. A processor receives the electrical signals and processes the same to determine if the component is operating abnormally based thereon. Another system within the vehicle is affected if the component is operating abnormally. The processor preferably applies pattern recognition techniques. Also, a method for automatically monitoring a component of a vehicle during operation of the vehicle on a restricted roadway, in which operation of the component is monitored in order to detect abnormal operation of the component, and if abnormal operation of the component is detected, the vehicle is automatically directed off of the restricted roadway.

Priority Data: US 13791898 19980820 A I; US 47607795 19950607 A R;

Related Application(s): 01 01

IPC (International Class): G01M01700

ECLA (European Class): B60N00202B4; B60N00202B6W; B60N00228P4; G07C00508D; G07C00500T

US Class: 701029; 340438; 340439; 701030; 701045; 702182; 702183; 706020

Agent(s): Roffe Brian

Examiner Primary: Louis-Jacques, Jacques H.

Assignments Reported to USPTO:

Reel/Frame: 09400/0935 **Date Signed:** 19980812 **Date Recorded:** 19980820
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

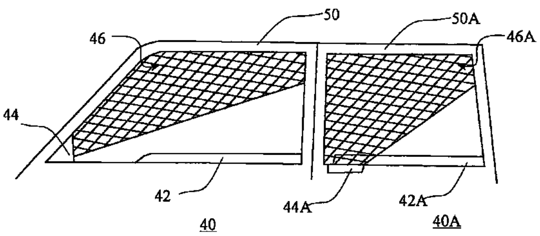
Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NEW YORK 11598-2051
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19980820	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:009400/0935; Effective date: 19980812;

20040708	()	FPAY	Year of fee payment: 4;
20080714	()	FPAY	Year of fee payment: 8;



US6984818B1 20060110

(ENG) System and method for detecting the presence of an object in an aperture

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 139504 A

Filing Date: 20041201

Issue/Publication Date: 20060110

Abstract: (ENG) System and method for detecting the presence of an object in an aperture in which an electromagnetic pulse is directed from an edge of a frame defining the aperture and electromagnetic waves reflected from an opposite edge of the frame are received at substantially the same location. A time of flight between the emission of the electromagnetic pulse and the reception of the reflected electromagnetic waves is measured. The presence of an obstacle in the aperture causes a variation in the time of flight from a reference time of flight in a situation where an obstacle is not present in the aperture. The system and method can be used in vehicles to determine the presence of obstacles in the path of a closing window, door, trunk lid, convertible top, or sunroof.

Priority Data: US 139504 20041201 A N; US 19169202 20020709 A 3 Y; US 15216002 20020521 A C Y; US 29238601 20010521 P Y;

Related Application(s): 11/001395 10/191692 20020709 6875976 US A; 60/292386 20010521 00; 10/191692 10/152160 20020521 ABANDONED

IPC (International Class): G06M00700; H01J04014

US Class: 250221; 340555; 318264

Publication Language: ENG

Agent(s): Roffe Brian

Examiner Primary: Porta, David

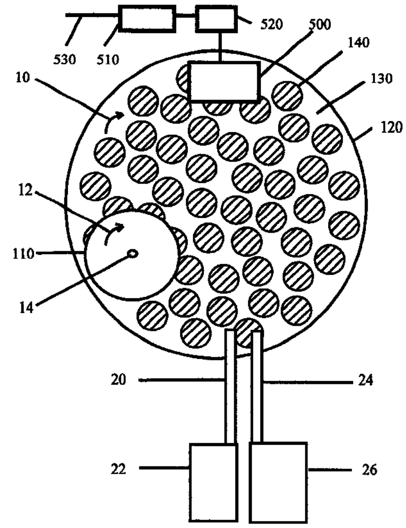
Examiner Assistant: Sohn, Seung C.

US Post Issuance:

--US Certificate of Correction: 20060328 20060418 a Certificate of Correction was issued for this patent; 20060502 20060523 a Certificate of Correction was issued for this patent

Legal Status:

Date	+/-	Code	Description
20060328	( )	CC	CERTIFICATE OF CORRECTION
20060502	( )	CC	CERTIFICATE OF CORRECTION
20090711	()	FPAY	Year of fee payment: 4;



US6641463B1 20031104

(ENG) Finishing components and elements

Assignee: BEAVER CREEK CONCEPTS INC US

Inventor(s): MOLNAR CHARLES J US

Application No: US 15151502 A

Filing Date: 20020520

Issue/Publication Date: 20031104

Abstract: (ENG) New, versatile finishing surfaces are described. Unitary finishing elements having discrete finishing members attached to unitary resilient body are disclosed for finishing microdevices such as semiconductor wafers. Finishing surfaces such as discrete finishing members can be comprised of a multiphase polymeric composition. The new unitary finishing elements have lower cost to manufacture and high precision. The unitary finishing elements and finishing surfaces can reduce unwanted surface defect creation on the semiconductor wafers during finishing.

Priority Data: US 15151502 20020520 A N; US 55650900 20000424 A 2 Y; US 13101699 19990426 P Y; US 13232999 19990503 P Y; US 13695499 19990601 P Y; US 14130299 19990628 P Y; US 14130499 19990628 P Y; US 15879799 19991012 P Y; US 11896799 19990206 P Y; US 13109799 19990426 P Y; US 13231699 19990503 P Y; US 13695599 19990601 P Y; US 14133799 19990628 P Y; US 14129899 19990628 P Y; US 15879699 19991012 P Y;

Related Application(s): 09/556509 20000424 6413153 US GRANTED; 13/101699 19990426 US; 60/132329 19990503 US; 60/136954 19990601 US; 60/141302 19990628 US; 60/141304 19990628 US; 60/158797 19991012 US; 11/896799 19990206 US; 60/131097 19990426 US; 60/132316 19990503 US; 60/136955 19990601 US; 60/141337 19990628 US; 60/141298 19990628 US; 60/158796 19991012 US

IPC (International Class): B24D00334; B24D00328; B24B03704; B24D00706

ECLA (European Class): B24B03711; B24B03704B; B24D00328; B24D00334C; B24D00706B

US Class: 451041; 051298; 451060; 451285; 451286; 451287; 451527; 451530; 451539; 451921

Publication Language: ENG

Filing Language: ENG

Examiner Primary: Hail, III, Joseph J.

Examiner Assistant: McDonald, Shantese

Assignments Reported to USPTO:

Reel/Frame: 14202/0975 **Date Signed:** 20030609 **Date Recorded:** 20030619
Assignee: BEAVER CREEK CONCEPTS INC. 12 MALVERN CT. WILMINGTON DELAWARE 19810

Assignor: BEAVER CREEK CONCEPTS INC.

Corres. Addr: BEAVER CREEKCONCEPTS INC. CHARLES J. MOLNAR 12 MALVERN CT. WILMINGTON, DELAWARE 19810
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FORDETAILS).

Reel/Frame: 23985/0422 **Date Signed:** 20100219 **Date Recorded:** 20100222
Assignee: MOLNAR, CHARLES J. 701 WEST BEALEY ST. ST MARYS GEORGIA 31558

Assignor: BEAVER CREEK CONCEPTS INC.

Corres. Addr: CHARLES J. MOLNAR 701 WBEALEY ST. ST. MARYS, GA 31558
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20030619	( )	AS	ASSIGNMENT New owner name: BEAVER CREEK CONCEPTS INC. 12 MALVERN CT.WILMINGTO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;REEL/FRAME:014202/0975; Effective date: 20030609;
20030619	()	AS	New owner name: BEAVER CREEK CONCEPTS INC., DELAWARE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;REEL/FRAME:014202/0975; Effective date: 20030609;
20030619	()	AS	New owner name: BEAVER CREEK CONCEPTS INC. 12 MALVERN CT.WILMINGTO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;REEL/FRAME:014202/0975; Effective date: 20030609;
20070416	()	FPAY	Year of fee payment: 4;
20100222	()	AS	New owner name: MOLNAR, CHARLES J.,GEORGIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;US-ASSIGNMENT DATABASE UPDATED:20100225;REEL/FRAME:23985/422; Effective date: 20100219;
20100222	()	AS	New owner name: MOLNAR, CHARLES J.,GEORGIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;REEL/FRAME:023985/0422; Effective date: 20100219;
20100222	()	AS	New owner name: MOLNAR, CHARLES J., GEORGIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BEAVER CREEK CONCEPTS INC.;REEL/FRAME:023985/0422; Effective date: 20100219;
20110923	()	FPAY	Year of fee payment: 8;
20110927	()	SULP	Year of fee payment: 7;

US6820897B2 20041123
US2002140215A1 20021003

(ENG) Vehicle object detection system and method

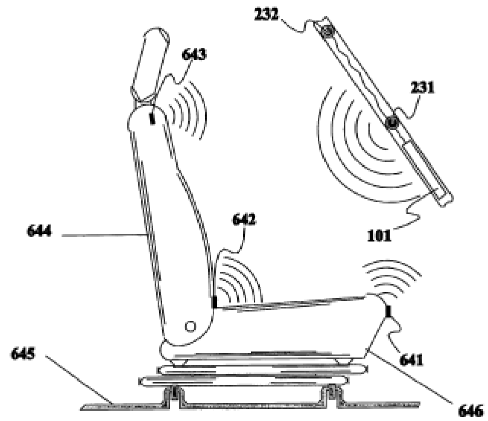
Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 15161502 A

Filing Date: 20020520

Issue/Publication Date: 20041123



Abstract: (ENG) System for obtaining information about an object in the vehicle including one or more resonators or reflectors arranged in association with the object, each resonator emitting an energy signal upon receipt of a signal at an excitation frequency, a transmitter device for transmitting signals at least at the excitation frequency of each resonator, an energy signal detector for detecting the energy signal emitted by each resonator upon receipt of the signal at the excitation frequency, and a processor coupled to the detector for obtaining information about the object upon analysis of the energy signal detected by the detector. The information obtained about the object may be a distance between each resonator and the detector, which positional information is useful for controlling components in the vehicle such as the occupant restraint or protection device. If the object is a seat, the information obtained about the seat may be an indication of the position of the seat, the position of the back cushion of the seat, the position of the bottom cushion of the seat, the angular orientation of the seat, and other seat parameters. The resonator(s) may be arranged within the object and may be a SAW device, antenna and/or RFID tag. When several resonators are used, each may be designed to emit an energy signal upon receipt of a signal at a different excitation frequency. The resonators may be tuned resonators including an acoustic cavity or a vibrating mechanical element.

Priority Data: US 15161502 20020520 A N; US 89143201 20010626 A 2 Y; US 83892001 20010420 A 2 Y; US 56355600 20000503 A 2 Y; US 43753599 19991110 A 2 Y; US 4770398 19980325 A 2 Y; US 64006896 19960430 A 2 Y; US 23997894 19940509 A B Y; US 4097893 19930331 A B Y; US 87857192 19920505 A C Y; US 50503695 19950721 A 1 Y; US 90587697 19970804 A 2 Y; US 63929900 20000815 A 2 Y; US 90587797 19970804 A 1 Y; US 54367800 20000407 A 2 Y; US 4770498 19980325 A 2 Y;

Related Application(s): 08/239978 19940509 ABANDONED 08/505036 19950721 5653462 US A GRANTED (PATENT) 08/040978 PENDING 08/905877 19970804 6186537 US A GRANTED (PATENT)<RDA continuation> 08/505036 PENDING 08/040978 PENDING 08/239978 PENDING 08/505036 PENDING 08/040978 PENDING; 09/891432 20010626 6513833 US A GRANTED (PATENT) 09/838920 20010420 PENDING<RDA continuation-in-part> 09/563556 20000503 6474683 US A GRANTED (PATENT) 09/437535 19991110 6712387 US A GRANTED (PATENT)<RDA continuation-in-part> 09/047703 19980325 6039139 US A GRANTED (PATENT) 08/640068 19960430 5829782 US A GRANTED (PATENT)<RDA continuation-in-part> 08/040978 19930531 ABANDONED 07/878571 19920505 ABANDONED 08/905876 19970804 5848802 US A GRANTED (PATENT)<RDA continuation-in-part> 07/878571 PENDING 10/151615 PENDING 09/639299 20000815 6422595 US A GRANTED (PATENT)<RDA continuation-in-part> 07/878571 PENDING 10/151615 PENDING 09/543678 20000407 6412813 US A GRANTED (PATENT)<RDA continuation-in-part> 09/047704 19980325 6116639 US A GRANTED (PATENT) 08/640068 PENDING 08/905876 PENDING 07/878571 PENDING

IPC (International Class): G01S01587; B60R02220; B60R01102; G01F023296; B60N00202; B60N00200; G01S00741; G01F02320; G01S00748; G01F02300; B60R02101; G01S01788; B60J01000; E05F01500; G01S007539; B60N00228; B60R016037; G10K011178; B60R01602; B60N00248; G01S01588; G06K00900; B60R00108; G01S01506; B60R021215; B60R021231; G01S01304; B60R02120; B60R021276; B60R021015; G01S01504; B60R021013; B60R02248; B60R0210134; B60R00112; G01S01789; B60R0210132; B60R02116; B60R02126

US Class: 280735; 701049; 342070

Agent(s): Roffe Brian

Examiner Primary: Dickson, Paul N.

Examiner Assistant: To, Toan C

Assignments Reported to USPTO:

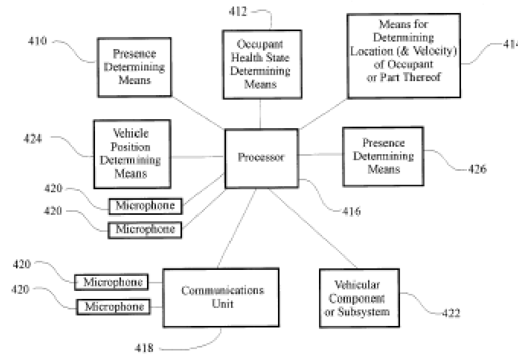
Reel/Frame: 12923/0570 **Date Signed:** 20020515 **Date Recorded:** 20020520
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILE NEW JERSEY 07834

Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE 366 LONGACRE AVENUE WOODMERE, NY 11598
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020520	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012923/0570;SIGNING DATESFROM 20020515 TO 20020518;
20020520	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:012923/0570;SIGNING DATES FROM 20020515 TO 20020518;
20020520	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:012923/0570;SIGNING DATESFROM 20020515 TO 20020518;
20080509	()	FPAY	Year of fee payment: 4;



US2002188392A1 20021212

(ENG) Telematics system

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 17470902 A

Filing Date: 20020619

Issue/Publication Date: 20021212

Abstract: (ENG) Vehicular telematics system including an occupant sensing system for determining a property or characteristic of occupancy of the vehicle constituting information about the occupancy of the vehicle and a communications device coupled to the occupant sensing system for transmitting the information. The occupant sensing system may include sensors, for example, an image-obtaining sensor for obtaining images of the passenger compartment of the vehicle, a motion sensor, receivers arranged to receive waves, energy or radiation from seating locations in the passenger compartment, heartbeat sensors, weight sensors associated with seats in the vehicle and/or chemical sensors. Vehicle sensors may be provided, each sensing a state of the vehicle or a state of a component of the vehicle. The communications device is coupled, wired or wirelessly, directly or indirectly, to each vehicle sensor and transmits the state of the vehicle or the state of the component of the vehicle.

Priority Data: US 17470902 20020619 A N; US 11453302 20020402 A 2 Y; US 75318601 20010102 A 2 Y; US 13791898 19980820 A 2 Y; US 47607795 19950607 A 2 Y; US 7906502 20020219 A 2 Y; US 76555801 20010119 A 2 Y; US 5870602 20020128 A 2 Y; US 89143201 20010626 A 2 Y; US 83892001 20010420 A 2 Y; US 56355600 20000503 A 2 Y; US 43753599 19991110 A 2 Y; US 4770398 19980325 A 2 Y; US 64006896 19960430 A 2 Y; US 23997894 19940509 A B Y; US 4097893 19930331 A C Y; US 87857192 19920505 A C Y; US 90587697 19970804 A 2 Y; US 50503695 19950721 A 1 Y; US 63929900 20000815 A 2 Y; US 90587797 19970804 A 2 Y; US 40962599 19991001 A 2 Y; US 44833799 19991123 A 2 Y; US 87851792 19920505 A 2 Y; US 44833899 19991123 A 2 Y; US 54367800 20000407 A 2 Y; US 4770498 19980325 A 2 Y; US 23137800 20000908 P Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y;

Related Application(s): 60/231378 20000908<RDA provisional application> 60/269415 20010216<RDA provisional application> 60/291511 20010516 60/304013 20010709; 08/505036 19950721 5653462 US GRANTED<RDA continuation> 08/040978 19930331 08/505036 19950721 5653462 US GRANTED 08/040978 19930331 08/505036 19950721 5653462 US GRANTED 08/040978 19930331 08/505036 19950721 5653462 US GRANTED 08/040978 19930331<RDA continuation> 08/505036 19950721 5653462 US GRANTED 08/239978 19940509; 10/114533 20020402<RDA continuation-in-part> 09/753186 20010102 09/137918 19980820 6175787 US GRANTED<RDA continuation-in-part> 08/476077 19950607 5809437 US GRANTED 10/079065 20020219<RDA continuation-in-part> 09/765558 20010119 10/114533 20020402 10/058706 20020128 09/891432 20010626<RDA continuation-in-part> 09/838920 20010420 09/563556 20000503 09/437535 19991110 09/047703 19980325 6039139 US GRANTED 08/640068 19960430 5829782 US GRANTED<RDA continuation-in-part> 08/040978 19930331 07/878571 19920505 08/905876 19970804 5848802 US GRANTED 07/878571 19920505 09/639299 20000815 6422595 US GRANTED 08/905877 19970804 6186537 US GRANTED<RDA continuation-in-part> 07/878571 19920505 09/409625 19991001 6270116 US GRANTED<RDA continuation-in-part> 08/905877 19970804 6186537

US GRANTED 07/878571 19920505<RDA continuation-in-part> 09/448337 19991123 6283503 US GRANTED 08/905877 19970804 6186537 US GRANTED 07/878517 19920505 5270883 US GRANTED<RDA continuation-in-part> 09/448338 19991123 6168198 US GRANTED 08/905877 19970804 6186537 US GRANTED 07/878571 19920505 09/543678 20000407 6412813 US GRANTED 09/047704 19980325 6116639 US GRANTED<RDA continuation-in-part> 08/640068 19960430 5829782 US GRANTED 08/040978 19930331

IPC (International Class): G01S007539; G01S00748; B60N00228; B60C02304; B60C01900; G01F023296; E05F01500; B60R02220; G01F02300; B60R02101; G01S00741; B60R01102; G07C00500; B60C01124; B60R016037; G01F02320; B60N00202; G01S01788; B60C02306; B60R00108; G06K00900; B60R01602; G01S01588; B60N00248; B60J01000; G01S01587; G07C00508; B60N00200; B60R021215; B60R02248; B60R0210134; B60R021015; B60R0210132; G01S01789; B60R02120; B60R021276; B60R00112; G01S01504; B60R021231; B60R02126; G01S01506; B60R021013; G01S01304; B60R02116

US Class: 701045

Assignments Reported to USPTO:

Reel/Frame: 13042/0562 **Date Signed:** 20020612 **Date Recorded:** 20020619

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL

Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020619	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:013042/0562;SIGNING DATESFROM 20020612 TO 20020618;
20020619	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL;REEL/FRAME:013042/0562;SIGNING DATES FROM 20020612 TO 20020618;
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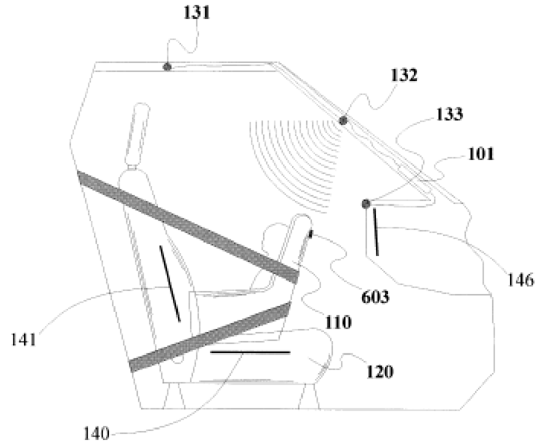
20071112	()	FPAY	Year of fee payment: 4;
20111226	()	REMI	

US6735506B2 20040511



(ENG) Telematics system

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 17470902 D

Filing Date: 20020619

Issue/Publication Date: 20040511

Abstract: (ENG) Vehicular telematics system including an occupant sensing system for determining a property or characteristic of occupancy of the vehicle constituting information about the occupancy of the vehicle and a communications device coupled to the occupant sensing system for transmitting the information. The occupant sensing system may include sensors, for example, an image-obtaining sensor for obtaining images of the passenger compartment of the vehicle, a motion sensor, receivers arranged to receive waves, energy or radiation from seating locations in the passenger compartment, heartbeat sensors, weight sensors associated with seats in the vehicle and/or chemical sensors. Vehicle sensors may be provided, each sensing a state of the vehicle or a state of a component of the vehicle. The communications device is coupled, wired or wirelessly, directly or indirectly, to each vehicle sensor and transmits the state of the vehicle or the state of the component of the vehicle.

Priority Data: US 75318601 20010102 A 2 Y; US 13791898 19980820 A 2 Y; US 47607795 19950607 A 2 Y; US 7906502 20020219 A 2 Y; US 76555801 20010119 A 2 Y; US 11453302 20020402 A 2 Y; US 5870602 20020128 A 2 Y; US 89143201 20010626 A 2 Y; US 83892001 20010420 A 2 Y; US 56355600 20000503 A 2 Y; US 43753599 19991110 A 2 Y; US 4770398 19980325 A 2 Y; US 64006896 19960430 A 2 Y; US 23997894 19940509 A B Y; US 4097893 19930331 A C Y; US 87857192 19920505 A C Y; US 90587697 19970804 A 2 Y; US 50503695 19950721 A 1 Y; US 63929900 20000815 A 2 Y; US 90587797 19970804 A 2 Y; US 40962599 19991001 A 2 Y; US 44833899 19991123 A 2 Y; US 54367800 20000407 A 2 Y; US 4770498 19980325 A 2 Y; US 30401301 20010709 P Y; US 29151101 20010516 P Y; US 26941500 20000216 P Y; US 23137800 20000908 P Y; US 17470902 20020619 A Y;

Related Application(s): 1994US-000239978 19940509 US ABANDONED; 08/505036 19950721 5653462 US GRANTED; 08/040978 00010101 US PENDING; 08/505036 19950721 5653462 US GRANTED; 1993US-000040978 19930331 US ABANDONED; 08/505036 19950721 5653462 US GRANTED; 1993US-000040978 19930331 US ABANDONED; 08/505036 19950721 5653462 US GRANTED; 1993US-000040978 19930331 US ABANDONED; 1994US-000239978 19940509 US ABANDONED; 08/505036 19950721 5653462 US GRANTED; 08/040978 00010101 US PENDING; 09/753186 20010102 US PENDING; 09/137918 19980820 6175787 US GRANTED; 08/476077 19950607 5809437 US GRANTED; 10/174709 00010101 US PENDING; 10/079065 20020219 US PENDING; 09/765558 20010119 US PENDING; 10/174709 00010101 US PENDING; 10/114533 20020402 US PENDING; 10/058706 20020128 US PENDING; 09/891432 20010626 US PENDING; 09/838920 20010420 US PENDING; 09/563556 20000503 US PENDING; 09/437535 19991110 US PENDING; 09/047703 19980325 6039139 US GRANTED; 08/640068 19960430 5829782 US GRANTED; 1993US-000040978 19930331 US ABANDONED; 1992US-000878571 19920505 US ABANDONED; 08/905876 19970804 5848802 US GRANTED; 1992US-000878571 19920505 US ABANDONED; 09/639299 20000815 US PENDING; 08/905877 19970804 6186537 US GRANTED; 1992US-000878571 19920505 US

ABANDONED; 09/409625 19991001 6270116 US GRANTED; 08/905877 19970804 6186537 US GRANTED; 1992US-000878571 19920505 US ABANDONED; 09/448338 19991123 6168186 US GRANTED; 08/905877 19970804 6186537 US GRANTED; 1992US-000878571 19920505 US ABANDONED; 09/543678 20000407 US PENDING; 09/047704 19980325 6116638 US GRANTED; 08/640068 19960430 5829782 US GRANTED; 1993US-000040978 19930331 US ABANDONED; 1992US-000878571 19920505 US ABANDONED; 08/905876 19970804 5848802 US GRANTED; 07/878571 00010101 US PENDING; 60-304013 20010709 US; 60-291511 20010516 US; 60/269415 20000216 US; 60/231378 20000908 US

IPC (International Class): B60N00228; G01F02300; B60C02304; B60C01900; G01S00748; G01F02320; E05F01500; G01F023296; G07C00500; B60R01602; G01S007539; G01S01587; B60R016037; B60C01124; B60R02220; G01S00741; B60N00202; G06K00900; G01S01588; B60C02306; G07C00508; B60R02101; B60N00248; B60J01000; G01S01788; B60N00200; G01S01504; G01S01304; B60R02126; B60R02116; B60R02120; B60R021015; B60R021231; B60R0210132; B60R02248; B60R021276; B60R021013; B60R00112; B60R0210134; G01S01789; G01S01506; B60R021215

ECLA (European Class): B60R021015; B60C01124; B60C01900; B60C02304C; B60C02304C4; B60C02304C6D; B60C02306C; B60J01000; B60M00100Y5A; B60N00200C; B60N00202B4; B60N00202B6B; B60N00202B6W; B60N00228; B60N00228B2; B60N00248C3C; B60N00248W; B60R016037; B60R0210136; B60R02220; E05F01500B6B; E05F01500B6B2; G01F02300G1A; G01F02320; G01F023296D; G01S00741D; G01S00748A; G01S007539; G01S01587; G01S01588; G01S01788; G06K00900H; G07C00500T; G07C00508D

US Class: 701036

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Beaulieu, Yonel

Assignments Reported to USPTO:

Reel/Frame: 13042/0562 **Date Signed:** 20020612 **Date Recorded:** 20020619
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL

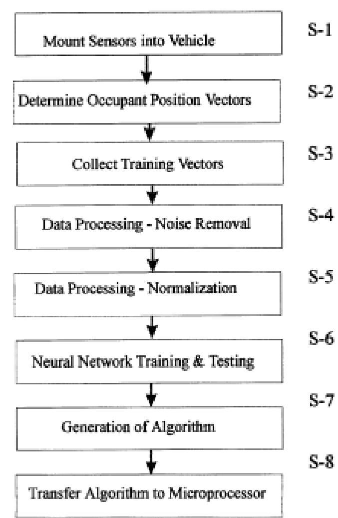
Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020619	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:013042/0562;SIGNING DATESFROM 20020612 TO 20020618;
20020619	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES

			INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL;REEL/FRAME:013042/0562;SIGNING DATES FROM 20020612 TO 20020618;
20020619	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:013042/0562;SIGNING DATESFROM 20020612 TO 20020618;
20071112	()	FPAY	Year of fee payment: 4;
20111226	()	REMI	

US6958451B2 20051025
US2003056997A1 20030327



(ENG) Apparatus and method for measuring weight of an occupying item of a seat

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DU VALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 17480302 A

Filing Date: 20020619

Issue/Publication Date: 20051025

Abstract: (ENG) Arrangement and method for determining weight of an occupying item in a seat including one or more weight sensors arranged to obtain a measurement of the force applied to the seat, a forcing function determination arrangement for measuring a forcing function of the seat and a processor coupled to the weight sensor(s) and forcing function determination arrangement for receiving the measurement of the force applied to the weight sensor(s) and the measurement of the forcing function from the forcing function measurement system and determining the weight of the occupying item based thereon. The forcing function determination arrangement may include an accelerometer and measures effects on the seat caused by load of a seatbelt associated with the seat and/or effects on the seat of road roughness, steering maneuvers, and a vehicle suspension system.

Priority Data: US 17480302 20020619 A N; US 90187901 20010709 A 2 Y; US 50034600 20000208 A 2 Y; US 12849098 19980804 A 2 Y; US 47478395 19950607 A 2 Y; US 97082297 19971114 A 2 Y; US 84955801 20010504 A 2 Y; US 19320998 19981117 A 2 Y; US 84955901 20010504 A 1 Y; US 75318601 20010102 A 2 Y; US 76702001 20010123 A 2 Y; US 77097401 20010126 A 2 Y;

Related Application(s): 09/901879 09/849559 20010504 PENDING; 10/174803 09/901879 20010709 6555766 US A 09/849559 09/193209 19981117 6242701 US A 09/193209 09/128490 19980804 6078854 US A 09/128490 08/970822 19971114 6081757 US A 08/970822 08/474783 19950607 5822701 US A 08/970822 10/174803 PENDING 10/174803 09/849559 PENDING 09/849559 09/193209 PENDING 09/193209 09/128490 PENDING 09/128490 08/970822 PENDING 08/970822 08/474783 PENDING 08/970822 10/174803 PENDING 10/174803 09/849558 20010504 6653577 US A 09/849558

09/193209 PENDING 09/193209 09/128490 PENDING 09/128490 08/970822 PENDING 08/970822 08/474783 PENDING 08/970822 10/174803 PENDING 10/174803 09/770974 20010126 6648367 US A 09/770974 09/767020 20010123 6533316 US A 09/767020 09/753186 20010102 6484080 US A 09/767020 10/174803 PENDING 10/174803 09/500346 20000208 6442504 US A 09/500346 09/128490 PENDING 09/128490 08/970822 PENDING 08/970822 08/474783 PENDING

IPC (International Class): B60N00268; G01G019414; B60N00202; B60N002015; G01S01588; B60N00200; B60N00266; B60N00206; B60R02101; B60N00228; G01S01587; B60N00248; G01S01506; B60R02246; B60R02220; B60R02120; B60R021203; B60R021276; B60R021015; B60R02126; B60R02228

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206S; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; B60N00266; B60N00268; G01G019414A; G01S01587; G01S01588

US Class: 177001; 177144; 702101; 180273; 280735; 701045

Publication Language: ENG

Agent(s): Roffe Brian

Examiner Primary: Gibson, Randy W.

US Post Issuance:

--US Certificate of Correction: 20060103 20060124 a Certificate of Correction was issued for this patent

--US Litigations: Automotive Technologies International Inc American Honda Motor Company Et A 20060317 Delaware 1:06cv187 ; Automotive Technologies International Inc Hyundai Motor America Et A 20060616 Delaware 1:06cv391

Assignments Reported to USPTO:

Reel/Frame: 13042/0575 **Date Signed:** 20020618 **Date Recorded:** 20020619

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

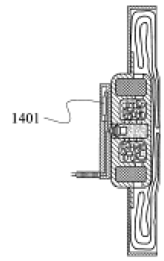
Assignor: BREED, DAVID S.

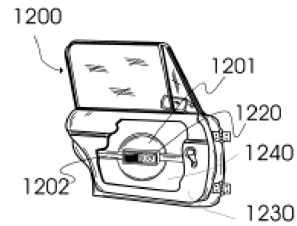
Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020619	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:013042/0575; Effective date: 20020618;
20060103	( )	CC	CERTIFICATE OF CORRECTION
20090409	()	FPAY	Year of fee payment: 4;





US7097201B2 20060829
US2005242555A1 20051103

(ENG) Side impact sensor systems

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; CASTELLI VITTORIO US ; PRUSZENSKI JR ANTHONY S US

Application No: US 17483705 A

Filing Date: 20050705

Issue/Publication Date: 20060829

Abstract: (ENG) Vehicle including an occupant protection apparatus for protecting an occupant during an impact into a side of the vehicle, and a side impact, electronic crash sensor assembly for detecting impact into the side of the vehicle and controlling the occupant protection apparatus responsive to the detected impact. The sensor assembly includes a sensor housing arranged in a door or between inner and outer side panels along a side of the vehicle, a movable sensing mass arranged within and movable in the lateral direction relative to the sensor housing in response to lateral accelerations thereof, a micro-processor containing an algorithm which generates a time-varying signal representative of lateral movement of the mass, analyzes the signal and generates a deployment signal based thereon, and a control unit for receiving the deployment signal from the micro-processor and controlling deployment of the occupant protection apparatus based thereon.

Priority Data: US 17483705 20050705 A N; US 96339004 20041012 A 1 Y; US 76879104 20040130 A 1 Y; US 43504599 19991108 A 1 Y; US 11496298 19980714 A 2 Y; US 10101793 19930916 A 2 Y;

Related Application(s): 11/174837 20050705 20050242555 20051103 US; 10/963390 20041012 US PENDING; 10/768791 20040130 US PENDING; 09/435045 19991108 6685218 US; 09/114962 19980714 6419265 US; 08/101017 19930916 5842716 US

IPC (International Class): B60R02116; B60R02120; B60R02133; B60R02121

ECLA (European Class): B60R02133; B60R02120

US Class: 2807302; 280735

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Culbreth, Eric

US Post Issuance:
--US Certificate of Correction: 20061121 20061212 a Certificate of Correction was issued for this patent

Assignments Reported to USPTO:
Reel/Frame: 19353/0388 **Date Signed:** 19991103 **Date Recorded:** 20070523
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

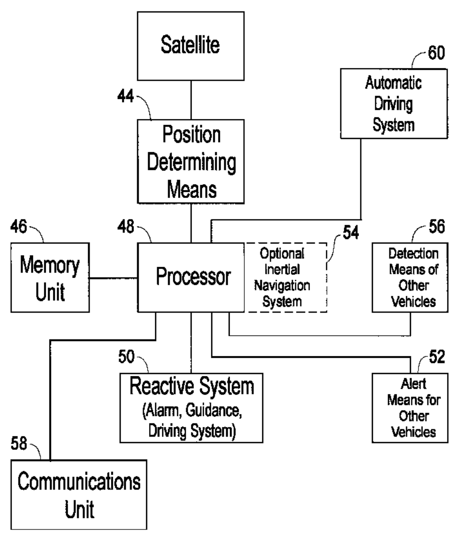
Assignor: BREED, DAVID S.; CASTELLI, VITTORIO; PRUSZENSKI, ANTHONY S., JR.

Corres. Addr: BRIAN ROFFE 11 SUNRISE PLAZA, SUITE 303 ATI-405 VALLEY STREAM, NY 11580
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20061121	( )	CC	CERTIFICATE OF CORRECTION
20070523	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:CASTELLI, VITTORIO;PRUSZENSKI, ANTHONY S., JR.;BREED, DAVID S.;REEL/FRAME:019353/0388;SIGNING DATES FROM 19991103 TO 20020228;
20070523	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:CASTELLI, VITTORIO;PRUSZENSKI, ANTHONY S., JR.;BREED, DAVID S.;REEL/FRAME:019353/0388;SIGNING DATES FROM 19991103 TO 20020228;
20070523	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:CASTELLI, VITTORIO;PRUSZENSKI, ANTHONY S., JR.;BREED, DAVID S.;REEL/FRAME:019353/0388;SIGNING DATES FROM 19991103 TO 20020228;
[illegible]	()	[illegible]	Effective date: 20100829;

US6370475B1 20020409



(ENG) Accident avoidance system

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 17704198 A

Filing Date: 19981022

Issue/Publication Date: 20020409

Abstract: (ENG) System and method for preventing vehicle accidents in which the absolute position of the vehicle is determined, e.g., using a satellite-based positioning system such as GPS, and the location of the vehicle relative to the edges of the roadway is then determined based on the absolute position of the vehicle and stored data relating to edges of roadways on which the vehicle may travel. A system or component within the vehicle is initiated, e.g., an alarm or warning system, or the operation of a system or component is affected, e.g., an automatic guidance system, if the location of the vehicle approaches close to an edge of the roadway or intersects with an edge of the roadway.

Priority Data: US 17704198 19981022 A Y; US 6272997 19971022 P Y;

Related Application(s): 60/062729 19971022 00

IPC (International Class): G01S01948; G01S01393; B60N00228; G08G00116

US Class: 701301; 340436; 34235708; 701215

Agent(s): Roffe Brian 0

Examiner Primary: Zanelli, Michael J.

Assignments Reported to USPTO:
Reel/Frame: 10101/0322 **Date Signed:** 19990607 **Date Recorded:** 19990721
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; JOHNSON, WENDELL C.

Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NY 11598-2051
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19990721	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:010101/0322;SIGNING DATES FROM 19990607 TO 19990618;
20051007	()	FPAY	Year of fee payment: 4;
20091006	()	FPAY	Year of fee payment: 8;

US6918459B2 20050719
US2002166710A1 20021114

(ENG) Method and apparatus for deploying airbags

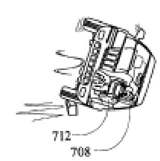
Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 18046602 A

Filing Date: 20020626

Issue/Publication Date: 20050719



Abstract: (ENG) Apparatus and method for deploying airbags in a vehicle in which a first inflatable airbag protects an occupant in a seating location during a crash and a second inflatable airbag moves the occupant in the seating location away from an interior surface of the vehicle upon inflation. A crash sensor system determines that a crash involving the vehicle will occur or is occurring and initiates inflation of the first and second airbags. The second airbag may be inflated prior to inflation of the first airbag such that inflation of the second airbag causes the occupant to be moved away from the interior surface of the vehicle and into a better position for deployment of the first airbag. In one exemplary embodiment, the first airbag is a side curtain airbag and the second airbag is arranged in a door of the vehicle to move the occupant away from the door.

Priority Data: US 18046602 20020626 A N; US 9708202 20020313 A 2 Y; US 82517301 20010403 A 2 Y; US 2408598 19980217 A 2 Y; US 24776094 19940523 A C Y; US 30788399 19990510 A 2 Y;

Related Application(s): 10/097082 20020313 US PENDING; 09/825173 20010403 6623033 US; 09/024085 19980217 6209909 US; 08/247760 19940523 US; 09/307883 19990510 6343810 US

IPC (International Class): G01S01788; B60N00228; B60N00202; G01S01388; G01S01588; G01S00741; B60R02121; B60R021233; B60N00200; G08G00116; B60R02232; B60R02101; B60R01920; B60R02116; B60R02226; G01S00748; B60R01942; G01S01587; B60R0210132; G01S007539; G01S007487; G01S01789; B60R0210134; B60R02100

ECLA (European Class): B60R021013; B60N00200C; B60N00202B4; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60R01920C; B60R01942; B60R021231L; B60R021233; B60R02226; B60R02232B; G01S00741D; G01S00748A; G01S01388; G01S01587; G01S01588; G01S01788; G08G00116A; G08G00116A2; G08G00116B

US Class: 180282; 2807301; 280734

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Dickson, Paul N.

Examiner Assistant: Rosenberg, Laura B.

US Post Issuance:
--US Certificate of Correction: 20050906 20050927 a Certificate of Correction was issued for this patent

Assignments Reported to USPTO:
Reel/Frame: 13063/0080 **Date Signed:** 20020626 **Date Recorded:** 20020626
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENILLE NEW JERSEY 07834

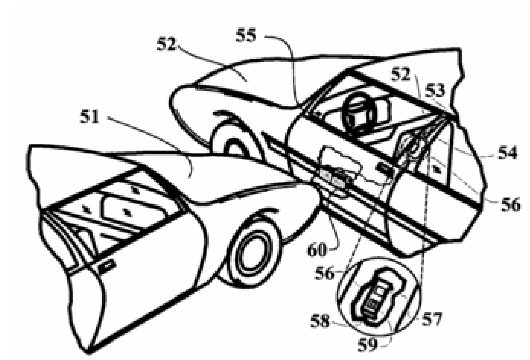
Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020626	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013063/0080; Effective date: 20020626;
20020626	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:013063/0080; Effective date: 20020626;
20020626	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013063/0080; Effective date: 20020626;

20050906	( )	CC	CERTIFICATE OF CORRECTION
20090908	()	REMI	Effective date: 20090719;
20090914	()	FPAY	Year of fee payment: 4;
20090914	()	PRDP	Effective date: 20090914;
20090914	()	SULP	



US7359782B2 20080415
US2005278098A1 20051215

(ENG) Vehicular impact reactive system and method

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 18359805 A

Filing Date: 20050718

Issue/Publication Date: 20080415

Abstract: (ENG) System and method for reacting to an expected impact involving a vehicle including an anticipatory sensor system for determining that an impact involving the vehicle is about to occur prior to the impact and an impact responsive system coupled to the sensor system and actuated after its determination of the expected impact. The sensor system includes wave receivers spaced apart from one another, each receiving waves generated by, modified by, or reflected from a common object exterior of the vehicle. The impact responsive system attempts to reduce the potential harm resulting from the impact and can be a protection apparatus which protects a vehicular occupant or a pedestrian, such as one including an airbag and an inflator for inflating the airbag.

Priority Data: US 18359805 20050718 A N; US 11147405 20050421 A 2 Y; US 75401404 20040108 A 2 Y; US 85136201 20010508 A 2 Y; US 18046602 20020626 A 2 Y; US 9708202 20020313 A 2 Y; US 82517301 20010403 A 2 Y; US 2408598 19980217 A 2 Y; US 24776094 19940523 A C Y; US 30788399 19990510 A 2 Y; US 44220403 20030124 P Y; US 20242400 20000508 P Y;

Related Application(s): 11/183598 20050718 20050278098 20051215 US; 60/442204 20030124 US; 60/202424 20000508 US; 11/111474 20050421 7209221 US; 10/754014 20040108 6885968 US; 09/851362 20010508 7049945 US; 10/180466 20020626 6918459 US; 10/097082 20020313 6755273 US; 11/183598 20050718 US PENDING; 10/180466 20020626 6918459 US; 10/097082 20020313 6755273 US; 09/825173 20010403 6623033 US; 09/024085 19980217 6209909 US; 08/247760 19940523 US ABANDONED; 09/307883 19990510 6343810 US; 09/024085 19980217 6209909 US

IPC (International Class): B60R02200; G01S01300

ECLA (European Class): G01S01793C; B60R0210134; G01S01393C

US Class: 701045; 180274; 340435; 340557; 34099513; 342118; 701046; 707010; 710029; 710038; 710046; 710048; 710117; 710200; 710301

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Black, Thomas

Examiner Assistant: Marc, McDieunel

US Post Issuance:

--US Certificate of Correction: 20080729 20080819 A Certificate of Correction was issued for this patent

Assignments Reported to USPTO:

Reel/Frame: 16791/0272 **Date Signed:** 20050718 **Date Recorded:** 20050718

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.

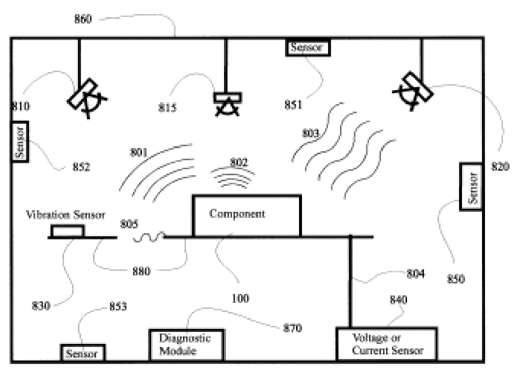
Corres. Addr: BRIAN ROFFE, ESQ. 11 SUNRISE PLAZA, ATI-293 VALLEY STREAM, NEW YORK 11580-6111

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20050718	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:016791/0272; Effective date: 20050718;
20050718	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:016791/0272; Effective date: 20050718;
20080729	()	CC	

US6738697B2 20040518
US2003009270A1 20030109



(ENG) Telematics system for vehicle diagnostics

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US

Application No: US 18867302 A

Filing Date: 20020703

Issue/Publication Date: 20040518

Abstract: (ENG) Vehicle diagnostic system which diagnoses the state of the vehicle or the state of a component of the vehicle and generates an output indicative or representative thereof. A communications device transmits the output of the diagnostic system to a remote location, possibly via a satellite or the Internet. The diagnostic system can include sensors mounted on the vehicle, each providing a measurement related to a state of the sensor or a measurement related to a state of the mounting location, and a processor coupled to the sensors and arranged to receive data from the sensors and process the data to generate the output indicative or representative of the state of the vehicle or its component. The processor may embody a pattern recognition algorithm trained to generate the output from the data received from the sensors and be arranged to control parts of the vehicle based on the output.

Priority Data: US 18867302 20020703 A N; US 17470902 20020619 A 2 Y; US 75318601 20010102 A 2 Y; US 13791898 19980820 A 2 Y; US 47607795 19950607 A 2 Y; US 7906502 20020219 A 2 Y; US 76555801 20010119 A 2 Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y; US 23137800 20000908 P Y;

Related Application(s): 60/304013 20010709 00 60/291511 20010516 00<RDA provisional application> 60/269415 20010216 00<RDA provisional application> 60/231378 20000908 00; 09/753186 20010102 6484080 US A GRANTED (PATENT) 09/137918 19980820 6175787 US A GRANTED (PATENT)<RDA continuation-in-part> 08/476077 19950607 5809437 US A GRANTED (PATENT) 10/188673 PENDING 10/079065 20020219 PENDING<RDA continuation-in-part> 09/765558 20010119 PENDING 10/188673 PENDING 10/174709 20020619 PENDING

IPC (International Class): G07C00508; B60C02304; B60C01900; B60C01124; G07C00500; B60C02306; B60N00202; B60N00228

US Class: 701029; 701034

Agent(s): Roffe Brian

Examiner Primary: Beaulieu, Yonel

Assignments Reported to USPTO:

Reel/Frame: 13095/0708 **Date Signed:** 20020702 **Date Recorded:** 20020703

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

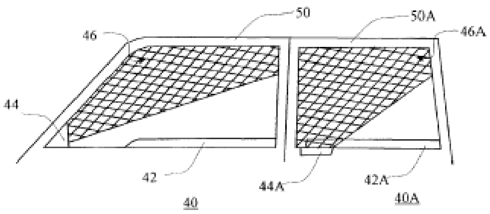
Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE, ESQ. BRIAN ROFFE 366 LONGACRE AVENUE WOODMERE, NY 11598-2417

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FORDETAILS).

Legal Status:

Date	+/-	Code	Description
20020703	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013095/0708; Effective date: 20020702;
20020703	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:013095/0708; Effective date: 20020702;
20020703	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013095/0708; Effective date: 20020702;
20071119	()	FPAY	Year of fee payment: 4;
20120102	()	REMI	



US6875976B2 20050405
US2002179822A1 20021205

(ENG) Aperture monitoring system and method

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 19169202 A

Filing Date: 20020709

Issue/Publication Date: 20050405

Abstract: (ENG) System and method for detecting the presence of an object in an aperture in which for modulated electromagnetic waves are directed from an edge of a frame defining the aperture and electromagnetic waves reflected from an opposite edge of the frame are received at substantially the same location. The phase change between the modulated electromagnetic waves and the reflected electromagnetic waves is measured wherein the presence of an obstacle in the aperture causes a variation in the phase change from a situation where an obstacle is not present. The system and method can be used in vehicles to determine the presence of obstacles in the path of a closing window, door, trunk lid, convertible top, or sunroof.

Priority Data: US 15216002 20020521 A 2; US 19169202 20020709 A Z; US 29238601 20010521 P;

Related Application(s): 60/292386 20010521 00; 10/152160 20020521 ABANDONED

IPC (International Class): G06M00700; H01J04014

ECLA (European Class): B60J007057B; G01S01702D

US Class: 250221; 340555; 318262

Agent(s): Roffe Brian

Examiner Primary: Luu, Thanh X.

Examiner Assistant: Sohn, Seung C.

Assignments Reported to USPTO:

Reel/Frame: 13102/0827 **Date Signed:** 20020705 **Date Recorded:** 20020709
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.

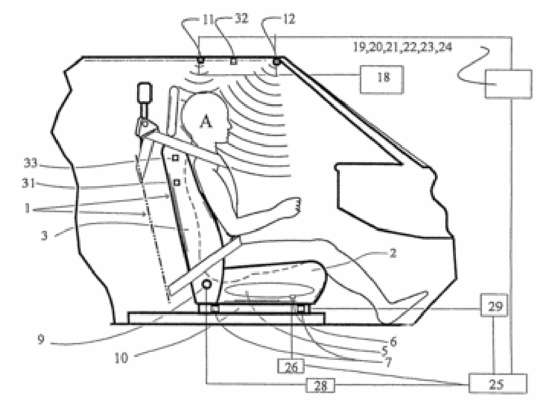
Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	**+/-**	**Code**	**Description**
20020709	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:013102/0827; Effective date: 20020705;
20020709	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF

20020709	()	AS	ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;JOHNSON, WENDELL C.;REEL/FRAME:013102/0827; Effective date: 20020705; New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S. /AR;REEL/FRAME:013102/0827; Effective date: 20020705;
20080930	()	FPAY	Year of fee payment: 4;

US7815219B2 20101019
US2005269810A1 20051208



(ENG) Weight measuring systems and methods for vehicles

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: US 19185005 A

Filing Date: 20050728

Issue/Publication Date: 20101019

Abstract: (ENG) Sensor system for sensing pressure applied to a seat by an occupant of the seat and for controlling deployment of an airbag which includes a bladder defining a chamber and which is adapted to be arranged in a seat portion of the seat, and a pressure sensor for measuring a pressure in the chamber. Deployment of the airbag is controlled based at least in part on the pressure in the chamber measured by the pressure sensor. A control module may be provided to control deployment of the airbag so that when the pressure sensor generates a signal based on the measured pressure in the chamber and provides the signal to the control module, the control module controls deployment of the airbag based on the signal.

Priority Data: US 19185005 20050728 A N; US 73395703 20031211 A 3 Y; US 84955901 20010504 A 2 Y; US 19320998 19981117 A 2 Y; US 12849098 19980804 A 2 Y; US 47478395 19950607 A 2 Y; US 97082297 19971114 A 2 Y; US 6101602 20020130 A 2 Y; US 90187901 20010709 A 2 Y; US 22778102 20020826 A 2 Y; US 50034600 20000208 A 2 Y;

Related Application(s): 11/191850 20050728 20050269810 US; 10/733957 20031211 7243945 US; 09/849559 20010504 6689962 US; 09/193209 19981117 6242701 US; 09/128490 19980804 6078854 US; 08/474783 19950607 5822707 US; 08/970822 19971114 6081757 US; 10/061016 20020130 6833516 US; 09/901879 20010709 6555766 US; 09/849559 20010504 6689962 US; 10/227781 20020826 6792342 US; 10/061016 20020130 6833516 US; 09/500346 20000208 6442504 US; 09/128490 19980804 6078854 US; 08/474783 19950607 5822707 US; 08/970822 19971114 6081757 US

IPC (International Class): B60R02116; B60R02101; G01G019414; B60N00202; B60N002015; G01S01588; B60N00200; B60N00266; B60N00206; B60N00228; G01S01587; B60N00248; G01S01506; B60R02246; B60R02220; B60R02120; B60R021203; B60R021276; B60R02126; B60R02228; B60R021015

ECLA (European Class): B60R021015; B60N00200C; B60N002015; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206S; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; B60N00266; G01G019414A; G01S01587; G01S01588

US Class: 280735; 180273; 180274; 701045

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: To, Toan C

Assignments Reported to USPTO:
Reel/Frame: 24948/0300 **Date Signed:** 20031210 **Date Recorded:** 20100907
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC, P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S; DUVALL, WILBUR E; MORIN, JEFFREY L

Corres. Addr: BRIANROFFE 8170 MCCORMICK BOULEVARD, SUITE 223 SKOKIE, IL 60203-2959
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20100907	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC,, NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S;DUVALL, WILBUR E;MORIN, JEFFREY L;SIGNINGDATES FROM 20031210 TO 20040924;REEL/FRAME:024948/0300;

US2003100088A1 20030529

(ENG) Protease inhibitor conjugates and antibodies useful in immunoassay

[no drawing available]

Assignee: SIGLER GERALD F. US

Inventor(s): METZ SIGRUN DE ; HUBER ERASMUS J DE ; VON DER ELTZ HERBERT W DE ; DERAS INA US ; HUI RAYMOND A US ; GHOSHAL MITALI US ; SIGLER GERALD F US ; ROOT RICHARD TERRY US

Application No: US 19205202 A

Filing Date: 20020710

Issue/Publication Date: 20030529

Abstract: (ENG) Activated haptens useful for generating immunogens to HIV protease inhibitors, immunogens useful for producing antibodies to HIV protease inhibitors, and antibodies and labeled conjugates useful in immunoassays for HIV protease inhibitors. The novel haptens feature an activated functionality at the central, non-terminal hydroxyl group common to all HIV protease inhibitors, e.g., saquinavir, nelfinavir, indinavir, amprenavir, ritonavir and lopinavir.

Priority Data: US 19205202 20020710 A A; US 30519201 20010713 P A;

Related Application(s): 60/305192 20010713

IPC (International Class): C12N00999; C07K01400; C07D48714

ECLA (European Class): C07K01638

US Class: 435184; 530405; 540557

Assignments Reported to USPTO:

Reel/Frame: 13487/0601 **Date Signed:** 20020913 **Date Recorded:** 20021023
Assignee: ROCHE DIAGNOSTICS CORPORATION 9115 HAGUE ROAD INDIANAPOLIS INDIANA 46250-0457

Assignor: DERAS, INA

Corres. Addr: ROCHE DIAGNOSTICS CORPORATION MARILYN L. AMICK 9115 HAGUE ROAD, BLDG D P.O. BOX 50457 INDIANAPOLIS, IN 46250-0457
Brief: ASSIGNMENT OFASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 13488/0261 **Date Signed:** 20021014 **Date Recorded:** 20021106
Assignee: ROCHE DIAGNOSTICS CORPORATION 9115 HAGUE ROAD INDIANAPOLIS INDIANA 46250-0457

Assignor: ROCHE DIAGNOSTICS GMBH

Corres. Addr: ROCHE DIAGNOSTICS CORPORATION MARILYN L. AMICK 9115 HAGUE ROAD, BLDG D P.O. BOX 50457 INDIANAPOLIS, IN 46250-0457
Brief: ASSIGNMENT OFASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 13488/0279 **Date Signed:** 20020919 **Date Recorded:** 20021106
Assignee: ROCHE DIAGNOSTICS GMBH SANDHOFER STRASSE 116 MANNHEIM D-68298 GERMANY

Assignor: HUBER, ERASMUS J.

Corres. Addr: ROCHE DIAGNOSTICS CORPORATION MARILYN L. AMICK 9115 HAGUE ROAD, BLDG D P.O. BOX 50457 INDIANAPOLIS, IN 46250-0457
Brief: ASSIGNMENT OF ASSIGNORSINTEREST (SEE DOCUMENT FOR DETAILS) .

Reel/Frame: 15215/0061 **Date Signed:** 20040101 **Date Recorded:** 20040902
Assignee: ROCHE DIAGNOSTICS OPERATIONS, INC. 9115 HAGUE ROAD INDIANAPOLIS INDIANA 46250

Assignor: ROCHE DIAGNOSTICS CORPORATION

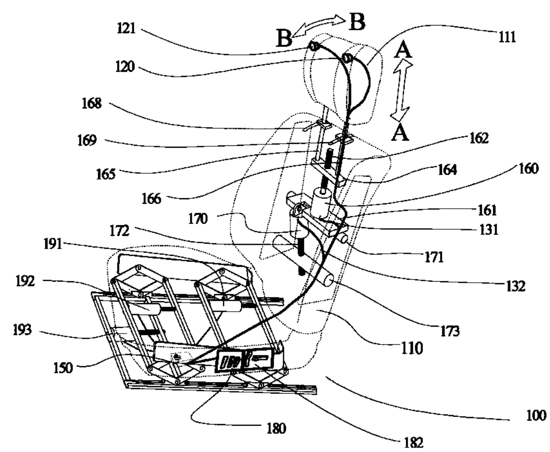
Corres. Addr: BRENT A. HARRIS 9115 HAGUE ROAD INDIANAPOLIS, INDIANA 46250
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20021023	()	AS	New owner name: ROCHE DIAGNOSTICS CORPORATION, INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:SIGLER, GERALD F.;HUI, RAYMOND A.;DERAS, INA;AND OTHERS;REEL/FRAME:013487/0601;SIGNING DATES FROM 20020912 TO 20020924;
20021106	()	AS	New owner name: ROCHE DIAGNOSTICS CORPORATION, INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ROCHE DIAGNOSTICS GMBH;REEL/FRAME:013488/0261; Effective date: 20021014;

20021106	()	AS	New owner name: ROCHE DIAGNOSTICS GMBH, GERMANY; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:HUBER, ERASMUS J.;VON DER ELTZ, HERBERT W.;METZ, SIGRUN;REEL/FRAME:013488/0279;SIGNING DATES FROM 20020919 TO 20020924;
20040902	()	AS	New owner name: ROCHE DIAGNOSTICS OPERATIONS, INC., INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ROCHE DIAGNOSTICS CORPORATION;REEL/FRAME:015215/0061; Effective date: 20040101;
20040902	()	AS	New owner name: ROCHE DIAGNOSTICS OPERATIONS, INC.,INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ROCHE DIAGNOSTICS CORPORATION;US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:15215/61; Effective date: 20040101;
20040902	()	AS	New owner name: ROCHE DIAGNOSTICS OPERATIONS, INC.,INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ROCHE DIAGNOSTICS CORPORATION;REEL/FRAME:15215/61; Effective date: 20040101;
20040902	()	AS	New owner name: ROCHE DIAGNOSTICS OPERATIONS, INC.,INDIANA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ROCHE DIAGNOSTICS CORPORATION;REEL/FRAME:015215/0061; Effective date: 20040101;

US6242701B1 20010605



(ENG) Apparatus and method for measuring weight of an occupying item of a seat

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; MORIN JEFFREY L US

Application No: US 19320998 A

Filing Date: 19981117

Issue/Publication Date: 20010605

Abstract: (ENG) An apparatus for measuring the weight of an occupying item of a seat including a support structure for mounting the seat to a substrate. The apparatus includes a strain gage transducer mounted on the support structure and arranged to provide a measurement of the strain of the support structure at the location at which it is mounted. A control system is coupled to the strain gage transducer for determining the weight of the occupying item of the seat based on the strain of the support structure measured by the strain gage transducer. The weight measuring apparatus is used in a seat adjustment apparatus for adjusting a seat in a passenger compartment of a vehicle including wave sensors for transmitting waves into the passenger compartment toward the seat, receiving reflected waves from the passenger compartment and generating an output representative of the reflected waves received by the

wave sensors, and a processor for receiving the outputs from the wave sensors and the weight measuring apparatus and evaluating the seated-state of the seat based thereon. The processor, e.g., directs a control unit to cause a portion of the seat to move based on the evaluation of the seated-state of the seat or to affect the deployment of an airbag.

Priority Data: US 19320998 19981117 A N; US 12849098 19980804 A 2 Y; US 97082297 19971114 A 2 Y; US 47478395 19950607 A 2 Y;

Related Application(s): 09/128490 19980804 6078854 US A GRANTED (PATENT) 08/970822 19971114 6081757 US A GRANTED (PATENT)<RDA continuation-in-part> 08/474783 19950607 5822707 US A GRANTED (PATENT)

IPC (International Class): G01S01588; B60N00206; B60N00202; G01S01587; G01G019414; B60N00200; B60N00228; B60N00248; B60R02101; B60R02120; B60R021276; B60R02220; B60R02246; B60R021015; B60R02126; B60R02228; G01S01506; B60R021203

ECLA (European Class): B60R021015; B60N00200C; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6C; B60N00202B6W; B60N00206S; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; G01G019414A; G01S01587; G01S01588

US Class: 177144; 177210R; 180273; 280735; 701045

Agent(s): Roffe Brian 0

Examiner Primary: Gibson, Randy W.

US Post Issuance:
--US Litigations: Automotive Technologies International Inc American Honda Motor Company Et A 20060317 Delaware 1:06cv187

Assignments Reported to USPTO:
Reel/Frame: 09846/0264 **Date Signed:** 19981126 **Date Recorded:** 19990325
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

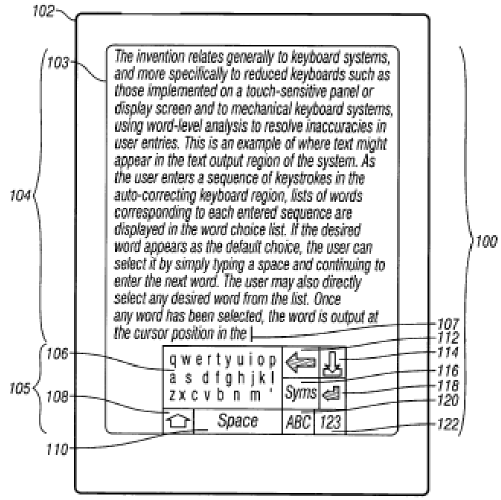
Assignor: BREED, DAVID S.; DUVALL, WILBUR E.; MORIN, JEFFREY L.

Corres. Addr: BRIAN ROFFE 376 YALE AVENUE WOODMERE, NY 11598-2051
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
19990325	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;DUVALL, WILBUR E.;MORIN, JEFFREY L.;REEL/FRAME:009846/0264;SIGNING DATES FROM 19981126 TO 19981206;
20041201	()	FPAY	Year of fee payment: 4;
20081130	()	FPAY	Year of fee payment: 8;

US7030863B2 20060418
US2005169527A1 20050804



(ENG) Virtual keyboard system with automatic correction

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; VAN MEURS PIM US

Application No: US 1951704 A

Filing Date: 20041220

Issue/Publication Date: 20060418

Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region. The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed or offered for selection, where the distance from each interaction location to each corresponding intended character may in general increase with the expected frequency of the intended word in the language or in a particular context. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations. Additionally, when the system cannot identify a sufficient number of likely word interpretation candidates of the same length as the input sequence, candidates are identified whose initial letters correspond to a likely interpretation of the input sequence.

Priority Data: US 1951704 20041220 A Y; US 58031900 20000526 A 2 N; US 53213103 20031222 P Y;

Related Application(s): 60/532131 20031222 US; 2003US-000621864 20030716 US; 09/580319 20000526 6801190 US

IPC (International Class): G09G00500; G06K00918; G06F01727; G06F003048; G06K00934; G06K00948; G06K00972

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

US Class: 345173; 345172; 715257

Publication Language: ENG

Filing Language: ENG

Agent(s): Glenn, Michael A.; Glenn Patent Group

Examiner Primary: Chow, Dennis Doon

US Post Issuance:
--US Certificate of Correction: 20100323 20100413 A Certificate of Correction was issued for this patent

Assignments Reported to USPTO:

Reel/Frame: 15926/0386 **Date Signed:** 20050401 **Date Recorded:** 20050421
Assignee: AMERICA ONLINE, INCORPORATED 22000 AOL WAY DULLES VIRGINIA 20166

Assignor: LONGE, MICHAEL R; VAN MEURS, PIM

Corres. Addr: GLENN PATENT GROUP 3475EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 18837/0141 **Date Signed:** 20060403 **Date Recorded:** 20070201
Assignee: AOL LLC 22000 AOL WAY DULLES VIRGINIA 20166

Assignor: AMERICAONLINE, INC.

Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE LMENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 18923/0517 **Date Signed:** 20060403 **Date Recorded:** 20070223
Assignee: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.) 22000AOL WAY DULLES VIRGINIA 20166

Assignor: AMERICA ONLINE, INC.

Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORSINTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 19425/0489 **Date Signed:** 20070605 **Date Recorded:** 20070613
Assignee: TEGIC COMMUNICATIONS, INC. 1000 DEXTER AVENUE N., SUITE 300 SEATTLE WASHINGTON 98109

Assignor: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE,INC AMERICA ONLINE,INC.)

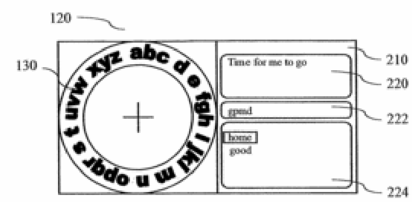
Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FORDETAILS).

Legal Status:

Date	**+/-**	**Code**	**Description**
20050421	( )	AS	ASSIGNMENT New owner name: AMERICA ONLINE, INCORPORATED, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:LONGE, MICHAEL R;VAN MEURS, PIM;REEL/FRAME:015926/0386;SIGNING DATES FROM 20050401 TO 20050407;
20050421	()	AS	New owner name: AMERICA ONLINE, INCORPORATED, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:LONGE, MICHAEL R;VAN MEURS, PIM;REEL/FRAME:015926/0386;SIGNING DATES FROM 20050401 TO 20050407;
20050421	()	AS	New owner name: AMERICA ONLINE, INCORPORATED, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:LONGE, MICHAEL R;VAN MEURS, PIM;REEL/FRAME:015926/0386;SIGNING DATES FROM 20050401 TO 20050407;
20070201	( )	AS	ASSIGNMENT New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;

20070201	()	AS	New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070223	( )	AS	ASSIGNMENT New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:18923/517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:18923/517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:18923/517; Effective date: 20060403;
20070613	( )	AS	ASSIGNMENT New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS

			INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20090922	()	FPAY	Year of fee payment: 4;
20100323	()	CC	



WO2004092906A3 20061026
WO2004092906A2 20041028

(ENG) DIRECTIONAL INPUT SYSTEM WITH AUTOMATIC CORRECTION

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; PALMER BRIAN US

Application No: US 2004011343 W

Filing Date: 20040409

Issue/Publication Date: 20061026

Abstract: (ENG) A system (100) associated with a text entry application, such as email or instant messaging, comprises an optional onscreen representation of a circular keyboard (130), a list of potential linguistic object matches (224), and a message (210) area where the selected words are entered. The circular keyboard is manipulated via a hardware joystick (110) or game-pad with analog joystick or omni-directional rocker switch built therein. The user points the joystick in the general direction of the desired letter, and then continues pointing roughly to each letter in the desired word. Once all letters have been roughly selected, buttons are used to select a specific word from the list of potential matches and send the selected word to the message area.

Priority Data: US 46173503 20030409 P Y; US 67789003 20031001 A Y;

IPC (International Class): G09G00508; G06F00300; G06F003033; G06F003023; G06F003048

ECLA (European Class): G06F003048A1M; G06F003023M6; G06F003023M8

Designated Countries:

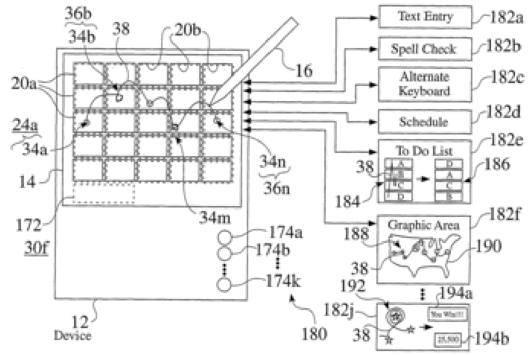
----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): GLENN, Michael, A. et al. Glenn Patent Group, 3475 Edison Way, Ste. L. , Menlo Park, CA 94025, US US

Legal Status: There is no Legal Status information available for this patent



WO2005036310A3 20071004
WO2005036310A2 20050421

(ENG) SELECTIVE INPUT SYSTEM BASED ON TRACKING OF MOTION PARAMETERS OF AN INPUT DEVICE

Assignee: AMERICA ONLINE INC US

Inventor(s): STEPHANICK JAMES US ; JAMES CHRISTINA US ; BRADFORD ETHAN R US ; LONGE MICHAEL R US

Application No: US 2004022916 W

Filing Date: 20040716

Issue/Publication Date: 20071004

Abstract: (ENG) A selective input system and associated method is provided which tracks the motion of a pointing device over a region or area. The pointing device can be a touchpad, a mouse, a pen, or any device capable of providing two or three-dimensional location. The region or area is preferably augmented with a printed or actual keyboard/pad. Alternatively, a representation of the location of the pointing device over a virtual keyboard/pad can be dynamically shown on an associated display. The system identifies selections of items or characters by detecting parameters of motion of the pointing device, such as length of motion, a change in direction, a change in velocity, and or a lack of motion at locations that correspond to features on the keyboard/pad. The input system is preferably coupled to a text disambiguation system such as a T9® or Sloppytype^{Tm} system, to improve the accuracy and usability of the input system.

Priority Data: US 50455203 20030919 P Y; US 67789003 20031001 A Y; US 88181904 20040628 A Y;

IPC (International Class): G09G00500; G06F003037; G06F003033; G06F003041; G06F003023; G06F003048

ECLA (European Class): G06F003048A3G; G06F003023M6; G06F003048A3T

Designated Countries:

----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW

----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM

----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PL PT RO SE SI SK TR

----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

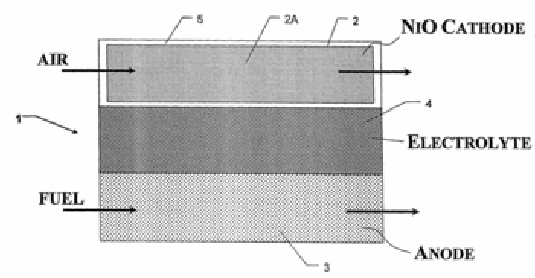
Publication Language: ENG

Filing Language: ENG

Agent(s): GLENN, Michael, A. et al. Glenn Patent Group, 3475 Edison Way, Ste. L., Menlo Park, CA 94025, US US

Legal Status: There is no Legal Status information available for this patent

WO2005069768A3 20070104
WO2005069768A8 20061019
WO2005069768A2 20050804



(ENG) MOLTEN CARBONATE FUEL CELL CATHODE WITH MIXED OXIDE COATING

Assignee: FUELCELL ENERGY INC US

Inventor(s): HILMI ABDELKADER US ; YUH CHAO-YI US

Application No: US 2004040099 W

Filing Date: 20041201

Issue/Publication Date: 20070104

Abstract: (ENG) A molten carbonate fuel cell cathode having a cathode body and a coating of a mixed oxygen ion conductor materials. The mixed oxygen ion conductor materials are formed from ceria or doped ceria, such as gadolinium doped ceria or yttrium doped ceria. The coating is deposited on the cathode body using a sol-gel process, which utilizes as precursors organometallic compounds, organic and inorganic salts, hydroxides and alkoxides and which uses as the solvent water, organic solvent or a mixture of same.

Priority Data: US 75548304 20040112 A Y;

IPC (International Class): H01M00810; H01M00486; B05D00512; H01M00490; H01M00496; H01M00488; H01M00814

ECLA (European Class): H01M00486B6; H01M00486K2; H01M00488F; H01M00490C; H01M00814B; H01M00814P

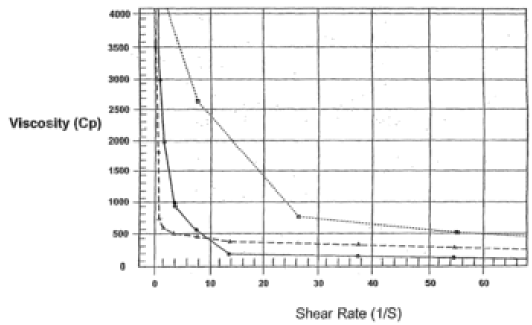
Designated Countries:
----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU MC NL PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): TORRENTE, John, J. Cowan, Liebowitz & Latman, P.C., 1133 Avenue of the Americas, New York, NY 10036, US US

Legal Status: There is no Legal Status information available for this patent



WO2005062934A3 20060202
WO2005062934A2 20050714

(ENG) METHOD AND COMPOSITION FOR CLEANING A FLUID DELIVERY SYSTEM

Assignee: GAGE PROD CO US

Inventor(s): MAXWELL JEFFREY US ; SUMMERFIELD STEPHEN US

Application No: US 2004043326 W

Filing Date: 20041222

Issue/Publication Date: 20060202

Abstract: (ENG) A composition for cleaning a fluid delivery system includes an agent which controls the rheology of the fluid so that its apparent viscosity decreases as the fluid is subjected to a shear force. In particular applications, the viscosity of the composition is greater than 600 centipoise when it is not subject to any shear and less than 600 centipoise when subject to a shear of at least 10 1/sec. The fluid may be thixotropic or a Bingham plastic, in some instances. In a specific embodiment, the viscosity of the composition is greater than 3000 centipoise when it is not subject to shear, less than 3000 centipoise at a shear of 10 1/sec, less than 1000 centipoise at a shear of 30 1/sec, and less than 600 centipoise at a shear of 60 1/sec. Also disclosed are methods for cleaning a fluid delivery system with these compositions.

Priority Data: US 53191403 20031222 P Y; US 1902004 20041221 A Y;

IPC (International Class): C11D00330; C11D00320; C11D00318; C11D00337; C11D01100; C11D01700

ECLA (European Class): C11D01700B6; C11D00318R; C11D00320C; C11D00320F; C11D00330; C11D00337C2; C11D01100B2D6

Designated Countries:

----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SM SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU MC NL PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

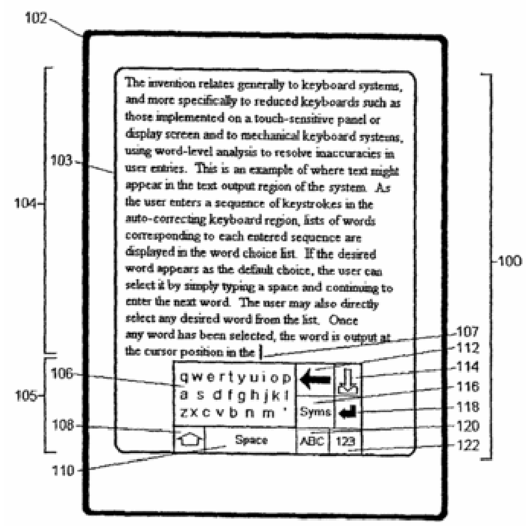
Publication Language: ENG

Filing Language: ENG

Agent(s): CITKOWSKI, Ronald, W. et al. Gifford, Krass, Groh, Sprinkle, Anderson & Citkowski, P.C., Suite 400, 280 N. Old Woodward, Birmingham, MI 48009-5394 US; CITKOWSKI, Ronald, W. et al. Gifford, Krass, Groh, Sprinkle, Anderson & Citkowski, P.C., Suite 400, 280 N. Old Woodward, Birmingham, MI 48009-5394 US

Legal Status: There is no Legal Status information available for this patent

WO2005064587A8 20070816
WO2005064587A3 20050915
WO2005064587A2 20050714



(ENG) VIRTUAL KEYBOARD SYSTEM WITH AUTOMATIC CORRECTION

Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; VAN MEURS PIM US

Application No: US 2004043329 W

Filing Date: 20041222

Issue/Publication Date: 20070816

Abstract: (ENG) An enhanced text entry system (100) which uses word-level analysis to correct inaccuracies automatically in user keystroke entries on reduced-size or virtual keyboards (105). A method and system determine alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting region (106). The actual interaction locations for the keystrokes may occur outside the boundaries of the specific keyboard key regions associated with the actual characters of the word interpretations proposed, where the distance from each interaction location to each corresponding intended character may increase with the expected frequency of the intended word in the language. Likewise, in a virtual keyboard system, the keys actuated may differ from the keys actually associated with the letters of the word interpretations. Each such sequence corresponds to a complete word, and the user can easily select the intended word from among the generated interpretations.

Priority Data: US 53213103 20031222 P Y; US 1951704 20041220 A Y;

IPC (International Class): G09G00500; G06K00918; G06F01727; G06F003048; G06K00934; G06K00948; G06K00972

ECLA (European Class): G06F003048A3; G06F003023M8; G06F003023P; G06F003048A3T; G06F003048K; G06F01727C; G06F01727P

Designated Countries:

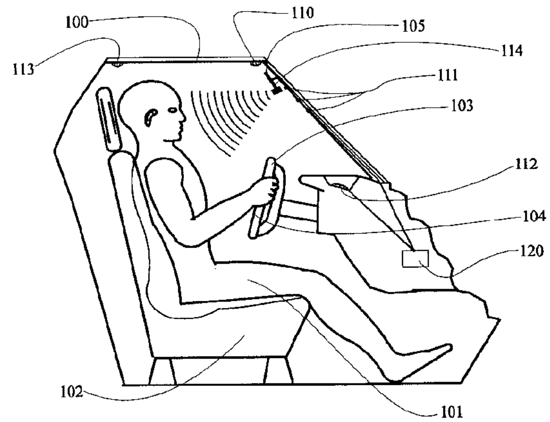
----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SM SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU MC NL PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): GLENN, Michael, A. et al. Glenn Patent Group, 3475 Edison Way, Ste. L., Menlo Park, CA 94025, US US

Legal Status: There is no Legal Status information available for this patent



US6141432A 20001031

(ENG) Optical identification and monitoring system using pattern recognition for use with vehicles

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 20061498 A

Filing Date: 19981130

Issue/Publication Date: 20001031

Abstract: (ENG) A vehicle interior monitoring system to identify, locate and monitor occupants, including their parts, and other objects in the passenger compartment and objects outside of a motor vehicle, such as an automobile or truck, by illuminating the contents of the vehicle and objects outside of the vehicle with electromagnetic, and specifically infrared, radiation and using one or more lenses to focus images of the contents onto one or more arrays of charge coupled devices (CCD arrays). Outputs from the CCD arrays, are analyzed by appropriate computational means employing trained pattern recognition technologies, to classify, identify or locate the contents or external objects. In general, the information obtained by the identification and monitoring system is used to affect the operation of some other system in the vehicle. When system is installed in the passenger compartment of an automotive vehicle equipped with an airbag, the system determines the position of the vehicle occupant relative to the airbag and disables deployment of the airbag if the occupant is positioned so that he/she is likely to be injured by the deployment of the airbag.

Priority Data: US 20061498 19981130 A N; US 47478695 19950607 A 1 Y; US 87857192 19920505 A C Y; US 4097893 19930331 A 2 Y; US 24776094 19940523 A 2 Y; US 23997894 19940509 A 2 Y;

Related Application(s): 08/474786 19950607 5845900 GRANTED; 07/878571 19920505 ABANDONED 08/040978 19930331 PENDING<RDA continuation-in-part> 08/247760 19940523 PENDING 08/239978 19940509 PENDING

IPC (International Class): B60N00228; B60N00202; G01S01588; G01S01788; B60N00200; G08G00116; B60N00248; G01S01587; G06K00900; B60R02101; B60R02220; B60R02126; B60R02248; B60R021015

ECLA (European Class): B60R021015; B60N00200C; B60N00202B4; B60N00202B6; B60N00202B6B; B60N00202B6W; B60N00228; B60N00228B2; B60N00228P4; B60N00248C2C; B60N00248C3C; B60N00248W; G01S01587; G01S01588; G01S01788; G06K00900H; G08G00116A; G08G00116A2; G08G00116B

US Class: 382100; 348143; 382103

Agent(s): Roffe Brian

Examiner Primary: Couso, Yon J.

US Post Issuance:

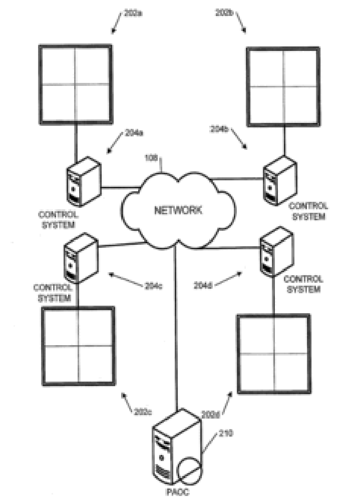
--US Certificate of Correction: 20010904 20010904 a Certificate of Correction was issued for this patent

Legal Status:

Date	+/-	Code	Description
20010904	( )	CC	CERTIFICATE OF CORRECTION
20040427	()	FPAY	Year of fee payment: 4;

20080416	()	FPAY	Year of fee payment: 8;

WO2007082204A3 20080103
WO2007082204A2 20070719



(ENG) ASSET PERFORMANCE OPTIMIZATION

Assignee: PRENOVA US

Inventor(s): CHAMBERS GREGORY L US ; VAN METER KENNETH US ; SMITH EDWARD M US ; GOLDEN PATRICK T US

Application No: US 2007060271 W

Filing Date: 20070109

Issue/Publication Date: 20080103

Abstract: (ENG) Included are embodiments for asset management. At least one embodiment of a method includes receiving, at a performance assessment and optimization center, data from at least one asset, the asset being configured to service an environment and performing at least one calculation, from the received data, to determine whether the asset is operating properly. Some embodiments include in response to a determination that the at least one asset is not operating properly, providing an indication related to operation of the asset.

Priority Data: US 75744606 20060109 P Y; US 61983807 20070104 A Y;

IPC (International Class): G06Q04000

ECLA (European Class): G05B01502; G06Q01000C

Designated Countries:
----Designated States: (national) AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LV LY MA MD MG MK MN MW MX MY MZ NA NG NI NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SK SL SM SV SY TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU LV MC NL PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): BONNER, Anthony, F. THOMAS, KAYDEN, HORSTEMEYER & RISLEY, LLP, 100 Galleria Parkway, N.W., Suite 1750, Atlanta, GA 30339, US US

Legal Status: There is no Legal Status information available for this patent

WO2009152421A1 20091217

(ENG) CRYSTALLINE POLYMORPHS OF GEMCITABINE BASE

[no drawing available]

Assignee: SCINOPHARM TAIWAN LTD

Inventor(s): CHEN SHU-PING ; SHIEH CHIA-LIN

Application No: US 2009047190 W

Filing Date: 20090612

Issue/Publication Date: 20091217

Abstract: (ENG) The present application provides several crystalline forms of gemcitabine base and methods of making the same.

Priority Data: US 13183508 20080612 P Y;

IPC (International Class): C07H019073; A61K031522

ECLA (European Class): C07H019073

Designated Countries:

----Designated States: (national) AE AG AL AM AO AT AU AZ BA BB BG BH BR BW BY BZ CA CH CL CN CO CR CU CZ DE DK DM DO DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LY MA MD ME MG MK MN MW MX MY MZ NA NG NI NO NZ OM PE PG PH PL PT RO RS RU SC SD SE SG SK SL SM ST SV SY TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW ::: (ARIPO) AP BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
----Regional Treaties: (EAPO) EA AM AZ BY KG KZ MD RU TJ TM
----EPO Extension States: (EPO) EP AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
----Elected States (PCT): (OAPI) OA BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

Publication Language: ENG

Filing Language: ENG

Agent(s): CHENG, Kent, H. Cohen Pontani Lieberman & Pavane LLP, 551 Fifth Avenue, New York, NY 10176, US US

Legal Status: There is no Legal Status information available for this patent

US2011234524A1 20110929

(ENG) Virtual Keyboard System with Automatic Correction

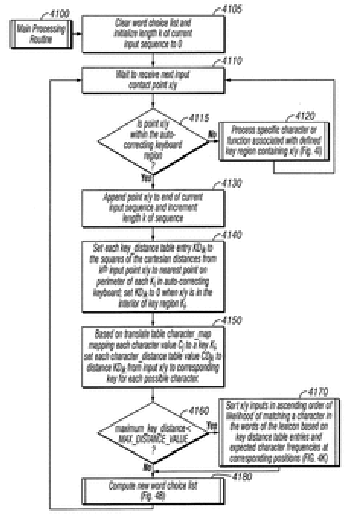
Assignee: LONGE MICHAEL R

Inventor(s): LONGE MICHAEL R US ; MEURS PIM VAN US

Application No: US 201113072499 A

Filing Date: 20110325

Issue/Publication Date: 20110929



Abstract: (ENG) There is disclosed an enhanced text entry system which uses word-level analysis to automatically correct inaccuracies in user keystroke entries on reduced keyboards such as those implemented on a touch-sensitive panel or display screen, or on mechanical keyboard systems. A method and system are defined which determine one or more alternate textual interpretations of each sequence of inputs detected within a designated auto-correcting keyboard region.

Priority Data: US 201113072499 20110325 A N; US 76568710 20100422 A 1 N; US 37900606 20060417 A B N; US 77548304 20040209 A 1 N; US 1951704 20041220 A 2 Y; US 53213103 20031222 P Y;

Related Application(s): 60/532131 20031222 US; 12/765687 20100422 7920132 US; 11/379006 20060417 US ABANDONED; 10/775483 20040209 7088345 US; 11/019517 20041220 7030863 US

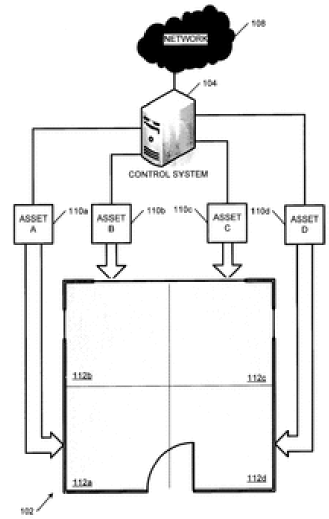
IPC (International Class): G06F003041; G09G00500; G06F01727; G06F003048; G06K00972; G06K00918; G06K00934; G06K00948

US Class: 345173

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent

US8094005B2 20120110
US2011193720A1 20110811



(ENG) Asset performance optimization

Assignee: PRENOVA INC US

Inventor(s): CHAMBERS GREGORY L US ; VAN METER KENNETH US ; SMITH EDWARD M US ; GOLDEN PATRICK T US

Application No: US 201113088815 A

Filing Date: 20110418

Issue/Publication Date: 20120110

Abstract: (ENG) Included are embodiments for asset management. At least one embodiment of a method includes receiving, at a performance assessment and optimization center, data from at least one asset, the asset being configured to service an environment and performing at least one calculation, from the received data, to determine whether the asset is operating properly. Some embodiments include in response to a determination that the at least one asset is not operating properly, providing an indication related to operation of the asset.

Priority Data: US 201113088815 20110418 A N; US 69776010 20100201 A 1 N; US 61983807 20070104 A 1 Y; US 75744606 20060109 P Y;

Related Application(s): 13/088815 20110418 20110193720 US; 60/757446 20060109 US; 12/697760 20100201 7928839 US; 11/619838 20070104 7659813 US

IPC (International Class): G08B02100

US Class: 340500; 340540; 34053924

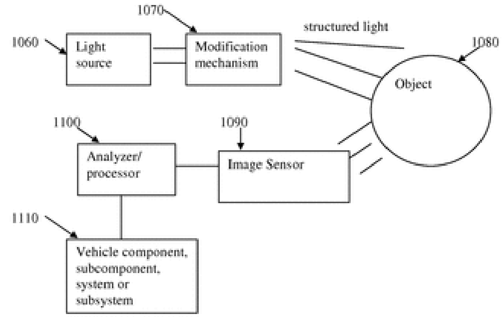
Publication Language: ENG

Filing Language: ENG

Agent(s): Thomas, Kayden, Horstemeyer & Risley, LLP

Examiner Primary: Hofsass, Jeffery

Legal Status: There is no Legal Status information available for this patent



US2011285982A1 20111124

(ENG) METHOD AND ARRANGEMENT FOR OBTAINING INFORMATION ABOUT OBJECTS AROUND A VEHICLE

Assignee: BREED DAVID S

Inventor(s): BREED DAVID S US

Application No: US 201113185770 A

Filing Date: 20110719

Issue/Publication Date: 20111124

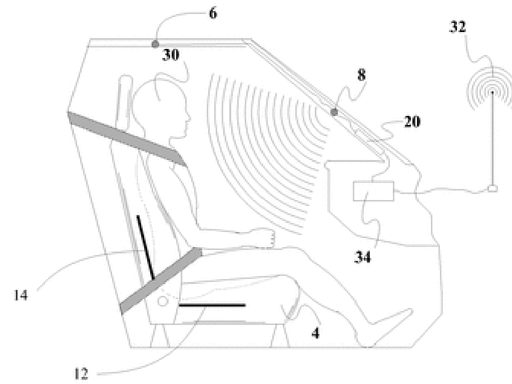
Abstract: (ENG) Arrangement and method for obtaining information about objects exterior of a vehicle in which a light source is mounted in the vehicle, structured light is projected into an area of interest exterior of the vehicle, rays of light forming the structured light originate from the light source, reflected light is detected at an image sensor at a position different than the position from which the structured light is projected, and the reflected light is analyzed relative to the projected structured light to obtain information about the object in the area of interest exterior of the vehicle. The structured light is designed to appear as if it comes from a source of light (virtual or actual) which is at a position different than the position of the image sensor.

Priority Data: US 201113185770 20110719 A N; US 2550105 20050103 A 3 N; US 11680802 20020405 A 2 Y; US 83891901 20010420 A 2 Y; US 76555901 20010119 A 2 Y; US 47625599 19991230 A 2 Y; US 38994799 19990903 A 2 Y; US 20061498 19981130 A 2 Y; US 47478695 19950607 A 1 Y; US 92504301 20010808 A 2 Y; US 41342603 20030414 A 2 Y; US 30210502 20021122 A 2 Y; US 93128804 20040831 A 2 Y; US 94088104 20040913 A 2 Y; US 11450798 19981231 P Y;

IPC (International Class): G01C00308; G01J00400; G01B01114; B60N00228; B60N00202; G06K00900; G01S01587; B60N00200; G01S01788; B60Q00114; G01S01588; B60R02101; B60R02220; B60R021015; B60R0210134

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent



US2012001463A1 20120105

(ENG) ARRANGEMENT FOR SENSING WEIGHT OF AN OCCUPYING ITEM IN A VEHICULAR SEAT

Assignee: BREED DAVID S

Inventor(s): BREED DAVID S US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: US 201113229788 A

Filing Date: 20110912

Issue/Publication Date: 20120105

Abstract: (ENG) In or for a vehicle, an arrangement for measuring weight of an occupant of a seat connected to a floor of the vehicle via a slide mechanism, the floor, in part, defining a passenger compartment of the vehicle. A support structure extends between the slide mechanism and the seat. A force sensing device is coupled to the support structure and configured for measuring force in the support structure indicative of weight applied by the occupant to the seat. The weight may be used for component control.

Priority Data: US 201113229788 20110912 A N; US 56056906 20061116 A 3 N; US 41342603 20030414 A 2 Y; US 84955901 20010504 A 2 Y; US 19320998 19981117 A 2 Y; US 12849098 19980804 A 2 Y; US 47478395 19950607 A 2 Y; US 97082297 19971114 A 2 Y; US 90187901 20010709 A 2 Y; US 6101602 20020130 A 2 Y; US 22778102 20020826 A 2 Y; US 50034600 20000208 A 2 Y; US 73395703 20031211 A 2 Y; US 93128804 20040831 A 2 Y; US 30336402 20021125 A 2 Y; US 17480302 20020619 A 2 Y; US 84955801 20010504 A 2 Y; US 94088104 20040913 A 2 Y; US 27897906 20060407 A 2 Y; US 42029706 20060525 A 2 Y; US 42352106 20060612 A 2 Y; US 42843606 20060703 A 2 Y; US 45687906 20060712 A 2 Y; US 45790406 20060717 A C Y; US 47071506 20060907 A 2 Y;

Related Application(s): 11/560569 20061116 US PENDING; 10/413426 20030414 7415126 US; 09/849559 20010504 6689962 US; 09/193209 19981117 6242701 US; 09/128490 19980804 6078854 US; 08/474783 19950607 5822707 US; 08/970822 19971114 6081757 US; 09/901879 20010709 6555766 US; 10/061016 20020130 6833516 US; 10/227781 20020826 6792342 US; 09/500346 20000208 6442504 US; 09/128490 19980804 6078854 US; 10/733957 20031211 7243945 US; 09/849559 20010504 6689962 US; 10/061016 20020130 6833516 US; 10/227781 20020826 6792342 US; 10/931288 20040831 7164117 US; 10/303364 20021125 6784379 US; 10/174803 20020619 6958451 US; 09/500346 20000208 6442504 US; 09/849558 20010504 6653577 US; 09/193209 19981117 6242701 US; 09/849559 20010504 6689962 US; 09/901879 20010709 6555766 US; 10/940881 20040913 7663502 US; 10/061016 20020130 6833516 US; 10/174803 20020619 6958451 US; 10/227781 20020826 6792342 US; 11/278979 20060407 7386372 US; 11/420297 20060525 7330784 US; 11/423521 20060612 7523803 US; 11/428436 20060703 7860626 US; 11/456879 20060712 7575248 US; 11/457904 20060717 US ABANDONED; 11/470715 20060907 7762582 US

IPC (International Class): B60N00244; G01G01908; B60R02116; G06F01900

ECLA (European Class): B60N00200C

US Class: 2972172; 701036; 701045; 177136

Publication Language: ENG

Filing Language: ENG

Assignments Reported to USPTO:

Reel/Frame: 26972/0211 **Date Signed:** 20110830 **Date Recorded:** 20110927

Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S; JOHNSON, WENDELL C; DUVALL, WILBUR E

Corres. Addr: BRIANROFFE, ESQ 8170 MCCORMICK BOULEVARD, SUITE 223 SKOKIE, IL 60076-2914

Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FORDETAILS).

Legal Status:

Date	+/-	Code	Description
20110927	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL, INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S;JOHNSON, WENDELL C;DUVALL, WILBUR E;SIGNING DATES FROM 20110830 TO 20110911;REEL/FRAME:026972/0211;

US6970599B2 20051129
US2004017946A1 20040129

(ENG) Chinese character handwriting recognition system

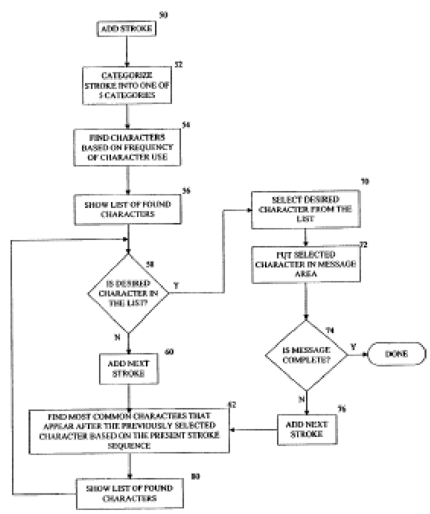
Assignee: AMERICA ONLINE INC US

Inventor(s): LONGE MICHAEL R US ; PALMER BRIAN US

Application No: US 20595002 A

Filing Date: 20020725

Issue/Publication Date: 20051129



Abstract: (ENG) A handwritten Chinese character input method and system is provided to allow users to enter Chinese characters to a data processor by adding less than three strokes and one selection movement such as mouse clicking or stylus or finger tapping. The system is interactive, predictive, and intuitive to use. By adding one or two strokes which are used to start writing a Chinese character, or in some case even no strokes are needed, users can find a desired character from a list of characters. The list is context sensitive. It varies depending on the prior character entered. Compared to other existing systems, this system can save users considerable time and efforts to entering handwritten characters.

Priority Data: US 20595002 20020725 A Y;

IPC (International Class): G06F003033; G06F00301; G06F00300; G06F003048; G06K00922

ECLA (European Class): G06F00301M; G06F003048A3G; G06K00922H

US Class: 382185

Publication Language: ENG

Filing Language: ENG

Agent(s): Glenn, Michael A.; Glenn Patent Group

Examiner Primary: Johns, Andrew W.

Examiner Assistant: Nakhjavan, Shervin

Assignments Reported to USPTO:

Reel/Frame: 13159/0894 **Date Signed:** 20020722 **Date Recorded:** 20020725
Assignee: AMERICA ONLINE, INC. 22000 AOL WAY DULLES VIRGINIA 20166

Assignor: LONGE, MICHAEL R.; PALMER, BRIAN

Corres. Addr: GLENN PATENT GROUP KIRK D. WONG3475 EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 18837/0141 **Date Signed:** 20060403 **Date Recorded:** 20070201
Assignee: AOL LLC 22000 AOL WAY DULLES VIRGINIA 20166

Assignor: AMERICAONLINE, INC.

Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE LMENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 18923/0517 **Date Signed:** 20060403 **Date Recorded:** 20070223
Assignee: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.) 22000AOL WAY DULLES VIRGINIA 20166

Assignor: AMERICA ONLINE, INC.

Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORSINTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 19425/0489 **Date Signed:** 20070605 **Date Recorded:** 20070613
Assignee: TEGIC COMMUNICATIONS, INC. 1000 DEXTER AVENUE N., SUITE 300 SEATTLE WASHINGTON 98109

Assignor: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE,INC AMERICA ONLINE,INC.)

Corres. Addr: GLENN PATENT GROUP 3475 EDISON WAY, SUITE L MENLO PARK, CA 94025
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FORDETAILS).

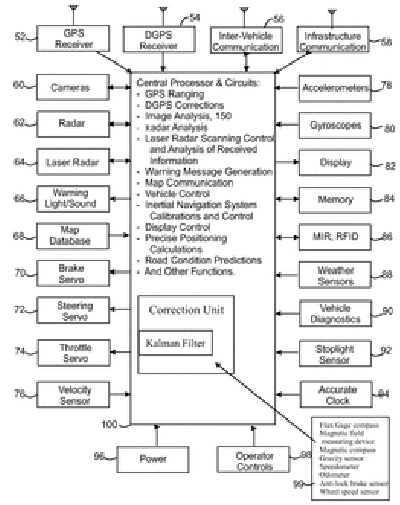
Legal Status:

Date	+/-	Code	Description
20020725	()	AS	New owner name: AMERICA ONLINE, INC., VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:LONGE, MICHAEL R.;PALMER, BRIAN;REEL/FRAME:013159/0894; Effective date: 20020722;
20070201	( )	AS	ASSIGNMENT New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;

20070201	()	AS	New owner name: AOL LLC, VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:18837/141; Effective date: 20060403;
20070201	()	AS	New owner name: AOL LLC,VIRGINIA; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018837/0141; Effective date: 20060403;
20070223	( )	AS	ASSIGNMENT New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:018923/0517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:18923/517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:18923/517; Effective date: 20060403;
20070223	()	AS	New owner name: AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FOR; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AMERICA ONLINE, INC.;REEL/FRAME:18923/517; Effective date: 20060403;
20070613	( )	AS	ASSIGNMENT New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;

20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC., WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);US-ASSIGNMENT DATABASE UPDATED:20100316;REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);US-ASSIGNMENT DATABASE UPDATED:20100504;REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:19425/489; Effective date: 20070605;
20070613	()	AS	New owner name: TEGIC COMMUNICATIONS, INC.,WASHINGTON; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:AOL LLC, A DELAWARE LIMITED LIABILITY COMPANY (FORMERLY KNOWN AS AMERICA ONLINE, INC.);REEL/FRAME:019425/0489; Effective date: 20070605;
[illegible]	()	[illegible]	Effective date: 20091129;

US7962285B2 20110614
US2008154495A1 20080626



(ENG) Inertial measurement unit for aircraft

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US

Application No: US 2065208 A

Filing Date: 20080128

Issue/Publication Date: 20110614

Abstract: (ENG) System for determining position of a vehicle includes an integral inertial measurement unit (IMU) including accelerometers and gyroscopes for providing raw data about movement of the vehicle and a correction unit coupled to the IMU and arranged to receive and/or derive positional corrections and the raw data from the IMU and generate accurate positional information about the vehicle based on the raw data and positional corrections. A navigation system is coupled to the correction unit and receives and acts upon the positional information of the vehicle provided by the correction unit. The IMU may be a MEMS-packaged IMU and integrated with the correction unit in combination with one another. A map database may be coupled to the navigation system which would receive information about a travel lane the vehicle is travelling on and could guide an operator of the vehicle based on the accurate positional information and travel lane information.

Priority Data: US 2065208 20080128 A N; US 46161906 20060801 A 2 Y; US 82244504 20040412 A 2 Y; US 11885802 20020409 A 2 Y; US 17704198 19981022 A 2 Y; US 67931700 20001004 A 2 Y; US 52355900 20000310 A C Y; US 90946601 20010719 A 2 Y; US 21663302 20020809 A 2 Y; US 2838605 20050103 A 2 Y; US 3432505 20050112 A 2 Y; US 46438506 20060814 A 2 Y; US 87441807 20071018 A 2 Y; US 56273006 20061122 A 2 Y; US 68181707 20070305 A 2 Y; US 77812707 20070716 A 2 Y; US 30450205 20051215 A 2 Y; US 71145205 20050825 P Y; US 6272997 19971022 P Y; US 12388299 19990311 P Y; US 63657404 20041216 P Y;

Related Application(s): 12/020652 20080128 20080154495 US; 60/711452 20050825 US; 60/636574 20041216 US; 11/461619 20060801 7418346 US; 10/822445 20040412 7085637 US; 10/118858 20020409 6720920 US; 09/177041 19981022 6370475 US; 09/679317 20001004 6405132 US; 09/523559 20000310 US ABANDONED; 09/909466 20010719 6526352 US; 10/216633 20020809 6768944 US; 11/028386 20050103 7110880 US; 10/822445 20040412 7085637 US; 11/034325 20050112 7202776 US; 10/822445 20040412 7085637 US; 12/020652 20080128 US PENDING; 11/464385 20060814 7629899 US; 11/034325 20050112 7202776 US; 11/028386 20050103 7110880 US; 12/020652 20080128 US PENDING; 11/874418 20071018 7610146 US; 11/562730 20061122 7295925 US; 12/020652 20080128 US PENDING; 11/681817 20070305 7426437 US; 11/034325 20050112 7202776 US; 12/020652 20080128 US PENDING; 11/778127 20070716 7912645 US; 11/304502 20051215 7324039 US; 11/034325 20050112 7202776 US

IPC (International Class): G01C02116; G06F01900; G01C02128

US Class: 701216; 701221

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Zanelli, Michael J.

Assignments Reported to USPTO:

Reel/Frame: 26192/0744 **Date Signed:** 20080127 **Date Recorded:** 20110428
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

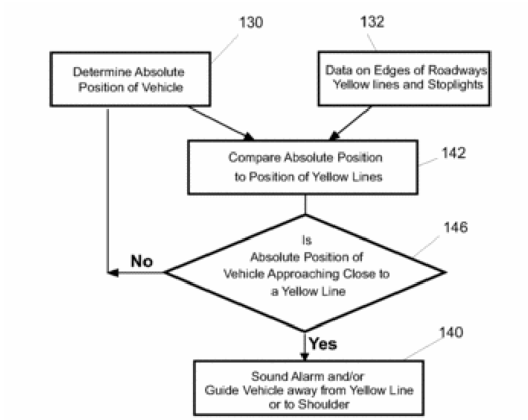
Assignor: BREED, DAVID S

Corres. Addr: BRIANROFFE 8170 MCCORMICK BOULEVARD, SUITE 223 SKOKIE, IL 60076-2914
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20110428	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S;REEL/FRAME:026192/0744; Effective date: 20080127;

US2009030605A1 20090129



(ENG) Positioning System

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US

Application No: US 2066208 A

Filing Date: 20080128

Issue/Publication Date: 20090129

Abstract: (ENG) System for determining accurate position of an object such as a vehicle includes a GPS positioning system arranged to communicate with one or more satellites to obtain GPS signals therefrom, a correction unit coupled to the positioning system and arranged to receive or derive positional corrections for positional data derived from the GPS signals to thereby improve accuracy of the position of the object provided by the positioning system, and a notification system for notifying a person concerned with the position of the object about the current position of the object. The correction unit may be a DGPS-based correction unit arranged to communicate with satellites to receive positional corrections therefrom and/or communicate with ground base stations to receive positional corrections therefrom.

Priority Data: US 2066208 20080128 A N; US 46161906 20060801 A 1 Y; US 82244504 20040412 A 2 N; US 11885802 20020409 A 2 N; US 17704198 19981022 A 2 N; US 67931700 20001004 A 2 N; US 52355900 20000310 A C N; US 90946601 20010719 A 2 N; US 21663302 20020809 A 2 N; US 2838605 20050103 A 2 N; US 3432505 20050112 A 2 N; US 46438506 20060814 A 2 N; US 87441807 20071018 A 2 N; US 56273006 20061122 A 2 N; US 68181707 20070305 A 2 N; US 77812707 20070716 A 2 N; US 30450205 20051215 A 2 N; US 71145205 20050825 P N; US 6272997 19971022 P N; US 12388299 19990311 P N; US 63657404 20041216 P N;

IPC (International Class): G01C02136

Publication Language: ENG

Legal Status: There is no Legal Status information available for this patent

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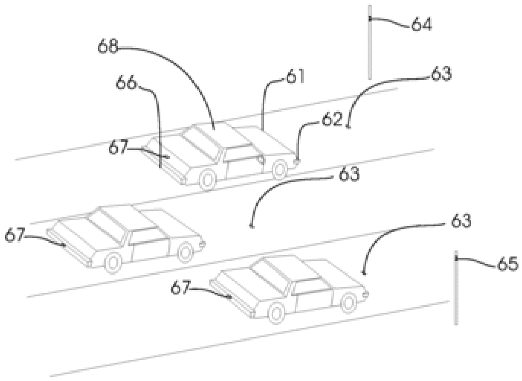


US2008119966A1 20080522

(ENG) Wireless Sensing and Communication System for Traffic Lanes

Assignee: BREED DAVID S

Inventor(s): BREED DAVID S US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: US 2068408 A

Filing Date: 20080128

Issue/Publication Date: 20080522

Abstract: (ENG) Wireless sensing and communication system including sensors located on the vehicle, in the roadway or in the vicinity of the vehicle or roadway and which provide information which is transmitted to one or more interrogators in the vehicle by a wireless radio frequency mechanism. Power to operate a particular sensor is supplied by the interrogator or the sensor is independently connected to either a battery, generator, vehicle power source or some source of power external to the vehicle. The sensors can provide information about the vehicle and its interior or exterior environment, about individual components, systems, vehicle occupants, subsystems, or about the roadway, ambient atmosphere, travel conditions and external objects. The sensors arranged on the roadway or ancillary structures would include pressure sensors, temperature sensors, moisture content or humidity sensors, and friction sensors.

Priority Data: US 2068408 20080128 A N; US 8273905 20050317 A 2 Y; US 70136103 20031104 A 2 Y; US 7906502 20020219 A 2 Y; US 76555801 20010119 A 2 Y; US 94088104 20040913 A 2 Y; US 61345303 20030703 A 2 Y; US 18867302 20020703 A 1 Y; US 26941501 20010216 P Y; US 29151101 20010516 P Y; US 30401301 20010709 P Y; US 23137800 20000908 P Y;

Related Application(s): 60-269415 20010216 US; 60-291511 20010516 US; 60-304013 20010709 US; 60/231378 20000908 US; 11/082739 20050317 US PENDING; 10/701361 20031104 6988026 US GRANTED; 10/079065 20020219 6662642 US GRANTED; 09/765558 20010119 6748797 US GRANTED; 10/940881 20040913 US PENDING; 10/613453 20030703 6850824 US GRANTED; 10/188673 20020703 6738697 US GRANTED; 10/079065 20020219 6662642 US GRANTED

IPC (International Class): G06F01700

ECLA (European Class): G08G0010967C2; G07C00500T; G07C00508R2; G08G0010967A1; G08G0010967B3

US Class: 701002

Publication Language: ENG

Filing Language: ENG

Assignments Reported to USPTO:
Reel/Frame: 21032/0187 **Date Signed:** 20080109 **Date Recorded:** 20080602

Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

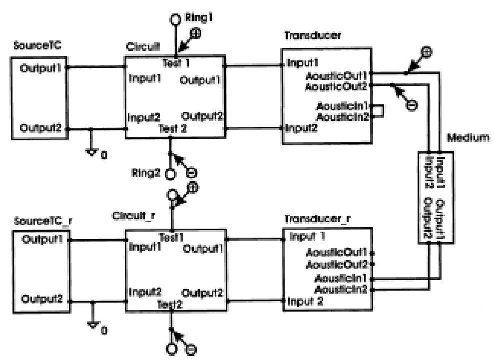
Assignor: BREED, DAVID S.; JOHNSON, WENDELL C.; DUVALL, WILBUR E.

Corres. Addr: BRIAN ROFFE ITI-050 11 SUNRISE PLAZA, SUITE 303 VALLEY STREAM, NY 11580
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20080602	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S.;JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:021032/0187;SIGNING DATES FROM 20080109 TO 20080118;

US6731569B2 20040504
US2003039173A1 20030227



(ENG) Methods for reducing ringing of ultrasonic transducers

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): YURCHENKO OLEKSANDR V UA ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: US 20852202 A

Filing Date: 20020730

Issue/Publication Date: 20040504

Abstract: (ENG) Methods for reducing ringing of dual-function ultrasonic air-coupled transducers in which at least one electrical passive circuit is applied to the transducer. The circuit may be either a linear circuit or a non-linear circuit. Different circuits can be applied to the transducer when the transducer is in a transmission mode than when the transducer is in a reception mode.

Priority Data: US 20852202 20020730 A I; US 10028202 20020318 A I; US 27646101 20010316 P I;

Related Application(s): 60/276461 20010316 00; 10/100282 20020318 ABANDONED

IPC (International Class): G01S01500

ECLA (European Class): B06B00102D2

US Class: 367138; 367903

Agent(s): Roffe Brian

Examiner Primary: Pihulic, Daniel T.

Assignments Reported to USPTO:

Reel/Frame: 13164/0259 **Date Signed:** 20020725 **Date Recorded:** 20020730
Assignee: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DANVILLE NEW JERSEY 07834

Assignor: DUVALL, WILBUR; JOHNSON, WENDELL C.; YURCHENKO, OLEKSANDR V.

Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVENUE WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020730	( )	AS	ASSIGNMENT New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:YURCHENKO, OLEKSANDR V. /AR;REEL/FRAME:013164/0259;SIGNING DATES FROM 20020725 TO 20020729;
20020730	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC., NEW JE; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:YURCHENKO, OLEKSANDR V.;DUVALL, WILBUR;JOHNSON, WENDELL C.;REEL/FRAME:013164/0259;SIGNING DATES FROM 20020725 TO 20020729;
20020730	()	AS	New owner name: AUTOMOTIVE TECHNOLOGIES INTERNATIONAL INC. P.O. BO; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:YURCHENKO, OLEKSANDR V. /AR;REEL/FRAME:013164/0259;SIGNING DATES FROM 20020725 TO 20020729;
[illegible]	()	REM FPAY	Year of fee payment: 4;
20080505	()	SULP	

US7840355B2 20101123
US2009033540A1 20090205

(ENG) Accident avoidance systems and methods

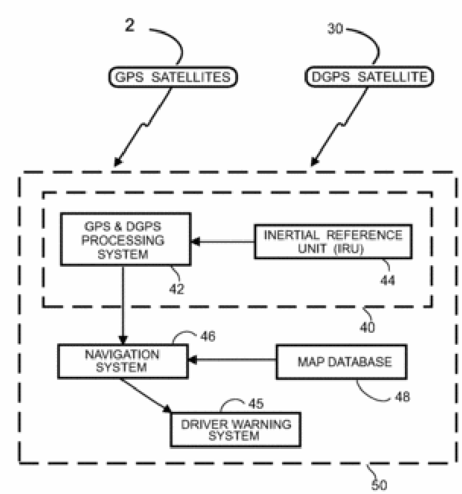
Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 20877108 A

Filing Date: 20080911

Issue/Publication Date: 20101123



Abstract: (ENG) Accident avoidance system for a host vehicle includes a global positioning system residing on the host vehicle for determining the host vehicle's location as the host vehicle travels, a communication system residing on the host vehicle operative to receive signals including information received directly from other vehicles indicating the locations thereof and traffic information received from an infrastructure-based station indicating the locations of other vehicles, and a navigation system residing on the host vehicle coupled to the global positioning system and the communication system. The navigation system displays images representing a vicinity associated with the host vehicle and showing indications of the locations of the other vehicles within the vicinity derived from the information received directly from the other vehicles and the traffic information received from the infrastructure-based station to thereby reduce the likelihood of a collision occurring between the host vehicle and the other vehicles.

Priority Data: US 20877108 20080911 A N; US 68181707 20070305 A 1 N; US 3432505 20050112 A 2 N; US 82244504 20040412 A 2 N; US 11885802 20020409 A 2 N; US 17704198 19981022 A 2 Y; US 67931700 20001004 A 2 N; US 52355900 20000310 A C Y; US 90946601 20010719 A 2 Y; US 21663302 20020809 A 2 N; US 46161906 20060801 A 2 Y; US 2838605 20050103 A 2 N; US 46438506 20060814 A 2 N; US 6272997 19971022 P Y; US 12388299 19990311 P Y; US 71145205 20050825 P Y;

Related Application(s): 12/208771 20080911 20090033540 US; 60/062729 19971022 US; 60123,882 19990311 US; 60/711452 20050825 US; 11/681817 20070305 7426437 US; 11/034325 20050112 7202776 US; 10/822445 20040412 7085637 US; 10/118858 20020409 6720920 US; 09/679317 20001004 6405132 US; 09/523559 20000310 US ABANDONED; 09/177041 19981022 6370475 US; 09/909466 20010719 6526352 US; 10/216633 20020809 6768944 US; 12/208771 20080911 US PENDING; 11/461619 20060801 7418346 US; 10/822445 20040412 7085637 US; 11/028386 20050103 7110880 US; 12/208771 20080911 US PENDING; 11/464385 20060814 7629899 US

IPC (International Class): G08G001137; G06F01700; G01S01948; G01C02126

ECLA (European Class): G08G00116; B60W03008; B60W03016; G01C02126; G01S00100S2C1; G01S00514S1B2B; G01S01393C; G01S01702C; G01S01793C; G01S01914; G01S01947; G06K00900V6

US Class: 701301; 701213; 701117; 701120; 3409951

Publication Language: ENG

Filing Language: ENG

Agent(s): Roffe, Brian

Examiner Primary: Zanelli, Michael J.

Assignments Reported to USPTO:

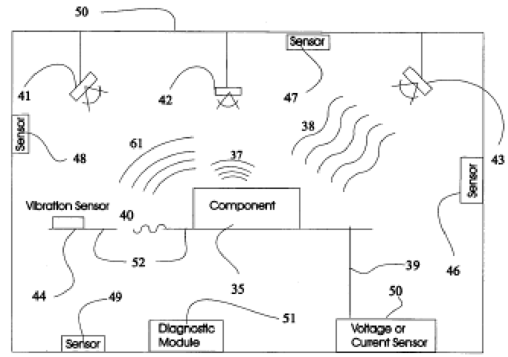
Reel/Frame: 25020/0050 **Date Signed:** 20070228 **Date Recorded:** 20100921
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S; DUVALL, WILBUR E; JOHNSON, WENDELL C

Corres. Addr: BRIANROFFE 8170 MCCORMICK BOULEVARD, SUITE 223 SKOKIE, IL 60076-2959
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20100921	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:BREED, DAVID S;DUVALL, WILBUR E;JOHNSON, WENDELL C;REEL/FRAME:025020/0050; Effective date: 20070228;



US7089099B2 20060808
US2006025897A1 20060202

(ENG) Sensor assemblies

Assignee: AUTOMOTIVE TECH INT US

Inventor(s): SHOSTAK OLEKSANDR T UA ; KOLOMEYKO ANATOLIY V UA ; BREED DAVID S US ; DUVALL WILBUR E US ; JOHNSON WENDELL C US

Application No: US 20886905 A

Filing Date: 20050822

Issue/Publication Date: 20060808

Abstract: (ENG) Sensor assembly capable of obtaining and providing a measurement of a physical quantity, e.g., measurement of temperature and/or pressure of a vehicular tire, includes an antenna capable of receiving a radio frequency signal, a radio frequency identification (RFID) device coupled to the antenna, a sensor coupled to the RFID device arranged to generate a measurement of the physical quantity or quantities, and a switch coupled to the RFID device and arranged to connect or disconnect the sensor from a circuit with the antenna dependent on whether the antenna receives a particular signal associated with the RFID device. When the antenna receives the particular signal associated with the RFID device, the RFID device causes the switch to close and connect the sensor in the circuit with the antenna to enable the measurement generated by the sensor to be directed to and transmitted by the antenna.

Priority Data: US 20886905 20050822 A N; US 12006505 20050502 A 3 Y; US 59283804 20040730 P Y;

Related Application(s): 60/592838 20040730 00; 11/208869 11/120065 20050502 PENDING

IPC (International Class): G06F00700

ECLA (European Class): G08G001017; B60C02300D; B60C02304C; B60R021013; G08G00116B

US Class: 701032; 701033; 701036

Publication Language: ENG

Agent(s): Roffe Brian

Examiner Primary: Beaulieu, Yonel

Legal Status:

Date	+/-	Code	Description
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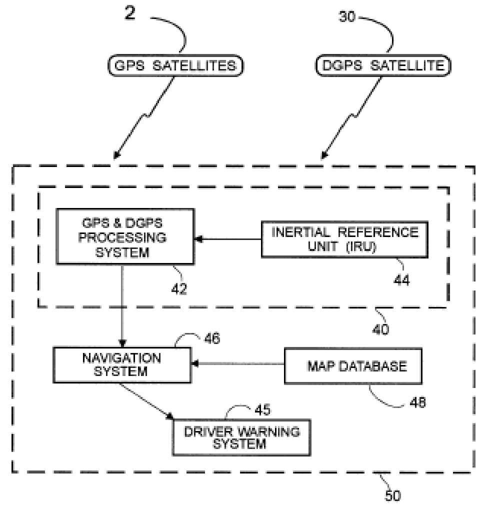

US6768944B2 20040727
US2003191568A1 20031009

(ENG) Method and system for controlling a vehicle

Assignee: INTELLIGENT TECH INT INC US

Inventor(s): BREED DAVID S US ; JOHNSON WENDELL C US ; DUVALL WILBUR E US

Application No: US 21663302 A

Filing Date: 20020809

Issue/Publication Date: 20040727

Abstract: (ENG) Control system and method for controlling a vehicle or a component of a vehicle in which an inertial reference unit includes accelerometers and gyroscopes which provide data on vehicle motion and a processor processes the data and controls the vehicle or the component of the vehicle based thereon. Movement of the vehicle may be controlled via control over servos, such as a servo associated with the braking system, a servo associated with the drive train or throttle and a servo associated with the steering system. A display to the driver can also be controlled by the processor to provide data on vehicle motion or data or information derived from the data on vehicle motion. Optionally, a Kalman filter is coupled to the processor for optimizing the data on vehicle motion from the inertial reference unit.

Priority Data: US 21663302 20020809 A N; US 11885802 20020409 A 2 Y;

Related Application(s): 10/118858 20020409 PENDING

IPC (International Class): G01C02300; B60W04006; G06F01900; B60W03008

US Class: 701301; 213036

Agent(s): Roffe Brian

Examiner Primary: Zanelli, Michael J.

Assignments Reported to USPTO:

Reel/Frame: 13215/0194 **Date Signed:** 20020808 **Date Recorded:** 20020809
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: BREED, DAVID S.

Corres. Addr: BRIAN ROFFE, ESQ. 366 LONGACRE AVE. WOODMERE, NY 11598-2417
Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Reel/Frame: 14812/0102 **Date Signed:** 20031204 **Date Recorded:** 20031216
Assignee: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O. BOX 8 DENVILLE NEW JERSEY 07834

Assignor: DUVALL, WILBUR E.; JOHNSON, WENDELL C.

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Brief: ASSIGNMENT OF ASSIGNORS INTEREST (SEEDOCUMENT FOR DETAILS).

Legal Status:

Date	+/-	Code	Description
20020809	( )	AS	ASSIGNMENT New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013215/0194; Effective date: 20020808;
20020809	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL INC., NEW J; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S.;REEL/FRAME:013215/0194; Effective date: 20020808;
20020809	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL INC. P.O. B; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:BREED, DAVID S. /AR;REEL/FRAME:013215/0194; Effective date: 20020808;
20031216	( )	AS	ASSIGNMENT New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O.; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:014812/0102;SIGNING DATES FROM 20031204 TO 20031210;
20031216	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC., NEW; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:014812/0102;SIGNING DATES FROM 20031204 TO 20031210;
20031216	()	AS	New owner name: INTELLIGENT TECHNOLOGIES INTERNATIONAL, INC. P.O.; : ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:JOHNSON, WENDELL C.;DUVALL, WILBUR E.;REEL/FRAME:014812/0102;SIGNING DATES FROM 20031204 TO 20031210;
20080115	()	FPAY	Year of fee payment: 4;