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United States Patent [19]

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

Dec. 3, 1990

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Related U.S. Application Data

Foreign Application Priority Data

[51] Int. Cl.⁵ G06F 15/20; F02D 41/00;

[52] U.S. Cl. 364/431.04; 364/431.03;

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364/431.04, 431.05, 424.01, 148, 150, 151, 152,

Continuation of Ser. No. 233,209, Aug. 17, 1988, aban-

doned, which is a continuation-in-part of Ser. No.

Japan 62-204006

Japan 52-270202

364/148; 123/480; 395/905

154; 123/480, 350; 395/905

B60K 41/00

[21] Appl. No.: 622,217

Aug. 19, 1987 [JP]

Oct. 28, 1987 [JP]

[22] Filed:

[63]

[30]

[56]

Onari et al.

[11] Patent Number:

5,189,621

[45] Date of Patent:

Feb. 23, 1993

| [54] | ELECTRO | NIC ENGINE CONTROL | 4,747,055 | 5/1988 | Eto et al 364/424.01 |
|------|------------|-----------------------------------|-----------|---------|-------------------------|
| | APPARAT | US | 4,763,745 | 8/1988 | Eto et al 364/174 |
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| [75] | Inventors: | Mikihiko Onari, Kokubunji; | 4,773,012 | 9/1988 | Ito et al 364/424.01 |
| | | Motohisa Funabashi, Sagamihara; | 4,829,434 | 5/1989 | Karmel et al 364/424.1 |
| | | Teruji Sekozawa, Kawasaki; Makoto | 4,853,720 | 8/1989 | Onari et al 364/431.07 |
| | | Shioya, Tokyo, all of Japan | EODI | EIGNI D | ATENT DOCUMENTS |

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Primary Examiner—Vincent N. Trans Attorney, Agent, or Firm—Fay, Sharpe, Beall, Fagan, Minnich & McKee

[57] ABSTRACT

An electronic engine control apparatus includes: a plurality of first sensors for detecting the driving action taken in accordance with a driver's intent; a plurality of second sensors for detecting the operating conditions of a vehicle and an engine; a plurality of actuators for controlling the engine; a unit for discriminating the driver's intent of how to drive the vehicle based on output signals from the first and second sensors; and a unit for controlling the engine to match the driver's intent by selectively adjusting at least one of the actuators, in accordance with the discriminated driver's intent.

59 Claims, 17 Drawing Sheets

| | | | | * | - |
|------------------------|-------------------|------------------------|-------------------------|--|-----------------------------|
| MEASURED VARIABLE | MEASURED VALUE | MEMBERSHIP FUNCTION | FREQUENCY DATA (Fki) | WEIGHT OF CONV. MATRIX (Mjk) | ESTIMATION OF DRIVING COND. |
| VEHICLE SPEED V | - TIME | S M L MEASURED SPEED | N FREQUENCY | Hw 2 Mt 1 St 1 CG 2 S M L | 2- CG St Mt Hw |
| dN/dt | 2 | | | Hw I I CG I S M L | W St Mt HW |
| ∂ th | Mm | S M L | | HW I I | 4 EDji |
| △ 8 th | 1-444/L | | ⇒ I | HW I I I I I I I I I I I I I I I I I I I | CG St Mt Hw |
| GEAR POSITION GP | 2,2,3 | • | ⇒ | <u> </u> | |
| STEERING SPEED | | • | → | Ý L | |



5,189,621

Feb. 23, 1993

CHARACTERISTIC DRIVINGACTIONS DEPENDENT ON DRIVER'S PREFERENCES & DRIVING ENVIRONMENT

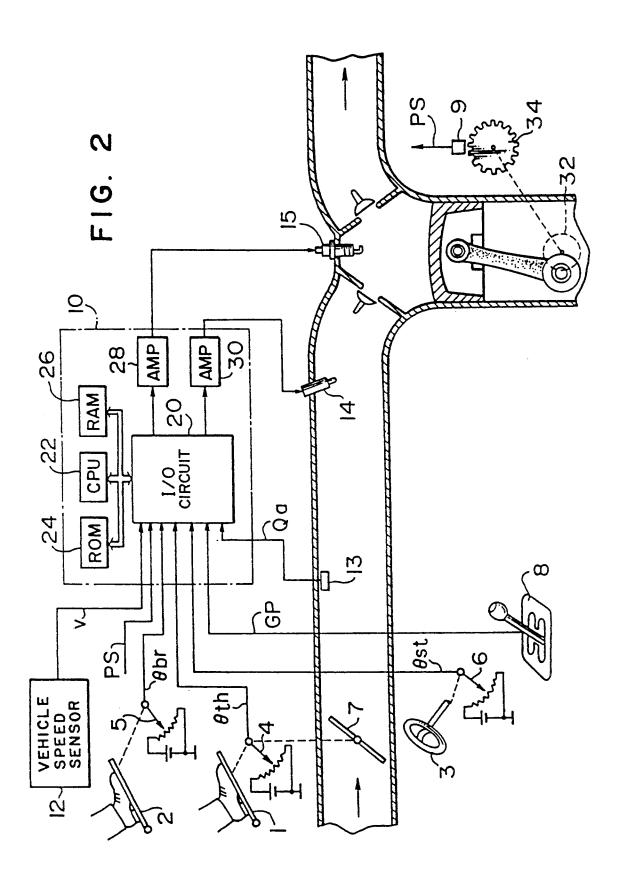
| | DRIVE | DRIVER'S PREFERENCE | ENCE | | DRIVING ENVIRONMENT | VIRONMENT | |
|---|-----------------------|---|--------------------------|------------|-------------------------|----------------------|----------------------|
| | GENTLE | NORMAL | SPORTY | CONGESTED | URBAN | MOUNTAIN ROAD | HIGHWAY |
| | (Ge) | (No) | (Sp) | (90) | (St) | (Mt) | (Hw) |
| THROTTLE VALVE OPENING DEGREE θ th | SMALL AS A WHOLE | MIDDLE WITH SLIGHT LARGE FLUCTUATION AS A WHOLE | © LARGE AS A WHOLE | SMALL | MIDDLE AS A WHOLE | LARGE AS A WHOLE | MIDDLE AS A WHOLE |
| Δθth | © SMALL | MIDDLE | © LARGE | O SMALL | LARGE | LARGE | SMALL |
| VEHICLE SPEED | | | | 0 | | | 0 |
| > | | | | row | MIDDLE | LOW ~ MIDDLE | HIGH |
| ENGINE SPEED | | | | | | | MIDDLE |
| Z | NON I | MIDDLE | HIGH | NO7 | MIDDLE | MIDDLE ~ HIGH | ~ HIGH |
| G, (dN) | SMALL | O | O LARGE | SMALL | MIDDLE | LARGE | SMALL |
| GEAR POSITION (GP) | HIGH SPEED SIDE | MIDDLE SPEED SIDE | LOW SPEED SIDE | LOW O | MIDDLE SPEED SIDE | LOW SPEED SIDE | HIGH SPEED |

Ø VERY LIKELYO SLIGHTLY LIKELY

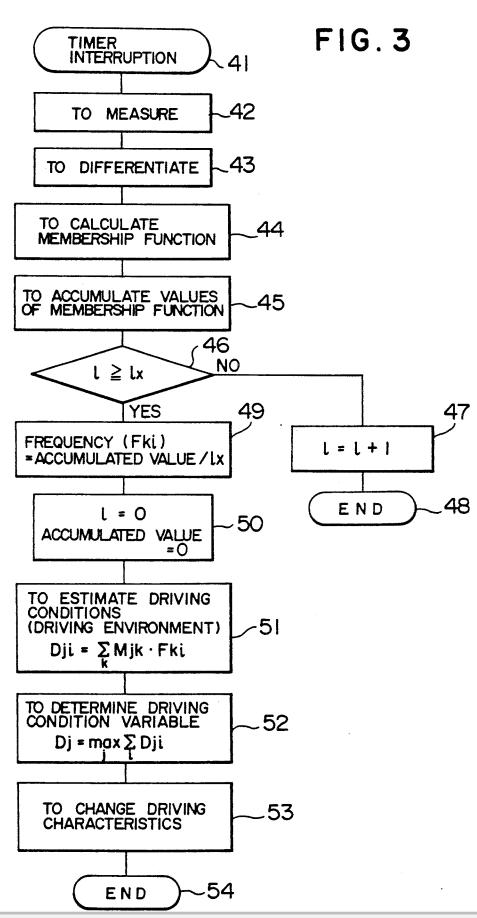
F16. IE

| / | | DRIVE | DRIVER'S PREFERENCE | RENCE | | DRIVING E | DRIVING ENVIRONMENT | |
|------------|---|---|---------------------|---|-----------|-----------------|--------------------------------------|---------|
| • | | GENTLE | NORMAL | SPORTY | CONGESTED | URBAN STREET | MOUNTAIN ROAD | HIGHWAY |
| | | (Ge) | (No) | (Sp) | (90) | (St) | (Mt) | (Hw) |
| N | FREQUENCY | нон | ПОМ | MIDDLE | H9IH | MIDDLE | НІСН | CO CO |
| OITOA T | TIMING | OUICK SHIFT-UP SLOW SHIFT-DOWN | MIDDLE | SLOW SHIFT-UP QUICK SHIFT-DOWN | | | SLOW SHIFT-UP QUOK SHIFT- DOWN | |
| SHIF | TIME MANTANED AT NEUTRAL POSITION | PIONE | MIDDLE | SHORT | | | SHORT | |
| 7 } | | | | | | | | 0 |
| Į. | SPEED FUNCTUALION | SMALL | MIDDLE | LARGE | LARGE | MIDDLE | LARGE | SMALL |
| 1 6 | FERING | | | | | | 0 | 0 |
| \$ | ROTARY SPEED | row | MIDDLE | HIGH | LOW | | HIGH | row |
| " | | | | | 0 | | 0 | 0 |
| DL | BRANE FREQUENCY | LOW | MIDDLE | HIGH | HIGH | | нен | LOW |











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