(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 397 174 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **90108825.2**

(51) Int. Cl.^{5}: **F02D 11/10**

(22) Date of filing: **10.05.90**

(30) Priority: **12.05.89 IT 6735589**

(43) Date of publication of application:
14.11.90 Bulletin 90/46

(84) Designated Contracting States:
DE ES FR GB SE

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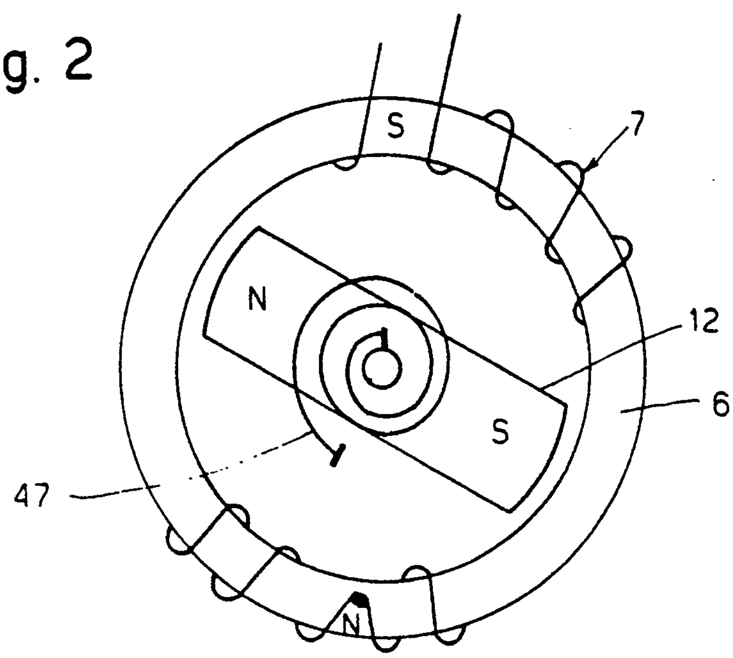
(54) Control member for a fluid flow regulating device, particularly on a motor vehicle.

(57) A control member (1) for a fluid flow regulating device (2), particularly on a motor vehicle, which member (1) comprises:
- a linear rotary motor (3) with a rotor (8) comprising a permanent magnet (12);
- means (25) for mechanically connecting the rotor (8) to a hub (15) supporting an on-off member (14) of the device (2); and
- an electronic control system (4) for controlling the linear motor (3) according to a number of vehicle status parameters and the operating condition of parts of the vehicle.

Fig. 2



EP 0 397 174 A1

The present invention relates to a control member for a fluid flow regulating device, particularly a throttle-controlled body such as a vehicle carburetor or fuel injection device.

At present, fuel flow along a throttle-controlled body is generally controlled by means of a mechanical member consisting of a complex system of levers connected to a pedal on the vehicle.

The aim of the present invention is to provide an electromechanical fluid flow regulating device featuring an electronic portion enabling a number of advantages, such as flow control according to a predetermined strategy, and others as a function of certain vehicle parameters and the operating status of the vehicle. With this aim in view, according to the present invention, there is provided a control member for a fluid flow regulating device, particularly on a motor vehicle, characterised by the fact that it comprises:

- a linear rotary motor with a rotor comprising a permanent magnet;
- means for mechanically connecting said rotor to a hub supporting an on-off member of said device; and
- an electronic control system for controlling said linear motor as a function of a number of vehicle status parameters and the operating condition of parts of said vehicle.

A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Fig.1 shows a partially-sectioned view of a control member in accordance with the teachings of the present invention;

Fig.2 shows a schematic operating diagram of a component on the Fig.1 member;

Fig.3 shows an operating graph of the Fig.2 component as a function of various parameters.

Number 1 in Fig.1 indicates a control member for a fluid supply device 2. Control member 1 comprises a single-phase linear rotary motor 3, and an electronic control system 4 designed to receive various parameters from sensors located at various points on the vehicle, and to control motor 3. Motor 3 comprises a stator 5 having a ferritic toroidal body 6 about which is wound an electric coil 7; and a rotor 8 having a central rotary iron core 11 and supporting a permanent magnet 12 in the form of a bar of given width located inside body 6.

Device 2 in the example shown comprises a duct 13 and a throttle valve 14 fitted on to a hub 15 extending radially outwards of duct 13, which may form part of a carburetor or fuel injection device.

With reference to Fig.1, motor 3 comprises a casing 16 having a cup-shaped body 17 housing stator 5 and rotor 8, and a plate 18 closing cup-shaped body 17. Said body 17 comprises an end wall 21 in which is formed a central through hole 22 coaxial with a through hole 23 formed axially in core 11 and inside which is fitted a shaft 24 connected to hub 15 by means of an oscillating joint 25 which is thus located inside hole 22. Though never before employed for rotating the hub of a throttle valve, joint 25 is of known type and, as such, will only be described briefly. Joint 25 comprises a spherical body 26 in which is formed a diametrical dead hole 27 engaged by one end 28 of hub 15. Hole 27 and end 28 present a substantially rectangular section with the shorter sides extending in the form of an arc of a circle, those of end 28 presenting a smaller diameter circumference so as to enable spherical body 26 to oscillate. Shaft 24 presents a first hollow end portion 31 corresponding with hole 22 and along which are formed two diametrically-opposed axial through slots 32 engaged by respective appendixes 33 extending from spherical body 26, which thus oscillates also in relation to shaft 24. Joint 25 is so installed as to compensate for any off-centering or misalignment between shaft 24 and hub 15.

Shaft 24 also presents a second end portion 34 extending inside a cavity 35 formed in plate 18 and closed by a cap 36. Motor 3 presents a potentiometer 37 having a resistive track 38 formed on an annular disc 41 supported on the face of cap 36 inside cavity 35; and a brush 42 supported on an annular body 43 fitted on to said second portion 34 of shaft 24. Outside said cavity 35, cap 36 also supports an electrical connector 44 with five blade type terminals 45, three relative to potentiometer 37, and two to electrical coil 7. On the face of core 11 facing plate 18, there is formed an annular seat 46 housing a helical spring 47 having a first end secured to core 11 and a second end to plate 18.

With reference to Fig.2, it will be noted that coil 7 is wound clockwise over half of body 6 and anticlockwise over the remaining half. Consequently, when coil 7 is supplied, two opposite magnetic poles, a north pole (N) and a south pole (S), are formed in diametrically-opposed positions. To be more precise, in this particular case, a south pole is formed at the start of the clockwise winding, which also corresponds to the end of the anticlockwise winding, while a north pole is formed at the point at which the winding of coil 7 changes direction. Permanent magnet 12 obviously presents a north pole (N) at a first end, and a south pole (S) at a second end. Commencing from a starting position of magnet 12 determined by spring 47, magnet 12 is subjected to a deflecting torque depending on the intensity of the current supplied to coil 7, so as to turn, against the action of spring 47, about the longitudinal axis of central core 11.

The Fig.3 graph shows the angular position (A.P.) of magnet 12 on the X axis, and, on the Y axis, the deflecting torque (D.T.) applied on magnet 12 for a given intensity of the current supplied to coil 7. Assuming as the starting position of magnet 12 that wherein the two north poles, and consequently also the south poles, are opposed, when coil 7 is supplied for example with current I1, the deflecting torque increases gradually (segment A') until magnet 12 is turned through 45°. From this point on (marked on the graph by line B), the deflecting torque remains substantially constant (segment A'') until magnet 12 is turned through a total of 135°. From this point on (marked on the graph by line C), the deflecting torque falls gradually to zero (segment A'''), at which point magnet 12 is turned through a total of 180°, i.e. with the north (south) pole of stator 5 opposed in relation to the south (north) pole of rotor 8. As can be seen from the Fig.3 graph, when the supply current to coil 7 is increased (I2, I3, I4, I5), the deflecting torque, though higher, remains constant between lines B and C. If we now include on the Y axis the restoring torque (R.T.) determined by spring 47, it will be noted that this increases gradually (line D) as a function of the angular position of magnet 12. Assuming now as the starting position of magnet 12 that marked by line B, i.e. magnet 12 turned 45° in relation to the previous position, magnet 12 can be seen to rotate linearly through 90° as a function of the increase in supply current to coil 7.

On the other hand, however, as shown in Fig.1, the travel of throttle 14 is 90° between the closed and fully open position of duct 13. Consequently, by means of motor 3 and assuming the starting position of magnet 12 to be that wherein the south pole is positioned at 45° in relation to the north pole of stator 5, opening of throttle 14 may be controlled linearly throughout its travel.

Electronic control system 4 is connected to a series of electric lines 51 for transmitting electric signals relative to a number of vehicle parameters, such as engine cooling water temperature, engine speed, wheel speed, etc. Control system 4 is also connected to an electric line 52 for transmitting an electric signal relative to the position of the accelerator pedal. On the basis of said signals and a given preset law, control system 4 provides for controlling supply to coil 7 over two lines 53, and for supplying potentiometer 37 and determining its resistance over three lines 54. As said resistance is, of course, proportional to the angular position of magnet 12, control system 4 also provides for controlling this parameter.

In actual use, with the vehicle engine running at idling speed, control system 4 supplies coil 7 with sufficient current to rotate throttle 14 by a small amount sufficient to supply enough fuel to maintain the engine at idling speed. When the accelerator pedal is depressed, control system 4 increases current supply to coil 7, thus causing magnet 12 to rotate linearly into a position depending on the amount of pressure exerted on the accelerator pedal. As it rotates, magnet 12 also rotates throttle 14, which therefore opens duct 13 according to the same linear law of rotation as magnet 12. Needless to say, fluid flow along duct 13 also increases linearly regardless of the speed at which the accelerator pedal is pressed. In other words, opening of throttle 14 is modulated and, consequently, the power of the vehicle engine controlled as a function of the ultimate position of the accelerator pedal, by processing the speed at which said ultimate position is attained.

The advantages of the present invention will be clear from the foregoing description.

In particular, it provides for a control member 1 for controlling the opening of a throttle 14, whereby, on the basis of specific vehicle operating parameters, a control system 4 controls a linear motor 3 which in turn controls modulated opening of throttle 14 according to a programmable law, thus enabling control system 4 to open throttle 14 as a function of the parameters detected by appropriate sensors. For example, the engine cooling water temperature is a decisive parameter for enabling control system 4 to open throttle 14 under cold engine starting conditions. Control system 4 is also designed to control operation of the engine at idling speed, when accelerating and, therefore, also during transient speed states.

On the basis of vehicle wheel and engine speed, control system 4 also provides for detecting skidding of the wheels and accordingly controlling the power of the vehicle engine. Finally, control system 4 presents a known pushbutton panel (not shown) installed in the passenger compartment of the vehicle, for setting the engine speed and, therefore, the speed of the vehicle, and which is particularly useful when driving along motorways. In addition to the above, the present invention also provides for many more advantages, such as the straightforward design of control member 1; troublefree connection to hub 15 of throttle 14; the absence of numerous parts subject to mechanical stress and wear, thus providing for increased working life and reduced maintenance; compact design; and, finally, relatively low cost in view of the numerous advantages involved.

To those skilled in the art it will be clear that changes may be made to control member 1 as described and illustrated herein without, however, departing from the scope of the present invention.

For example, device 2 may be installed on any type of fluid circuit, which fluid, on a vehicle for example, may consist of air, an air-fuel mixture or pure fuel. Moreover, device 2 may present an on-off member other than that represented by throttle

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Claims

1) - A control member for a fluid flow regulating device (2), particularly on a motor vehicle, characterised by the fact that it comprises:

- a linear rotary motor (3) with a rotor (8) comprising a permanent magnet (12);
- means (25) for mechanically connecting said rotor (8) to a hub (15) supporting an on-off member (14) of said device (2); and
- an electronic control system (4) for controlling said linear motor 3 as a function of a number of vehicle status parameters and the operating condition of parts of said vehicle.

2) - A control member as claimed in Claim 1, characterised by the fact that said linear motor (3) comprises spring means (47) defining a restoring torque in opposition to the deflecting torque imposed on said rotor (8); said restoring torque being linearly proportion to the angular position of said rotor (8).

3) - A control member as claimed in Claim 2, characterised by the fact that said linear motor (3) presents a stator (5) comprising a ferritic toroidal body (6) and an electric coil (7) wound clockwise about half of said toroidal body (6) and anticlockwise about the other half; said rotor (8) rotating a maximum of 180°.

4) - A control member as claimed in Claim 3, characterised by the fact that said deflecting torque as a function of the angular position of said rotor (8) remains constant over a long section (A″) substantially corresponding to a 90° variation in the angular position of said rotor (8); the starting position of said rotor (8) being fixed substantially at the starting point (B) of said constant deflecting torque section (A″), and the angular position of said rotor (8) being linearly proportional to the intensity of the supply current to said coil (7).

5) - A control member as claimed in Claim 4, characterised by the fact that said starting position of said rotor (8) corresponds to minimum fluid flow along said device (2), and by the fact that the maximum ultimate position of said rotor (8), corresponding to maximum fluid flow along said device (2), is 90° from said starting position.

6) - A control member as claimed in at least one of the foregoing Claims, characterised by the fact that said control system (4) is supplied with an electric signal relative to the position of the accelerator pedal on said vehicle and contributing towards control of said linear motor (3).

7) - A control member as claimed in at least one of the foregoing Claims, characterised by the fact that said linear motor (3) presents a potentiometer (37) defining a resistance value proportional to the angular position of said rotor (8); said potentiometer (37) being connected to said control system (4) which thus provides for determining the angular position of said rotor (8).

8) - A control member as claimed in at least one of the foregoing Claims, characterised by the fact that said connecting means comprise an oscillating joint (25) for compensating any off-centering or misalignment between said rotor (8) and said hub (15).

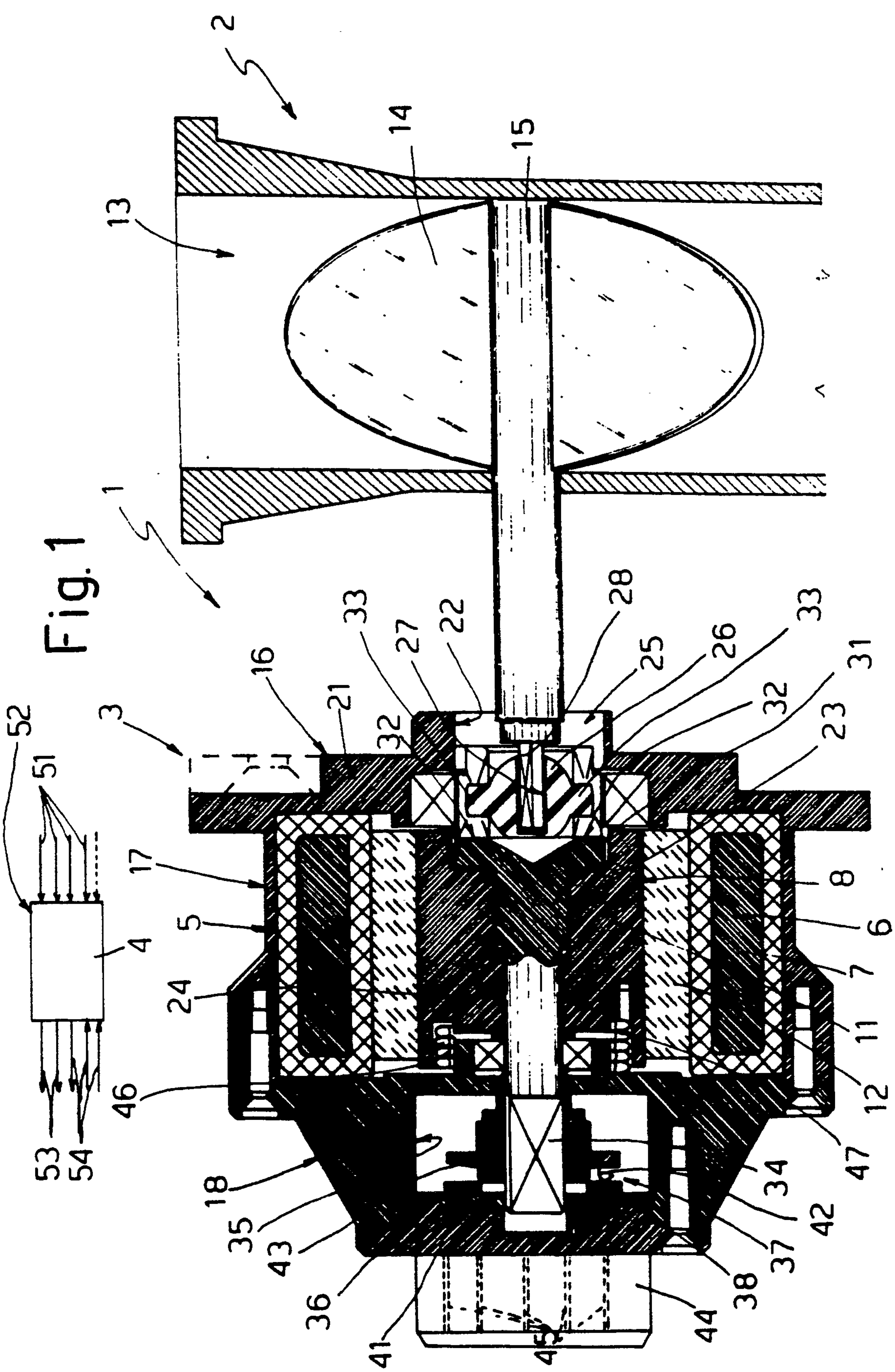
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Fig. 1

Fig. 2

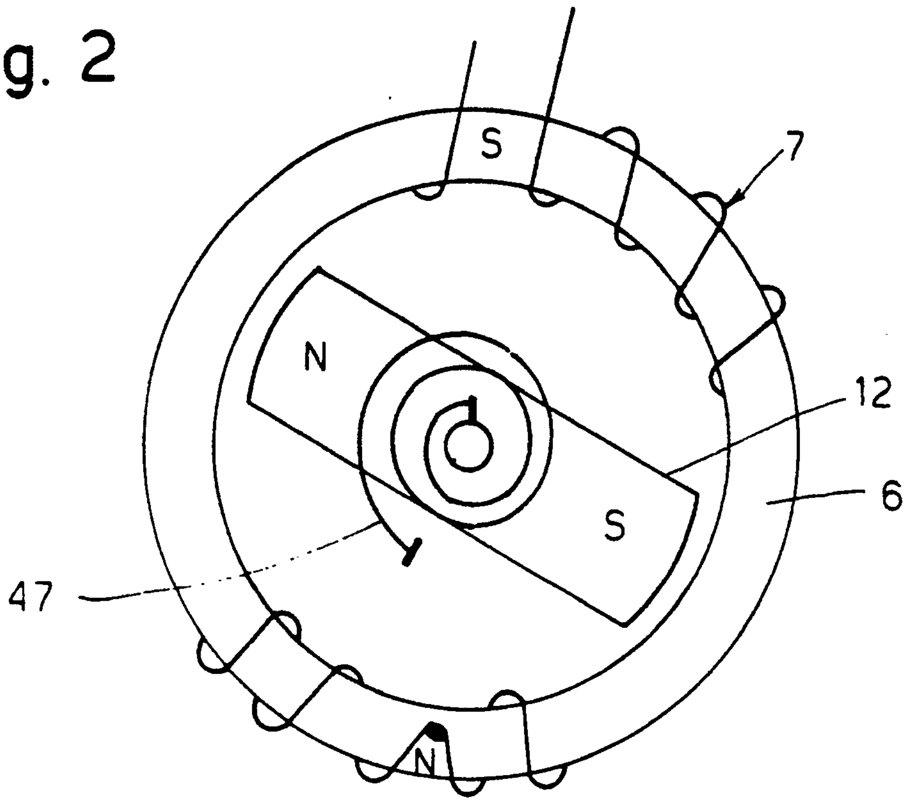
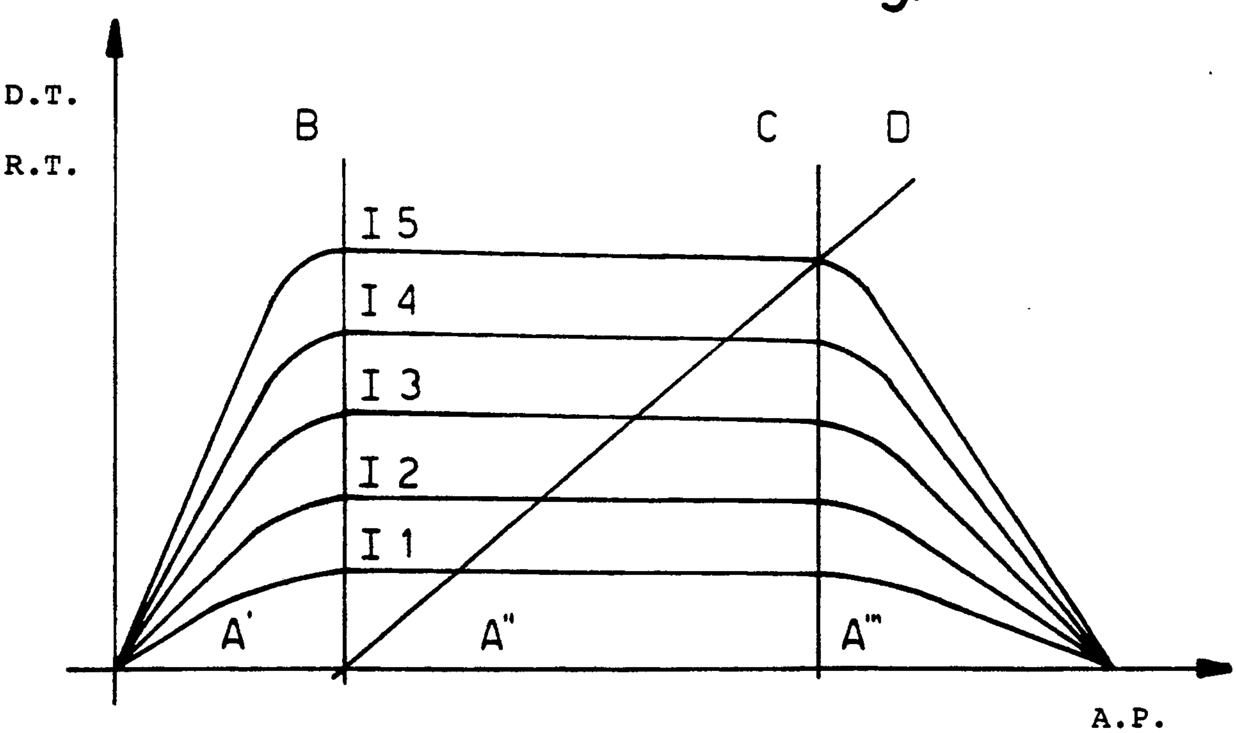


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 90 10 8825

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 281 466 (RENAULT) * Column 1 - column 3, line 55 * ---	1,3-7	F 02 D 11/10
X	DE-A-3 039 521 (VDO ADOLF SCHINDLING) * Whole document * ---	1-5	
X	DE-A-3 013 984 (BOSCH) * Figures 2,4; abstract * -----	1-5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 02 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-08-1990	GAGLIARDI P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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