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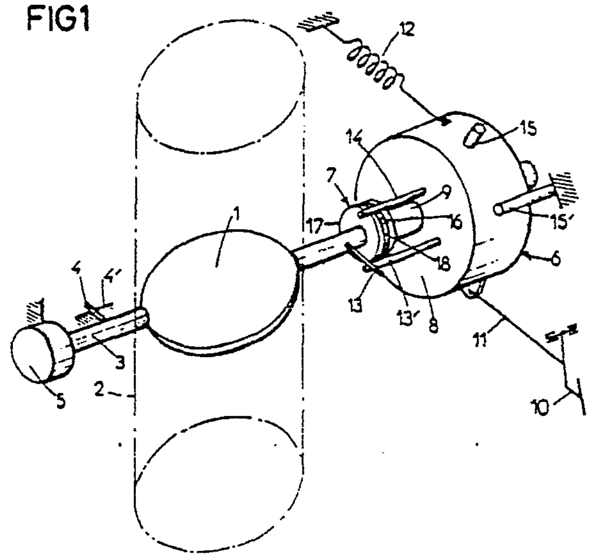
(54) Control device for the air-intake throttle valve of an internal-combustion engine.

(57) The device according to the invention comprises a motor (6), the stator (8) of which is coupled to an accelerator pedal (10), whilst the rotor (9) of this motor is connected to the throttle valve (1) by means of a frictional coupling member (7). An excitation of the motor (6) causes a rotation of the rotor in relation to the stator, which makes it possible to reduce the opening of the throttle valve by a predetermined angle under certain circumstances. The correction to the opening angle of the throttle valve carried out in this way by means of the motor makes it possible to prevent any unpleasant reaction from being transmitted to the accelerator pedal (10).

The invention is used on anti-skid or speed-regulating devices for motor vehicles driven by an internal-combustion engine.

FIG1



EP 0 341 659 A1

Control device for the air-intake throttle valve of an internal-combustion engine.

The present invention relates to a control device for the air-intake throttle valve of an internal-combustion engine used for the propulsion of a motor vehicule and, more particularly, to such a device comprising an actuator for selectively reducing the opening angle of the throttle valve in relation to that obtained as a result of the sole action of the vehicle driver on an accelerator pedal.

In some situations, it can be expedient to have means for automatically reducing the torque delivered by the internal-combustion engine equipping a motor vehicle, independently of the control obtained as a result of the pressure exerted by the vehicle driver on the accelerator pedal. As an example, such a reduction of this engine torque, brought about by a control unit, is used when the skidding of the wheels of the vehicle, when the latter starts up, is to be prevented or when it is desirable to limit the speed of the vehicle, make a change of ratio in the gearbox, etc.

Actuators for modifying the position of the throttle valve are used to this effect, and for safety reasons in the event of the breakage of the pedal/throttle-valve connection, these actuators are interposed between this pedal and a restoring spring of the air-intake throttle valve. The effect of modifying the position of the throttle valve and therefore the restoring force of the spring by means of the actuator is to give rise to an unpleasant reaction on the accelerator control for the vehicle driver.

Document EP 174,662 makes known a device for regulating the speed of a vehicle and for preventing the skidding of the wheels of this vehicle, which comprises a throttle-valve actuator controlled both by an electronic control unit and by an accelerator pedal, in order to act on a mechanical assembly comprising the throttle valve, two arms and two springs associated with this throttle valve. The actuator comprises an electric motor, a clutch, a reducer, two arms and a lever, all forming a device which is complex and therefore costly. As regards a reduction of the opening of the throttle valve controlled by the electronic control unit, only some compensation of the resulting unpleasant reaction on the accelerator pedal for the driver is obtained by means of mechanical members.

This reaction is eliminated completely by means of another solution which involves placing a second throttle valve in series with the main throttle valve in the air-intake pipe of the engine. The accelerator pedal acts in the main throttle valve whilst, to obtain a substantial reduction in the opening of the intake pipe, the second throttle valve is actuated by means of an electronic control unit. However, this solution has various disadvantages : mechanical complexity, an increase in the pressure losses in the air-intake pipe and complexity in the strategies for the controlling of the opening of the second throttle valve which result from interactions between the relative positions of the two throttle valves.

Furthermore, from document FR-A-2.599.805 a device for actuating the air-intake throttle is known, the actuator of which being of the spring balanced, unidirectional, and variable reluctuance type. In addition to the fact that a device of this kind can only increase the air-intake throttle opening, it exhibits drawbacks in respect of the safety of the vehicle driver. As a matter of fact, the air-intake throttle position can be maintained only if the throttle control remains continuously on. A control failure may result either in a fierce deceleration of the vehicle or, worse, in a fierce uncontrollable acceleration.

An object of the present invention is, therefore, to provide a control device for the air-intake throttle valve for an internal-combustion engine propelling a motor vehicle, comprising means for automatically reducing the opening of the throttle valve under the control of a control unit, this device being simple, reliable and of low production cost.

Another object of the present invention is to provide such a device, by means of which no unpleasant reaction is transmitted to the accelerator pedal during a reduction of the opening of the throttle valve controlled by the control unit.

A further object of the present invention is to provide such a device which, in insuring the stability of the air throttle position in case of a control failure, reduces the hazards for the vehicle driver.

These objects of the invention and others which will emerge later are achieved by means of a control device for the air-intake throttle valve of an internal-combustion engine, of the type comprising an accelerator pedal for normally controlling the opening angle of the throttle valve, a spring for returning this pedal towards an inactive position, an actuator installed between the pedal and the throttle valve in order selectively to reduce this opening angle in relation to that which would be obtained as a result of the sole action of the pedal, the actuator consisting of a motor comprising a stator movable in terms of rotation relative to the supporting structure of the throttle valve and coupled to the return spring and to the accelerator pedal which controls its angular position, and a rotor coupled in terms of rotation to the throttle valve, said device being characterized by coupling means provided between the throttle valve and the stator for maintaining their relative angular position in case of feed power cut of the motor, the device also possessing means for feeding the motor in order to rotate selectively the rotor and the throttle valve through a predetermined angle corresponding to a desired reduction of the opening angle of the latter, without this rotation exerting any reaction on the accelerator pedal via the stator.

Stops limit the relative movements of the throttle valve and of the stator of the motor in relation to the supporting structure of the device on the one hand and of the throttle valve in relation to the stator on the other hand.

According to a first embodiment of the invention, the motor is a mechanically non-reversible two-way geared motor.

The rotor of the motor is coupled to a rotary axle of the throttle valve by means of a frictional coupling member generating a frictional torque higher than that necessary for driving the throttle valve in rotation and lower than that exerted by the return spring of the pedal on the stator.

According to a second embodiment of the invention, the motor is a mechanically reversible two-way geared motor. The rotor of the motor is fixed to the axle of the throttle valve.

A frictional member couples the rotor and the stator with a frictional torque higher than that necessary for driving the throttle valve in rotation and lower than the torque generated by the return spring on the stator.

In all these embodiments, the accelerator pedal can be coupled to the actuator by means of a cable passing over a winding shell carried by the periphery of the stator of the motor.

In the accompanying drawing given purely by way of example :

- Figure 1 is a diagrammatic perspective view of the control device for the air-intake throttle valve of an internal-combustion engine used for the propulsion of a motor vehicle, according to a first embodiment of the invention,

- Figure 2 is a graph showing the angular position of the throttle valve of the device according to the invention as a function of an acceleration control executed by depressing the accelerator pedal, if appropriate with a correction made by means of the actuator of the device according to the invention, and

- Figures 3A and 3B are a diagrammatic plan view of a second embodiment of the device according to the invention and of a particular member of this device respectively.

Reference is made to Figure 1 of the drawing, which shows that a device according to a first embodiment of the invention comprises a throttle valve 1 mounted in an air-intake pipe 2 of an internal-combustion engine, so as to be movable in terms of rotation about an axle 3 integral with the throttle valve 1. A movable stop 4 projects from the axle 3 in order to interact with a stationary counterstop 4′ integral with the supporting structure of the device, this counterstop 4′ defining the maximum closing position of the throttle valve 1 in the intake pipe 2. At the left-hand end (as seen in the Figure) of the axle 3, the device can have an angular-position sensor 5 which serves for supplying a signal representing information on the angular position of the throttle valve in relation to the supporting structure to at least one control unit of the internal-combustion engine intended more particularly for the propulsion of a motor vehicle, as is well known in the art.

The other (right-hand) end of the axle 3 is coupled to an actuator 6 by means of a frictional coupling member 7. This actuator 6 consists of a mechanically non-reversible two-way geared motor comprising a stator 8 and a rotor 9, the rotor of the motor being aligned with the rotary axle of the throttle valve, to which it is coupled by means of the frictional coupling member 7. For example, with such a geared electric motor, an electrical control alone can modify the relative position of the rotor and stator, in the two opposite directions of rotation. According to the present invention, the stator 8 is movable in terms of rotation about the axle of the rotor, and its angular position on this axle is controlled by an accelerator pedal 10 coupled mechanically to the stator by means of a connection indicated diagrammatically at 11. Thus, depressing the accelerator pedal 10 adjusts the angular position of the stator 8. A spring 12 is fastened at one end to the stator 8 and its other end to the supporting structure of the device, in order to exert a restoring torque on the stator 8 and, at the same time, on the accelerator pedal. When the spring 12 acts alone on the pedal 10, the latter occupies an initial inactive "high" position.

The device also possesses various stops and counterstops which limit the movements of the various above-mentioned members in relation to the supporting structure of the device or the movements of these members relative to one another. Thus, in addition to the movable stop 4 and the stationary counterstop 4′ there is on the axle 3, at its right-hand end, as seen in Figure 1, a movable stop 13 which interacts with a movable counterstop 13′ projecting axially from the stator of the motor, in order to limit the opening position of the throttle valve 1, set by depressing the pedal 10, as regulated by the vehicle driver. The interaction of the stops 4, 4′ and 13, 13′ respectively in the absence of any action on the accelerator pedal defines the "high" position of the pedal and the closed position of the throttle valve respectively. In the absence of any control of the motor, contact between the stops

13 and 13′ is maintained as a result of the mechanical non-reversibility of the geared motor. A second movable counterstop 14 angularly distant from the counterstop 13′ projects axially from the stator, in order to limit the maximum angular deviation of the throttle valve in relation to that set by the movable counterstop 13′ when the motor acts on the throttle valve in order to reduce the opening angle of the latter, and for other purposes, as will be seen in detail later.

Finally, a movable stop 15 projects from the periphery of the stator 8 of the motor, in order to interact with a stationary counterstop 15′ integral with the supporting structure of the device, in order to define the full opening position of the throttle valve obtained as a result of the sole action of the pedal 10 on this throttle valve.

The device is completed by means (not shown) for feeding energy to the motor 6, these means being controlled by a control unit which determines the reduction in angular opening which the motor 6 is to impart to the throttle valve 3 in some situations, such as those mentioned above, for example to prevent a skidding of the wheels of a motor vehicle as the result of too high an engine torque exerted on the wheels of this vehicle, in view of the coefficient of friction of these on a particular road surface, or to limit the speed of the vehicle to a predetermined value which the vehicle must not exceed.

According to an important characteristic of the device according to the invention, the usefulness of which will be seen later, the frictional coupling member 7 consists of a disc 18 made of a frictional material, this disc being gripped between two mutually confronting coaxial ends 16 and 17 of the axle of the throttle valve 1 and of the output shaft of the rotor 9 of the motor 6 respectively. Thus, the rotation of the rotor 9 of the motor is transmitted to the throttle valve by means of the frictional torque generated by this friction disc 16. According to an important characteristic of the present invention, this frictional torque is below the torque exerted by the return spring 12 on the stator 8 of the motor, so that the latter torque can override the action of the preceding torque in order to allow a rapid return of the stator to the initial position when the pedal 10 returns to its inactive position, independently of a possible angular deviation brought about previously between the stator and the throttle valve 1.

The functioning of the device illustrated in Figure 1 will now be described in conjunction with the graph of Figure 2 which shows the angular position of the throttle valve as a function of the acceleration control, as adjusted by depressing the accelerator pedal 10. We first look at the functioning of the device when the motor 6 does not introduce any correction in the value of the angular position of the throttle valve, as results from the pressure exerted on the pedal 10. The stator 8 then transmits the desired angular position to the throttle valve by means of the frictional coupling member 7, without any relative movement occurring between the stator 8 and the rotor 9, the motor 6 not being excited by its feed means. This is represented by the curve portion 21 of the graph of Figure 2. In this situation, the connection between the pedal 10 and the throttle valve is direct.

Now if the control unit determines that the vehicle is in a situation where it is important to reduce the opening of the throttle valve in order to reduce the torque transmitted to the wheels of the vehicle by the engine, this unit commands the feeding of the motor 6, the effect of which is to free the rotation of the rotor 9 relative to the stator 8 in the anti-clockwise direction, looking at this rotor from the left-hand end of the rotary axle of the throttle valve 1 (Figure 1), in order thereby to reduce the opening of the throttle valve by moving the stop 13 away from the counterstop 13′ integral with the stator of the motor 6. This is represented by the curve 22 of the graph of Figure 2.

The action of limiting the opening of the throttle valve continues according to the curve 23 if the acceleration control brough about by the pedal 10 is maintained, until it is no longer necessary to limit the opening of the throttle valve.

The limiting action continues according to the curve 24 if the acceleration control brought about by the pedal 10 is reduced slowly from the point 22′ in relation to the response time of the actuator, the limitation control then eventually no longer being necessary (point 24′).

The limiting action continues according to the curves 25 and 26 if the acceleration control defined by the pedal is reduced rapidly from the point 22′. The curve 25 corresponds to the rotation of the throttle valve 1 until the contact of the movable stop 4 on the stationary counterstop 4′. The curve 26 corresponds to the action of the frictional coupling member 7 which slides in order to restore contact between the movable stop 13 and the counterstop 13′, without waiting for the return action of the rotor 9. This function of the frictional coupling member 7 is very important because it makes it possible to obtain a rapid and complete return of the pedal 10 to its inactive position, without waiting for the return of the motor to its initial position.

The motor 6 makes it possible to obtain only an opening of the throttle valve which is less than that corresponding to the command given by the pedal. A modification in the position of the rotor causes no change in the tension of the return spring. This arrangement ensures that the force exerted on the pedal is not modified as a result of a variation in position of the throttle valve attributable to the motor 6. Thus, the driver then does not feel any unpleasant reaction on the accelerator pedal, in accordance with the aim pursued by the present invention.

The motor can control the opening of the throttle valve only between the position commanded by the pedal (or by the action of the return spring in the event of failure) and a closing position defined by the counterstop 4′ which regulates the opening of the throttle valve under idling conditions. Also, in case of a feed power cut of the motor 6, the angular relationship of the throttle valve with respect to the stator remains unchanged, thus preventing any fierce speed variation of the vehicle. The mechanical coupling between the stator and the output shaft of the geared motor 6 permits to obtain this feature which ensures the safety of the device.

It was seen above that the movable counterstop 14 projecting from the stator of the motor 6 serves for limiting the reduction of the opening of the throttle valve attributable to this motor when it is actuated. This counterstop provides another advantageous result. In fact, it happens that, for various reasons (icing up, etc.), the throttle valve remains blocked in its closing position when the vehicle is started. In this case, by depressing the pedal 10 as far as it will go, the counterstop 14 can be forced against the movable stop 13 as a result of a rotation in the clockwise direction (looking at the device axially from the left of Figure 1), in order at the same time to detach the movable stop 4 from the stationary counterstop 4′ and thereby release the throttle valve in a simple way and at low cost. To allow such a release, the maximum amount of angular correction is limited by the actuator to a value slightly below the maximum angular amount of rotation of the throttle valve. The actuator thus controls the position of the throttle valve between the position required by the pedal and either the closing position of the throttle valve or the lower limit defined by the position of the counterstop 14 on the stator 8 of the motor 6.

Figures 3A and 3B illustrate a second embodiment of the device according to the invention. In these Figures, reference numerals identica to those used in Figure 1 denote members identical or similar to the corresponding members of the device of Figure 1. In this embodiment, the rotor 9 is integral with the rotary axle of the throttle valve 1. The notched disc 30 is fastened coaxially on the rotary axle of the throttle valve 1 which thus also forms the rotor of the motor 6. The sliding necessary for the rapid return of the accelerator pedal to the inactive position is then provided between the stator and the rotor of the motor 6 as a result of a mechanical reversibility of the geared motor used in this embodiment. This embodiment of the invention also possesses a frictional coupling member 32 (represented by broken lines) between the stator 8 of the motor and a disc 30 integral with the rotor. In the customary operating mode, contact between the stops 13 and 13′ is obtained by means of the frictional torque between the stator and the rotor. The advantage of this arrangement is that it is not necessary to feed energy to the motor in this mode. The frictional torque is lower than the torque generated by the return spring on the stator and higher than the torque necessary for driving the throttle valve in rotation.

The embodiment of Figures 3A and 3B also differs from that of figure 1 in the use made of the notched disc 30 to define the stops 4 and 13 integral with the throttle valve 1 and their interaction with the counterstops 4′ and 13′. As shown in Figure 3B, the stops 4 and 13 are defined by radial ends of two peripheral notches cut out in the disc 30, the dimensions of these notches allowing a certain deflection of the counterstops 4′ and 13′ in relation to the stops 4 and 13 respectively. The latter are thus integral with the rotor in this embodiment. The counterstop 4′ remains integral with the supporting structure of the device according to the invention, whilst the stop 13′ projects from the stator of the motor 6, as in the embodiment described previously.

According to an advantageous arrangement which can be incorporated in the device according to the invention and which is shown in Figure 3A, the connection 11 between the pedal 10 and the stator 8 of the motor is made by a cable which passes along a groove 19 extending round the periphery of the stator of the motor 6, according to the various possible forms known for the winding shells of such a cable in conventional control devices for the opening of a throttle valve. This improves the compactness of the device according to the invention.

Thus, in accordance with the aims pursued, the various above-described embodiments of the control device for an air-intake throttle valve according to the invention make it possible to obtain a controlled reduction in the opening of the throttle valve as a function of certain circumstances, namely skidding of the wheels, exceeding a critical speed, etc., without this correction causing an unpleasant reaction force to be transmitted to the accelerator pedal, this being achieved by means of simple and reliable means inexpensive to put into practice.

Claims

1. Control device for the air-intake throttle valve of an internal-combustion engine, of the type comprising an accelerator pedal for normally controlling the opening angle of the throttle valve, a spring for returning this pedal towards an inactive position, and an actuator installed between the pedal and the throttle valve in order selectively to reduce this opening angle in relation to that which would be obtained as a result of the sole action of the pedal, the actuator consisting of a motor (6) comprising a stator (8) movable in terms of rotation relative to the supporting structure of the throttle valve (1) and coupled to the return spring and to the accelerator pedal (10) which controls its angular position, and a rotor (9) coupled in terms of rotation to the throttle valve, said device being characterized in that it comprises coupling means provided between the throttle valve and the stator for maintaining their relative angular position in case of feed power cut of the motor, the device also possessing means for feeding the motor in order to rotate selectively the rotor (9) and the throttle valve (1) through a predetermined angle corresponding to a desired reduction of the opening angle of the latter, without this rotation exerting any reaction on the accelerator pedal (10) via the stator (8).

2. Device according to Claim 1, characterized in that the return spring (12) exerts a torque on the stator of the motor in order to return the accelerator pedal (10) towards its inactive position when the latter ceases to be depressed.

3. Device according to either one of Claims 1 and 2, characterized in that the motor is a mechanically non-reversible two-way geared motor.

4. Device according to Claim 3, characterized in that the rotor of the geared motor is coupled to a rotary axle of the throttle valve by means of a frictional coupling member (7) generating a frictional torque higher than that necessary for driving the throttle valve in rotation and lower than that exerted by the return spring of the pedal on the stator.

5. Device according to Claim 4, characterized in that the throttle valve (1), the output shaft (9) of the geared motor and the coupling member (7) are coaxial, the coupling member (7) consisting of two mutually confronting ends (16, 17) of the rotary axles of the throttle valve (1) and of the rotor (9) respectively and of a member (18) made of a friction material interposed between these two ends.

6. Device according to either one of Claims1 and 2, characterized in that the motor is a mechanically reversible two-way geared motor the rotor of which is coupled to the body of the stator by a frictional member (32) with a frictional torque lower than the torque generated by the return spring on the stator and higher than that necessary for driving the throttle valve in rotation.

7. Device according to Claim 6, characterized in that the rotor (9) of the motor is integral with the axle of the throttle valve.

8. Device according to any one of the preceding Claims, characterized in that it possesses a movable stop (13) integral with the throttle valve and interacting with a movable counterstop (13′) integral with the stator of the motor, in order, when the actuator is inactive, to define the opening position of the throttle valve, as regulated by the pedal.

9. Device according to any one of the preceding Claims, characterized in that it possesses a movable counterstop (14) integral with the stator and, if appropriate, interacting with the movable stop (13), in order to define the maximum angular correction determined by the actuator.

10. Device according to any one of the preceding Claims, characterized in that it possesses a movable stop (4) integral with the throttle valve and interacting with a stationary counterstop (4′) carried by the supporting structure of the throttle valve, in order to define the maximum closing position of the throttle valve.

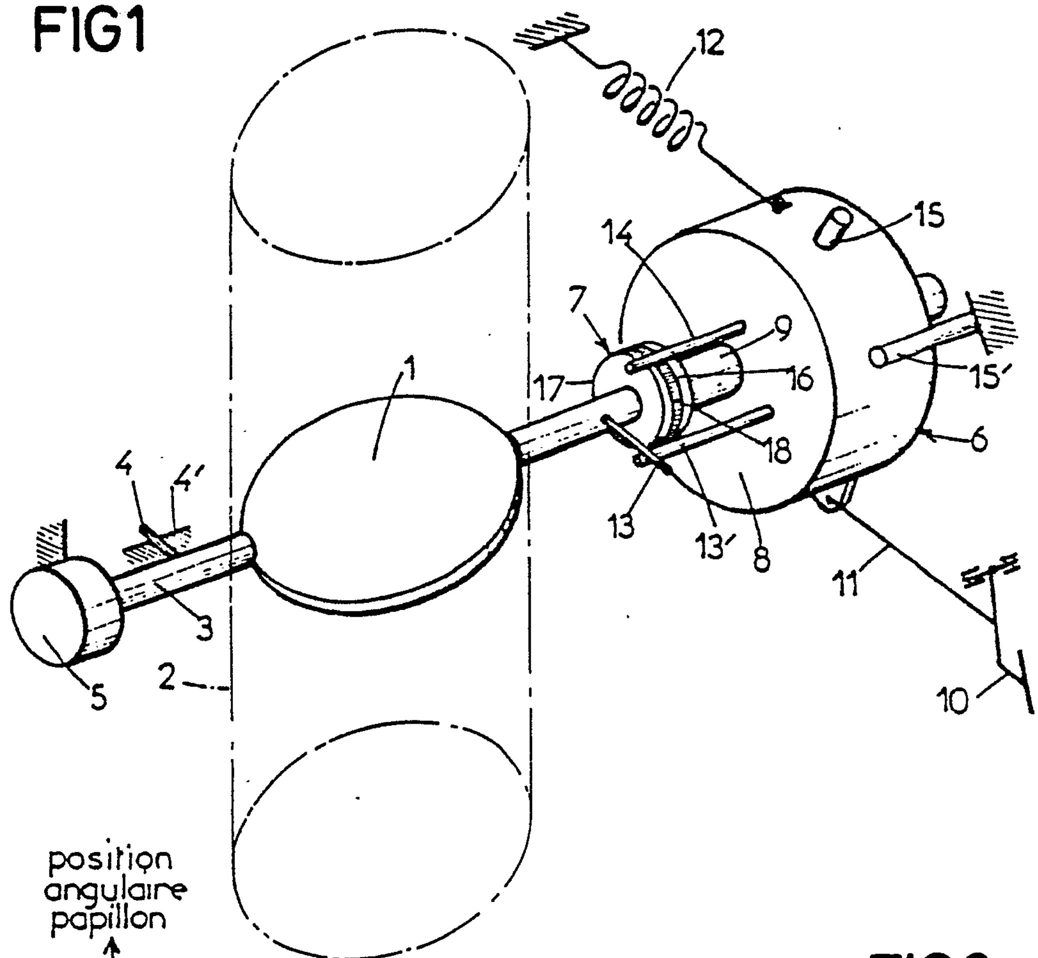
11. Device according to any one of the preceding Claims, characterized in that it possesses a movable stop (15) integral with the stator and interacting with a counterstop (15′) integral with the supporting structure, in order to define the full opening position of the throttle valve.

12. Device according to any one of Claims 9 to 11, characterized in that the stops and counterstops are arranged in such a way that the actuator cannot return the throttle valve to a complete closing position when the accelerator pedal is completely depressed.

13. Device according to any one of Claims 1 to 7, characterized in that it possesses a disc 30 integral with the rotary axle of the throttle valve and having two notches defining stops (4, 13) interacting respectively with a stationary counterstop (4′) and a movable couterstop (13′) integral with the structure and with the stator respectively, in order to define respectively the maximum closing position of the throttle valve and the opening position of the throttle valve when the actuator is inactive.

14 Device according to any one of the preceding Claims, characterized in that the accelerator pedal is coupled to the actuator by means of a cable (11) passing over a winding shell carried by the periphery of the stator of the motor.

FIG1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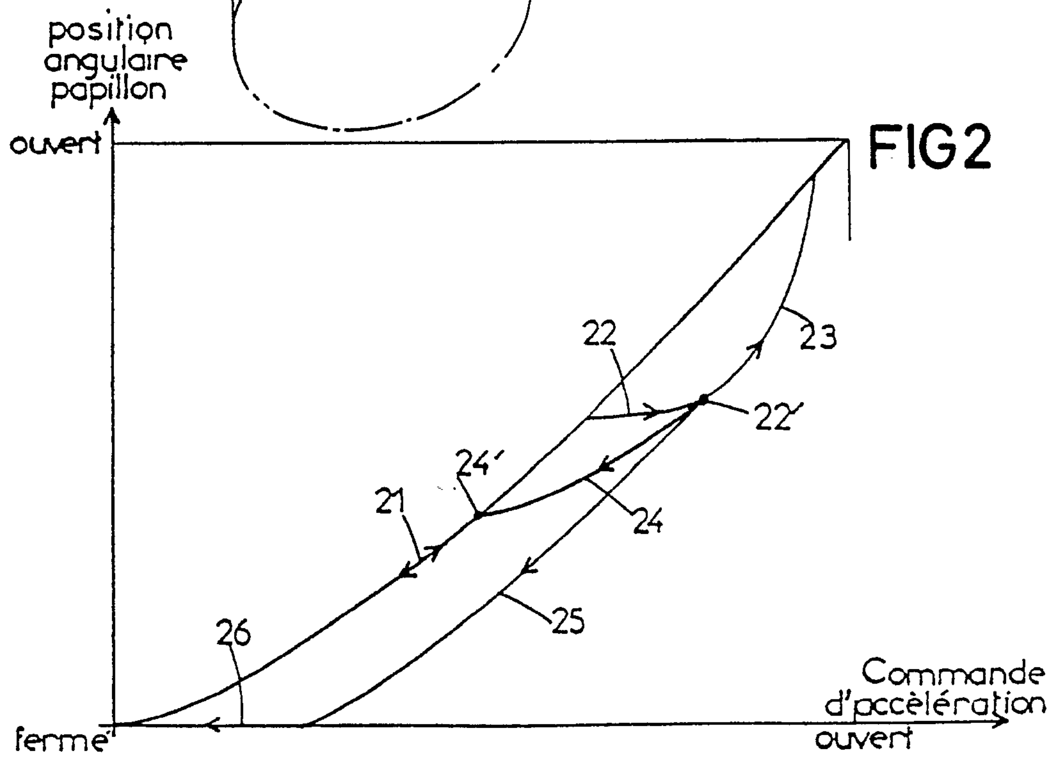
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FIG2

FIG 3a

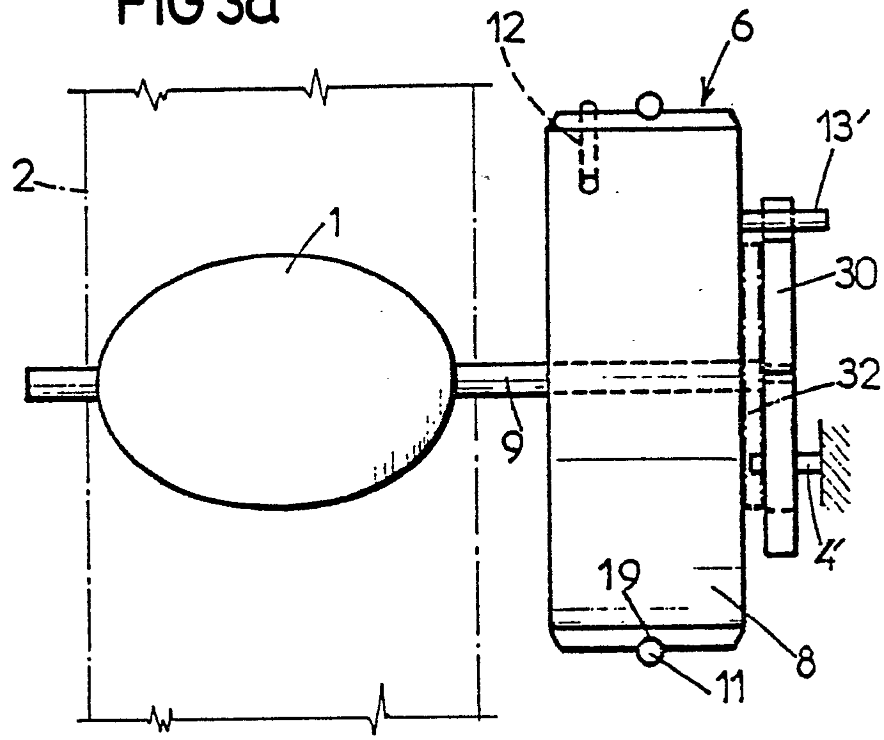
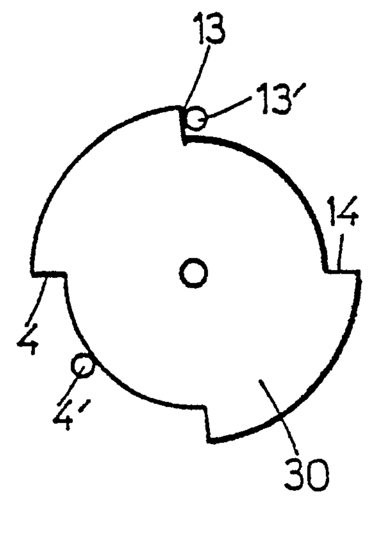


FIG 3b



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EUROPEAN SEARCH REPORT

Application Number

EP 89 10 8321

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.4)
X,D	FR-A-2 599 805 (BOSCH) * Whole document * ---	1-3,7	F 02 D 11/10
A	FR-A-2 559 209 (RENAULT) * Page 1, line 1 - page 2, line 28 * ---	3,6,7	
A	PATENT ABSTRACTS OF JAPAN, vol. 4, no. 80 (M-15)[562], 10th June 1980, page 96 M 15; & JP-A-55 40 315 (ISHIKAWAJIMA HARIMA JUKOGYO K.K.) 21-03-1980 ---	4-6	
A	US-A-4 367 805 (TOTANI et al.) * Figure 2; column 2, line 64 - column 3, line 37 * ---	8-13	
A	PATENT ABSTRACTS OF JAPAN, vol. 11, no. 318 (M-632)[2765], 16th October 1987; & JP-A-62 101 847 (NIPPON DENSO CO. LTD) 12-05-1987 -----	1,14	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 02 D B 60 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-07-1989	GAGLIARDI P.

CATEGORY OF CITED DOCUMENTS

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