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(12) # EUROPEAN PATENT APPLICATION

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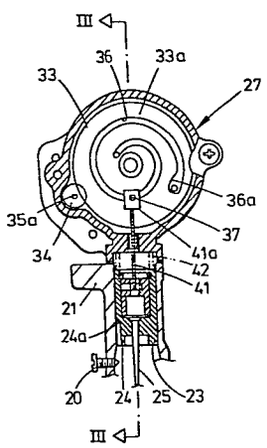
(54) **Throttle valve control device for an engine.**

(57) A throttle valve control device (27) in an engine of the type, in which a control member having a controlling electric motor (35) is attached to an intake barrel member (21) formed with an intake passage (22) and equipped with a throttle valve (24,24') in said intake passae, and in which said throttle valve has its opening controlled by said electric motor (35). A cam disc (33a), drivingly connected with said electric motor (35), is formed with a spiral groove (36) around its center axis and said control member is formed with guide portions (38, 39; 40; 50) extending radially from said cam disc (33a). There is provided a sliding member (37) engaging with said groove (36) and said guide portions. Said sliding member (37) and said throttle valve (24,24') are connected by means of a connecting member (41,41',41'').

Fig. 2



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PATENTANWÄLTE

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Throttle Valve Control Device for an Engine

The present invention relates to a control device for the engine throttle valve, which is suitable for a motor bicycle or other small-sized vehicles, and more particularly to a device for opening and closing the throttle valve by means of an electric motor.

According to the prior art, there has been known a device, in which a screw is made to follow an electric motor thereby to control the opening of the throttle valve to a larger or smaller level through the rotations of the screw so that the vehicle may run at a desired speed (as is disclosed in Japanese laid-open utility model application No. 54-42822. However, the device disclosed has a disadvantage that, in case the electric motor further operates in the opening or closing direction when the throttle valve is in its fully opened or closed position, the screw is locked so that the subsequent reverse operation is made impossible by the wedge action.

Generally speaking, there have been known in the art a number of devices, in which a cam following an electric motor is used to open and close a butterfly-type throttle valve so that a vehicle may run at a desired speed. If it is intended to apply such device to the carburetor which is equipped with the piston-type throttle valve and which is frequently used in a small-sized engine of the

motor bicycle, the rotational output of the electric motor has to be converted into reciprocal motions. In order to prevent that device from being large-sized, however, the kind of a cam usable is limited, and still the worse a clearance is liable to be established in the connection between the cam follower and the throttle valve thereby to make it difficult to finely adjust the opening of the throttle valve.

It is the task of the invention to improve a throttle valve control device as indicated in the introductory part of claim 1 such that it allows for a more simple construction and avoids the danger of blocking reverse operation in case the electric motor further operates when the throttle valve is in its fully opened or closed position, and allows for fine control of the opening of the throttle valve.

In a throttle valve control device, said task of the invention is solved by the features as contained in the characterizing part of claim 1.

By means of the cam disc formed with a spiral groove for drivingly connecting the electric motor with the throttle valve, even if, at the fully opened or closed position of the throttle valve, the electric motor further operates in its opening or closing direction, the subsequent reverse operations can be prevented from being locked and unabled by the wedge action, as is different from the prior art using a screw. Also, since the throttle valve is forcedly opened and closed by the actions of the spiral grooves and the sliding member in accordance with the rotations of the spiral groove, the transmission of the operating force is smooth and irreversible so that the operations of the throttle valve are not disturbed by the fluctuations in the intake vacuum exerted upon the lower face thereof and by other disturbances but can be controlled precisely.

Further developments and improvements of the present invention are claimed in the subclaims.

In particular, the throttle valve is designed either as a sliding piston-type valve or as a butterfly-type valve.

Also, the cam disc is either connected to said electric motor through a reduction gear means or is directly connected to said electric motor.

Furthermore, the connecting member for connecting the sliding member and the throttle valve may be a rack engaging a gear connected with the butterfly-type throttle valve.

Also, said connecting member may be a connecting lever having bifurcated supporting arms, which extend, while interposing said cam disc inbetween, to support the two ends of said sliding member.

Alternatively, the sliding member may be connected with a two-armed lever, one arm being pivotally mounted by a stationary pin and the other arm being connected with the connecting member.

The invention will be described in connection with the drawings showing different embodiments of the invention.

Fig. 1 - is a side elevation showing a portion of the bicycle, which is driven by a prime mover and on which the device according to the present invention is installed,

Fig. 2 - is a sectional view, showing an essential portion of a first embodiment of a control device according to the invention,

Fig. 3 - is a section taken along line III-III of Fig. 2,

Fig. 4 - is a sectional view similar to Fig. 2, showing a second embodiment of the invention,

Fig. 5 - is a section taken along line V-V of Fig. 4,

Fig. 6 - shows an enlarged detail of the embodiment as shown in Figs. 4 and 5,

Figs. 7A and 7B - show a cross-section and a side elevation of a modification of the embodiments as shown in Figs. 1 to 3,

Figs. 8A to 8C - show a further embodiment of the invention,

and

Figs. 9A to 9C - show a further embodiment of the invention.

Fig. 1 is a side elevation showing a portion of the prime mover driven bicycle, on which the device according to the present invention is installed. Indicated at reference numerals 1 and 2 in Fig. 1 are the frame of the motor bicycle and the engine which is suspended on the frame 1, respectively. Numeral 3 indicates the rear wheel which is driven by a pulley 4 forced into contact with the outer circumference thereof. This pulley 4 is coupled with the centrifugal clutch 6 which is driven by the engine 2 through a V-belt 5. More specifically, when the engine 2 is started to reach a higher speed than a predetermined level, the centrifugal clutch 6 is applied to rotate the pulley 4 thereby to drive the rear wheel 3 so that the bicycle is driven to run. Numeral 7 indicates the intake pipe of the engine 2, which has communication with the atmosphere by way of a carburetor 8 and an air cleaner 9. Numeral 11 indicates an exhaust pipe which functions to exhaust the burned gases to the atmosphere via a muffler 12. Numeral 13 indicates a pair of foot-type crank pedals, through which the rear wheel 3 can be driven through a chain 14 and a (not shown) free wheel in a similar manner to a usual bicycle. In the embodiment being described, the crank pedals 13 are used to drive the rear wheel 3 so as to start or help the engine 2. Numeral 15 indicates the oil tank which has its inside space divided into two compartments for reserving a fuel and a lubricant separately from each other.

Figs. 2 and 3 show both the carburetor suitable for the engine of this type and a control mechanism therefor. Indicated at numeral 21 is the intake barrel of the carburetor 8, which is formed with both an intake passage 22 and a guide bore 23 intersecting the intake passage 22 at a right angle for guiding the throttle valve. Numeral 24 indicates the piston-type throttle valve which is fitted in and guided by the afore-mentioned guide bore 23 so that it can move back and forth in the intake passage 22 thereby to control the flow rate of intake air.

Numeral 25 indicates the jet needle which is attached to the lower face of the throttle valve 24 for varying the effective open area of a fuel injection port 26 in accordance with the upward and downward movements of the throttle valve 24 thereby to control the injection rate of the fuel. Incidentally, numeral 20 indicates the idle adjusting screw which has its leading end engaging with the inclined groove 24a of the throttle valve 24 thereby to control the minimum opening of the throttle valve 24. The construction of the carburetor 8 thus far described is substantially similar to the well-known one.

A control member 27 for opening and closing the throttle valve 24 is fastened to the upper portion of the intake barrel 21 by means of a screw S. The control member 27 is equipped with both a main case 28 formed with an opening and a cover 29 for closing the opening of the main case 28 and is formed in its inside with a mechanism chamber 31. There are disposed within this mechanism chamber 31 both a larger gear 33 loosely fitted in a center pivot pin 32 and a smaller gear 34 meshing with the larger gear 33 such that the two gears 33 and 34 constitute a reduction gear mechanism. This gear mechanism is driven by the electric motor 35 which is attached to the outer side of the main case 28. A step motor is used as the electric motor 35 of the embodiment. Numeral 35a indicates the output shaft of the electric motor 35, which extends through the main case 28 while retaining the afore-mentioned smaller gear 34 thereon. On the other hand, the afore-mentioned larger gear 33 has a cam disc 33a formed around its center axis with a spiral groove 36, through which a pin-shaped sliding member or follower pin 37 extends. This sliding member 37 has its two end portions engaging with the radial guide grooves 38 and 39, which are formed to face the inner walls of the main case 28 and the cover 29, so that it reciprocates within the guide grooves 38 and 39 in accordance with its displacement within the spiral groove 36 as the larger gear 33

rotates. Numeral 41 indicates a steel string which connects the sliding member 37 and the throttle valve 24 and which has its lower end portion, as viewed in the drawings, connected to the throttle valve 24 in a known manner and its upper end portion fixed to a coupling member 41a loosely fitted in the sliding member 37. Numeral 42 indicates a weak spring which functions to bias the throttle valve 24 at all times in the same direction and which may be dispensed with if the steel string 41 is short. The width of the spiral groove 36 is made at the same size except its portion for pushing the sliding member 37 to the lowermost position, i.e., its outer end portion and at a slightly larger size than the sliding member 37. The reason why the groove 36 has its outer end portion 36a slightly widened is to prevent the sliding member 37 from being forced into contact with one side of the groove 36 by the displacement of the throttle valve 24 thereby partly to make the operations of the larger gear 33 irregular and partly to damage the groove 36.

In the throttle valve control device thus constructed, when the electric motor 35 is automatically rotated forward or backward by the intention of the rider of the bicycle, i.e., by the rider's manipulation of a control member or in accordance with the running condition of the bicycle, these forward or backward rotations are transmitted through the smaller gear 34 to the larger gear 33 thereby to rotate the spiral groove 36 which is formed in the cam disc 33a of the latter gear 33. When the groove 36 is rotated, the sliding member 37 meshing therewith is reciprocally moved, while being guided by the guide grooves 38 and 39, so that the throttle valve 24 connected thereto through the steel string 41 is opened and closed. The minimum opening of the throttle valve 24 is predetermined by means of the screw 20 such that the inclined surface 24a of the throttle valve 24 is born on the tapered leading end of the screw 20 thereby to block further opening of the throttle valve 24.

As has been described hereinbefore, according to the present invention, since the throttle valve 24 is forcibly opened and closed by the actions of the spiral groove 36 and the sliding member 37 in accordance with the rotations of the spiral groove 36, the transmission of the operating force is smooth and irreversible so that the operations of the throttle valve 24 are not disturbed by the fluctuations in the intake vacuum exerted upon the lower face thereof and by other disturbances but can be controlled percisely. Moreover, since the spiral groove 36 is used, even if, at the fully opened or closes position of the throttle valve 24, the electric motor 35 further operates in its opening or closing direction, the subsequent reverse operations can be prevented from being locked and unabled by the wedge action, as is different from the case using the screw. Still moreover, since the spiral groove 36 has its rotations effected, while being reduced, by the smaller and larger gears 34 and 33, even if the error in the stopped position of the electric motor 35 is more or less enlarged, it does not appear as a large error in the stop position of the spiral groove.

Figs. 4 to 6 show another embodiment of the piston valve type carburetor 8 suitable for the engine of the aforementioned type and an opening control device for the carburetor 8. The same reference numerals are used for similar or corresponding parts and elements. This carburetor 8 is equipped with both an intake barrel 21 forming an intake passage 22 and a guide bore 23 for guiding a piston-type throttle valve 24. Numerals 25 and 20 indicate a needle valve mounted in the lower side of the throttle valve 24 and stop screw 20 for adjusting the idle opening of the throttle valve 24, respectively.

A throttle valve control device 27 for opening and closing the throttle valve 24 is fastened to the upper portion of the guide bore 23 by means of a screw S. In a case 28 constituting a part of the device 27, there is disposed the

reduction gear mechanism which is composed of both a larger gear 33 loosely fitted on a center pivot pin 32 and a smaller gear 34 meshing with the larger gear 33. These gears 33 and 34 are driven by the electric motor 35 which is attached to the outer side of the case 28. Numeral 35a indicates the electric motor shaft which is disposed to extend through the case 28 and to which the afore-mentioned smaller gear 34 is fixed. The cam disc 33a of the afore-mentioned larger gear 33 is formed with a spiral groove 36 around the center axis thereof. A follower pin 37 is disposed through that groove 36. The follower pin 37 is sized and positioned to engage with the two vertical guide grooves 38 and 39, which have both their end portions facing the inner sides of the case 28, so that it can move up and down within its guide grooves 38 and 39 as the larger gear 33 rotates. Numeral 41' indicates the connecting lever which connects the follower pin 37 to the throttle valve 24. This connecting lever 41' is molded of a synthetic resin and is formed at its upper portion, as viewed from the drawing, with the two supporting arms 41a', which extend, while interposing the cam disc 33a inbetween, to support the end portions of the follower pin 37, and at its lower portion with both a recess 43 and an outwardly extending flange 44. Indicated at numeral 45 are the slits which are formed at a plurality of circumferential positions in the lower portion of the connecting lever 41'. On the other hand, a bore 46 at the upper portion of the throttle valve 24 connected to the connecting lever 41' is formed with an inner circumferential groove 47, as better seen from Fig. 6, and the lower portion of the connecting lever 41' has its outer circumference reduced with the use of the slits 45 so that it engages with the afore-mentioned inner circumferential groove 47 through the bore 46. The inner circumferential groove 47 has a larger width than the thickness of the flange 44 so that the connecting lever 41' can slightly move in the axial direction but is usually urged onto the upper wall of the inner circumferential groove 47 by the action of a spring 42' which is

mounted under compression on the lower side of the connecting lever 41'. Incidentally, that spring 42' functions, at its lower end, to push and hold the needle valve 25 onto and at the throttle valve 24, respectively, through a clip 48 which is retained by the needle valve 25.

The idle adjustment is performed at a position, in which the groove 36 pushes the follower pin 37 to the lowermost level, and under the condition, in which the electric motor 35 is left inoperative. This idle adjustment is actually effected by rotating the stop screw 20. By the rotations of the stop screw 20, the throttle valve 24 is moved up and down (Fig. 6 shows the condition under which the throttle valve 24 is located at its lowermost position), but these upward and downward movements are absorbed by the clearance in the afore-mentioned groove 42 so that there is no fear of the follower pin 37 biting the groove 36.

In the throttle valve control device thus construed, if the electric motor 35 is rotated forward or backward in accordance with either the intention of the rider of the bicycle or the running condition of the bicycle, the forward or backward rotations are reduced by the actions of the smaller and larger gears 34 and 33 thereby to rotate the groove 36 which is formed in the cam disc 33a. In accordance with the rotations of the groove 36, the follower pin 37 is moved up and down within the guide grooves 38 and 39 thereby to move up and down the connecting lever 41' supporting the end portion of the follower pin 37 so that the throttle valve 24 is either pulled up by the upper side of the flange 44 or pushed down by the lower side of the same against the action of the spring 42'. Thus, the throttle valve 24 is opened and closed by the cam disc 33a.

As has been described hereinbefore, according to the present invention, since the rotations of the electric motor for controlling the throttle valve are reduced by

the reduction gear mechanism thereby to drive the gear disc with the resultantly strengthened force, there is obtained an advantage that the use of a small-sized electric motor is made possible. Moreover, since the rotations of the electric motor and accordingly the cam disc are converted into reciprocal motions, the drive force is strengthened simultaneously with the conversion, thus resulting in another advantage that the drive power is further strengthened. Still moreover, since the follower pin has its end portions supported by the supporting arms of the connecting lever at both the sides of the cam disc, it is prevented from being vertically inclined during its operation thereby to ensure the smooth operations of the throttle valve, thus inviting still another advantage that the opening and closing operations of the throttle valve in a small quantity can be performed highly precisely.

Incidentally, the present invention may be modified such that the cam disc is rotated not indirectly through the reduction gear mechanism but directly by the electric motor (as shown in Figs. 7A and 7B). As arrangement and operation of the remaining control device are the same as those in the foregoing embodiments, a further description is not necessary. By this construction its overall height can be reduced and it may be manufactured more easily and at lower costs.

Thus, there can be attained an advantage that a complex construction for effecting the feedback control of the electric motor 35 in accordance with the position of the spiral groove 36 can be dispensed with so that the device can be produced in a small size and at a low cost.

Also in the embodiment as shown in Figs. 8A to 8C, the cam disc 33 is rotated directly by the electric motor 35. However, the connecting member between the throttle valve 24' and the sliding member 37 engaging the spiral groove 36 of the cam disc 33 is connected to a rack 41'', which

is guided in a guiding member 40. Said rack 41'' engages with its teeth a gear 49, which is directly connected with the butterfly-type throttle valve 24'. In Fig. 8C a section along the line C-C through the guiding member 40 and the rack 41'' is shown.

Although not shown, this embodiment of the invention may also be modified such that the cam disc 33 is rotated indirectly through the reduction gear mechanism as shown in the first and second embodiments instead of being rotated directly by the electric motor 35.

In the operation of the embodiment as shown in Figs. 8A to 8C, the rack 41'' is moved up and down by rotating the cam disc 33, which is attached to the shaft 35a of the pulse motor 35, so that the pinion gear 49 attached to the shaft of the butterfly valve 24' may be rotated to control the butterfly valve.

In this embodiment, the motor cannot be rotated from the side of the butterfly valve because the butterfly valve is always operated by the command from the motor.

In Figs. 9A to 9C there is shown a further embodiment of the invention, which differs from the foregoing embodiments in that the follower pin or sliding member 37 is connected to a two-armed lever 50, one arm of which is pivotally mounted about a stationary pin 51, whereas the other arm is connected with the metal string 41 as also used in the first embodiment.

When rotating the cam disc 33a by the pulse motor 35, the sliding member 37 rotates the lever 50 about its pivot. By these rotations, the throttle valve 24, which is attached to the lower end of the metal string attached to the leading end of the lever 50, is moved up and down.

As the center axis of the spiral groove cam disc is offset from the center line of the throttle valve 24, the height of the overall construction can be reduced. Since the stroke of the upward and downward movements of the throttle valve can be amplified in accordance with the lever ratio, the spiral groove stroke, that means the cam disc diameter, can also be reduced.

Fig. 9C shows a view of the two-armed lever 50 and the cam disc 33 in the direction A. As shown therein, the two-armed lever 50 may have a U-shaped cross-section at its leading end with its connecting leg removed at its remaining part in order to enclose the cam disc 33 at its two side surfaces, as shown also in Fig. 9B of the drawings.

Claims:

1. A throttle valve control device (27) for an engine of the type, in which a control member having a controlling electric motor (35) is attached to an intake barrel member (2) formed with an intake passage (22) and equipped with a throttle valve (24,24') in said intake passage, and in which said throttle valve has its opening controlled by said electric motor (35), characterized in that a cam disc (33a) drivingly connected with said electric motor (35) is formed with a spiral groove (36) around its center axis, in that said control member is formed with guide portions (38,39;40;50) extending radially from said cam disc (33a), in that there is provided a sliding member (37) engaging with said groove (36) and said guide portions, and in that said sliding member (37) and said throttle valve (24,24') are connected by means of a connecting member (41,41',41'').

2. A throttle valve control device as set forth in claim 1, further characterized in that said throttle valve (24) is designed as a sliding piston-type valve.

3. A throttle valve control device as set forth in claim 1, further characterized in that said throttle valve (24') is designed as a butterfly-type valve.

4. A throttle valve control device as set forth in claim 1 or 2, characterized in that said cam disc (33a) connected to said electric motor (35) is formed as a gear (33) meshing with a smaller gear (34), the gear (33) and the smaller gear (34) forming reduction gear means (33,34).

5. A throttle valve control device as set forth in claim 3 or 4, characterized in that said connecting member (41'') is a rack engaging a gear (49) connected with the butterfly-type throttle valve (24').

6. A throttle valve control device as set forth in any of claims 1 to 4, characterized in that said connecting member (41') is a connecting lever having bifurcated supporting arms (41a') which extend, while interposing said cam disc (33a) inbetween, to support the two ends of said sliding member (37).

7. A throttle valve control device as set forth in claim 1 or 2, characterized in that said sliding member (37) is connected with a two-armed lever (50), one arm of which being pivotally mounted on a stationary pin (51), and the other arm being connected with the connecting member (41).

8. A throttle valve control device as set forth in any of claims 1 to 3 and 5 to 7, characterized in that said cam disc (33a) is directly connected to said electric motor (35).

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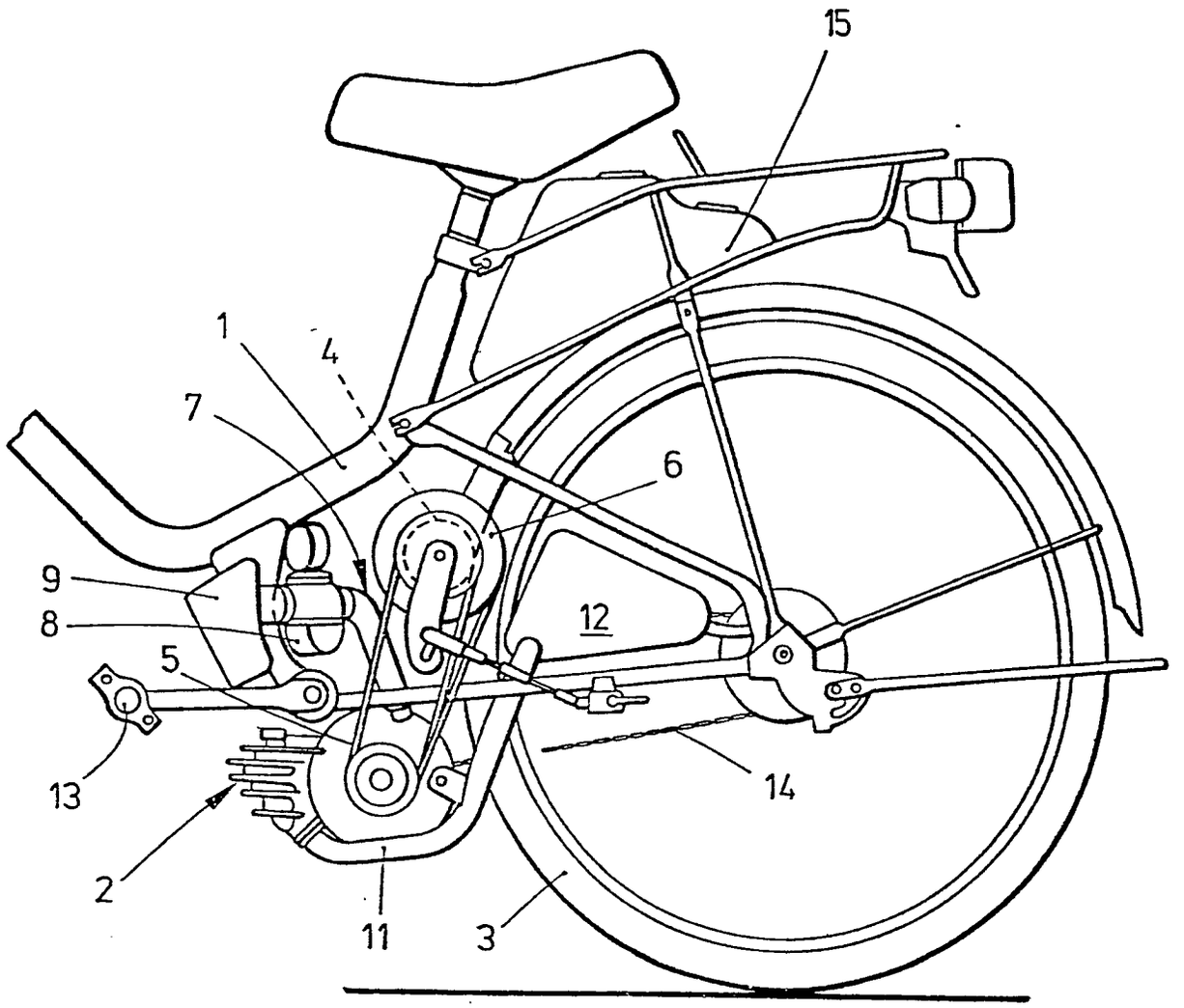

Fig.1

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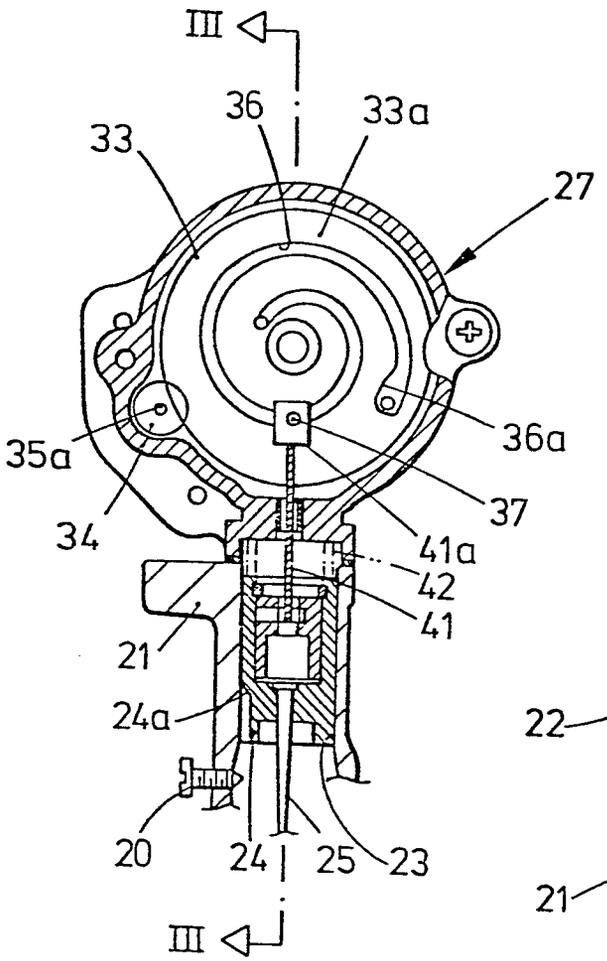

Fig. 2

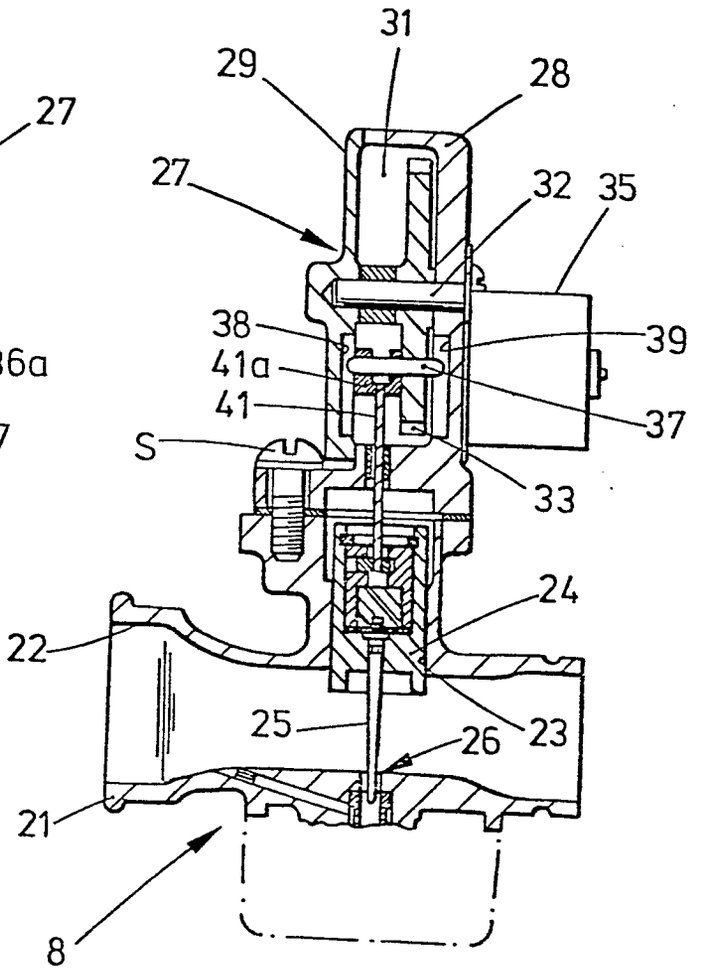

Fig.3

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Fig.4

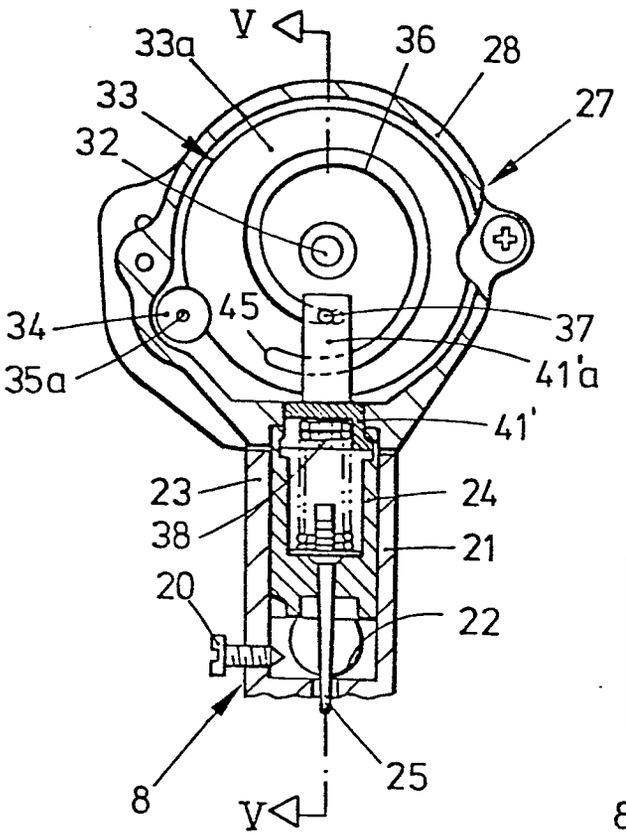


Fig.5

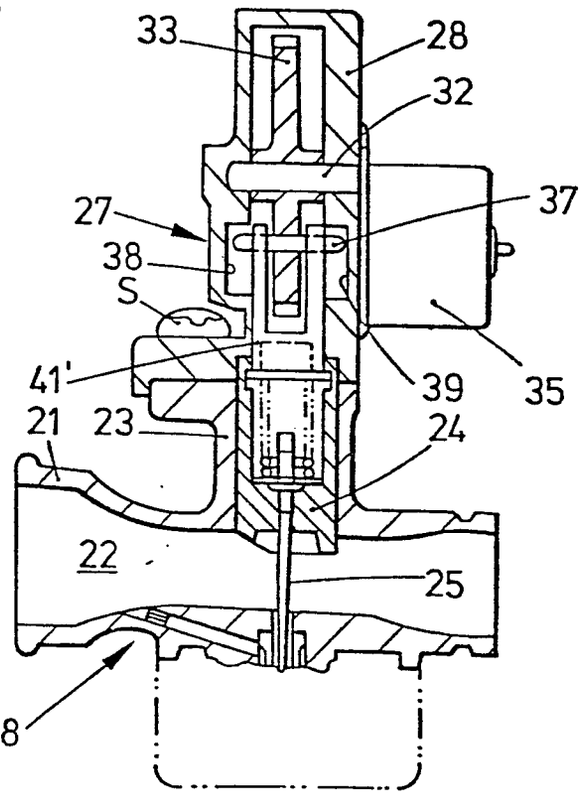
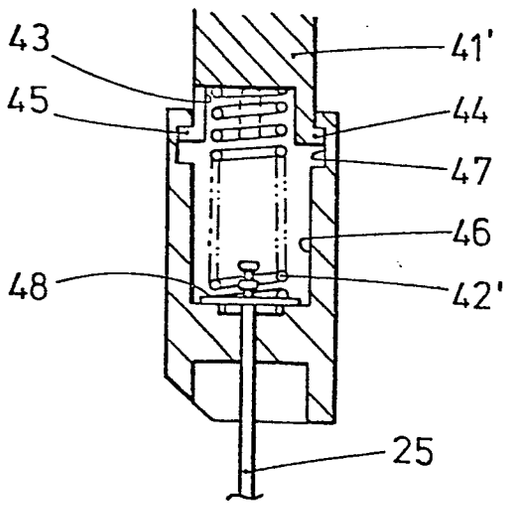


Fig.6



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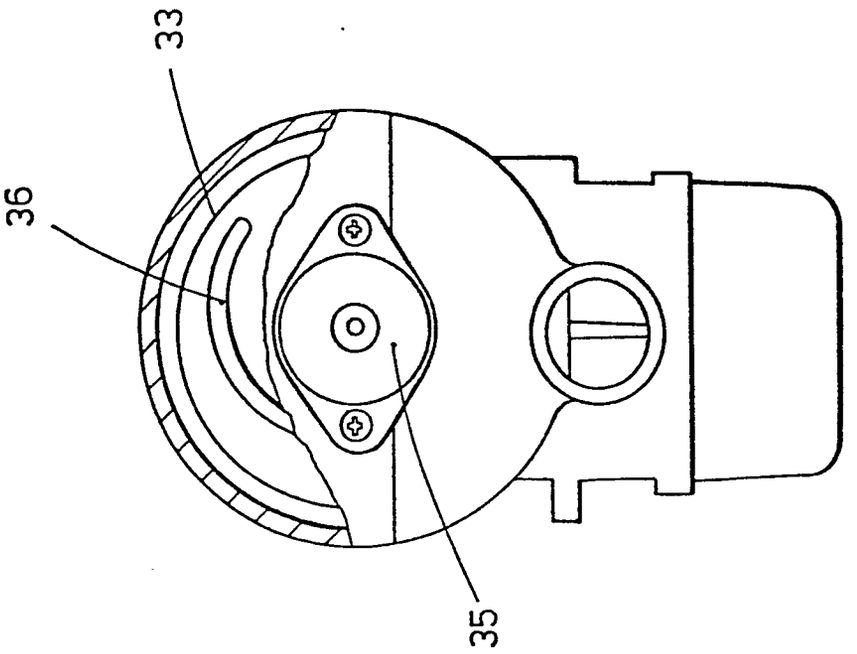

Fig.7B

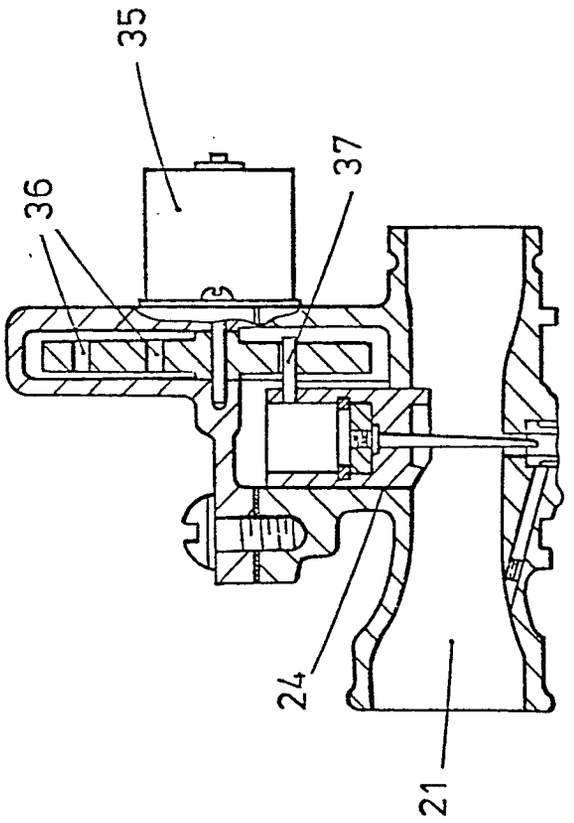

Fig.7A

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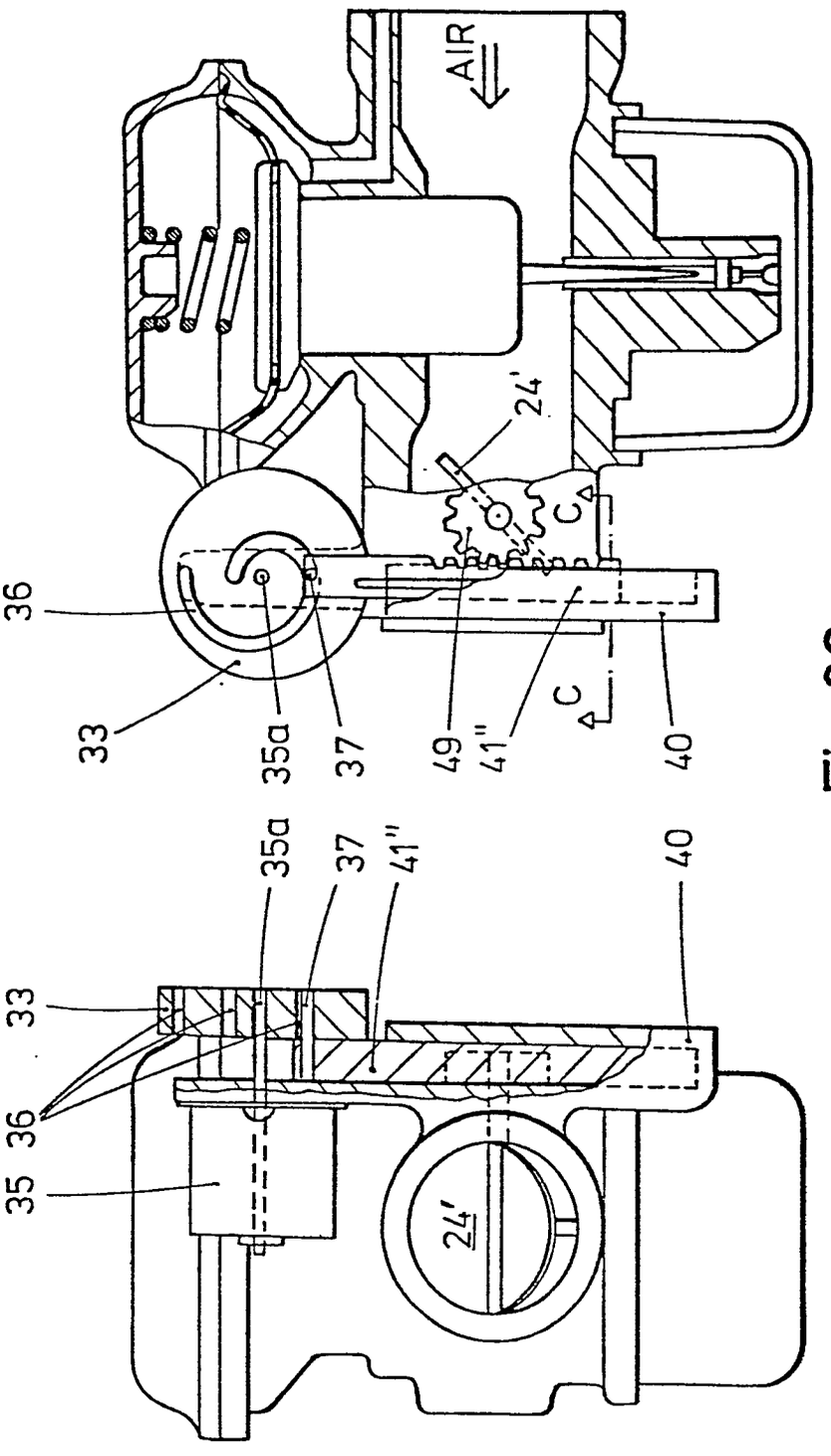

Fig.8B

Fig.8C

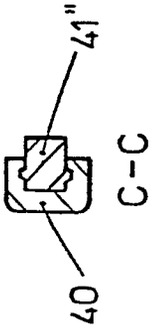

Fig.8A

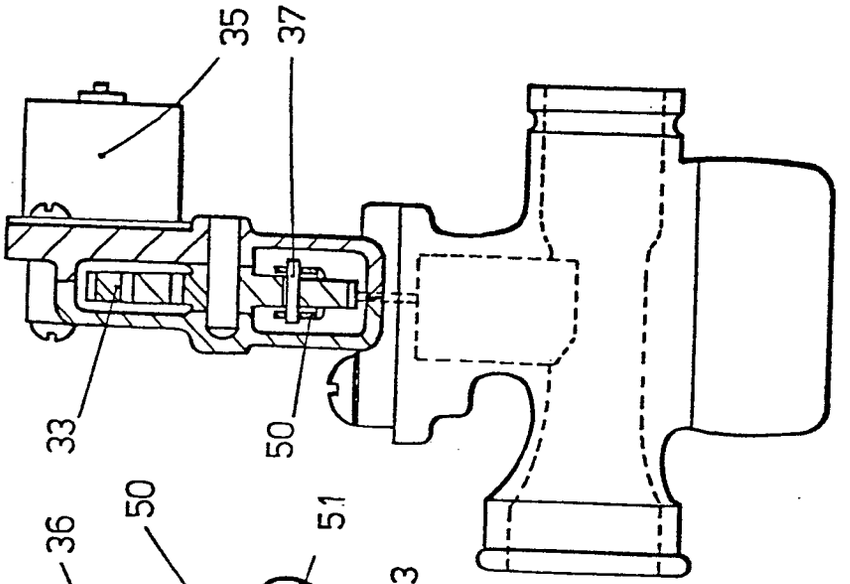

Fig.9B

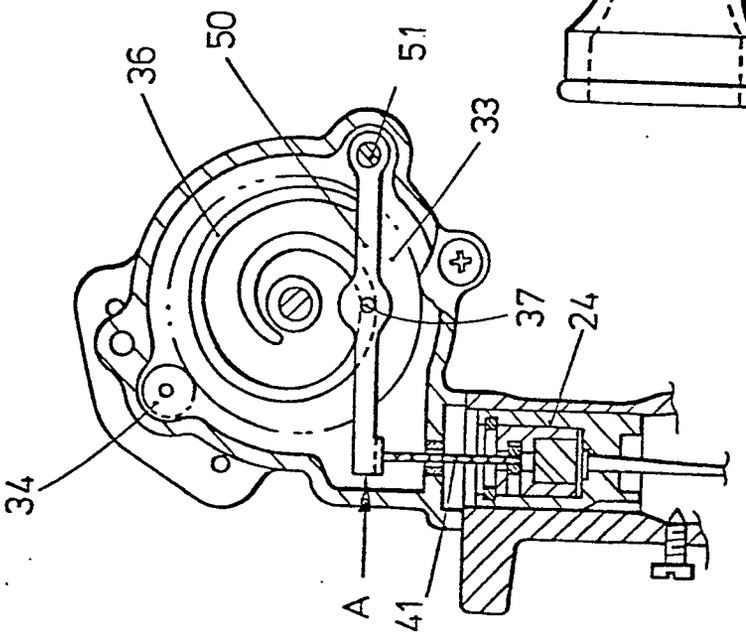

Fig.9A

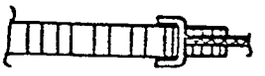

Fig.9C

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 10 7462

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	FR - A - 2 335 753 (BMW) * Page 1, lines 1-5, 23-40; page 2, lines 1-14; page 2, lines 36-40; page 3, lines 1-21, 27-30, 35-40; page 4, lines 1-5 * & GB - A - 1 562 630	1,7
A	FR - A - 889 441 (MOTEURS RENAULT POUR L'AVIATION) * Page 1, lines 1-4; 13-25; figure *	1
A	US - A - 2 680 818 (RINGWALD) * Column 1, lines 1-4, 35-40; column 2, lines 24-33; column 3, lines 12-29; 55-75; column 4, lines 1-34 *	1
A	GB - A - 988 657 (MIZUNO) * Page 1, lines 11-44; 70-88; page 2, lines 1-17,43-80; figures 1,2 *	1

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 02 D 11/10

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

F 02 D
F 16 H
B 60 K

CATEGORY OF CITED DOCUMENTS

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T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25-02-1981	JORIS