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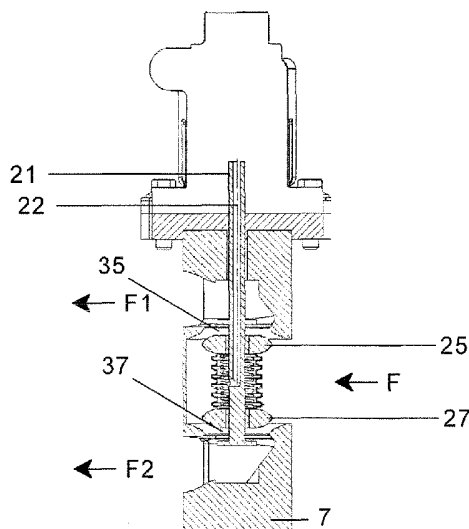
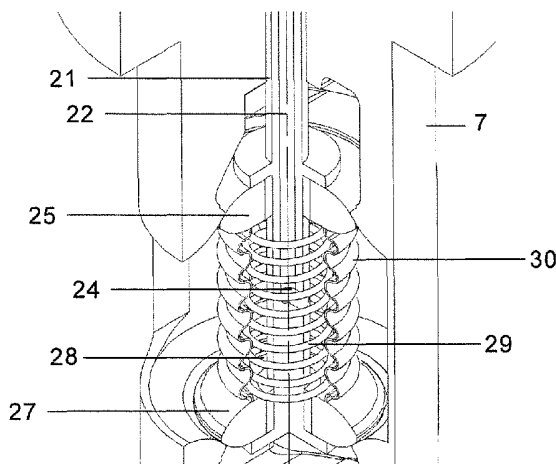
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ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: BY-PASS AND EGR INTEGRATED VALVE



(57) Abstract: A by-pass and EGR integrated valve for regulating the passage of a gas from one/two inlet area/areas (1; 53, 55) towards one/two outlet area/areas (3, 5; 51), comprising a body (7) with an internal chamber (9) where the inlet gas is received through the inlet passages (11; 63, 65) and directed towards the outlet passages (13, 15; 61) through inlet/outlet openings (35, 37), and a member for closing the outlet passages (13, 15) or inlet passages (63, 65) is formed by a pin (21) than can be axially actuated along the pin (21) between two stops (31, 33) fixed thereto, and additionally a bellows (30) controlled by a pneumatic actuator.

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**BY-PASS AND EGR INTEGRATED VALVE****TECHNICAL FIELD**

5 The present invention refers to a valve integrating a by-pass function and a regulating function in one part, and more particularly to a valve for fulfilling these two functions in an exhaust gas recirculation (EGR) system of an internal combustion engine.

**BACKGROUND ART**

10 Different exhaust gas recirculation systems in internal combustion engines, called EGR systems, are known in the current state of the art.

These systems recirculate exhaust gases from the exhaust manifold to the intake manifold of the engine after subjecting  
15 them to a cooling process for the purpose of reducing the amount of NOx emissions.

As the cooling of the exhaust gases is not appropriate in certain operating conditions of the engine, the use of by-pass pipes has been proposed in the art, allowing the recirculation  
20 of exhaust gases without passing through the heat exchanger under the control of a valve channeling the exhaust gases either towards the heat exchanger or else towards said by-pass pipe, according to pre-established conditions. Different proposals for by-pass valves are known in this sense, such as those disclosed  
25 in patent EP 0 971 427 B1 and in patent applications WO 03/085252 A2, WO 03/062625 A1, EP 1 291 509 A2 and EP 1 355 058 A2.

On the other hand, different types of valves used for controlling the amount of gas to recirculate, generally referred  
30 to as EGR valves, are known in the state of the art.

**DISCLOSURE OF INVENTION**

The present invention proposes a by-pass valve and integrated EGR for regulating the passage of a gas from an inlet area to two outlet areas or from two inlet areas to an outlet  
35 area, comprising the following main elements:

- A body with an internal chamber where the inlet gas is received through one/two inlet passage/passages, coming from the

inlet area/areas, and directed towards one/two outlet passage/passages leading to the outlet area/areas. The internal chamber has two inlet/outlet openings, the opening/closing of which constitutes the objective of the valve.

5           - A closing member formed by a pin that can be axially actuated by means of an actuator with two plates for opening/closing said openings joined by a spring, the plate-spring assembly being able to be shifted along the pin between two stops fixed thereto.

10           The valve operation can be schematically described as follows:

          - When the valve is closed, said plates close the inlet/outlet openings of the chamber as a result of the force of the spring.

15           - In order to open one of the openings, the pin is shifted in the suitable direction such that the stop next to the plate which closes it drags it towards the other plate which remains closing the other opening.

          A feature of the valve according to the present invention is that it can perform both the function of controlling the amount of gas to be recirculated, as well as the function of choosing the circuit through which the gas must circulate, whereby it can replace the two separate valves (EGR valve and by-pass valve) traditionally used in EGR systems.

25           The closing member can further comprise a bellows joined to the two plates and demarcating an enclosure with the pin inside and a pneumatic actuator which allows regulating the pressure inside said enclosure so as to change the axial dimension of the bellows and therefore the distance between the two plates. When  
30 this pneumatic actuator creates a vacuum inside the enclosure, the bellows is compressed, making the plates approach one another, enabling the simultaneous opening of the two openings of the valve.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

35           Other features and advantages of the present invention can be gathered from the following detailed description of an illustrative and by no means limiting embodiment of its object

in relation to the attached drawings.

Figures 1 and 2 show perspective views, from different positions, of a valve according to the present invention with an inlet area and two outlet areas.

5           Figures 3a, 3b and 3c are cross sectional views of the valve represented in Figures 1 and 2 when the valve is closed and when it is open towards both outlet passages, respectively.

10           Figures 4a, 4b and 4c show cross sectional views of a valve according to the present invention with two inlet areas and one outlet area when the valve is closed and when it is open for both of the inlet passages, respectively.

Figure 5 shows a perspective view of a valve according to the present invention with one inlet or outlet area in its lower portion.

15           Figure 6 shows a cross sectional view of the valve represented in Figure 5.

Figure 7 shows a perspective view of a valve according to the present invention, wherein the closing member further includes a bellows joining the plates.

20           Figure 8 shows a cross sectional view of the valve represented in Figure 7 in a situation in which the two openings of the valves are open.

#### **BEST MODE FOR CARRYING OUT THE INVENTION**

25           In the embodiment of the invention which will first be described in reference to Figures 1-3, it can be seen that the valve according to the invention is formed by a body 7 internally housing a pin 21 incorporating two plates 25, 27 coupled thereto, joined by a spring 29, between two stops 31, 33.

30           An internal chamber 9, a gas inlet passage 11 leading to the valve from the inlet area 1 and two gas outlet passages 13, 15 leading to the outlet areas 3, 5, and two openings 35, 37 communicating the chamber 9 with the outlet passages 13, 15 can be observed on the body 7.

35           As shown in Figure 3a, when the valve is closed the two plates close the openings 35, 37 as a result of the force of the spring 29.

As is shown in Figure 3b, in order to open the valve so

that the inlet gas exits through the outlet passage 15 following the arrow F, the pin 21 is actuated by means of an actuator (not represented) housed in the block 8 so that it shifts upwards with enough force so that the stop 33 drags the plate 27, 5 overcoming the strength of the spring 29. In this embodiment, the other stop 31 limits the movement of the pin 21 as it comes into contact with the body 7, but the end of the run is not necessarily defined by the stop, but the actuator can determine it in other manners. The plate 27 can therefore be located 10 between the rest position represented in Figure 3a and the maximal opening position represented in Figure 3b, controlling the amount of gas through the magnitude of its shifting.

Similarly and according to Figure 3c, in order to open the valve so that the inlet gas exits through the outlet passage 13 15 following arrow F, the pin 21 is actuated by means of said actuator which shifts downwards with enough force so that the stop 31 drags the plate 25 overcoming the strength of the spring 29. The other stop 33 limits the movement of the pin 21 as it comes into contact with the body 7 in this embodiment, but as 20 was previously indicated, it may be determined by the actuator itself. The plate 25 can therefore be located between the rest position represented in Figure 3a and the maximal opening position represented in Figure 3c, controlling the amount of gas through the magnitude of its shifting.

25 This valve with one inlet area and two outlet areas is particularly applicable for an EGR system heat exchanger with a by-pass pipe, the inlet area 1 being connected to the exhaust manifold and the outlet areas 3, 5 to the cooling module and to the by-pass pipe.

30 As previously indicated and according to that shown in Figure 4a, the valve can have two inlet areas 53, 55 and one outlet area 51. Figures 4b and 4c show the valve operation so that the gas passes from the inlet passage 65 to the outlet assembly 61 and from inlet passage 63 to the outlet passage 61 35 by means of a dynamic identical to that of the valve represented in the previous figures.

This valve with two inlet areas and one outlet area is

particularly applicable for an EGR system heat exchanger with a by-pass pipe, the two inlet areas 53, 55 being connected to the cooling module and to the by-pass pipe and the outlet area 51 to the intake manifold.

5 In the embodiment shown in Figures 5 and 6, one of the inlets/outlets is arranged in the lower portion but as can particularly be deduced from Figure 6, valve operation is identical to that explained above.

10 In the embodiment shown in Figures 7 and 8, it is observed that the closing member further includes a bellows 30 joined to the plates 25, 27, demarcating an enclosure 28 with the pin 21 inside. A pneumatic actuator (not represented) can create a vacuum in the enclosure 28 through the passage 22 arranged inside the pin 21 and ending within it at the elbow 24, causing  
15 a variation in the axial dimension of the bellows 30 which allows, as particularly shown in Figure 8, the simultaneous opening of the two inlet openings 35, 37.

For its part, with respect to the actuator axially actuating the pin 21, the bellows 30 behaves similarly to the  
20 spring 29.

Both actuators can function independently or simultaneously according to the desired results.

Four possible situations of a valve with one inlet area and two outlet areas for an EGR system heat exchanger with a by-pass  
25 pipe will be described below as an example:

- Full power engine operation: Valve is closed. The two outlet openings 35, 37 leading towards, respectively, the cooling module and the by-pass pipe are closed as they are in contact with the plates 25, 27 due to the effect of the spring  
30 29 (Figure 3a, wherein the bellows 30 is not represented, which exercises no relevant function in this situation in which the pneumatic actuator is inactive).

- Engine warm-up phase: The outlet opening 35 leading towards the cooling module is closed and the outlet opening 37  
35 leading towards the by-pass pipe is open due to the effect of the actuator moving the pin 21 in combination with the stop 33 dragging the plate 27 (Figure 3b, wherein the bellows 30 is not

represented, which exercises no relevant function in this situation in which the pneumatic actuator is inactive).

- Motor regulating phase: The two openings 35, 37 are open due to the effect of the pneumatic actuator (Figure 8, wherein  
5 the vacuum created by the pneumatic actuator in the enclosure 28 makes the plates 25, 27 approach one another, overcoming the strength of the spring 29). In this situation, the other actuator can also be actuated so as to distribute the gas F through the two outlet openings 35, 37 in the desired ratio  
10 between the flow F1 exiting towards the cooling module and the flow F2 exiting towards the by-pass pipe.

- Hot engine phase: The outlet opening 35 leading to the cooling module is open and the outlet opening 37 leading to the by-pass pipe is closed due to the effect of the actuator moving  
15 the pin 21 in combination with the stop 31 dragging the plate 25 (Figure 3c, wherein the bellows 30 is not represented, which exercises no relevant function in this situation in which the pneumatic actuator is inactive).

An additional advantage of this embodiment is that the  
20 bellows 30 exercises a function of protecting the pin 21 from corrosion and preventing unwanted incrustations.

As the person skilled in the art will understand, the outer shape of the body 7 of the valve and of the block 8 joined to it suggests a shape that is "insertable" in the appropriate place  
25 of the EGR system and may require as many additional members necessary for carrying out the corresponding couplings.

With respect to the described embodiments of the invention, those modifications comprised within the scope defined by the following claims can be introduced.

**CLAIMS**

1.- A valve for regulating the passage of a gas from an inlet area (1) to two outlet areas (3, 5), or from two inlet areas (53, 55) to an outlet area (51), comprising a body (7) with an internal chamber (9) where the inlet gas is received through the inlet passages (11; 63, 65) and is directed towards the outlet passages (13, 15; 61), and a member for closing the outlet passages (13, 15) or inlet passages (63, 65), respectively, characterized in that:

10 a) the closing member is formed by a pin (21) that can be axially actuated by means of an actuator, with two plates (25, 27) joined by a spring (29) and shiftable along the pin (21) between two stops (31, 33) fixed thereto;

15 b) the body (7) includes inlet/outlet openings (35, 37) leading to/coming from the chamber (9) cooperating with the plates (25, 27), which are located between them, for their opening and closing, using the force of the spring (29) to close the openings (35, 37) when the valve is closed, and using the shifting of the pin (21) in either direction so that one of the plates (25, 27) shifts when dragged by one of the stops (31, 33), opening one of the openings (35, 37) and keeping the other one closed.

2.- A valve according to claim 1, characterized in that the actuator has means for controlling the magnitude of shifting of the pin (21), facilitating a means of regulating the amount of gas passing through the opened opening.

3.- A valve according to claim 1, characterized in that the closing member also comprises a bellows (30) joined to the two plates (25, 27) and demarcating an enclosure (28) with the pin (21) inside and a pneumatic actuator which allows creating a vacuum inside said enclosure (28) so as to reduce the axial dimension of the bellows (39), allowing the simultaneous opening of the two openings (35, 37).

4. A valve according to claim 3, characterized in that the pneumatic actuator acts on the enclosure (28) through a passage (22) arranged inside the pin (21) and ending inside it.

5.- A valve according to any of the previous claims,



characterized in that the body (7) is configured so as to be coupled to an EGR system heat exchanger with a by-pass pipe, the inlet area (1) being connected to the exhaust manifold and the outlet areas (3, 5) to the cooling module and to the by-pass pipe.

5  
6.- A valve according to any of the previous claims, characterized in that the body (7) is configured so as to be coupled to an EGR system heat exchanger with a by-pass pipe, the two inlet areas (53, 55) being connected to the cooling module and to the by-pass pipe and the outlet area (51) to the intake manifold.

10

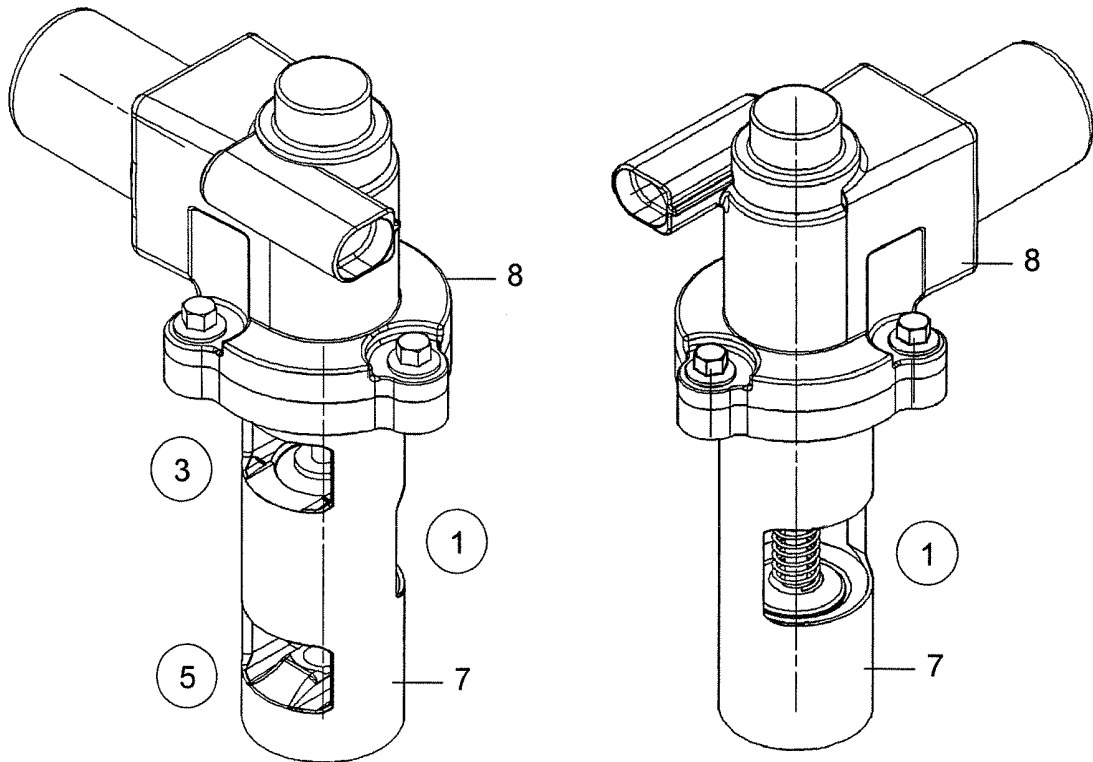


FIG. 1

FIG. 2

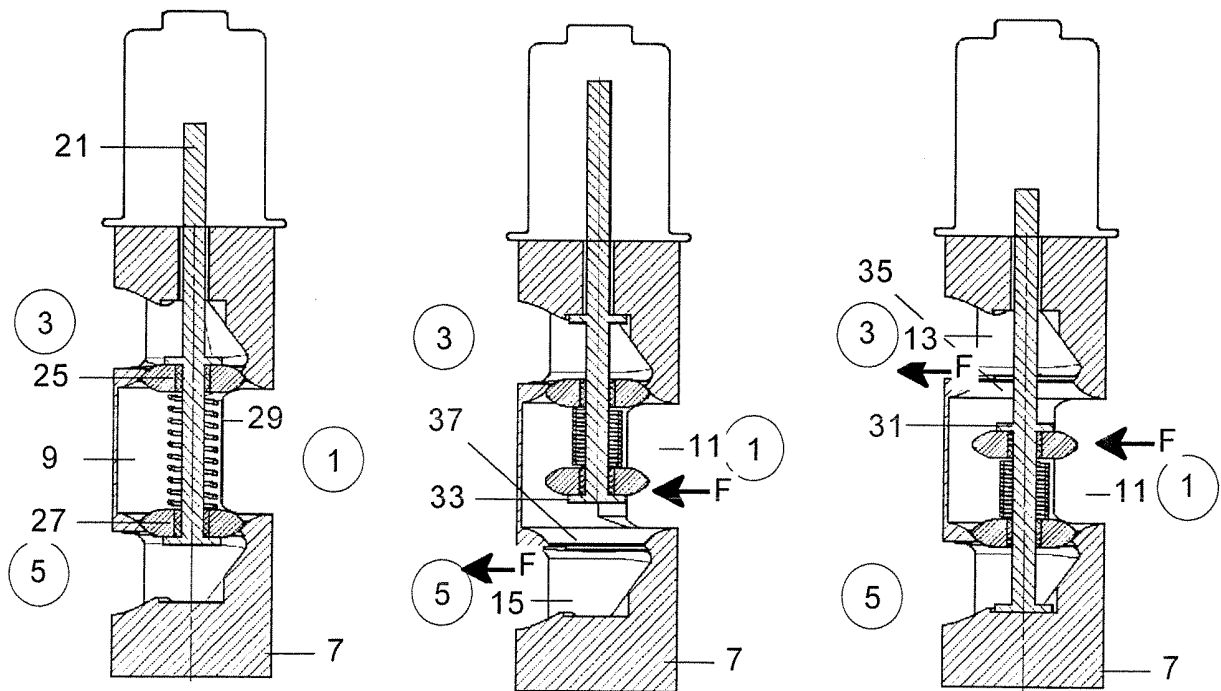


FIG. 3a

FIG. 3b

FIG. 3c

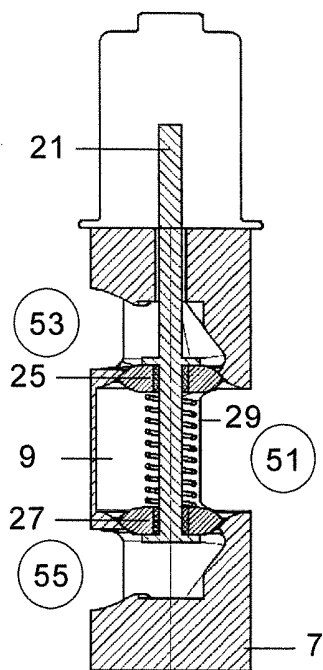


FIG. 4a

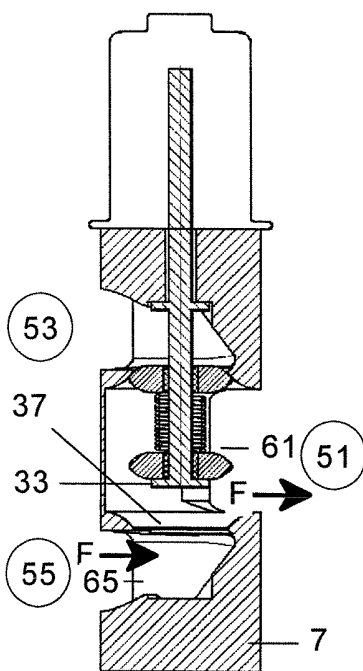


FIG. 4b

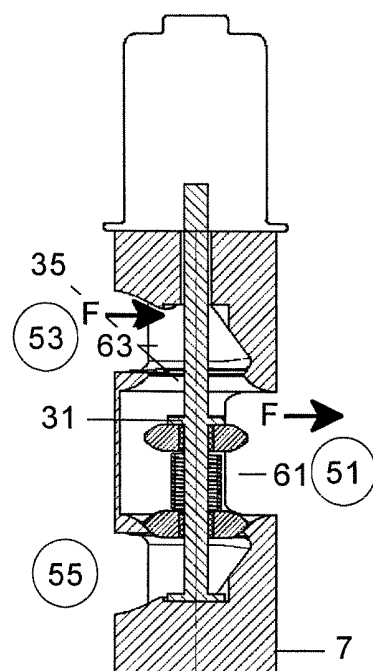


FIG. 4c

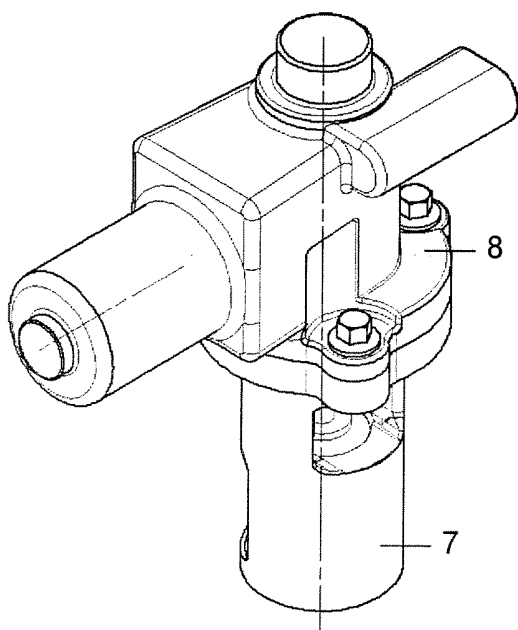


FIG. 5

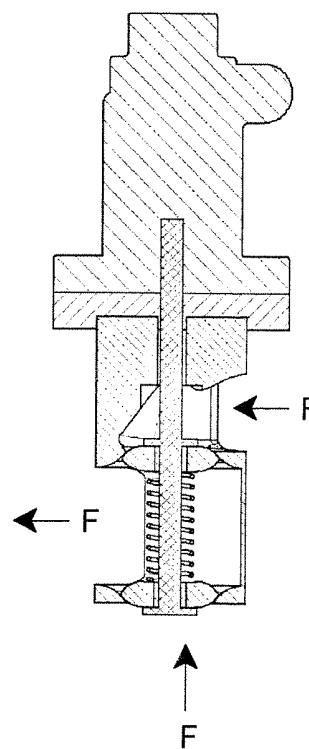


FIG. 6

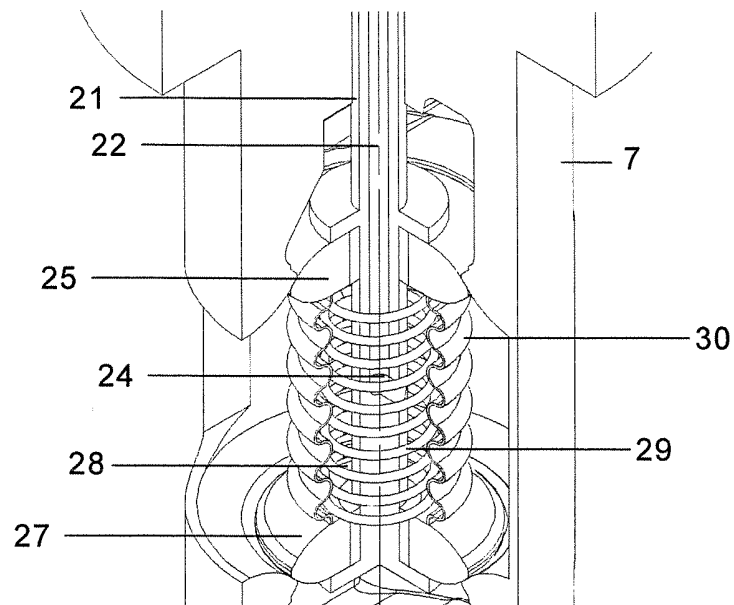


FIG. 7

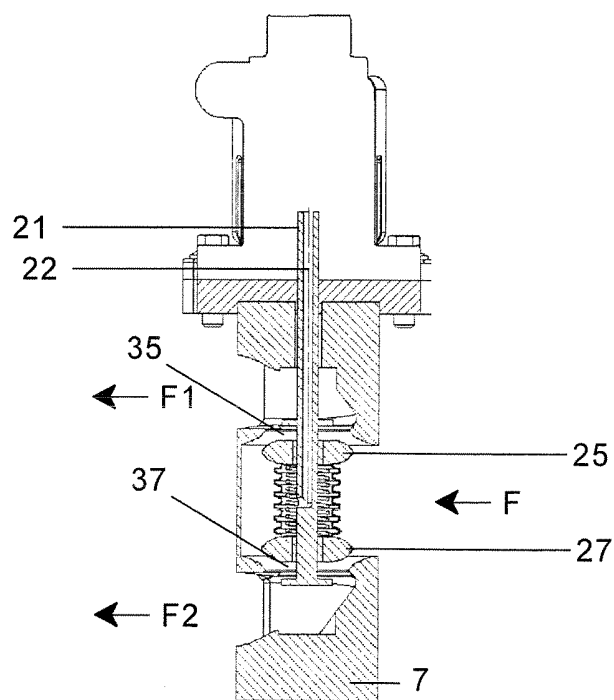


FIG. 8

## INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER  
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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 197 33 964 A1 (VOLKSWAGEN AG, 38440 WOLFSBURG, DE) 11 February 1999 (1999-02-11) column 2, line 29 - column 3, line 43; figures 1,2,5,6	1,2,5,6
A	FR 2 827 011 A (RENAULT) 10 January 2003 (2003-01-10) page 4, line 26 - page 8, line 17; figures 2-4	1

 Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19733964	A1	11-02-1999	NONE
FR 2827011	A	10-01-2003	NONE