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(54) **Title:** COMPRESSED-GAS BYPASS VALVEN

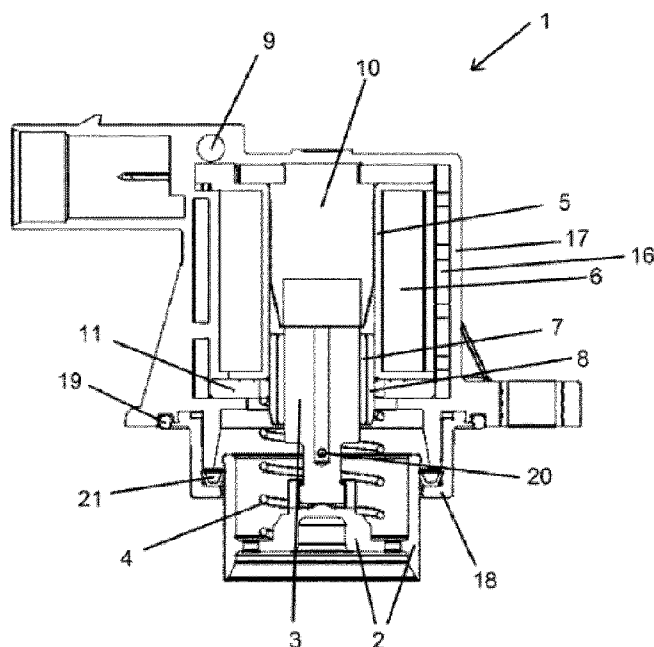


Fig. 2

(57) **Abstract:** A compressed-gas bypass valve (1) for a turbocharged engine, comprising: a moveable valve core, comprising a valve head (2) and an armature (3) in a floating connection with the valve head (2); an elastic component (4) for pressing the valve head (2) into a non-actuated position; a bushing (7) provided around the periphery of the armature (3), the bushing (7) being used to guide the movement of the armature (3); and a wire reel (5) at least partially surrounding the bushing (7), a coil (6) being wound on the wire reel (5). The compressed-gas bypass valve of the present utility model uses the electromagnetic force produced by a solenoid valve as a driving force, and has a smaller size, a simple structure, and even better performance.



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Description

Compressed-gas bypass valven

5 **Technical Field**

The present utility model relates to the field of machinery, in particular to a compressed-gas bypass valve for a turbocharged engine.

10

Background art

There are already a large number of electronic valves applied in the technical field of automobiles. Of these, the vacuum valve is one of the more commonly used types. The shortcomings of such a vacuum valve are that it has a large size and structural complexity due to the need for auxiliary parts such as a vacuum channel and valve. Another shortcoming of the vacuum valve is that it has a long response time.

20

Content of the utility model

The problem solved by the present utility model is to provide a compressed-gas bypass valve, wherein the compressed-gas bypass valve has a simple structure and improved performance while being of smaller dimensions.

To solve the above problem, the compressed-gas bypass valve provided by the present utility model comprises: a moveable valve core, comprising a valve head and an armature in a floating connection with the valve head; an elastic component for pressing the valve head into a non-actuated position; a bushing provided around the periphery of the armature, the bushing being used to guide the movement of the armature; and a wire reel at least partially surrounding the bushing, a coil being wound on the wire reel. The compressed-gas bypass valve of the present utility model uses the electromagnetic force produced by a solenoid valve

as a driving force, and has a smaller size, a simple structure, and even better performance.

5 The compressed-gas bypass valve of the present utility model has the following advantages with respect to the prior art: based on mature solenoid valve technology in the prior art, a compressed-gas bypass valve with a smaller size, a simple structure, and even better performance is designed, using the electro-magnetic force produced by a solenoid valve to replace a vacuum
10 as a driving force.

Description of the accompanying drawings

15 Fig. 1 shows the structure and layout of a compressed-gas back-flow pipeline having a compressed-gas bypass valve according to the present utility model.

20 Fig. 2 shows schematically a sectional view of an embodiment of the compressed-gas bypass valve according to the present utility model.

Fig. 3 shows schematically an exploded view of the components of an embodiment of the compressed-gas bypass valve.

25 Fig. 4 shows schematically a graph comparing the performance curves of a solenoid valve with a magnetically permeable sleeve and a solenoid valve with no magnetically permeable sleeve.

30 Fig. 5 shows a schematic view of the coil in an embodiment of the solenoid valve.

Fig. 6 shows a graph comparing the performance curves of a completely sealed coil and a non-sealed coil.

35

Fig. 7 shows a schematic diagram of a floating connection between a valve head and an armature, established by means of a DGBB bearing.

5 Fig. 8 shows a schematic diagram of a floating connection between a valve head and an armature, established by means of a snap-fit.

10 Fig. 9 shows a partial magnified schematic diagram of the direct floating connection between the valve head and the armature in Fig. 2.

Particular embodiments

15 Compressed-gas bypass valves according to embodiments of the present invention are described below with reference to the accompanying drawings. In the description which follows, many specific details are expounded to give those skilled in the art a more comprehensive understanding of the present utility model. 20 However, it will be clear to those skilled in the art that some of these specific details could be omitted in the implementation of the present utility model. Moreover, it should be appreciated that the present utility model is by no means limited to the specific embodiments presented. On the contrary, it would be 25 possible to realize the present utility model using any combination of the following features and key elements, regardless of whether they relate to different embodiments. Therefore, the following aspects, features, embodiments and advantages serve the sole purpose of illustration, and should not be regarded as 30 key elements or definitions of the claims, unless clearly mentioned in the claims.

Turbocharged engines, i.e. engines with a turbocharger, are being used in ever increasing numbers in modern motorized vehicles, to 35 improve energy efficiency. In turbocharged engines, exhaust gases drive the turbocharger turbine disposed in the exhaust pipeline, thereby simultaneously making an air compressor

connected to the turbine compress incoming air. The air that has undergone compression (hereinafter referred to as compressed air) passes through a compressed-air intercooler to arrive at the throttle valve, thereby entering the engine cylinder for combustion.

Fig. 1 shows the structure and layout of a compressed-gas back-flow pipeline having a compressed-gas bypass valve according to the present utility model. According to the present utility model, a compressed-gas back-flow pipeline connected in parallel with the air compressor is provided upstream of the compressed-air intercooler, to enable compressed gas to flow from the air compressor outlet back to the air compressor inlet. The back-flow of compressed gas can prevent a surge in the gas flow, and thereby prevent damage to the turbine blades caused by a surge jitter. Moreover, the back-flow of compressed gas can also allow the turbine to keep rotating to reduce turbine lag during acceleration and protect the throttle valve.

As Fig. 1 shows, a compressed-gas bypass valve is provided in the compressed-gas back-flow pipeline. When not energized, the compressed-gas bypass valve keeps the back-flow pipeline closed. This being the case, compressed air passes through the compressed-air intercooler, throttle valve and intake manifold to enter the engine cylinders. When energized, the compressed-gas bypass valve opens the back-flow pipeline, and compressed air can flow back to the intake end of the air compressor via the compressed-gas bypass valve.

Figs. 2 and 3 show schematically a sectional view and an exploded view, respectively, of an embodiment of the compressed-gas bypass valve according to the present utility model. As Figs. 2 - 3 show, the compressed-gas bypass valve 1 comprises a moveable valve core and an elastic component 4 for pressing the moveable core into a non-actuated position, the moveable core comprising a valve head 2 and an armature 3. As Figs. 2 and 9 show, a direct floating connection can be established between the valve head 2 and

armature 3. A spherical structure which facilitates floating of the valve head 2 and armature 3 can be clearly seen in Fig. 9; the spherical structure should be a protrusion on that side of the valve head 2 which faces the armature 3. Alternatively, as shown in Fig. 7, a floating connection can be established between the valve head 2 and armature 3 by means of a support device, such as a DGBB bearing 15 (deep groove ball bearing). The DGBB bearing is snap-connected to the valve head 2; the connection between the DGBB bearing and the armature 3 is accomplished by means of an interference fit. Floating of the valve head 2 and armature 3 relative to one another can be achieved by adjusting the clearance of the DGBB bearing. Alternatively, as shown in Fig. 8, a floating connection is established between the valve head 2 and armature 3 by a snap-fit. Specifically, a bowl-shaped connection element 25 can be used to establish a floating connection between the valve head 2 and armature 3 by a snap-fit. The periphery of the bowl-shaped connection element 25 is connected to the valve head 2, and there is a through-hole in the center of the bowl-shaped connection element 25, the armature 3 being snap-fitted in the through-hole. For example, the elastic component 4 may be a helical compression spring. When power is cut off from the compressed-gas bypass valve 1, the valve head 2 presses downwards on a valve seat (not shown) under the action of gravity and of the elastic component 4, thereby closing the gas passage.

A bushing 7 is provided around the periphery of the armature 3, the bushing 7 being used as a guiding structure for the movement of the armature 3.

The compressed-gas bypass valve 1 further comprises a wire reel 5 which at least partially surrounds the bushing 7. A coil 6 is wound on the wire reel 5.

In addition, multiple stators for enhancing the magnetic force of the compressed-gas bypass valve 1 may be provided, e.g. a first stator 10 disposed above the armature 3, and an annular second

stator 11 arranged around the armature. Each stator is made of magnetically permeable material.

When the compressed-gas bypass valve 1 is energized, a magnetic
5 circuit is formed by the first stator 10, the second stator 11 and the armature 3, and under the action of the electromagnetic force produced by the coil 6, the armature 3 moves upwards, simultaneously driving the valve head 2 upwards, opening the compressed-gas bypass valve 1 and thereby opening the gas
10 passage.

The compressed-gas bypass valve 1 further comprises a housing 16 which surrounds the coil 6, an outer encapsulating element 17 which surrounds the housing 16, and a protective cover 18 around
15 the valve head 2. Preferably, the housing 16 is made of a magnetically permeable material to enhance the magnetic force, and together with the coil 6 forms a completely sealed coil structure. A sealing element for sealing, such as an O-ring 19, is provided between the outer encapsulating element 17 and the
20 protective cover 18. A sealing element such as a V-ring 21 is provided between the protective cover 18 and the valve head 2.

In one advantageous embodiment, the armature 3 of the compressed-gas bypass valve 1 is cylindrical.
25

In one advantageous embodiment, a lubricating layer is provided on an inner peripheral wall of the bushing 7 to facilitate guiding of the armature 3, while also reducing resistance to movement. With such a design, there is no need to plate the armature 3 itself
30 with a lubricating layer separately, and so costs are reduced.

In one advantageous variation, the bushing 7 is made of a magnetically permeable material, so that the magnetic force of the solenoid valve is increased and performance is boosted.
35

In one advantageous variation, a sleeve 8 is fitted between the bushing 7 and the wire reel 5; installation of the sleeve 8 may

for example be accomplished by means of an interference fit. Such a structure helps to increase the magnetic force of the compressed-gas bypass valve 1, thereby optimizing performance.

5 In one advantageous variation, the sleeve 8 is made of a magnetically permeable material. Not only can this give more room for optimizing the stator structure, but the use of a magnetically permeable material for the sleeve itself also plays a definite role in terms of improving performance. Fig. 4 shows schematically a graph comparing the performance curves of a solenoid valve with a magnetically permeable sleeve and a solenoid valve with no magnetically permeable sleeve. It can be seen from Fig. 4 that under the same conditions, with the size of the solenoid valve remaining unchanged, the magnetic force can be increased by about 53.8% overall. Correspondingly, under the same magnetic force supply conditions, the dimensions of the compressed-gas bypass valve 1 can be reduced.

In one advantageous embodiment, the armature 3 is hollow and has a vent hole 20, to prevent a vacuum (which would hinder movement) from forming during movement. Preferably, the vent hole 20 is located halfway along the length of the armature 3. Preferably, the fewer the vent holes 20, the better; the smaller the size thereof, the better.

25 Fig. 5 shows a schematic view of the coil 6 in an advantageous embodiment of the solenoid valve. It can be seen from Fig. 5 that the coil 6 has a completely sealed structure. Fig. 6 shows a graph comparing the performance curves of a completely sealed coil and a non-sealed coil. It can be seen from Fig. 6 that a coil with a completely sealed structure is not only conducive to an increased magnetic force, but also more stable than a non-sealed coil in terms of performance.

35 In one advantageous embodiment, as Figs. 2 - 3 show, the compressed-gas bypass valve 1 further comprises an electronic component 9 for absorbing pulse energy. In such an embodiment,

the provision of the electronic component 9 for absorbing pulse energy can protect the valve body from being damaged by a sudden change in external voltage, such as a pulse. In addition, the electronic component 9 for absorbing pulse energy can absorb
5 energy produced by the valve body, protecting the customer's electricity supply terminal from damage and satisfying the EMC requirements of the automobile industry. Moreover, the electronic component for absorbing pulse energy may be various electronic components known to those skilled in the art, such as
10 a diode. Thus the compressed-gas bypass valve 1 can take the form of a diverse range of products, ensuring that it is suited to different customer requirements.

Finally, in one advantageous embodiment, the wire reel 5 is made
15 by injection molding. On the wire reel 5 are provided multiple, preferably 2, annular ribs, so as to prevent plastic from entering and filling crevices during injection molding of the plastic, causing valve failure.

20 Although the present utility model has been disclosed above by way of preferred embodiments, it is by no means defined thereby. Any changes or modifications made by any person skilled in the art without departing from the spirit and scope of the present utility model should be included within the scope of protection
25 thereof. Thus the scope defined by the claims should be regarded as the scope of protection of the present utility model.

Patent claims

1. A compressed-gas bypass valve (1) for a turbocharged engine,
characterized in that it comprises:
5 a moveable valve core, comprising a valve head (2) and an
armature (3) in a floating connection with the valve head (2);
an elastic component (4) for pressing the valve head (2) into
a non-actuated position;
a bushing (7) provided around the periphery of the armature
10 (3), the bushing (7) being used to guide the movement of the
armature (3); and
a wire reel (5) at least partially surrounding the bushing
(7), a coil (6) being wound on the wire reel (5).
- 15 2. The compressed-gas bypass valve as claimed in claim 1,
characterized in that the armature (3) is cylindrical.
3. The compressed-gas bypass valve as claimed in claim 1,
characterized in that a lubricating layer is provided on an
20 inner peripheral wall of the bushing (7).
4. The compressed-gas bypass valve as claimed in claim 1,
characterized in that the bushing (7) is made of magnetically
permeable material.
- 25 5. The compressed-gas bypass valve as claimed in claim 1,
characterized in that a sleeve (8) is fitted between the
bushing (7) and the wire reel (5).
- 30 6. The compressed-gas bypass valve as claimed in claim 5,
characterized in that there is an interference fit between
the bushing (7) and the sleeve (8).
- 35 7. The compressed-gas bypass valve as claimed in claim 5,
characterized in that the sleeve (8) is made of a magnetically
permeable material.

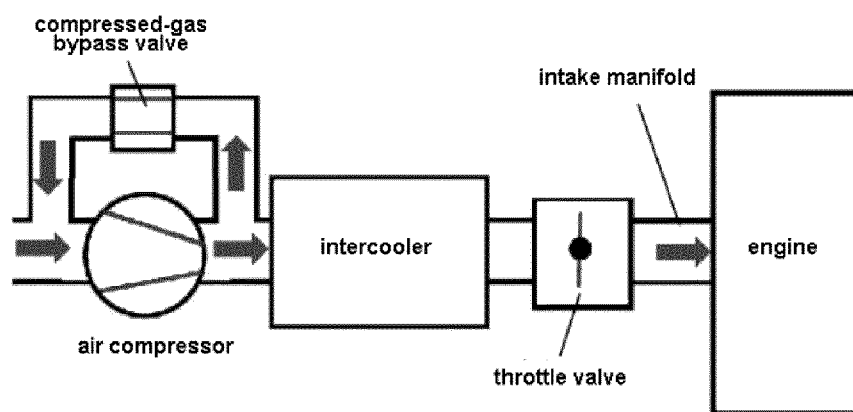
8. The compressed-gas bypass valve as claimed in claim 1, characterized in that the armature (3) has a hollow structure and a vent hole (20) is provided in the armature (3).
- 5 9. The compressed-gas bypass valve as claimed in claim 8, characterized in that the vent hole is located halfway along the length of the armature.
- 10 10. The compressed-gas bypass valve as claimed in claim 1, characterized in that it further comprises a housing (16) which surrounds the coil, the housing (16) and the coil (6) forming a completely sealed structure.
- 15 11. The compressed-gas bypass valve as claimed in claim 1, characterized in that the compressed-gas bypass valve (1) further comprises an electronic component (9) for absorbing pulse energy.
- 20 12. The compressed-gas bypass valve as claimed in claim 11, characterized in that the electronic component (9) for absorbing pulse energy is a diode.
- 25 13. The compressed-gas bypass valve as claimed in claim 1, characterized in that at least 2 annular ribs are provided on the wire reel (5).
- 30 14. The compressed-gas bypass valve as claimed in claim 1, characterized in that a floating connection is established between the valve head (2) and the armature (3) by means of a protrusion on that side of the valve head (2) which faces the armature (3).
- 35 15. The compressed-gas bypass valve as claimed in claim 1, characterized in that a floating connection is established between the valve head (2) and the armature (3) by means of a deep groove ball bearing (15), the deep groove ball bearing (15) being snap-connected to the valve head (2), and the

connection between the deep groove ball bearing (15) and the armature (3) being accomplished by means of an interference fit.

- 5 16. The compressed-gas bypass valve as claimed in claim 1,
characterized in that a floating connection between the valve
head (2) and the armature (3) by means of a bowl-shaped
connection element (25), the periphery of the bowl-shaped
connection element (25) being connected to the valve head
10 (2), a through-hole being provided in the center of the
bowl-shaped connection element (25), and the armature (3)
being snap-fitted in the through-hole.

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Drawings accompanying the description

**Fig. 1**

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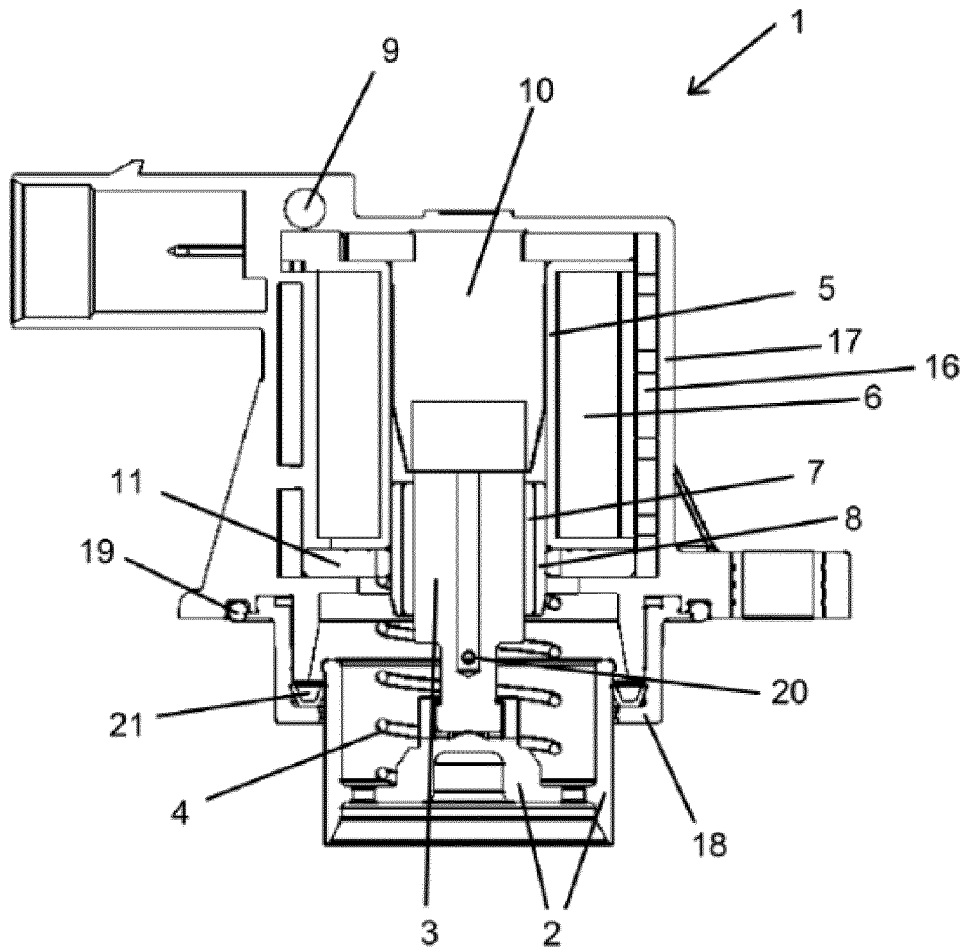


Fig. 2

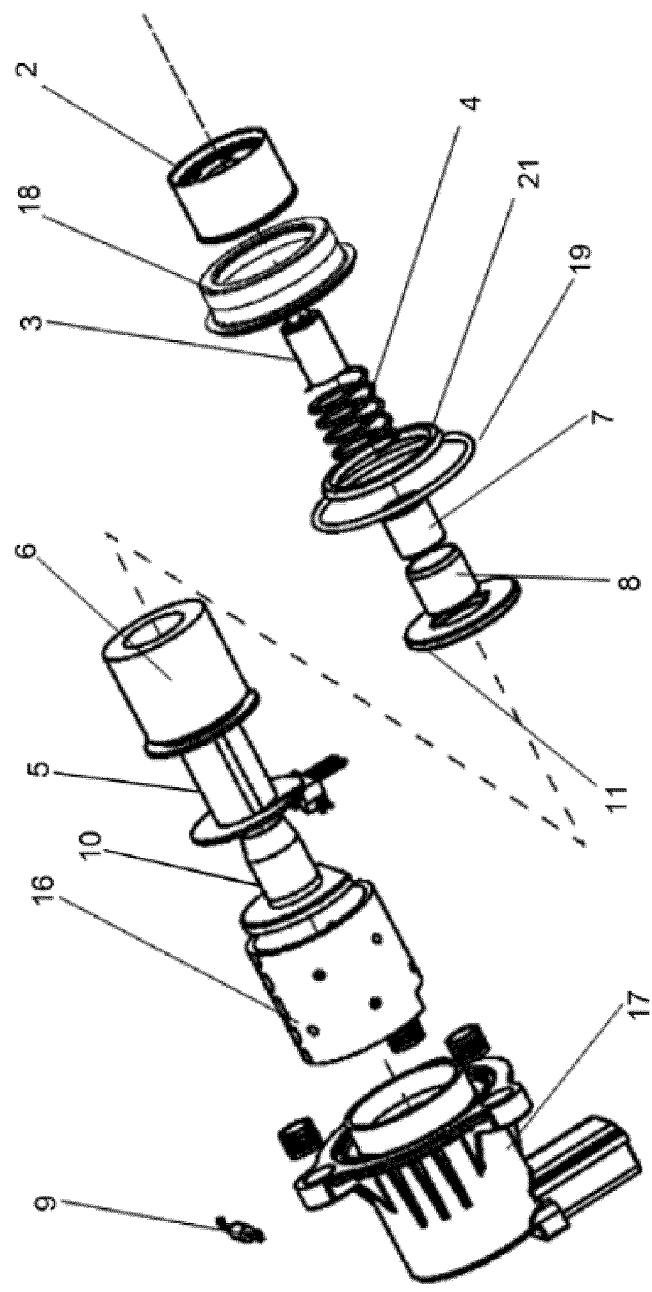


Fig. 3

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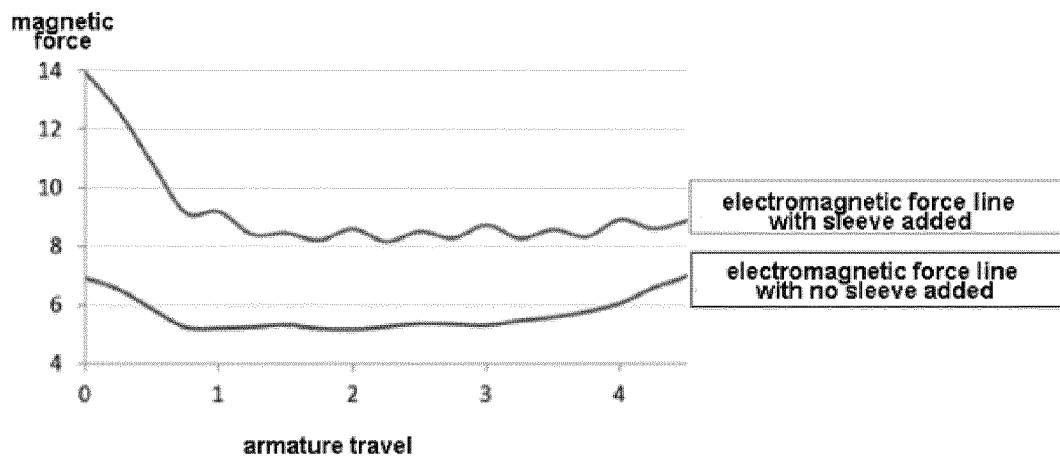


Fig. 4

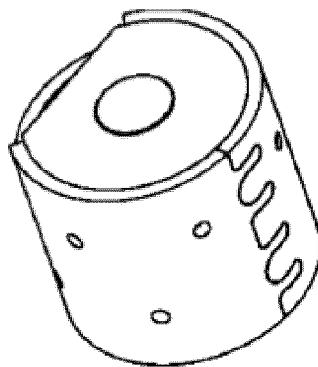


Fig. 5

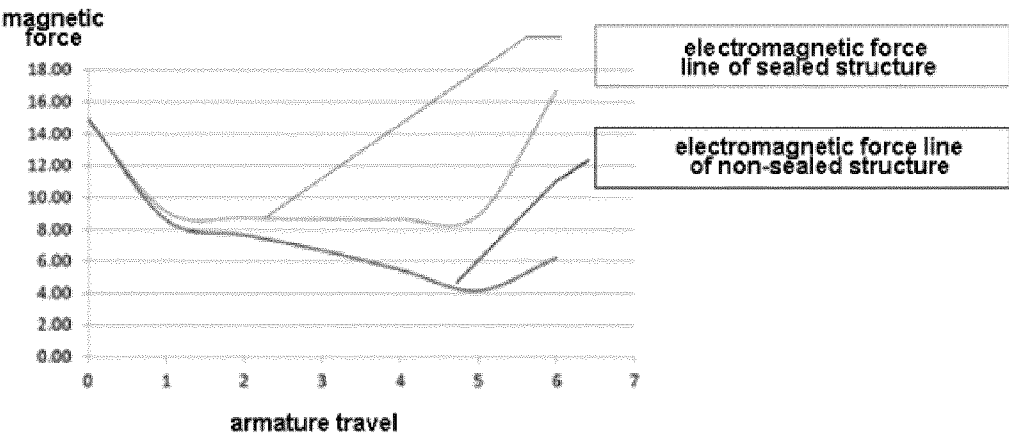


Fig. 6

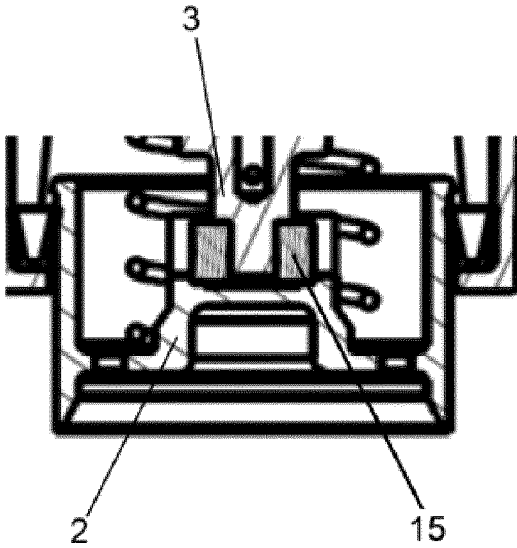


Fig. 7

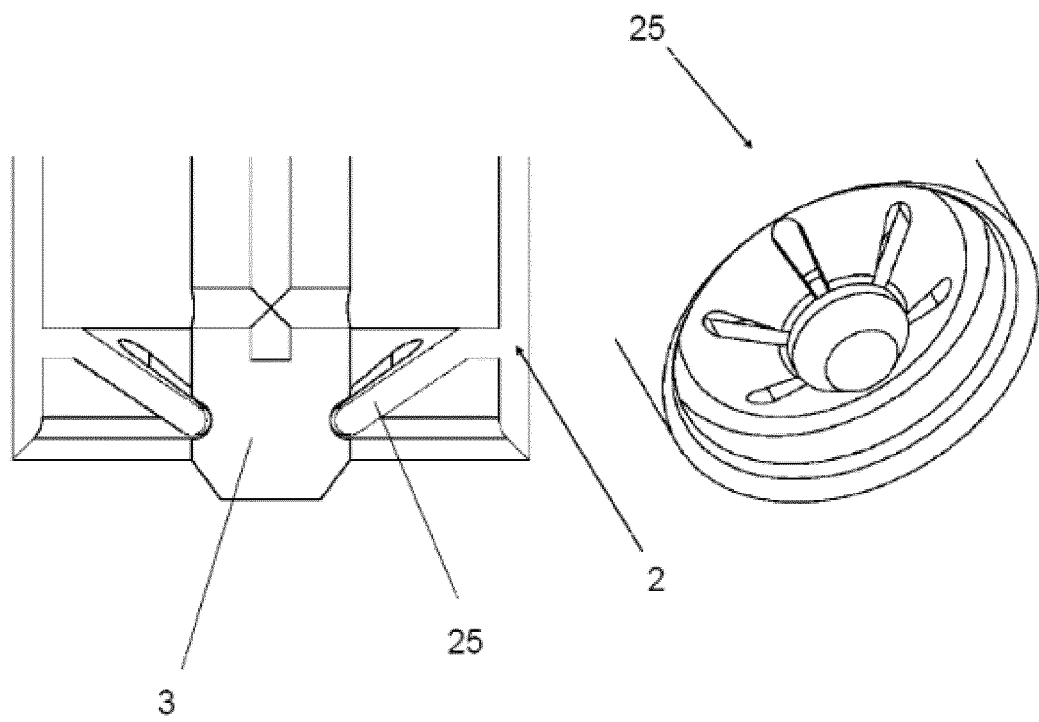


Fig. 8

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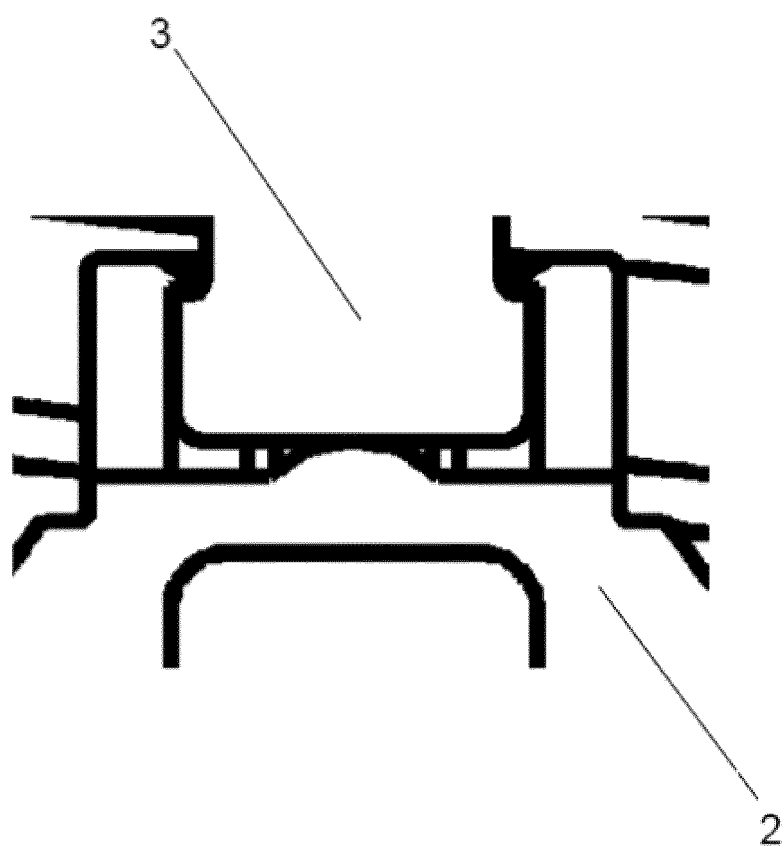


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/077346

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02B37/16 F02B39/00
ADD.

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)
F02B

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/029814 A1 (KAYSER AUTOMOTIVE SYSTEMS GMBH [DE]; BIELASS EKKEHARD [DE]) 23 March 2006 (2006-03-23) figures 1-3	1-10, 13, 14, 16
Y		11, 12
A		15
Y	US 4 688 384 A (PEARMAN DAVID J [US] ET AL) 25 August 1987 (1987-08-25) column 4, line 61 - line 68	11, 12
X	WO 2009/105405 A1 (CONTINENTAL AUTOMOTIVE SYSTEMS [US]; HORNBY MICHAEL J [US]; CZIMMEK PE) 27 August 2009 (2009-08-27) figures 1-9	1-10
X	DE 10 2008 031738 A1 (PIERBURG GMBH [DE]) 7 January 2010 (2010-01-07) figures 1-3	1-10
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☒ See patent family annex.

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Date of the actual completion of the international search

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24/03/2014

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Morales Gonzalez, M

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/077346

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2011 016276 A1 (EAGLE ACTUATOR COMPONENTS GMBH & CO KG [DE]) 11 October 2012 (2012-10-11) figures 1-3 -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/077346

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006029814 A1	23-03-2006	DE 102004044439 A1 EP 1789711 A1 WO 2006029814 A1	06-04-2006 30-05-2007 23-03-2006
US 4688384 A	25-08-1987	NONE	
WO 2009105405 A1	27-08-2009	US 2010288954 A1 WO 2009105405 A1	18-11-2010 27-08-2009
DE 102008031738 A1	07-01-2010	NONE	
DE 102011016276 A1	11-10-2012	NONE	