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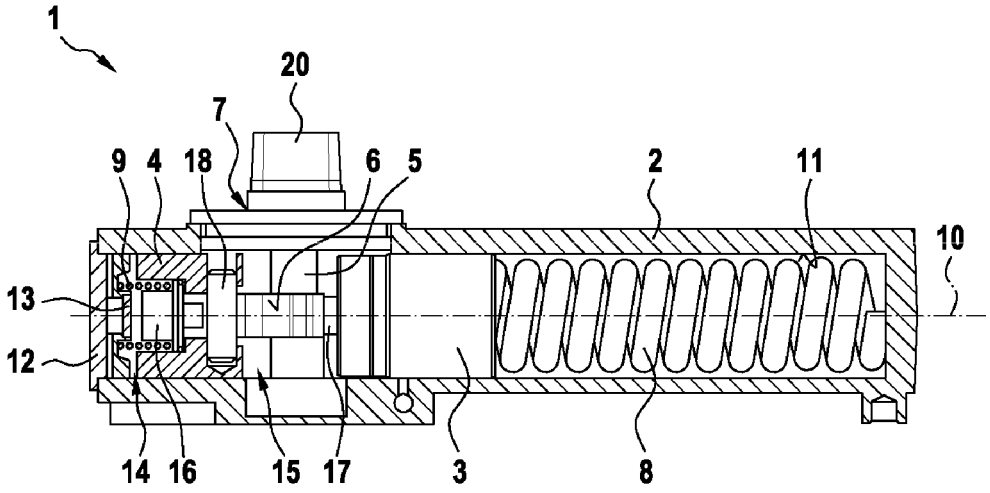
(54) **Floor door closer**

(57) The invention regards a floor spring (1), comprising a housing (2), a first piston (3), a second piston (4), and a spindle (5) including a cam surface (6) and extending through an opening (7) of the housing (2), wherein the spindle (5) is connected to the first piston (3) and the second piston (4) via a cam drive, wherein the cam drive allows a translation of a longitudinal movement of the first piston (3) and/or second piston (4) into a rotational movement of the spindle (5).

Fig. 2



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Description

[0001] The present invention regards a floor spring. Such floor springs are provided in the floor and function as a door hinge. The door can then be operated by the floor spring directly at the hinge such that no further door operator needs to be mounted on the door itself.

[0002] A floor spring commonly known from the prior art is shown in figure 1. The floor spring 100 has a piston 101 which is guided in a housing 103. Two connecting lugs 104 are connected to the piston 101 such that a movement of the connecting lugs 104 is transferred to piston 101 along the housing 103. Further, the floor spring 100 comprises a closer spring 102, which is sandwiched between the piston 101 and the housing 103 around the connecting lugs 104. Therefore, the piston 101 is always subjected to the spring force that changes with the position of the piston 101 that is in turn followed the movement of the connecting lugs 104.

[0003] Finally, the floor spring 100 has a spindle 107 which is provided within the housing 103 in perpendicular to the closer spring 102 and the piston 101. The spindle 107 has a spindle head 108 protruding outside the housing 103 and functioning as a connecting interface between the floor spring and the door wing. This allows coupling of a door rotation with the spindle 107 via the spindle head 108. In order to couple the rotation of the spindle 107 to a movement of the piston 101, the spindle 107 comprises a cam surface 106. On the other side, the two connecting lugs 104 are connected via two rollers 105 rolling on the cam surface 106 of the spindle 107. At null position, both rollers will be in contact with the cam surface 106. Only one roller will be in contact with the cam surface 106 when the spindle 107 is rotated away from the null position. The 3rd roller 105 (close to the spring 102) acts as a safety counter roller.

[0004] In case a door wing connected to the spindle 107 is rotated in the manner to open the door wing, the cam surface 106 and one of the rollers105 (far from the spring 102) convert the rotation of the spindle 107 into a linear movement of the connecting lugs 104 and in turn pulls the piston 101 towards the spindle 107. This results in a compression of the closer spring 102 by the movement of the piston 101. Therefore, the floor spring 100 is loaded with energy to move the door wing back to the original position i.e. closing of the door wing.

[0005] However, the above described prior art floor spring 100 requires a lot of components for manufacturing. This results in high costs due to material usage of individual components a long assembly time due to complexity of assembly.

[0006] Therefore, the objective of the invention is to provide a floor spring which is easy to assemble, cheap to manufacture and save in operations.

[0007] The result of this objective is achieved by the features of independent claim 1. Therefore, the object is solved by a floor spring comprising a housing, a first piston, a second piston, and a spindle. The spindle extends through an opening of the housing. Further, the spindle is connected to the first piston and the second piston such that a transformation of a longitudinal movement of the first piston and/or second piston into a rotational movement of the spindle is allowed. The first piston and the second piston are formed integrally as a hybrid piston, such that both, the first piston and the second piston, are parts of the hybrid piston. By providing such a floor spring, the number of parts required for assembling is reduced. This results in a simplified assembly procedure thus such the inventive floor spring can be manufactured cheaper than the prior art floor springs. Also, the overall dimensions of the inventive floor spring can be reduced due to the compactness of the cam driven system with hybrid piston.

[0008] The dependent claims contain advantageous embodiments of the present invention.

[0009] Preferably, the first piston and the second piston are assembled within the housing along the same axis. In particular, the first piston and the second piston are provided along a longitudinal axis of the housing. In particular, the longitudinal axis intersects with an axis of the spindle.

[0010] In order to achieve a reliable transformation between rotation of the spindle and longitudinal movement of the first piston, the first pinion has to be pressed against the cam surface of the spindle at all time. This assurance is provided by a closer spring sandwiched between an inner wall of the housing and the first piston. This design also allows the compression of the closer spring as soon as the spindle is rotated (in the direction of the opening of the door wing) that translates into the linear movement of the first piston. On the other side, this act of compressing of the closer spring presses the first piston via a main roller against the cam surface of the spindle, such that the spindle can be rotated (in the direction of the closing of the door wing) under the force of the loaded closer spring. In particular, the closer spring is first loaded by manual opening of a door that is connected to the spindle and after which, the closer spring forces the closing of the door by pressing the first piston onto the cam surface of the spindle via the main roller that translates into a turning moment on the spindle.

[0011] Accordingly, in order to achieve a reliable transformation between rotation of the spindle and movement of the second piston, the second pinion has to be pressed against the cam surface of the spindle. This is performed by an auxiliary spring sandwiched between an inner wall of the end cap and the second piston. In particular, the auxiliary spring works against the closer spring, while the auxiliary spring is weaker than the closer spring. Therefore, the above described functionality of closing a door after the door was opened manually is not affected negatively. However, the described design guarantees that both, the first piston and the second piston are pressed to the cam surface anytime.

[0012] Preferably, the auxiliary spring is supported on an end cap of the housing. The end cap is provided for

closing a manufacturing opening of the floor spring. Further, the end cap or the second piston comprises a filter for filtration within the housing.

[0013] The second piston preferably separates a first fluid chamber from a second fluid chamber within the housing. The housing comprises a fluid passage connecting the first fluid chamber and the second fluid chamber. In this way, a damping system is installed. When moving the second piston due to rotation of the spindle caused by the closer spring pressing the first piston against the cam surface, the second piston damps the rotation by the spindle. The damping is achieved by the fluid passage, which allows a regulated flow of fluid from the first fluid chamber to the second fluid chamber. Therefore, the speed of the movement of the second piston is strongly determined by the fluid flowing from the first fluid chamber to the second fluid chamber. Preferably, the fluid passage comprises a valve for setting said flow.

[0014] In case the above mentioned damping system is provided, any rotation of the spindle is damped. This would result in an activation of the damping during the opening of the door which would cause an uncomfortable handling of the door. To avoid such drawbacks, the second piston preferably comprises a check valve allowing flow of the fluid from the second fluid chamber to the first fluid chamber. Therefore, the door can be opened without damping force, such that the damping system is only active when closing the door.

[0015] Additionally, there might be the case that the door is forcibly closed by a user while the damping system exerting a damping force. This might cause a huge pressure within the first fluid chamber and the fluid passage. In order to prevent damage of the floor spring, the second piston preferably comprises a pressure relief system. In particular, the pressure relief system is a spring valve. The pressure relief system allows flow of the fluid from the first fluid chamber to the second fluid chamber when a predetermined pressure within the first fluid chamber is exceeded.

[0016] Preferably, the cam surface comprises at least one recess for the provision of a hold-open function. In particular, the recess is provided such that it abuts with the main roller of the first piston when the spindle is rotated to the position in which the hold-open function shall apply. With the main roller of the first piston sitting inside the recess, the cam surface cannot rotate without providing an additional torque to the spindle. This additional torque has to be provided to the spindle by a user when the door shall be closed. In particular, the user has to rotate the door into the closing direction to slide the main roller of the first piston out of the recess. As soon as the main roller of the first piston is out of the recess, the closer spring and the first piston rotate the spindle to close the door.

[0017] In a preferred embodiment, a diameter of the spindle and a length of the housing are set at an approximate ratio of 1:8. Additionally or alternatively, the diameter of the spindle and a width of the housing are set at an approximate ratio of 1:3. Yet additionally or alternatively, the diameter of the spindle and a height of the housing are set at an approximate ratio of 1:2. This allows a compact design of the floor spring. Despite the compact design, the floor spring can supply the same amount of torque provided on the spindle as in the prior art, e.g. for rotating a door. This means that the same door weights as in the prior art can be moved with the inventive floor spring according to the preferred embodiment, while the dimensions of the floor spring are reduced.

[0018] Particular embodiments of the invention are now described based on the attached drawings. In the drawings,

Fig. 1 is a schematic overview of the floor spring according to the prior art,

Fig. 2 is a schematic overview of the floor spring according to a first embodiment of the present invention,

Fig. 3 is a schematic view of a part of the floor spring according to the first embodiment of the present invention, and

Fig. 4 is a schematic view of a part of the floor spring according to a second embodiment of the present invention.

[0019] Figure 2 is a schematic overview of the floor spring 1 according to a first embodiment of the invention. The floor spring 1 comprises a housing 2, which is formed to have an at least partly cylindrical inner surface. Therefore, an inner wall 11 of the housing 2 is at least partly formed cylindrically. In the housing 2, a first piston 3 and a second piston 4 are guided. In particular, the first piston 3 is a closing piston while the second piston 4 is a damping piston. Both, the first piston 3 and the second piston 4 are provided along the longitudinal axis 10 of the housing 2.

[0020] Between the inner wall 11 of the housing 2 and the first piston 3, a closer spring 8 is provided. The closer spring 8 preferably is a coil spring. In the same way as the first piston 3 and second piston 4, the closer spring 8 is orientated along the longitudinal axis 10 of the housing 2.

[0021] The closer spring 8 can be loaded by the movement of the first piston 3. In particular, the first piston 3 moves to compress the closer spring 8 when a door connected to the floor spring 1 is opened. Thereafter, the energy stored in the closer spring 8 can be used to move the first piston 3 such that the door can be moved back to a closed state.

[0022] The floor spring 1 also comprises an auxiliary spring 9, which is also provided along the longitudinal axis 10 of the housing 2. The auxiliary spring 9 is sandwiched between an end cap 12 of the housing 2 and the second piston 4. In particular, the auxiliary spring 9 is

weaker than the closer spring 8. The end cap 12 is an element closing an opening of the housing 2, while the opening allows assembly of the components of the floor spring 1 within the housing 2. In particular, the end cap 12 has a thread which is screwed into the housing 2.

[0023] In order to connect a door to the floor spring 1, the floor spring 1 comprises a spindle 5 extending through the housing 2. The spindle 5 has a spindle head 20 on an area outside the housing 2 such that a door can be connected to that spindle head 20. Since the floor spring 1 is to be provided in a floor of a room, the spindle head 20 is supposed to function as a lower hinge of the door. In this way, the door can be directly operated without any door operators visible on the door.

[0024] The spindle 5 further has a cam surface 6 which is employed to set up a cam drive between the spindle 5 and the first piston 3 as well as the second piston 4. Therefore both, the first piston 3 and the second piston 4 abut the cam surface 6 of the spindle 5. The closer spring 8 assures that the first piston 3 is pressed firmly against to the cam surface 6 while the auxiliary spring 9 assures that the second piston 4 is pressed firmly against to the cam surface 6. Therefore, the first piston 3 and the second piston 4 can be moved by rotating the spindle 5 and thus the cam surface 6. Accordingly, the cam surface 6 and thus the spindle 5 can be rotated by moving the first piston 3 due to the force of the closer spring 8. Since the closer spring 8 is stronger than the auxiliary spring 9, the first piston 3 and the second piston 4 can be moved against the force of the auxiliary spring 9 by energy stored by the closer spring 8.

[0025] In case the door is opened, the movement of the door is transferred to the spindle 5 via the spindle head 20. Therefore, the spindle 5 and thus the cam surface 6 are rotated. The rotation of the cam surface 6 causes the first piston 3 to be moved such that the closer spring 8 is compressed. In this way, energy is stored within the closer spring 8 such that the closer spring 8 is enabled to move the first piston 3. Due to the movement of the first piston 3, the cam surface 6 and thus the spindle 5 are rotated. This rotation is transferred to the door via the spindle head 20 such that the door is moved back to the closed state.

[0026] The second piston 4 functions to damp the movement of the spindle 5. Therefore, the second piston 4 separates a first fluid chamber 14 from a second fluid chamber 15. A not shown fluid passage within the housing 2 connects the first fluid chamber 14 and the second fluid chamber 15. In particular, the fluid passage has a regulatory valve to set the flow through the fluid passage. The second piston 4 further has a one-way valve allowing a fluid provided within the second fluid chamber 15 to flow into the first fluid chamber 14.

[0027] In case the door is opened, the second piston 4 moves such that the first fluid chamber 14 is enlarged and the second fluid chamber 15 is reduced. This means that fluid flows from the second fluid chamber 15 to the first fluid chamber 14 via the fluid passage of the housing 2 and/or the one-way valve of the second piston 4. In particular, no damping force is generated.

[0028] In case the door is closed by the closer spring 8, the second piston 4 is moved by the cam surface 6 such that the first fluid chamber 14 is reduced and the second fluid chamber 15 is enlarged. This means that fluid flows from the first fluid chamber 14 to the second fluid chamber 15 via the fluid passage of the housing 2. Since the maximum flow of the fluid can be changed by the valve provided within the fluid passage, a user settable damping force is generated. The damping force prevents the door from being slammed against the door frame.

[0029] However, there might be the case that the door is closed manually such that both, the force of the closer spring 8 and the force of a user trying to close the door act on the second piston 4. Therefore, the pressure within the first fluid chamber 14 and the fluid passage increase. In order to prevent damage caused due to high fluid pressure, the second piston 4 comprises a pressure relief system 16. The pressure relief system preferably is a spring valve allowing flow of the fluid from the first fluid chamber 14 to the second fluid chamber 15 when a predetermined fluid pressure within the first fluid chamber 14 is exceeded.

[0030] Further, the first piston 3 has a main roller 17 rolling on the cam surface 6. The second piston has a rolling bolt 18 rolling on the cam surface 6. Details of the connection between first piston 3, second piston 4 and cam surface 6 are shown in figure 3. Due to the roller 17 and the rolling bolt 18, the friction generated of the cam surface 6 sliding on the first piston 3 and second piston 4 is reduced. Therefore, the floor spring 1 allows opening the door without increased force.

[0031] Figure 4 is a schematic view of a part of the floor spring 1 according to a second embodiment of the invention. The only difference to the first embodiment is the shape of the cam surface 6. The cam surface 6 according to the second embodiment has a recess 19. In case the door is opened, the recess 19 is rotated together with the cam surface 6. As soon as the door is positioned at a predetermined opening angle is, the recess 19 abuts the main roller 17 of the first piston 3. Therefore, the recess 19 prevents the cam surface 6 from rotation such that a hold-open function is established. In this state, the closer spring 3 provides pressure onto the first piston 3, which causes torque acting on the spindle 5. However, the recess 19 abutting the main roller 17 of the first piston 3 prevents rotation of the spindle 5 until an additional torque is loaded to the spindle by a user pushing the door into the closing direction. Due to this additional torque, the main roller 17 of the first piston 3 can be slid out of the recess 19 such that the door is no longer held open. Therefore, the door can be closed by the floor spring 1 as in the first embodiment.

[0032] The second embodiment allows providing a hold-open function without the need to provide any additional elements on the door. Providing a recess on the

cam surface 6 is rather simple, such that the manufacturing process of the floor spring 1 is not affected negatively. However, the floor spring 1 according to the second embodiment of the invention provides an increased comfort when operating the door.

[0033] Regarding all embodiments, it can be seen, that the overall number of parts is very small compared with the prior art floor spring 100 shown in figure 1. Therefore, the manufacturing costs and assembly time can be reduced. Additionally, the overall dimensions of the floor spring 1 are reduced compared with the prior art floor spring 100. In particular, the dimension of the cam surface 6 provided on the spindle 5 is reduced. In particular, a diameter of the spindle 5 and a length of the housing 2 are set at an approximate ratio of 1:8. Further, the diameter of the spindle 5 and a width of the housing 2 are set at an approximate ratio of 1:3. Finally, the diameter of the spindle 5 and a height of the housing 2 are set at an approximate ratio of 1:2. Therefore, the floor spring 1 has a very compact design such that less mounting space for the floor spring 1 is required. Nevertheless, the same door weights as in the prior art can be handled by the floor spring 1.

Reference numerals

[0034]

1	floor spring
2	housing
3	first piston
4	second piston
5	spindle
6	cam surface
7	opening of the housing
8	closer spring
9	auxiliary spring
10	longitudinal axis of the housing
11	inner wall of housing
12	end cap
13	filter
14	first fluid chamber
15	second fluid chamber
16	pressure relief system
17	main roller
18	rolling bolt
19	recess
20	spindle head

100	floor spring (prior art)
101	piston (prior art)
102	closer spring (prior art)
103	housing (prior art)
104	connecting lug (prior art)
105	roller (prior art)
106	cam surface (prior art)
107	spindle (prior art)
108	cam (prior art)

Claims

1. Floor spring (1), comprising

- a housing (2),
- a first piston (3),
- a second piston (4), and
- a spindle (5) including a cam surface (6) and extending through an opening (7) of the housing (2),

wherein the spindle (5) is connected to the first piston (3) and the second piston (4) via a cam drive, wherein the cam drive allows a translation of a longitudinal movement of the first piston (3) and/or second piston (4) into a rotational movement of the spindle (5).

2. Floor spring (1) according to claim 1, **characterized in that** the first piston (3) and the second piston (4) are provided within the housing (2) along the same axis (10).

3. Floor spring (1) according to any one of previous claims, **characterized by** a closer spring (8) provided between an inner wall (11) of the housing (2) and the first piston (3), such that the first piston (3) is pressed against the cam surface (6) of the spindle (5).

4. Floor spring (1) according to any one of previous claims, **characterized by** an auxiliary spring (9) provided between an inner wall (11) of the housing (2) and the second piston (4), such that the second piston (4) is pressed against the cam surface (6) of the spindle (5).

5. Floor spring (1) according to claim 4, **characterized in that** the auxiliary spring (9) is supported on an end cap (12) of the housing (2), wherein the end cap (12) or the second piston (4) comprise a filter (13) for filtering a fluid provided within the housing (2).

6. Floor spring (1) according to any one of previous claims, **characterized in that** the second piston (4) separates a first fluid chamber (14) from a second fluid chamber (15) within the housing (2), wherein the housing (2) comprises a fluid passage connecting the first fluid chamber (14) and the second fluid chamber (15).

7. Floor spring (1) according to claim 6, **characterized in that** the second piston (4) comprises a pressure relief system (16), in particular a spring valve, allowing flow of a fluid from the first fluid chamber (14) to the second fluid chamber (15) when a predetermined pressure within the first fluid chamber (14) is exceeded.

8. Floor spring (1) according to any one of previous claims, **characterized in that** the first piston (3) comprises at least one main roller (17) rolling on the cam surface (6) of the spindle (5) and/or the second piston (4) comprises at least one rolling bolt (18) rolling on the cam surface (6) of the spindle (5).

9. Floor spring (1) according to any one of previous claims, **characterized in that** the cam surface (5) comprises at least one recess (19)

10. Floor spring (1) according to any one of previous claims, **characterized in that**

- a diameter of the spindle (5) and a length of the housing (2) are set at an approximate ratio of 1:8 and/or
- a diameter of the spindle (5) and a width of the housing (2) are set at an approximate ratio of 1:3 and/or
- a diameter of the spindle (5) and a height of the housing (2) are set at an approximate ratio of 1:2.

Fig. 1

(prior art)

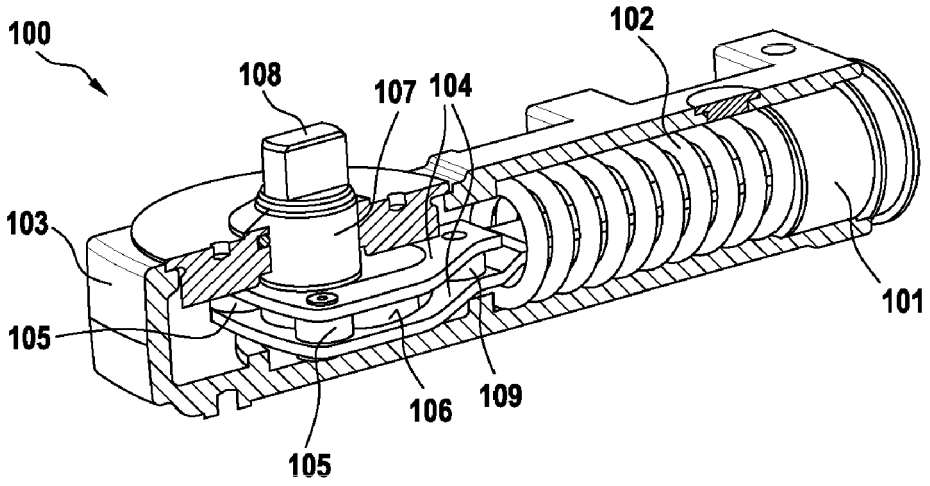


Fig. 2

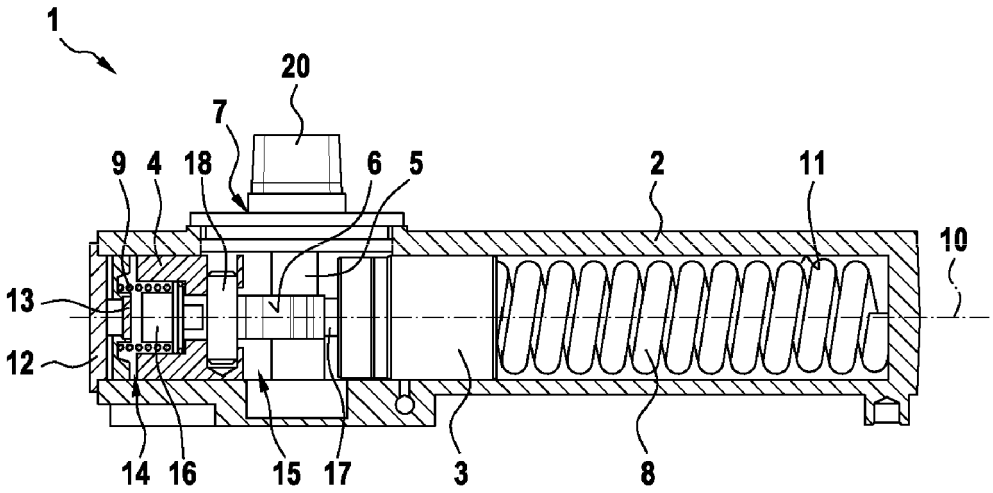


Fig. 3

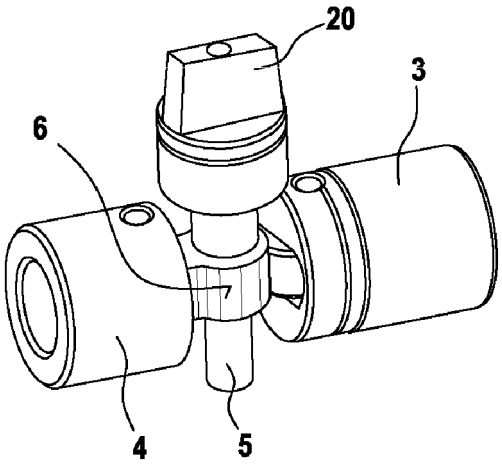
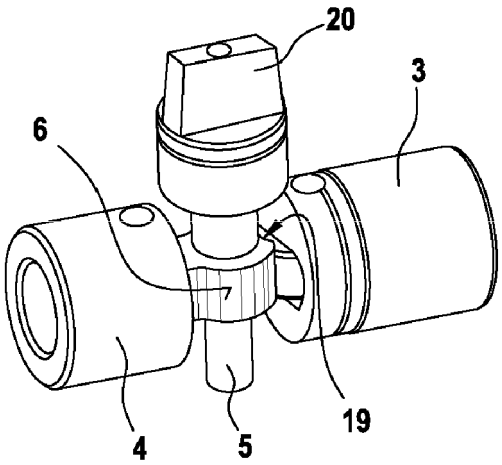


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 6670

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 186 982 A2 (DORMA GMBH & CO KG [DE]) 19 May 2010 (2010-05-19) * paragraph [0035] - paragraph [0043]; figures 3-5 *	1-6,8-10	INV. E05F3/10
X	EP 1 895 086 A2 (ABLOY OY [FI]) 5 March 2008 (2008-03-05) * paragraph [0010] - paragraph [0018]; figures 1-3 *	1-4,6-10	

TECHNICAL FIELDS SEARCHED (IPC)
E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 April 2015	Guillaume, Geert

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2186982 A2	19-05-2010	DE 102008058059 A1	20-05-2010
		EP 2186982 A2	19-05-2010
EP 1895086 A2	05-03-2008	AU 2007209802 A1	06-03-2008
		EP 1895086 A2	05-03-2008
		FI 20065523 A	22-02-2008
		US 2008042330 A1	21-02-2008

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