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(54) **DOOR CLOSER AND DOOR ASSEMBLY**

(57) The invention is related to a door closer (10) comprising a first housing (11), a second housing (12), a transmission element (13), a first piston (15) and a second piston (16) solidly attached by a rod (17). The first piston (15) is arranged in the first housing (11) to receive the linear movement of the transmission element (13) and the second piston (16) is arranged in the second housing (12). A resilient element (18) is arranged to provide a return force against the first piston (15). The second housing (12) comprises at least a first valve (1) and

a second valve (2), both valves being located in the first half (23), the second valve (2) being located closer to the first end (21) than the first valve (1). The first valve (1) is configured to allow only fluid outlet from the stroke zone (20) to the exterior of the second piston (16) and the second valve (2) is configured to allow only fluid inlet inside the stroke zone (20) from the exterior of the second piston (16). The invention also provides a door assembly (100) comprising such a door closer (10).

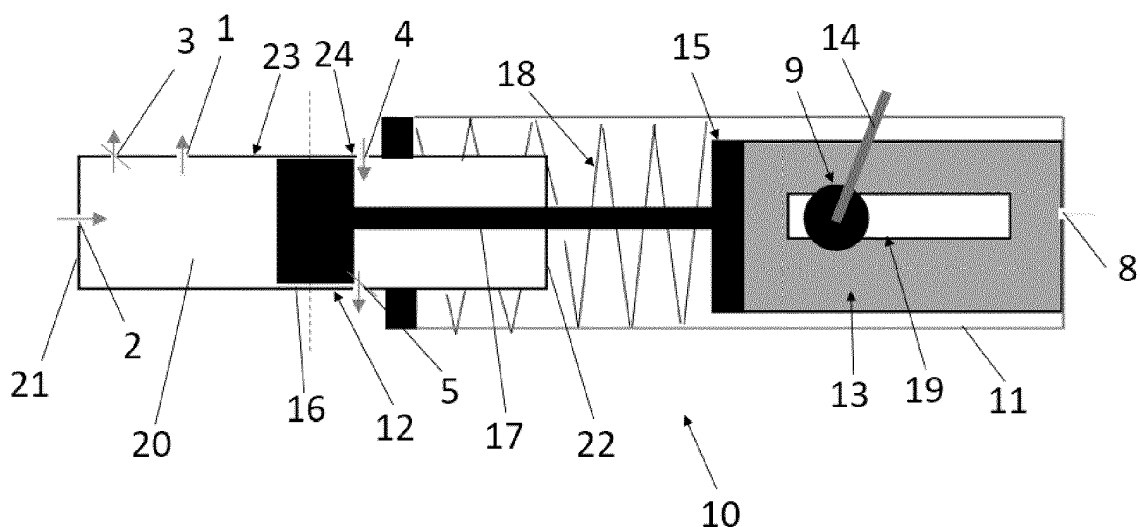


Fig. 1a

Description

TECHNICAL FIELD

[0001] This invention is related to the field of door closing systems, e. g., those used in doors of residential or commercial buildings, and more particularly, to the devices which are in charge of adjusting the power size of those systems.

STATE OF THE ART

[0002] Automated door closing systems are used to make a door close automatically when it has been opened. These systems are usually based on a spring which stores energy when the door is being opened and exerts a return force to close the door. The initial position of the spring may be tuned by means of a spring adjustment disc, to choose the opposition force that the spring offers and the closing force that is exerted afterwards. The control of the door behaviour is done by the adjustment of valves and the location of port holes in the door closer. The location of port holes and piston creates damping chambers within the door closer. These chambers are connected by oil channels which are regulated by the valves. The movement and velocity of the oil within the oil channel modulate the door behaviour.

[0003] However, the use of oil has several disadvantages: firstly, the oil enclosed in the door closer is susceptible of contamination due to wear particles which may fall from moving metal parts, which may lead the valves to be choked. This may cause disruption to the movement of oil within the oil channel. As it is an enclosed hydraulic system, these contaminations cannot be purged out of the door closer. Further, the process of oil filling must be precisely controlled as well for a good performance and quality of the door closer. Finally, proper sealing of the oil is required to prevent oil leakage, which is not allowed, since it would cause damage to people's clothing or to the floor of a building.

[0004] An alternative solution for this problem is therefore sought.

SUMMARY OF THE INVENTION

[0005] The invention provides an alternative solution for providing a closing system by a door closer according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0006] Unless otherwise defined, all terms (including technical and scientific terms) used herein are to be interpreted as is customary in the art. It will be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealised or overly formal sense unless expressly so defined herein.

[0007] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be under-

stood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0008] In a first inventive aspect, the invention provides a door closer which comprises

a transmission element, configured to transform a rotary movement of a door bar in a linear movement;
a first housing and a second housing;
a piston assembly comprising a first piston and a second piston solidly attached by a rod, the first piston being arranged in the first housing to receive the linear movement of the transmission element and the second piston being arranged in the second housing;
a resilient element which is arranged to provide a return force against the first piston in response to the movement of the first piston

wherein the second housing has a stroke zone with a cross section suitable for the second piston to slide tightly, the stroke zone having a first end located furthest from the first piston and a second end located closest to the first piston, the stroke zone being divided in a first half, which is the half of the stroke containing the first end, and a second half, which is the half of the stroke containing the second end;

wherein the second housing comprises at least a first valve and a second valve, both valves being located in the first half, the second valve being located closer to the first end than the first valve,

wherein the first valve is configured to allow only fluid outlet from the stroke zone to the exterior of the second piston and the second valve is configured to allow only fluid inlet inside the stroke zone from the exterior of the second piston.

[0009] This door closer has several advantages compared with traditional ones. Firstly, there is no requirement to do oil filling; air fills first and second housings naturally, so there is no concern about insufficient filling as compared with current solutions. There are no problems associated with oil leakage, since air is supposed to enter an exit without any risk and without any harmful consequences for clothing or floor. The second piston, which is the "air piston" is physically separated from the first piston, which is the "closer piston", which is enclosed in a separate housing with the spring, thus minimizing wear contamination on the valves. Finally, purging wear particles to the open air is possible with this system: air-flows free between the interior of the housings and the environment, without the need of hydraulic channels to connect the chambers. This will keep the system clean and will reduce the chances of speed variations as compared to current door closers which use an enclosed system, and when hydraulic chambers are required to transfer oil between chambers.

[0010] In some particular embodiments, the second

housing further comprises a third valve located in the first half, the third valve being located closer to the first end than the first valve, wherein the third valve is configured to allow only fluid outlet from the stroke zone to the exterior of the second piston.

[0011] This third valve is intended to control backcheck in the door closer, since the space left in the stroke zone when the second piston reaches the first valve is managed by this third valve.

[0012] In some particular embodiments, the third valve is adjustable. This option provides an adjustable back-check.

[0013] In some particular embodiments, the second housing further comprises a fourth valve and a fifth valve, both valves being located in the second half, closer to the centre of the second housing than to the second end, wherein the fourth valve is configured to allow only fluid inlet inside the stroke zone from the exterior of the second piston and the fifth valve is configured to allow only fluid outlet from the stroke zone to the exterior of the second piston.

[0014] Fourth valve allows the displacement of the second piston along the stroke zone. Fifth valve controls the speed of the closing door.

[0015] In different particular embodiments, the second housing further comprises a sixth valve and a first hole, the sixth valve being located in the first half, closer to the centre of the second housing than to the first end, and the first hole being located in the second half, closer to the centre of the second housing than to the second end, wherein the sixth valve is configured to allow only fluid inlet inside the stroke zone from the exterior of the second piston and the first hole is configured to allow fluid communication between the interior of the second housing and the exterior of the second housing.

[0016] The first hole allows the displacement of the second piston along the stroke zone. The sixth valve allows the latch control in the final stage of the closing movement.

[0017] In some particular embodiments, the second valve and/or the sixth valve are adjustable. Controlling the adjustment of the second valve allows a control of the closing speed, and controlling the adjustment of the sixth valve allows a controlled latch closing movement.

[0018] In some particular embodiments, the first housing comprises a second hole configured to allow fluid communication between the interior of the first housing and the exterior of the first housing.

[0019] This second hole eases the movement of the transmission element inside the first housing.

[0020] In some particular embodiments, the resilient element is a spring. This spring is configured to provide a return force which may be modified according to the manufacturer's requirements.

[0021] In some particular embodiments, the transmission element comprises

a pinion which is configured to be solidly attached to

the door bar; and

a gear meshed with the pinion which is arranged to communicate the translation movement to the first piston.

[0022] This pinion and rack system is a robust way of providing the conversion of the rotary movement of the door in a linear movement, which is dampened by the piston assembly. In fact, the gear may be solidly attached to the first piston, to achieve a more reliable operation.

[0023] In some particular embodiments, the transmission element comprises a cam element which is configured to be solidly attached to the door bar, wherein the cam element has a non-circular shape so that when the cam rotates with the movement of the door bar, the cam pushes the first piston.

[0024] This cam element is an alternative way of providing the conversion of the rotary movement into a linear one. The shape of the cam may be carefully designed to provide a force profile which is suitable for each door. The resilient element pushes the first piston against the cam element in those stages where the cam arm decreases, so that the first piston is always in contact with the cam and may transmit the movement reliably.

[0025] In a further inventive aspect, the invention provides a door assembly comprising

a door closer according to the first inventive aspect; and

a door comprising a bar which is coupled to the transmission element.

[0026] This door assembly has a maintenance much simpler than traditional ones, which use an oil damping closer system.

[0027] In some particular embodiments, the door closer is concealed in the door.

[0028] This arrangement provides a compact outcome regarding the second door, where the biasing element is concealed. The connecting element is pivotally attached to the second door, and the point of the second door where the pinion of the connecting element is pivotally attached is called hinge point.

[0029] When the biasing element is concealed, this door system does not require any space in the device where it is installed.

BRIEF LIST OF DRAWINGS AND REFERENCE NUMBERS

[0030] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figures 1a to 1c shows the operational scheme of three positions of a first embodiment of a door closer according to the invention.

Figures 2a to 2c shows the operational scheme of three positions of a second embodiment of a door closer according to the invention.

Figure 3 shows a door assembly 100 according to the invention.

[0031] Elements of the example embodiments are consistently denoted by the same reference numerals throughout the drawings and detailed description where appropriate:

1	First valve
2	Second valve
3	Third valve
4	Fourth valve
5	Fifth valve
6	Sixth valve
7	First hole
8	Second hole
9	Pinion
10	Door closer
11	First housing
12	Second housing
13	Transmission element
14	Door bar
15	First piston
16	Second piston
17	Rod
18	Spring
19	Gear
20	Stroke zone
21	First end of the stroke zone
22	Second end of the stroke zone
23	First half of the stroke zone
24	Second half of the stroke zone
50	Door
100	Door assembly

DETAILED DESCRIPTION OF THE INVENTION

[0032] The example embodiments are described in sufficient detail to enable those of ordinary skill in the art to embody and implement the systems and processes herein described. It is important to understand that embodiments can be provided in many alternate forms and should not be construed as limited to the examples set forth herein.

[0033] Accordingly, while embodiment can be modified in various ways and take on various alternative forms, specific embodiments thereof are shown in the drawings and described in detail below as examples. There is no intent to limit to the particular forms disclosed. On the contrary, all modifications, equivalents, and alternatives

falling within the scope of the appended claims should be included.

[0034] Figures 1a to 1c shows the operational scheme of three positions of a first embodiment of a door closer 10 according to the invention.

[0035] Figure 1a shows a first position of this first embodiment of a door closer 10 according to the invention. This door closer 10 comprises

10 a first housing 11 and a second housing 12;
a transmission element 13, which is configured to transform a rotary movement of a door bar 14 in a linear movement;
15 a piston assembly comprising a first piston 15 and a second piston 16 solidly attached by a rod 17, a spring 18 which is arranged to provide a return force against the first piston 15 in response to the movement of the first piston 15.

20 **[0036]** The piston assembly comprises two pistons 15, 16 which move as a single element due to the rod 17 which connects them. However, the first piston 15 is arranged in the first housing 11 to receive the linear movement of the transmission element 13, while the second piston 16 is arranged in the second housing 12. The rod 17 goes through both housings to provide a solid connection between the pistons 15, 16.

25 **[0037]** The second housing 12 has a stroke zone 20 with a cross section suitable for the second piston 16 to slide tightly. The second piston usually has a round section, so the second housing usually has a round section too, which is slightly greater than the round section of the second piston, so that the second piston 16 may slide tightly inside the second housing. The way of achieving this tight slide is known by the skilled person.

30 **[0038]** The stroke zone 20 has a first end 21 located furthest from the first piston 15 and a second end 22 located closest to the first piston 15, thus dividing the stroke zone 20 in a first half 23, which is the half of the stroke containing the first end 21, and a second half 24, which is the half of the stroke containing the second end 22.

35 **[0039]** The second housing 12 comprises several valves:

45 a first valve 1 located in the first half 23;
a second valve 2 located in the first half 23, the second valve 2 being located closer to the first end 21 than the first valve 1;
50 a third valve 3 located in the first half 23, the third valve 3 being located closer to the first end 21 than the first valve 1;
a fourth valve 4 located in the second half 24, closer to the centre of the second housing 12 than to the second end 22, and
55 a fifth valve 5 located in the second half 24, closer to the centre of the second housing 12 than to the second end 22.

[0040] The first valve 1, the third valve 3 and the fifth valve 5 are configured to allow only fluid outlet from the stroke zone 20 to the exterior of the second piston 16. The third valve 3 is adjustable, so that the door closer manufacturer may choose the rate of fluid outlet allowed by the third valve 3.

[0041] On the other hand, the second valve 2 and the fourth valve 4 are configured to allow only fluid inlet inside the stroke zone 20 from the exterior of the second piston 16.

[0042] The first housing comprises a second hole 8 configured to allow fluid communication between the interior of the first housing 11 and the exterior of the first housing 11.

[0043] The operation of this embodiment would be as follows:

When the door is completely closed, the door closer 10 would have the aspect of figure 1a, with the transmission element 13 abutting against one wall of the first housing 11. The spring 18 is at its maximum elongation and the second piston 16 is at its closest position to the second end 22 of the second housing 12.

[0044] While the door is being opened, the door bar 14 moves the pinion 9, since both elements are solidly attached, and then the gear 19, which is meshed with the pinion 9, converts the rotary movement of the door bar 14 into a translation movement of the first piston 15. This first piston 15 compresses the spring 18 and also moves the second piston 16, since both pistons are solidly attached. The second piston 16 moves along the stroke zone 20 of the second housing 12. In this embodiment, while the second piston 16 is being displaced, the fourth valve 4 lets air enter the second housing 12 while the fifth valve 5 is closed due to pressure gradient. On the other hand, the first valve 1 and the third valve 3 let air exit the second housing 12, while the second valve 2 is closed due to pressure gradient. This movement corresponds to the door opening until the second piston 16 reaches the first valve 1.

[0045] Figure 1b shows this door closer 10 when the second piston 16 reaches the first valve 1. The portion of the stroke zone which separates the second piston 16 from the first end 21 is called backcheck camera. Depending on the adjustment of the third valve 3, this backcheck will be more or less direct, allowing the door approaching the final angle in a dumped way or directly preventing from moving any further. The position of the first valve 1 will define at which angle does this backcheck appear and the adjustment of the third valve 3 will define the way this backcheck is managed.

[0046] Once the door is open, the closing stage may begin. According to what may be seen in figure 1c, the spring 18 exerts a return force against the first piston 15, which is transmitted to the second piston 16 by means of the rod 17. This causes the second piston to travel along the stroke zone 20. While this movement takes place, the second valve 2 lets air enter the second housing 12 while the first and third valves 1, 3 are closed due

to pressure gradient. On the other hand, the fifth valve 5 let air exit the second housing 12, while the fourth valve 4 is closed due to pressure gradient. This fifth valve 5 may be adjustable to define the speed of the door closing movement.

[0047] Figures 2a to 2c shows the operational scheme of three positions of a second embodiment of a door closer 10 according to the invention.

[0048] Figure 2a shows a first position of this second embodiment of a door closer 10 according to the invention. This door closer 10 also comprises

a first housing 11 and a second housing 12;
a transmission element 13, which is configured to transform a rotary movement of a door bar 14 in a linear movement;
a piston assembly comprising a first piston 15 and a second piston 16 solidly attached by a rod 17,
a spring 18 which is arranged to provide a return force against the first piston 15 in response to the movement of the first piston 15.

[0049] The arrangement of the pistons 15, 16, the rod 17 and the stroke zone 20 are the same as in the previous embodiment.

[0050] However, in this case, the second housing 12 comprises some valves which are different from the ones in the previous embodiment. The complete set of valves of this embodiment is as follows:

a first valve 1 located in the first half 23;
a second valve 2 located in the first half 23, the second valve 2 being located closer to the first end 21 than the first valve 1;
a third valve 3 located in the first half 23, the third valve 3 being located closer to the first end 21 than the first valve 1;
a sixth valve 6 located in the first half 23, closer to the centre of the second housing than to the first end 21, and
a first hole 7 located in the second half 24, closer to the centre of the second housing than to the second end 22.

[0051] The first valve 1 and the third valve 3 are configured to allow only fluid outlet from the stroke zone 20 to the exterior of the second piston 16. The third valve 3 is adjustable, so that the door closer manufacturer may choose the rate of fluid outlet allowed by the third valve 3.

[0052] On the other hand, the second valve 2 and the sixth valve 6 are configured to allow only fluid inlet inside the stroke zone 20 from the exterior of the second piston 16.

[0053] Finally, the first hole 7 is configured to allow fluid communication between the interior of the second housing 12 and the exterior of the second housing 12.

[0054] The first housing also comprises a second hole 8 configured to allow fluid communication between the

interior of the first housing 11 and the exterior of the first housing 11.

[0055] The operation of this embodiment would be as follows:

When the door is completely closed, the door closer 10 would have the aspect of figure 2a, with the transmission element 13 abutting against one wall of the first housing 11. The spring 18 is at its maximum elongation and the second piston 16 is at its closest position to the second end 22 of the second housing 12.

[0056] While the door is being opened, the door bar 14 moves the pinion 9, since both elements are solidly attached, and then the gear 19, which is meshed with the pinion 9, converts the rotary movement of the door bar 14 into a translation movement of the first piston 15. This first piston 15 compresses the spring 18 and also moves the second piston 16, since both pistons are solidly attached. The second piston 16 moves along the stroke zone 20 of the second housing 12. In this embodiment, while the second piston 16 is being displaced, the first hole 7 lets air enter the second housing 12 while the sixth valve 6 is closed due to pressure gradient. On the other hand, the first valve 1 and the third valve 3 let air exit the second housing 12, while the second valve 2 is closed due to pressure gradient. This movement corresponds to the door opening until the second piston 16 reaches the first valve 1.

[0057] Figure 2b shows this door closer 10 when the second piston 16 reaches the first valve 1. The portion of the stroke zone which separates the second piston 16 from the first end 21 is called backcheck camera. Depending on the adjustment of the third valve 3, this backcheck will be more or less direct, allowing the door approaching the final angle in a dumped way or directly preventing from moving any further. The position of the first valve 1 will define at which angle does this backcheck appear and the adjustment of the third valve 3 will define the way this backcheck is managed.

[0058] Once the door is open, the closing stage may begin. According to what may be seen in figure 2c, the spring 18 exerts a return force against the first piston 15, which is transmitted to the second piston 16 by means of the rod 17. This causes the second piston to travel along the stroke zone 20. While this movement takes place, the second valve 2 lets air enter the second housing 12 while the first and third valves 1, 3 are closed due to pressure gradient. On the other hand, the first hole 7 let air exit the second housing 12, while the sixth valve 6 is closed due to pressure gradient until it is reached by the second piston 16. This second valve 2 may be adjustable to define the speed of the door closing movement.

[0059] However, this embodiment allows a latch-force final movement. As seen in figure 2d, once the second piston 16 overcomes the sixth valve 6, the sixth valve 6 also allows air to enter the second housing 12, together with second valve 2. This increasing in the air inlet causes an increase in the closing force in the final angle, when

it is necessary to overcome a final latch to keep the door closed.

[0060] Figure 3 shows a door assembly 100 comprising

a door closer 10 as shown in any of the previous embodiments, and

a door 50 comprising a door bar 14 which is coupled to the transmission element 13 of the door closer 10.

[0061] This door closer 10 is concealed in the door 50.

Claims

1. Door closer (10) comprising

a first housing (11) and a second housing (12);
a transmission element (13), configured to transform a rotary movement of a door bar (14) in a linear movement;

a piston assembly comprising a first piston (15) and a second piston (16) solidly attached by a rod (17), the first piston (15) being arranged in the first housing (11) to receive the linear movement of the transmission element (13) and the second piston (16) being arranged in the second housing (12);

a resilient element (18) which is arranged to provide a return force against the first piston (15) in response to the movement of the first piston (15);

wherein the second housing (12) has a stroke zone (20) with a cross section suitable for the second piston (16) to slide tightly, the stroke zone (20) having a first end (21) located furthest from the first piston (15) and a second end (22) located closest to the first piston (15), the stroke zone (20) being divided in a first half (23), which is the half of the stroke containing the first end (21), and a second half (24), which is the half of the stroke containing the second end (22);

wherein the second housing (12) comprises at least a first valve (1) and a second valve (2), both valves being located in the first half (23), the second valve (2) being located closer to the first end (21) than the first valve (1),

wherein the first valve (1) is configured to allow only fluid outlet from the stroke zone (20) to the exterior of the second piston (16) and the second valve (2) is configured to allow only fluid inlet inside the stroke zone (20) from the exterior of the second piston (16).

2. Door closer (10) according to claim 1, wherein the second housing (12) further comprises a third valve (3) located in the first half (23), the third valve (3) being located closer to the first end (21) than the first

valve (1), wherein the third valve (3) is configured to allow only fluid outlet from the stroke zone (20) to the exterior of the second piston (16).

3. Door closer (10) according to claim 2, wherein the third valve (3) is adjustable. 5
4. Door closer (10) according to any of the preceding claims, wherein the second housing (12) further comprises a fourth valve (4) and a fifth valve (5), both valves (4, 5) being located in the second half (24), closer to the centre of the second housing (12) than to the second end (22), wherein the fourth valve (4) is configured to allow only fluid inlet inside the stroke zone (20) from the exterior of the second piston and the fifth valve (5) is configured to allow only fluid outlet from the stroke zone (20) to the exterior of the second piston (16). 10 15
5. Door closer (10) according to any of claims 1 to 3, wherein the second housing (12) further comprises a sixth valve (6) and a first hole (7), the sixth valve (6) being located in the first half (23), closer to the centre of the second housing than to the first end (21), and the first hole (7) being located in the second half (24), closer to the centre of the second housing than to the second end (22); wherein the sixth valve (6) is configured to allow only fluid inlet inside the stroke zone (20) from the exterior of the second piston (16) and the first hole (7) is configured to allow fluid communication between the interior of the second housing (12) and the exterior of the second housing (12). 20 25 30
6. Door closer (10) according to claim 5, wherein the second valve (2) and/or the sixth valve (6) are adjustable. 35
7. Door closer (10) according to any of the preceding claims, wherein the first housing comprises a second hole (8) configured to allow fluid communication between the interior of the first housing (11) and the exterior of the first housing (11). 40
8. Door closer (10) according to any of the preceding claims, wherein the resilient element is a spring. 45
9. Door closer (10) according to any of the preceding claims, wherein the transmission element comprises 50
 - a pinion (9) which is configured to be solidly attached to the door bar (14); and
 - a gear (19) meshed with the pinion (9) which is arranged to communicate the translation movement to the first piston (15). 55
10. Door closer (10) according to any of claims 1 to 8, wherein the transmission element (13) comprises a

cam element (31) which is configured to be solidly attached to the door bar (14), wherein the cam element (31) has a non-circular shape so that when the cam element (31) rotates with the movement of the door bar (14), the cam element (31) pushes the first piston (15).

11. Door assembly (100) comprising

a door closer (10) according to any of the preceding claims
 a door (50) comprising a door bar (14) which is coupled to the transmission element (13) of the door closer (10).

12. Door assembly (100) according to claim 11, wherein the door closer (10) is concealed in the door (50).

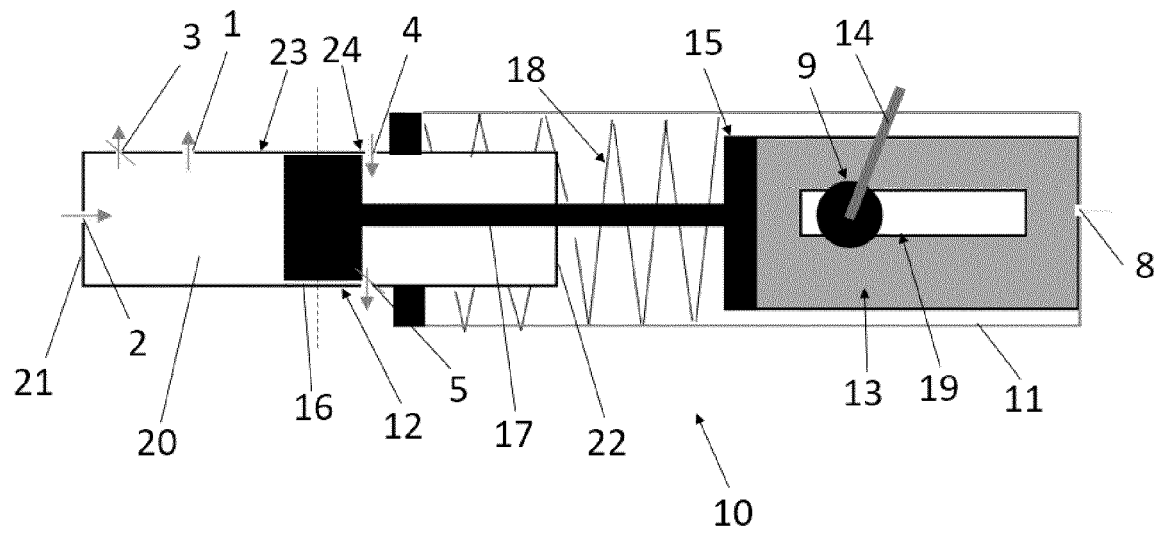


Fig. 1a

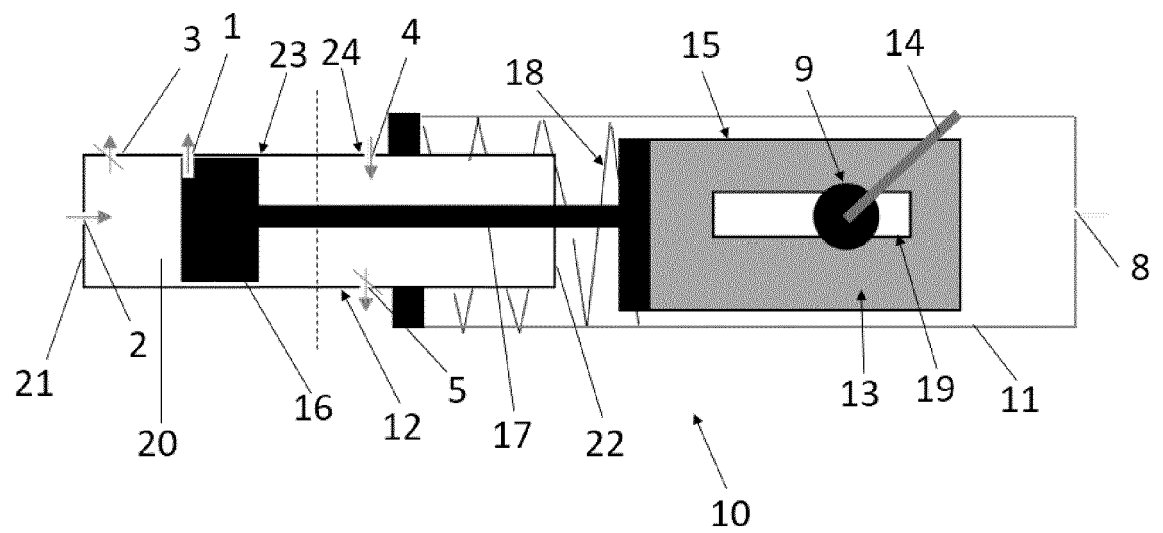


Fig. 1b

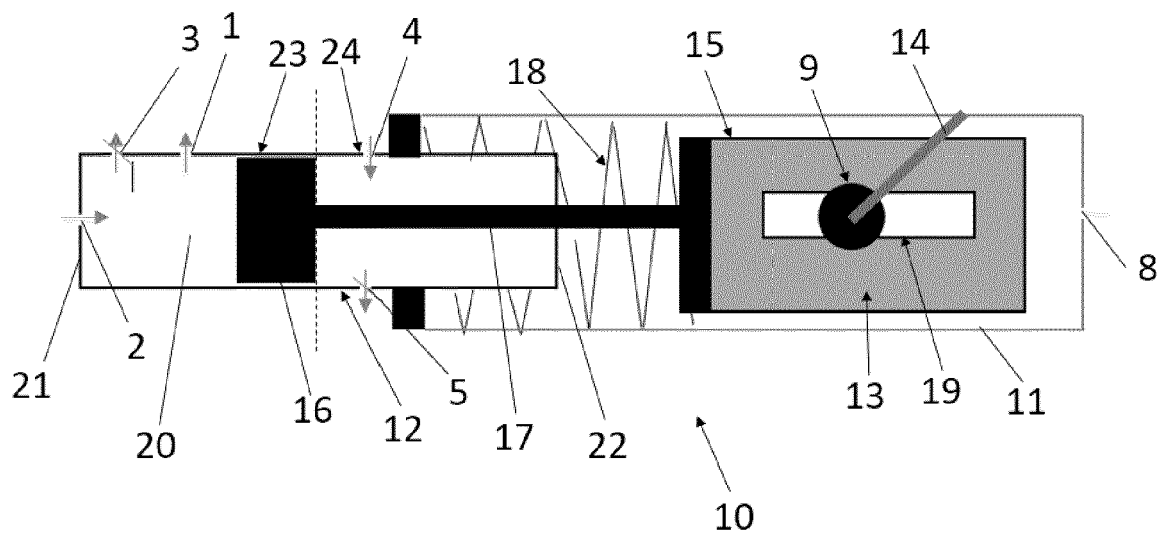


Fig. 1c

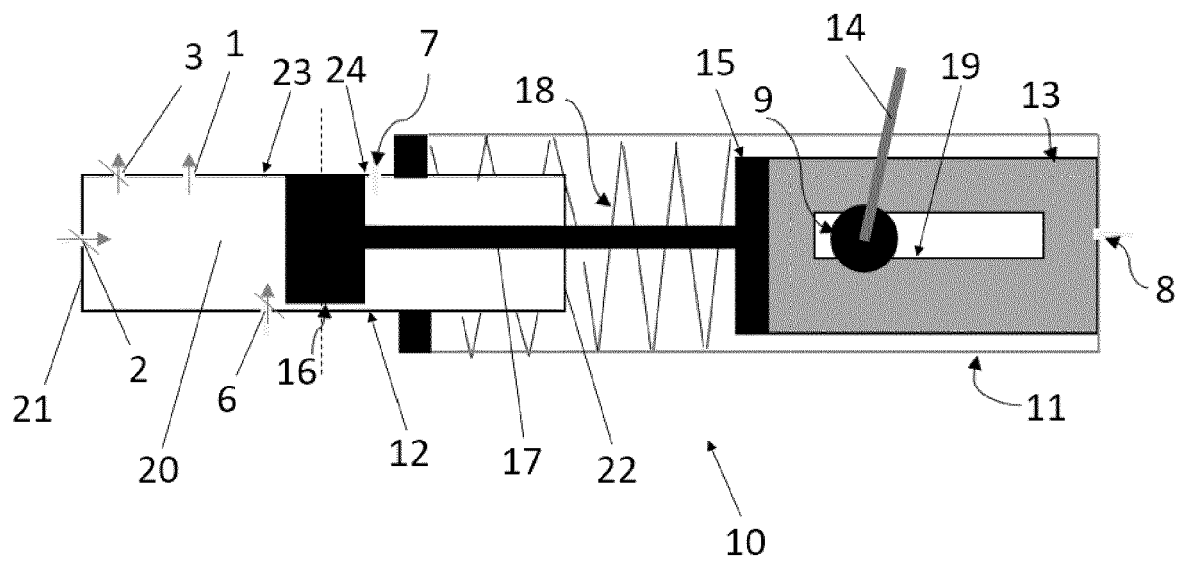


Fig. 2a

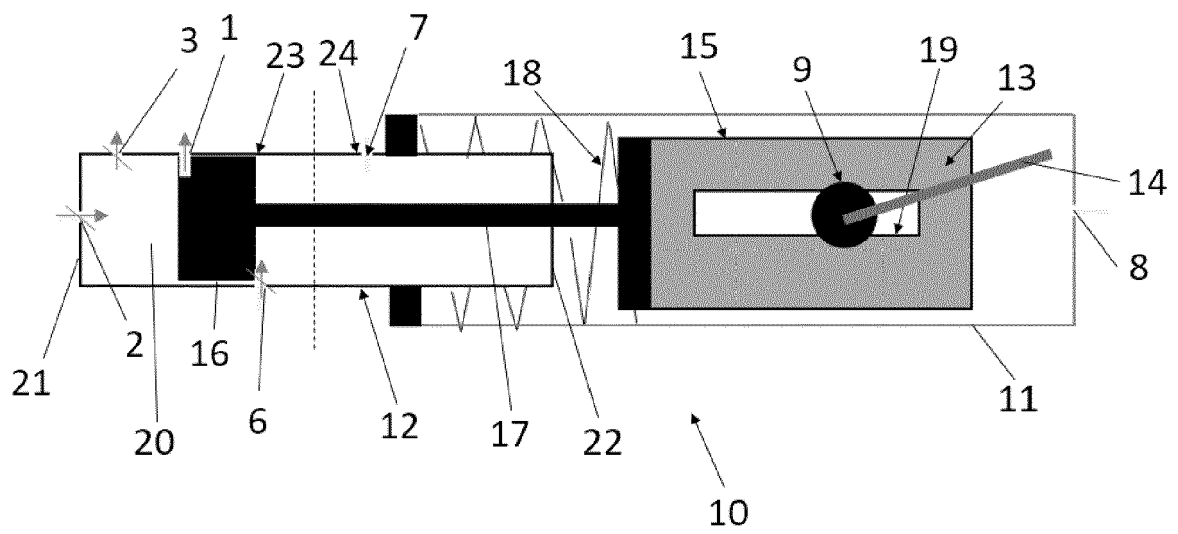


Fig. 2b

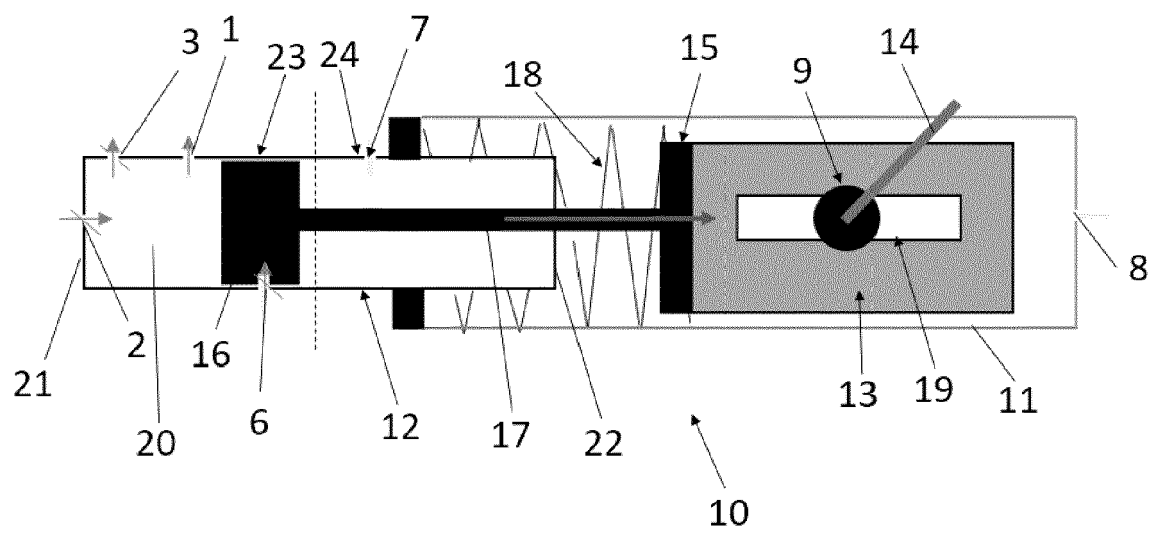


Fig. 2c

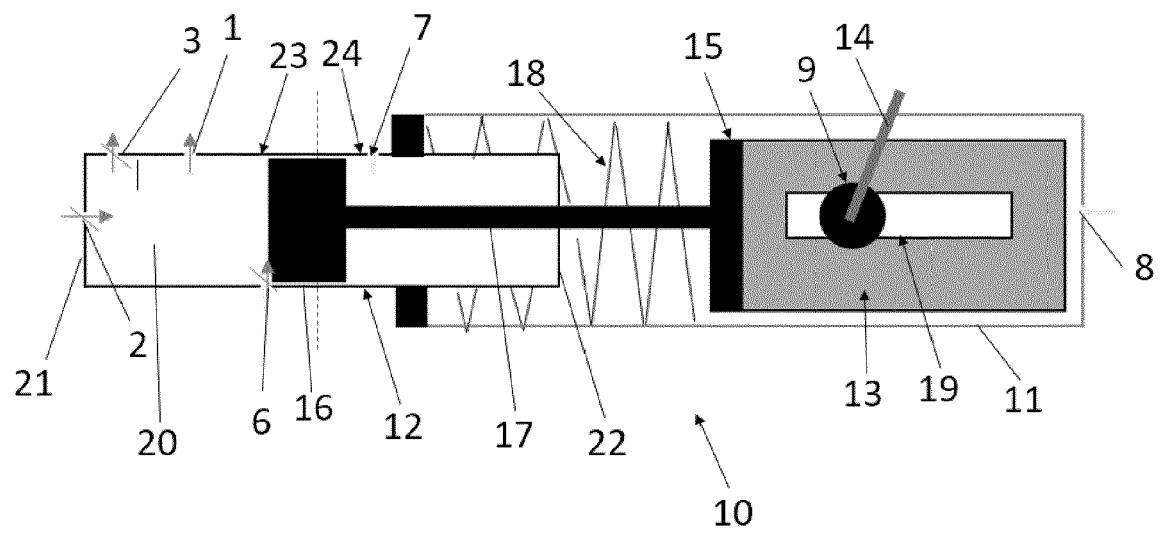


Fig. 2d

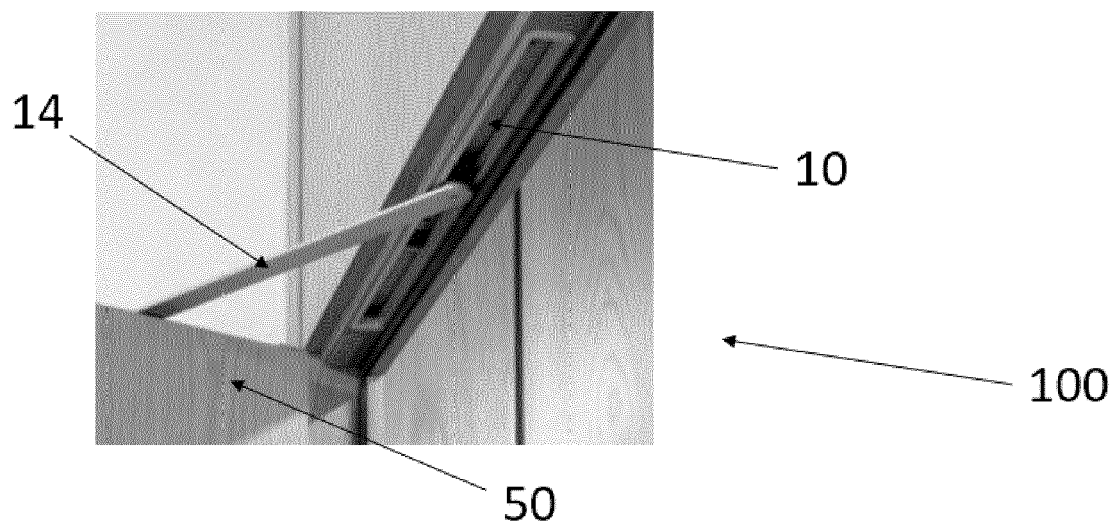


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 19 16 3906

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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 A	GB 897 848 A (VERRERIES APPLIQUEES) 30 May 1962 (1962-05-30) * page 1, lines 87-86 * * page 3, lines 5-33 * * figures 1-3,5,6 *	1,8, 10-12 2-7,9	INV. E05F3/02 E05F3/10 E05F3/12
Y A	JP S56 5768 U (TOMEI ELECTRIC CO.) 19 January 1981 (1981-01-19) * figure 1 *	1,7-9, 11,12 2-6	
Y A	WO 2008/124816 A1 (WABTEC HOLDING CORP. (US)) 16 October 2008 (2008-10-16) * paragraphs [0001], [0022], [0024], [0029] * * figures 1,3-5 *	1,7-9, 11,12 2-6	
A	US 2017/247922 A1 (WANG FAN SHUI [CN]) 31 August 2017 (2017-08-31) * paragraphs [0004], [0005], [0048] - [0052] * * figures 1-4,9 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 September 2019	Examiner Wagner, Andrea
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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