(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 119 860 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.11.2009 Bulletin 2009/47

(21) Application number: **07832291.4**

(22) Date of filing: **21.11.2007**

(51) Int Cl.:
E05F 3/08 *(2006.01)* ***E05F 1/12*** *(2006.01)*
E05F 3/20 *(2006.01)*

(86) International application number:
PCT/JP2007/072561

(87) International publication number:
WO 2008/099546 (21.08.2008 Gazette 2008/34)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **15.02.2007 JP 2007034512**

(71) Applicant: **Nitto Kohki Co., Ltd.**
Tokyo 146-8555 (JP)

(72) Inventor: **OKADA, Tadashi**
Tokyo 146-8555 (JP)

(74) Representative: **Domenego, Bertrand**
Cabinet Lavoix
2, place d'Estienne d'Orves
75441 Paris Cedex 09 (FR)

(54) DOOR CLOSER

(57) [Problem to be Solved] A door closer is provided that is capable of reducing the change in closing time of a door with an ambient temperature change and also capable of preventing damage to a piston and a casing when the door is closed.

[Solution Means] A door closer 10 is installed along the axis of rotation of a door D. The door closer 10 has a closing-urging section 12 that urges the door D toward a closed position and a speed adjusting section 14 that adjusts the return speed of the door D. The speed adjusting section 14 has a cylindrical casing 11, a piston 34 that moves in the casing 11 in response to opening and closing of the door D, and an oil storage section 26 that stores an oil (damping fluid) P. The piston 34 is in thread engagement with a cylinder 24 and vertically movable in the cylinder while being braked by the oil stored in the oil storage section 26. The oil has a small change in viscosity with temperature. The oil storage section 26 is provided with a compression spring (resilient member) 38 that presses the piston 34 toward one end side of the direction of its movement.

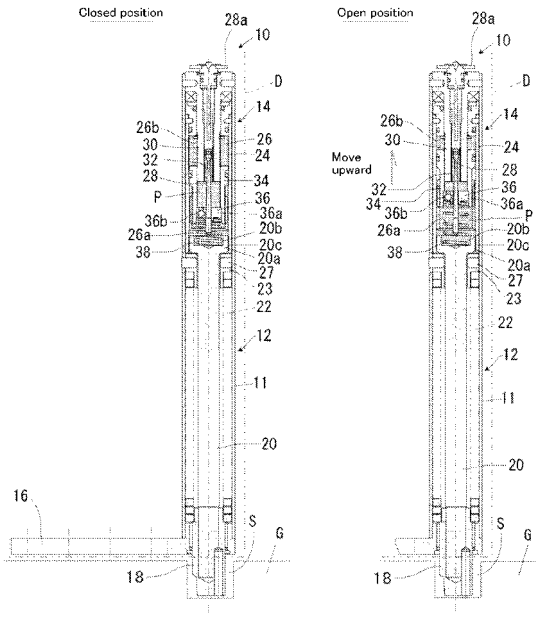

FIG.1

EP 2 119 860 A1

Description

Technical Field

[0001] The present invention relates to a door closer having a hydraulic braking mechanism.

Background Art

[0002] Patent Literature 1 noted below discloses a door closer that closes a door by the urging force of a return spring and that has a hydraulic braking mechanism provided in a casing to prevent the door from closing rapidly. The braking mechanism is provided with a piston which moves in response to opening and closing of the door. The piston is vertically movable through thread engagement with a cylinder provided on the inner periphery of the casing. When the piston moves vertically, the piston receives the braking force of an oil (damping fluid) filled in the casing and this enables the door to be closed slowly. It should be noted that, as shown in the enlarged view of Fig. 4, the piston 134 is provided with a fluid passage 136a through which the oil is allowed to flow between an upper oil storage part 126b and a lower oil storage part 126a, and also provided with an adjusting rod (adjusting means) 128 used to adjust the amount of oil moving through the fluid passage.

Patent Literature 1: Japanese Patent Application Publication No. 2006-161452

Disclosure of Invention

Technical Problem

[0003] The conventional technique disclosed in Patent Literature 1, however, has the following problems. Because a mineral oil is used as the oil, the viscosity of the oil considerably changes depending on a change in temperature. Therefore, every time the ambient temperature changes, it is necessary to adjust the amount of oil flowing through the fluid passage 136a by adjusting the adjusting rod 128.

[0004] Meanwhile, a predetermined backlash is provided between a thread groove 125 formed on the inner periphery (cylinder) of the casing 111 and a thread ridge 135 formed on the outer peripheral surface of the piston 134 to allow the piston 134 to move smoothly. Therefore, when the door is closed, the lower surface 135b of the thread ridge 135 and the lower surface 125b of the thread groove 125 are caused to collide with each other across the backlash between the respective threads of the piston and the cylinder by the urging force of the return spring, which may damage the piston and the inner periphery of the cylinder.

[0005] Further, when the door is thrown open, the upper surface (one side surface) 135a of the thread ridge 135 and the upper surface (one side surface) 125a of the thread groove 125 collide with each other across the backlash between the respective threads of the piston and the cylinder, which may also damage the piston and the inner periphery of the cylinder.

[0006] An object of the present invention is to provide a door closer capable of readily reducing the change in door closing time which is caused due to an ambient temperature change and also capable of preventing damage to the piston and the cylinder when the door is opened and closed.

Solution to Problem:

[0007] The present invention provides a door closer installed along the axis of rotation of a door. The door closer includes a closing-urging section that urges the door toward a closed position, and a speed adjusting section that adjusts the return speed of the door when moving toward the closed position. The speed adjusting section has a tubular cylinder, an oil storage section formed in the cylinder to store a damping fluid, and a piston that moves in the oil storage section in response to opening and closing of the door. The oil storage section has an upper oil storage part formed at the upper side of the piston, and a lower oil storage part formed at the lower end side of the piston. The piston is in thread engagement with the cylinder and movable in the cylinder while being braked by the damping fluid stored in the oil storage section. The piston is provided with a fluid passage that allows the damping fluid to flow between the upper oil storage part and the lower oil storage part. The piston is further provided with an adjusting means that adjusts the amount of damping fluid passing through the fluid passage. The damping fluid has a small change in viscosity with temperature. The oil storage section is provided with a resilient member that presses the piston toward one end of the direction of movement of the piston. One side surface of a thread ridge formed on the outer peripheral surface of the piston is pressed against one side surface of a thread groove formed on the inner periphery of the cylinder by the urging force of the resilient member.

[0008] In this door closer, a resilient member is provided in the oil storage section to press the piston toward one end of the direction of movement of the piston, thereby pressing one side surface of the thread ridge formed on the outer peripheral surface of the piston against one side surface of the thread groove formed on the inner periphery of the cylinder. Therefore, when the door starts to move from the open position toward the closed position, even if the piston is moved toward the one end of the direction of movement of the piston, it is possible to prevent collision between the one side surface of the thread ridge formed on the piston and the one side surface of the thread groove formed on the cylinder and hence possible to prevent damage to the piston and the cylinder.

[0009] When the door moves from the closed position

toward the open position, the piston, which is in thread engagement with the cylinder, moves in a state where the one side surface of the thread ridge is pressed against the one side surface of the thread groove by the pressing force of the resilient member. When the door moves from the open position toward the closed position, because the one side surface of the thread ridge formed on the outer peripheral surface of the piston is pressed against the one side surface of the thread groove formed on the inner periphery of the cylinder, it is possible to prevent collision between the one side surface of the thread ridge of the piston and the one side surface of the thread groove of the cylinder and hence possible to prevent damage to the piston and the casing (cylinder).

[0010] In addition, the use of a damping fluid having a small change in viscosity with temperature makes it unnecessary to adjust the amount of damping fluid moving through the fluid passage by adjusting the adjusting rod every time the ambient temperature changes.

[0011] Silicone oil is recommended to be used as the damping fluid.

[0012] Preferably, the silicone oil has a lubricant added thereto.

[0013] Thus, because the silicone oil has a lubricant added thereto, it is possible to improve the wear resistance of the thread ridge of the piston and the thread groove of the cylinder when the one side surface of the thread ridge and the one side surface of the thread groove slide against each other.

[0014] Further, the door closer is characterized as follows. The resilient member is a compression spring disposed in the lower oil storage part. The closing-urging section is provided with a shaft secured to a floor. The shaft is provided at its top with an enlarged-diameter part having an enlarged diameter. The enlarged-diameter part has a cylindrical recess which is coaxial with the shaft. The outer peripheral surface of the enlarged-diameter part and the cylinder are secured in close contact with each other to prevent the damping fluid stored in the oil storage section from leaking out thereof. The upper end of the enlarged-diameter part reaches a position where it is substantially the same level as the lower end of the adjusting means to widen the area of close contact between the outer peripheral surface of the enlarged-diameter part and the cylinder. The lower part of the compression spring is held in the recess.

[0015] Thus, the upper end of the enlarged-diameter part reaches a position where it is substantially coincident with the lower end of the adjusting means to widen the area of close contact between the outer peripheral surface of the enlarged-diameter part and the cylinder. Therefore, it is possible to prevent the damping fluid stored in the oil storage section from leaking out thereof. In addition, by forming the recess on the inner periphery of the enlarged-diameter part, the volumetric capacity of the lower oil storage part can be increased without providing a special space therefore. Further, the lower part of the compression spring is held in the recess, therefore, the compression spring can be stably held without the need to provide a special seat to mount the spring. The assembly is easy because the compression spring can be installed simply by putting it in the lower oil storage part.

Best Mode for Carrying Out the Invention

[0016] Embodiments of the door closer according to the present invention will be explained below with reference to the accompanying drawings. A first embodiment will be explained with reference to Figs. 1 and 2.

A door closer 10 according to the first embodiment of the present invention is of the center-hung type and has a substantially cylindrical casing 11, which has a closing-urging section 12 that urges a door D toward a closed position and a speed adjusting section 14 that adjusts the return speed of the door D. It should be noted that, in this embodiment, the door D is a fire door.

[0017] The closing-urging section 12 has a door mount 16 provided at the bottom thereof to mount the door D thereon, a support leg 18 inserted into and secured to a seat S provided on a floor G, a shaft 20 secured to the support leg 18, and a coil spring 22 disposed between the outer peripheral surface of the shaft 20 and the inner peripheral surface of the casing 11. The lower end of the coil spring 22 is secured to the shaft 20. The upper end of the coil spring 22 is retained by a set pin 27 attached to a spring seat 23 secured to the casing 11. The top of the shaft 20 is provided with an enlarged-diameter part 20a having an enlarged diameter. The enlarged-diameter part 20a has a cylindrical recess 20b, which is formed coaxially with the shaft 20.

[0018] The outer peripheral surface 20c of the enlarged-diameter part 20a and an inner tube 24 are secured in close contact with each other by brazing. To widen the area of close contact between the outer peripheral surface 20c of the enlarged-diameter part 20a and the inner tube 24, the upper end of the enlarged-diameter part 20a reaches a position where it is substantially coincident with the lower end of an adjusting rod 28. The brazing between the outer peripheral surface 20c of the enlarged-diameter part 20a and the inner tube 24 prevents the damper oil stored in an oil storage section 26 from leaking out thereof.

[0019] The speed adjusting section 14 has the inner tube (cylinder) 24 provided in close contact with the inner peripheral surface of the casing 11 to define an oil storage section 26 for storing a damper oil (damping fluid) P. The speed adjusting section 14 further has a piston 34 that moves vertically in the oil storage section 26, and an adjusting rod installation part 30 having a through-hole 32 through which an adjusting rod 28 (described later) is installed. The adjusting rod installation part 30 is splined to the piston 34. The piston 34 is unable to rotate relative to the adjusting rod installation part 30 but vertically movable relative to the adjusting rod installation part 30.

[0020] The oil storage section 26 is divided into upper

and lower parts by the piston 34. Thus, the oil storage section 26 has a lower oil storage part (highpressure chamber) 26a formed below the piston 34 and an upper oil storage part (low-pressure chamber) 26b formed above the piston 34.

[0021] The piston 34 is in thread engagement with the inner tube 24. A thread ridge 35 formed on the outer peripheral surface of the piston 34 spirally moves along a thread groove 25 formed on the inner tube 24, thereby allowing the piston 34 to move vertically in the oil storage section 26 (Fig. 2). Further, a predetermined backlash is provided between the thread ridge 35 and the thread groove 25.

[0022] The lower end of the piston 34 is provided with an adjusting valve 36 that adjust the movement of the damper oil P in the oil storage section 26. The adjusting valve (fluid passage) 36 has a cylindrical first adjusting part 36a and a second adjusting part 36b equipped with a check valve. The first adjusting part 36a adjusts the amount of damper oil P flowing from the lower oil storage part 26a toward the upper oil storage part 26b when the piston 34 moves upward (during the door D is closing). The second adjusting part 36b prevents, with the check valve, the damper oil P from flowing from the lower oil storage part 26a toward the upper oil storage part 26b when the piston 34 moves downward. In addition, the second adjusting part 36b allows the damper oil P to flow from the upper oil storage part 26b toward the lower oil storage part 26a when the piston 34 moves upward.

[0023] The adjusting rod 28 has a tapered configuration in which the diameter gradually increases toward its lower end. The adjusting rod 28 is vertically movable in response to the adjustment of an adjusting knob 28a provided on its top to adjust the clearance formed between the tapered part of the adjusting rod 28 and the first adjusting part 36a, thereby allowing adjustment of the flowing amount of damper oil P. It should be noted that, in this embodiment, the adjusting rod 28 needs to be adjusted only when the door D is installed; it is unnecessary to adjust the adjusting rod 28 every time the ambient temperature changes.

[0024] The damper oil P used herein is silicone oil having a predetermined lubricant added thereto.

The lower oil storage part 26a is provided with a compression spring (resilient member) 38. The lower part of the compression spring 38 is held in the recess 20b of the shaft 20. The lower end of the compression spring 38 abuts against the bottom of the recess 20b. The upper end of the compression spring 38 abuts against the lower end of the piston 34. It should be noted that the compression spring 38 preferably has a spring force (pressing force) with which the upper surface 35a of the thread ridge 35 of the piston 34 presses against the upper surface 25a of the thread groove 25 of the inner tube 24 when the door D is in the open position.

[0025] The following is an explanation of the operation of the door closer according to this embodiment. When the door D is opened from the closed position (shown in Fig. 1(a)) toward the open position (shown in Fig. 1(b)), the piston 34, which moves in response to the movement of the door mount 16 carrying the door D, rotates. Then, the thread ridge 35 formed on the outer periphery of the piston 34 spirally moves along the thread groove 25 formed on the inner tube 24. Consequently, the piston 34 moves upward in the oil storage section 26. At this time, the coil spring 22 in the closing-urging section 12 is twisted around the axis of the shaft 20. Thus, a predetermined urging force is imparted to the coil spring 22. In addition, the piston 34 moves upward in a state where the upper surface (one side surface) 35a of the thread ridge 35 formed on the outer peripheral surface of the piston 34 is constantly pressed against the upper surface (one side surface) 25a of the thread groove 25 formed on the inner tube 24 by the pressing force of the compression spring 38 provided in the lower oil storage part 26a. At this time, the damper oil P flows from the upper oil storage part 26b toward the lower oil storage part 26a through the second adjusting part 36b.

[0026] At a moment when the door D moves from the closed position toward the open position, the piston moves upward. However, the upper surface 35a of the thread ridge 35 of the piston 34 is constantly pressed against the upper surface 25a of the thread groove 25 of the inner tube 24. Therefore it is possible to prevent collision between the upper surface 35a of the thread ridge 35 formed on the piston 34 and the upper surface 25a of the thread groove 25 formed on the inner tube 24 and hence possible to prevent damage to the piston 34 and the inner tube 24.

[0027] Meanwhile, when the door D is to be closed, it is moved toward the closed position by the restoring force of the coil spring 22 having a predetermined urging force imparted thereto, and the piston 34, which moves in response to the movement of the door mount 16 carrying the door D, rotates in the opposite direction to that during the door-opening operation. At this time, the thread ridge 35 formed on the outer periphery of the piston 34 spirally moves along the thread groove 25 formed on the inner tube 24. Thus, the piston 34 moves downward in the oil storage section 26.

[0028] The piston 34 moves downward in a state where the upper surface 35a of the thread ridge 35 formed on the outer peripheral surface of the piston 34 is constantly pressed against the upper surface 25a of the thread groove 25 formed on the inner periphery of the inner tube 24 by the pressing force of the compression spring 38 provided in the lower oil storage part 26a. Further, when the piston 34 moves downward in the oil storage section 26, the speed of downward movement of the piston 34 is adjusted by the resistance of the damper oil P flowing through the clearance formed between the tapered part of the adjusting rod 28 and the first adjusting part 36a. The upper surface 35a of the thread ridge 35 of the piston 34 is constantly pressed against the upper surface 25a of the thread groove 25 of the inner tube 24, therefore it is possible to prevent collision between the lower surface

35b of the thread ridge 35 formed on the piston 34 and the lower surface 25b of the thread groove 25 formed on the inner tube 24 at the moment that the door D starts to move from the open position toward the closed position, and hence possible to prevent damage to the piston 34 and the casing (inner tube) 11. Further, when the door D is in the open position, the pressure in the lower oil storage part 26a is high. Therefore, the pressing force of the compression spring 38 and the reaction force of the damper oil P simultaneously act on the piston 34, and it is possible to prevent collision between the lower surface 35b and the lower surface 25b of the thread groove 25 formed on the inner tube 24 even more effectively at the moment that the door D starts to move toward the closed position.

[0029] It should be noted that, in the present invention, a fire door is used as the door D and the weight of the door D is large for that reason. Therefore, a coil spring 22 having a large restoring force is used. Accordingly, a larger force acts on the inner tube 24 compared with the case of an ordinary door at the moment that the door D starts to move toward the closed position. However, the upper surface 35a of the thread ridge 35 of the piston 34 is constantly pressed against the upper surface 25a of the thread groove 25 of the inner tube 24, therefore it is possible to prevent collision between the lower surface 35b of the thread ridge 35 of the piston 34 and the lower surface 25b of the thread groove 25 of the inner tube 24 and hence possible to prevent damage to the piston 34 and the casing (inner tube) 11.

[0030] In addition, silicone oil P is used as the damper oil, therefore the change in viscosity of the oil caused by a temperature change is small. Therefore, it is unnecessary to adjust the clearance formed between the tapered part of the adjusting rod 28 and the first adjusting part 36a by adjusting the adjusting rod 28 every time the ambient temperature changes, and it is possible to reduce the change in closing time of the door D which is influenced by an ambient temperature change. Further, the silicone oil P has a lubricant added thereto, therefore it is possible to improve the wear resistance of the thread ridge 35 of the piston 34 and the thread groove 25 of the inner tube 24 when the lower edge 35b of the thread ridge 35 and the lower edge 25b of the thread groove 25 slide against each other.

[0031] Further, the upper end of the enlarged-diameter part 20a reaches a position where it is substantially coincident with the lower end of the adjusting rod 28, thereby widening the area of brazing between the outer peripheral surface 20c of the enlarged-diameter part 20a and the inner tube 24 of the casing 11. Therefore, it is possible to prevent the damper oil stored in the oil storage section 26 from leaking out thereof. In addition, forming the recess 20a on the inner periphery of the enlarged-diameter part 20a enables the volumetric capacity of the lower oil storage part 26a to be increased without providing a special space therefore. Further, because the lower part of the compression spring 38 is held in the recess 20a, the compression spring can be stably held without the need to provide a special spring mounting seat.

[0032] Next, a second embodiment will be explained with reference to Fig. 3. It should be noted that, in the following second embodiment, the same parts as those in the above-described first embodiment are denoted by the same reference signs as used in the first embodiment, and a detailed explanation for them is omitted.

In the second embodiment, an adjusting rod 50, which is capable of changing the amount of damper oil Q flowing through the clearance formed in the first adjusting part 36a in accordance with a temperature change, is provided. More specifically, the adjusting rod 50 is provided on its top with an expansion member 54 that expands and contracts according to the result of detection by a temperature sensor 52. When the temperature sensor 52 detects a temperature lower than a predetermined temperature, the expansion member 54 expands downward causing the adjusting rod 50 to move downward and resulting in an enlargement of the clearance in the first adjusting part 36a (Fig. 3(a)).

[0033] Accordingly, even when the viscosity of the damper oil Q has become high under low-temperature conditions, the flow rate of oil flowing through the clearance in the first adjusting part 36a can be kept constant and the closing speed of the door D can be kept constant.

[0034] Conversely, when the temperature sensor 52 detects a temperature higher than a predetermined temperature, the expansion member 54 expands upward causing the adjusting rod 50 to move upward and resulting in a reduction of the clearance in the first adjusting part 36a (Fig. 3(b)). Accordingly, even when the viscosity of the damper oil Q has become low under high-temperature conditions, the flow rate of oil flowing through the clearance in the first adjusting part 36a can be kept constant, and the closing speed of the door D can be kept constant.

[0035] In the second embodiment, the expansion member 54 is provided on the top of the adjusting rod 50, which is adjustably moved up and down according to the result of detection by the temperature sensor 52. Therefore, even if the viscosity of the damper oil Q easily varies with changes in temperature, the flow rate of oil flowing through the clearance in the first adjusting part 36a can be kept constant, and the closing speed of the door D can be kept constant without the need to adjust the adjusting rod every time the ambient temperature changes.

[0036] Although some embodiments of the door closer 10 according to the present invention have been described above, the present invention is not limited to these embodiments. For example, although the compression spring 38 is provided in the lower oil storage part 26a, the present invention is not limited thereto. A tension spring may be provided in the upper oil storage part 26b. The door closer 10 is not limited to the center-hung type but may be of the hinged type.

Brief Description of the Drawings

[0037]

Fig. 1 is a vertical sectional view of a door closer according to a first embodiment of the present invention: (a) shows the door closer in a closed position: (b) shows the door closer in an open position.

Fig. 2 is an enlarged vertical sectional view of a piston and vicinities of the piston of the door closer shown in Fig. 1.

Fig. 3 is a vertical sectional view showing a main part of a door closer according to a second embodiment of the present invention: (a) shows the door closer under low-temperature conditions: (b) shows the door closer under ordinary-temperature conditions; and (c) shows the door closer under high-temperature conditions.

Fig. 4 is an enlarged vertical sectional view of a piston and vicinities of the piston of a door closer according to a conventional example.

List of Reference Signs:

[0038] 10: door closer; 11: casing; 12: closing-urging section; 14: speed adjusting section; 16: door mount; 18: support leg; 20: shaft; 20a: enlarged-diameter part; 20b: cylindrical recess; 22: coil spring; 24: inner tube (cylinder); 25: thread groove; 25a: upper surface (one side surface) of thread groove; 25b: lower surface (one side surface) of thread groove; 26: oil storage section; 26a: lower oil storage part; 26b: upper oil storage part; 28: adjusting rod (adjusting means); 28a: adjusting knob; 30: adjusting rod installation part; 32: through-hole; 34: piston; 35: thread ridge; 35a: upper surface (one side surface) of thread ridge; 35b: lower surface (one side surface) of thread ridge; 36: adjusting valve; 36a: first adjusting part; 36b: second adjusting part; 38: compression spring (resilient member); 50: adjusting rod; 52: temperature sensor; 54: expansion member; D: door; P, Q: damper oil (damping fluid); G: floor; and S: seat.

Claims

1. A door closer installed along an axis of rotation of a door, the door closer comprising:

a closing-urging section that urges the door toward a closed position; and
a speed adjusting section that adjusts a return speed of the door when moving toward the closed position;

the speed adjusting section including:

a tubular cylinder;
an oil storage section formed in the cylinder to store a damping fluid; and
a piston that moves in response to opening and closing of the door in the oil storage section;
the oil storage section having an upper oil storage part formed at an upper side of the piston, and a lower oil storage part formed at a lower end side of the piston;
the piston being in thread engagement with the cylinder and movable in the cylinder while being braked by the damping fluid stored in the oil storage section, the piston being provided with a fluid passage that allows flow of the damping fluid between the upper oil storage part and the lower oil storage part, and adjusting means that adjusts an amount of damping fluid passing through the fluid passage;
the damping fluid having a small change in viscosity with temperature;
the oil storage section being provided with a resilient member that presses the piston toward one end side of a direction of movement of the piston;
wherein one side surface of a thread ridge formed on an outer peripheral surface of the piston is pressed against one side surface of a thread groove formed on an inner periphery of the cylinder by an urging force of the resilient member.

2. The door closer of claim 1, wherein the damping fluid is silicone oil.

3. The door closer of claim 2, wherein the silicone oil has a lubricant added thereto.

4. The door closer of claim 1, wherein the resilient member is a compression spring disposed in the lower oil storage part;
the closing-urging section being provided with a shaft secured to a floor;
the shaft being provided at its top with an enlarged-diameter part having an enlarged diameter, the enlarged-diameter part having a cylindrical recess coaxial with the shaft;
an outer peripheral surface of the enlarged-diameter part and the cylinder being secured in close contact with each other to prevent the damping fluid stored in the oil storage section from leaking out thereof;
an upper end of the enlarged-diameter part reaching a position where it is substantially coincident with a lower end of the adjusting means to widen an area of close contact between the outer peripheral surface of the enlarged-diameter part and the cylinder;
a lower part of the compression spring being held in the recess.

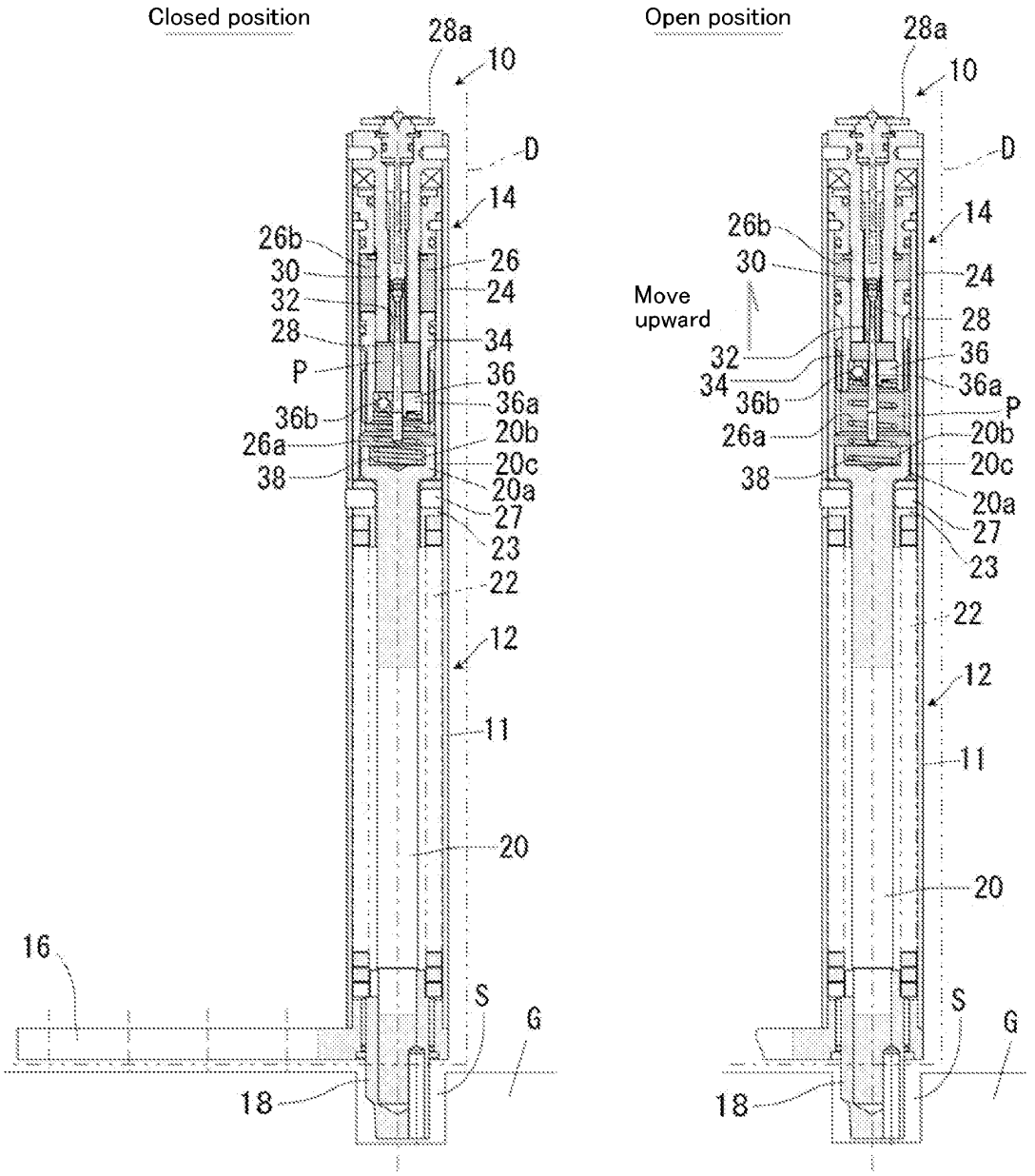
Closed position
28a
10
D
14
26b
30
32
28
P
36b
26a
38
26
24
34
36
36a
20b
20c
20a
27
23
22
12
11
20
16
18
S
G
Open position
28a
10
D
14
26b
30
Move upward
32
34
36b
26a
38
24
28
36
36a
P
20b
20c
20a
27
23
22
12
11
20
18
S
G

FIG.1

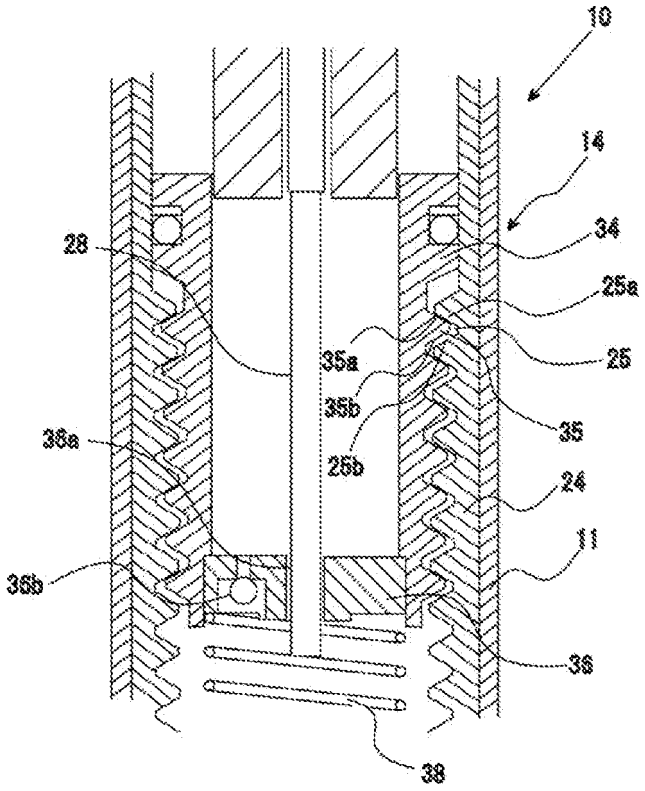

FIG.2

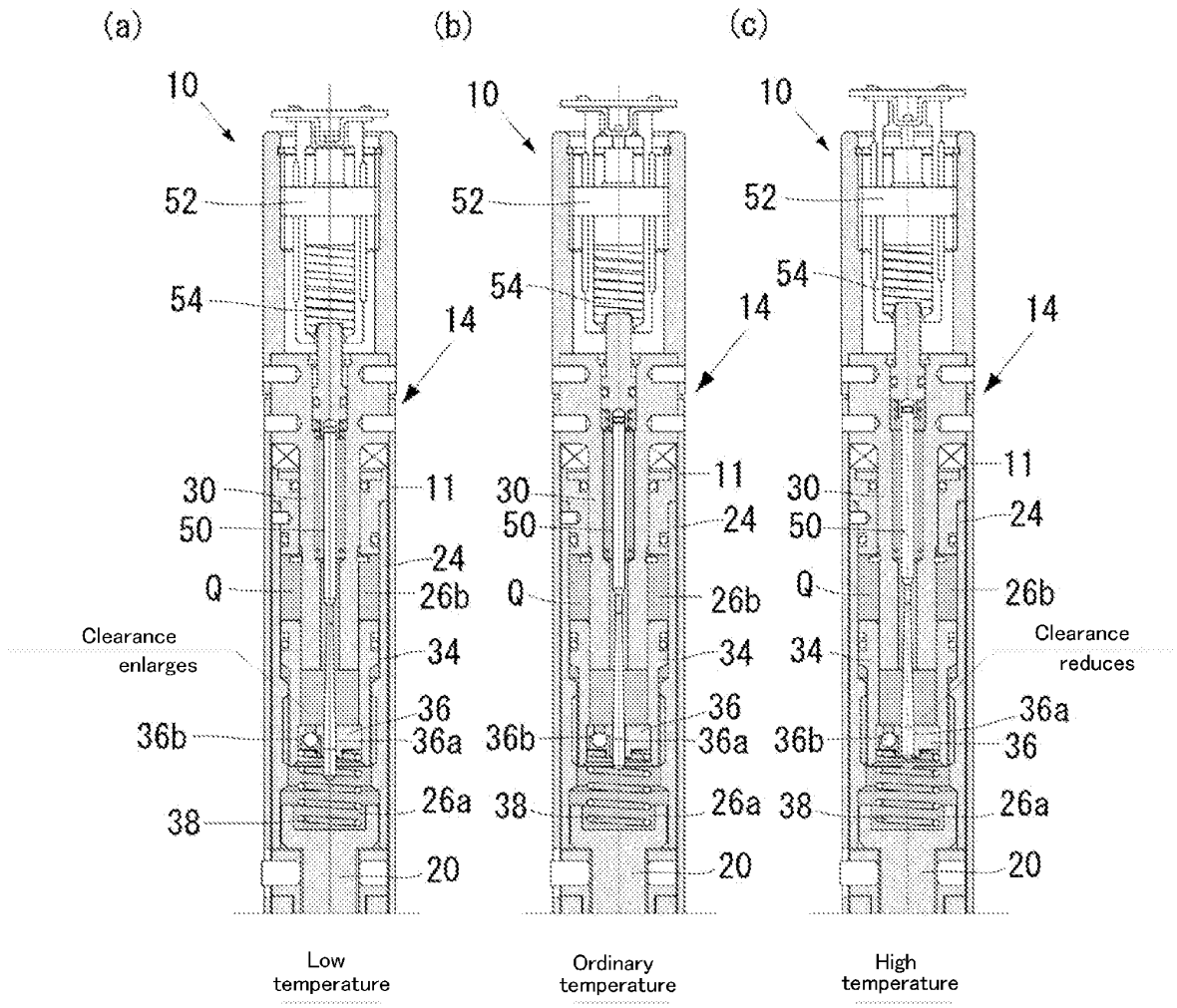
(a)
(b)
(c)
10
52
54
14
30
50
Q
11
24
26b
34
36
36a
26a
20
36b
38
Clearance enlarges
Clearance reduces
Low temperature
Ordinary temperature
High temperature

FIG.3

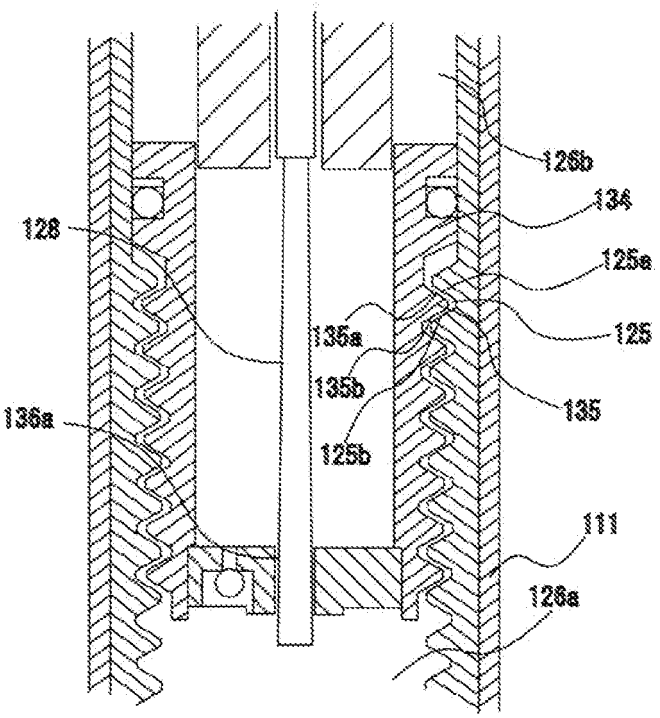

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/072561

A. CLASSIFICATION OF SUBJECT MATTER
E05F3/08(2006.01)i, *E05F1/12*(2006.01)i, *E05F3/20*(2006.01)i

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)
E05F3/08, E05F1/12, E05F3/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-239046 A (Nitto Kohki Co., Ltd.), 26 August, 2004 (26.08.04), Par. Nos. [0013] to [0029]; Figs. 1 to 9 & TW 237085 B	1-4
A	JP 2003-3745 A (NTN Corp.), 08 January, 2003 (08.01.03), Par. Nos. [0018] to [0025]; Figs. 1 to 4 & CN 1397710 A	1-4
A	JP 8-93312 A (Nippon Electric Industry Co., Ltd.), 09 April, 1996 (09.04.96), Par. No. [0011] (Family: none)	1-4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 March, 2008 (13.03.08)	25 March, 2008 (25.03.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/072561

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 6-81876 A (Fuji Seiki Kabushiki Kaisha), 22 March, 1994 (22.03.94), Full text; all drawings (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006161452 A **[0002]**