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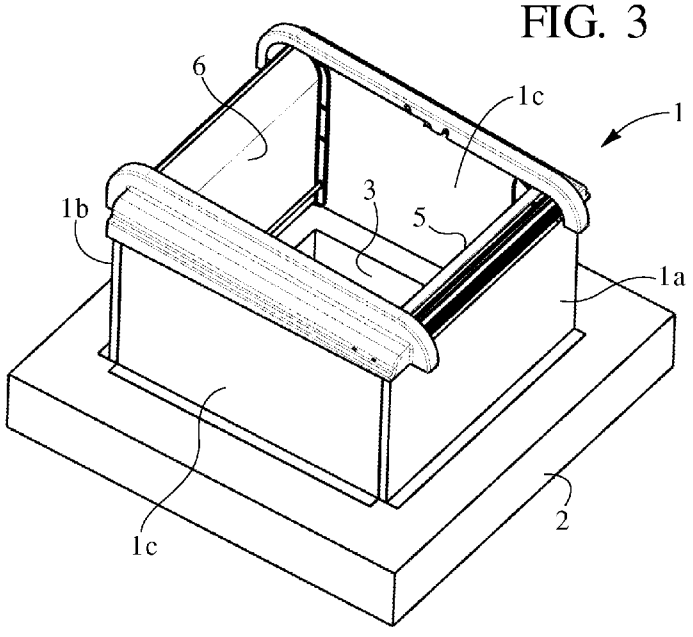
(54) **Title**: SMOKE AND HEAT EVACUATOR

FIG. 3



(57) **Abstract**: A smoke and heat evacuator that can be applied at a generally horizontal opening (3) of the roof of a closed environment, comprising an oscillating shutter (4) that can be displaced from a normally closed position in which the opening (3) is obstructed in a fluid-tight way to an open position to enable evacuation of smoke and heat through the opening (3). Displacement for opening the shutter, formed by two opposed leaves (5, 6), is obtained, following upon release of a retention device (21) carried by one of the shutters (5) and actuated by means of a wire made of a shape-memory metal-alloy (31), as a result of a rotation thereof downwards by gravity.

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"Smoke and heat evacuator"

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Field of the invention

The present invention relates to devices for evacuation of smoke and heat from closed environments in the event of fire.

More in particular, the subject of the invention is an evacuator that can be applied at a substantially horizontal opening provided in the roof of the premises and comprises oscillating-shutter means mobile between a normally closed position, in which the opening is obstructed in a fluid-tight way, and an open position to enable evacuation of fumes and heat out of the opening. Actuator means are provided for governing displacement of the shutter means from the closed position to the open position in a governed or automatic way, in the event of emergency.

Prior art

Smoke and heat evacuators of the type defined above are known, for example, from the documents Nos. WO-97/33062, EP-A-2025849, and FR-2778854. All these devices envisage opening of the shutter means, usually constituted by a single leaf, as a result of a rotation outwards, i.e., upwards, typically obtained with the use of a linear actuator, in particular a hydraulic jack.

Conventional solutions of the above sort present a dual drawback.

In the first place, in the condition where the shutter is open, the passage for evacuation of fumes and heat is partially obstructed, and hence limited, by the presence of the actuator. In the second place, the oscillation outwards of the shutter, upon command for opening thereof, can be hindered by the possible presence of snow on the roof where the opening for the

evacuator is provided, which can limit, if not even preclude, opening thereof.

EP-1529911 and US-3874130 provide opening displacement of the oscillating-shutter means as a result of a rotation thereof downwards. The actuator means performing opening are however relatively complicated and unreliable, namely in case of exposition to high temperatures.

Summary of the invention

The object of the present invention is to overcome the aforesaid drawbacks, and said object is achieved thanks to the fact that a smoke and heat evacuator according to the preamble of Claim 1 is mainly characterized in that the actuator means include shape-memory means.

Advantageously, the aforesaid actuator means comprise a device for releasable retention of the shutter means in the aforesaid closed position, and a device for release of the retention device, comprising a wire made of a shape-memory metal alloy, to enable rotation downwards by gravity of the shutter means.

According to a preferred embodiment of the invention the shutter means include a pair of opposed oscillating shutters, a first one of which bears, at one end, the aforesaid retention device with the corresponding release device, and a second one rests with its end on said end of the first shutter.

Thanks to this arrangement, opening of the smoke and heat evacuator according to the invention can be obtained in the event of emergency in a prompt and immediate way, without any adverse effect due to possible loads of snow weighing on the shutters and moreover making available the widest possible section of passage towards the external environment in so far as, unlike the evacuators according to the known art

referred to above, the internal actuator that in conventional evacuators governs oscillation upwards of the shutter means is eliminated.

Brief description of the drawings

The invention will now be described in detail with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a schematic perspective view of a smoke and heat evacuator according to the invention, represented in the closed condition;
- Figure 2 is a schematic vertical cross-sectional view of the evacuator of Figure 1;
- Figure 3 is a perspective view similar to that of Figure 1 illustrating the evacuator according to the invention in the open condition;
- Figure 4 is a vertical cross-sectional view at a larger scale of the evacuator of Figure 3;
- Figure 5 illustrates in greater detail a part of Figure 2;
- Figure 6 is a further enlarged and simplified view of a detail of Figure 5;
- Figure 7 is a simplified cross-sectional view according to the line VII-VII of Figure 5;
- Figure 8 is a perspective view of Figure 7;
- Figure 9 is a view similar to that of Figure 8, in which some components are omitted for convenience of illustration;
- Figure 10 is a perspective view at a larger scale of a detail of Figure 9;
- Figure 11 shows at a larger scale a detail of Figure 7 in a first condition;
- Figure 12 is a view similar to that of Figure 11 illustrating a second operating condition;
- Figure 13 is a cross-sectional view at a larger scale according to the line XIII-XIII of Figure 2;

- Figure 14 is a view similar to that of Figure 2 representing a configuration of partial opening of the evacuator according to the invention to provide periodic ventilation of the internal environment; and

- Figures 15 and 16 show two details of Figure 2 at a larger scale.

Detailed description of the invention

With initial reference to Figures 1, 2 and 3, 4 a smoke and heat evacuator according to the invention basically includes an annular support 1, typically quadrangular in shape, applied directly on a base 2 at an opening 3 formed, substantially in a horizontal position, in the roof of a closed environment, such as an industrial shed, a warehouse, office premises, and the like.

Set at the top of the support 1 is a normally closed shutter, designated as a whole by 4, which can be opened completely to enable evacuation of smoke and heat from the premises, and even only partially to enable periodic ventilation of the premises.

According to the peculiar characteristic of the invention, complete opening of the shutter 4, with the modalities that will be clarified in what follows, is obtained by means of an oscillation downwards thereof, i.e., towards the inside of the opening 3, instead of upwards, i.e., towards the outside of said opening 3.

More in particular, the shutter 4, which in the closed condition can present a slight inclination with respect to the base 2 and is hence slightly oblique with respect to the horizontal in the way more clearly visible in Figure 2, is formed by a pair of leaves 5, 6 that can be sent down by gravity, starting from the closed position of Figures 1 and 2, to a substantially vertical position, in which they are set immediately adjacent to two respective opposite walls 1a, 1b of the

support 1.

With reference now in greater detail to Figures 5, 6 and 15, 16, the leaf 5 is articulated at one of its ends 7 to an oscillation pin 8 carried by the top of the wall 1a, whereas its opposite end, designated by 9, is provided with a device for retention in a closed position, which is releasable according to what will be clarified in what follows in order to free said end 9 and to enable rotation of the leaf 5 downwards, as has been said by gravity.

The other leaf 6 is also articulated at one end 10 to the top of the wall 1b, however, indirectly via an oscillation pin 11 carried by the top of the stem 12 of a linear actuator 13, typically constituted by an electric jack, the function of which will be clarified in what follows.

The opposite end of the leaf 6, designated by 14, rests on the end 9 of the leaf 5, in the way represented in greater detail in Figure 6. As may be seen in Figure 6, set between the ends 9 and 14 is a gasket 15, inserted within a seat 16 of the end 14. In addition, said ends 9 and 14 have respective shaped and mutually compenetrated edges 17, 18, which perform a dual function: defining a labyrinth designed to prevent any infiltration of water towards the inside, and transmitting the thrust downwards from the leaf 5 to the leaf 6 upon opening of the shutter 4.

The device for retention of the leaf 5 in the closed position is shown in greater detail in Figures 7 to 9 and is designated as a whole by 19: it comprises a substantially channel-shaped sectional element 28, fixed along the bottom face of the end 9 of the leaf 5 in the way represented in Figure 6, and a blocking mechanism (omitted in Figure 6 for simplicity of illustration) designated as a whole by 20 in Figure 9.

Said blocking mechanism 20 is made up of a pair of carriages 21, one of which is represented at a larger scale in Figure 10, set in a condition opposed to the ends of the guide sectional element 28. Each carriage 21 comprises a respective supporting body 22, rotatably mounted within which are two wheeled moving elements 23 and which forms at its outer end a raised appendage 24 in turn bearing two rotating side wheels 25.

The two carriages 21 are pushed, by the action of respective springs 26, so as to come to rest against contrast elements 27 fixed within the guide sectional element 28, in a position projecting outwards in the way represented in Figure 11. In said position, the appendage 24 of each carriage 21 is inserted underneath a respective canopy-like element 29 provided at the top of a respective side 1c of the support 1 set in a direction transverse to the sides 1a, 1b. Each canopy-like element 29 is formed with an inclined chute 30 designed to co-operate with the rollers 25 of the appendage 24 of the carriage 21, in the way that will be clarified in what follows.

A gasket 33 (Figures 11 and 12) extends between a bottom appendage 34 projecting underneath each side of each leaf 5, 6 and the corresponding side 1c of the support 1 for ensuring fluid-tight sealing along said areas in the condition where the shutter 4 is closed.

The two carriages 21 are interconnected via a wire made of a shape-memory metal alloy (SMA) 31, which extends along the guide sectional element 28. The SMA wire 31 is connected to an electrical-supply cable 32, in turn connected to the grid via a remote switch. When the SMA wire 31 is electrically supplied and heated by the Joule effect, it undergoes a linear contraction (for example, in the region of 5%) as a result of which the two carriages 21 move towards one another, against

the action of the respective springs 26. In this way, the rollers 25 carried by the appendage 24 move underneath the corresponding canopy-like element-like elements 29, first intercepting the chutes 30, in the way represented in Figure 12, and then releasing the guide sectional element 28 and hence the leaf 5 from the walls 1c. The interaction between the rollers 25 and the canopy-like element-like elements 29 provides a thrust downwards of the end 9 of the leaf 5, which enables, in the case of sticking, separation of the gaskets 33 from the sides 1c of the support 1 so as to release the leaf 5 in a safe way.

In this way, the leaf 5 is able to turn by gravity downwards around the pin 8, first drawing along the end 14 of the leaf 6, thanks to the interaction between the terminal edges 17 and 18, and then releasing the corresponding oscillation downwards of said leaf 6, thus enabling complete opening of the shutter 4 in the position represented in Figures 3 and 4. As may be seen in said figures, the leaves 5, 6 are set vertically immediately adjacent to the walls 1a, 1b of the support 1, and the passage of fluid from the opening 3 towards the outside is thus completely unobstructed.

As anticipated previously, the end 10 of the leaf 6 of the shutter 4 is articulated to the side 1b of the support 1 in an indirect way, i.e., via the pin 11 carried by the top of the stem 12, which is normally set in the contracted configuration represented in Figures 2, 4, and 13. Extension of the actuator 13, in the way represented in Figure 14, causes oscillation of the entire shutter 4 about the articulation pin 8 so as to raise the end 10 of the leaf 6 above the side 1b of the support 1 for providing, selectively, a partial opening of the shutter 4 for periodic aeration of the internal environment through the opening 3.

The arrangement of the linear actuator 13 is in any case such that, in the condition of complete opening of the shutter 4, it does not obstruct in any way communication of the opening 3 with the external environment in so far as, as may be seen in Figure 4, it is in said condition confined in the space comprised between the leaf 6 and the wall 1b.

Of course, the details of construction and the embodiments may vary widely with respect to what is described and illustrated herein, without thereby departing from the scope of the present invention as defined in the ensuing claims.

CLAIMS

1. A smoke and heat evacuator that can be applied at a generally horizontal opening (3) of the roof of a closed environment, comprising oscillating-shutter means (4) mobile between a normally closed position in which said opening (3) is obstructed in a fluid-tight way and an open position to enable evacuation of smoke and heat through said opening (3), and actuator means (19) for governing displacement of said shutter means (4) from said closed position to said open position, wherein opening displacement of said shutter means (4) is obtained, following upon intervention of said actuator means (19), as a result of a rotation thereof downwards, characterized in that said actuator means (19) include shape-memory means (31).

2. The evacuator according to Claim 1, characterized in that said actuator means (19) comprise a device (21) for releasable retention of said shutter means (4) in said closed position, and a device for release of said retention device (21), including a wire made of a shape-memory metal alloy (31), to enable rotation downwards by gravity of said shutter means (4).

3. The evacuator according to Claim 2, characterized in that said oscillating-shutter means (4) have a first side (7) articulated to a supporting structure (1) and a second side (9), opposite to the first side (7), equipped with a pair of side latches (24, 25) that are normally engaged to respective striker parts (29, 30) of said supporting structure (1) and are interconnected via said shape-memory metal-alloy wire (31), contraction of which by thermal effect causes mutual approach of said latches (24, 25) and their disengagement from said striker parts (29,

30).

4. The evacuator according to Claim 3, characterized in that each of said latches (24, 25) is carried by a respective carriage (21) mobile within a guide (28) of said shutter means (4), and said supporting structure (1) comprises, for each carriage (21), a guide part (30) co-operating with the respective latch (24, 25) for applying, during its disengagement from said striker part (29, 30), a thrust downwards on said second side (9) of the oscillating-shutter means (4).

5. The evacuator according to Claim 4, characterized in that arranged between said oscillating-shutter means (4) and said supporting structure (1) are lateral hermetic-seal gaskets (33).

6. The evacuator according to any one of Claims 1 to 5, characterized in that said oscillating-shutter means (4) include a pair of opposed oscillating shutters (5, 6), a first one (5) of which bears said retention device (21) and said release device (31) on said second side (9), and a second one (6) rests with a corresponding second side (14) thereof on said second side (9) of the first shutter (5).

7. The evacuator according to Claim 6, characterized in that set between the second side (9) of the first shutter (5) and the second side (14) of the second shutter (6) is a gasket (15).

8. The evacuator according to Claim 6 or Claim 7, characterized in that the second side (9) of the first shutter (5) and the second side (14) of the second shutter (6) are formed with respective partially compenetrated terminal edges (17, 18).

9. The evacuator according to any one of Claims 6 to 8, characterized in that said second shutter (6) has a first side (10) articulated to said supporting

structure (1) via a mobile shaft (11) that can be displaced vertically via a lifting actuator (13).

10. The evacuator according to one or more of the preceding claims, characterized by fact that said supporting structure is constituted by a frame (1) overlying said opening (3).

11. The evacuator according to any one of the preceding claims, characterized in that said oscillating-shutter means (4) in said normally closed position are set in a slightly oblique condition.

AMENDED CLAIMS
received by the International Bureau on 11.07.2012

CLAIMS

1. A smoke and heat evacuator that can be applied at a generally horizontal opening (3) of the roof of a closed environment, comprising oscillating-shutter means (4) mobile between a normally closed position in which said opening (3) is obstructed in a fluid-tight way and an open position to enable evacuation of smoke and heat through said opening (3), and actuator means (19) for governing displacement of said shutter means (4) from said closed position to said open position, wherein opening displacement of said shutter means (4) is obtained, following upon intervention of said actuator means (19), as a result of a rotation thereof downwards, wherein said actuator means (19) comprise a device (21) for releasable retention of said shutter means (4) in said closed position, and a device for release of said retention device (21), including a wire made of a shape-memory metal alloy (31), to enable rotation downwards by gravity of said shutter means (4), characterized in that said oscillating-shutter means (4) have a first side (7) articulated to a supporting structure (1) and a second side (9), opposite to the first side (7), equipped with a pair of side latches (24, 25) that are normally engaged to respective striker parts (29, 30) of said supporting structure (1) and are interconnected via said shape-memory metal-alloy wire (31), contraction of which by thermal effect causes mutual approach of said latches (24, 25) and their disengagement from said striker parts (29, 30).

2. The evacuator according to Claim 1, characterized in that each of said latches (24, 25) is carried by a respective carriage (21) mobile within a guide (28) of said shutter means (4), and said

supporting structure (1) comprises, for each carriage (21), a guide part (30) co-operating with the respective latch (24, 25) for applying, during its disengagement from said striker part (29, 30), a thrust downwards on said second side (9) of the oscillating-shutter means (4).

3. The evacuator according to Claim 2, characterized in that arranged between said oscillating-shutter means (4) and said supporting structure (1) are lateral hermetic-seal gaskets (33).

4. The evacuator according to any one of Claims 1 to 3, characterized in that said oscillating-shutter means (4) include a pair of opposed oscillating shutters (5, 6), a first one (5) of which bears said retention device (21) and said release device (31) on said second side (9), and a second one (6) rests with a corresponding second side (14) thereof on said second side (9) of the first shutter (5).

5. The evacuator according to Claim 4, characterized in that set between the second side (9) of the first shutter (5) and the second side (14) of the second shutter (6) is a gasket (15).

6. The evacuator according to Claim 4 or Claim 5, characterized in that the second side (9) of the first shutter (5) and the second side (14) of the second shutter (6) are formed with respective partially compenetrated terminal edges (17, 18).

7. The evacuator according to any one of Claims 4 to 6, characterized in that said second shutter (6) has a first side (10) articulated to said supporting structure (1) via a mobile shaft (11) that can be displaced vertically via a lifting actuator (13).

8. The evacuator according to one or more of the preceding claims, characterized by fact that said supporting structure is constituted by a frame (1)

overlying said opening (3).

9. The evacuator according to any one of the preceding claims, characterized in that said oscillating-shutter means (4) in said normally closed position are set in a slightly oblique condition.

FIG. 1

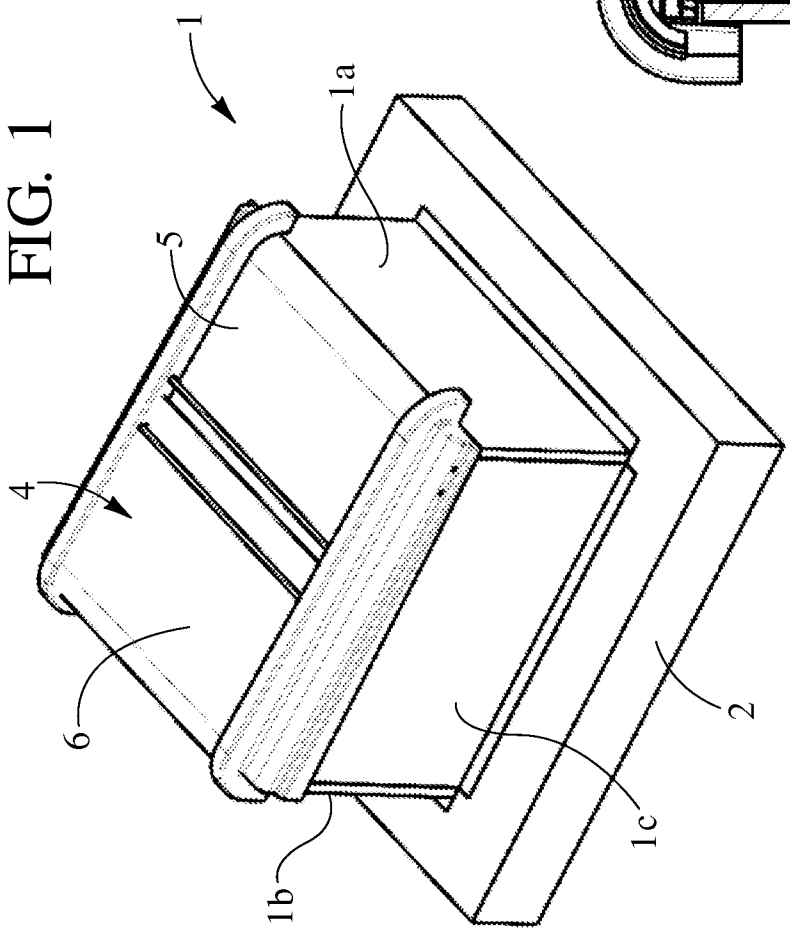


FIG. 2

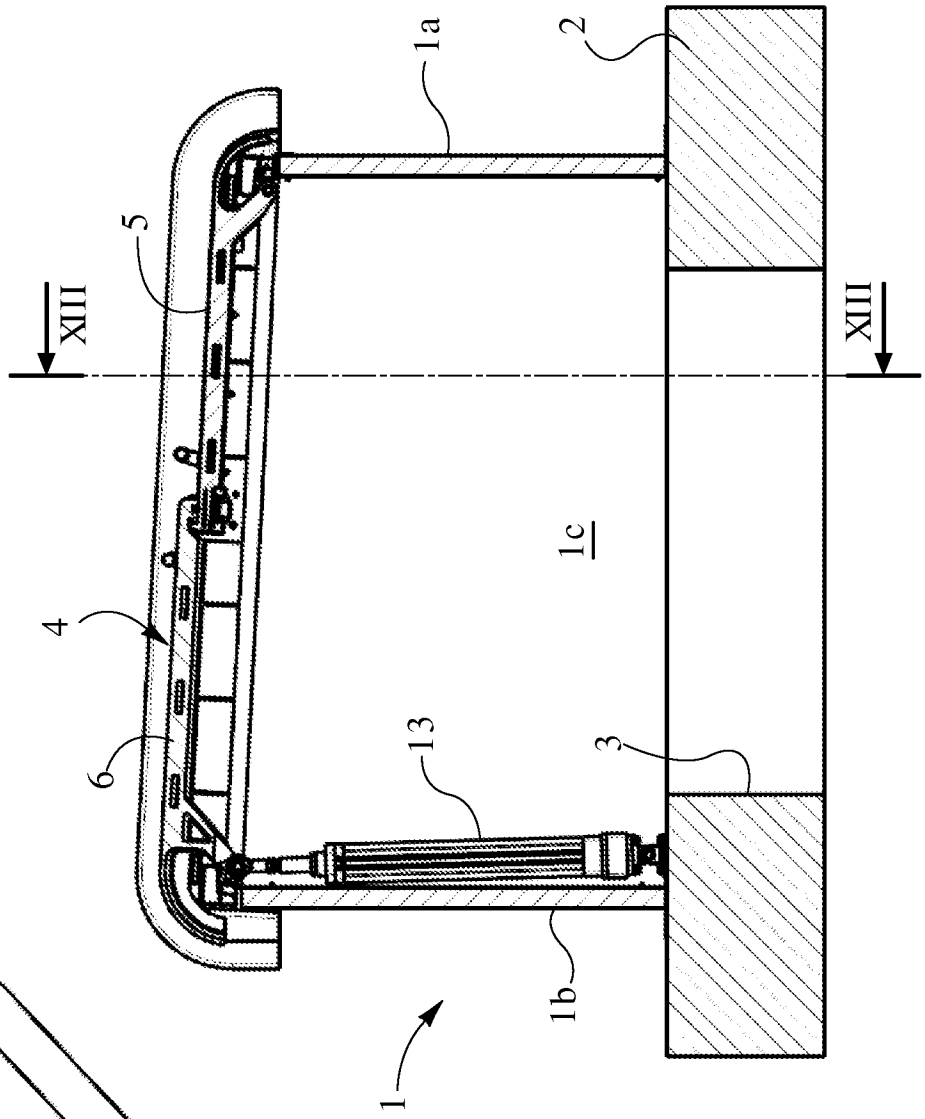


FIG. 3

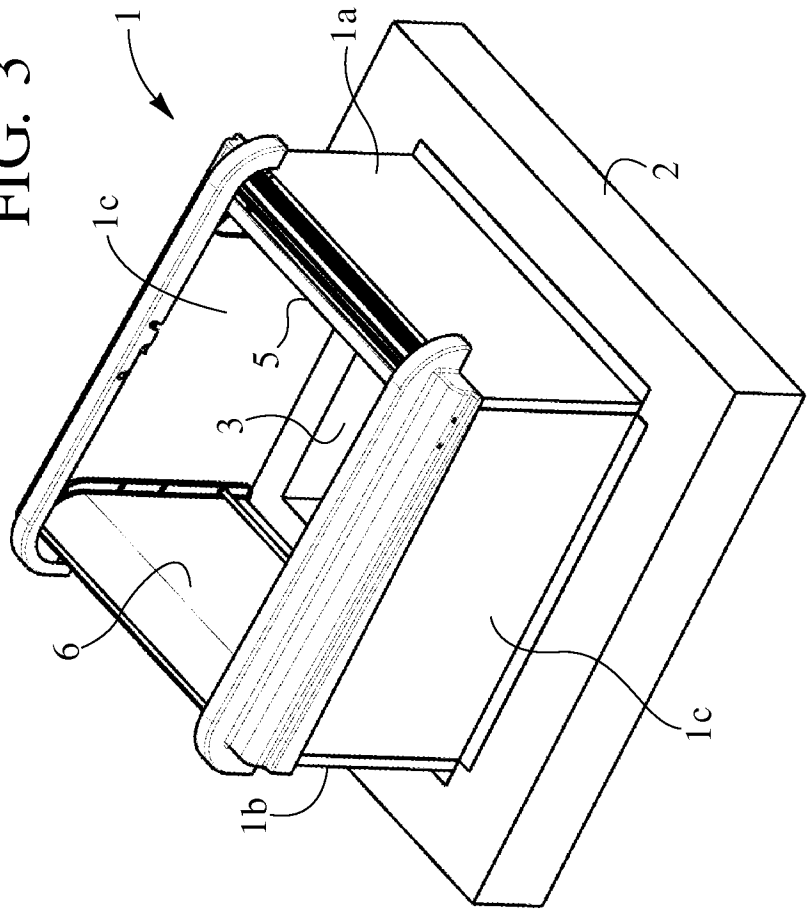


FIG. 4

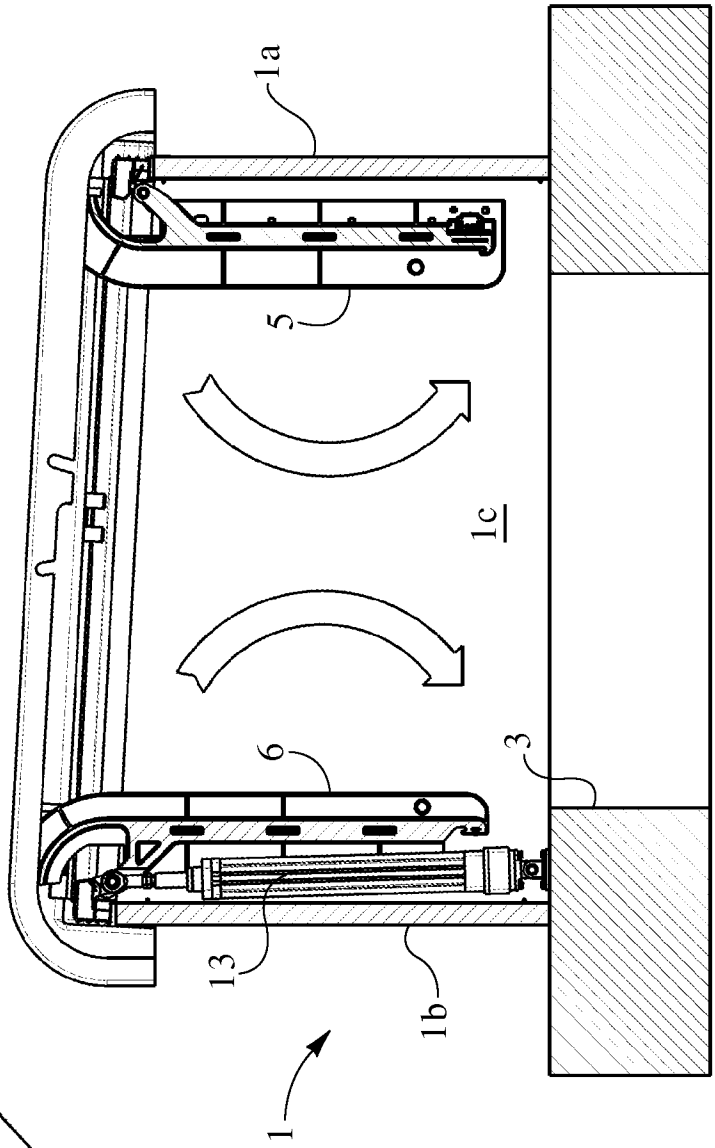


FIG. 5

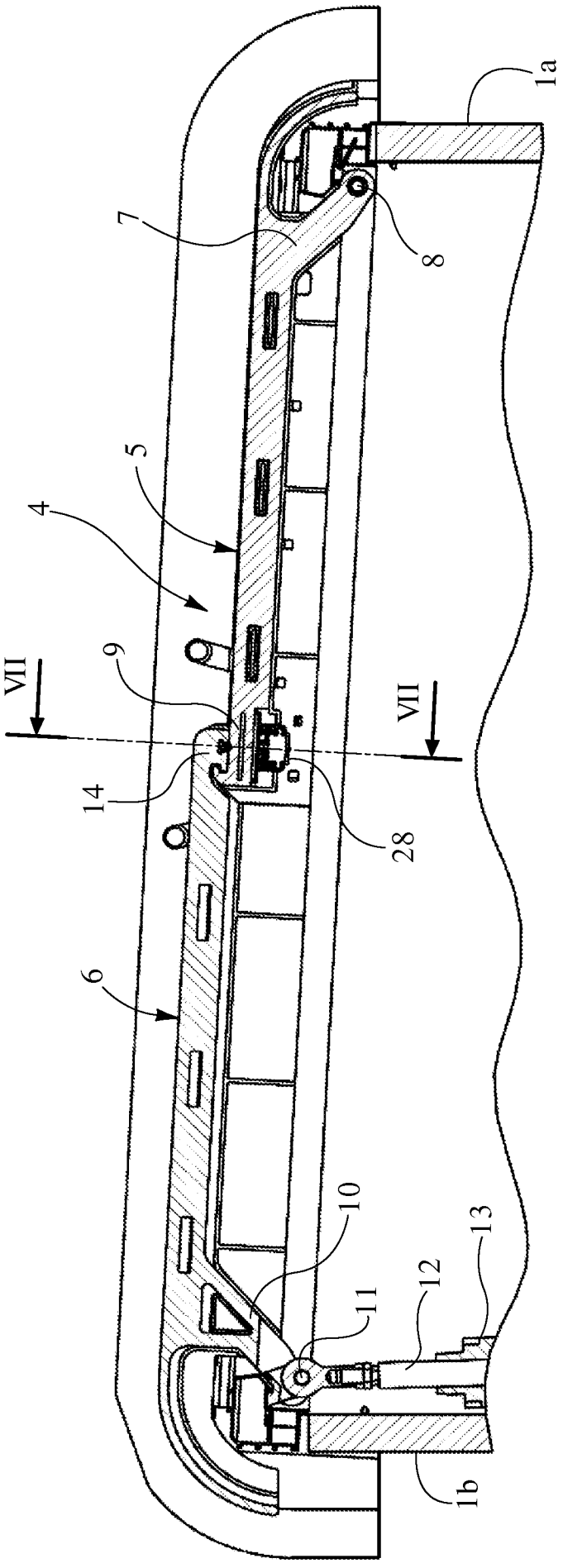


FIG. 6

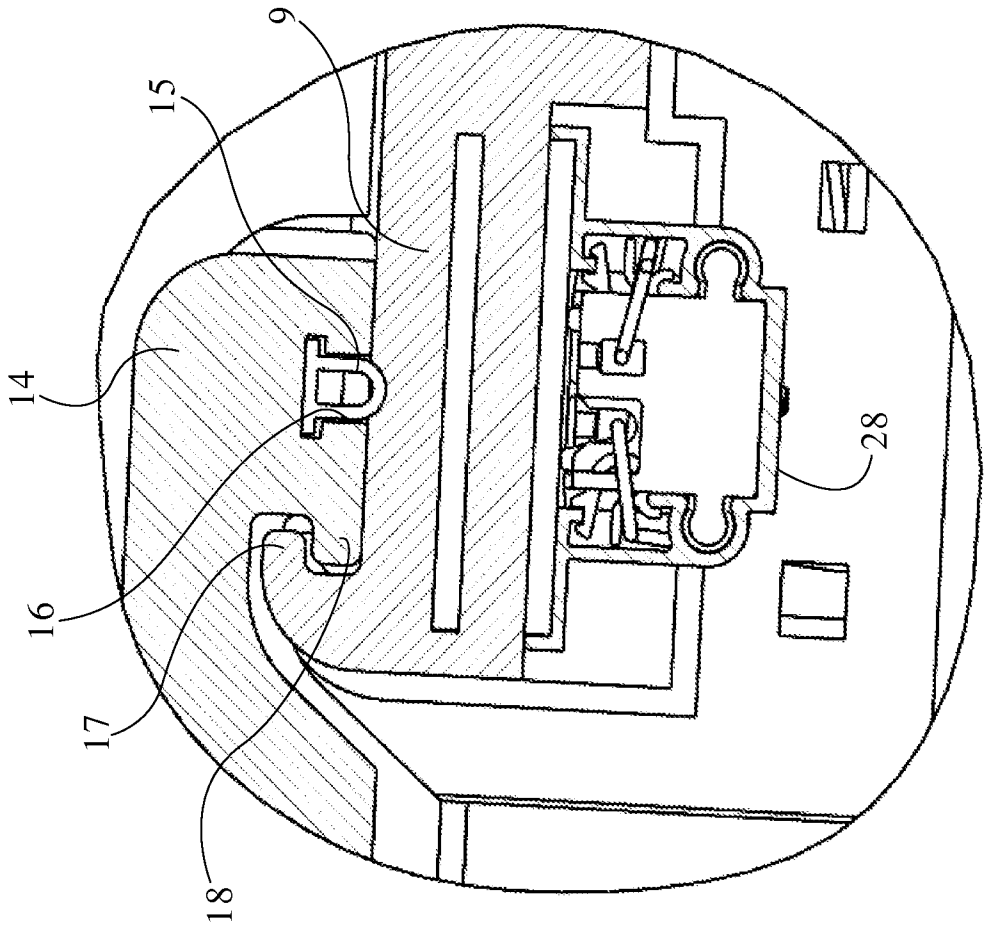
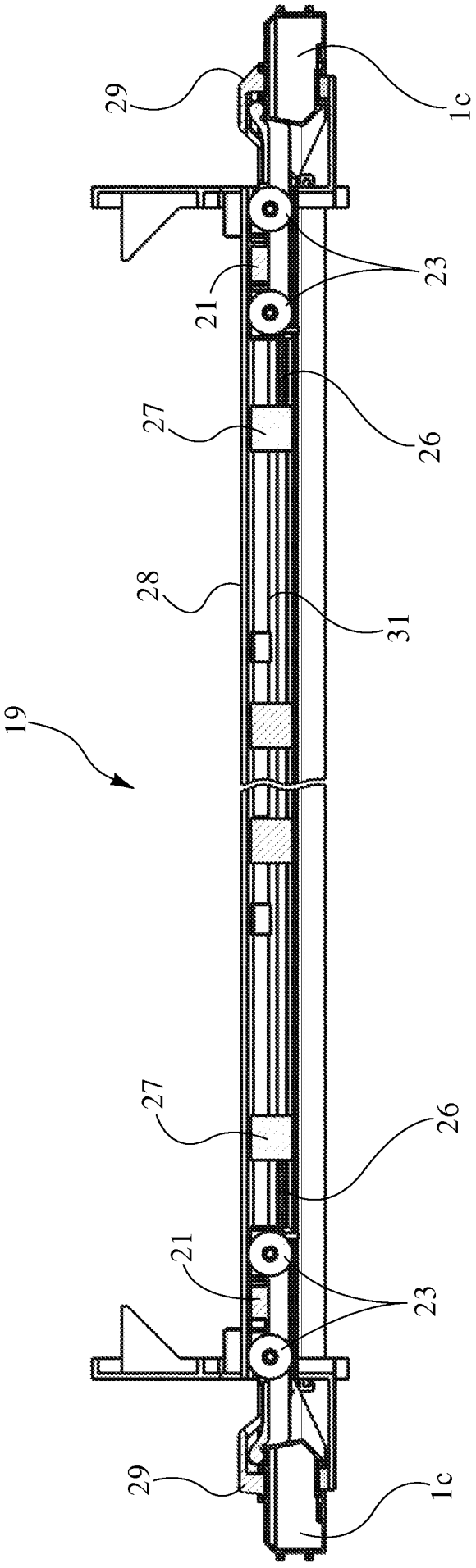


FIG. 7



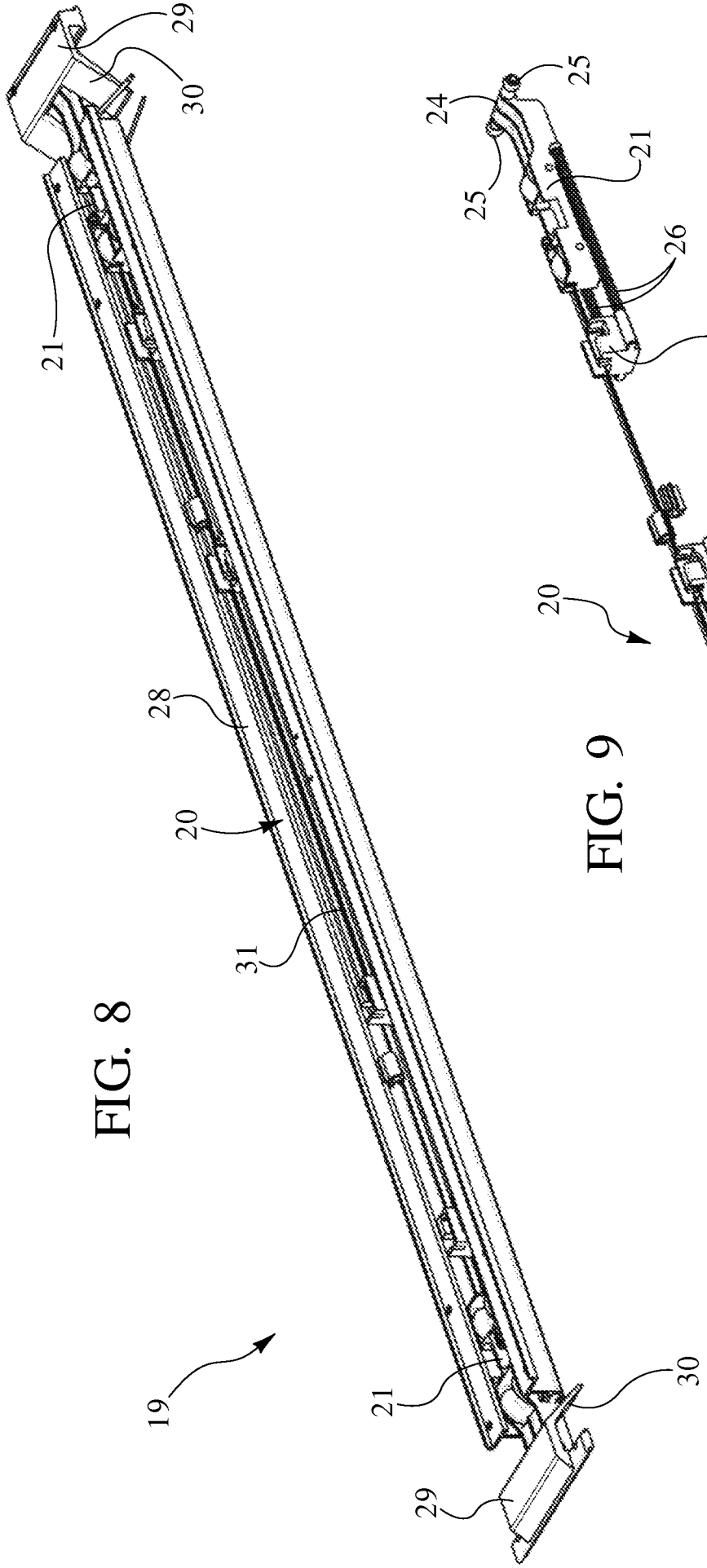

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FIG. 8

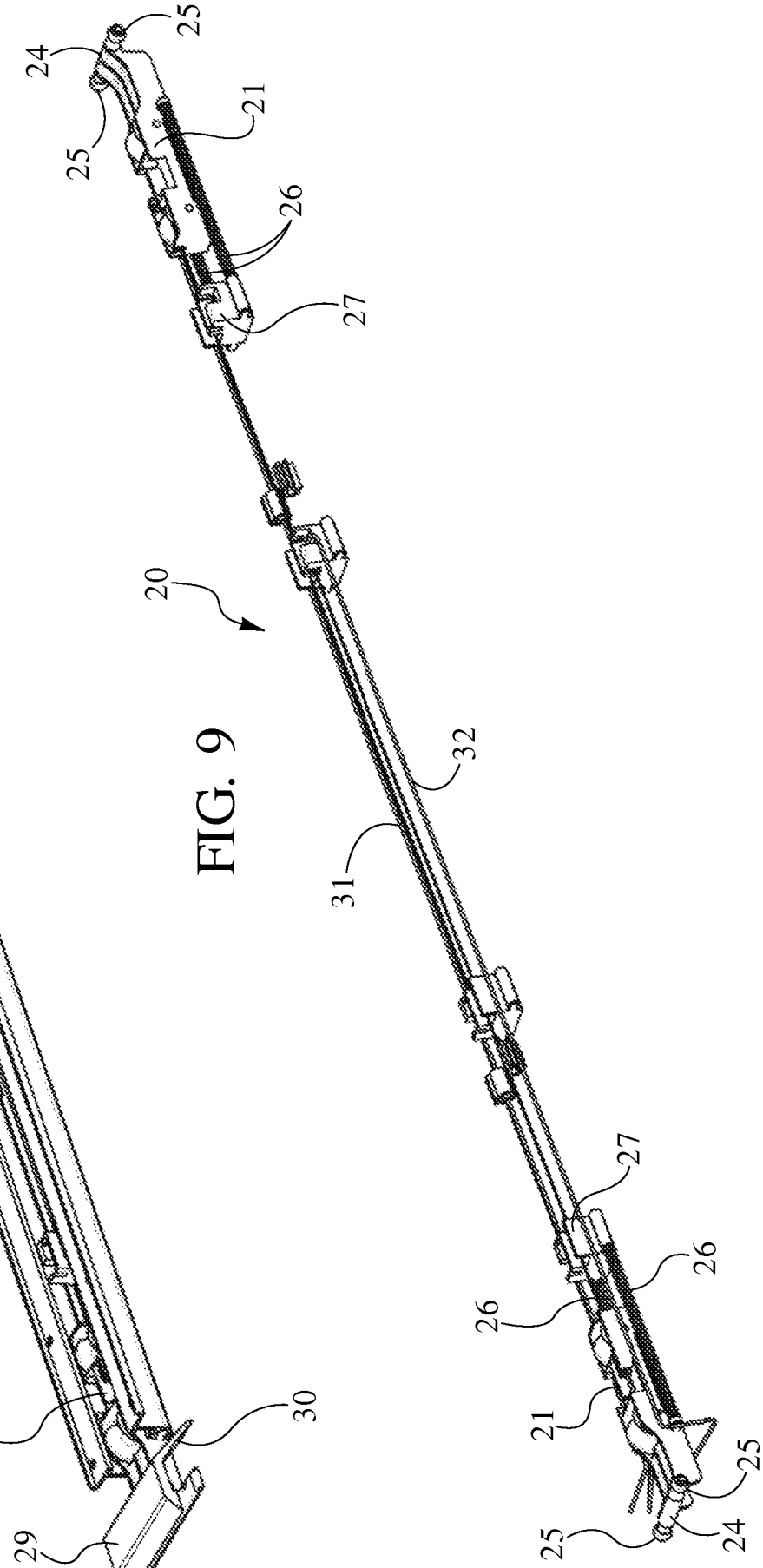
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FIG. 9

FIG. 10

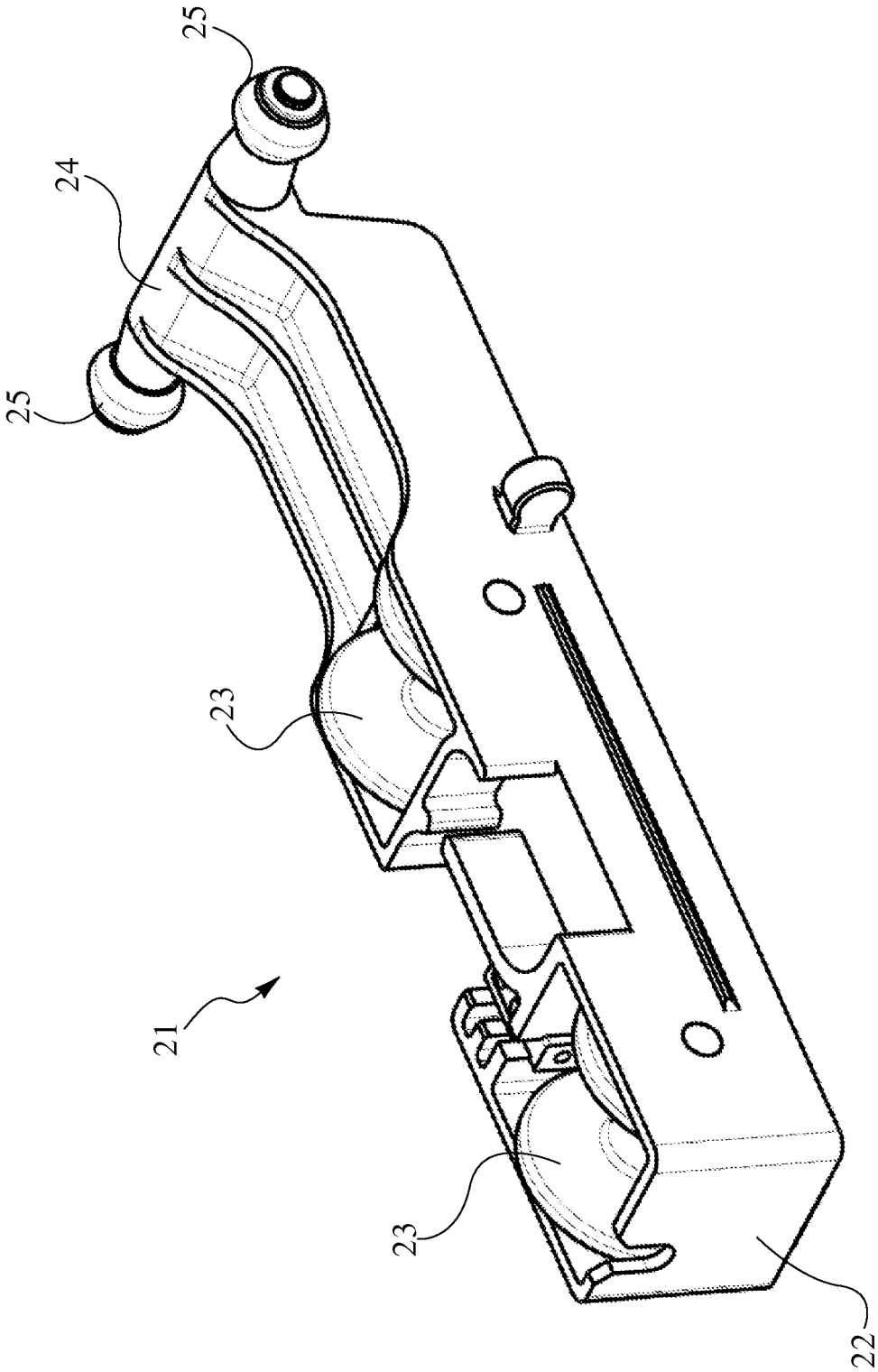


FIG. 11

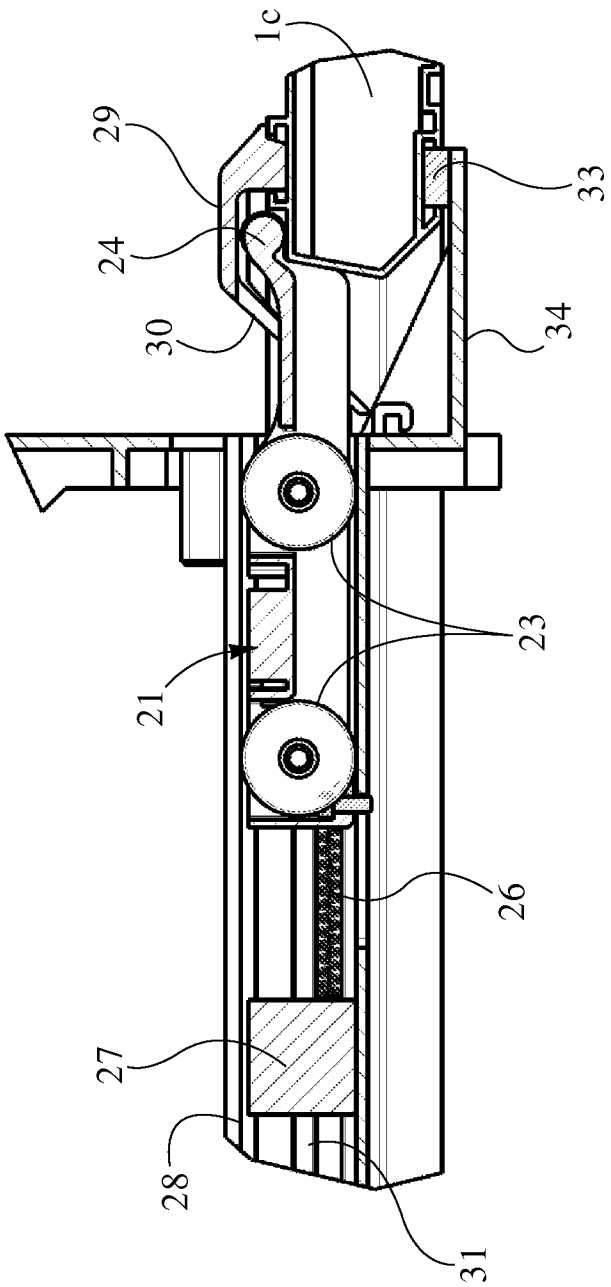


FIG. 12

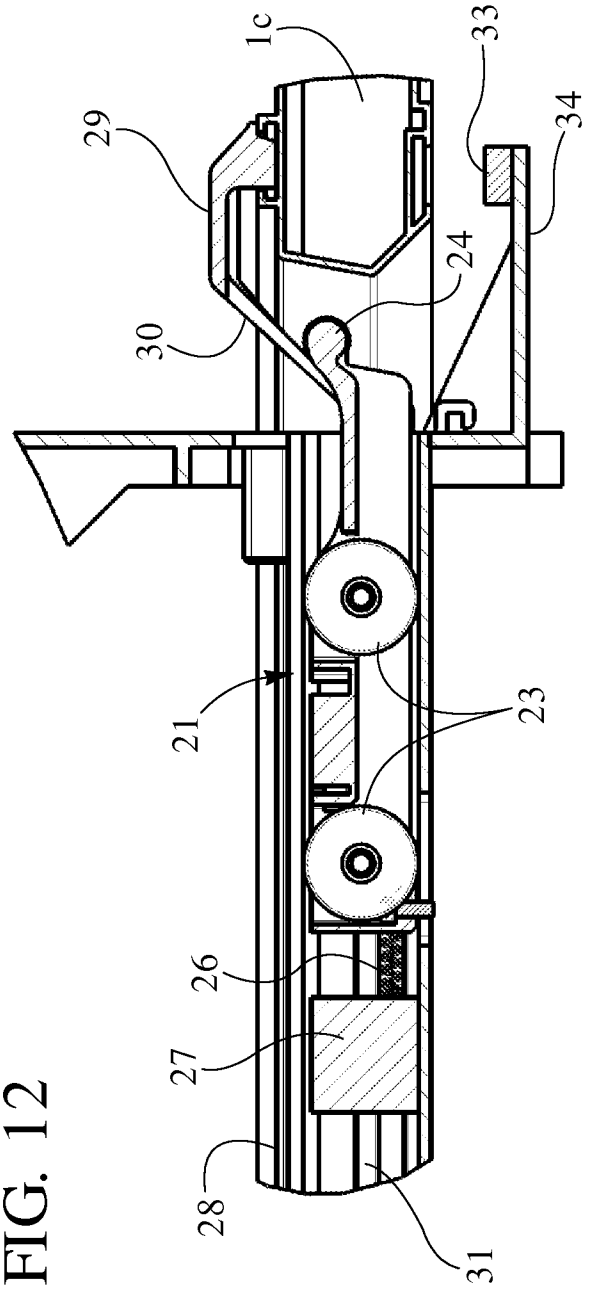


FIG. 13

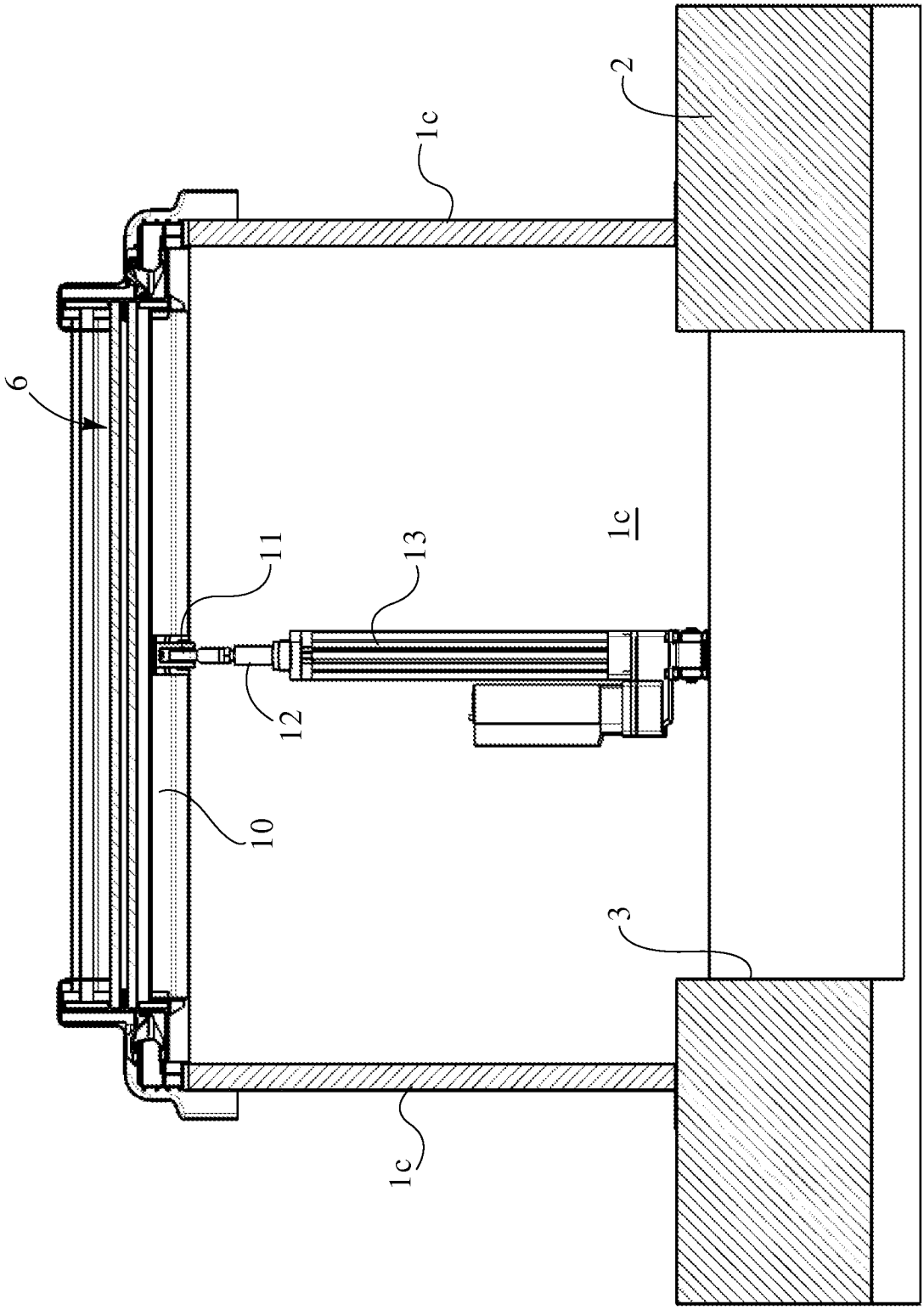


FIG. 14

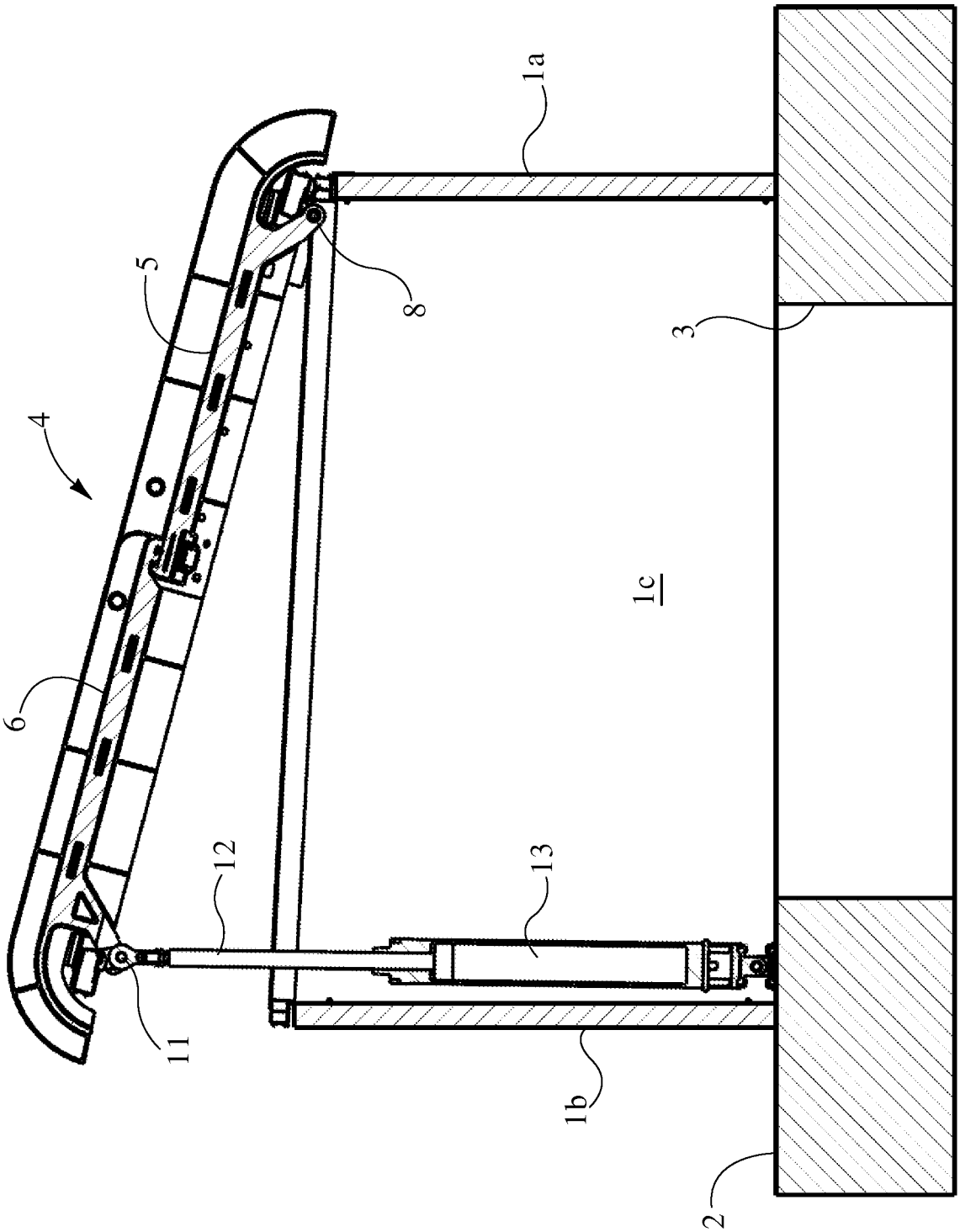


FIG. 16

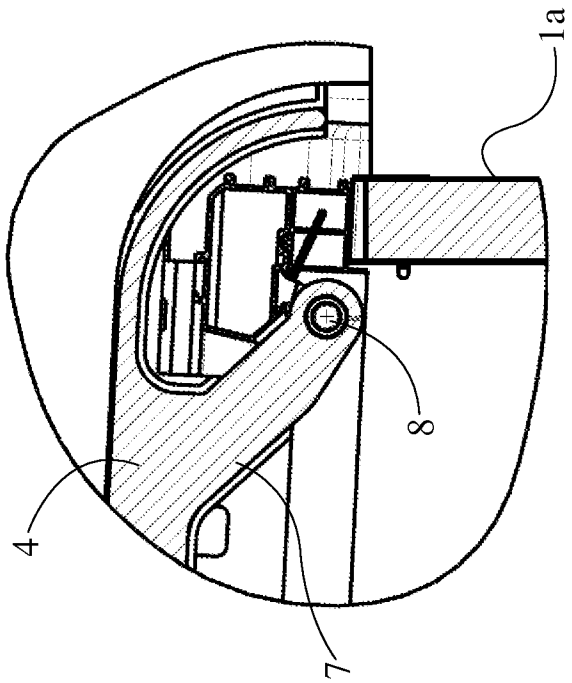
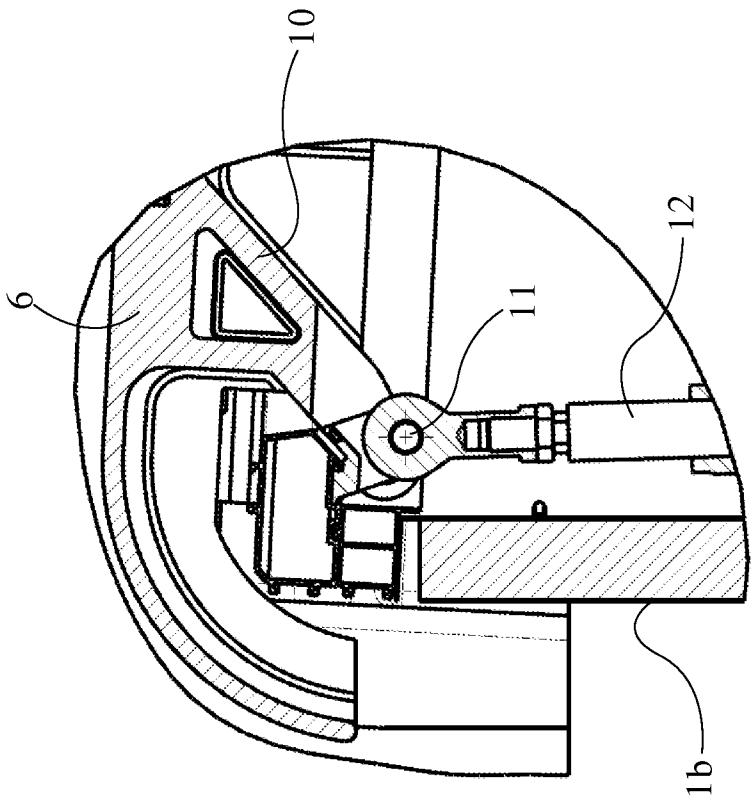


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/050611

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62C2/12 F24F7/02 E05F15/20 E04D13/035
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E05F A62C E05D F24F E04D F03G

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 10 292508 A (HIJIRI KENSETSU KK) 4 November 1998 (1998-11-04)	1
Y	abstract; figures 1,5	2,10,11
X	JP 4 230097 A (CANON KK) 19 August 1992 (1992-08-19)	1
Y	abstract; figure 6	2,10,11
Y	EP 1 557 563 A1 (GAMBARDELLA VALERIA [IT]) 27 July 2005 (2005-07-27) abstract	1,2
Y	EP 1 529 911 A2 (BERTOLDO F LLI S N C [IT]) 11 May 2005 (2005-05-11) the whole document	1,2,10, 11

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 May 2012	14/05/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Valenza, Davide

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/050611

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 3 874 130 A (MURAMATSU MOBUHIRO ET AL) 1 April 1975 (1975-04-01) the whole document -----	1,2,10, 11
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Information on patent family members

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