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(54) **SLIDING DOOR DRIVE DEVICE WITH SAFETY CONTROL**

(57) A drive device for a door (1) sliding on a machine frame, between an open position and a closed position in which it seals an opening of a compartment (W), includes a pair of belt drives (3, 4, 5, 8) arranged on opposite sides of the door (1) and connected thereto via mounting contrivances which allow the door (1) also a shift in the direction (Z) orthogonal to its sliding plane, each mounting contrivance comprising a trolley (2) integral with the belt (3) and carrying the door (1) through two levers (9) pivoted between the door (1) and the trolley (2) at a position inwards of the door (1) as well as elastic means that bias the door (1) outwards.

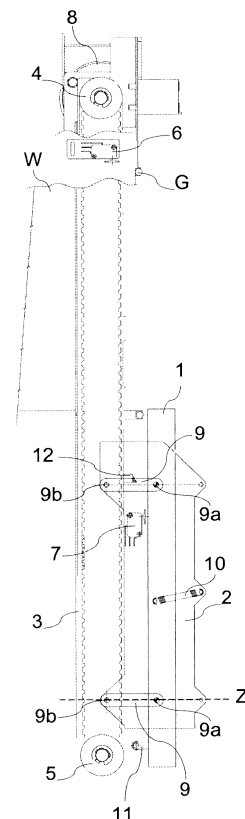


Fig.3a

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Description

[0001] The present invention relates to a device for the movement of a sliding door, comprising a safety control and a shift in a direction orthogonal to the sliding plane. Specific reference will be made in the following to such a device applied to a machine for washing and disinfection, typically of articles used in the medical field, but it is clear that the device can be applied to other types of machines comprising the same type of door (e.g. dish-washers, sterilizers, refrigerators, ovens, etc.).

[0002] It is known that a machine for washing and disinfection usually includes a wash tank provided with a front opening surrounded by a sealing gasket and closed by a door sliding vertically upwards to give access to the tank, this sliding movement being conferred to the door by a drive device. Such a device generally consists of two belt drives, one on each side of the door, each drive comprising a belt mounted on a pair of pulleys one of which is driven by a motor (which can also be only one for both drives). The device also comprises a safety system that in the phase of descent of the door controls the stopping or the reversal of the rotation of the motor(s), and thus the reopening of the door, if it detects an obstacle on the closure path.

[0003] This safety system is required to prevent the door, in combination with the lower edge of the opening of the wash tank, from having a "scissor effect" on an object or an operator should it/him be found on its path. To this purpose, the presence of the obstacle can be detected from the increase in the drive torque required to move the door or, more preferably, by a micro-switch that is activated by the door itself that moves towards the tank in a direction orthogonal to the sliding plane as a consequence of the contact with the obstacle.

[0004] EP 1949843 describes a device of this type in which the belt drive is not connected to the door directly but through a mechanical contrivance that comprises a trolley on which the door is mounted so as to be able to make said orthogonal shift. More specifically, the door is carried by the trolley through horizontal pins that engage substantially vertical eyelets the upper end of which is closer to the tank with respect to the lower end. In this way, in the normal downward movement the door pins rest on the lower ends of the eyelets, but when the door encounters an obstacle (which can also be the end-of-travel stop) the pins rise along the eyelets due to the relative movement of the trolley which continues to descend and the door shifts perpendicularly towards the tank activating the switch.

[0005] The device described in EP 1949843 further comprises a spring arranged between the trolley and the door in a substantially vertical position, so as to exert a force in the direction opposite to the gravity force exerted on the door. This spring serves to reduce the impact of the door on the obstacle prior to the intervention of the safety system, since a part of the weight of the door is compensated by the spring force.

[0006] This known solution, although quite effective, still has some drawbacks the first of which is the ability to operate only with a downward closing movement but not in the case of closure upwards or sideways (left or right). Furthermore, since the weight of the door is concentrated on the pins that slide in the eyelets the movement is not quite smooth and the eyelets have wear problems, in fact the document itself states that the eyelets are preferably made of a material with high wear resistance.

[0007] The object of the present invention is therefore to provide a sliding door drive device that is free from said drawbacks. This object is achieved by means of a device of the type described above in which the door is mounted on each trolley through at least two levers pivoted between the door and the trolley at a position inwards of the door, as well as through elastic means that bias the door outwards (note that inwards/outwards is defined with respect to the wash tank).

[0008] A first important advantage of the present device is to provide the safety control and the orthogonal shift of the door with a smoother movement, which guarantees a lower wear of the components and a higher speed of operation of the safety system.

[0009] A second significant advantage of this device is that it can be applied on a machine which provides for the closure of the door in any direction and not only downwards, even if the sliding plane is inclined with respect to the vertical.

[0010] A further notable advantage of the above device stems from its great simplicity that makes it inexpensive, robust and reliable.

[0011] Still another advantage of the subject device, in its preferred embodiment, is that of being provided with a second switch, having an adjustable position, which is activated by the trolley so as to precisely trim the compression of the gasket caused by the orthogonal shift of the door when the latter reaches the end-of-travel stop.

[0012] Further advantages and characteristics of the device according to the present invention will become apparent to those skilled in the art from the following detailed description of some embodiments thereof with reference to the accompanying drawings, in which:

Figs.1 and 2 are schematic front views of two machines to which the present device can be applied; Figs.3a-3c are schematic side views showing the closing movement of a first embodiment of the device applied to the machine of Fig.1;

Figs.4a-4b are schematic side views showing the operation of the first embodiment of the device in case of encounter with an obstacle during the ascent or descent of the door, respectively;

Figs.5a-5b are schematic side views showing the closing movement of a second embodiment of the device applied to the machine of Fig.1; and

Fig.6 is an enlarged detail showing the preferred location of an end-of-travel closure sensor.

[0013] Referring to figures 1 and 2, there is seen that a drive device according to the invention can be applied both on a machine which provides for the opening of door 1 downwards (Fig.1) and on a machine with the conventional opening of door 1 upwards (Fig.2), as indicated by the representation in broken lines of the door in the open position. In the first case the vertical dimension of the machine is reduced since door 1 does not protrude upwards in the open position, so that the machine can also be placed in a more limited space.

[0014] As previously mentioned, the device comprises two belt drives with the relative mounting contrivances of the door, one on each side of the door, but for the sake of simplicity figures 3 a to 6 show only the unit on the left side of the machine, the unit on the right side being equal and symmetrical to it. Each unit conventionally includes a trolley 2, on which door 1 is mounted, attached to a belt 3 which extends between a drive pulley 4 and a return pulley 5. The size and layout of door 1 and belt 3 are such that in the open position of Fig.3a the front opening of tank W, surrounded by a sealing gasket G, is freely accessible. The device also comprises at least two micro-switches 6 and 7 operatively connected to a control unit (not shown), respectively suitable to detect the arrival of door 1 at its closing position and to control the stopping/rotation reversal of motor 8 which drives the drive pulley 4, as better explained in the following.

[0015] The novel aspect of this device, as mentioned above, resides in the mode of mounting door 1 on each trolley 2, which in the first embodiment illustrated in figure 3a includes a pair of levers 9, one near the top and one near the base of trolley 2, pivoted between door 1 and trolley 2 at a position inwards of door 1. In other words, the outermost end of each lever 9 is rotatably secured on door 1 through a first pin 9a whereas the innermost end is rotatably secured on trolley 2 through a second pin 9b.

[0016] A horizontal spring 10 arranged between door 1 and trolley 2, in a position outwards of door 1 and central between levers 9, pulls door 1 outwards. The strength of spring 10 is sufficient to overcome the gravity force exerted on door 1 which tends to rotate levers 9 downwards, so that door 1 remains spaced from micro-switch 7 and the sealing gasket G and levers 9 are aligned with the Z direction orthogonal to the sliding plane.

[0017] In the light of this description, the simple and effective operation of the device according to the present invention is readily understood with the aid of figures 3b to 4b.

[0018] Starting from the open position of Fig.3a, the closing movement of door 1 is started by activating motor 8 which rotates the drive pulley 4 (in the counter-clockwise direction in the illustrated example) which drives belt 3 that lifts trolley 2 integral therewith which drags door 1 upwards through levers 9. Thanks to the force of spring 10 that keeps levers 9 in the horizontal position, door 1 does not make contact during the ascent movement with gasket G nor with the safety switch 7.

[0019] The upward movement of door 1 stops when an internal bracket 11 integral therewith abuts against an stop 12 secured to the frame of the machine, while the trolley 2 continues to rise until it activates micro-switch 6 (Fig.3c). Since the ascent of door 1 is blocked by stop 12, in this final portion Y of the closing travel the internal pins 9b of levers 9 rise with trolley 2 and due to the fixed length R of levers 9 the external pins 9a are pulled towards tank W by a distance X, overcoming the resistance of spring 10. In practice, levers 9 rotate downwards with respect to trolley 2 (clockwise in the figures) and door 1 shifts in the Z direction orthogonally to the sliding plane so as to press the sealing gasket G and to achieve the hermetic closure of tank W.

[0020] Note that when the top of door 1 comes flush with the upper edge of the front opening of tank W, i.e. when the risk of the "scissors effect" terminates, the bottom of door 1 comes flush with switch 7. In this way, when door 1 shifts orthogonally through distance X in the final portion Y of the closing travel it is no longer overlapped to switch 7, which therefore is not activated in the normal closing movement of door 1 in the position but only in case of contact with an actual obstacle.

[0021] This latter occurrence is illustrated in figures 4a and 4b which respectively show the cases of contact with an obstacle B during the ascent and the descent of door 1, in the first case the operation of the device being entirely similar to that described above for the normal closing movement of door 1, only that it is obstacle B that blocks the ascent of door 1 instead of the stop 12. In the second case the operation is completely symmetrical to that described above, i.e. the descent of trolley 2 causes levers 9 to rotate upwards with respect to trolley 2 (counterclockwise in Fig.4b), but in both cases the orthogonal shift of door 1 towards tank W causes the activation of the safety switch 7 that stops or reverses the rotation of motor 8.

[0022] Note that it is sufficient to move above tank W micro-switch 7 and the end-of-travel elements 11, 12 to apply a device similar to that described above to the machine of Fig.2 in which the closing movement takes place downwards. In other words, the device operates in the same way both with the closing movement upwards and downwards and in both cases it provides a safety control during both the opening and closing of door 1.

[0023] Figures 5a and 5b, similar to figures 3a and 3b, show another embodiment which differs in that the single spring 10 arranged centrally between door 1 and trolley 2 is replaced by two springs 10 arranged directly between the external pins 9a of levers 9 and anchorage points 2a on trolley 2. These anchorage points 2a are preferably aligned with the internal pins 9b but they could also be slightly higher, as in the first embodiment, or one higher and one lower so as to compensate the respective vertical pull components of springs 10.

[0024] Finally, Fig.6 shows an enlarged detail of Fig.3c in which you can note how micro-switch 6 that detects the closing position of door 1 is mounted so as to be

activated by trolley 2 and not directly by door 1. Moreover the position of micro-switch 6 can be adjusted through a slot 6a extending in the sliding direction of door 1 and allowing to trim with great precision the compression of gasket G by door 1. In fact due to the small angle of rotation of lever 9 along the circular arc of radius R centered on the internal pin 9b, the shifting Y of the external pin 9a along the sliding direction is greater than the shifting X in the direction orthogonal to the sliding plane, whereby a change in the position of micro-switch 6 results in a change of Y and makes possible a very fine adjustment of distance X.

[0025] Note that further embodiments not illustrated in the figures may be easily obtained by combining the above-described embodiments in case of specific constructional requirements such as cost, size, strength, redundancy, etc. For example, the first and second embodiments may be combined by arranging springs 10 between door 1 and trolley 2 both in a central position and at levers 9, so as to obtain the force required for supporting door 1 through a greater number of smaller springs that offer greater reliability.

[0026] It is therefore clear that the above-described and illustrated embodiments of the device according to the invention are just examples susceptible of various modifications in addition to those already mentioned above. In particular, the belt drive may be replaced by another type of transmission (e.g. rack) and springs 10 may be replaced by other equivalent elastic means.

[0027] Moreover, as mentioned earlier, although the illustrated device provides a vertical up/down movement it could be used for a horizontal left/right movement through a simple rotation of 90° in the vertical plane, whereby any reference to the vertical arrangement of the above-described elements can be understood as horizontal in the case of horizontal movement and vice versa (therefore also the definitions upper/lower or top/bottom can be understood as right/left).

Claims

1. Drive device for a door (1) sliding on a machine frame between an open position and a closed position in which it seals an opening of a compartment (W) of said machine, said drive device including a pair of drives and a pair of mounting contrivances, the sliding movement of said door (1) being provided by said pair of drives arranged on opposite sides of the door (1) parallel to the sliding direction, the door (1) being connected to the pair of drives via said pair of respective mounting contrivances which allow it also a shift in the direction (Z) orthogonal to its sliding plane between an outer position normally maintained during its sliding movement between said open and closed positions and an inner position in which the door (1) presses on a sealing gasket (G) arranged around the opening of said compartment

(W), each mounting contrivance comprising a trolley (2) integral with a mobile drive element of the respective drive, **characterized in that** each mounting contrivance further includes at least two levers (9) pivoted between the door (1) and the trolley (2) at a position inwards of the door (1) as well as elastic means biasing the door (1) outwards.

2. Device according to claim 1, **characterized in that** the elastic means comprise one or more springs (10) arranged between the door (1) and the trolley (2) at a position outwards of the door (1).
3. Device according to claim 1 or 2, **characterized in that** the elastic means include a number of springs (10) equal to the number of levers (9), each spring (10) being arranged between a pin (9a) connecting a lever (9) to the door (1) and an anchorage point (2a) on the trolley (2).
4. Device according to claim 2 or 3, **characterized in that** the springs (10) are substantially horizontal.
5. Device according to any of the preceding claims, **characterized in that** it further comprises at least one micro-switch (7) operatively connected to a control unit to control the stopping/reversal of the sliding movement of the door (1), said at least one micro-switch (7) being positioned so as to be activated by the door (1) only when the latter shifts towards the compartment (W) in the direction (Z) orthogonal to its sliding plane without being in its closing position.
6. Device according to any of the preceding claims, **characterized in that** it further comprises at least one micro-switch (6) operatively connected to a control unit to detect the arrival of the door (1) at its closing position, **characterized in that** the position of said at least one micro-switch (6) is adjustable along the sliding direction and the micro-switch (6) is arranged so as to be activated by the trolley (2).
7. A machine for washing and disinfection, **characterized by** comprising a drive device for a sliding door (1) according to any of the preceding claims.

Amended claims in accordance with Rule 137(2) EPC.

1. Drive device for a door (1) slidable on a machine frame between an open position and a closed position in which it is suitable to seal an opening of a compartment (W) of said machine, said drive device including a pair of drives and a pair of mounting contrivances, said pair of drives being arrangeable on opposite sides of said door (1) parallel to the sliding direction in order to provide the sliding movement of

the door (1), the door (1) being connectable to the pair of drives via said pair of respective mounting contrivances which allow it also a shift in the direction (Z) orthogonal to its sliding plane between an outer position normally maintained during its sliding movement between said open and closed positions and an inner position in which the door (1) presses on a sealing gasket (G) arranged around the opening of said compartment (W), each mounting contrivance comprising a trolley (2) integral with a mobile drive element of the respective drive, **characterized in that** each mounting contrivance further includes at least two levers (9) pivotable between the door (1) and the trolley (2) at a position inwards of the door (1) as well as elastic means suitable to bias the door (1) outwards, inwards/outwards being defined with respect to the compartment (W).

2. Device according to claim 1, **characterized in that** the elastic means comprise one or more springs (10) arrangeable between the door (1) and the trolley (2) at a position outwards of the door (1).
3. Device according to claim 1 or 2, **characterized in that** the elastic means include a number of springs (10) equal to the number of levers (9), each spring (10) being arrangeable between a pin (9a) connecting a lever (9) to the door (1) and an anchorage point (2a) on the trolley (2).
4. Device according to claim 2 or 3, **characterized in that** the springs (10) are substantially horizontal.
5. Device according to any of the preceding claims, **characterized in that** it further comprises at least one micro-switch (7) operatively connected to a control unit to control the stopping/reversal of the sliding movement of the door (1), said at least one micro-switch (7) being positioned so as to be activated by the door (1) only when the latter shifts towards the compartment (W) in the direction (Z) orthogonal to its sliding plane without being in its end-of-travel closing position.
6. Device according to any of the preceding claims, **characterized in that** it further comprises at least one micro-switch (6) operatively connected to a control unit to detect the arrival of the door (1) at its end-of-travel closing position, **characterized in that** the position of said at least one micro-switch (6) is adjustable along the sliding direction and the micro-switch (6) is arranged so as to be activated by the trolley (2).
7. A machine for washing and disinfection, **characterized by** comprising a drive device for a sliding door (1) according to any of the preceding claims.

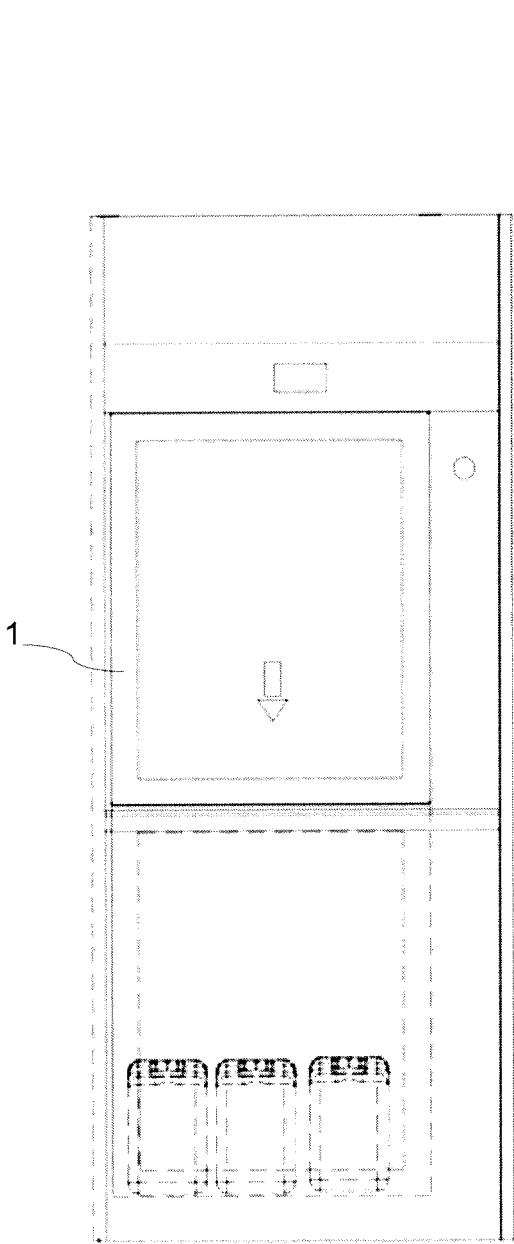


Fig.1

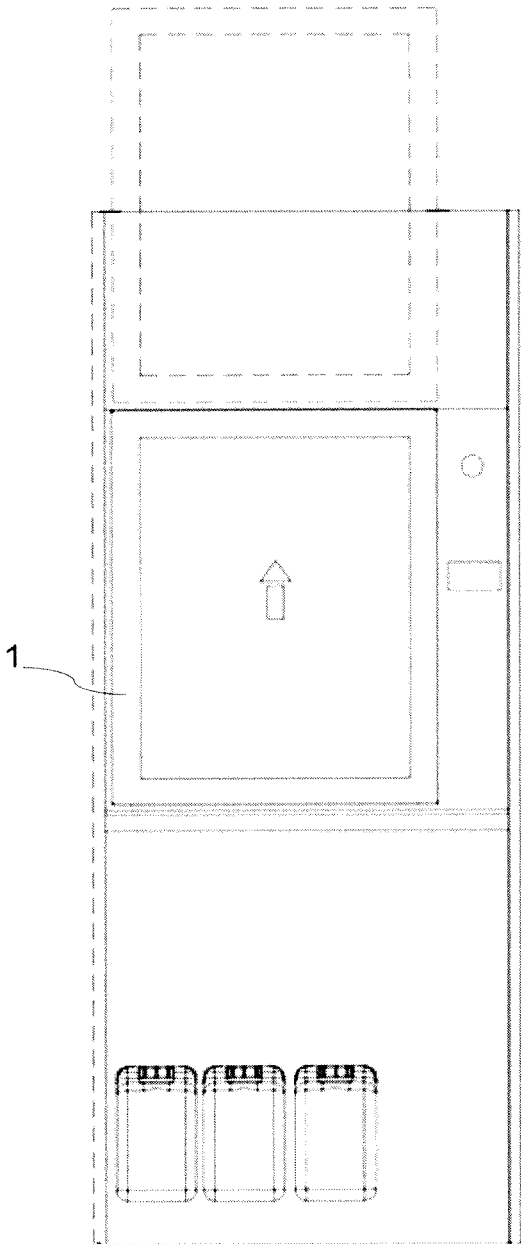


Fig.2

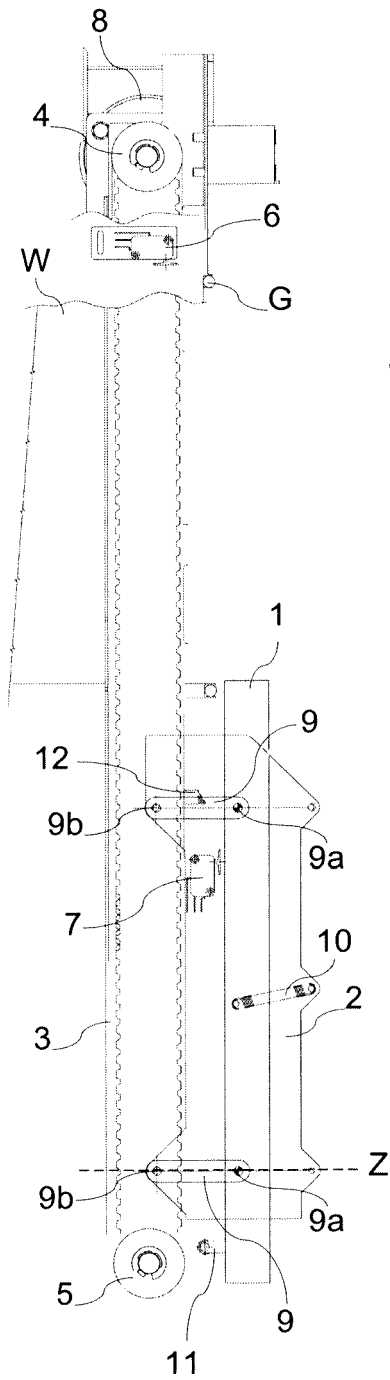


Fig.3a

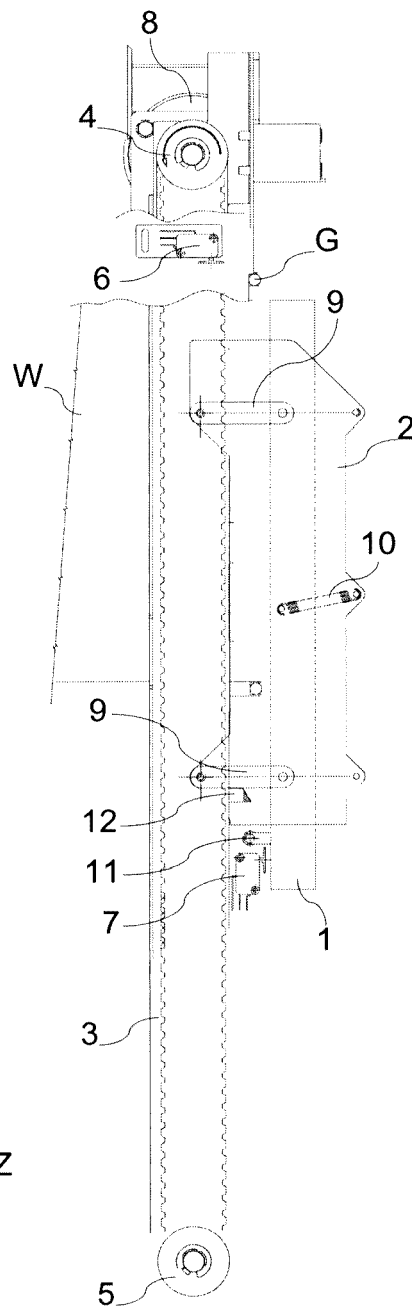


Fig.3b

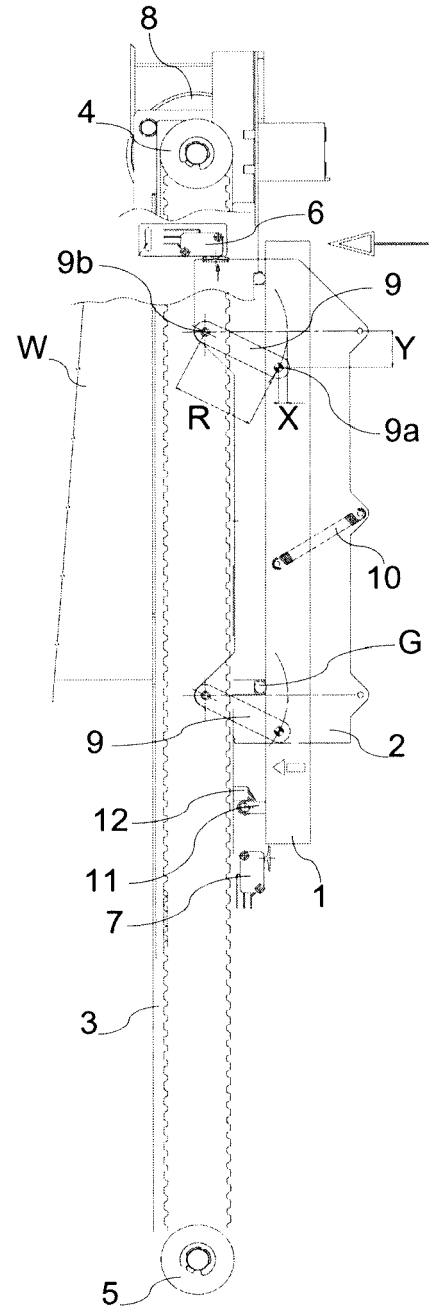


Fig.3c

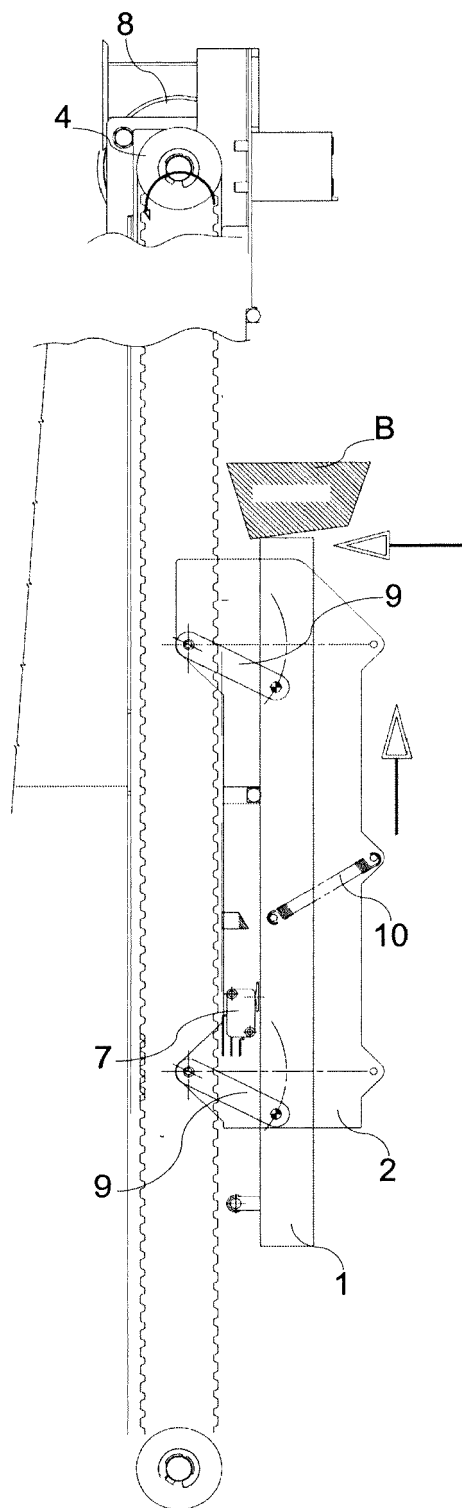


Fig. 4a

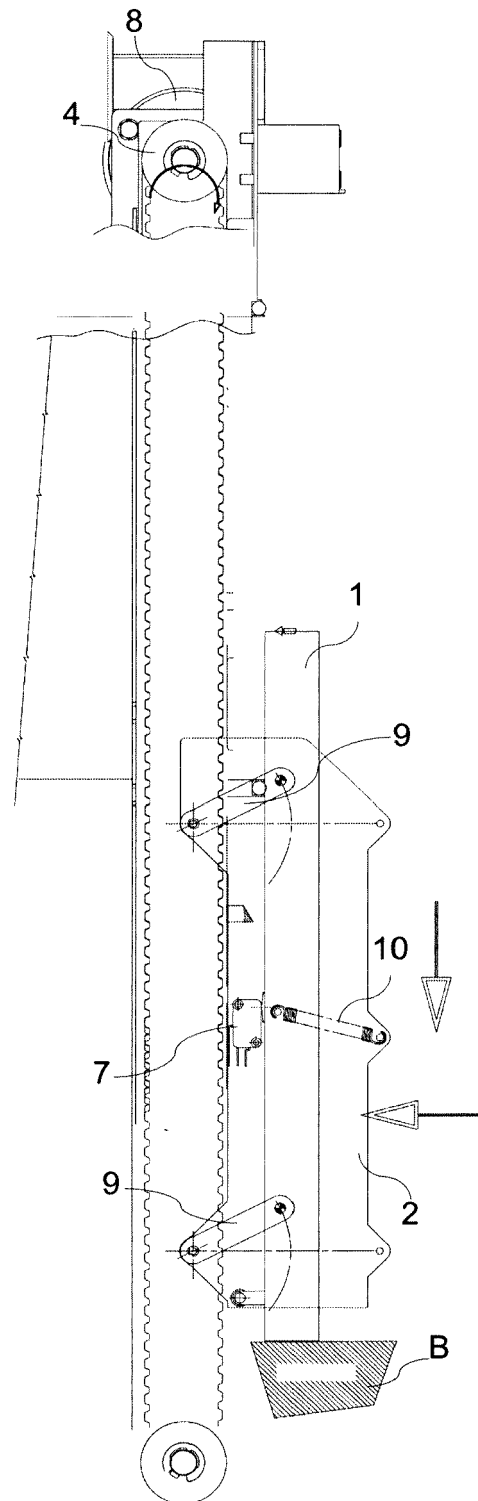


Fig. 4b

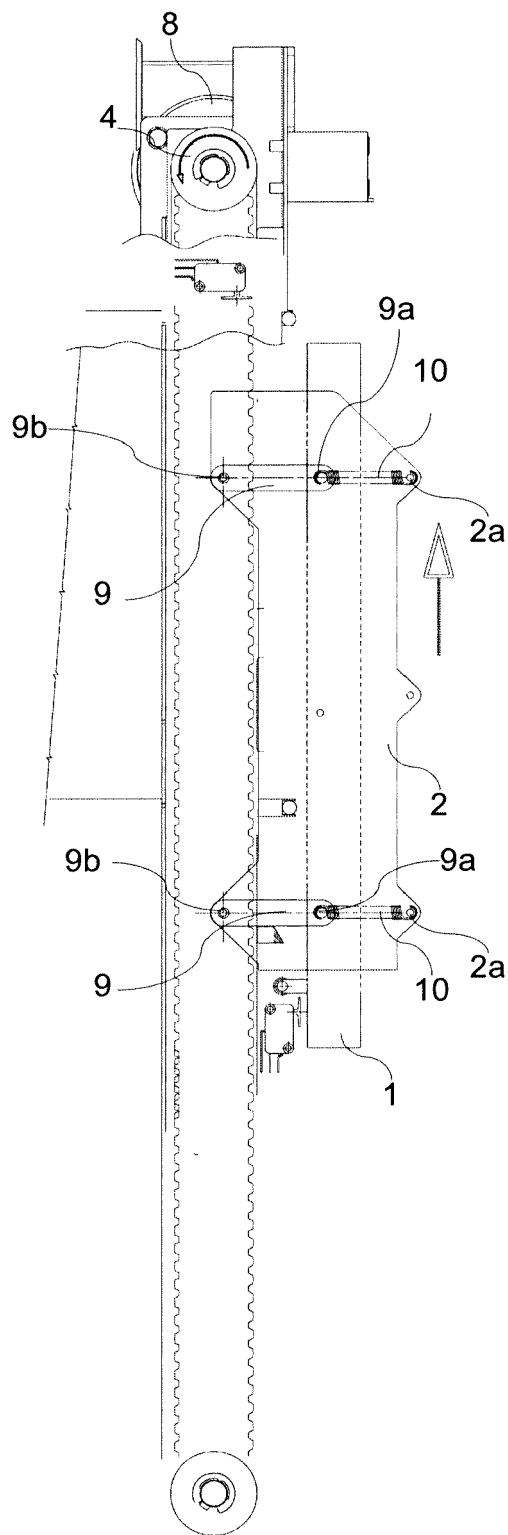


Fig.5a

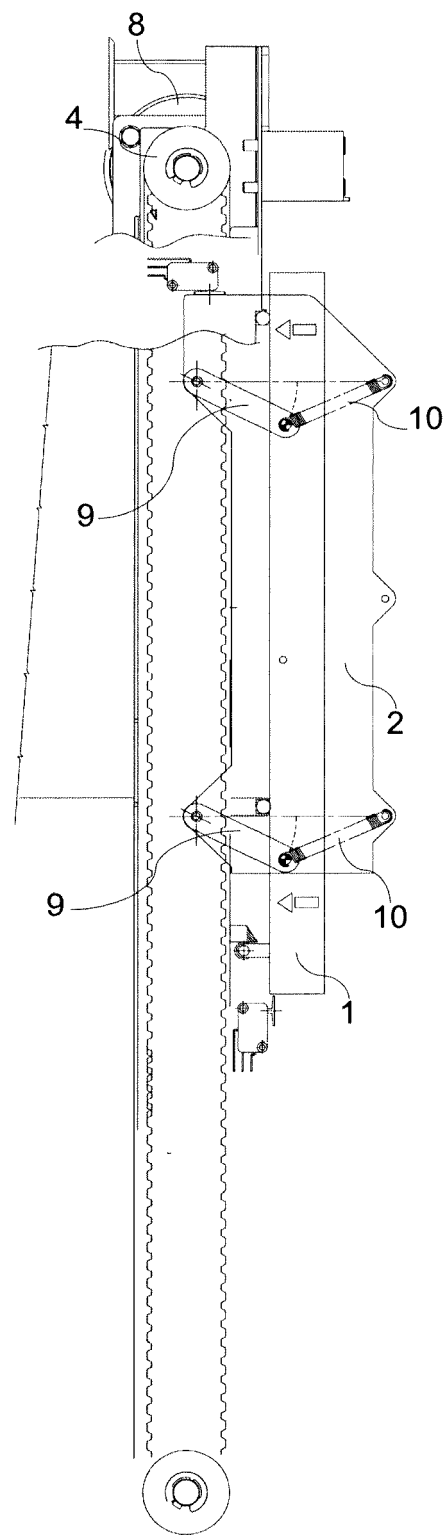


Fig.5b

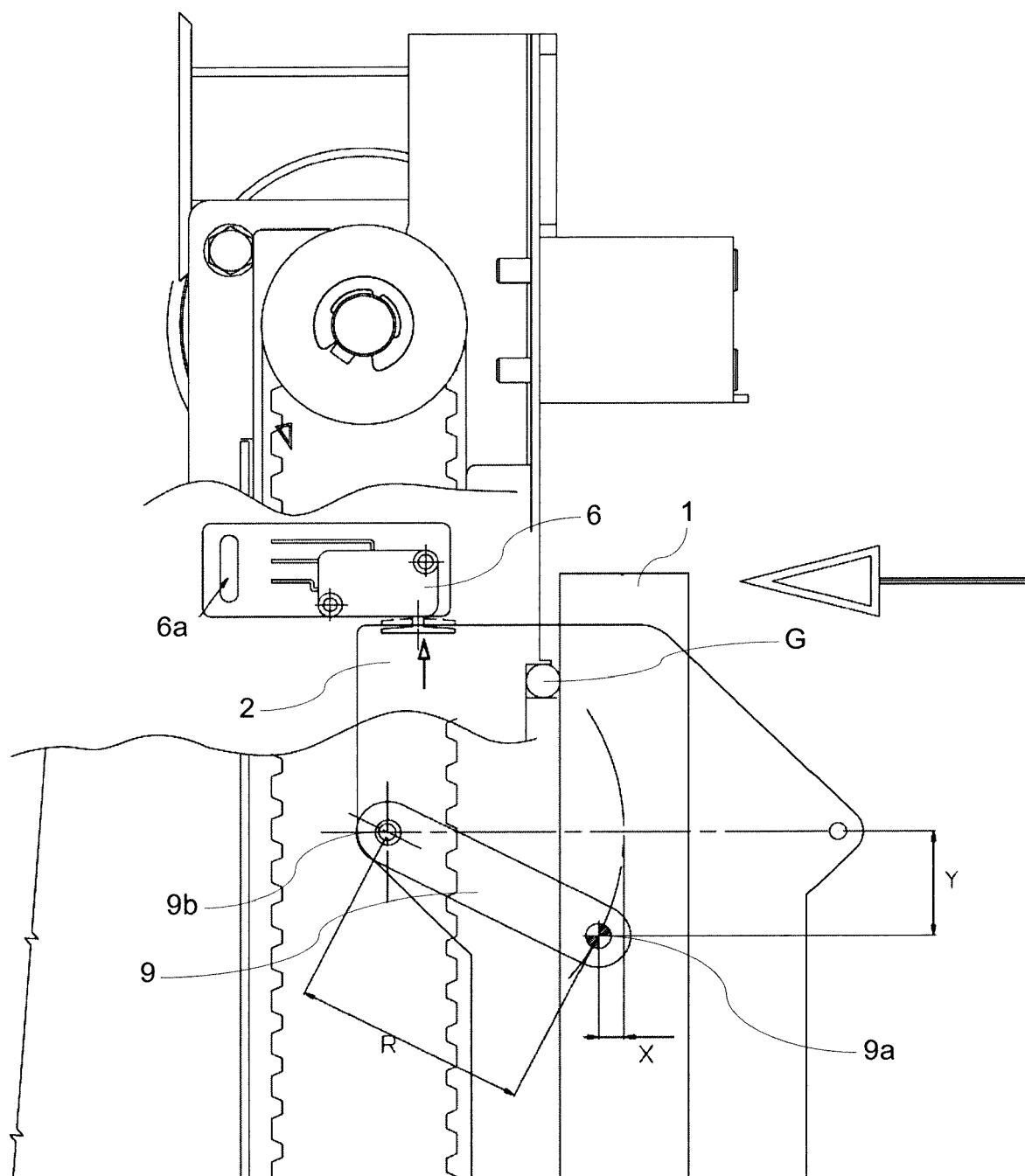


Fig.6



EUROPEAN SEARCH REPORT

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			TECHNICAL FIELDS SEARCHED (IPC)
			A47L D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 July 2016	Examiner Stroppa, Giovanni
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