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(54) **SLIDING DOOR DRIVE DEVICE**

(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 (X) orthogonal to its sliding plane, each mounting contrivance comprising a trolley (2) integral with the belt (3) and carrying the door (1) through two articulated parallelograms (9) whose outermost vertex (9a) is rotatably fixed on the trolley (2) and whose innermost vertex (9b) is rotatably fixed on the door (1) and engages a V-shaped profile (10) formed on the trolley (2) with a symmetrical arrangement with respect to the direction (X) orthogonal to the sliding plane, the device further comprising springs (11) which pull outwards the innermost vertex (9b).

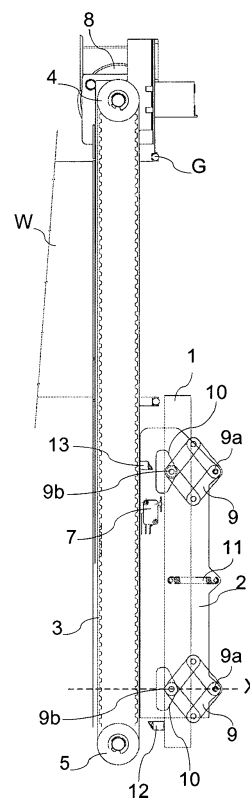


Fig.3a

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. dishwashers, 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. Note that in the case in which the shift is caused by the end-of-travel stop this must also include a second switch that turns off the first switch, otherwise the motor would stop or reverse the movement of the door that could not close the tank by going to press the sealing gasket.

[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 one articulated parallelogram whose outermost vertex is rotatably fixed on the trolley and whose innermost vertex is rotatably fixed on the door and engages a V-shaped profile formed on the trolley with a symmetrical arrangement with respect to the direction orthogonal to the sliding plane, the device further comprising elastic means that pull outwards said innermost vertex (note that outermost/innermost 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] Still another advantage of the subject device, in its preferred embodiment, is to do without the second switch since the safety switch which controls the stopping/reversal of the motor is not affected by the orthogonal shift of the door when the latter reaches the end-of-travel stop.

[0011] 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; Fig.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.5-7 are schematic side views showing three other embodiments of the device; and

Fig.8 is a schematic front view of the embodiment of Fig.6.

[0012] 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.

[0013] 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 3a to 7 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 one micro-switch 7 operatively connected to a control unit (not shown) for controlling the stopping/rotation reversal of motor 8 which drives the drive pulley 4, as better explained in the following.

[0014] 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 figures 3a-3c includes a pair of articulated parallelograms 9, one near the top and one near the base of trolley 2, whose outermost vertex 9a is rotatably fixed on trolley 2 and whose innermost vertex 9b is rotatably fixed on door 1. Each innermost vertex 9b engages a V-shaped profile 10 which is formed on trolley 2 with a symmetrical arrangement with respect to the X direction orthogonal to the sliding plane.

[0015] A horizontal spring 11 arranged between door 1 and trolley 2, in a central position between profiles 10, pulls outwards the innermost vertex 9b of each parallelogram 9 so that it engages the tip of the V shape of the respective profile 10. The force of spring 11 is sufficient to overcome the gravity force exerted on door 1 which tends to drag vertices 9b towards the lower ends of profiles 10, so that door 1 remains spaced from switch 7 and the sealing gasket G.

[0016] 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.

[0017] 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 parallelograms 9. Thanks to the force of spring 11 that keeps the innermost vertices 9b engaged in the tip of the V shape of profiles 10, door 1 does not make contact during the ascent movement with gasket G nor with the safety switch 7.

[0018] The upward movement of door 1 stops when an internal bracket 12 integral therewith abuts against an end-of-travel stop 13 secured to the frame of the machine, while the trolley 2 continues to rise until the innermost vertices 9b arrive into abutment with the lower end of profiles 10 (Fig.3c). Since the ascent of door 1 is blocked by stop 13, in this final portion of the closing travel the V-shaped profiles 10 push the innermost vertices 9b of parallelograms 9 towards tank W, overcoming the resistance of spring 11 and rotating parallelograms 9 counter-clockwise around the outermost vertices 9a. As a consequence, door 1 shifts in the X direction orthogonally to the sliding plane so as to press the sealing gasket G and to achieve the hermetic closure of tank W.

[0019] Note that when the top of door 1 comes flush with the upper edge of the front opening of tank W (Fig.3b), 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 in the final portion of the closing travel it is no longer overlapped to switch 7 which therefore is not activated. Thus it is not necessary to provide a second switch on the end-of-travel stop 13 as in the above-described prior art device, since the safety switch 7 is not activated in the normal closing movement of door 1 in the end-of-travel position but only in case of contact with an actual obstacle.

[0020] 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 end-of-travel stop 13. In the second case the operation is completely symmetrical to that described above, i.e. the innermost vertices 9b arrive at the upper end of profiles 10 and parallelograms 9 rotate clockwise, 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.

[0021] Note that it is sufficient to move micro-switch 7 and the end-of-travel elements 12, 13 above tank W 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.

[0022] Figures 5 to 7, similar to Fig.3b, show three other embodiments which differ from the first embodiment

in terms of number and/or arrangement of the connection parallelograms 9 and/or of the elastic means which tend to compress them horizontally. More specifically, in the second embodiment of Fig.5 the single horizontal spring 11 arranged centrally between door 1 and trolley 2 is replaced by two horizontal springs 11 arranged directly between vertices 9a and 9b of the upper and lower parallelogram 9 respectively, while in the third embodiment of Fig.6 it is replaced by a vertical spring 11' arranged between the adjacent free vertices 9c, 9d of the two parallelograms 9 (i.e. the upper vertex 9c of the lower parallelogram 9 and the lower vertex 9d of the upper parallelogram 9) .

[0023] Finally, in the fourth embodiment of Fig.7 the mounting of door 1 on trolley 2 provides a single parallelogram 9 and a single profile 10 arranged in a central position, with a pair of vertical springs 11", respectively arranged between trolley 2 and the free vertices 9c, 9d (which are free in that they are not bound to door 1 or trolley 2 as the other two vertices 9a, 9b).

[0024] 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 horizontal springs 11 both between door 1 and trolley 2 and between vertices 9a and 9b, so as to obtain the force required for supporting door 1 through a greater number of smaller springs that offer greater reliability.

[0025] The same applies to the possible doubling and/or different positioning of the springs or other components illustrated in the figures where this is possible and desirable. For example, the front view of Figure 8 shows how in the third embodiment the mounting contrivance on each side of door 1 comprises a vertical spring 11' arranged outside of parallelograms 9, but this spring may also be arranged inside of parallelograms 9 (or between these and trolley 2) or the contrivance could include two springs 11' respectively arranged inside and outside of parallelograms 9. Furthermore, it would also be possible to arrange parallelograms 9 inside of trolley 2, i.e. between the latter and door 1, provided that the pins that constitute vertices 9b extend outwards up to engagement with profiles 10 formed in trolley 2.

[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 11, 11', 11" may be replaced by other equivalent elastic means. Also the fact that in each articulated parallelogram 9 all sides have the same length and that vertices 9a, 9b are aligned in the X direction orthogonal to the sliding plane when door 1 is open, although preferable, is not strictly necessary.

[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, the sliding movement of said door (1) being provided by a pair of drives arranged on opposite sides of the door (1) parallel to the sliding direction, the door (1) being connected to said drives via a pair of respective mounting contrivances which allow it also a shift in the direction (X) 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** the door (1) is mounted on each trolley (2) through at least one articulated parallelogram (9) whose outermost vertex (9a) is rotatably fixed on the trolley (2) and whose innermost vertex (9b) is rotatably fixed on the door (1) and engages a V-shaped profile (10) formed on the trolley (2) with a symmetrical arrangement with respect to said direction (X) orthogonal to the sliding plane, the device further comprising elastic means which pull outwards said innermost vertex (9b).
2. Device according to claim 1, **characterized in that** the elastic means comprise one or more horizontal springs (11) arranged between the door (1) and the trolley (2).
3. Device according to claim 1 or 2, **characterized in that** the door (1) is mounted on each trolley (2) through two articulated parallelograms (9) arranged respectively near the ends of the trolley (2).
4. Device according to claim 3, **characterized in that** the elastic means comprise one or more vertical springs (11') arranged between the adjacent free vertices (9c, 9d) of the two articulated parallelograms (9).
5. Device according to any of the preceding claims, **characterized in that** the elastic means comprise two or more vertical springs (11") arranged respec-

tively between the free vertices (9c, 9d) of an articulated parallelogram (9) and the trolley (2).

6. Device according to any of claims 2 to 5, **characterized in that** the springs (11; 11'; 11'') are arranged outside of the articulated parallelograms (9). 5
7. Device according to any of the preceding claims, **characterized in that** the articulated parallelograms (9) are arranged outside of the trolleys (2). 10
8. Device according to any of the preceding claims, **characterized in that** each articulated parallelogram (9) has equal sides and the outermost (9a) and innermost (9b) vertices which are aligned in the direction (X) orthogonal to the sliding plane when the door(1) is open. 15
9. 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 (X) orthogonal to its sliding plane without being in its end-of-travel closing position. 20
10. A machine for washing and disinfection, **characterized by** comprising a drive device for a sliding door (1) according to any of the preceding claims. 25

Amended claims in accordance with Rule 137(2) EPC. 30

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 comprising 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 said drives via said pair of respective mounting contrivances which allow it also a shift in the direction (X) 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 comprises at least one articulated parallelogram (9) through which the door (1) is mounted on each trolley 40

(2), wherein the outermost vertex (9a) of said at least one articulated parallelogram (9) is rotatably fixed on the trolley (2) and its innermost vertex (9b) is rotatably fixed on the door (1) and engages a V-shaped profile (10) formed on the trolley (2) with a symmetrical arrangement with respect to said direction (X) orthogonal to the sliding plane, the device further comprising elastic means which pull outwards said innermost vertex (9b).

2. Device according to claim 1, **characterized in that** the elastic means comprise one or more horizontal springs (11) arranged between the door (1) and the trolley (2).
3. Device according to claim 1 or 2, **characterized in that** the door (1) is mounted on each trolley (2) through two articulated parallelograms (9) arranged respectively near the ends of the trolley (2).
4. Device according to claim 3, **characterized in that** the elastic means comprise one or more vertical springs (11') arranged between the adjacent free vertices (9c, 9d) of the two articulated parallelograms (9).
5. Device according to any of the preceding claims, **characterized in that** the elastic means comprise two or more vertical springs (11'') arranged respectively between the free vertices (9c, 9d) of an articulated parallelogram (9) and the trolley (2).
6. Device according to any of claims 2 to 5, **characterized in that** the springs (11; 11'; 11'') are arranged outside of the articulated parallelograms (9).
7. Device according to any of the preceding claims, **characterized in that** the articulated parallelograms (9) are arranged outside of the trolleys (2).
8. Device according to any of the preceding claims, **characterized in that** each articulated parallelogram (9) has equal sides and the outermost (9a) and innermost (9b) vertices which are aligned in the direction (X) orthogonal to the sliding plane when the door (1) is open.
9. 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 (X) orthogonal to its sliding plane without being in its end-of-travel closing position. 55

10. A machine for washing and disinfection, **characterized by** comprising a drive device for a sliding door (1) according to any of the preceding claims.

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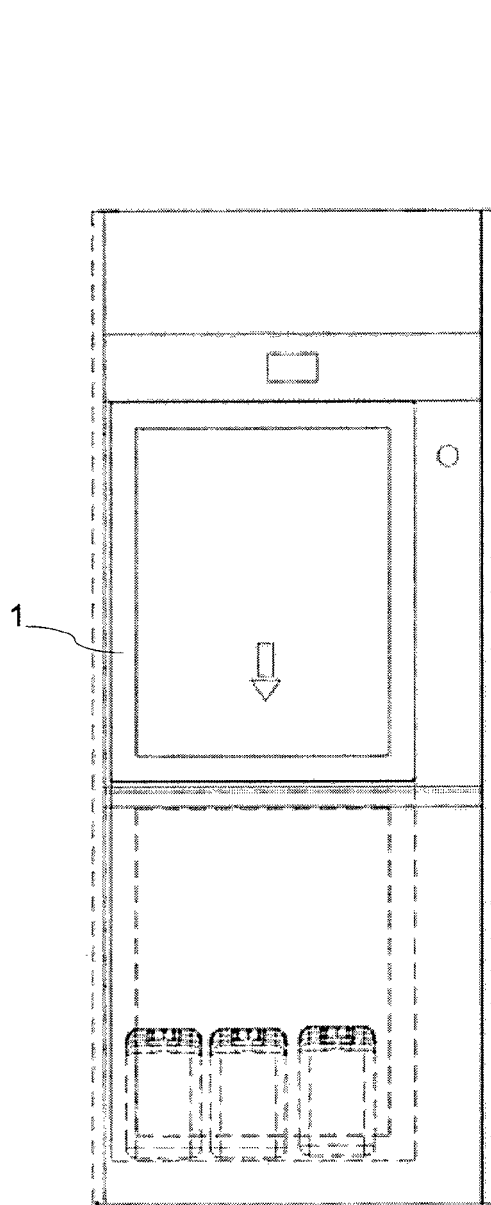


Fig.1

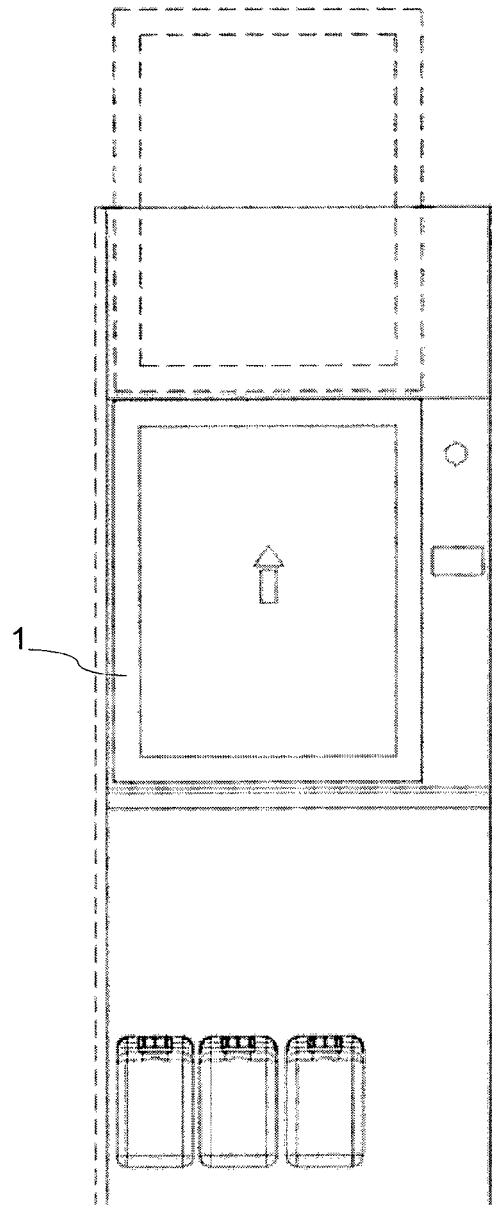


Fig.2

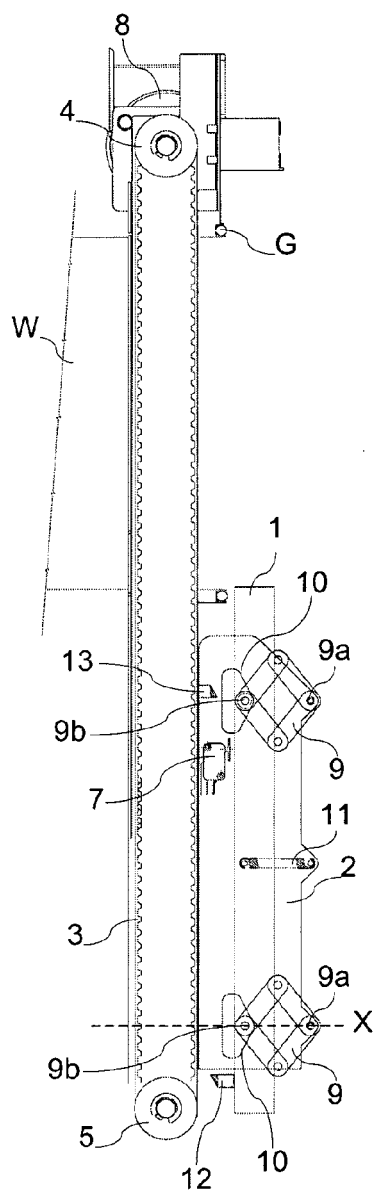


Fig.3a

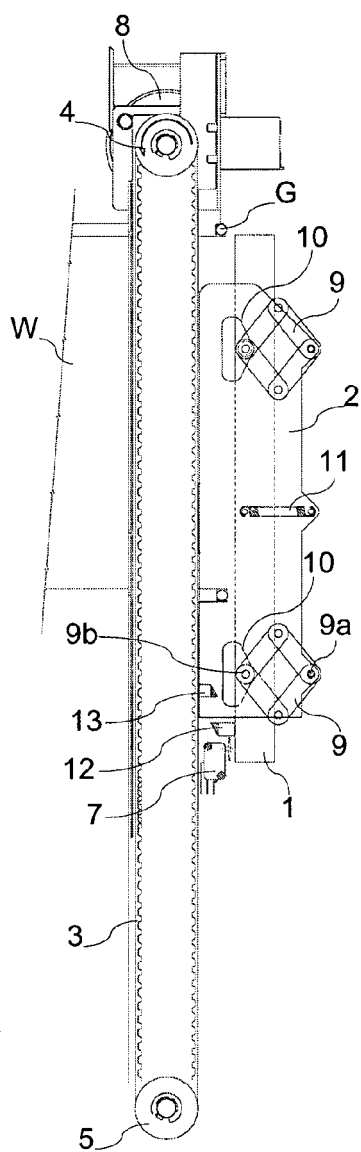


Fig.3b

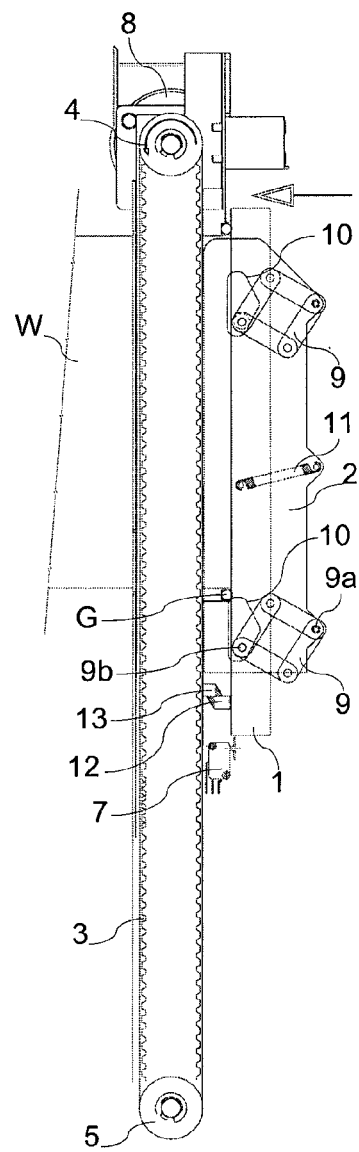


Fig.3c

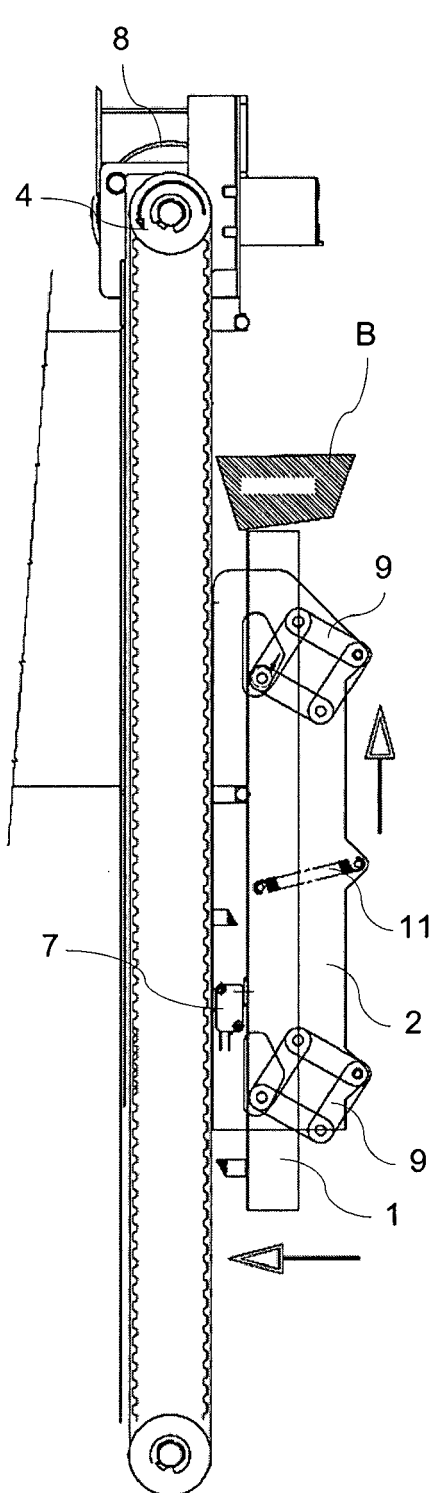


Fig. 4a

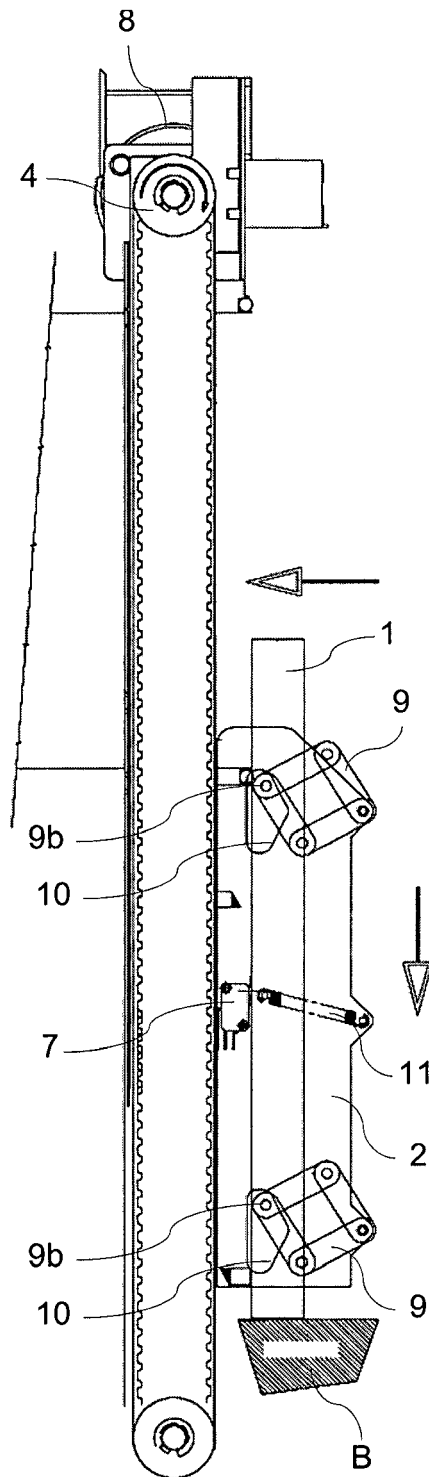


Fig. 4b

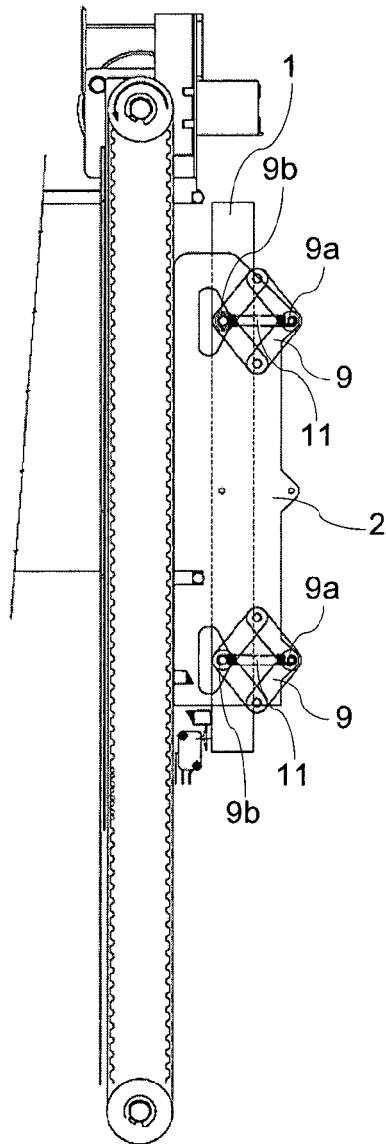


Fig. 5

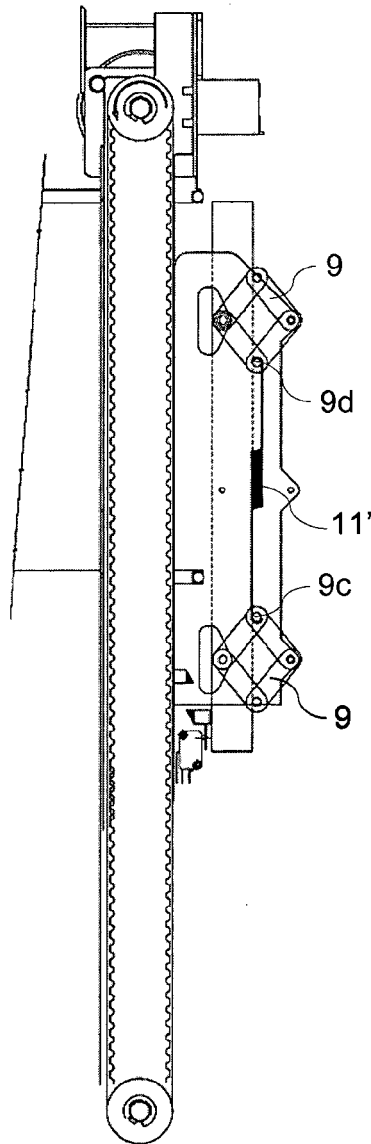


Fig. 6

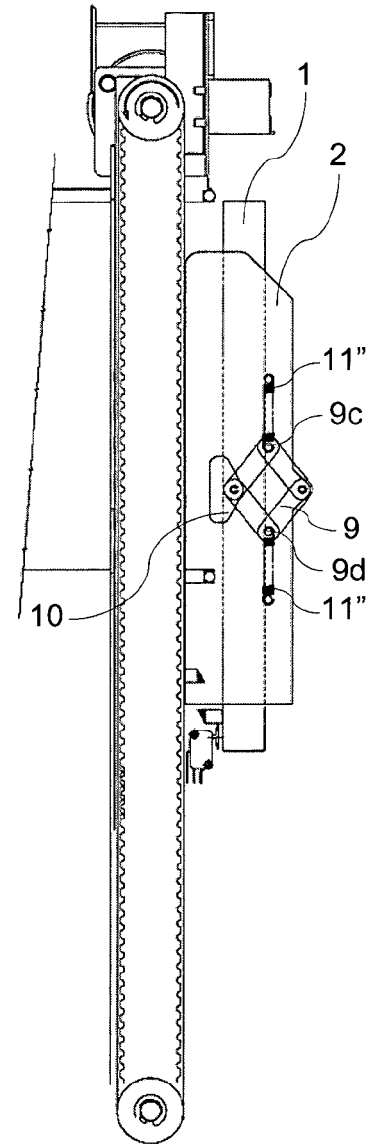


Fig. 7

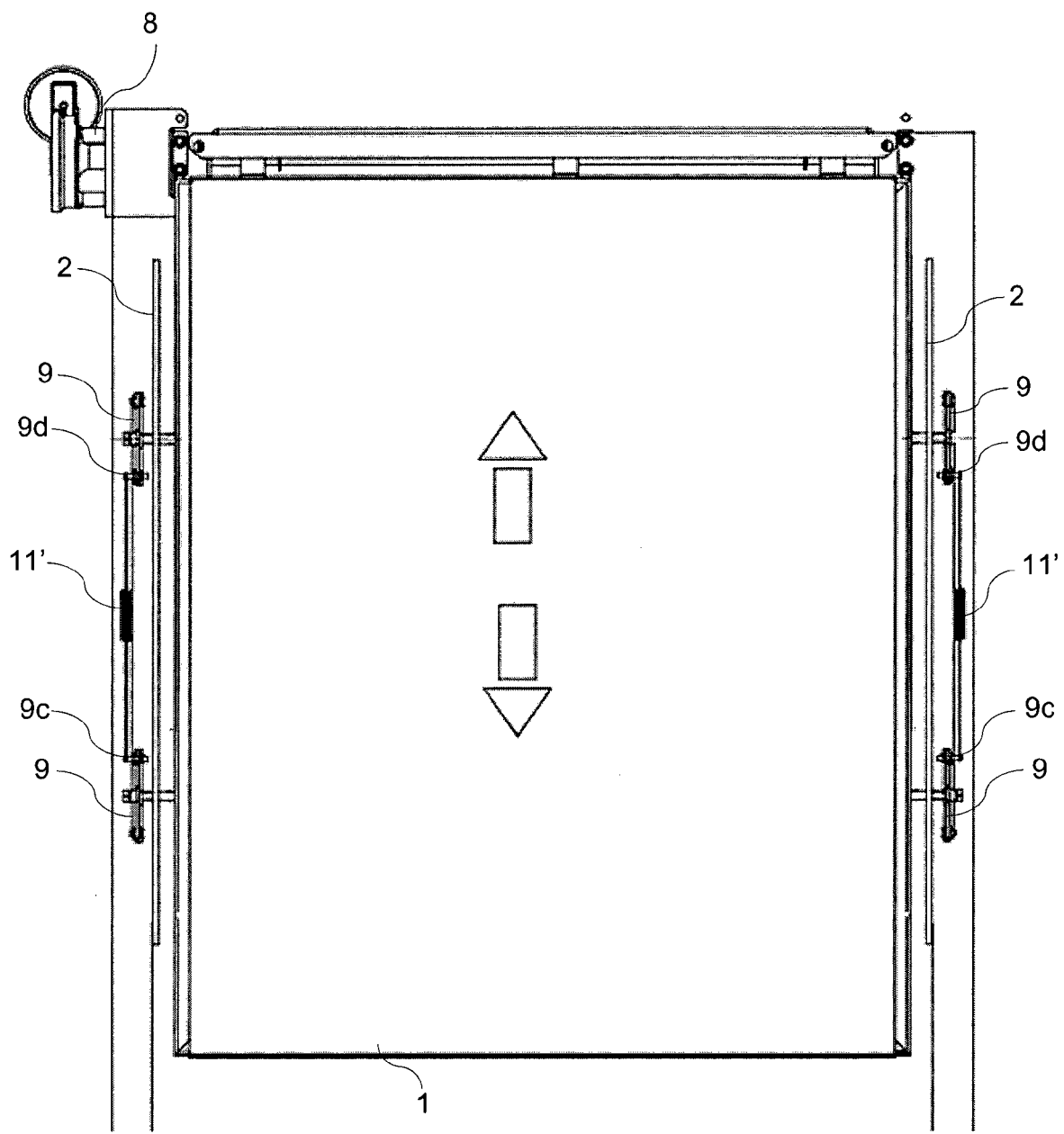


Fig.8



EUROPEAN SEARCH REPORT

Application Number
EP 15 42 5028

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	DE 195 14 303 A1 (MIELE & CIE [DE]) 31 October 1996 (1996-10-31) * column 1, line 67 - column 3, line 63; figures 1-4 *	1-10	ADD. A47L15/42 E05D15/40 E05D13/00
			TECHNICAL FIELDS SEARCHED (IPC)
			A47L E05D E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 September 2015	Examiner Rémondot, Xavier
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 42 5028

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03-09-2015

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EP 1949843	A1	30-07-2008	NONE
DE 19514303	A1	31-10-1996	NONE

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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