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## (54) Hoist mechanism with slack rope switch for a vertically movable door

(57) The hoist mechanism of the vertically movable door has a reel (32) fitted around an axis (30), which is rotated by means of a motor, on which reel hoist wire (28) is stored. The hoist mechanism further contains a slack switch for halting the motor when the tension of the hoist wire decreases. The slack switch is arranged in connection with the reel, and it has a rod (52), which is fitted to rest itself against the hoist wire unravelling from the reel and to alter its line of travel. The hoist wire holds the slack switch in the first position as long as its tension exceeds a predetermined threshold value, whereby the motor functions normally. When the tension of the hoist wire falls below the threshold value, for example as a result of the hoist wire breaking, the slack switch moves into the second position, which switches off the function of the motor. The slack switch comprises a first and a second support arm (50a, 50b), which are attached at their first end in a pivoted manner (54) to the structures of the vertically movable door. The rod resting itself against the hoist wire is attached at its ends to the ends of the support arms, and the hoist wire is fitted to travel between the support arms over the rod. The slack switch is arranged to move from the first position into the second position by rotating around the pivot pin (54). The rotation of the slack switch occurs by means of gravity, when the potential energy stored in the slack switch is released. The hoist mechanism according to the invention can be used in vertically movable doors of fabric, which fold upwards.

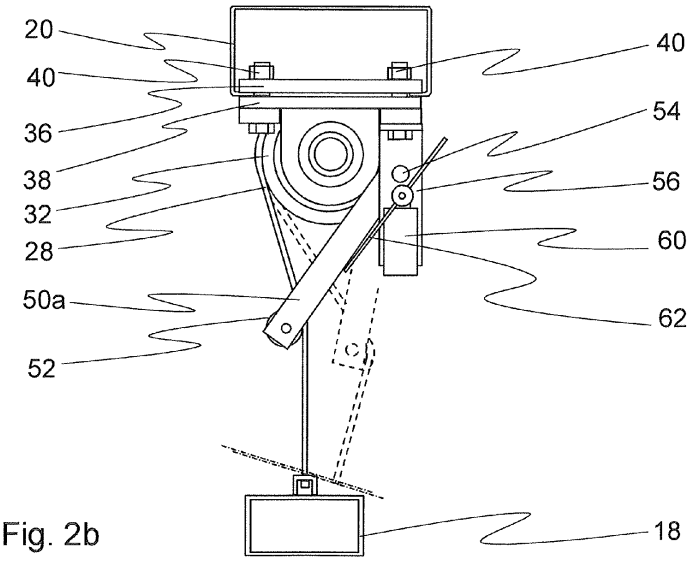


Fig. 2b

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## Description

**[0001]** The invention relates to a hoist mechanism for a vertically movable door, which hoist mechanism has at least one reel for a flexible suspension member, such as a hoist wire, an axis, around which the reel is fitted, a motor for rotating the axis and a slack switch for halting the motor when the tension of the hoist wire decreases. The invention also relates to a vertically movable door, which is equipped with a hoist mechanism according to the invention.

**[0002]** Vertically movable doors of fabric are generally used as partitions in manufacturing spaces, and as doors of passages in halls and facilities. Vertically movable doors of fabric with two fabrics have an inner and an outer fabric, between which there are transverse horizontal reinforcements. In the upper edge of the vertically movable door there is an upper casing, wherein the hoist mechanism of the door and the motor belonging thereto are placed. In the lower edge of the vertically movable door there is a lower beam, which is connected to the hoist mechanism with at least two hoist lines or wires travelling between the inner and outer fabric. In the vertical edges of the vertically movable door there are edge rails, which guide the linear movement of the horizontal reinforcements and the lower beam. The vertically movable door is opened by lifting the lower beam upwards with the aid of the hoist mechanism, whereby the horizontal reinforcements are gathered on the lower beam and the inner and outer fabrics are folded on different sides of the lower beam. The vertically movable door is correspondingly closed by lowering the lower beam suspended on the hoist lines or wires against the lower edge of the opening or the floor of the space.

**[0003]** Vertically movable doors of fabric are typically large. The width and height of a vertically movable door functioning for example as a partition in an industrial hall or as the door of an aircraft hangar can be several, even tens of meters. Large vertically movable doors are heavy, wherefore special attention needs to be paid to the operational reliability and the use safety of the hoist mechanism of the doors. Vertically movable doors of fabric are thus equipped with a safety locking mechanism, which prevents uncontrolled falling of the door, for example due to the breaking of the hoist lines or wires. In addition to the safety locking, the motor of the hoist mechanism of the vertically movable door can be equipped with an emergency halt mechanism, which is activated in connection with a malfunction of the hoist mechanism, such as the breaking or slackening of a hoist wire.

**[0004]** A vertically movable door is known from reference publication US 4368770, the hoist mechanism of which comprises a reel placed in the centre of the upper edge of the door, onto which reel two hoist wires have been reeled. The hoist wires pass by the upper corners of the door to the edges of the door and are attached to the lower beam of the door. In the upper corners of the door there is a slack switch touching the hoist wire, which halts the motor of the hoist mechanism when the tension of the hoist wire decreases. The structure of the slack switch has not been described in more detail in the reference publication.

**[0005]** It is an object of the invention to provide a hoist mechanism for a vertically movable door, where the emergency halt of the hoist mechanism is realized in a safe and simple manner.

**[0006]** The objects of the invention are obtained with a hoist mechanism and a vertically movable door, which are characterized in what is presented in the independent claims. Some advantageous embodiments of the invention are presented in the dependent claims.

**[0007]** The hoist mechanism of the vertically movable door according to the invention has at least one reel for a flexible suspension member, such as for a hoist wire. The reel is fitted around the axis to be rotated with the motor. The hoist mechanism further contains a slack switch for halting the motor when the tension of the hoist wire decreases. In the invention the slack switch is arranged in connection with the reel, and it has an element, which is fitted to rest itself against the hoist wire unravelling from the reel and to alter its line of travel. The hoist wire directs a force component onto the element resting itself thereagainst, which force component holds the slack switch in a first position as long as the tension of the hoist wire exceeds a predetermined threshold value. When the slack switch is in the first position, the motor of the hoist mechanism functions normally. When the tension of the hoist wire falls below the predetermined threshold value, for example as a result of the hoist wire breaking or detaching, the slack switch moves into a second position, which switches off the function of the motor.

**[0008]** In an advantageous embodiment of the hoist mechanism according to the invention the slack switch comprises a first and a second support arm, which are attached at their first end in a pivoted manner to the structures of the vertically movable door. The element resting itself against the hoist wire is a rod, which is attached at its ends to the ends of the support arms, and the suspension member is fitted to travel between the support arms over the rod.

**[0009]** In a second advantageous embodiment of the hoist mechanism according to the invention the slack switch is arranged to move from the first position into the second position by rotating around a pivot pin. The rotation of the slack switch occurs by means of gravity, when the potential energy stored in the slack switch is released.

**[0010]** A third advantageous embodiment of the hoist mechanism according to the invention further comprises a micro switch, which has a detecting member for detecting the position of the slack switch. Said detecting member is advantageously a detecting rod extending beneath the first support arm, which detecting rod activates the micro switch.

**[0011]** The vertically movable door according to the invention has a door plate, in the bottom edge of which there is a lower beam. The vertically movable door has

a hoist mechanism, which has at least one reel for a flexible suspension member, such as a hoist wire. The suspension member is attached at its first end to the reel and at its second end to the lower beam of the vertically movable door. The hoist mechanism further includes an axis, around which the reel is fitted, and a motor for rotating the axis. Rotating the axis in a first rotation direction makes the suspension members reel onto the reels, whereby the lower beam attached to the suspension member rises upwards and the vertically movable door opens. Correspondingly rotating the axis in the second rotation direction makes the suspension members unravel from the reels, whereby the lower beam descends downwards by means of gravity and the vertically movable door closes. The hoist mechanism further contains a slack switch for halting the motor when the tension of the hoist wire decreases. In the vertically movable door according to the invention the slack switch is arranged in connection with the reel, and it has an element, which is fitted to rest itself against the suspension member unravelling from the reel and to alter its line of travel. The tight suspension member directs a force component onto the element resting itself thereagainst, which force component holds the slack switch in a first position as long as the tension of the suspension member exceeds a predetermined threshold value. When the slack switch is in the first position, the motor of the hoist mechanism functions normally. When the tension of the suspension member falls below the predetermined threshold value, for example as a result of the suspension member breaking or detaching, the slack switch moves into a second position, which switches off the function of the motor.

**[0012]** In an advantageous embodiment of the vertically movable door according to the invention, said slack switch comprises a first and a second support arm, which are attached at their first end in a pivoted manner to the structures of the vertically movable door. The element is a rod, which is attached at its ends to the ends of the support arms, and the suspension member is fitted to travel from the reel between the support arms over the rod to the lower beam.

**[0013]** In a second advantageous embodiment of the vertically movable door according to the invention, said slack switch is arranged to move from the first position into the second position by rotating around a pivot pin. The rotating of the slack switch is arranged to occur due to the gravitational force of the slack switch.

**[0014]** In a third advantageous embodiment of the vertically movable door according to the invention the hoist mechanism comprises several reels fitted around the axis, and a slack switch of its own has been arranged in connection with each reel.

**[0015]** In a fourth advantageous embodiment of the vertically movable door according to the invention it is a vertically movable door of fabric, advantageously a vertically movable door of fabric with two fabrics, which folds upwards.

**[0016]** It is an advantage of the hoist mechanism according to the invention that it is structurally simple and functionally reliable. The slack switch, which halts the motor of the hoist mechanism, functions without an external power source by means of gravity, which ensures its reliable operation.

**[0017]** It is a further advantage of the invention that its manufacturing costs are low.

**[0018]** In the following, the invention will be described in detail. In the description, reference is made to the appended drawings, in which

Figure 1 shows as an example a vertically movable door according to the invention seen from the front,

Figure 2a shows as an example a hoist mechanism of a vertically movable door according to the invention seen as a perspective view and

Figure 2b shows the hoist mechanism of Figure 2a seen from the side.

**[0019]** Figure 1 shows as an example a vertically movable door according to the invention seen from the front. The vertically movable door shown in Figure 1 is a so-called vertically movable door of fabric with two fabrics, which folds upwards, which has a rectangular flexible door plate 10. The door plate comprises two substantially parallel surface fabrics at a distance from each other, a first surface fabric 12 and a second surface fabric 14, and a number of horizontal reinforcements 16 between the first and second surface fabrics. The horizontal reinforcements are beam-like parts preferably of aluminium, which are situated in a horizontal position at a distance from each other. The surface fabrics are polyester web reinforced PVC fabric or some other sufficiently durable fabric material suited for the purpose. The surface fabrics are advantageously protected from fire, mould and UV light. In the lower edge of the door plate there is a case-like lower beam 18 and in the upper edge of the door plate there is an upper casing 20, in connection with which the hoist mechanism of the door plate is placed. The hoist mechanism includes an axis, which is substantially as long as the width of the door plate, around which axis there are reels, and a motor 22 for rotating the axis (the axis and the reels are not shown in the figure). Each reel has a hoist wire 28, which is attached at its second end to the lower beam. The operation of the hoist mechanism is controlled with a control centre 24, which is placed beside the vertically movable door on the wall of the space. In the vertical edges of the vertically movable door there are side rails 26a, 26b, which guide the ends of the lower beam and the horizontal reinforcements to move in the direction of the side rails.

**[0020]** Figure 2a shows as an example the hoist mechanism of a vertically movable door according to the invention seen as a perspective view. In order to better bring out the structure of the hoist mechanism, the wall of the upper casing 20 of the vertically movable door has

partially been removed. Figure 2b shows the hoist mechanism of Figure 2a seen from the side, from the direction of the end of the axis 30.

**[0021]** The hoist mechanism comprises an axis 30, around which cylindrical reels 32 have been fitted. The reels are attached to the axis in a fixed manner, so that the rotation of the axis generates rotation of the reels. The axis is rotated with the motor included in the hoist mechanism (the motor is not shown in the figure). The number of the reels depends on the width of the vertically movable door. In narrow vertically movable doors two reels are enough, one in each edge of the vertically movable door. Wider vertically movable doors need to be equipped with several reels. There can thus be 2, 3, 4, 5, 6, 7, 8 or more than eight reels, depending on the width of the door. The first end of the hoist wire 28 is attached to the reel and the second end of the hoist wire is attached to the lower beam 18 of the vertically movable door (Figure 1). The weight of the lower beam generates a load on the hoist wire, which keeps the hoist wire tight. Rotating the axis in a first rotation direction makes the hoist wire reel onto the reels, whereby the lower beam attached to the hoist wire rises upwards and the vertically movable door opens. Correspondingly rotating the axis in the second rotation direction makes the hoist wire unravel from the reels, whereby the lower beam descends downwards by means of gravity and the vertically movable door closes.

**[0022]** The axis 30 is suspended from the upper casing 20 by means of support members 34. The upper casing is a C profile made of metal, in the free edges of the flanges of which there are edges 42 pointing towards each other. The upper casing of a functional vertically movable door is, when attached to the upper edge of the door opening or the ceiling of the installation space of the vertically movable door, in the position according to Figure 2a, where the gap remaining between the edges 42 of the upper casing points downwards. The support members 34 have a plate-like upper support 36 and a lower support 38, which is substantially the same shape as the upper support. The upper support and the lower support are attached to each other on top of each other with attaching bolts 40, so that the edges 42 of the upper casing are pressed between the upper and lower supports (Figure 2b). In the second surface of the lower support, which surface points downwards in Figure 2a, there is a bearing housing 44, in the centre of which there is a bearing 46. The bearing can be a sliding, ball or roller bearing. In the centre of the bearing there is a hole, through which the axis 30 passes. The number of support members depends on the length of the axis, the number of the reels and the load of the hoist wires. There are advantageously two support members for each reel, whereby the support members are placed on both sides of the reel at a distance from the reel.

**[0023]** A slack switch has been arranged in connection with each reel 32, for monitoring the tightness of the hoist wire 28. The slack switch has a first support arm 50a, which is placed beside the first end of the reel, and a second support arm 50b, which is placed beside the second end of the reel. The first ends of the support arms are attached with a pivot pin 54 (Figure 2b) to attaching protrusions 56, which are attached to the flange of the upper casing 20. The pivot pin is located on the first side of the axis at a distance from the axis, when seen from the end of the axis (Figure 2b). The second ends of the support arms are connected to each other with a rod 52, which is substantially parallel to the axis 30. The hoist wire 28 unravelling from the periphery of the reel 32 travels between the support arms 50a, 50b over the rod 52 to the lower beam. The own weight of the lower beam generates a load on the hoist wires, wherefore the hoist wire strives to find its way to the vertical line passing by the periphery of the reel and the lower beam. The rod 52 attached to the second ends of the support arms settles below the reel, at a distance in the sideward direction from the vertical line passing by the periphery of the reel and the lower beam of the vertically movable door. The tight hoist wire, loaded by the own weight of the lower beam, turns over the rod and touches its surface, i.e. the rod alters the line of travel of the hoist wire, generating a curve in it. This curve generated in the hoist wire is however rather small, so it does not cause significant friction, which would increase the tension force of the hoist wire or increase the burden on the motor of the hoist mechanism. A horizontal force component is directed from the tight hoist wire onto the rod resting against it. This force component forces the rod to move to the other side of the axis 30 when seen from the end of the axis, which makes the support arms 50a, 50b rotate clockwise around the pivot pins 54. When the support arms rotate, their centre of gravity and the centre of gravity of the rod 52 moves upwards, i.e. potential energy is stored into them. In connection with the first ends of the support arms there can be stops, with which the turning of the support arms in the clockwise direction, i.e. in the direction of the first side of the axis, is limited.

**[0024]** In Figure 2b the rod 52 and the support arms 50a, 50b drawn with a solid line are in the first position, where the hoist wire 28 is in the loaded tight position. If the hoist wire breaks or it detaches at its first or second end, its tension force disappears. Thus no horizontal force component is directed from the hoist wire onto the rod, whereby the rod and the support arms rotate by means of gravity around the pivot pins 54 in a counterclockwise direction towards the second position, where the support arms are nearly vertical. When the tension in the hoist wire is removed, the potential energy stored in the support arms and the rod is thus released, which makes the slack switch rotate into the second position. This second position is shown in Figure 2b with dotted lines.

**[0025]** The hoist mechanism further includes a micro switch 60, which has a detecting rod 62 extending beneath the first support arm 50a. In the first position of the hoist mechanism the first support arm 50a stays above

the detecting rod, separated from the detecting rod, due to the horizontal force component directed by the hoist wire onto the rod 52. When the tension of the hoist wire is removed or decreases significantly, the horizontal force component provided thereby is removed, whereby the hoist mechanism is turned into the second position shown in Figure 2b with dotted lines. In this second position the first support arm presses the detecting rod 62, which activates the micro switch 60. The micro switch is connected with conductors to a control centre 24, which controls the operation of the motor 22 belonging to the hoist mechanism. The activation of the micro switch sends a halt command to the control centre, which halts the motor 22 rotating the axis 30. Thus all the reels 32 attached to the axis stop, whereby the movement of the door stops. Instead of a detecting rod the micro switch can be equipped with some other measuring sensor or detecting member, which detects the position of the slack switch.

**[0026]** In the hoist mechanism according to the invention a slack switch of its own has been arranged in connection with each reel, which slack switch monitors the tension of the hoist wire stored on the reel in question. The hoist mechanism thus immediately reacts to a significant decrease in the tension in even one hoist wire by halting and locking all hoist wires of the vertically movable door to be immobile.

**[0027]** In the description above, the suspension member of the vertically movable door is a hoist wire, which is reeled onto a reel of the hoist mechanism. It is clear to someone skilled in the art that instead of a wire, some other flexible structural part which reels onto a roll and withstands tension, such as a hoist line, chain, rope or cable, can be used as the suspension member of the vertically movable door.

**[0028]** Some advantageous embodiments of the hoist mechanism and vertically movable door according to the invention have been described above. The invention is not limited to the solutions described above, but the inventive idea can be applied in numerous ways within the scope of the claims.

## Claims

1. A hoist mechanism for a vertically movable door, which hoist mechanism has at least one reel (32) for a flexible suspension member, such as a hoist wire (28), an axis (30), around which the reel is fitted, a motor (22) for rotating the axis and a slack switch for halting the motor when the tension of the suspension member decreases, **characterized in that** said slack switch is arranged in connection with the reel and it has an element (52), which is fitted to rest itself against the suspension member unravelling from the reel, whereby the slack switch is arranged to remain in a first position when the tension of the suspension member exceeds a predetermined threshold value and to move into a second position, which switches off the function of the motor, when the tension of the suspension member falls below the predetermined threshold value.

2. The hoist mechanism according to claim 1, **characterized in that** said slack switch comprises a first and a second support arm (50a, 50b), which are attached at their first end in a pivoted manner (54) to the structures of the vertically movable door, and the element (52) is a rod, which is attached at its ends to the ends of the support arms, whereby the suspension member is fitted to travel between the support arms (50a, 50b) over the rod.

3. The hoist mechanism according to claim 1 or 2, **characterized in that** said slack switch is arranged to move from the first position into the second position by rotating around a pivot pin (54) and said rotation is arranged to occur by means of the gravitational force of the slack switch.

4. The hoist mechanism according to any of the claims 1-3, **characterized in that** it further comprises a micro switch (60), which has a detecting member for detecting the position of the slack switch.

5. The hoist mechanism according to claim 4, **characterized in that** said detecting member is a detecting rod (62), which extends beneath the first support arm (50a), and which activates the micro switch.

6. A vertically movable door, which has a door plate (10), a lower beam (18), a hoist mechanism, which has at least one reel (32) for a flexible suspension member, such as a hoist wire (28), which suspension member is attached at its second end to the lower beam, an axis (30), around which the reel is fitted, a motor (22) for rotating the axis and a slack switch for halting the motor when the tension of the suspension member decreases, **characterized in that** said slack switch is arranged in connection with the reel and it has an element (52), which is fitted to rest itself against the suspension member unravelling from the reel, whereby the slack switch is arranged to remain in a first position when the tension of the suspension member exceeds a predetermined threshold value and to move into a second position, which switches off the function of the motor, when the tension of the suspension member falls below the predetermined threshold value.

7. The vertically movable door according to claim 6, **characterized in that** said slack switch comprises a first and a second support arm (50a, 50b), which are attached at their first end in a pivoted manner (54) to the structures of the vertically movable door, and the element (52) is a rod, which is attached at

its ends to the ends of the support arms, whereby the suspension member is fitted to travel from the reel (32) between the support arms (50a, 50b) over the rod to the lower beam (18).

**8.** The vertically movable door according to claim 6 or 7, **characterized in that** said slack switch is arranged to move from the first position into the second position by rotating around a pivot pin (54) and said rotation is arranged to occur by means of the gravitational force of the slack switch.

**9.** The vertically movable door according to any of the claims 6-8, **characterized in that** it further comprises a micro switch (60), which has a detecting member for detecting the position of the slack switch.

**10.** The vertically movable door according to claim 9, **characterized in that** said detecting member is a detecting rod (62), which extends beneath the first support arm (50a), and which activates the micro switch.

**11.** The vertically movable door according to any of the claims 6-10, **characterized in that** the hoist mechanism comprises several reels (32) fitted around the axis (30) and a slack switch of its own has been arranged in connection with each reel.

**12.** The vertically movable door according to any of the claims 6-11, **characterized in that** it is a vertically movable door of fabric, advantageously a vertically movable door of fabric with two fabrics, which folds upwards.

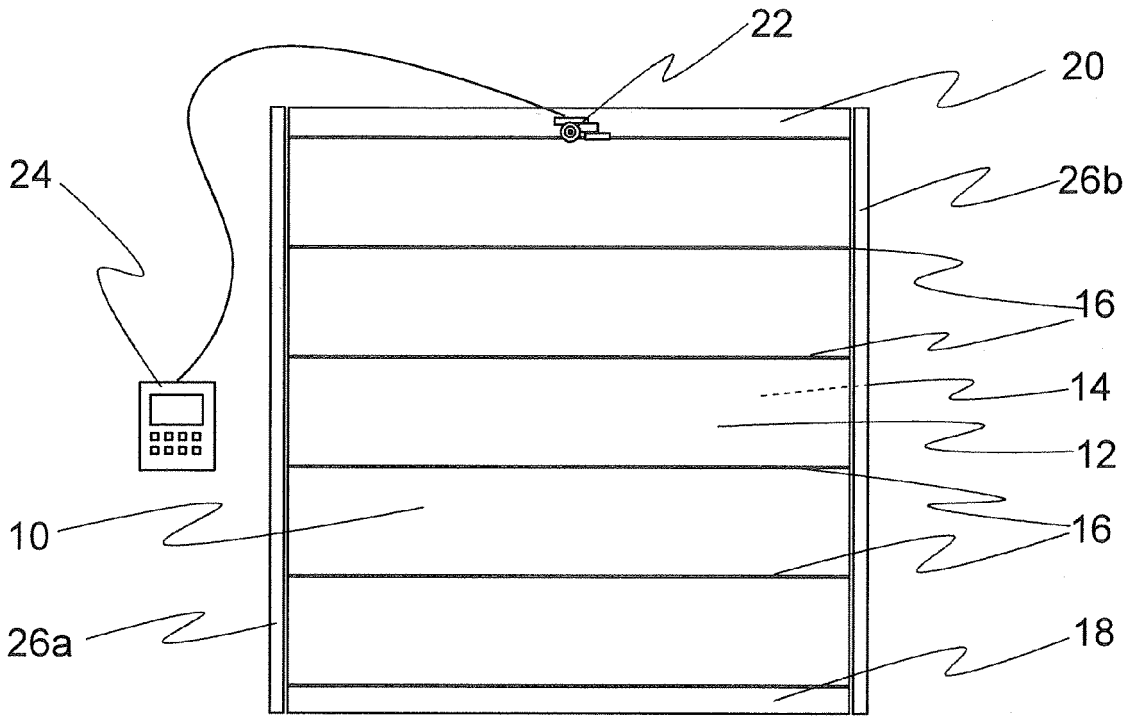


Fig. 1

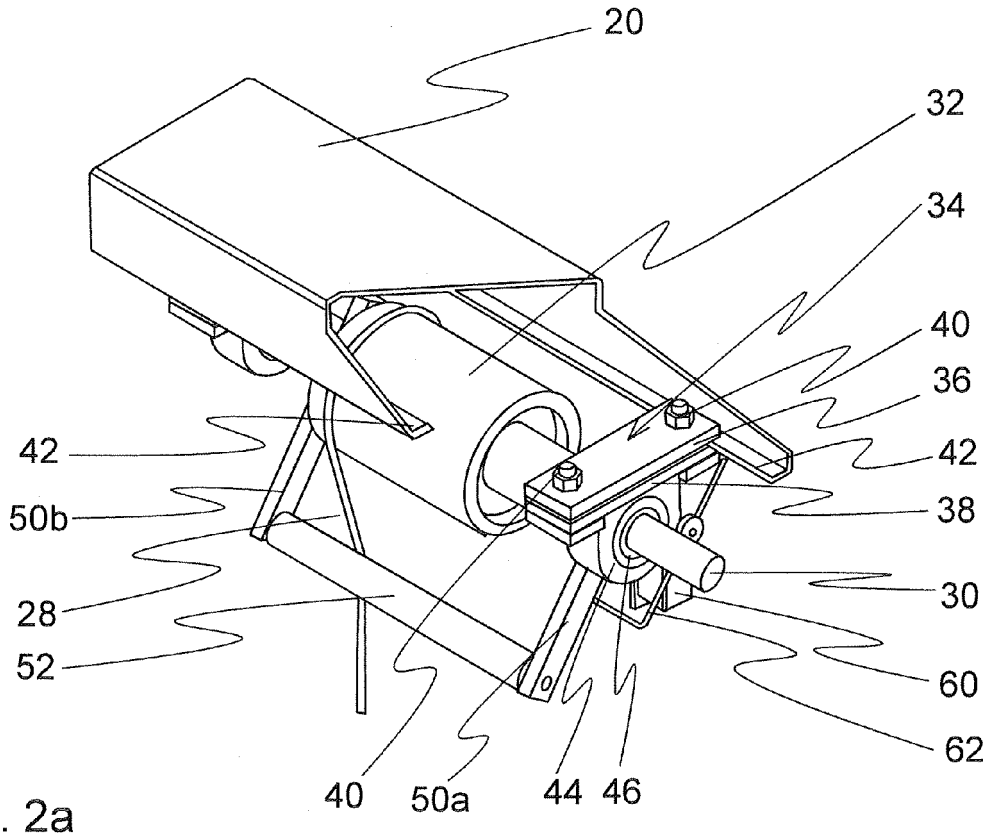
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Fig. 2a

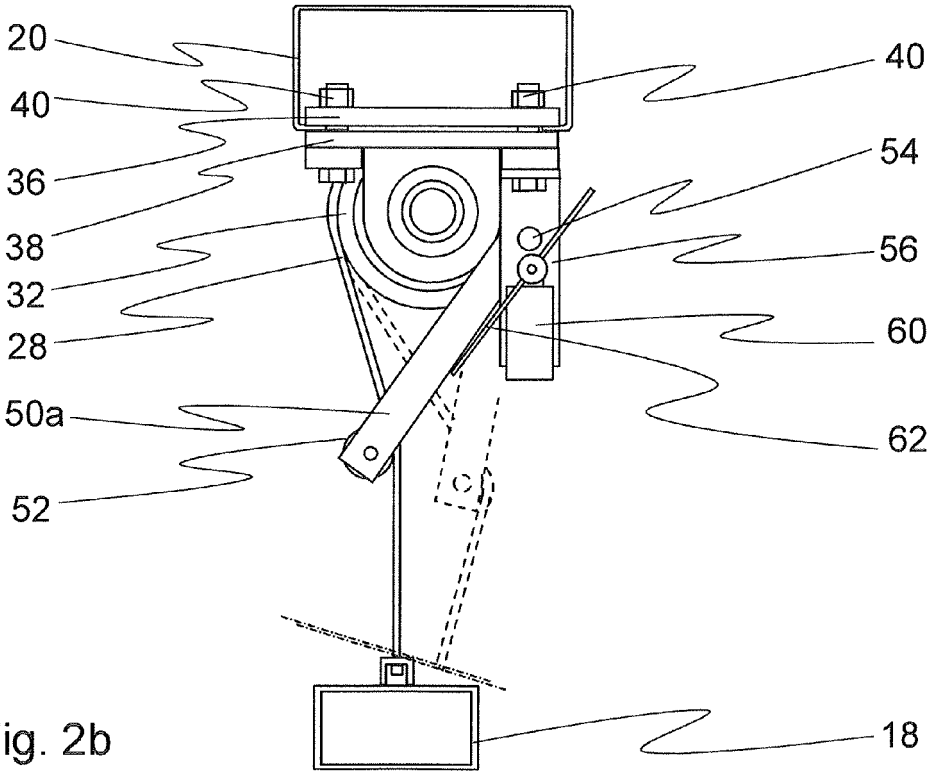
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Fig. 2b

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# EUROPEAN SEARCH REPORT

Application Number
EP 10 19 0418

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y | US 2002/184824 A1 (MCCARTNEY PHILLIP [US] ET AL) 12 December 2002 (2002-12-12)<br>* paragraph [0023] - paragraphs [0028], [0031]; figures 1,2 *<br>----- | 1,3-6, 8-12<br>2,7 | INV.<br>E06B9/80<br>E05D13/00<br>B66D1/40 |
| Y | WO 2008/048561 A2 (DAVENPORT CARLTON A [US]) 24 April 2008 (2008-04-24)<br>* figure 2 *<br>----- | 2,7 | |
| A | US 2008/245484 A1 (TILLMAN JOHN [US]) 9 October 2008 (2008-10-09)<br>* abstract *<br>----- | 1-12 | |

TECHNICAL FIELDS SEARCHED (IPC)

B66D
E05D
E06B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 10 March 2011 | Schwertfeger, C |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 19 0418

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10-03-2011

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 2002184824 A1 | 12-12-2002 | NONE | |
| WO 2008048561 A2 | 24-04-2008 | NONE | |
| US 2008245484 A1 | 09-10-2008 | NONE | |

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

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 4368770 A **[0004]**