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(54) **Skylight with operator for vertical opening movement**

(12) to move the sash (2) and support the load of the sash (2). The guide mechanisms (4) and/or operators (12) may be integrated in the frame (1) / sash (2).

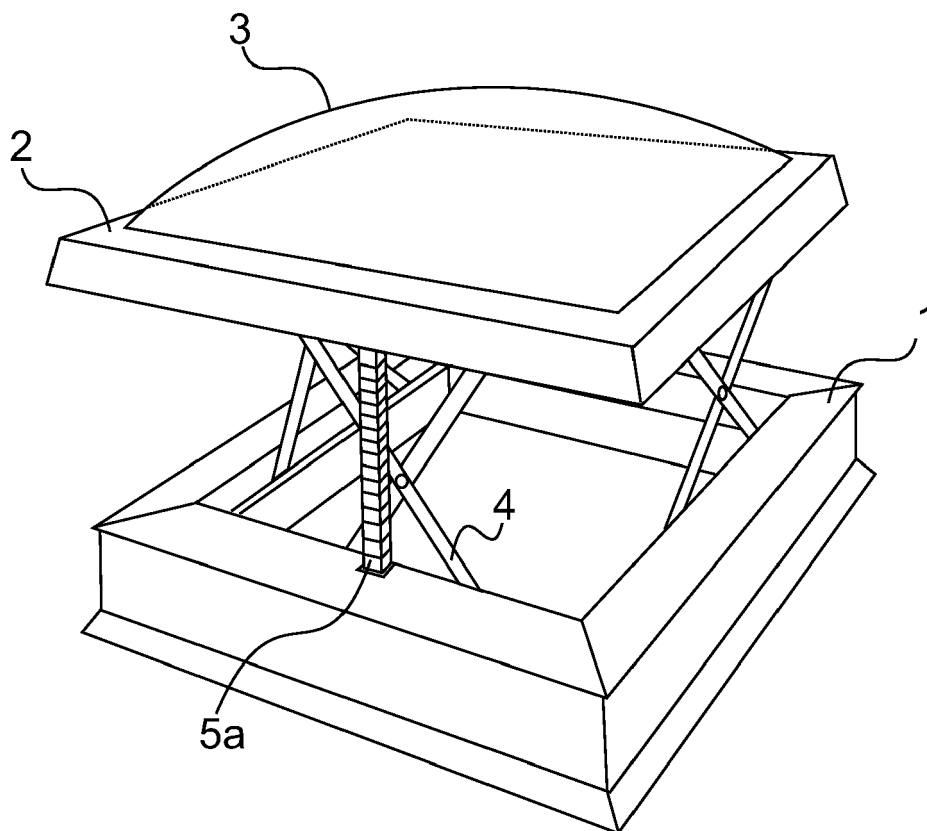


Fig. 1

Description

Field

[0001] The exemplary and non-limiting embodiments of this invention relate generally to skylights and more particularly to a motorised skylight which opens by parallel vertical displacement.

Background

[0002] Skylights are used for transmission of outdoor natural lighting through roofs to building interiors. There exist two types of skylights, one type for sloping roofs and other type skylights for flat/horizontal roofs. The horizontal skylight may open by a hinge and rotation, by linear guide which enable sideways sliding or by vertical parallel displacement where the skylight is vertically raised.

[0003] For example EP0979333B1 shows a motorised skylight which opens vertically by parallel displacement.

[0004] DK174562 shows a vertical window which opens by sideways displacement, however vertical windows are not suitable for roof use.

[0005] JP60-29835 shows a skylight with 4 scissor mechanisms i.e. one on each side of the skylight. Such skylights conventionally open little (small opening height) which is not suitable for smoke ventilation.

Summary

[0006] It would be desirable to provide a skylight which enhances the operation of the motorised opening mechanism and provides a large aperture (i.e. smoke ventilation by law requires an opening almost corresponding to a complete open aperture).

[0007] It would be desirable to provide a skylight which enhances the ventilation by providing an opening which is independent from the wind direction.

[0008] It would be desirable to provide a skylight which limits precipitation entry during ventilation.

[0009] It would be desirable to provide a skylight which has a slim frame and a large opening. Further it would be desirable to provide a concealed motorised opening mechanism. Further it would be desirable to provide a motorised opening mechanism which does not extend below the frame of skylight.

[0010] It would be desirable to provide a motorised skylight which uses the same frame/sash as a non motorised skylight. Because smoke ventilation only requires that a few skylights are able to open, both regular and motorised skylights may use the same components.

[0011] These enhancements and advantages are provided by a first non-limiting exemplary embodiment comprising a skylight comprising: a frame, a sash movable in relation to the frame by substantially vertical movement, the frame and sash each consist of 4 sides,

the vertical movement of the sash is provided by two means: a guide mechanism means which guide the vertical movement and keep the sash and frame substantially parallel, and

operator drive means which are configured to move the sash.

[0012] The enhancements and advantages are provided by a second non-limiting exemplary embodiment comprising a skylight comprising: a frame, a sash substantially covering the frame, the frame and sash each consist of four sides, the sash is configured substantially for vertical movement, a guide mechanism is attached to each of the four respective sides of the frame and the sash, and at least two rigid chain operators provided substantially symmetrically about the centre and, the rigid chain operators are substantially configured to move the sash.

[0013] Favourable embodiments are defined in the dependent claims.

[0014] Other features and advantages of the disclosed embodiments will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings. Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, etc]" are to be interpreted openly as referring to at least one instance of the element, device, component, etc., unless explicitly stated otherwise.

Brief description of the drawings

[0015] The foregoing and other aspects of the teachings of this invention are made more evident in the following description, when read in conjunction with the attached figures, wherein:

Fig. 1 shows an example of a skylight.

Fig. 2 shows an example of a guide mechanism.

Fig. 3 shows an example of a chain operator drive.

Fig. 4 shows the guide mechanism and operators from above.

Fig. 5 shows the guide mechanism and operators in 3D.

Fig. 6 shows an example of the skylight in open/raised position.

Fig. 7 shows a cross section of the skylight frame in the closed position.

Fig. 8 shows a cross section of the skylight frame in the open/raised position.

Detailed description

[0016] The disclosed embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which certain examples are shown. These disclosed examples may, however, be em-

bodied in many different forms and should not be construed as limited; rather, these examples are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosed embodiments to those skilled in the art. Like numbers refer to like elements throughout.

[0017] Some skylights are used for smoke ventilation. Such skylights must be able to open even when covered by snow and this requires the opening mechanism to handle about 3 times more weight than the sole skylight weight.

[0018] To provide high force spindle or cylinder operators are usually used, but these operators often also extend below the frame of skylight i.e. the spindle or cylinder operator extends into the free air. Consequently spindle and cylinder operators do not have a nice appearance and the assembly and transport is not optimal. A spindle or cylinder operator may use a link mechanism, but transmitting force through link mechanisms requires a mechanism with large dimensions, more parts and consequently costs, maintenance and appearance is affected.

[0019] Fig. 1 illustrates an example of a motorised skylight with a parallel vertical displacement opening mechanism.

[0020] The skylight opens by vertically raising the sash 2 and pane 3. By vertical and/or parallel displacement is understood, that the sash is raised vertically while the frame 1 and sash 2 remain substantially parallel. So the sash moves in one dimension only. In this disclosure the opening of the skylight is understood as raising the sash or moving the sash.

[0021] The skylight has a frame 1 configured for horizontal mounting on a roof. The frame 1 may be placed on a curb (not shown). Both the frame 1 and sash 2 each consist of 4 respective sides. The opening of the skylight is provided by two means: a guide mechanism means which guide the raising and keep the frame and sash substantially parallel and operator drive means which carry the load (sash 2) when it is raised. The guide mechanism means may be provided by scissors mechanisms 4. The guide mechanism means may be provided as a linear guide mechanism. The guide mechanism means 4 may also be provided by a telescopic guide for example located in each corner of the skylight. The operator drive means may be a rigid chain operator 5a,12. Both single and/or double chain operators (where 2 chains mesh to create stiff column) may be employed. The 4 guide mechanisms each comprise a first profile attached to the sash and a second profile attached to the frame wherein the first and second profile is connected by a collapsible mechanism 4.

[0022] Fig 2. illustrates a scissors mechanism linkage 4. The scissor mechanism 4 comprises a first rail 6 and a second rail 7. The rails 6,7 are connected by crossing scissor links 8,9. The rails may be C shaped to guide a sled 10 which supports one end of the links. The mechanism has one first end 11 where the links 8,9 are fixed

and a second end where the links may travel. The first rail 6 is secured to the sash 2 and the second rail 7 is secured to the frame 1. When the skylight is closed the guide mechanism 4 is fully collapsed This dead position of the guide mechanism 4 is possible because the scissor mechanism 4 does not transmit any raising force.

[0023] Fig 3 illustrates a rigid chain operator 12 with a collapsed chain 5. The chain is driven by a sprocket and after the exit the chain is rigid 5a. The chain operator 12 has a self locking gear, for example by using a worm gear or a gear lock. Hereby the load of the sash 2 can be supported. The rigid chain 5a is secured to the sash 2. Hereby the sash may be raised without applying any load forces to the guide or scissor mechanisms 4.

[0024] Fig 4 illustrate the scissor mechanism 4 and operator drive 5 viewed from above. The guide mechanism is configured to control and guide the substantially vertical displacement of the sash. The sash/frame each have 4 sides 4a-4d. On each respective side 4a-4d there is provided a scissor mechanism. The scissor mechanisms 4 and operator 5 are also shown on fig. 5 and fig. 6 (note the chains are not extended on fig. 5 and 6).

[0025] The rigid chain operator 5a,12 raises and carries the load of the sash 2 e.g. the skylight. In one example at least two rigid chain operators 12 are used and the operators 12 are provided substantially symmetrically about the centre and the rigid chain operators 5a,12 are configured to carry the load of the skylight e.g. sash 2. The rigid chain operators 5a,12 substantially carry the load of the sash in the open position. The skylight has open position, closed position and position in between. The rigid chain operators 5a,12 are configured to move the sash 2 and carry the load of the sash in at least one position. The rigid chain operators 5a,12 support load of the sash 2 in at least one position.

[0026] The extended rigid chains may bend in one direction and in one example the operators are arranged so the direction in which the chains bend point mutually towards each other or away from each other. Hereby the sum of the chains creates a structure which better resist bending.

[0027] In one example the operator 12 motors comprise feedback to a controller, which controls the motors synchronously in order to raise the load parallel. The at least two rigid chain operator motors have feedback and are driven synchronous.

[0028] The 4 scissor mechanisms 4a-4d each individually restrict movement in the longitudinal direction (e.g. along the rails 6,7). The scissors are not individually configured to cope with torsion and transversal forces in the plane of the frame/sash. Each scissor shaped mechanism substantially confines the movement in one dimension only. By providing 4 scissor mechanisms, one on each respective side a configuration is provided which is suitable to cope with torsion and transversal forces. By using 4 scissor mechanisms merely for guiding the vertical movement, the dimensions of the 4 scissor mechanisms may be very small. For example it has proven that

4 scissors, where each scissor link 8,9 is less than a cm thick may support a skylight weighting more than 200kg. (The thickness is defined as the cross section seen from above fig 4). In particular fig. 6 illustrates that by using slim scissor mechanisms 4, one on each respective side, the mechanisms occupy little space and provide a firm guide and/or support. Both the height and the thickness of the scissor mechanisms 4 may be compact. In one example the 4 scissor mechanisms are identical. In one example the 4 scissor mechanisms 4 are provided substantially on the centre of each of the 4 respective sides. In one example the 4 scissor mechanisms 4 are provided substantially symmetrically about the centre of gravity. By these examples the load is evenly distributed and the raising motion is smooth etc.

[0029] As mentioned this configuration provides an enhanced skylight support which is compact and may be integrated in the sash/frame. This configuration also provides an opening which is independent of the wind direction. The configuration of 4 scissor mechanisms also provides a large aperture because the sash may be lifted highly. In one example the skylight sash may be lifted more than $0,3 \times W$, where W is the width of the skylight sash (for example as seen on fig. 6). Preferably the skylight sash is lifted between $0,4$ to $0,8 \times W$. To provide this high lift of the sash 2 each scissor mechanism 4 longitudinal length in the collapsed position is more than 50% of the skylight sash width. Preferably the scissor mechanism longitudinal length is more than more than 60% of the skylight sash width. By lifting the skylight highly as provided by the mechanism 4 and operators 12 it is possible to provide smoke ventilation with sufficient flow and aperture area even though the sash is situated above the frame.

[0030] Fig. 7 and 8 show a cross section of the skylight in closed and open positions. The sash 2 substantially covers the frame 1 located beneath the sash 2. The operators 12 are integrated in the frame 1. The two operators 12 are provided substantially symmetrically about the centre to substantially support the centre of gravity. The two operators 12 are offset from the centre to provide room for the winding chain 5. The chain 5 is wound up inside the frame 1 profile. As mentioned the four guide scissor mechanisms provide low dimensions, which enable the scissor mechanism 4 in the collapsed position to fit inside the frame 1. As may be seen the scissor mechanism 4 take up less than 50% of the frame cross section width. Preferably the scissor mechanism 4 cross section width is less than 4 cm.

Hereby the scissor mechanism may be used in a frame from a regular skylight and this enables the re-use of components and also provides a consistent look.

[0031] It will be understood that the embodiments described herein are merely exemplary and that variations and modifications of the teachings will still fall within the scope of this disclosure. For example it may be possible to add springs to provide lifting force and lessen the load on the operators. For example the operator synchroni-

zation may also be done mechanically by interconnecting the operators by transmission components. For example the mechanisms may comprise more scissors e.g. multiple scissor mechanisms stacked or multiple scissor mechanisms side by side. For example other suitable collapsible mechanisms may be used, like telescopic etc. Furthermore, some of the features of the examples of this disclosure may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings, examples and exemplary embodiments of this disclosure, and not in limitation thereof.

Claims

1. A skylight comprising:

a frame 1,
a sash 2 movable in relation to the frame 1 by substantially vertical movement,
the frame 1 and sash 2 each consist of 4 sides,
the vertical movement of the sash 2 is provided by two means:

a guide mechanism means which guide the vertical movement and keep the sash and frame substantially parallel, and
operator drive means which are configured to move the sash 2.

2. A skylight according to any previous claims, comprising:

a frame 1,
a sash 2 substantially covering the frame 1,
the frame 1 and sash 2 each consist of four sides,
the sash is configured substantially for vertical movement ,
a guide mechanism is attached to each of the four respective sides 4a-4d of the frame 1 and the sash 2, and
at least two rigid chain operators 12 provided substantially symmetrically about the centre and,
the rigid chain operators 12 are substantially configured to move the sash 2.

3. A skylight according to any previous claims, wherein:

each of the respective four sides comprise a collapsible scissor mechanism 4 linking a first rail 6 secured to the sash 2 and a second rail 7 secured to the frame 1.

4. A skylight according to any previous claims, wherein:

rigid chains 5a are secured to the sash 2 and at least two rigid chain operators 12 push the rigid chain 5a substantially vertically and the rigid chains thereby substantially carry the load of the sash 2.

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5. A skylight according to any previous claims, wherein the scissor mechanisms 4 and/or operators 12 are integrated in the frame and/or sash in the closed position. 10
6. A skylight according to any previous claims, wherein the sash 2 may be raised more than $0,3 \times W$, preferably between $0,4$ to $0,8 \times W$, where W is the width of the skylight sash. 15
7. A skylight according to any previous claims, wherein the rigid chain operator 12 fold the rigid chain 5 and the folded chain is comprised inside the frame 1 profile. 20
8. A skylight according to any previous claims, wherein each guide or scissor mechanism longitudinal length in the collapsed position is more than 50% of the corresponding sash 2 width. 25
9. A skylight according to any previous claims, wherein the guide or scissor mechanism 4 does not carry any substantial weight from the sash 2. 30
10. A skylight according to any previous claims, wherein rigid chain operators comprise chains which have a collapsible side and wherein the chains are oriented so that the collapsible sides are either facing towards eachother or away from eachother. 35

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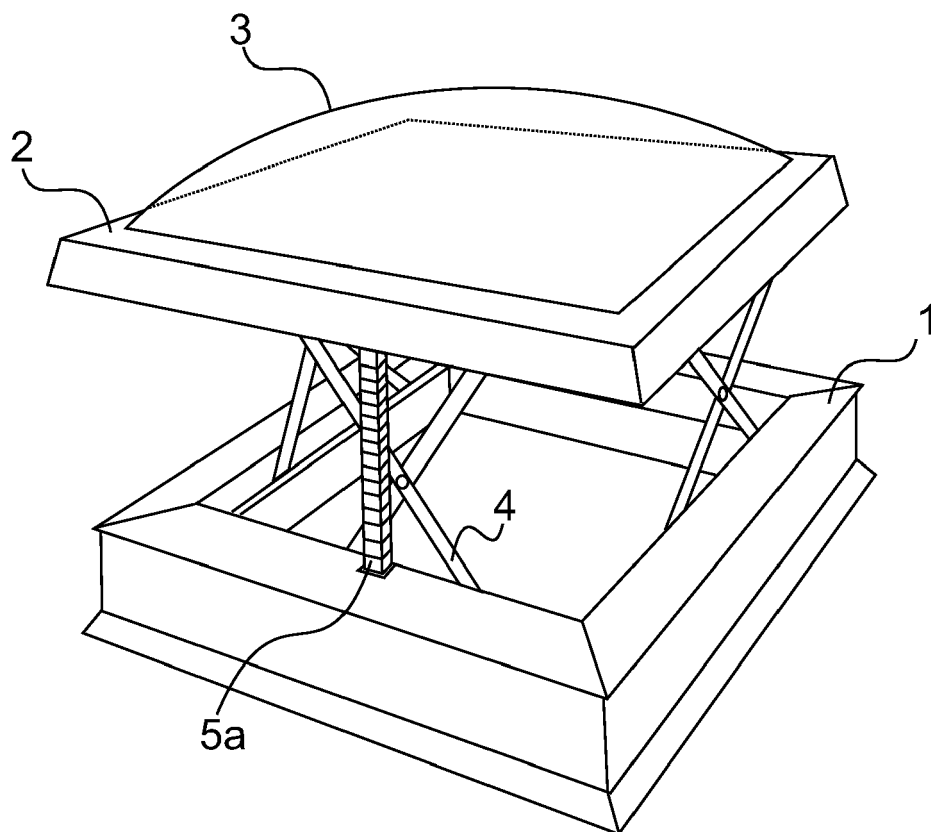


Fig. 1

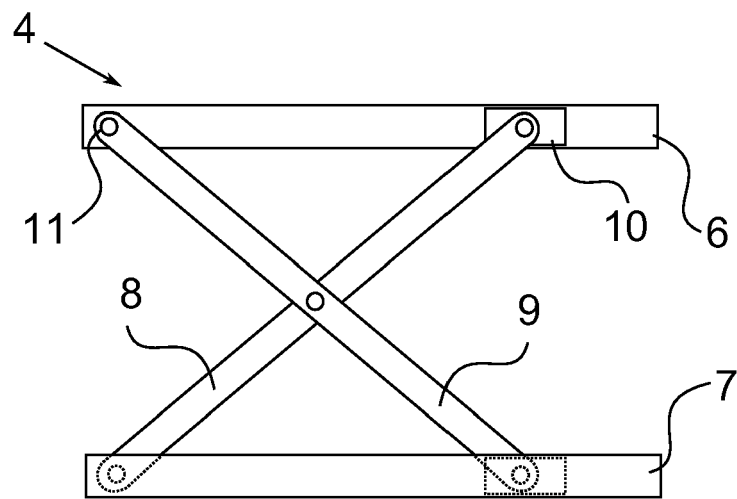


Fig. 2

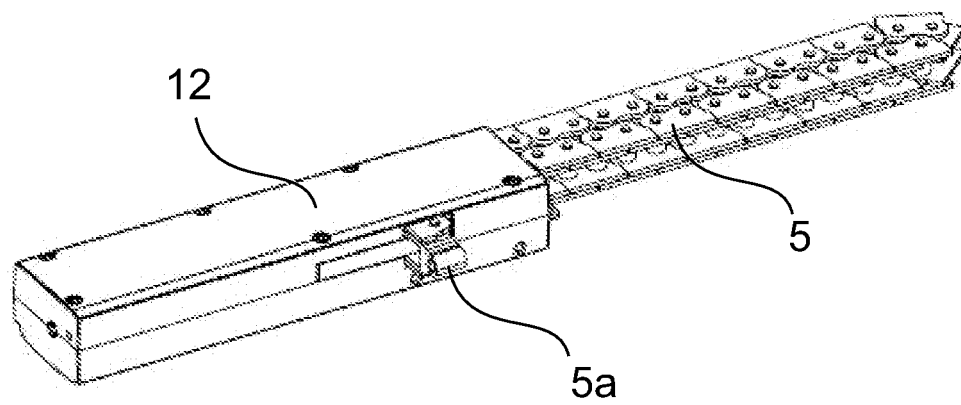


Fig. 3

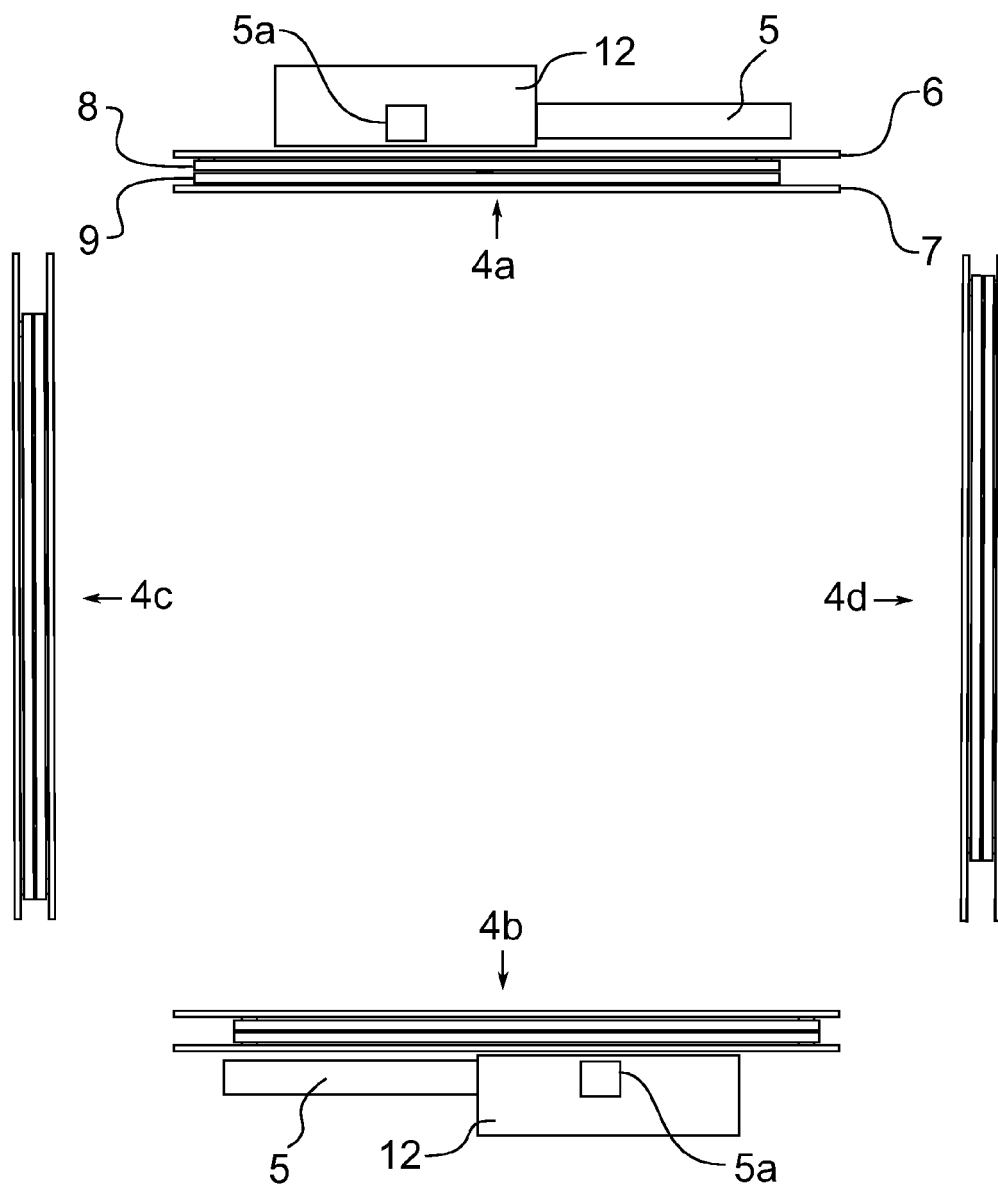
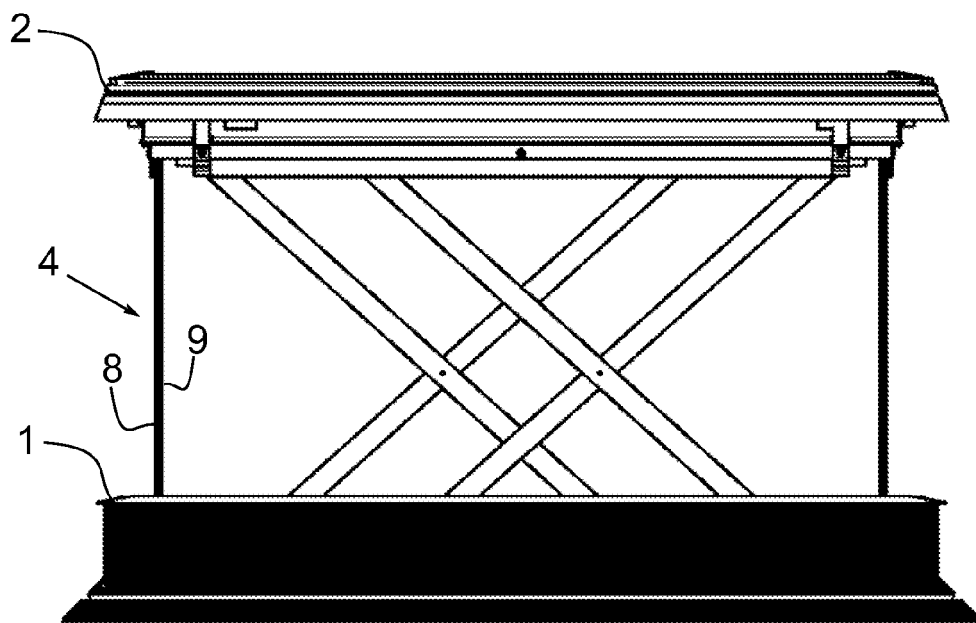
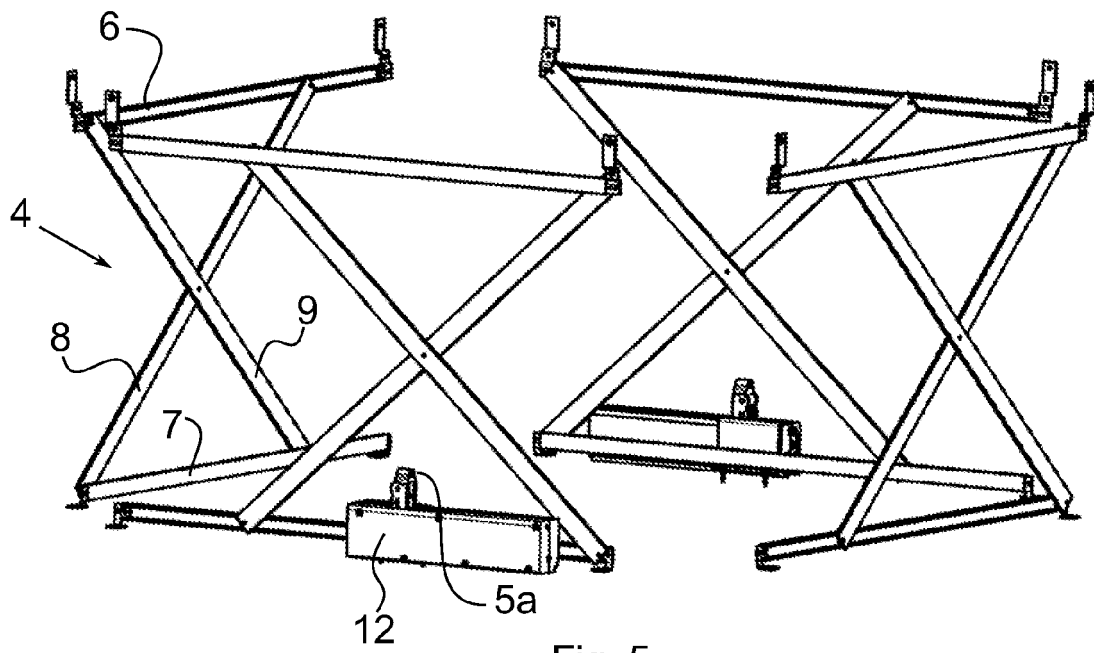


Fig. 4



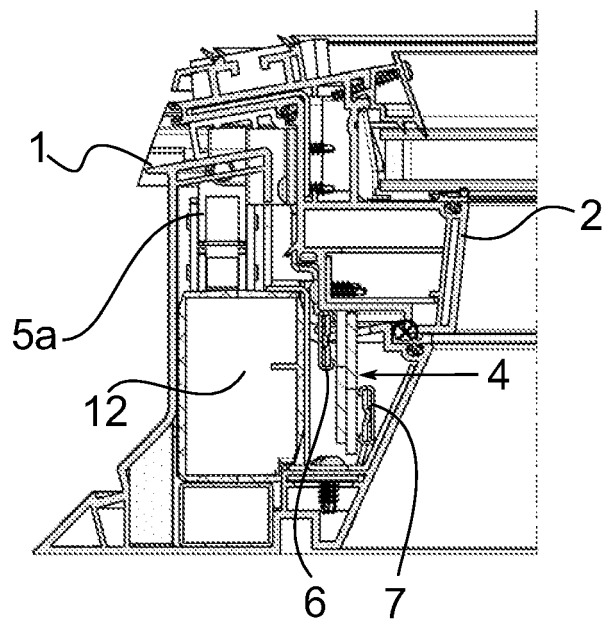


Fig. 7

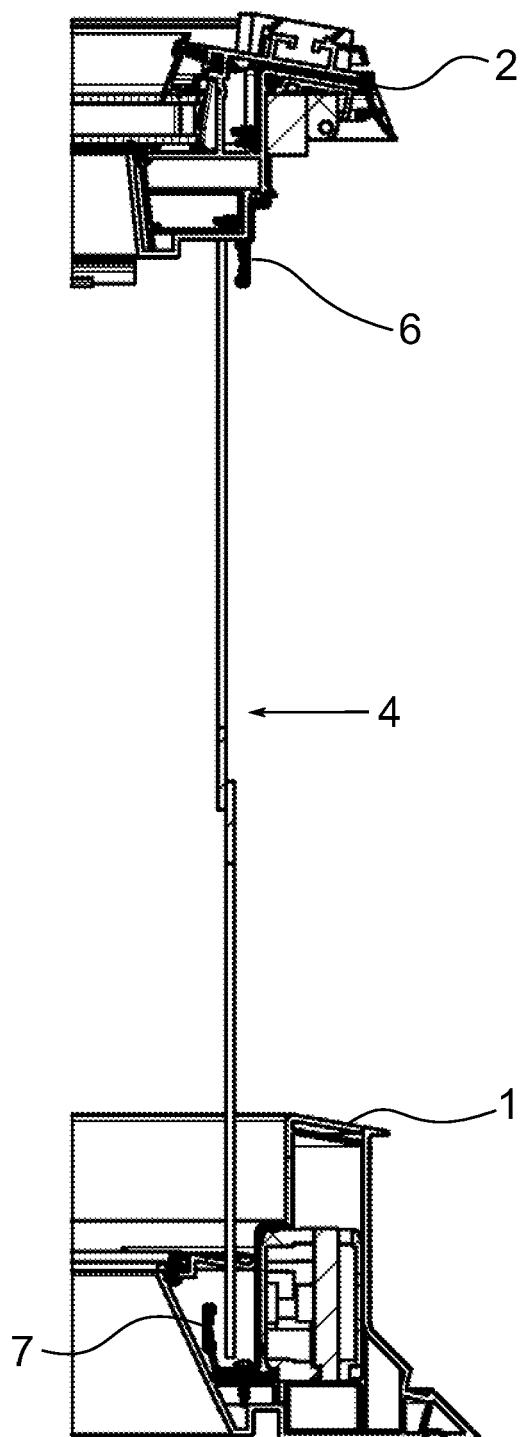


Fig. 8



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