

Description

[0001] The present invention relates to a roof ventilation device comprising a fixed frame, a roof hatch, such as a roof light, which is hingedly connected to the fixed frame and an actuator assembly for opening the roof hatch, as well as to the actuator assembly as such.

BACKGROUND

[0002] Roof ventilation hatches with automatic opening in case of fire or other hazardous situations are widely applied for emergency ventilation in buildings to allow for removal of smoke or heat from the interior. The hatches are very often transparent or translucent, such as domes or pyramids made from glass or plastics materials, e.g. acryl glass, known as roof lights or skylights.

[0003] A commonly applied device for opening a roof light is disclosed in DE 42 44 012, in which a pinion drive on the frame part and a rack cooperating therewith and arranged on the opening part is use for the actuating mechanism. The drawback is that the rack necessarily will extend below the frame part when the roof light is closed, which defines a lower limit of the height between the floor and the roof in the rooms of the building in which the roof light may be applied so that the rack does not constitute an annoyance or even a danger to persons in the rooms. Furthermore, prefabricated roof lights with such actuating mechanism mounted can not be packed closely together due to the racks, and the actuating mechanism will therefore be mounted on the location where the roof lights are installed in order to save transport space and thereby costs. A somewhat similar actuating mechanism is shown in DE 42 40 985, employing a gas cylinder with a piston connected to the roof light for the opening thereof. The cylinder extends downwards perpendicular to the roof light and well beyond the fixed frame part of the roof light and has the same drawbacks as disclosed above. EP 0 610 558 discloses a roof light with an arrangement with a gas piston for the opening thereof, which arrangement is designed to be taken apart for transport, so that the arrangement does not extend beyond the fixed frame part of the roof light and therefore may be packed closely together, and to be assembled again without the use of tools. However, when the arrangement is assembled it extends downward beyond the fixed frame with the drawbacks discussed above.

[0004] GB 2 253 243 and EP 0 692 640 both disclose a roof light opened by a gas cylinder and a piston hinged to the fixed frame and to the roof light, respectively, which in the closed position of the roof light are parallel to the fixed frame and upon opening of the roof lights pivots so that the cylinder extends downwards beyond the fixed frame when the roof light is fully open. Although the above-discussed disadvantages during the closed position of the roof light are resolved, the opening arrangement still extends downwards beyond the fixed

frame and will require a minimum of high between the floor and the roof in the rooms of the building in which the roof light may be applied for the arrangement not to constitute an obstacle and a hazard to people moving in said rooms when the roof lights are opened, in particular during an emergency situation where they are used for removing smoke or heat from the room.

[0005] US 3 516 210 and US 3 728 956 both disclose roof lights that are manually or automatically opened by means of preloaded torsion springs, which allow for a design of the opening mechanism so it does not extend downwards beyond the fixed frame of the roof light. Closing of the roof lights and preloading of the torsion springs have to be performed manually, which impedes the use of the roof lights for ordinary ventilation in non-emergency situations as well as the periodic test of the opening mechanisms to ensure that they are in function.

[0006] With the present invention, a roof ventilation device is provided with a roof hatch which is hingedly connected to the fixed frame and an actuator assembly for opening the roof hatch, comprising a lever arm which at a first end is pivotally connected to the roof hatch and drive means arranged on the fixed frame for displacing a second end of the lever arm along a predetermined path substantially in the plane of the fixed frame so as to open the roof hatch. Thereby it is made possible that the actuator assembly is designed so that the assembly may be accommodated substantially within the fixed frame of the roof ventilation device in the closed position of the roof hatch and is not required to extend downwards from the frame in the opened or closed position thereof with the disadvantages involved as discussed previously, which is an object of the present invention.

[0007] The opening force of the actuator assembly on the hatch should be sufficient to lift the hatch, to overcome that the hatch may stick to the fixed frame and a possible presence of loose material on the upper side of the hatch, such as snow or dry leaves. The power supply of the actuator assembly is in most cases limited to a local supply of pressurised gas or an electrical emergency power supply system. With the present invention, a varying gearing between the drive means and the opening movement is provided, so that a given movement of the second end of the lever arm along the predetermined path at the initiation of the opening operation results in a smaller upwards movement of the roof hatch, whereas the same given movement of the second end of the lever arm at a later stage of the opening operation results in a larger upwards movement of the roof hatch, so that a sufficiently open stage of the roof hatch for the ventilation purpose, e.g. 45° to horizontal, is reached sufficiently rapidly. Thereby, the opening of the roof hatch may be effectuated in a satisfactory manner with a supply of a minor power source only, which also is an object of the present invention.

[0008] It is a further object of the present invention that the roof hatch may be opened and closed by operation of the actuator assembly for test and non-emer-

gency opening for ventilation of the building

[0009] Other advantages of the present invention and the specific embodiments thereof will become apparent in the following disclosure of the invention.

BRIEF DESCRIPTION OF THE PRESENT INVENTION

[0010] Thus, the present invention relates to a roof ventilation device comprising a fixed frame to be fixed in the roof construction of a building, a roof hatch which is hingedly connected to the fixed frame and an actuator assembly for opening the roof hatch, the actuator assembly comprising a lever arm which at a first end is pivotally connected to the roof hatch, wherein the actuator assembly comprises drive means arranged on the fixed frame for displacing a second end of the lever arm along a predetermined path substantially in the plane of the fixed frame so as to open the roof hatch.

[0011] The roof hatch may preferably be of a transparent of translucent material, such as acrylic plastic shaped as a dome. The path extends substantially in the plane of the fixed frame, by which is understood that the path extends substantially within the space defined by the frame and has a major component in the plane, e.g. in the horizontal plane for a ventilation device installed on a flat roof, which is a preferred embodiment. The path may extend in a curved shape and/or at an angle to the general plane of frame, e.g. at an angle to horizontal with a ventilation device according to the present invention installed in a horizontal roof construction. A possible angle and the advantages thereof are discussed below.

[0012] In a preferred embodiment of the present invention, the second end of the lever arm is connected to a slide that runs along a guide therefore fastened to the fixed frame, which guide defines the predetermined path. With the provision of the slide and guide, it is obtained that the vertical forces to be exerted on the hatch are transferred to the fixed frame, and the drive means are only required to provide the force for driving the slide along the guide. The slide and guide may e.g. be constituted by a slide shoe running along a slide bar, such as in a track in the slide bar or a sleeve sliding on a guide bar, or alternatively by a slide bar or guide bar connected to the second end of the lever bar and a slide shoe or sleeve fastened to the fixed frame.

[0013] The drive means for driving the slide along its guide may e.g. be a piston driven by a pressurised fluid, such as a pressurised gas, but gas pistons have some drawbacks in that they normally are not reversible and able to close the hatch again and that they require the storage of pressurised gas over a longer period of time. The pressurised gas tends to leak over time, and the containers for pressurised gas have to be replaced or refilled after each periodic test of the device. Thus, an electrical drive unit that may be powered by an electrical emergency power supply system is preferred, such as a chain actuator or a wire actuator, which preferably is

arranged to drive the slide in both directions to open as well as to close the hatch, an angular actuator, e.g. with a gear wheel (pinion) on the slide and a rack arranged along the guide, etc. However, it is in general preferred for all embodiments of the present invention to employ an electrically driven linear actuator as the drive means.

[0014] In particular, it is preferred to employ a linear actuator, which at a first end is connected to the slide and at a second end is hinged to the fixed frame, whereby a degree of mechanical freedom in the actuator assembly is ensured so that the linear actuator is not subjected to other forces than the reaction force from the slide. A linear actuator is in general an actuator of which the distance between the first and the second end is varied by activation of the actuator, such as a fluid pressure-driven cylinder or a spindle actuator in which a nut is connected to the slide. The use of the latter type is preferred for the present invention.

[0015] The most advantageous results with the above-described varying gearing between the drive means and the opening movement is obtained when the lever arm in a closed position of the roof hatch is arranged to extend at an angle to horizontal within the range of 8 - 30°, such as within the range of 12 - 24°, and preferably within the range of 15 - 19°, so that the first end of the lever arm is arranged at a higher position than the second end thereof.

[0016] The direction in which the lever arm extends is the direction of the line between the two connecting points at the first end and second end thereof, respectively, without consideration to the shape of the lever arm there between.

[0017] It is also advantageous that the predetermined path, e.g. in the form of a guide as discussed previously, extends at an angle to horizontal within the range of 8 - 30°, such as within the range of 12 - 24°, and preferably within the range of 15 - 19°, so that the second end of the lever arm is arranged at a higher position at an open position of the roof hatch than at a closed position thereof. Thereby, the displacement of the second end of the lever arm by the drive means provides the opening movement from the change in angular position of the lever arm as well as the vertical translation of the lever arm due to the orientation of the path.

[0018] It is particularly advantageous that the predetermined path extends at substantially the same angle to horizontal as the lever arm in a closed position of the roof hatch, such as with an angle to horizontal as discussed above.

[0019] In a particularly preferred embodiment, the lever arm comprises a locking part for engaging a corresponding holding part arranged on the fixed frame to thereby exercises a downward holding force on the roof hatch, the locking part is arranged to engage the holding part when the roof hatch is shifted from an open position to a closed position thereof and to disengage from the holding part when the roof hatch is shifted from the closed position to the open position thereof. The pivotal

connection between the lever arm and the roof hatch may furthermore be adapted to allow for a translation, i. e. substantially without a concurrent rotation thereof, of the lever arm in the longitudinal direction thereof during engagement and disengagement of the locking part and the holding part. The first end of the lever arm may be pivotally connected to the roof hatch by means of a pin having an elongated cross-section engaging a slot formed so that the pin in the closed position of the roof hatch, where the locking part engages the holding part, is positioned in a narrower section of the slot, thereby preventing the pin from turning about the longitudinal axis thereof, and the pin during the opening operation of the roof hatch is situated in a wider section of the slot, allowing the pin to turn about the longitudinal axis thereof.

[0020] The present invention furthermore relates to an actuator assembly as such for opening a roof hatch which is hingedly connected to a fixed frame, the assembly comprising a lever arm having a first end for pivotally connection to the roof hatch and drive means to be arranged on the fixed frame for displacing a second end of the lever arm along a predetermined path substantially in the plane of the fixed frame so as to open the roof hatch. Preferred embodiments of the actuator assembly are discussed previously with reference to the roof ventilation device.

BRIEF DESCRIPTION OF THE DRAWING

[0021] An embodiment of the present invention is for illustrative purposes presented in the accompanying drawing, of which

Fig. 1 is an exploded, perspective view of an actuator assembly according to the present invention,

Fig. 2 is a perspective view of the actuator assembly of Fig. 1,

Fig. 3A is a side view of the roof ventilation device in a closed position thereof,

Fig. 3B shows a detail of the lever arm of the actuator assembly of Figs. 1 and 2 in the locked position,

Fig. 4A is a side view of the roof ventilation device in an open position thereof,

Fig. 4B shows a detail of the lever arm of the actuator assembly of Figs. 1 and 2 in the unlocked position,

Fig. 5 shows a perspective view of a roof ventilation device according to the present invention, in which a roof hatch is moved to an open position by means of two actuator assemblies of Figs. 1 and 2,

Fig. 6 is a detail of Fig. 5 showing one of the actuator assemblies, and

Fig. 7 is a perspective view of five frames for roof ventilation devices of Fig. 5 with the actuator assemblies of Figs. 1 and 2 mounted thereon, wherein the frames are stacked for transportation.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE PRESENT INVENTION

[0022] The embodiment of an actuator assembly according to the present invention shown in Figs. 1 and 2 comprises linear actuator with a motor housing 1 containing an electrical motor and gearing, which drives the rotation of a spindle accommodated in the spindle housing 2. The spindle is engaged by a nut, which together with the actuator slide 3 (shown in two parts in Fig. 1) is displaced along the spindle and the spindle housing 2 by rotation of the spindle. The connection between the nut and the actuator slide 3 extends through a not shown longitudinal slot provided in the longitudinal side of the spindle housing 2 that faces away from the viewer. The spindle housing 2 is hinged to a mounting 4 that is suited to be fastened to the fixed frame of the roof ventilation device. A slide bar 5 that is suited to be fastened to the fixed frame houses a hard nylon slide shoe 6 that can slide along the slide bar 4 and is connected to the actuator slide 3 by a pin 7 extending through a longitudinal slot 8 in the slide bar 4. A lever arm 9 is at a second end 10 thereof pivotally connected to the pin 7 and at a first end 11 thereof to a roof hatch mounting 12, which is suited to be fastened to the roof hatch. The lever arm 9 comprises a locking part 13 formed as an open slot for engaging with an end 14 of the slide bar 4 when the roof hatch is in the closed position, so as to hold the roof hatch down in close contact with the upper edge of the fixed frame.

[0023] Details of the locking part 13 and the engagement thereof with the slide bar 4 are shown in Fig. 3B, which together with Fig. 4B shows details of the connection between the first end 11 of the lever arm 9 and the roof hatch mounting 12.

[0024] A closed roof ventilation device with an actuator assembly of Fig. 1 mounted thereon is shown in a closed position thereof in Fig. 3A. The device comprises a fixed frame 15 for being fixed in the roof construction and a hatch comprising a transparent dome 16 of acrylic plastics and a hinged frame 17 fastened to the dome 16.

[0025] Details of the lever arm 9 and the locking thereof by means of the locking part 13 and the end 14 of the slide bar is shown in Fig. 3B, corresponding to the position of the roof hatch shown in Fig. 3A. The slot 18 between the locking part 13 and the body of the lever arm 9 provides for a certain elasticity of the locking part 13, so that it may obtain a good grip of the end 14 of the slide bar 8. The first end 11 of the lever arm 9 is pivotally connected to the roof hatch by means of a pin 19 fas-

tened to the roof hatch mounting 12 and having an elongated cross-section engaging a slot 20 formed so that the pin 19 in the closed position of the roof hatch, where the locking part 13 engages the holding part 14, is positioned in a narrower section of the slot 20 as shown in Fig. 3B, thereby preventing the pin 19 from turning about the longitudinal axis thereof, and the pin 19 during the opening operation of the roof hatch is situated in a wider section of the slot 20 as shown in Fig. 4B, allowing the pin 19 to turn about the longitudinal axis thereof. A locking pin 21 is passed through a hole in the pin 19 so as to secure the lever arm 9 to the pin 19.

[0026] Fig. 4A is a side view of the roof ventilation device in an open position thereof, in which the position of the hinges 22 between the frame 17 of the roof hatch and the fixed frame 15 is visible, and Fig. 4B shows a detail of the first end 11 of the lever arm 9 of the actuator assembly of in the unlocked position corresponding to Fig. 4A.

[0027] Fig. 5 shows a perspective view of a roof ventilation device according to the present invention, in which a roof hatch is moved to an open position by means of two actuator assemblies, and Fig. 6 is a detail of Fig. 5 showing one of the actuator assemblies.

[0028] Fig. 7 is a perspective view of five frames 15 for roof ventilation devices with the actuator assemblies mounted thereon, wherein the frames 15 are stacked directly on top of each other for transportation thereof. This close stacking without dismounting of the assemblies is made possible by the embodiment of the actuator assemblies according to the present invention.

Claims

1. A roof ventilation device comprising a fixed frame (15), a roof hatch (16, 17) which is hingedly connected to the fixed frame (15) and an actuator assembly for opening the roof hatch, the actuator assembly comprising a lever arm (9) which at a first end (11) is pivotally connected to the roof hatch, **characterised in that** the actuator assembly comprises drive means (1, 2, 3) arranged on the fixed frame (15) for displacing a second end (10) of the lever arm (9) along a predetermined path substantially in the plane of the fixed frame (15) so as to open the roof hatch.
2. A device according to claim 1, wherein the second end (10) of the lever arm (9) is connected to a slide (6) that runs along a guide (5) therefore fastened to the fixed frame (15), which guide (5) defines the predetermined path.
3. A device according to claim 2, wherein the drive means comprises a linear actuator (1, 2, 3), which at a first end (3, 7) is connected to the slide (6) and at a second end is hinged to the fixed frame (15).
4. A device according to claim 3, wherein the linear actuator is a spindle actuator of which a nut is connected to the slide (6).
5. A device according to any of the preceding claims, wherein the lever arm (9) in a closed position of the roof hatch (16, 17) is arranged to extend at an angle to horizontal within the range of 8 - 30°, such as within the range of 12 - 24°, and preferably within the range of 15 - 19°, so that the first end (11) of the lever arm (9) is arranged at a higher position than the second end (10) thereof.
6. A device according to any of the preceding claims, wherein said predetermined path extends at an angle to horizontal within the range of 8 - 30°, such as within the range of 12 - 24°, and preferably within the range of 15 - 19°, so that the second end (10) of the lever arm (9) is arranged at a higher position at an open position of the roof hatch (16, 17) than at a closed position thereof.
7. A device according to any of the preceding claims, wherein the predetermined path extends at substantially the same angle to horizontal as the lever arm (9) in a closed position of the roof hatch (16, 17).
8. A device according to any of the preceding claims, wherein the lever arm (9) comprises a locking part (13) for engaging a corresponding holding part (14) arranged on the fixed frame (15) to thereby exercises a downward holding force on the roof hatch (16, 17), the locking part (13) is arranged to engage the holding part (14) when the roof hatch is shifted from an open position to a closed position thereof and to disengage from the holding part when the roof hatch is shifted from the closed position to the open position thereof.
9. A device according to claim 8, wherein the pivotal connection between the lever arm (9) and the roof hatch (16, 17) is adapted to allow for a translation of the lever arm (9) in the longitudinal direction thereof during engagement and disengagement of the locking part (13) and the holding part (14).
10. A device according to claim 9, wherein the first end of the lever arm (9) is pivotally connected to the roof hatch (16, 17) by means of a pin (19) having an elongated cross-section engaging a slot (20) formed so that the pin (19) in the closed position of the roof hatch, where the locking part (13) engages the holding part (14), is positioned in a narrower section of the slot (20), thereby preventing the pin (19) from turning about the longitudinal axis thereof, and the pin during the opening operation of the roof hatch is situated in a wider section of the slot, al-

lowing the pin to turn about the longitudinal axis thereof.

11. An actuator assembly for opening a roof hatch (16, 17) which is hingedly connected to a fixed frame (15), the assembly comprising a lever arm (9) having a first end (11) for pivotally connection to the roof hatch,
characterised in that
the actuator assembly comprises drive means (1, 2, 3) to be arranged on the fixed frame (15) for displacing a second end (10) of the lever arm (9) along a predetermined path substantially in the plane of the fixed frame (15) so as to open the roof hatch.
12. An assembly according to claim 11, wherein the second end (10) of the lever arm (9) is connected to a slide (6) that runs along a guide (5) therefore to be fixedly arranged on the fixed frame (15), which guide (5) defines the predetermined path.
13. An assembly according to claim 12, wherein the drive means comprises a linear actuator (1, 2, 3), which at a first end (3, 7) is connected to the slide (6) and at a second end is adapted to be hinged to the fixed frame (15).
14. An assembly according to claim 13, wherein the linear actuator is a spindle actuator of which a nut is connected to the slide (6).
15. An assembly according to any of claims 11-14, wherein the slide bar (5) extends substantially parallel to the lever arm (9) in a closed position of the roof hatch (16, 17).
16. An assembly according to any of claims 11-15, wherein the lever arm (9) comprises a locking part (13) for engaging a corresponding holding part (14) arranged on the fixed frame (15) to thereby exercises a downward holding force on the roof hatch (16, 17), the locking part (13) is arranged to engage the holding part (14) when the roof hatch is shifted from an open position to a closed position thereof and to disengage from the holding part when the roof hatch is shifted from the closed position to the open position thereof.
17. An assembly according to claim 16, wherein the pivotal connection between the lever arm (9) and the roof hatch (16, 17) is adapted to allow for a translation of the lever arm (9) in the longitudinal direction thereof during engagement and disengagement of the locking part (13) and the holding part (14).
18. An assembly according to claim 17, wherein the first end of the lever arm (9) is arranged to be pivotally connected to the roof hatch (16, 17) by means of a

pin (19) having an elongated cross-section engaging a slot (20) formed so that the pin (19) in the closed position of the roof hatch (16, 17), where the locking part (13) engages the holding part (14), is positioned in a narrower section of the slot (20), thereby preventing the pin (19) from turning about the longitudinal axis thereof, and the pin (19) during the opening operation of the roof hatch is situated in a wider section of the slot, allowing the pin to turn about the longitudinal axis thereof.

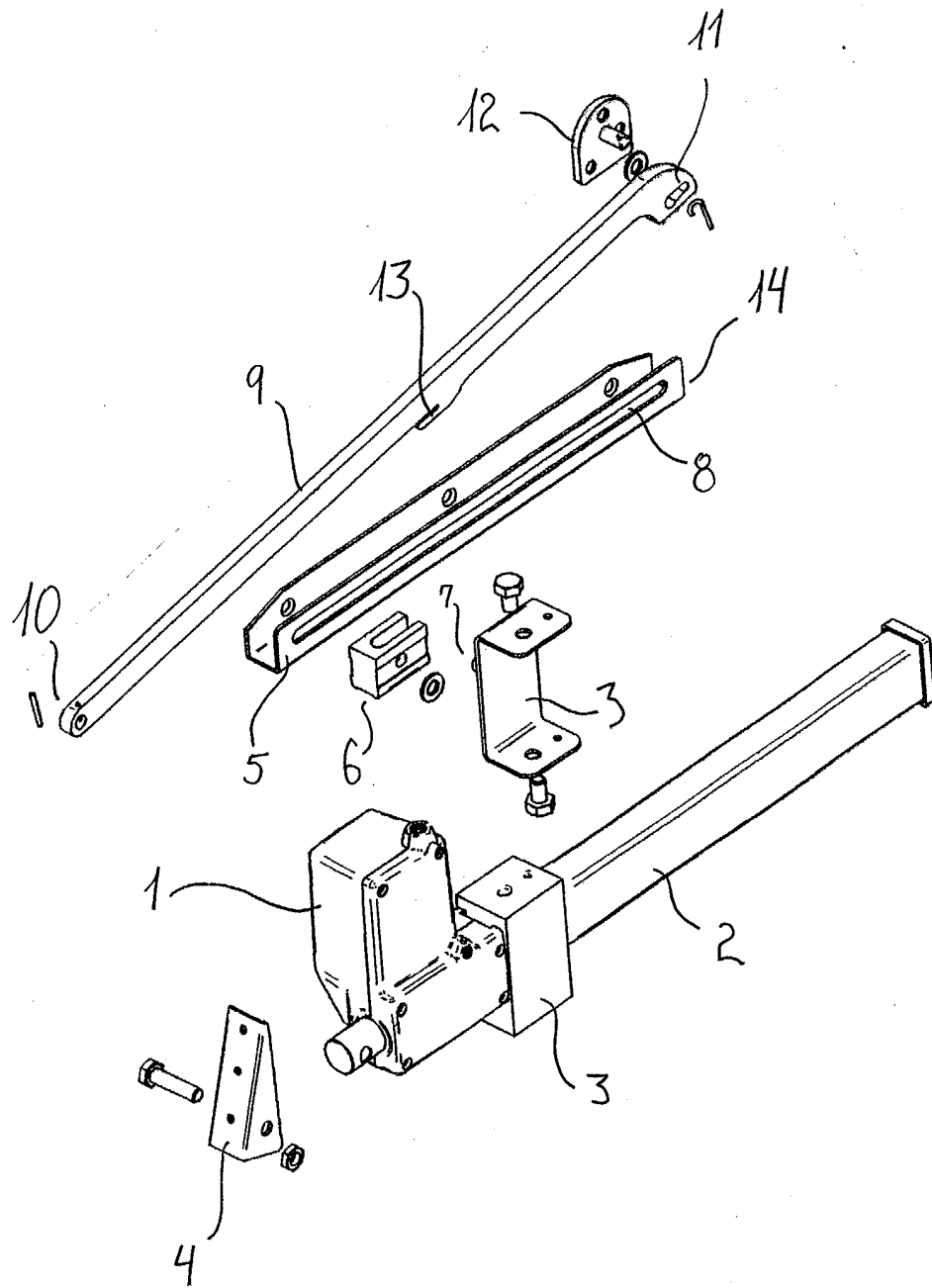


Fig. 1

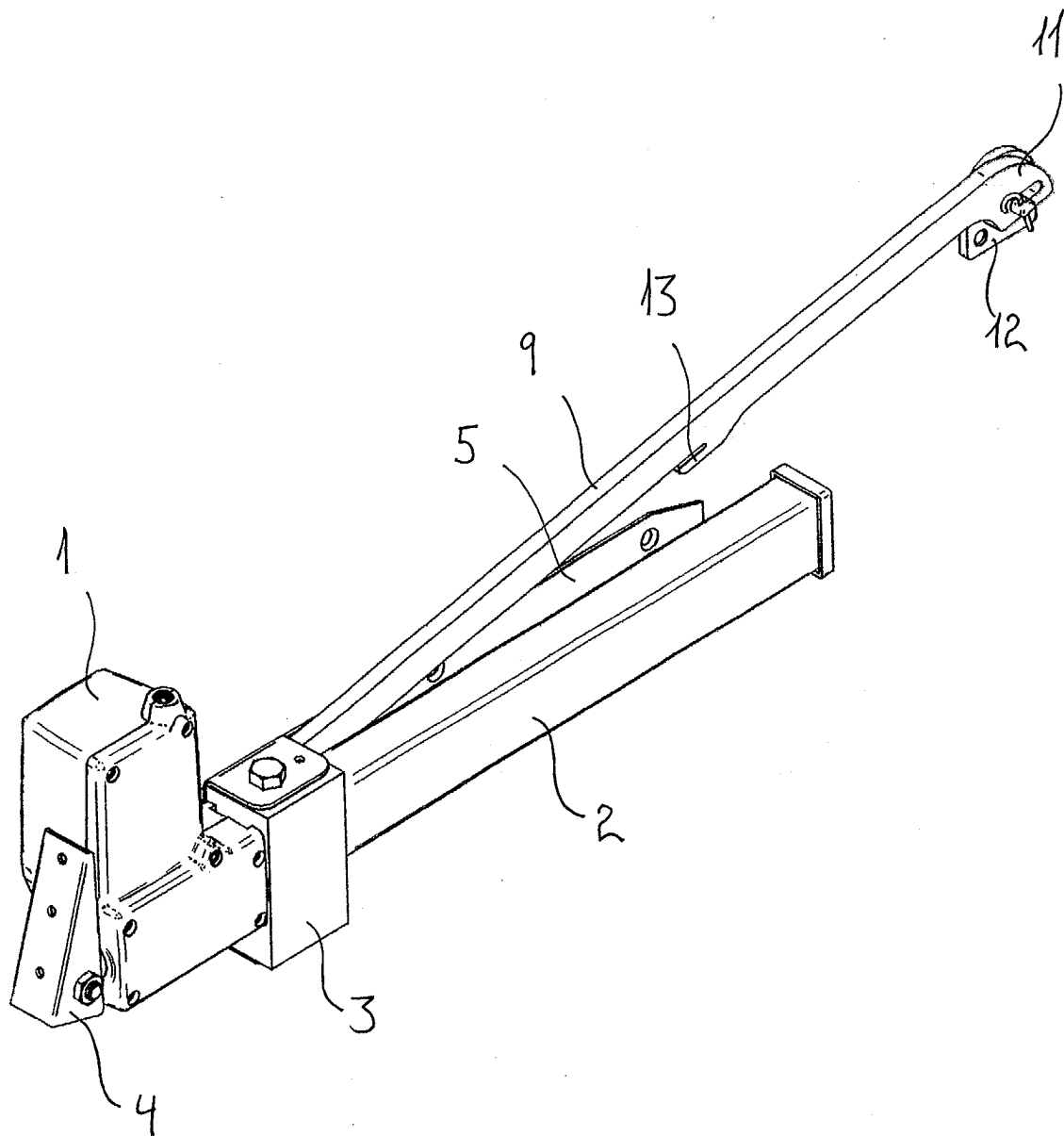


Fig. 2

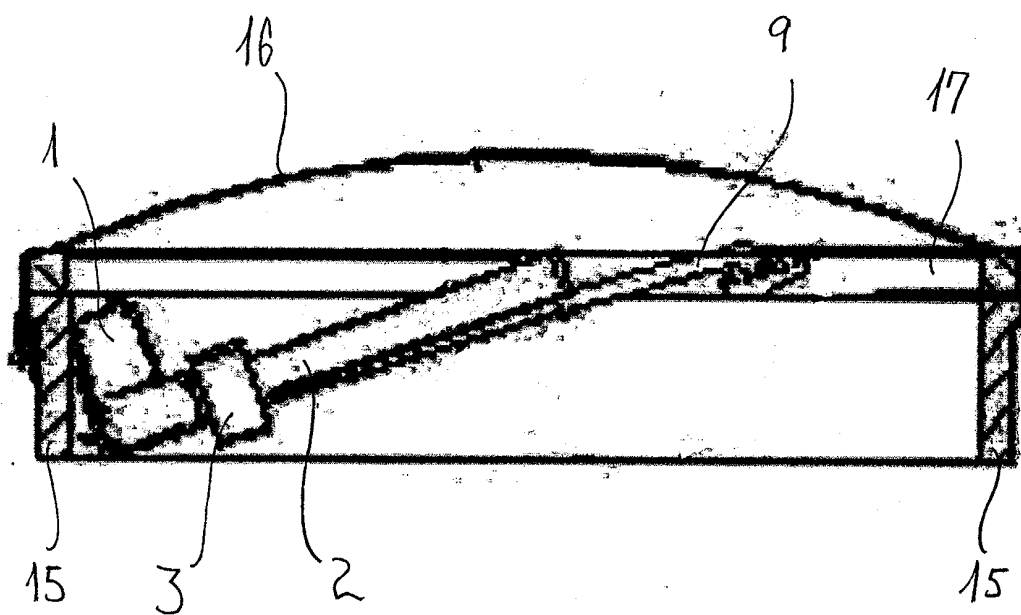


Fig. 3A

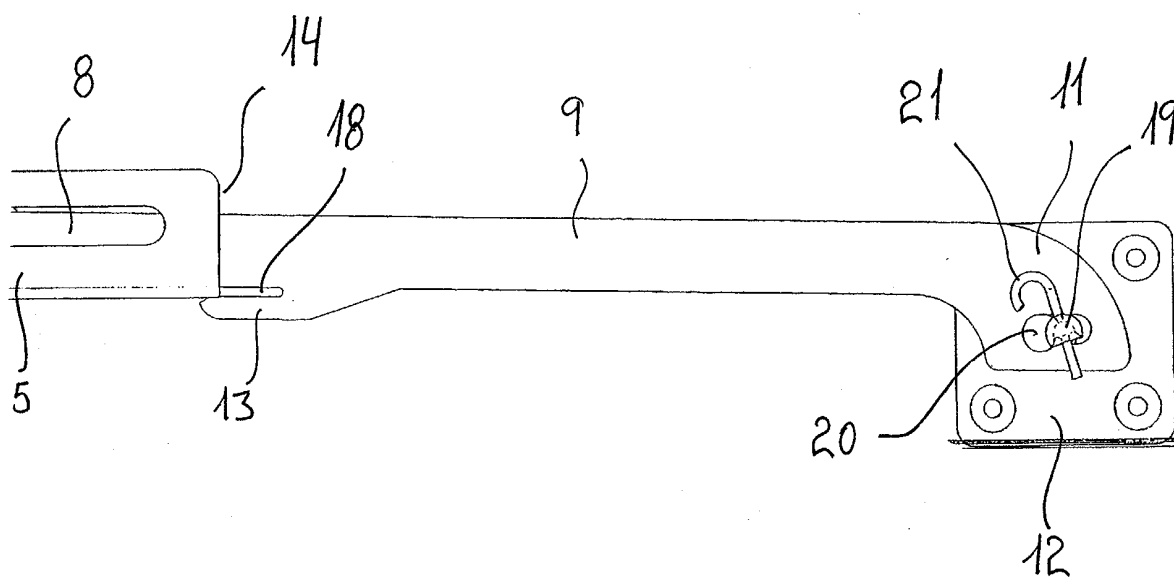


Fig. 3B

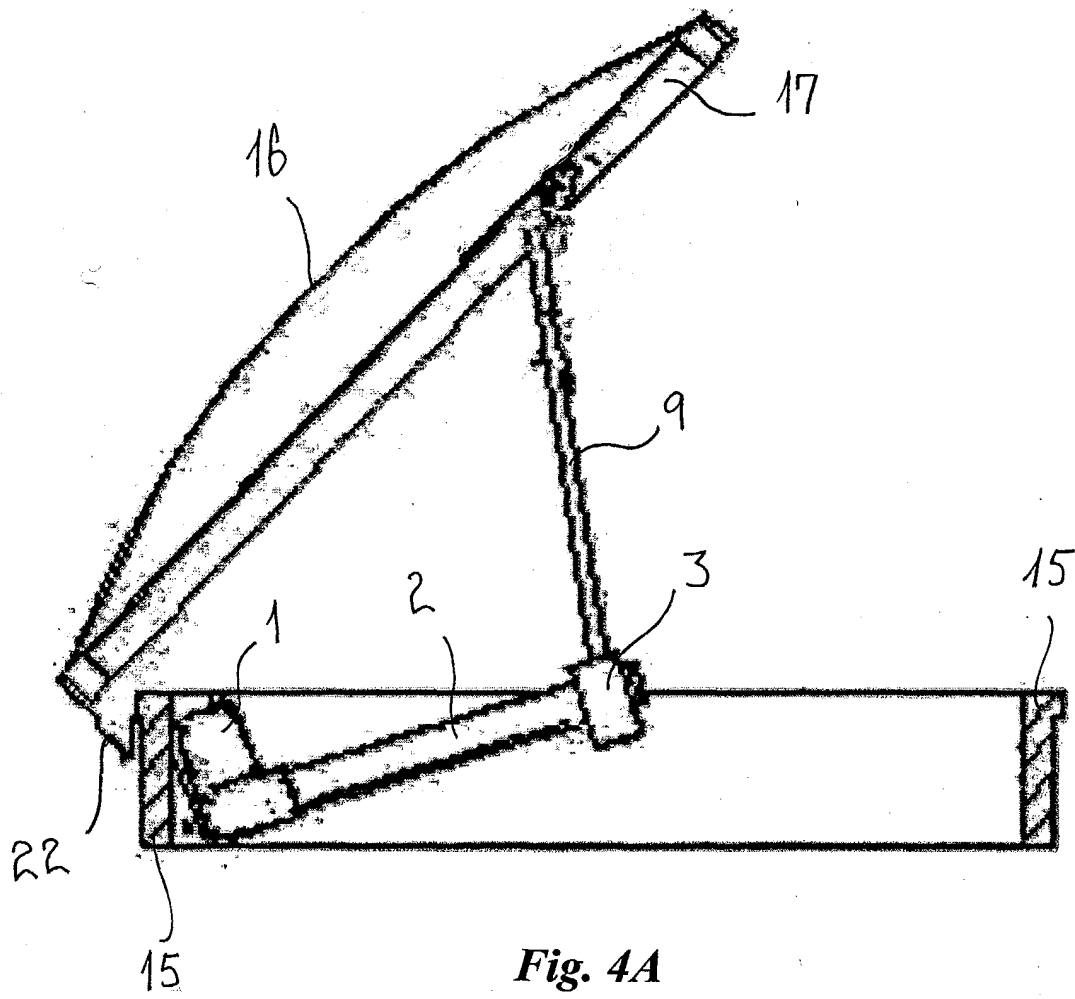


Fig. 4A

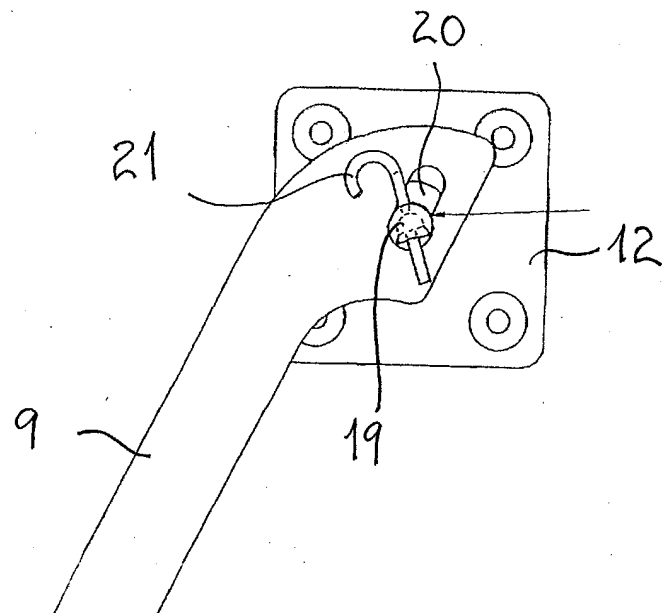


Fig. 4B

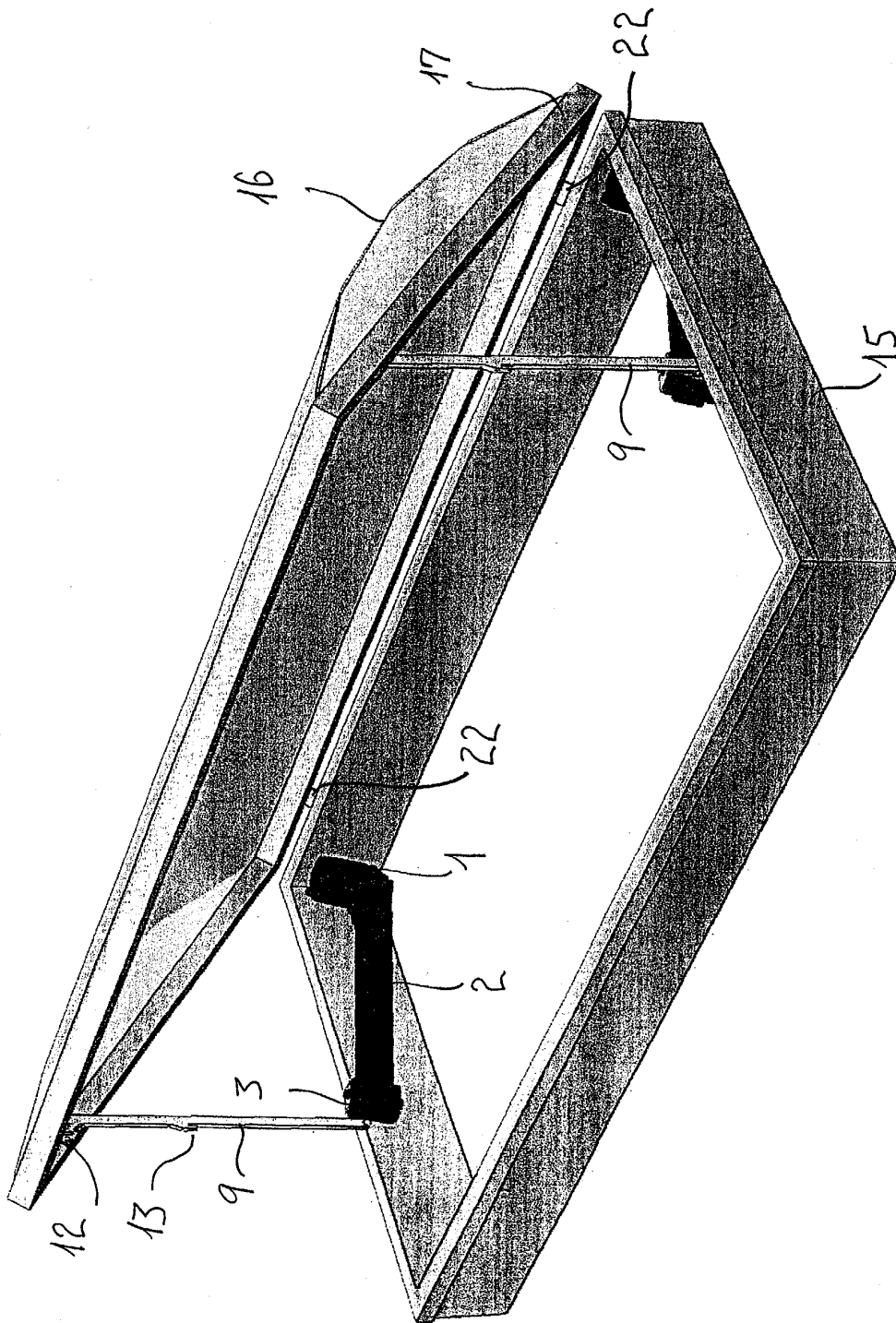


Fig. 5

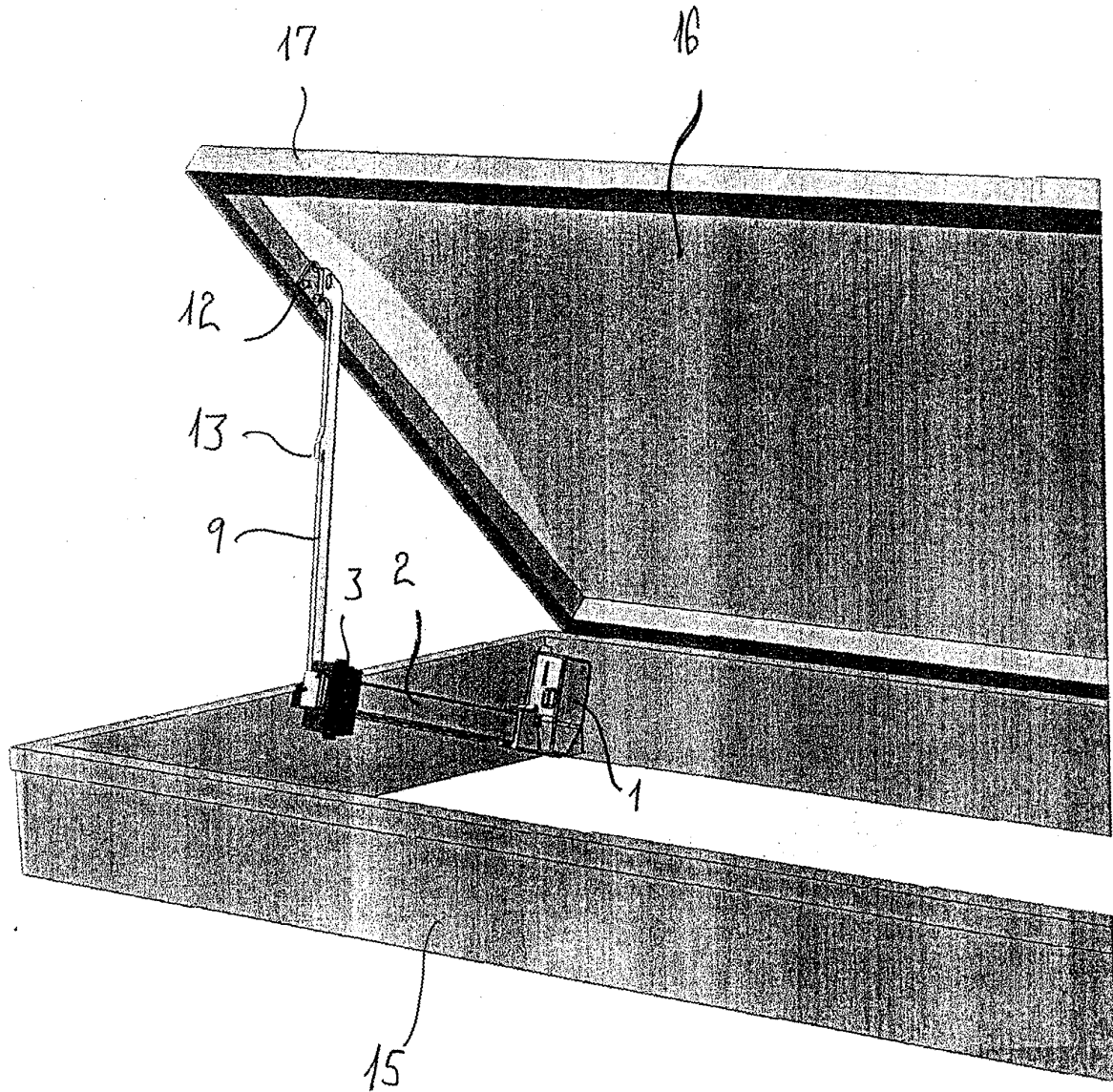


Fig. 6

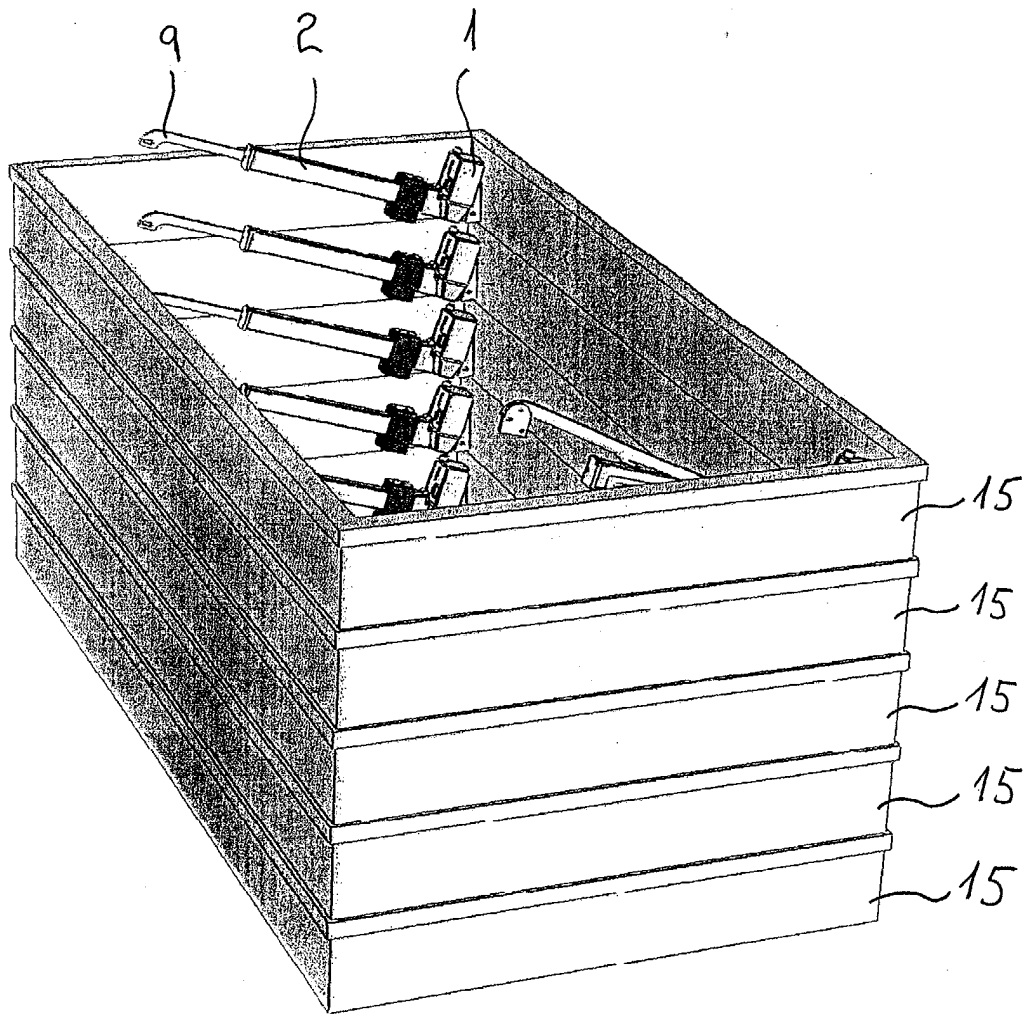


Fig. 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 07 9011

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 710 759 A (HAUTAU GMBH W) 8 May 1996 (1996-05-08) * column 1, line 3 - line 11 * * column 5, line 56 - column 7, line 9 * * column 8, line 25 - column 9, line 15; figures 1,1A,5,5A * ---	1-7, 11-15	E05F15/12 E04D13/035
X	DE 42 45 017 C (HAUTAU GMBH W) 24 October 2002 (2002-10-24) * column 2, line 8 - line 21 * * column 2, line 50 - column 3, line 2 * * column 3, line 8 - line 29; figure 5 * ---	11-15	
X	EP 0 291 468 A (SAIP COMPONENTI S P A) 17 November 1988 (1988-11-17) * column 2, line 63 - column 3, line 33; figure 4 * -----	1,2,5, 7-9,11, 12,16,17 10,18	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 June 2004	Examiner Guillaume, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 07 9011

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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02-06-2004

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