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(54) SMOKE AND HEAT EXHAUST VENTILATION SYSTEM

(57) The invention is a smoke and heat exhaust ventilation system (1) comprising: a base (2) delimited by a counter frame (3) and arranged peripherally with respect to a through opening (4) made in the structure of a building and placing one or more rooms in communication with the external environment; a cover (5) delimited by a frame (6) and associated with the counter frame (3) of the base (2) by means of hinges (7) suited to allow the cover (5) to rotate to open and close the through opening (4); rotation means (10) suited to rotate the cover (5) and comprising a linear electric actuator (11) and an articulation unit (14) operatively connected to the linear electric actuator (11). The articulation unit (14) comprises a connecting rod (18) which connects the head (16) of the stem (12) of the actuator (11) to the frame (6) of the cover (5).

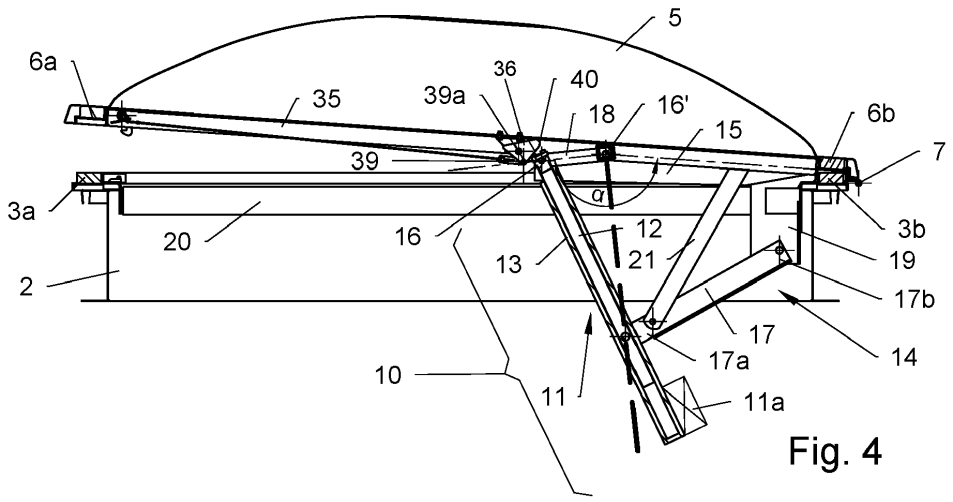

Fig. 4

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Description

[0001] The invention concerns a smoke and heat exhaust ventilation system suited to be installed in buildings for the purpose of evacuating smoke and heat from the rooms in case of fire.

[0002] A smoke and heat exhaust ventilation system, which here below will be simply referred to as "ventilation system" for the sake of description simplicity, substantially comprises a cover, perimetrically delimited by a frame and made of a metallic or non-metallic material, which is connected to a counter frame by means of hinges, wherein said counter frame perimetrically delimits a base. The base, which is also preferably made of a metallic material, delimits the perimeter of a through opening made in the structure of a building and communicating with the external environment.

[0003] The installation of ventilation systems in buildings is required by the safety regulations in force, according to which, furthermore, in case of fire the cover must open automatically and within a predetermined lapse of time.

[0004] According to the known art, the cover is usually arranged in the closed position with the frame facing and resting against the counter frame of the base and is mechanically connected to moving means comprising one or more connecting mechanisms and a gas-operated actuator which, in case of fire, is fed with pressurized carbon dioxide (CO_2) to open the cover almost instantaneously. More specifically, carbon dioxide is contained in a small cylinder whose dispenser mouth is connected to the feeding way of the pneumatic actuator and sealed by means of a breakable membrane.

[0005] When special sensors installed in the room detect the presence of smoke or a temperature increase exceeding a pre-established threshold, a suitable actuator perforates the membrane so that the carbon dioxide flows out of the small cylinder towards the gas-operated actuator, causing the cover to open. According to an embodiment known in the art, the membrane is perforated by an actuator that is activated by an explosive micro charge which is primed by the Joule effect of a remotely powered electric resistor.

[0006] According to another embodiment, also belonging to the known art, the membrane is perforated by an actuator that is activated by preloaded elastic means when the latter are released following the breakage of a heat sensitive vial.

[0007] Both of the known embodiments mentioned above, however, have some recognized drawbacks that are briefly listed here below.

[0008] The embodiment using an explosive micro charge has the drawback that in some cases the opening of the cover of the ventilation system can take place in a completely accidental manner.

[0009] In fact, the electric device that triggers the explosive micro charge is highly sensitive to atmospheric discharges, induced currents and radio frequency interference present in the environment, and in some circumstances this may cause the ignition of the explosive micro charge and thus the undesired opening of the cover of the ventilation system.

[0010] Another drawback is constituted by the fact that in order to periodically check the efficiency of the cover opening device of each ventilation system it is necessary to detonate an explosive micro charge or to intentionally destroy a heat sensitive vial.

[0011] Since the cost of the maintenance technician entrusted with this task must be added to the cost of the explosive micro charges and of the heat sensitive vials, it can be understood that each periodic efficiency check is expensive, especially if a large number of ventilation systems is installed in the building.

[0012] A further drawback is due to the fact that, after each periodic efficiency check, the operators must reach each ventilation system, usually installed on the roof of the building and thus in a position which is uncomfortable to reach, to replace the explosive micro charges or the heat sensitive vials.

[0013] Another and yet not the least drawback also lies in that, every time the user needs to open the cover intentionally, he has to proceed manually or through an automatic activation, which involves the destruction of an explosive micro charge or of a heat sensitive vial with the respective CO_2 or nitrogen cylinders. In the case of opening devices using heat sensitive vials, in order to avoid the need to make the explosive micro charge explode whenever the cover of the ventilation system is opened intentionally, suitable electromechanical solenoid means have been devised which are installed in each ventilation system and allow the operator to reset it after the opening of the cover of the ventilation system.

[0014] The devices of this type have high costs for the implementation of the system, to which the cost for the work of the maintenance technician must in any case be added.

[0015] Notwithstanding the limitations and the drawbacks listed above, all the opening devices of the ventilation systems described above have, however, the advantage of being extremely reliable as they guarantee with almost absolute certainty that the cover of the skylights will open in case of fire.

[0016] However, according to the present state of the art in the sector, most manufacturers tend to replace the gas-operated actuators fed with pressurized CO_2 or nitrogen with linear electric actuators, wherein each actuator comprises an extendable stem that is set moving by kinematic mechanisms associated with an electric motor.

[0017] The use of linear electric actuators instead of gas-operated actuators fed with CO_2 or nitrogen requires that the electric motors that activate the actuators be powered at a low voltage with batteries connected to the electric power supply line in buffer mode.

[0018] It can be understood that the manufacturers of ventilation systems prefer to use linear electric actuators of the type mentioned above, considering that using them

instead of gas-operated actuators fed with pressurized CO_2 allows the ventilation systems to be constructed in a simpler manner as wells as a simplification of the entire system, since it is only necessary to provide an electric power supply line for the electric motors that set the stems of the actuators in motion.

[0019] In the known embodiments of ventilation systems using linear electric actuators, the end of the stem is directly connected to the frame of the cover, and this leads to the drawback that the manufacturer needs to use actuators where the stroke of the stem is longer, which means having stems whose length and cost increase as the size of the cover, measured according to the thrust direction of the actuator, increases.

[0020] Furthermore, the need to use actuators with stems having increasing lengths means that the manufacturer cannot standardize the electric actuators to be used, limiting the number of the latter.

[0021] The present invention intends to overcome all the drawbacks mentioned above by providing a ventilation system that uses a single linear electric actuator whose stem has just one length and one stroke, independently of the size of the cover measured according to the thrust direction of the actuator.

[0022] The object is achieved through the provision of the improved smoke and heat exhaust ventilation system carried out according to the main claim, to which reference is made.

[0023] Other characteristics of the invention are described in the dependent claims.

[0024] Advantageously, the ventilation system with electric actuator that is the subject of the invention makes it possible to use linear electric actuators having shorter and thus less expensive stems compared to the linear electric actuators that are applied to ventilation systems of the known art having the same size.

[0025] Still advantageously, the invention makes it possible to standardize the device designed to move the cover of the ventilation systems by using a single electric actuator whose stem has just one length and one stroke for all the sizes of covers.

[0026] This also results in the further advantage that it is possible to unify all the types and sizes of the iron and steel elements connecting the electric actuator and the lever mechanisms that open and close the cover and the other elements making up the ventilation system.

[0027] The objects and advantages listed above are highlighted in greater detail in the description of a preferred embodiment of the invention, which is provided here below, by way of non-limiting example, making reference to the attached drawings, wherein:

- Figure 1 shows an axonometric view of the smoke and heat exhaust ventilation system that is the subject of the invention in the open position;
- Figures 1a and 1b show two enlarged details of Figure 1;
- Figure 2 shows a front view of the ventilation system of Figure 1 arranged in the closed position;
- Figure 3 shows a side view of the ventilation system of Figure 1 arranged in the closed position;
- Figure 3a shows an enlarged detail of Figure 3;
- Figure 4 shows the ventilation system of Figure 3 in a slightly open position;
- Figures from 5 to 9 show the ventilation system of the invention in different open positions;
- Figure 10 shows a front axonometric view of the ventilation system of the invention in a partially open position;
- Figures 10a and 10b show two enlarged details of Figure 10.

[0028] An overview of the smoke and heat exhaust ventilation system of the invention is shown in Figures from 1 to 10, where it is indicated as a whole by 1. Furthermore, Figures 1a, 1b, 3a, 10a, 10b represent enlarged details of the ventilation system shown in the overall views of Figures from 1 to 10.

[0029] With particular reference to Figure 1, it can be observed that the smoke and heat exhaust ventilation system **1,** which here below is referred to just with the term "ventilation system **1"** for the sake of description simplicity, comprises a base **2** delimited by a counter frame **3** and arranged on the periphery of a through opening **4** made in the structure of a building and a cover **5** delimited by a frame **6** associated with the counter frame **3** of the base **2** by means of hinges **7.**

[0030] The through opening **4** places one or more rooms of the building in communication with the external environment and in case of fire the hinges **7** allow the cover **5** to rotate and open so that smoke and heat can be let out.

[0031] For this purpose, the ventilation system **1** is provided with rotation means **10** suited to rotate the cover **5,** which can be observed in particular in Figure 2 and in the successive Figures from 3 to 10, and which comprise a linear electric actuator **11,** here below referred to just with the term "actuator **11"** for the sake of description simplicity, having a power unit **11a** which sets a stem **12** moving linearly inside a cylinder **13.**

[0032] The rotation means **10** comprise also an articulation unit **14** operatively connected to the actuator **11** and comprising at least one first rod **15** visible in particular in Figures from 3 to 9 and connecting the head **16** of the stem **12** of the actuator **11** to the counter frame **3** of the base **2** and at least one second rod **17** connecting the cylinder **13** to the counter frame **3** of the base **2.**

[0033] Preferably but not necessarily, in order to guarantee good stability during the movement, in the embodiment of the articulation unit **14** described herein there are two first rods **15** placed side by side and parallel to each other and two second rods **17** also placed side by side and parallel to each other.

[0034] According to the invention, the articulation unit **14** comprises also at least one connecting rod **18** that connects the head **16** of the stem **12** to the frame **6** of

the cover **5.**

[0035] In order to guarantee good stability during movement two connecting rods **18** are provided, placed side by side and parallel to each other.

[0036] More specifically, it can be observed that each connecting rod **18** has the first end **18a** hinged to the head **16** of the stem **12** of the actuator **11** and the second end **18b** hinged to the crosspiece **22** of the cover **5,** which is included and fixed between two opposite sides **6a, 6b** of the frame **6** that delimits the cover **5** peripherally.

[0037] Regarding the first rods **15** and the second rods **17,** it can be observed that each first rod **15** has the first end **15a** hinged to the head **16** of the stem **12** of the actuator **11,** while each second rod **17** has the first end **17a** hinged to the cylinder **13.**

[0038] Furthermore, the second end **15b** of each first rod **15** and the second end **17b** of each second rod **17** are both connected to the counter frame **3** as they are hinged to a supporting bracket **19** that belongs to the crosspiece **20** of the counter frame **3,** which is included between and fixed to the ends of two opposite sides **3a, 3b** of the counter frame **3** of the base **2.**

[0039] It can also be observed that the second end **15b** of each first rod **15** e the second end **17b** of each second rod **17** are hinged to distinct points of the supporting bracket **19.**

[0040] More specifically, the second end **17b** of each second rod **17** is arranged within the area perimetrically delimited by the base **2** and located below the plane **X** defined by the upper surface **3c** of the counter frame **3** and the second end **15b** of each first rod **15** is located above said plane **X** defined by the upper surface **3c** of the counter frame **3.**

[0041] Furthermore, the second end **15b** of each first rod **15** and the second end **17b** of each second rod **17** are aligned according to a direction **Z** that is inclined with respect to a vertical direction and incident on the plane **X** defined by the upper surface **3c** of the counter frame **3.**

[0042] Finally, it can be observed that the articulation unit **14** also comprises at least one third rod **21,** in the embodiment described herein two third rods **21** placed sided by side and parallel to each other, each of which connects a first rod **15** and a second rod **17** corresponding to it, and in each third rod **21** it is possible to identify a first end **21a** hinged to an intermediate area of the first rod **15** and a second end **21b** hinged to an intermediate area of the second rod **17.**

[0043] In this way, the actuator **11** and the articulation unit **14** are kinematically connected to each other, and when the actuator **11** is operated they cooperate with each other to rotate the cover **5,** as illustrated below with reference to the figures.

[0044] The ventilation system **1** comprises also coupling means **30** which are configured in such a way as to lock the cover **5** onto the counter frame **3** when the linear electric actuator **11** is in the rest condition and the frame **6,** which delimits the cover **5,** is arranged so that it faces and is in contact with the counter frame **3** of the base **2,** as shown in Figure 3.

[0045] Furthermore, the coupling means **30** are configured to be also able to open the cover **5** after it has been released from the counter frame **3,** which takes place automatically when the actuator **11** is activated, as described in greater detail below.

[0046] It can be observed that the coupling means **30** comprise a revolving rod **31,** visible also in the detail Figure 1b, associated with the cover **5** through supporting means, not indicated in the figures and supported by the frame **6,** to which rod one or more hook-shaped coupling elements **33** are fixed and thus rotate rigidly with the revolving rod **31** when it is set rotating according to its longitudinal axis.

[0047] In the particular embodiment described herein, and as shown in Figures 1 and 10, the hook-shaped coupling elements **33** are three and two of them are arranged at the ends of the revolving rod **31,** while one of them, instead, is arranged in an intermediate position on the revolving rod **31** itself, as shown in Figure 1b.

[0048] In another embodiment, the hook-shaped coupling elements **33** can be present in any number and be arranged in any position along the revolving rod **31.** Hook-shaped coupling counter elements **34** are also provided, which belong to the counter frame **3** of the base **2** and are configured to cooperate with the hook-shaped coupling elements **33.**

[0049] Finally, there is a tie rod **35** which connects the rod **31** to a manoeuvring lever **36** associated with the cover **5** and visible in Figure 1a, which is configured to activate the tie rod **35** and release the hook-shaped coupling elements **33** from the hook-shaped coupling counter elements **34** when the thrusting action of the head **16** of the stem **12** of the actuator **11** acts on the manoeuvring lever **36** and makes it rotate, as can be observed in Figure 4.

[0050] In fact, as clearly shown in Figure 1a, the manoeuvring lever **36** is revolvingly associated with the cover **5** through a rotation pin **39a** which constrains it to a fixed support **42** fixed to the crosspiece **22** of the cover **5** itself.

[0051] Furthermore, the manoeuvring lever **36** is provided with a reference plane **40** suited to come into contact with the head **16** of the stem **12** of the actuator **11,** as can be observed in particular in Figure 4.

[0052] It can also be observed, in particular in Figures from 3 to 9 and in the detail Figure 1b, that the tie rod **35** has the first end **35a** fixed to a projecting coupling element **37** belonging to the revolving rod **31** and the second end **35b** fixed to the manoeuvring lever **36** through a fork **38** and a pin **39** passing therethrough. The ends of the tie rod **35** can be connected to the revolving rod **31** and to the manoeuvring lever **36** even through means that are different from those described.

[0053] When the cover **5** is in the closed position, as shown in Figure 3, if the head **16** of the stem **12** of the actuator **11** counteracts the reference plane **40** of the manoeuvring lever **36,** the thrusting action produced by

the actuator **11** generates, with respect to the rotation pin **39a,** a torque which causes the rotation of the manoeuvring lever **36** around the rotation pin **39a** and places the tie rod **35** under traction.

[0054] The traction of the tie rod **35** in turn causes the rotation of the rod **31** around its longitudinal axis and of the hook-shaped coupling elements **33** connected to it, which release the respective hook-shaped coupling counter elements **34,** thus allowing the opening of the cover **5** to start, as shown in Figure 4.

[0055] The revolving rod **31** is also associated with elastic means **41** visible in particular in Figure 1b, which are configured to make the rotation of the revolving rod **31** elastic, so that the hook-shaped coupling elements **33** spontaneously snap on the hook-shaped coupling counter elements **34** when the manoeuvring lever **36** is free from contact with the head **16** of the stem **12** of the actuator **11** and the frame **6** of the cover **5** is lowered so that it faces and rests against the counter frame **3** of the base **2,** in the position which can be observed in Figure 3.

[0056] Preferably but not necessarily, the elastic means **41** comprise a cylindrical spring **41a** wound externally on the revolving rod **31** and having one end fixed to the same revolving rod **31** and the opposite end in contact with the crosspiece **22** of the cover **5.**

[0057] It can be observed, in particular in Figures 1, 1a, 1b and 10, that the elastic means **41,** the tie rod **35** and the manoeuvring lever **36** are associated with the cover **5,** being arranged on and connected to the crosspiece **22** included between two opposite sides **6a, 6b** of the frame **6** which delimits the cover **5** peripherally.

[0058] From an operational point of view, with reference to Figure 3 showing the side sectional view of the ventilation system **1** with the cover **5** arranged in the closed position, it can be observed that the head **16** of the stem **12** of the actuator **11** is spaced from the reference plane **40** of the manoeuvring lever **36** and the hook-shaped coupling elements **33** are coupled with the respective hook-shaped coupling counter elements **34,** as shown in Figure 3a, and are maintained in the coupled position by the elastic torsion exerted by the cylindrical spring **41a** on the revolving rod **31.**

[0059] In this configuration the cover **5** is and remains permanently closed.

[0060] If the actuator **11** is activated, when the head **16** of its stem **12** comes into contact with the reference plane **40** of the manoeuvring lever **36,** the latter rotates around the rotation pin **39a** and places the tie rod **35** under traction.

[0061] The traction applied to the tie rod **35** overcomes the elastic force of the cylindrical spring **41a** and causes the rotation of the revolving rod **31,** which separates the hook-shaped coupling elements **33** from the corresponding hook-shaped coupling counter elements **34** and causes the cover **5** to start opening.

[0062] From this moment, the cover **5,** which is not coupled with the counter frame **3** any longer, can be opened through the movement of the stem **12** of the actuator **11,** passing through all the configurations shown in Figures from 4 to 8 until reaching the configuration of maximum opening, which corresponds to an angle of approximately 158° and is shown in Figure 9.

[0063] It should be noticed that when the stem **12** is withdrawn from the cylinder **13,** the length of the actuator **11** increases and the articulation unit **14** makes the actuator **11** rotate clockwise so that it progressively assumes all the different positions shown in Figures from 3 to 9.

[0064] During these movements, the head **16** of the stem **12** of the actuator **11** axially compresses the connecting rod **18** which, being rigid and indeformable and forming an angle α**,** always smaller than a straight angle, with the crosspiece **22** of the cover **5,** starting from the configuration represented in Figure 3 is forced to rotate rigidly counter clockwise, thus moving its second end **18b** upwards until reaching the configuration shown in Figure 7, in which the cover **5** is open in a position that is substantially orthogonal to the base **2.**

[0065] In this way, the second end **18b** of the connecting rod **18,** being connected to the crosspiece **22,** exerts a thrusting action on the cover **5,** lifting it due to the rotation around the hinges **7.**

[0066] In addition to the operational description provided above, in order to illustrate the invention correctly and to show that the set objects of the invention have been achieved, reference is made to Figures from 5 to 9, which illustrate how the stem **12** of the actuator **11** is lengthened as a result of different opening angles of the cover **5.**

[0067] In particular, Figures from 5 to 9 compare, for some identical opening angles of the cover **5,** the lengthening **C** of the stem **12** in the case of the invention, in which its head **16** is connected to the crosspiece **22** through the connecting rod **18,** with the lengthening **C'** that would result if the stem of the actuator, schematically represented with a thick broken line, had the head **16'** directly connected to the crosspiece **22,** as is the case in the ventilation systems known in the art.

[0068] Substantially, in Figures from 5 to 9 it is shown a comparison between the values of the lenghtening **C** and **C',** respectively in the case of the invention, in which the head **16** of the stem **12** is connected to the crosspiece **22** through the connecting rod **18,** and in the case of the known art, indicated with a thick broken line, in which the head **16** of the stem **12** is directly connected to the crosspiece **22.**

[0069] Switching from the configuration represented in Figure 5, which corresponds to an opening angle of the cover **5** of approximately 45° and in which the lenghtening **C** and **C'** of the stems are substantially equal to each other, to the configuration shown in Figure 6 and to the final configuration of maximum opening, equal to approximately 158°, it can be observed that the lengthening **C'** continues to increase considerably with respect to the lengthening **C.**

[0070] This proves that if the head **16'** of the stem of the actuator were directly connected to the crosspiece

22 of the cover **5,** it would be necessary to use an actuator with a longer stem and thus a larger size, and consequently more expensive than that used in the ventilation system **1** of the invention. However, it is essential to take into consideration also the presence of the third rod **21** which connects the first rod **15** and the second rod **17** together.

[0071] In fact, it can be observed in the figures that the lengthening of the stem **12** of the actuator **11** causes the first rod **15** and the second rod **17** to rotate clockwise, as the third rod **21** that connects them makes both of them rotate clockwise with respect to the respective second end **15b** and second end **17b.** In this way, the rotation of the second rod **17** causes the progressive lifting of the actuator **11,** which on the contrary in the absence of the third rod **21** would not be lifted, with respect to the initial position of Figure 3 when the cover **5** is closed.

[0072] Therefore, to obtain the openings shown in Figures from 4 to 9 it would be necessary to use an actuator having an extremely longer and thus more cumbersome, and above all more expensive stem compared to that which, instead, can be used in the ventilation system **1** of the invention thanks to the presence of the third rod **21.**

[0073] Thus, in the ventilation system **1** of the invention the connecting rod **18** and the third rod **21** operatively interact during the stroke of the stem **12** of the actuator **11** and produce a synergy which, in comparison with the known art and given the same opening angles of the covers, makes it possible to considerably reduce the stroke of the stem of the actuator being used.

[0074] Consequently, it is possible to use smaller, less cumbersome, and also less expensive actuators, thus achieving the object of the invention.

[0075] It is also important to note that the articulation unit **14** is sized in such a way that when the cover **5** is opened by an angle of approximately 45°, as shown in Figure 5, the second rod **17** is arranged in a substantially horizontal direction and the actuator **11,** instead, is arranged in a substantially vertical direction.

[0076] In this configuration, the head **16** of the stem **12** is arranged in the limit condition in which it is in contact with the manoeuvring lever **36** and directly exerts on the crosspiece **22** the maximum thrust to lift the cover **5.**

[0077] Once the opening angle of approximately 45° has been exceeded, the head **16** of the stem **12** is not in contact with the manoeuvring lever **36** any longer, as can be observed for example in Figure 6, and the connecting rod **18** transmits to the crosspiece **22** the thrust force required to lift the cover **5** which is produced by the lengthening of the stem **12** of the actuator **11.**

[0078] It should also be observed that, starting from the geometric and functional configuration of the articulation unit **14** shown in Figure 6, the angle α formed by the connecting rod **18** and the crosspiece **22** during the progressive opening of the cover **5** keeps decreasing.

[0079] Experimental tests have made it possible to verify that as the amplitude of the angle α decreases the opening of the cover **5** is accelerated continuously until reaching the position of maximum opening shown in Figure 9.

[0080] The advantage represented by a higher opening speed of the cover **5** compared to the known art is thus achieved.

[0081] Finally, it can be observed that the rotation means **10** suited to rotate the cover **5,** comprising the articulation unit **14** and the actuator **11** cooperating with each other, in the position shown in Figures from 1 to 10 are capable of moving a cover **5** of any size and can therefore be applied to any ventilation system of any size.

[0082] It may be necessary to vary the power of the power unit **11a** so as to adapt it to the weight of the cover **5** to be lifted.

[0083] It is thus possible to standardize the construction of the ventilation systems **1** using always the same rotation means **10** for rotating the cover **5** and modifying only the dimensions of the base **2** and of the cover **5** according to the user's needs.

[0084] There are, therefore, evident economic advantages deriving, for the manufacturer, from the smaller number of components to be managed in the warehouse, and, for the user, from an increased availability of spare parts for maintenance activities.

[0085] Obviously, the ventilation system **1** of the invention will be electrically connected to batteries fed by the electrical network in buffer mode and will be managed by a special control unit comprising sensors suited to detect smoke, heat, or other exceptional conditions so as to activate the opening of one or more ventilation systems **1** of the invention in case of fire or other anomalous conditions.

[0086] The cover **5** can be of any type and shape, and can be made from any opaque, translucent, or transparent material.

[0087] Furthermore, the ventilation system **1** of the invention can also serve as a skylight and be opened and closed as desired by the user to ventilate rooms. According to the above, it can be understood that the ventilation system **1** of the invention achieves all the set objects.

[0088] During execution, modifications and variants of the ventilation system of the invention can be carried out which are not described herein and which, if they fall within the scope of the following claims, must all be considered protected by the present patent.

Claims

1. Smoke and heat exhaust ventilation system (1) comprising:

   - a base (2) delimited by a counter frame (3) and arranged peripherally with respect to a through opening (4) made in the structure of a building, said through opening (4) being configured to place the inside of one or more rooms of said building in communication with the external en-

vironment;
- a cover (5) delimited by a frame (6) associated with the counter frame (3) of said base (2) by means of hinges (7) that allow said cover (5) to rotate to open and close said through opening (4);
- rotation means (10) suited to rotate said cover (5), comprising:

  - a linear electric actuator (11) comprising a power unit (11a) which sets a stem (12) moving linearly inside a cylinder (13);
  - an articulation unit (14) operatively connected to said linear electric actuator (11) and comprising at least one first rod (15) connecting the head (16) of said stem (12) to said counter frame (3) and at least one second rod (17) connecting said cylinder (13) to said counter frame (3),

characterized in that said articulation unit (14) also comprises at least one connecting rod (18) which connects said head (16) of said stem (12) to said frame (6).

2. Smoke and heat exhaust ventilation system (1) according to claim 1, **characterized in that** said articulation unit (14) also comprises at least one third rod (21) which connects said first rod (15) and said second rod (17) together, wherein in said third rod (21) it is possible to identify a first end (21a) hinged to an intermediate area of said first rod (15) and a second end (21b) hinged to an intermediate area of said second rod (17).

3. Smoke and heat exhaust ventilation system (1) according to any of the preceding claims, **characterized in that** said connecting rod (18) comprises a first end (18a) hinged to said head (16) of said stem (12) and a second end (18b) hinged to a crosspiece (22) fixed between two opposite sides (6a, 6b) of said frame (6).

4. Smoke and heat exhaust ventilation system (1) according to any of the preceding claims, **characterized in that** said first rod (15) has the first end (15a) hinged to said head (16) of said stem (12) and said second rod (17) has the first end (17a) hinged to said cylinder (13), wherein the second end (15b) of said first rod (15) and the second end (17b) of said second rod (17) are both connected to said counter frame (3) and are both hinged to a supporting bracket (19) which belongs to a crosspiece (20) fixed between two opposite sides (3a, 3b) of said counter frame (3).

5. Smoke and heat exhaust ventilation system (1) according to claim 4, **characterized in that** said second end (15b) of said first rod (15) and said second end (17b) of said second rod (17) are hinged to distinct points of said supporting bracket (19).

6. Smoke and heat exhaust ventilation system (1) according to claim 5, **characterized in that** said second end (17b) of said second rod (17) is arranged within the area which is perimetrically delimited by said base (2) and below the plane (X) defined by the upper surface (3c) of said counter frame (3), and said second end (15b) of said first rod (15) is arranged above said plane (X) defined by said upper surface (3c) of said counter frame (3).

7. Smoke and heat exhaust ventilation system (1) according to claim 6, **characterized in that** said second end (15b) of said first rod (15) and said second end (17b) of said second rod (17) are aligned according to a direction (Z) which is inclined with respect to a vertical direction and incident on said plane (X) defined by said upper surface (3c) of said counter frame (3).

8. Smoke and heat exhaust ventilation system (1) according to any of the preceding claims, **characterized in that** it comprises coupling means (30) configured in such a way as to lock said frame (6) delimiting said cover (5) to said counter frame (3) delimiting said base (2) when said frame (6) is arranged so that it faces and rests against said counter frame (3).

9. Smoke and heat exhaust ventilation system (1) according to claim 8, **characterized in that** said coupling means (30) comprise:

  - a rod (31) associated with said cover (5) and having its ends revolvingly connected to supporting means (32) supported by said frame (6) of said cover (5);
  - one or more hook-shaped coupling elements (33) fixed to said rod (31);
  - one or more hook-shaped coupling counter elements (34) belonging to said counter frame (3) of said base (2) and configured to cooperate with said hook-shaped coupling elements (33);
  - a tie rod (35) connecting said rod (31) to a manoeuvring lever (36) associated with said cover (5),

said manoeuvring lever (36) being configured to operate said tie rod (35) and release said hook-shaped coupling elements (33) from said hook-shaped coupling counter elements (34) when the thrust force produced by said head (16) of said stem (12) belonging to said linear electric actuator (11) makes said manoeuvring lever (36) rotate.

10. Smoke and heat exhaust ventilation system (1) ac-

cording to claim 9, **characterized in that** said tie rod (35) has the first end (35a) fixed to a projecting coupling element (36) belonging to said rod (31) and the second end (35b) fixed to said manoeuvring lever (36) through a fork (38) and a through pin (39).

11. Smoke and heat exhaust ventilation system (1) according to claim 9 or 10, **characterized in that** said manoeuvring lever (36) is revolvingly associated with said cover (5) through a rotation pin (39a) and is provided with a reference plane (40) suited to come into contact with said head (16) of said stem (12) of said linear electric actuator (11).

12. Smoke and heat exhaust ventilation system (1) according to any of claims from 9 to 11, **characterized in that** it comprises elastic means (41) associated with said rod (31) and configured to make the rotation of said rod (31) elastic.

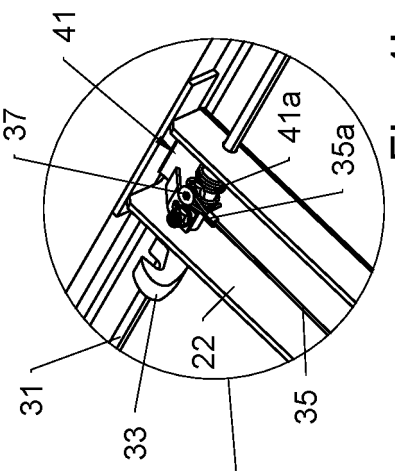


Fig. 1b

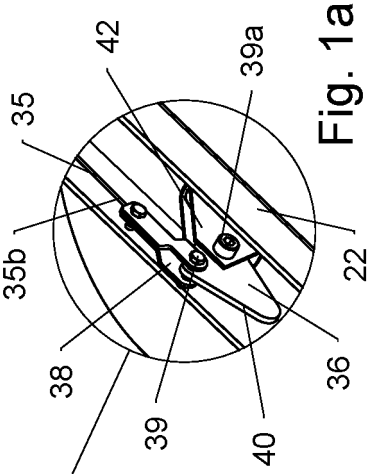


Fig. 1a

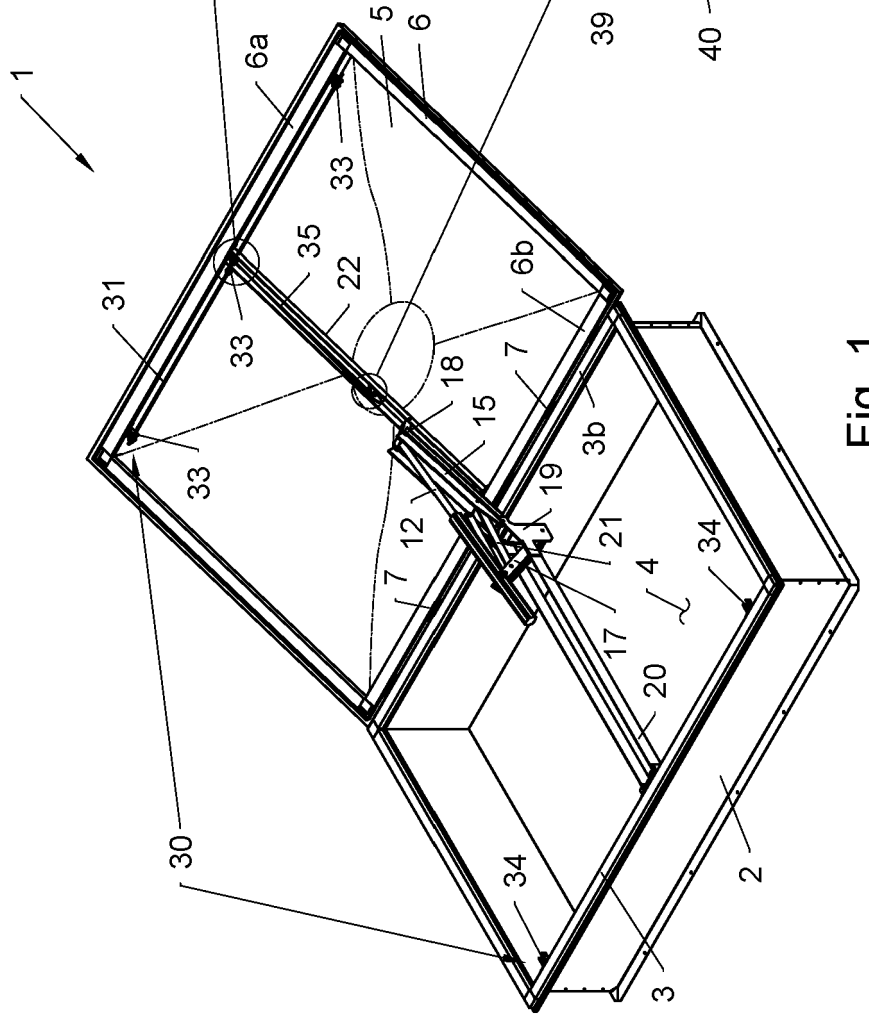


Fig. 1

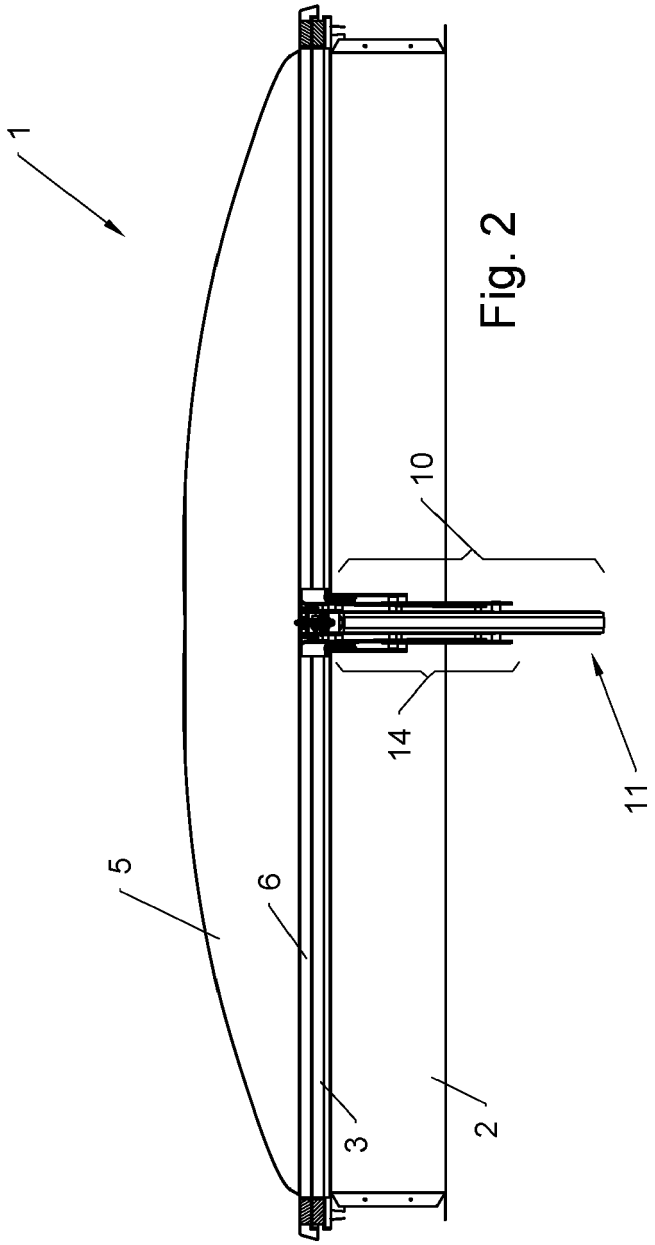
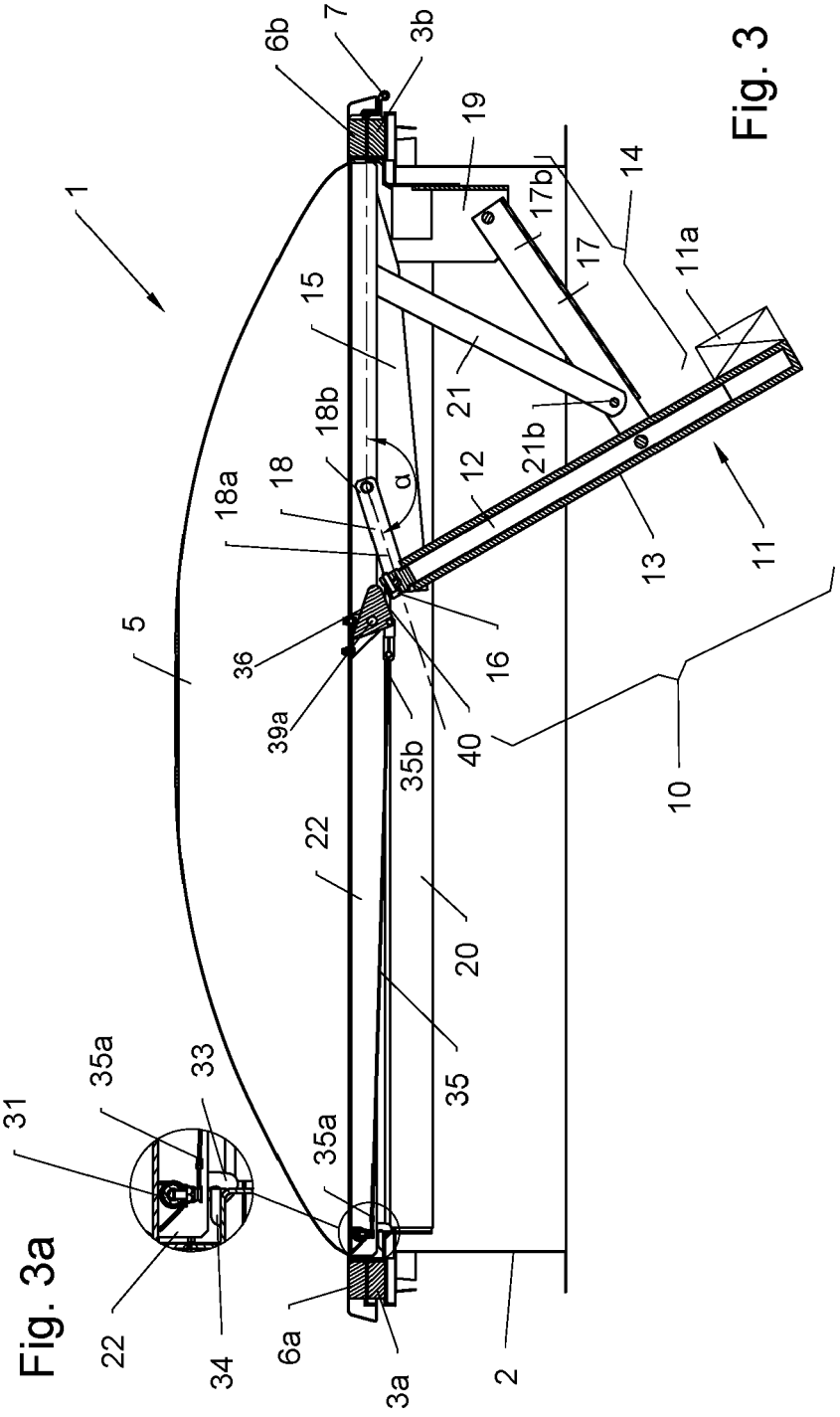


Fig. 2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6b
7
3b
19
14
17b
17
11a
15
21
18b
18a
18
α
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21b
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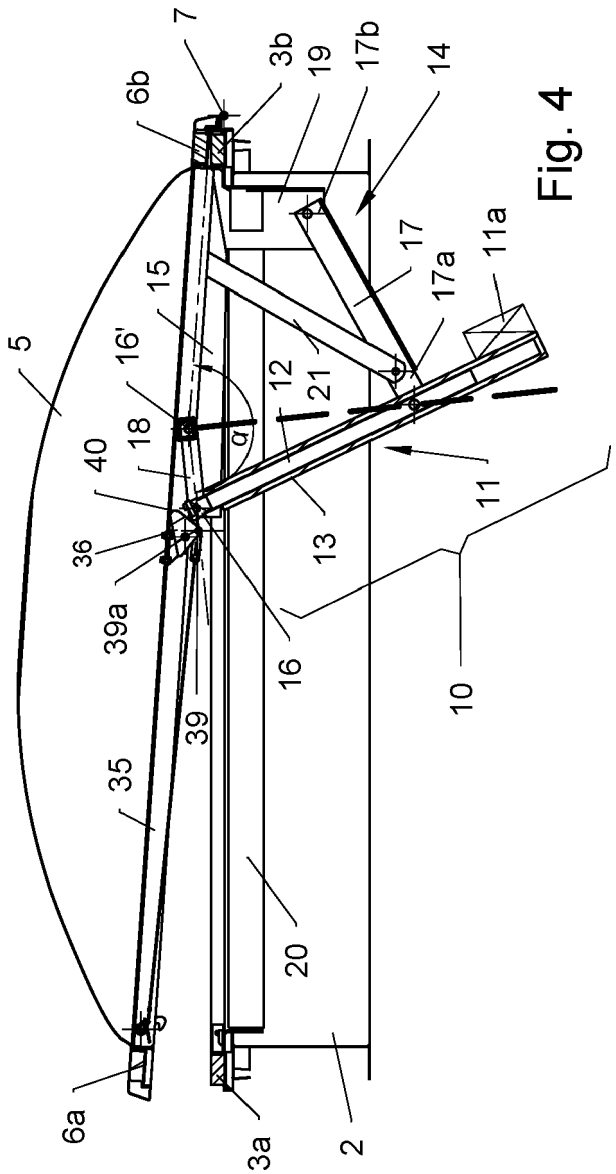
5
36
16
39a
40
35b
10
22
20
35
35a
33
31
35a
22
34
6a
3a
2

Fig. 3

Fig. 3a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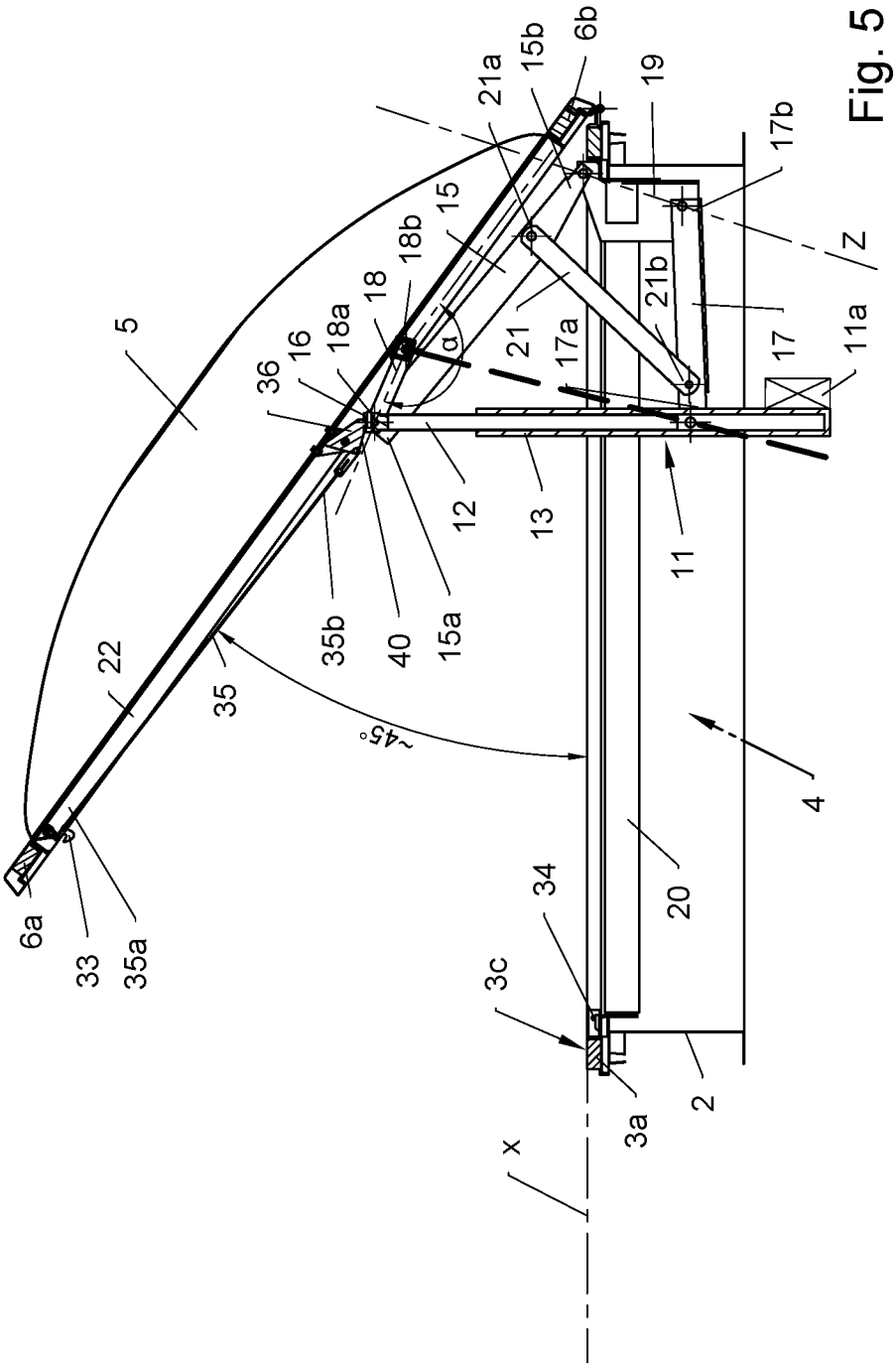
3b
19
17b
14
6b
17
11a
17a
15
16'
5
12
21
18
α
40
11
36
13
39a
16
10
39
35
20
6a
3a
2

Fig. 4


6b
15b
21a
19
17b
Z
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18
18a
16
36
5
α
21
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21b
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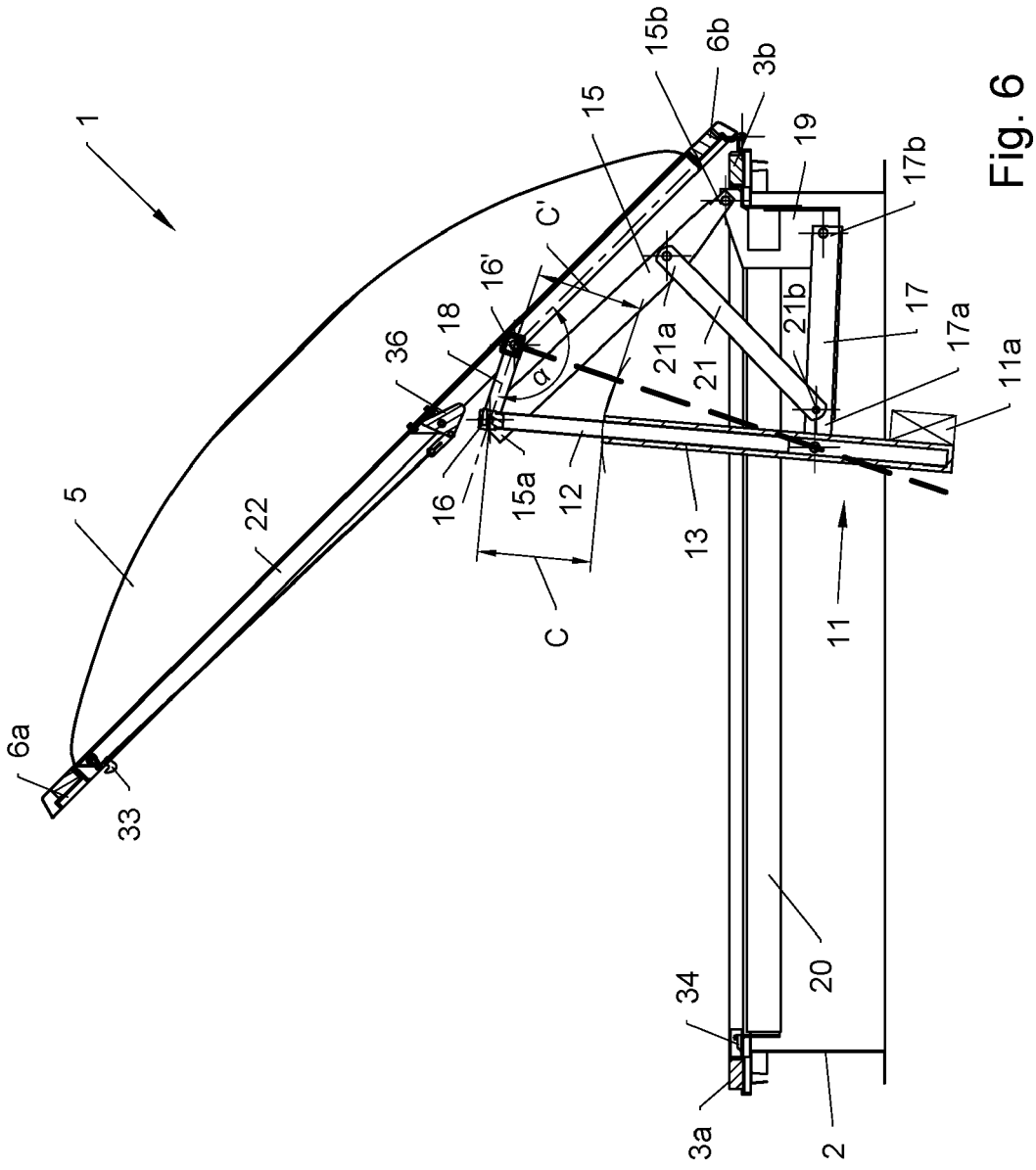
11a
12
13
11
35b
40
15a
22
35
~45°
4
6a
33
35a
34
3c
20
3a
2
x

Fig. 5


1
5
6a
33
22
36
18
16'
C'
α
16
15a
12
C
15
15b
6b
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21a
21
21b
17
17a
11a
13
11
20
34
3a
2

Fig. 6

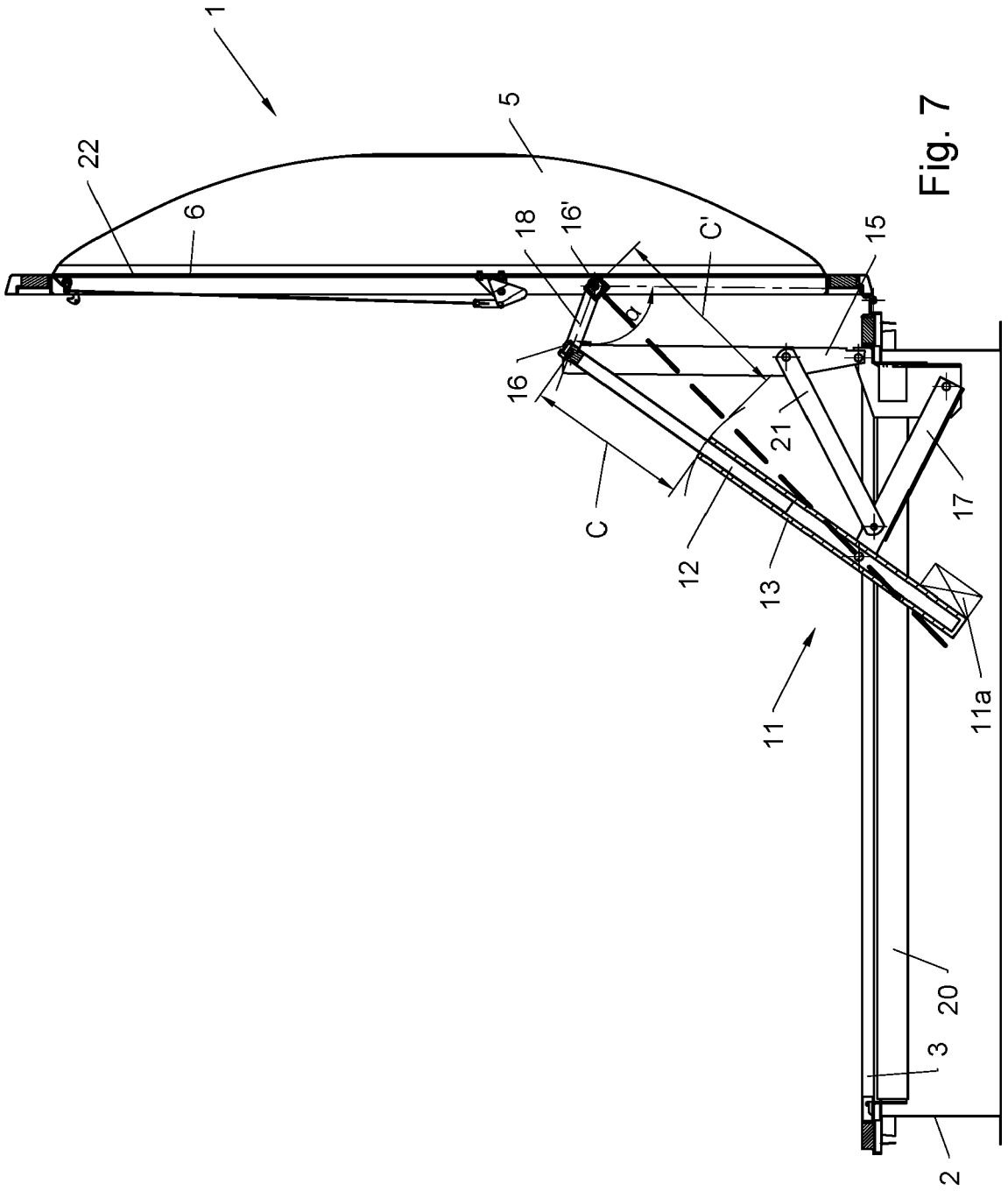

Fig. 7

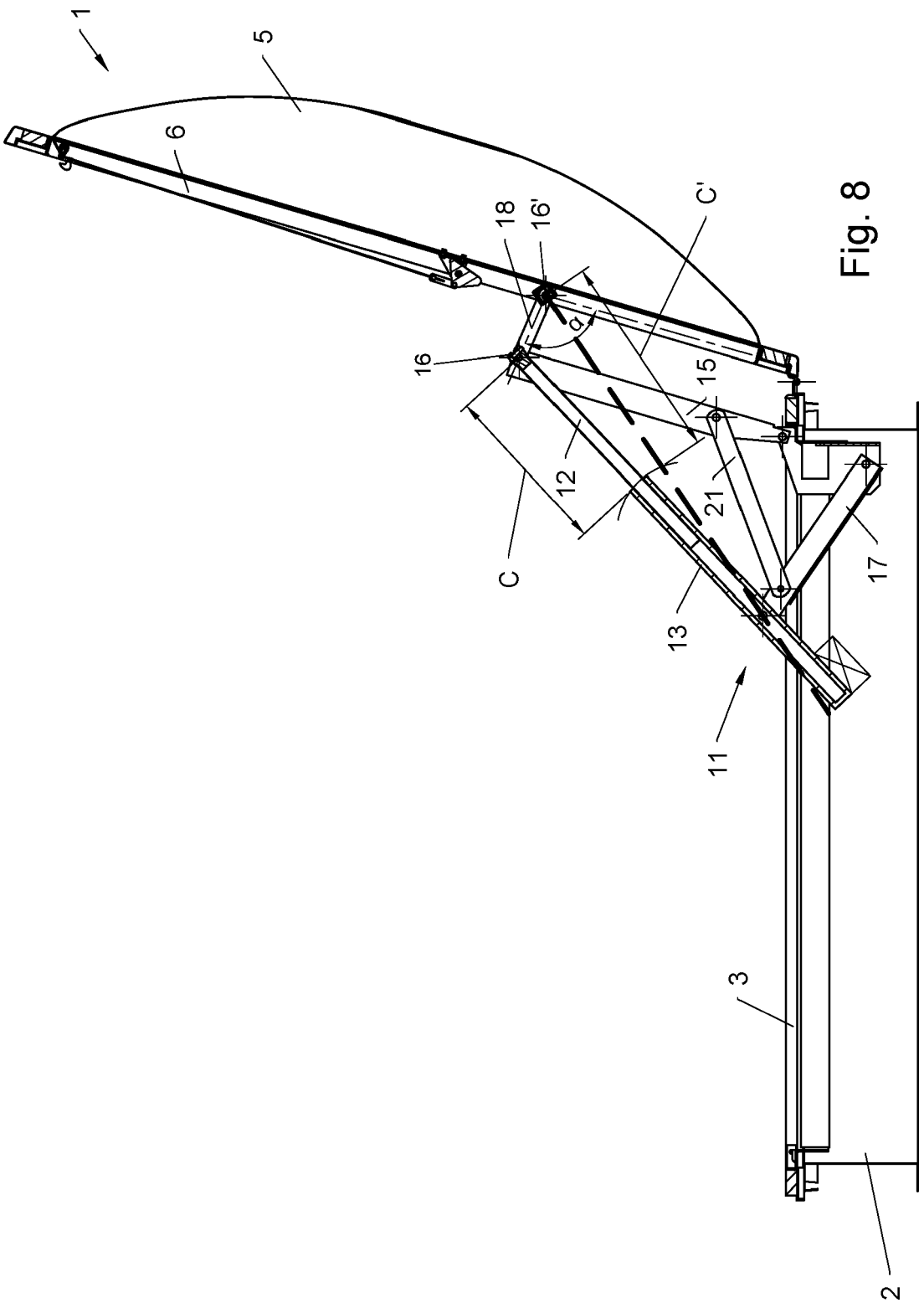

Fig. 8

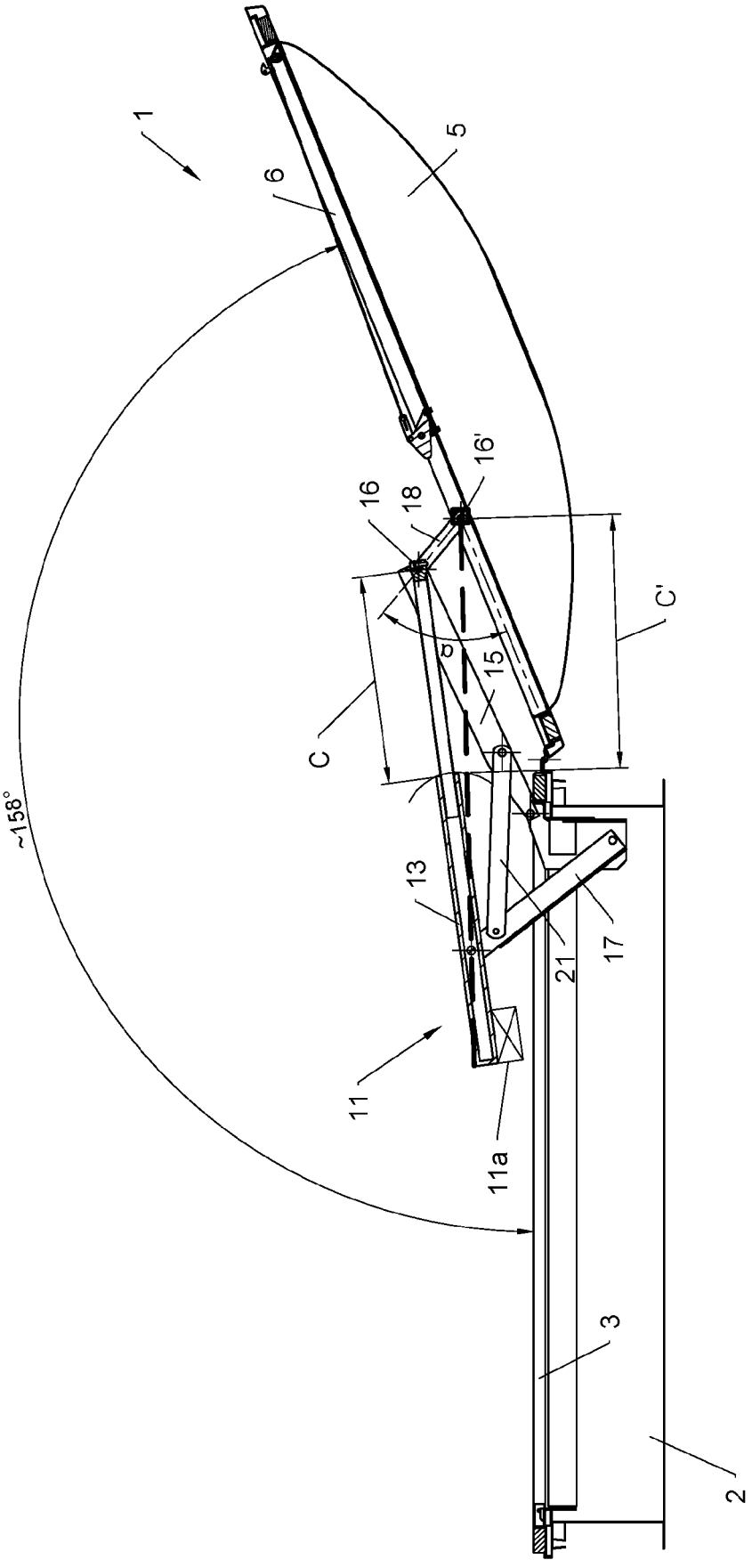

Fig. 9

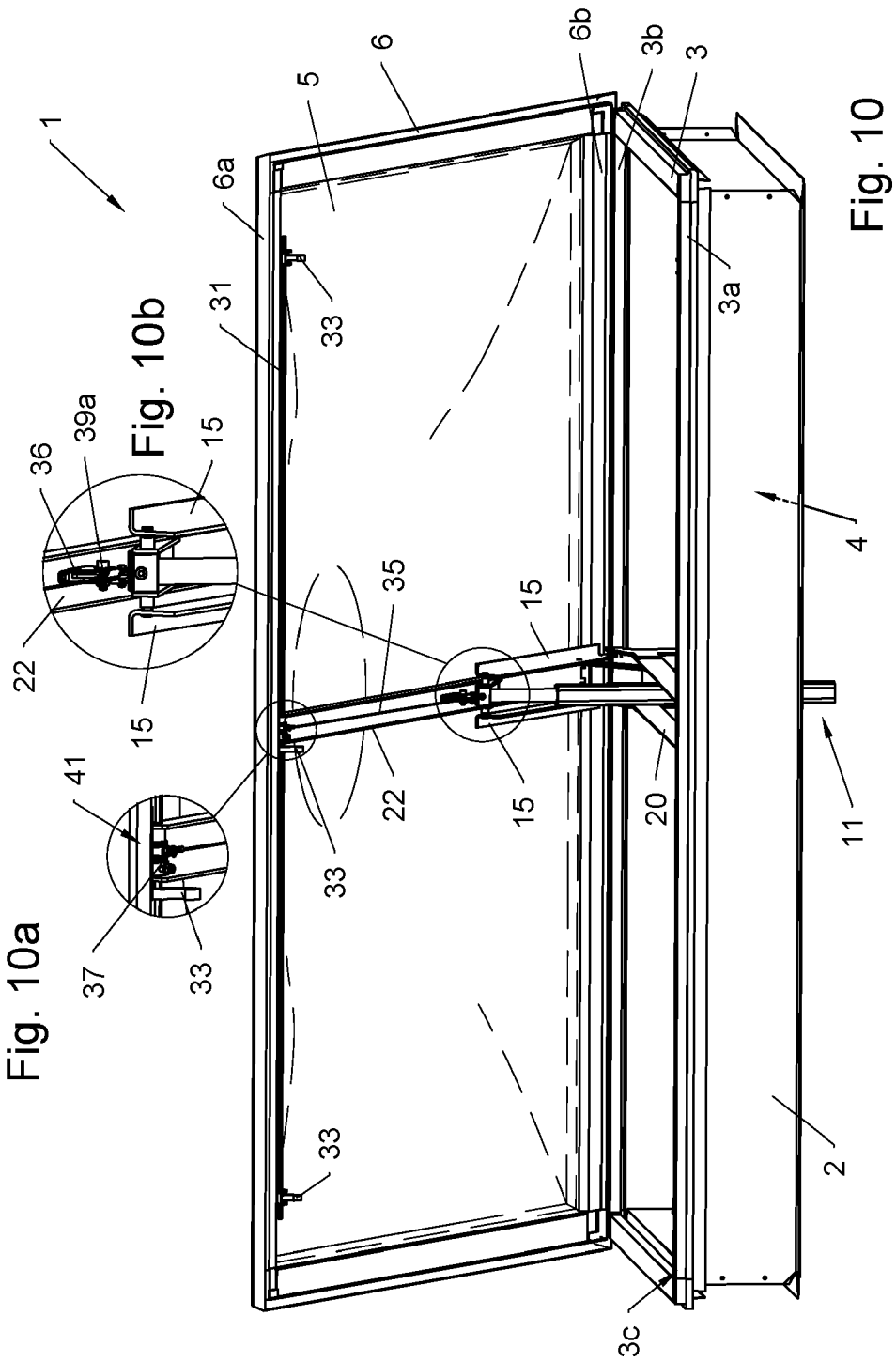

Fig. 10a

Fig. 10b

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 7324

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 20 2010 010494 U1 (JOFO PNEUMATIK GMBH [DE]) 5 December 2011 (2011-12-05) * paragraphs [0052] - [0088]; figures 1-4 * -----	1,3-8 9-12	INV. E05D15/40 E05F15/616 E05F15/63 F24F7/02
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E05D
F24F
E05F
E04D

2 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 March 2022	Rémondot, Xavier

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