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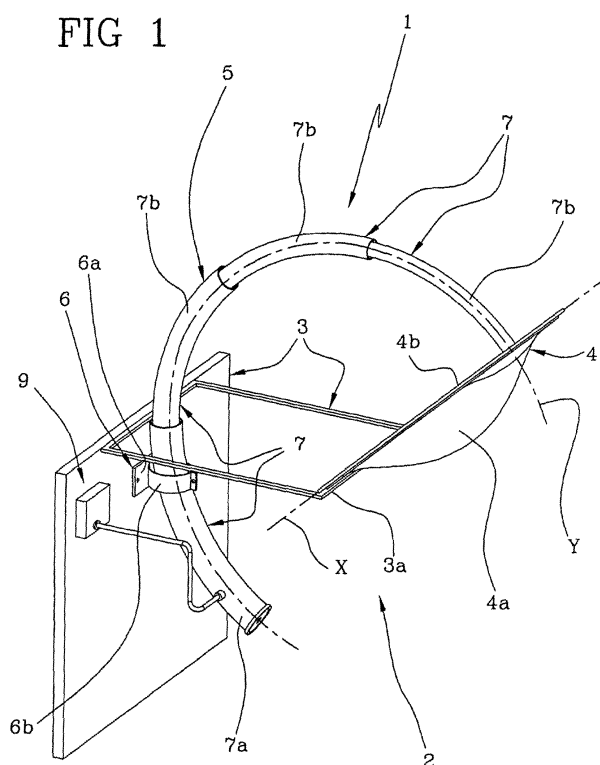
Remarks:
 Amended claims in accordance with Rule 137(2) EPC.

(54) **An opening and closing device for elements activated in rotation**

(57) A skylight (2) for buildings comprises a support structure (3) which is fixable to an aperture afforded in a building and a closing element (4) hinged to the support structure (3). The closing element (4) is rotatable with respect to the support structure (3) about an axis (X) between a closed position, in which the light is closed by closing element (4), and an open position, in which the aperture is open. The skylight (2) also comprises a mov-

ing device associated to the closing element (4) to rotate the closing element (4) between the closed position and the open position. The moving device (1) comprises an actuator (5) which can be activated to move between a retracted position thereof, in which the closing element (4) is arranged in a closed position, and an extended position thereof, in which the closing element (4) is open. The actuator (5) develops prevalently in an arch, so that it moves along a curved trajectory.

FIG 1



Description

[0001] The invention relates to device for opening and closing a rotating element, in particular skylights, hatches and the like, and a skylight provided with the opening and closing device.

[0002] The present invention is applicable in the construction sector, and in particular can be installed on roofs and/or walls of buildings in predetermined places and/or areas, to allow the passage of natural light from the outside to the inside, and, when the skylight is open, also the passage of air between the inside and the outside.

[0003] As is known, skylights are generally provided with a support structure, such as for example a frame or the like. The support structure is appropriately applied at a respective space or like aperture afforded through a roof or a wall of a building. Usually skylights are provided with a suitable closing element, normally transparent, to enable passage of natural light, which is suitably hinged to the support structure in order to be able to rotated about a hinge axis between a closed position and an open position.

[0004] Generally, these skylights are provided with a moving device which is operatively connected to the closing element in order to move the element between a closed position and an open position. The moving device comprises a hydraulic actuator operatively supported by a special support structure which is engaged to opposite sides of the support structure of the skylight, and which thus significantly occupies the aperture.

[0005] In more detail, the hydraulic actuator is in part supported by fixed support rods which substantially lie on the lie plane of the aperture and which extend centrally thereof from one side to the other of the support structure of the skylight, and in part by a series of mobile support rods, hinged together and to the fixed support rods and to the lower end of the actuator. Like the bottom end, the upper end of the actuator is hinged, directly or by means of suitable connecting frames, to the closing element. In this way, the actuation of the hydraulic actuator, which is done by activating known command means, causes a longitudinal extension thereof, and a rotation both with respect to the closing element and to its own support structure, while it passes from a substantially vertical starting position to a final position which is inclined with respect to the horizontal lie plane of the hole.

[0006] The command means normally used for operating the hydraulic actuator can be associated to suitable safety systems which sense risks by monitoring significant parameters in the building, such as for example the temperature.

[0007] The applicant has found that known skylights are not free of drawbacks and can be improved in various ways, mainly in relation to the obstruction of the light by the moving device, as the light which serves not only to illuminate the building but also enables aeration thereof, especially in emergency situations such as fire or the like, in which one or more escape routes must be provided

for smoke and/or noxious fumes.

[0008] The applicant has further found that the particularly unwieldy structure of the known moving devices for skylights constitutes a limitation to their use. In more detail, as the normally-used linear actuators tend to project laterally with respect to the shape of the aperture of the skylight, the skylight cannot be positioned close to walls which are perpendicular to the lie plane of the aperture.

[0009] Lastly, the hydraulic actuators used for activating the closing elements of skylights tend to suffer significantly from fatigue as they act prevalently in opposition to the force of gravity.

[0010] The aim of the present invention is to resolve the problems encountered in the prior art.

[0011] In particular, an aim of the present invention is to reduce the size of the moving devices associated to the skylights.

[0012] A further aim of the present invention is to reduce the obstruction of the aperture at present necessary for skylights.

[0013] A further aim of the invention is to provide a moving device which is able to move the respective closing element without any fatigue.

[0014] The technical objective and the set aim are substantially attained by a moving device for rotatably closing and opening, in particular skylights, hatches and the like, and a skylight provided with the moving device as described in the appended claims.

[0015] The description will now follow, with reference to the accompanying figures of the drawings, provided purely by way of non-limiting example, in which:

figure 1 is a schematic perspective view of a skylight provided with a moving device for a closing and opening element of the present invention;

figure 2 is a schematic section of the skylight of figure 1, made along a transversal plane to the closure element and diametral of the moving device, in which the moving device is arranged in a retracted position and the closing element is in the closed position;

figure 3 is a further section view of the skylight of the preceding figures, made along the same section plane as figure 2, in which the moving device is in the extended position and the closing element is in the open position; figure 4 is a schematic section of a preferred embodiment of the activation organ of the moving device of the preceding figures.

[0016] With reference to the figures of the drawings, 1 denotes in its entirety a moving device for rotatably-opening closing elements, in particular skylights, hatches and the like.

[0017] As illustrated in figures from 1 to 3, the above-mentioned device 1 is operatively associated to a skylight 2 which comprises a support structure 3 which is applicable to an aperture (not illustrated) afforded in a building structure (not illustrated), such as a roof of a shed, a

storehouse, a workshop and/or any other structure requiring the presence of points of illumination and aeration. The support structure 3 is advantageously the same shape as the aperture to which the skylight 2 is to be applied.

[0018] In the illustrated embodiment represented in figure 1, the support structure 3 exhibits a substantially square shape. However, it could be of any other shape that can be correctly installed in a particular aperture.

[0019] Still with reference to figures from 1 to 3, the skylight 2 is provided with a closing element 4 which is suitably hinged to the support structure 3, preferably along a side 3a of the frame thereof. The closing element 4 is connected rotatably to the support structure 3, about a hinge axis X. Consequently the closing element 4 is rotatable with respect to the corresponding aperture in the building to which the skylight 2 is engaged.

[0020] In more detail, the closing element 4 is rotatable between a closed position (figure 2), in which the aperture and the support structure 3 are closed by the closing element 4, and an open position (figure 3), in which the hole and the support structure 3 are disengaged from the closing element 4 and are therefore open.

[0021] With reference to figures from 1 to 3, the closing element 4 exhibits a substantially cupola shape. In particular, the closing element 4 exhibits a convex external surface 4a which faces outwards when the closing element 4 is in the closed position, and a concave internal surface which faces the opposite side with respect to the external surface 4a. The closing element 4 is preferably made of a substantially transparent material which allows passage of light from the outside towards the inside. However both the transparency and the shape of the closing element 4 are characteristics that can change according to the needs and aims the skylight is intended for. Still with reference to figures from 1 to 3, the moving device 1 is operatively associated to the closing element 2 to rotate the closing element 2 between the closed position and the open position.

[0022] The device 1 advantageously comprises at least an actuator 5, preferably hydraulic, which is fixable to the support structure 3 of the skylight 2.

[0023] In detail, the actuator 5 is fixed to the support structure 3 of the skylight 2 by means of a fixing structure 6 which exhibits an attachment plate 6a and a support ring 6b developing projectingly from the attachment plate 6a. The support ring 6b preferably exhibits two halves which can be reciprocally distanced or neared to envelop and retain at least a portion of the actuator 5. Both the plate 6a and the halves of the support ring 6b advantageously exhibit one or more holes 6c for engaging respective threaded elements (not illustrated as of known type) which enable the plate 6a to be fixed to the support structure 3 and the reciprocal engaging of the halves of the support ring 6b about the actuator 5.

[0024] With reference to figures from 1 to 3, the actuator 5 prevalently develops along an arched trajectory Y, so that the movement thereof from the retracted position

(figure 2) to the extended position (figures 1 and 3) follows a curved trajectory.

[0025] The curved trajectory of the actuator 5 is advantageously substantially parallel to the trajectory of each point of the closing element 4 during the rotation thereof from the closed position to the open position. In other words the curved trajectory of the actuator 5 is parallel to the trajectory which each point of the closing element 4 performs during the rotation thereof.

[0026] Still with reference to figures from 1 to 3, the actuator 5 overall exhibits a telescopic structure which can extend and retract along the above-mentioned curved trajectory.

[0027] In more detail, the actuator 5 comprises a plurality of arched segments 7, which are slidably and consecutively guided one on another. Each segment 7 exhibits a longitudinal development which is substantially parallel to the longitudinal development of the other segments 7. One of the segments, preferably the base segment 7a, is retained by the above-mentioned support ring 6b so that it is engaged to the support structure 3 of the skylight 2. On the opposite side to the base segment 7a, the actuator includes at least a segment 7b which is directly or indirectly engaged to the closing element 4, preferably at the internal surface 4b thereof.

[0028] The base segment 7a remains fixed to the fixed structure 6 and to the support structure 3, while the other segments 7b are mobile along the curved trajectory.

[0029] In the embodiment of figures from 1 to 3, the actuator 5 comprises three mobile segments 7b which are slidable and hermetically engaged to one another. Note however that the number of mobile segments 7b can vary according to the size of each component constituting the skylight 2, without limiting the invention to a predetermined number of segments 7.

[0030] In order to enable each mobile segment 7b to slide on a further mobile segment 7b and/or the base segment 7a, the mobile segments 7b each exhibit a transversal section which is smaller than the transversal segment 7b preceding it, and greater than the transversal section of the mobile segment following it. In even more detail, each mobile segment 7b is inserted sealedly in the segment which precedes it, when the moving device 1 is in the retracted position.

[0031] With reference to figures from 1 to 3, the transversal section of the actuator 5 decreases, segment 7 by segment 7, starting from the base segment 7a and up to the closing element 4, when the moving device 1 is in the extended position thereof.

[0032] Each segment 7 further exhibits a hollow body which, apart from being able to axially insertingly receive the consecutive mobile segment 7b, is advantageously in fluid communication with the mobile segment 7b in order to enable a retraction or extension of the actuator which contemporaneously interests all of the segments 7 thereof.

[0033] In order to move the closing element 4, the base segment 7a is in turn in communication with a supply

source 8 (figure 4) of an actuating fluid of known type.

[0034] Naturally the supply source 8 can be of any known type which is able to provide the actuator 5 with the activation fluid at the necessary pressure for the segments 7 to slide with respect to one another between the retracted position and the extended position.

[0035] As can be seen in figure 1, the device 1 is advantageously provided with an activation organ 9 which is operatively associated to the supply source 8 of the actuation fluid to move the actuator as described above following an activation command which can be an electric signal coming from a control switch, manually activatable from inside the building, or it can come from an automatic activation system which intervenes in special conditions, such as for example emergency situations.

[0036] The activation organ 9 is preferably a safety organ suitably provided with means for detecting 10 which can detect a predetermined activation situation in order to move the actuator 5. The means for detecting 10 comprise at least a heat sensor 11 which is sensitive to changes in temperature.

[0037] With reference to the embodiment illustrated in figure 4, the heat detector 4 exhibits a structure which at a predetermined temperature gives way, consequently freeing-up a blocking system 12 which retains a cutting element 13 in a retracted position. Once the blocking system 12 is freed up by the heat detector 11, a precompressed helix spring, engaged to the cutting element 13, overcomes the opposition of the blocking system 12 and displaces the cutting element 13 towards a tank 14 containing a pressurised fluid, preferably a gas, such as for example carbon dioxide. The cutting element 13 cuts an opening through a sealed mouth 15 of the tank 14, causing the exit of the fluid, which, through a system of channels and/or conduits, reaches the actuator 5, displacing it from the retracted position to the extended position.

[0038] This type of safety system advantageously enables automatic opening of the skylight 2 during a fire, offering an escape route to combustion fumes generated internally of a closed place.

[0039] Note however that the safety system proposed herein can be made differently from how it is described herein. The skylight could even be provided with different safety devices from those used for reacting to a fire, in cases where there might be different primary risks. The skylights 2 and/or the moving devices 1 associated thereto could be provided with more than one security system, which could ensure the opening of the skylight in various emergency situations.

[0040] The present invention solves the problems encountered in the prior art and attains the set aims.

[0041] Firstly, the moving device of the present invention is fixed to the support structure of the closing elements by a simple structure of limited size. Consequently the device 1 does not significantly obstruct the aperture in the building the skylight is associated to, and therefore does not block passage of air between the inside and the outside of the building.

[0042] Further, the special arched structure of the actuator of the device enables application of the skylight 2 also close to walls that are perpendicular to the lie plane of the passage hole, as the actuator is always contained internally of the maximum space occupied by the hole on the lie plane thereof. In other words, the arched structure of the actuator 5 enables it to reach maximum extension via a curved extension trajectory, without its projecting from the skylight beyond the confines of the hole the skylight is fixed in.

[0043] Last, but not least, the arched structure of the actuator enables it to operate almost always in transversal directions to the force of gravity, thus preventing directly-opposing situations with regard thereto. This means that the moving device is less subject to fatigue stress with respect to linear-type devices during opening and/or closing operations.

Claims

1. An opening and closing device for elements activated in rotation, in particular skylights, hatches and the like, of a type hinged to a support structure (3) and rotatably with respect thereto about a hinge axis (X) between a closed position, in which at least an aperture is closed by a closing element (4), and an open position, in which the aperture is disengaged from the closing element (4) and is at least partly open, the device (1) comprising:

a fixing structure (6) associable to the support structure (3);

at least an actuator (5) engaged to the fixing structure (6) and operatively engaged to the closing element (4), the actuator being actuable to move between a retracted position thereof, in which the closing element (4) is arranged in a closed position, and an extended position thereof, in which the closing element (4) is situated in an open position;

characterised in that the actuator (5) develops prevalently along an arched trajectory, so that the movement of the actuator (5) from the retracted position thereof to the extended position thereof follows a curved trajectory.

2. The device of claim 1, wherein the curved trajectory of the actuator (5) is substantially parallel to a trajectory of each point of the closing element (4) during the rotation thereof from the closed position to the open position.
3. The device of claim 1 or 2, wherein the actuator (5) exhibits a telescopic structure.
4. The device of one or more of the preceding claims, wherein the actuator (5) comprises a plurality of

arched segments (7), slidably guided consecutively one on another, the segments (7) each exhibiting a longitudinal development which is substantially parallel to a longitudinal development of the other segments (7) and at least one of the segments (7) is engaged to the closing element (4).

5. The device of one or more of the preceding claims, wherein the actuator (5) comprises a base segment (7a) which is rigidly engaged to the fixing structure (6) and a plurality of mobile segments (7b) slidably and sealedly guided longitudinally on the base segment (7a) or on other mobile elements (7b), the segments (7) developing longitudinally substantially parallel to one another.
6. The device of claim 5, wherein the mobile segments each exhibit a transversal section which is smaller than a transversal section of a preceding segment (7) of the segments (7), and a greater section than a transversal section of the mobile segment (7b) which follows, each mobile segment (7b) being sealedly inserted in the preceding segment (7) when the moving device (1) is in a retracted position.
7. The device of claim 6, wherein the actuator (5) is a hydraulic actuator.
8. The device of claim 7, wherein each segment (7) exhibits a hollow body which is in fluid communication with a consecutive segment (7b) of the segments, the base segment (7a) being in communication with a supply source (8) of an activating fluid.
9. The device of claim 8, comprising an activating organ (9) operatively associated to the supply source (8) of the activating fluid, for moving the actuator (5) between the retracted position thereof and the extended position thereof.
10. The device of claim 9, wherein the activating organ (9) is provided with means for detecting (10) for sensing a predetermined activation condition, the activating organ (9) activating the actuator (5) to move between the retracted position thereof and the extended position thereof on detection of the predetermined activation condition.
11. The device of claim 10, wherein the means for detecting (10) comprise at least a heat detector (11) which is sensitive to variations in temperature, the heat detector (11) activating the activating device (9) on sensing a predetermined safety temperature.
12. A skylight (2) for buildings, comprising:

a support structure (3) which is fixable to an aperture afforded through a building;

a closing element (4) hinged to the support structure (3), the closing element (4) being rotatable with respect to the support structure (3) about a hinge axis (X) between a closed position, in which the aperture is closed by the closing element (4), and an open position, in which the aperture is disengaged from the closing element (4) and is at least partly open;

a moving device (1) operatively associated to the closing element (4) and activatable to rotate the closing element (4) between the closed position and the open position;

characterised in that the moving device (1) comprises at least an actuator (5), as in one or more of the preceding claims.

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

1. A skylight (2) for buildings, comprising:

a support structure (3) which is fixable to an aperture afforded through a building;

a closing element (4) hinged to the support structure (3), the closing element (4) being rotatable with respect to the support structure (3) about a hinge axis (X) between a closed position, in which the aperture is closed by the closing element (4), and an open position, in which the aperture is disengaged from the closing element (4) and is at least partly open;

a moving device (1) operatively associated to the closing element (4) and activatable to rotate the closing element (4) between the closed position and the open position;

the moving device (1) comprising at least an actuator (5) developing prevalently along an arched trajectory; the actuator being movable from a retracted position to an extended position following an arched trajectory; the actuator (5) exhibiting a telescopic structure; and, being a hydraulic actuator.

2. The device of claim 1, wherein the curved trajectory of the actuator (5) is substantially parallel to a trajectory of each point of the closing element (4) during the rotation thereof from the closed position to the open position.

3. The device of one or more of the preceding claims, wherein the actuator (5) comprises a plurality of arched segments (7), slidably guided consecutively one on another, the segments (7) each exhibiting a longitudinal development which is substantially parallel to a longitudinal development of the other segments (7) and at least one of the segments (7) is engaged to the closing element (4).

4. The device of one or more of the preceding claims, wherein the actuator (5) comprises a base segment (7a) which is rigidly engaged to the fixing structure (6) and a plurality of mobile segments (7b) slidably and sealedly guided longitudinally on the base segment (7a) or on other mobile elements (7b), the segments (7) developing longitudinally substantially parallel to one another. 5

5. The device of claim 4, wherein the mobile segments each exhibit a transversal section which is smaller than a transversal section of a preceding segment (7) of the segments (7), and a greater section than a transversal section of the mobile segment (7b) which follows, each mobile segment (7b) being sealedly inserted in the preceding segment (7) when the moving device (1) is in a retracted position. 10 15

6. The device of claim 1, wherein each segment (7) exhibits a hollow body which is in fluid communication with a consecutive segment (7b) of the segments, the base segment (7a) being in communication with a supply source (8) of an activating fluid. 20

7. The device of claim 6, comprising an activating organ (9) operatively associated to the supply source (8) of the activating fluid, for moving the actuator (5) between the retracted position thereof and the extended position thereof. 25 30

8. The device of claim 9 7, wherein the activating organ (9) is provided with means for detecting (10) for sensing a predetermined activation condition, the activation organ (9) activating the actuator (5) to move between the retracted position thereof and the extended position thereof on detection of the predetermined activation condition. 35

9. The device of claim 8, wherein the means for detecting (10) comprise at least a heat detector (11) which is sensitive to variations in temperature, the heat detector (11) activating the activating device (9) on sensing a predetermined safety temperature. 40 45

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FIG 1

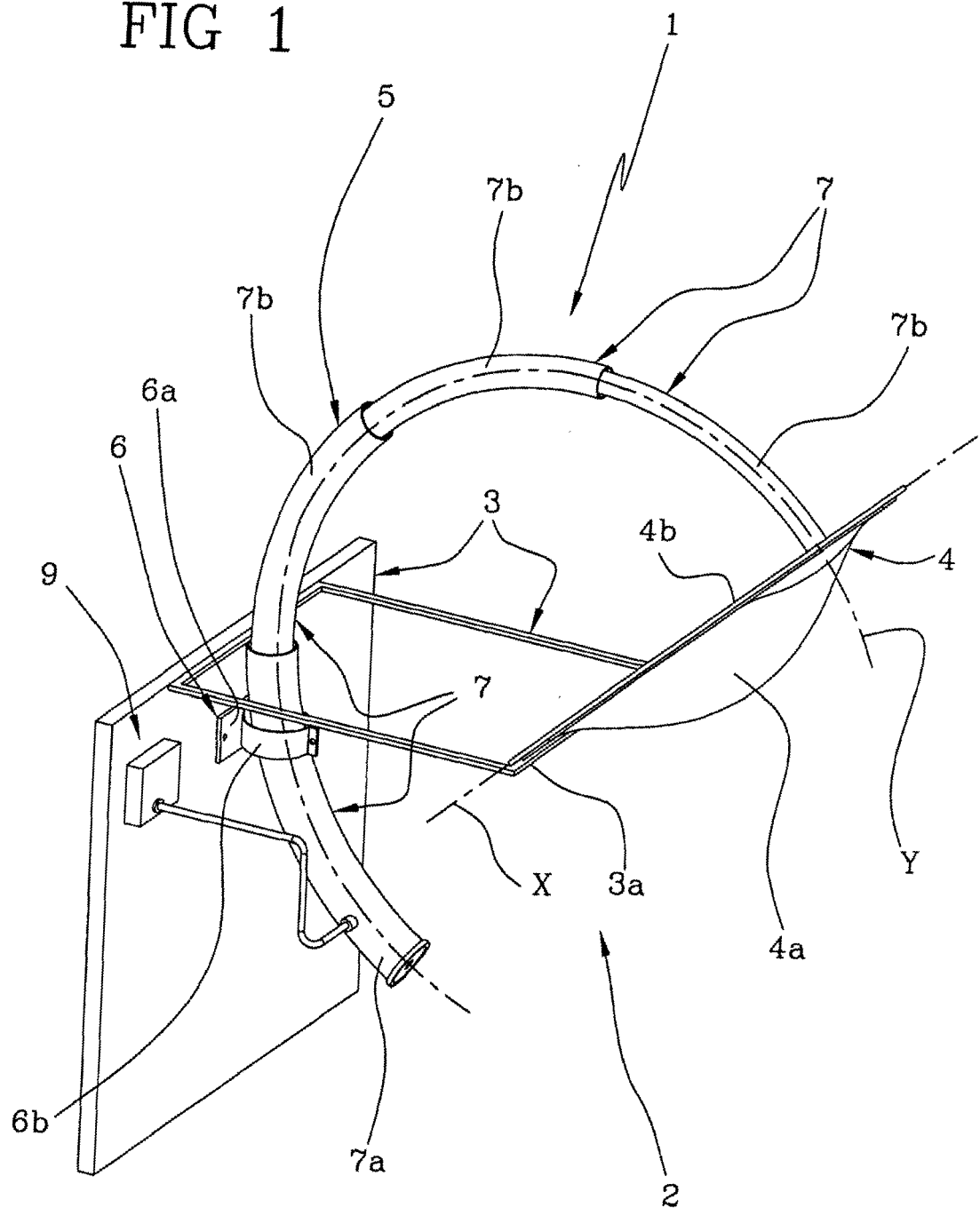


FIG 2

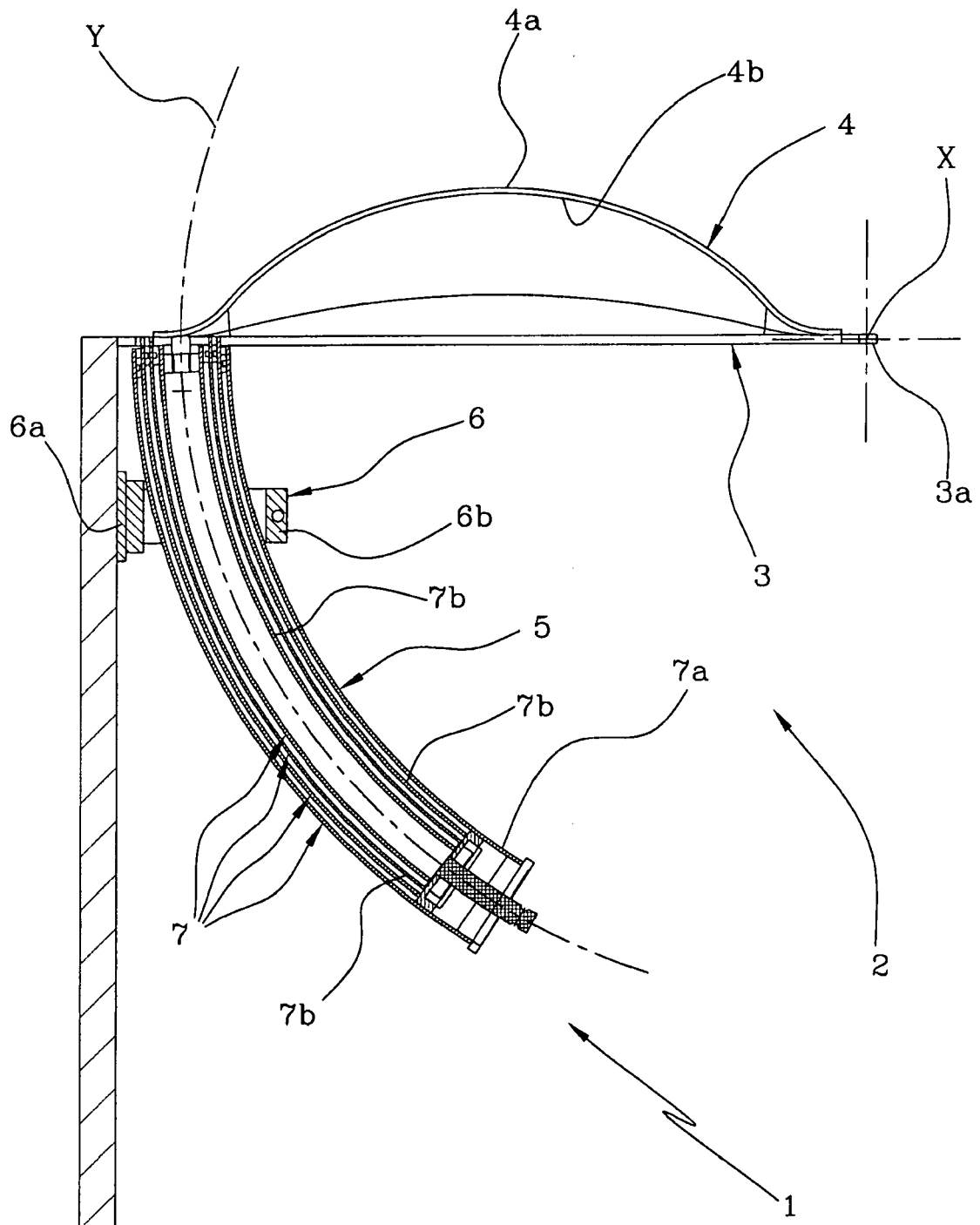


FIG 3

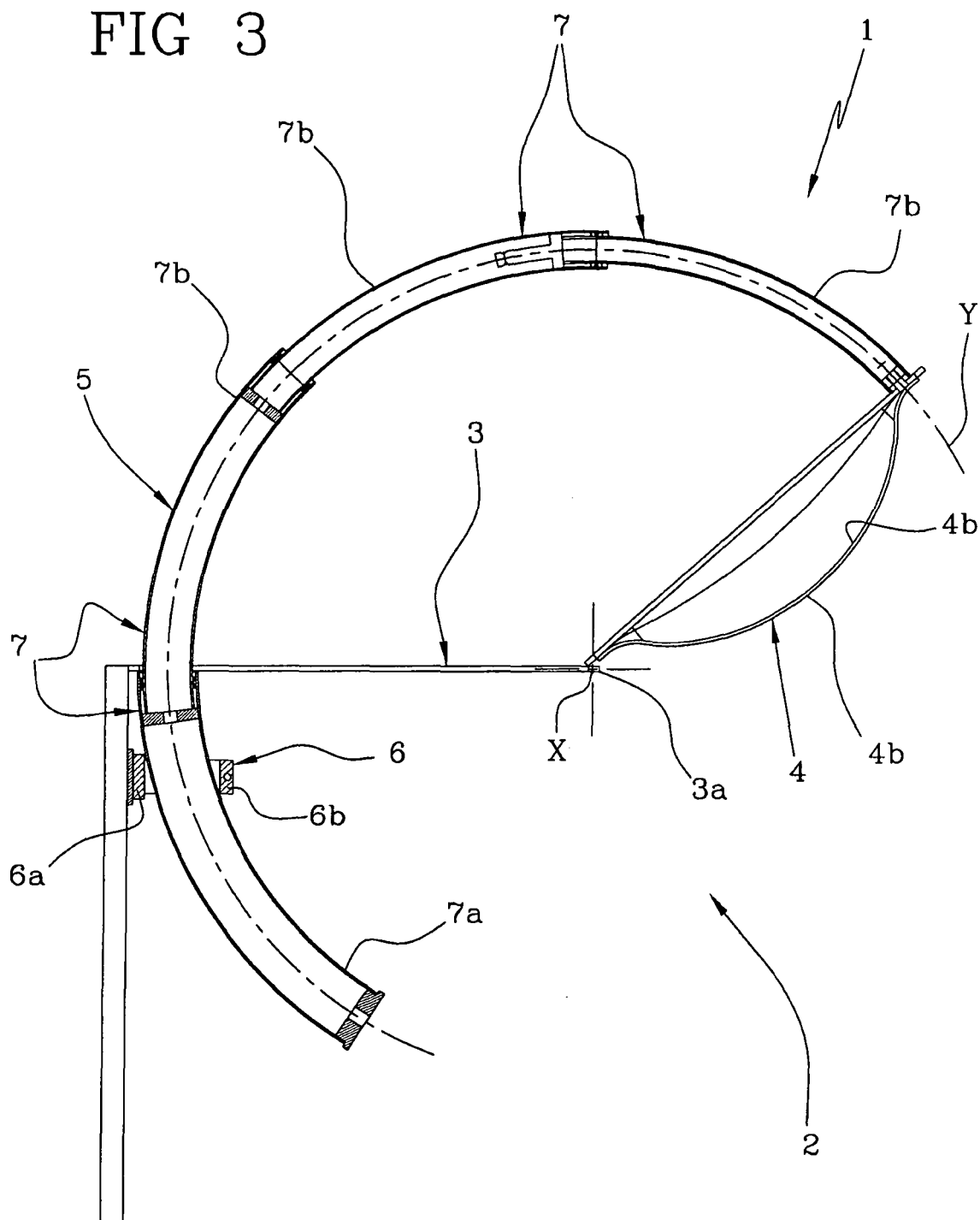
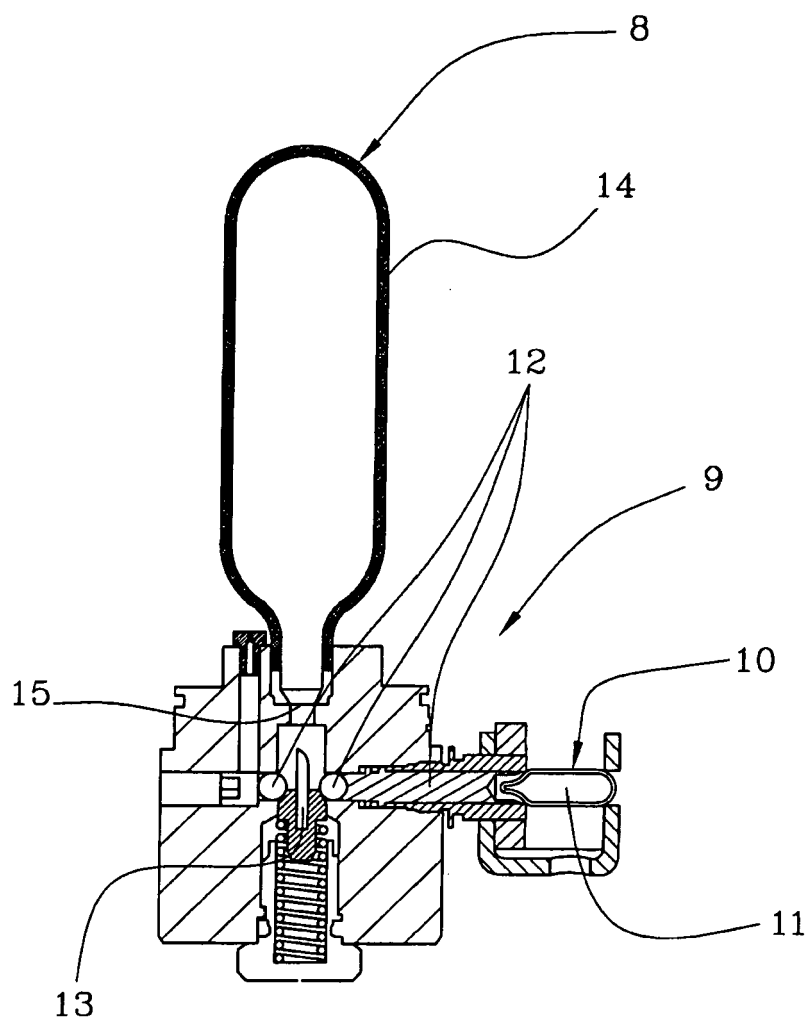


FIG 4





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5493

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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 4 December 2007	Examiner Mund, André
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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EPO FORM 1503 03/82 (F04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 42 5493

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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04-12-2007

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