



(11) **EP 3 536 887 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**11.09.2019 Bulletin 2019/37**

(51) Int Cl.:  
**E06B 5/16 (2006.01)**

(21) Application number: **19160464.4**

(22) Date of filing: **04.03.2019**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**KH MA MD TN**

(71) Applicant: **Asivo OY**  
**41120 Puuppola (FI)**

(72) Inventors:  
• **KASKISMAA, Sami**  
**44100 ÄÄNEKOSKI (FI)**  
• **KINNUNEN, Anssi**  
**41120 PUUPPOLA (FI)**

(30) Priority: **05.03.2018 FI 20185208**  
**21.11.2018 FI 20185979**

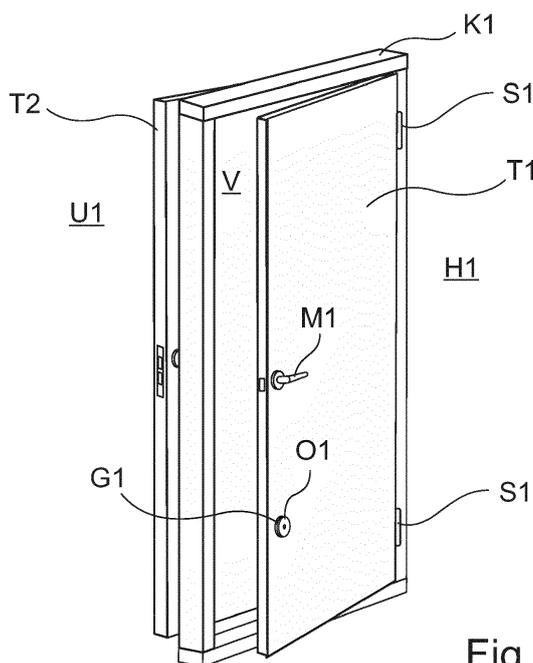
(74) Representative: **Helke, Kimmo Kalervo**  
**Kespat Oy**  
**Vasarakatu 1**  
**40320 Jyväskylä (FI)**

(54) **METHOD IN A FIRE SITUATION IN CONNECTION WITH A DOUBLE-LEAF DOOR, AND A DOUBLE-LEAF DOOR STRUCTURE**

(57) Door structure and method for eliminating excess pressure caused by a fire and the concomitant force that holds an inner door shut in connection with a double-leaf door structure (100) in a fire situation.

In the method according to the invention, excess pressure is equalized between the room interior (H1) and the intermediate space (V) between the inner door (T1)

and the outer door by equipping the inner door (T1) with a pressure-equalizing channel (O1), by means of which the air space in the room interior (H1) and the air space in the intermediate space (V) are joined, whereupon the opening of the inner door (T1) is facilitated and the force holding the door shut resulting from the pressure difference is significantly reduced.



**Fig. 1b**

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## Description

**[0001]** The invention is directed to a method in a fire situation in connection with a double-leaf door as well as to a double-leaf door structure. Here, a double-leaf door designates two doors in the same frame in which the doors open in opposite directions, the outer door outwards and the inner door inwards.

**[0002]** For decades already, firemen have encountered incidents in which the victim of the fire was found directly behind the inner door - why had the victim not gotten out?

**[0003]** A person sleeping in a fire situation wakes up and notices the raging fire, thick smoke and runs to the outer door. He turns the handle of the inner door and pulls the door inwards. At the last moment he wonders why the door is not opening. There isn't even a lock. Why is the door locked? He then succumbs to the smoke. This person remembered that the door opens easily - the handle is pressed downward, the inner door is pulled open, and the outer door is reached immediately.

**[0004]** The reason the door would not open is the excess pressure inside the building caused by the fire.

**[0005]** A pressure difference caused by the fire is generated between the space between the inner door and outer door of the double-leaf door structure and the interior of the building, which creates a force that pushes the inner door outward and prevents the door from opening inward. The pressure difference between the interior of the building and the intermediate space between the doors does not even need to be great in order to prevent the opening of the door. In particular, a fragile person will not be able to open the door, but will rather collapse behind the inner door.

**[0006]** A considerable force that holds the door shut is already created with small pressure differences between the intermediate space between the doors and the interior of the building onto the inner door of the double-leaf door structure when the surface area of the door is large. A fire situation creates excess pressure in the interior of the building in relation to the outside air. The excess pressure can last for several minutes and often arises when the person becoming aware of the fire rushes to the front door and tries to open the double-leaf door structure's inner door, which opens inwards. According to research data, an adult male is able to open the door once the pressure has dropped to a level of 700 Pa. The excess pressure caused by a fire is frequently much greater.

**[0007]** According to the invention set out in this application, in order to eliminate this so-called holding force, a method is proposed for a fire situation, according to which the inner door is equipped with a pressure-equalizing channel through the inner door, i.e. through the thickness of the leaf, in order to equalize the pressures on the different sides of the inner and outer doors. According to the invention, the free-flow channel thus acts as a pressure-equalizing channel. In this case, the pressure of the room interior in a fire situation passes via the

pressure-equalizing channel to the other side of the inner door, where the pressure decreases sufficiently, whereupon the force holding the inner door (T1) shut as a result of the pressure difference decreases significantly, advantageously to a range between 1 - 100 N. The inner door can now be opened again.

**[0008]** Advantageously, the inner door is equipped with a free-flow valve comprising the free-flow channel, said valve always being open according to an advantageous embodiment of the invention.

**[0009]** The proposed device according to the invention can easily be implemented with an intermediate space volume in the range of 100 - 600 litres, more advantageously in the range of 120 - 300 litres, and especially in a range of 100 - 10 m<sup>3</sup>. A large intermediate space volume requires the channels to have a considerably large combined surface area, which can still be implemented in accordance with the same inventive principle.

**[0010]** According to an advantageous embodiment of the invention, the free-flow channel is in the body of the lock and spans the thickness of the lock. The lock body is arranged in an aperture of the inner door in such a way that the inlet and outlet ends of the free-flow channel running through the width of the lock body reach the corresponding holes of the inner door.

**[0011]** It is also possible to use a turnable handle structure in which a turnable handle itself comprises the longitudinal channel and in which a handle element also comprises the channel. In this case, the free-flow path is formed directly in the turnable handle/shaft structure.

**[0012]** In an embodiment of the method according to the invention, the inner door of the double-leaf door structure is equipped with a valve comprising the pressure-equalizing channel, the closer element of said valve moving outwards towards the outer door in a situation of excess pressure. The closer element moves against the spring force of a spring or springs and opens a flow path from one side of the inner door to the other side. After reaching the other end position, the closer element / piston element is locked there by means of a magnet. This way, the flow path is always kept open in a fire situation in spite of pressure fluctuations caused by the fire in the room interior.

**[0013]** According to the invention, the double-leaf door structure comprises an outer door and an inner door, which opens towards the interior of the building. In the double-leaf door structure according to the invention, the outer door and the inner door are connected to the same frame element and are both hinged to the same. The inner door opens towards the interior of the room with its vertical edge moving towards the vertical shoulder structure of the door frame. The outer door opens outwards.

**[0014]** In order to equalize a pressure difference over the thickness of the inner door in a fire situation, the inner door of the door structure comprises a pressure-equalizing channel running through it. Advantageously, a valve is thus used in which there is a free flow path from one side of the inner door to its other side. It is also possible

to use a valve structure comprising a closing element or so-called piston element that moves as a result of the influence of the pressure difference, said closing element moving against a spring's spring force to a second end position where there is a magnet which locks the closing element in the position in question. In this case, the closing element stays in the so-called open position for the entire duration of the fire situation. In a normal situation, the closing element closes the free-flow channel so that there is no adverse effect on the inner door's thermal insulation.

**[0015]** According to an embodiment of the double-leaf door structure, the pressure-equalizing channel is located in the door handle's rotatable shaft and handle parts.

**[0016]** According to an advantageous embodiment of the invention, a two-part valve is arranged in the hole drilled in the inner door. One half of the valve is placed in the hole through the inner door from one side of the inner door and the other valve half is inserted from the other side. The halves are joined by screws. The central free flow path is equipped with foils or plates, which act as thermal insulation and sound suppressors. On both ends of the valve and thus on both sides of the inner door are cover casings, which act with a snap fastener.

**[0017]** The distinctive features of the method in a fire situation in connection with a double-leaf door structure as well as of a double-leaf door structure according to the invention are set out in the claims.

**[0018]** The invention is explained below with reference to the advantageous embodiments shown in the attached figures. It is not intended to limit the invention exclusively to these embodiments in any way.

Figure 1A shows an axonometric projection of a double-leaf door structure with the doors closed.

Figure 1B shows a double-leaf door structure with the doors open. The inner door opens in the direction of the room interior H and the outer door opens in an out-ward direction U or towards a staircase.

Figure 2 shows the section I-I indicated in Figure 1A.

Figure 3 shows a three-dimensional view of the valve structure of the pressure-equalizing channel in the inward-opening inner door of the double-leaf door structure shown in Figure 2.

Figure 4A shows an advantageous embodiment of the invention, according to which the pressure-equalizing channel is formed in the lock body of the inner door.

Figure 4B shows a solution for a lock body, according to which a valve element is arranged in the pressure-equalizing channel, said valve element comprising the cylinder body as well as end plates on both sides of the lock body.

Figure 4C shows the section V-V indicated in Figure

4B.

Figure 5A shows a further embodiment of the pressure-equalizing valve.

Figure 5B shows the cross section II-II of the valve shown in Figure 5A.

Figure 6 shows a solution used for a pressure-equalizing channel in the inner door, according to which the turnable shaft of the door latch as well as the inner door's turnable handles comprise a bore hole or comparable.

**[0019]** Figure 1A shows a double-leaf door structure 100, an inner door T1 and an outer door T2 in a closed position. In Figure 1B the inner door T1 and the outer door T2 are in an open position. Doors T1 and T2 are hinged in a rotatable manner to a common frame K with hinge means S1 and S2.

**[0020]** The inner door T1 opens inwards toward the room interior H1 and the outer door T2 opens outwards towards the open air U1 or towards some other space outside the apartment such as a staircase. Both doors are hinged by means of hinges S1 and S2 to the same common frame K1. The inner door T1 opens by turning or pulling the door handle M1 toward the room interior H1. The outer door T2 opens outwards toward the building exterior/open air U1.

**[0021]** According to the invention, the inner door is equipped with a pressure-equalizing channel O1, which spans the thickness of the door leaf. In the door's (T1) closed position, the free-flow channel O1 in question is open toward both the room interior H1 and the intermediate space V between the inner door T1 and the outer door. The volume of the intermediate space V is in a range of 100 - 600 litres and advantageously in a range of 150 - 300 litres. The excess pressure in the fire space H1 can fluctuate in a range between 1-5 kPa. If the surface area of the inner door is 2 square metres and the handle is at the edge of the 1 metre wide door, a pulling force of approximately 2000 N is required at an excess pressure of 2 kPa, if the intermediate space is not pressurized. In a fire situation, the pressure increases over several minutes in the room interior and in the fire space H1, and if there is no pressure-equalizing channel, a difference in pressure between the room interior H1 and the intermediate space V of the door structure 100 is created as well as a holding force, which clamps the inner door T1 in the closed position. When the door's surface area is even greater than 3 square metres and the aforementioned pressure difference occurs, a larger pulling force needs to be applied to the handle in order for the door to open. In an emergency situation, this can be critical. An individual can succumb to the smoke behind the door.

**[0022]** In this application, the inner door T1 is equipped with a pressure-equalizing channel O1. This facilitates a pressure connection and an unobstructed flow of the air between the room interior H1 and the intermediate space

V of the double-leaf door structure 100. In a fire situation, the respective pressures in the room interior H1 and in the intermediate space V are equalized, after which it is again possible to open the inner door T1 by pulling the handle M1 inwards.

**[0023]** Figure 2 shows a partial section of the double-leaf door structure 100 according to the invention along the line I-I shown in Figure 1A. Figure 4A shows an axonometric projection of the pressure-equalizing valve 12 of Figure 2, while Figure 4B shows an exploded view of the parts of the valve 12.

**[0024]** The inner door T1 is placed in the structure against the edges 10 and 11 of the frame K1. There are rabbets on both sides of the frame, i.e. both on the inner side and on the outer side. The handle M1 in the inner door T1 and the lock J in the outer door T2 are above the valve 12 and the pressure-equalizing channel O1. The pressure-equalizing channel O1 opens toward the room interior H1 and toward the intermediate space between the doors T1 and T2. The pressure-equalizing channel O1 comprises a sound-insulation structure 13, which according to the embodiment shown in the figure is composed of sound-dampening or baffle plates 13a1, 13a2, 13a3... arranged in a zigzag fashion. The baffle plates are, moreover, attached to a wire frame or right to the walls of the channel O1, as shown in the figures. The planes of the small plates 13a1, 13a2... are arranged at different angles with respect to one another. Sound waves thus bounce from one plate to another and the sound is dampened effectively. Moreover, the plates 13a1, 13a2 can advantageously be made of a porous material that absorbs sound well. The wire frame with its baffle plates 13a1, 13a2... or the individual baffle plates are arranged inside the pressure-equalizing channel O1 of the valve's 12 first valve body 14 from one end of the channel O1 to the other. A sleeve part 15a of a second valve body 15 and a sleeve part of the first valve body 14 connected thereto are inserted in the hole G1 running through the width of the inner door T1, said hole advantageously being created by means of a saw. Sound bounces off the plates 13a1, 13a2... and is dampened. Air and its pressure pass freely via the channel O1 from the room interior H1 to the intermediate space V. As a result of this arrangement, the pressure in the intermediate space V approaches the pressure in the room interior H1 in a fire situation.

**[0025]** The inner door T1 can then be opened.

**[0026]** The first valve body 14 comprises a cylinder part 14a and a flange part 14b. The cylinder or sleeve part 14a is inserted in the other cylinder or sleeve part 15a of the valve body 15, the cylinder or sleeve part 15a being larger in diameter. The second valve body 15 also comprises a flange part 15b at the end of a hollow sleeve part 15a. The parts 14 and 15 are attached to each other by means of screws 16 in such a manner that the flange part 14b of the first valve body 14 and the flange part 15b of the second valve body 15 press against the door surfaces on both sides of the inner door T1 and that the

sleeve part 15a of the valve body 15 is inserted in the bore hole G1 running through the inner door T1 of the door structure 100.

**[0027]** The edges 10a and 11a of the inner door T1 shown in Figure 2 come right up to the edges 10 and 11 of the frame K1.

**[0028]** Analogously, the edges 18 and 19 of the outer door T2 come right up against the first seal edge 21 and second seal edge 22 of the frame K1. The opening direction of the inner door T1 toward the room interior and fire space H1 is designated by the arrow Z1, while the opening direction of the outer door T2 toward the outside area U1 or the like, e.g. toward a staircase, is designated by the arrow Z2.

**[0029]** Besides the pressure-equalizing valve 12, Figures 2,3 depict attachment balls 23 in the flanges 14b and 15b, to which corresponding cup fasteners 24 in the covers 25 and 26 are joined.

**[0030]** The covers 24 and 25 act as sight screens as well as sound-dampening structures.

**[0031]** The pressure-equalizing channel O1 and the pressure-equalizing valves 12 can be used not only in new doors, but also in old doors in order to render them safe in fire situations.

**[0032]** Older door structures in which the inner door (T1) and the outer door (T2) are hinged to the same common frame (K), in which an intermediate space (V) is formed between the doors (T1, T2) and in which the inner door (T1) opens towards the room interior (H1) are rendered fire-safe by forming a pressure-equalizing channel (O1) in the same between the room interior (H1) and the intermediate space (V) and by sealing any cracks leaking outward. The outer door and potential mail slot as well as any other openings must be sealed in order to prevent pressure escaping to the outside from the intermediate space.

**[0033]** Figure 4A shows an embodiment according to the invention, according to which a free-flow channel is formed in the lock body of the lock element. The free-flow channel O1 runs through the width W of the lock body 36 of the lock 360. The lock body is fit into an indentation in the inner door T1, said indentation opening towards the lateral surface of the inner door. Holes with corresponding diameters are made in the inner door T1 in such a manner that the pressure-equalizing channel extends from the room interior to the intermediate space V. The pressure-equalizing channel O1 advantageously has a round cross section.

**[0034]** The shape of the pressure-equalizing channel O1 is advantageously round. Other shapes are also possible, such as square or oval. The largest diameter of the pressure-equalizing channel O1, e.g. the diameter of the circle, is advantageously in a range between 15 mm - 40 mm and more advantageously in a range between 20 mm - 35 mm.

**[0035]** Figure 4B shows a valve 37 arranged in the free-flow channel or pressure-equalizing channel O1 of the lock body 36. The valve 37 comprises end plates 38a,

38b on both sides of the valve body 37a and lock body 36 as well as flow paths S into the hollow interior 37b of the valve body 37a.

[0036] Figure 4C shows the section V-V indicated in Figure 4B. Inside the valve body 37a is a sound insulator or sound dampener 39. In the middle of the flow path, there is a closer element 40, which is subjected to a spring load. Connected to the closing flap 41 of the closer element 40 is a shaft part 42, at the end of which a rotatable joint 43 and a spring 44 are provided. The closing flap 43 is pressed with the force of the spring 44 against an oblique support surface comprising openings. The closing flap 43 is advantageously made of a sound-dampening material. It is also possible to implement an embodiment according to which the joint 43 is not necessary, but rather the shaft part 42 is itself a spring element that bends.

[0037] In a fire situation, the excess pressure moves the closing flap to the open position and the pressures can be equalized. It is also possible to arrange a sound-dampening structure extending in a zigzag fashion in the interior of the valve body 37a.

[0038] Figures 5A and 5B show an embodiment of the pressure-equalizing channel O1 as a pressure-equalizing valve 12, which is similar to the pressure-equalizing valve 12 shown in Figures 2,4A,4B and which comprises a first valve body 14 and a second valve body 15 as well as hollow sleeve parts 14a and 15a and flange parts 14b, 15b connected to the ends of the sleeve parts 14a and 15a. The sleeve part 15a encompasses the sleeve part 14a. The end of the sleeve part 15 comprises a central flow aperture 27.

[0039] In the section shown in Figure 5B, there is a closer element 28 inside the structure and inside sleeve 14a, said closer element 28 comprising a round end plate 29 connected to a hollow sleeve body 30. The sleeve body is open at its other end. Inside the sleeve body 30 is a coil spring 31. One end of the coil spring 31 acts on the inner surface of the round end plate 29, while the other end presses against the inner surface of the flange 14b. The flow apertures 32 are located around the circumference (indicated by dashed lines 33c) or are made to extend through the round end plate 29.

[0040] At the ends of the sleeve parts 14a, 15a is a flow aperture 33a,33b extending through the sleeve parts 14a, 15a up to the flange 14b. The flange 14b can also comprise a flow aperture 33c to the intermediate space in order to bring the pressure in the intermediate space V to the same level as in the room interior H1.

[0041] It works as follows. When the pressure increases in the room interior H1 as a result of the fire, a pressure difference is created between the intermediate space V of the double-leaf door structure 100 and the room interior H1. Via the flow path 27, the pressure acts on the closer element 28, which moves against the spring force of the spring 31 toward the intermediate space V, whereupon the pressure passes from the room interior or fire space H1 to the intermediate space V. The pressures in the

spaces H1 and V are equalized. It is thus possible to open the inner door T1 normally by pulling the turnable handle M1.

[0042] According to one embodiment, the structure can be equipped with a magnetic coupling device, which locks the closer element 28 in the open position. This way, an oscillation of the closer element 28 in accordance with potential pressure fluctuations in the room interior or fire space H1 during the fire can be avoided in a fire situation.

[0043] Figure 6 shows the composition of the pressure-equalizing channel O1 in the handle element M1 of the inner door T1. The pressure-equalizing channel O1 is located in the handle shaft 35 and in the handle parts M1.

[0044] The pressure-equalizing channel O1 is formed in such a manner that the pressure is equalized via the pressure-equalizing channel O1 between the intermediate space V of the double-leaf door structure 100 and the room interior H1.

## Claims

1. Method in a fire situation in connection with a double-leaf door structure (100) for the elimination of excess pressure caused by a fire and for the elimination of the concomitant force holding an inner door shut, **characterized in that**, according to the method the pressure between the room interior (H1) and the intermediate space (V) between the inner door (T1) and the outer door (T2), said intermediate space (V) having a volume in the range of 100 - 300 litres, is equalized by equipping the inner door (T1) with a pressure-equalizing channel (O1) by means of which the air space of the room interior (H1) and the air space of the intermediate space (V) are joined, whereby the opening of the inner door (T1) is made possible and the force holding the inner door (T1) shut due to the pressure difference decreases significantly, preferably by a quantity in the range of 0.1 - 100 N.
2. Method according to claim 1, **characterized in that** old door structures, in which the inner door (T1) and the outer door (T2) are hinged to the same common frame (K), in which an intermediate space (V) is formed between the doors (T1,T2) and in which the inner door (T1) opens towards the room interior (H1), are made fire-safe by forming a pressure-equalizing channel (O1) between the room interior (H1) and the intermediate space (V) and by sealing openings that leak to the outside.
3. Method according to claim 1 or 2, **characterized in that** a hole is formed in the inner door (T1), in which hole a pressure-equalizing valve (12) is arranged.
4. Double-leaf door structure (100) comprising an inner

- door (T1) opening inwards toward the room interior (H1) and an outer door (T2) opening outwards, the inner door (T1) and outer door (T2) being hinged in a rotatable fashion to the frame (K1) by means of hinge means (S1,S2), the intermediate space (V) between the outer door (T2) and the inner door (T1) having a volume of 100 - 10 m<sup>3</sup> litres, **characterized in that**, in order to eliminate the increase in pressure in the room interior (H1) produced by the fire situation as well as the concomitant force which holds the inner door (T1) shut, a pressure-equalizing channel (O1) is provided between the room interior (H1) and intermediate space (V) between the doors (T1,T2).
- 5
12. Double-leaf door structure (100) according to any of the preceding claims 4 - 11, **characterized in that** the valve structure (12) encompassing the pressure-equalizing channel (O1) comprises a closer element (28;40) which closes and opens the pressure-equalizing channel (O1), wherein,  
10 due to the increasing pressure in the room interior (H1) and the pressure difference between the air in the room interior (H1) and the air in the intermediate space (V) between the inner door (T1) and the outer door (T2) caused by the fire, the closer element (28) moves against the spring force of the spring (31) to a position that opens the pressure-equalizing channel (O1), whereupon the pressures between the intermediate space (V) and the room interior (H1) can be equalized and the force pressing the inner door (T1) shut is eliminated and the inner door (T1) can subsequently be opened by pulling the door handle.
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5. Double-leaf door structure (100) according to claim 4, **characterized in that** the inner door (T1) comprises through its width a hole (G1), which acts as the pressure-equalizing channel (O1).
- 20
6. Double-leaf door structure (100) according to claim 4, **characterized in that** a pressure-equalizing channel (O1) is formed in the lock body (36) of the inner door's (T1) lock (360) and extends through the width (W) of the lock body.
- 25
7. Double-leaf door structure (100) according to claim 4, **characterized in that** a valve (37) is provided in the pressure-equalizing channel (O1) of the lock body, said valve (37) comprising a closer element (40) that opens under pressure and the valve body (37a) of the valve (37) comprising a sound-dampening material (39) as well as end plates (38a, 38b) .
- 30
8. A double-leaf door structure (100) according to any one of claims 4 - 7, **characterized in that** the largest diameter of the pressure-equalizing channel is in the range of 15 mm - 40 mm and advantageously in the range of 20 mm - 35 mm.
- 35
9. Double-leaf door structure according to any of claims 4 - 8, **characterized in that** the pressure-equalizing channel (O1) has a round cross section.
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10. Double-leaf door structure (100) according to claim 7, **characterized in that** the pressure-equalizing channel (O1) is equipped with sound-dampening plates (13a1, 13a2, 13a3...) arranged in a zigzag fashion.
- 45
11. Double-leaf door structure (100) according to claim 4, **characterized in that** the sound-dampening plates (13a1, 13a2, 13a3...) are arranged in a wire frame (14), which is inserted in a sleeve part (14a) of the first body part (14) of the pressure-equalizing valve and the sleeve part (14a) of the first body part (14) is inserted in a sleeve part (15a) of the second body part (15), and **in that** the ends of the sleeve parts (14a, 15a) comprise flange parts (14b, 15b),  
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- the surfaces of which press against the surfaces of the inner door (T1), and **in that** protective coverings (25, 26) are provided, which are attached to the flange parts (14b, 15b) by means of a snap fastener.
13. Double-leaf door structure (100) according to claim 4, **characterized in that** the pressure-equalizing channel (O1) is formed in the door handles (M1) and in the handle shaft (36) of the inner door (T1).
14. Double-leaf door structure (100) according to any of the preceding claims 4 - 13, **characterized in that** the volume of the intermediate space (V) between the doors (T1, T2) is in the range of 120-300 litres.





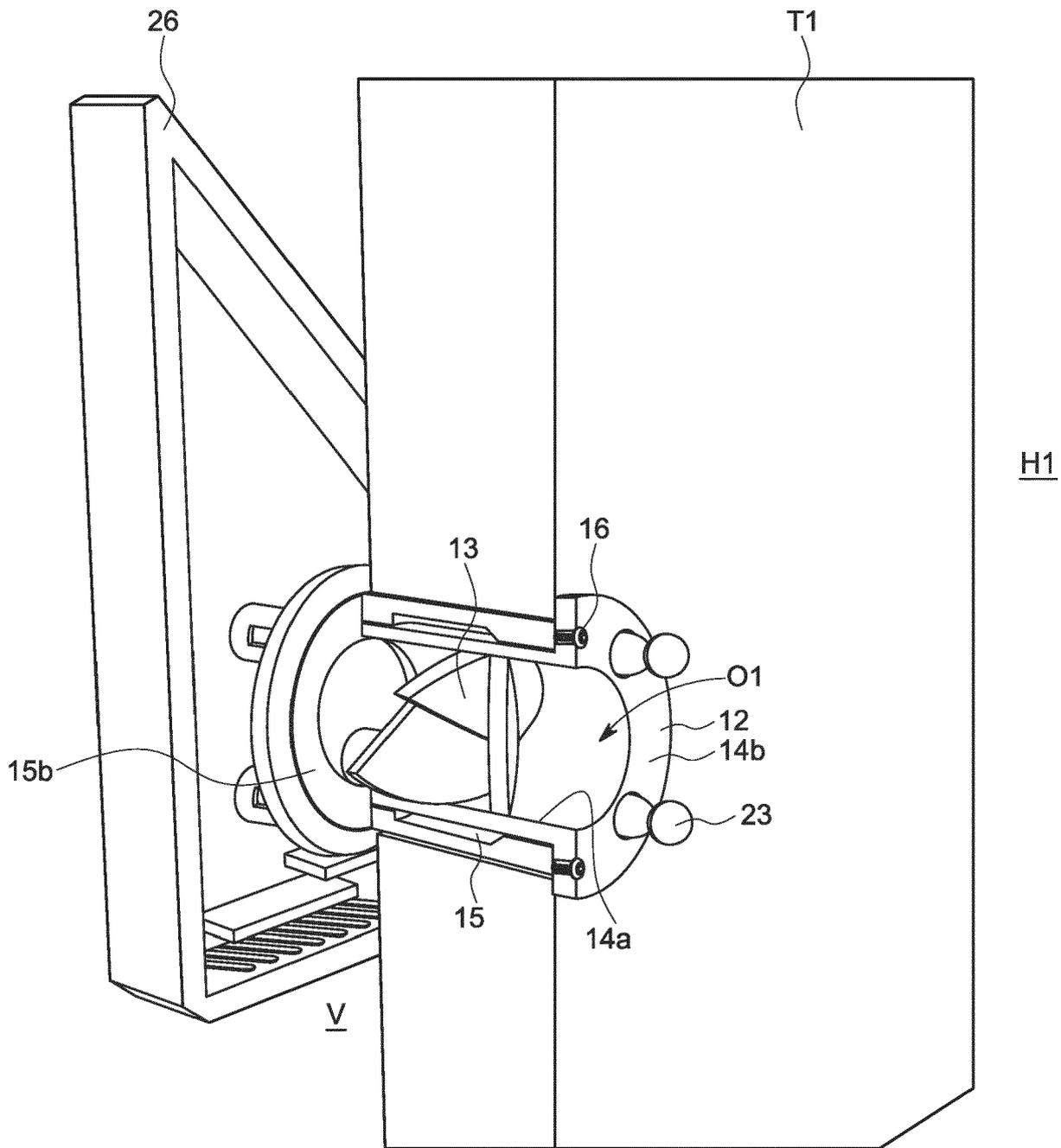


Fig. 3

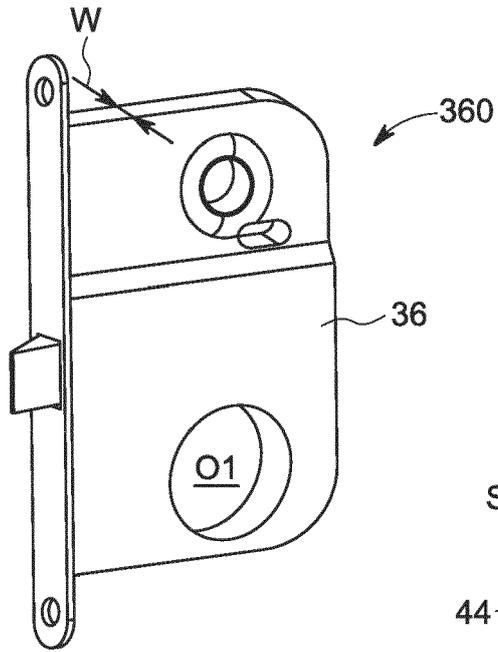


Fig. 4a

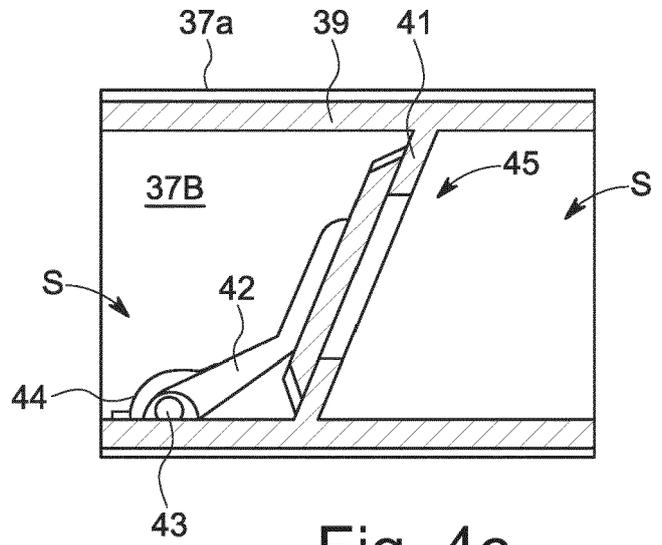


Fig. 4c

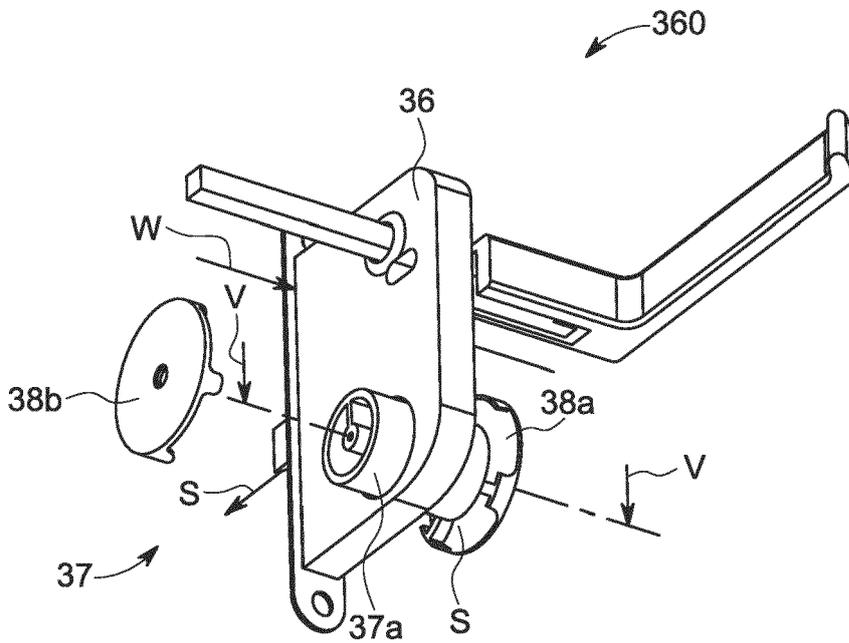


Fig. 4b

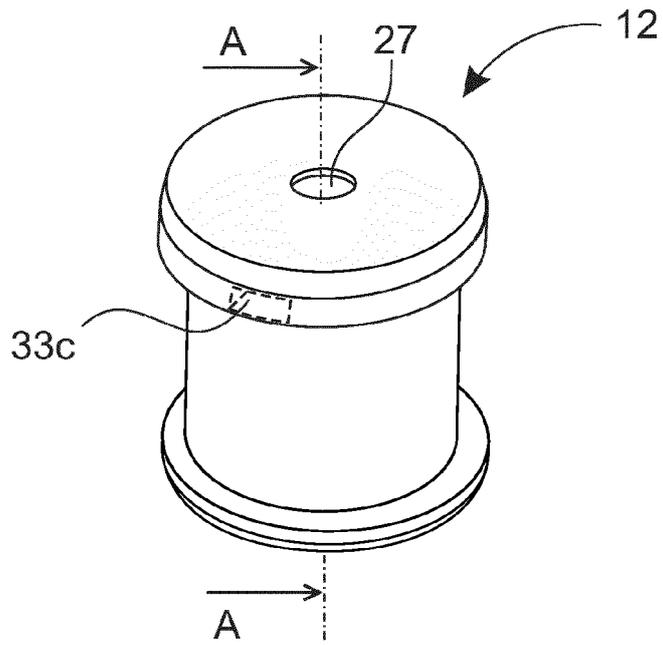


Fig. 5a

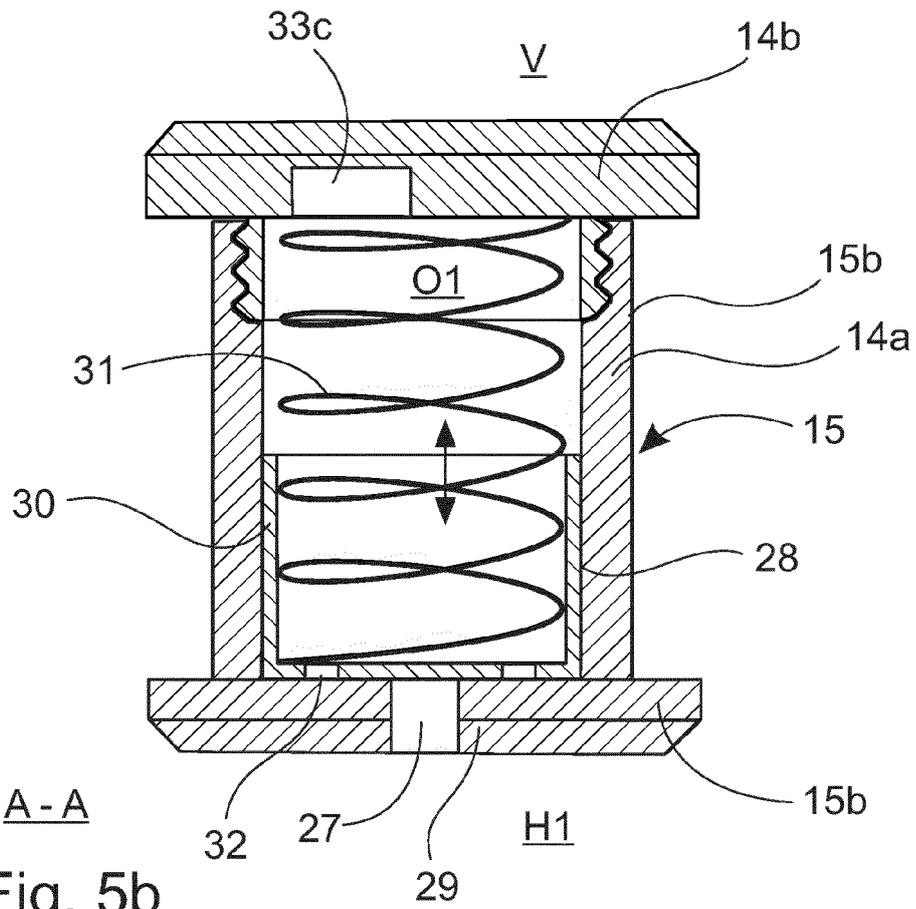


Fig. 5b

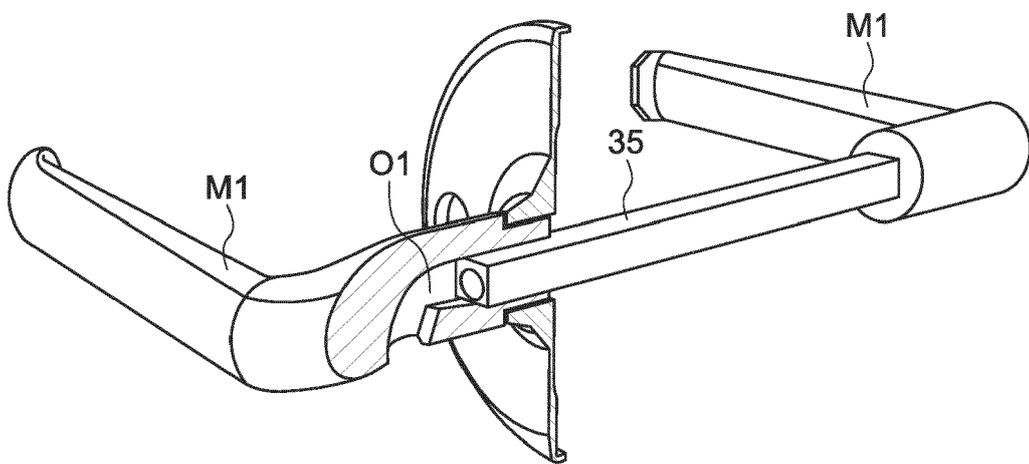


Fig. 6



EUROPEAN SEARCH REPORT

Application Number  
EP 19 16 0464

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2006/283086 A1 (RITTIE JOHN [US]) 21 December 2006 (2006-12-21)	6-14	INV. E06B5/16
Y	* paragraph [0004]; figure 1 * -----	1-3	
X	US 2008/148645 A1 (RISSONE ROBERT [US]) 26 June 2008 (2008-06-26)	4-14	
Y	* figures 3, 4a, 5a * -----	1-3	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2015/128841 A1 (ZHU SASCHA SHUXIA [DE]; WANG QIUYUAN [DE]) 3 September 2015 (2015-09-03) * figures 5,6,33-35 * -----	6,7,13	
The present search report has been drawn up for all claims			E06B
Place of search <b>The Hague</b>		Date of completion of the search <b>9 July 2019</b>	Examiner <b>Jülich, Saskia</b>
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			

EPO FORM 1503 03/02 (P04C01)

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

EP 19 16 0464

5 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  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-07-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006283086 A1	21-12-2006	NONE	
US 2008148645 A1	26-06-2008	US 2008148645 A1 US 2012210650 A1	26-06-2008 23-08-2012
WO 2015128841 A1	03-09-2015	EP 3111024 A1 WO 2015128841 A1	04-01-2017 03-09-2015

EPO FORM P0459

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