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(54) **CONCEALED HINGE**

(57) The present invention relates to a concealed hinge (1) of the type utilisable for pivotally connecting a movable leaf to a stationary frame. The hinge (1) according to the invention has a structure allowing a non-uniform rotary-translational movement of the leaf relative to the frame. Along the opening/closing path of said leaf it is possible to have some path sections in which the movement is mainly, or even substantially, a translational movement, and other sections in which the movement is

mainly, or even substantially, a rotary movement. Thanks to such a measure, the invention is advantageously applicable in all cases in which it is preferable to have a non-uniform rotary-translational movement of the movable leaf relative to the frame, and more particularly in all cases in which one or more seals are provided between the leaf and the corresponding frame. In such cases, use of the hinge according to the invention ensures the proper seal compression during door closure.

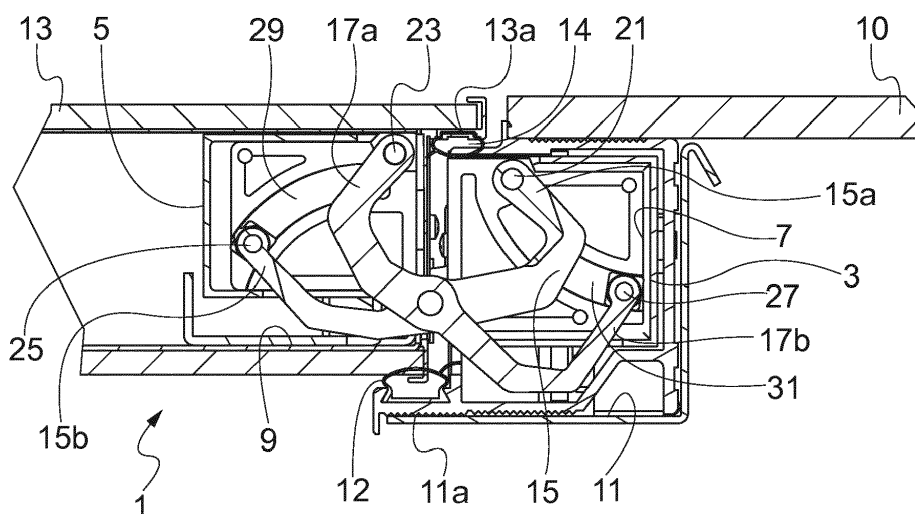


Fig. 3a

Description

Technical field of the invention

[0001] The present invention relates to a concealed hinge, of the type utilisable for pivotally connecting a movable leaf to a stationary frame.

[0002] More particularly, the present invention relates to a concealed hinge which is advantageously utilisable for pivotally connecting a door leaf to the corresponding frame.

Prior Art

[0003] Concealed hinges, also referred to as invisible hinges, are known in the art, which allow pivotally connecting a door leaf to the door frame in such a manner that the door leaf can rotate by 180° relative to the frame and which cannot be seen from the outside when the door is closed.

[0004] Concealed hinges of the above type are known for instance from United States patents US 1 484 093 and US 1 688 996.

[0005] Referring also to Figs. 1a and 1b, in general terms a prior art concealed hinge 101 includes a first hinge body 103, adapted to be inserted into a corresponding cavity 107 of a door frame 111, and a second hinge body 105 adapted to be inserted into a corresponding cavity 109 of a door leaf 113.

[0006] The first hinge body 103 and the second hinge body 105 are mutually connected by means of a first hinge arm 115 and a second hinge arm 117 which are rotatably connected by means of a pivot pin 119. A first end 115a of the first hinge arm 115 is rotatably connected to a rotation pin 121 which is fixedly attached to the first hinge body 103, and the second end 115b of the first hinge arm 115 is rotatably connected to a sliding pin 125 which in turn is slidably mounted in a guide groove 129 provided in the second hinge body 105. Correspondingly, a first end 117a of the second hinge arm 117 is rotatably connected to a rotation pin 123, which is fixedly attached to the second hinge body 105, and the second end 117b of the second hinge arm 117 is rotatably connected to a sliding pin 127, which in turn is slidably mounted in a guide groove 131 provided in the first hinge body 103.

[0007] Guide grooves 129, 131 can be either rectilinear (as in the example shown in Figs. 1a, 1b) or curvilinear. As clearly shown in Fig. 1a, said guide grooves 129, 131 exhibit a mirror-like symmetry with respect to a plane P passing through pivot pin 119 and perpendicular to the aligned surfaces of door frame 111 and door leaf 113 when the door is closed.

[0008] Thanks to the structure of the concealed hinge described above, the door leaf can perform a rotary-translational movement allowing opening said door leaf by up to 180° relative to the door frame without interferences.

[0009] Yet, such a solution is not devoid of drawbacks.

In particular, the prior art concealed hinges are suitable for use with advantage when they are applied to interior doors, but they cannot be applied in similarly advantageous manner to exterior doors.

[0010] Actually, in case of exterior doors, it is to be taken into account that one or more seals are to be provided around the door profile on the door leaf and/or the door frame in correspondence of suitable abutments. Said seals aim at providing an effective thermal and acoustic insulation while providing permeability to air and at the same time tightness to water and humidity. In order to ensure that the above aims are achieved, said seals are to be suitably compressed, and hence deformed, when the door is closed.

[0011] In the case of the prior art concealed hinges, like those shown in Figs. 1a and 1b, the rotary-translational movement of the door leaf relative to the frame is uniform and constant.

[0012] As a first consequence, during the initial portion of the door opening movement, the door leaf is not sufficiently spaced apart from the frame, and the abutment bearing the seal on the door leaf could interfere with the door frame and vice versa.

[0013] As a second and more serious consequence, in the end portion of the door closing movement, the door leaf moves in a direction which is substantially parallel to the surface of the door frame, so that it is impossible to apply the adequate compression to the door seals.

[0014] Therefore, it is the main object of the present invention to provide an improved concealed hinge that allows overcoming the limitations of the prior art hinges.

[0015] More particularly, it is the main object of the present invention to provide an improved concealed hinge that, if applied to a door having one or more seals between the door leaf and the door frame, allows taking into account the need to house and to properly compress and deform said one or more seals.

[0016] The above and other objects are achieved by the concealed hinge according to the invention, as claimed in the appended claims.

Synthetic disclosure of the invention

[0017] A concealed hinge according to the invention includes a first hinge body adapted to be secured to a door frame, a second hinge body adapted to be secured to a door leaf, and a pair of hinge arms which are rotatably connected together by means of a pivot pin. The first hinge arm is rotatably connected at one end to a rotation pin which is fixedly attached to the first hinge body, and at the opposite end to a sliding pin which in turn is slidably mounted in one or more guide grooves provided in the second hinge body. The second hinge arm is rotatably connected at one end to a rotation pin which is fixedly attached to the second hinge body, and at the opposite end to a sliding pin which in turn is slidably mounted in one or more guide grooves provided in the first hinge body.

[0018] According to the invention, the guide groove provided in the first hinge body and the guide groove provided in the second hinge body are curvilinear and they do not exhibit a mirror-like symmetry with respect to a plane passing through the pivot axis of the hinge arms and perpendicular to the aligned surfaces of the door frame and the door leaf when the door is closed.

[0019] On the contrary, said guide grooves are made so that the guide groove in one of said hinge bodies is curvilinear and has its concavity facing the pivot axis of the hinge arms, and the guide groove of the other one of said hinge bodies is curvilinear and has its concavity facing away from the pivot axis of the hinge arms, i.e. it has its convexity facing the pivot axis of the hinge arms.

[0020] Preferably, the guide groove provided in the hinge body secured to the door leaf is shaped as an arc of which the concavity faces the pivot axis of the hinge arms, and the guide groove provided in the hinge body secured to the door frame is shaped as an arc of which the convexity faces the pivot axis of the hinge arms.

[0021] Thanks to the asymmetrical configuration of the guide grooves of the hinge according to the invention it is possible to achieve a non-uniform rotary-translational movement of the door leaf relative to the door frame: along the opening/closing path of the door leaf it is possible to achieve some path sections in which the movement is mainly, or even substantially, a translational movement, and other sections in which the movement is mainly, or even substantially, a rotary movement.

[0022] More particularly, in case of application to doors providing for the use of seals between the door frame and the door leaf, thanks to the structure of the hinge according to the invention, it will be possible to obtain that, in the initial portion of the door opening movement, and hence in the end portion of the door closing movement, respectively, the door leaf movement is mainly, or even substantially, a translational movement in a direction substantially perpendicular to the plane of the frame of the door itself.

[0023] Thanks to such a measure, during opening the door leaf can rotate without interferences relative to the frame notwithstanding the provision of the abutments housing the seal. Moreover, thanks to such a measure, it will be possible to enable opening the door leaf by 180° without interferences between the hinge parts and the abutment bearing the seal, as on the contrary would occur with the prior art solutions. Always thanks to such a measure, during closure the seals can become properly compressed and deformed.

Brief description of the drawings

[0024] Other features and advantages of the invention will become more apparent from the detailed description of a preferred embodiment of the invention itself, given hereinbelow by way of non-limiting example with reference to the accompanying drawings, in which:

- Figs. 1a, 1b are cross-sectional views showing an example of a concealed hinge according to the prior art, shown in two different configurations;
- Fig. 2 is a perspective view showing a concealed hinge according to a preferred embodiment of the invention;
- Figs. 3a to 3d are cross-sectional views, taken along line III - III, of the concealed hinge of Fig. 2, shown in four different configurations.

Detailed description of an embodiment of the invention

[0025] Hereinafter, reference will be made to a preferred embodiment of the invention, relating to the application to an exterior door. Yet, the invention is not to be considered as being limited to this application only.

[0026] Referring first to Fig. 2, a concealed hinge according to the invention is shown, denoted in the whole by reference numeral 1.

[0027] Said concealed hinge 1 includes a first hinge body 3 adapted to be secured to the stationary door frame (not shown in Fig. 2 for the sake of clarity), and a second hinge body 5 adapted to be secured to the movable door leaf (not shown in Fig. 2 for the sake of clarity). The first hinge body 3 and the second hinge body 5 are provided with respective holes 4, 6 for the passage of fastening means, such as for instance screws, nails and the like, for the fastening to the door frame and the door leaf, respectively.

[0028] The first hinge body 3 and the second hinge body 5 are mutually connected through a first hinge arm 15 and a second hinge arm 17, which are rotatably connected by means of a pivot pin 19 defining a pivot axis for said hinge arms 15, 17.

[0029] Advantageously, the material and the geometry of hinge arms 15, 17 are chosen so that they can bear the load associated with the weight of an exterior door, which is significantly higher than that of the interior doors.

[0030] More particularly, in the illustrated embodiment, the first arm 15 is substantially H-shaped, with the vertical side arms extending over the whole height of hinge bodies 3, 5, and with a horizontal central arm. In turn, the second arm 17 extends over the whole height of hinge bodies 3, 5 and has a central window allowing the passage of the horizontal central arm of the first arm 15 and its rotation.

[0031] The structure and the operation of hinge arms 15, 17, and more generally of hinge 1 according to the invention, are disclosed hereinbelow with reference to Figs. 3a to 3d, in which the hinge is shown as being applied to an exterior door including a door frame 11 secured to a wall 10 and a movable door leaf 13 associated with the frame. The sequence from Fig. 3a to Fig. 3d shows the door opening sequence from a closed door configuration (Fig. 3a) to a wholly open door configuration (Fig. 3d), in which door leaf 13 is rotated by 180° relative to the door frame. The door closure sequence takes place according to the reverse sequence, that is, from the con-

figuration shown in Fig. 3d to the configuration shown in Fig. 3a.

[0032] In order to ensure a proper thermal insulation, the exterior door is equipped with suitable seals extending along the profile of the door itself. A first seal 12 is applied to door frame 11 and, to this end, said door frame 11 has, on its side facing the interior, a projecting peripheral edge 11a acting as an abutment for door leaf 13, and said first seal 12 is applied onto the face of said projecting peripheral edge 11a facing door leaf 13. A second seal 14 is applied to door leaf 13 and, to this end, said door leaf 13 has, on its side facing the interior, a projecting peripheral edge 13a acting as an abutment for door frame 11, and said second seal 14 is applied onto the face of said projecting peripheral edge 13a facing door frame 11. When the door is closed (see Fig. 3a), door leaf 13 abuts against peripheral edge 11a of door frame 11, peripheral edge 13a of door leaf 13 abuts against door frame 11 and seals 12, 14 are compressed between said door leaf and said door frame and consequently are suitably deformed. In this way, it is possible to ensure a proper thermal and acoustic insulation as well as a proper permeability to air and a proper tightness to water and humidity.

[0033] Door leaf 13 is hinged to door frame 11 through one or more concealed hinges 1 according to the invention.

[0034] Thanks to the provision of concealed hinges, door leaf 13 can rotate by 180° relative to door frame 11 (see Fig. 3d) and, when the door is closed (see Fig. 3a), no hinge element can be seen from the outside

[0035] As shown in detail in Figs. 3a to 3d, the first hinge body 3 and the second hinge body 5 are mutually connected through a first hinge arm 15 and a second hinge arm 17, which are rotatably connected by means of a pivot pin 19 defining a pivot axis for said hinge arms 15, 17.

[0036] A first end 15a of the first hinge arm 15 is rotatably connected to a rotation pin 21 which is fixedly attached to the first hinge body 3, and the second end 15b of the first hinge arm 15 is rotatably connected to a sliding pin 25 the ends of which are slidably mounted inside a pair of guide grooves 29 provided in the bottom wall and the top wall, respectively, of the second hinge body 5, only the groove provided in the bottom wall being visible in the Figures.

[0037] Correspondingly, a first end 17a of the second hinge arm 17 is rotatably connected to a rotation pin 23 which is fixedly attached to the second hinge body 5 and the second end 17b of the second hinge arm 17 is rotatably connected to a sliding pin 27 the ends of which are slidably mounted inside a pair of guide grooves 31 provided in the bottom wall and the top wall, respectively, of the first hinge body 3, only the groove provided in the bottom wall being visible in the Figures.

[0038] Thanks to the provision of guide grooves 29, 31 and to the possibility for the ends of hinge arms 15, 17 to slide inside said guide grooves, a rotary-translational

movement of door leaf 13 connected to door frame 11 by means of hinge 1 is obtained, which movement allows opening and closing the door.

[0039] According to the invention, guide grooves 29, 31 of the first and second hinge bodies 3, 5 are curvilinear and they do not exhibit a mirror-like symmetry with respect to a plane passing through pivot pin 19 and perpendicular to the aligned surfaces of door frame 11 and door leaf 13 when the door is closed.

[0040] On the contrary, according to the invention, the guide grooves in one of the hinge bodies are curvilinear and their concavities face the pivot axis of the hinge, whereas the guide grooves in the other hinge body are curvilinear and their convexities face the pivot axis of the hinge. More particularly, referring to the embodiment shown in Figs. 3a - 3d, guide grooves 31 of the second hinge body are curvilinear and their concavities face pivot axis 19 of hinge 1, whereas guide grooves 29 of the first hinge body are curvilinear and their convexities face pivot axis 19 of hinge 1.

[0041] In the preferred embodiment of the invention shown in Figs. 3a - 3d, guide grooves 29, 31 substantially have a circular arc shape. Yet, it is possible that guide grooves 29, 31 have a different and more complex curvilinear shape.

[0042] In the preferred embodiment of the invention shown in Figs. 3a - 3d, guide grooves 29, 31 substantially have the same radius of curvature and the same extension, and only differ in the orientation of their concavities/convexities with respect to hinge pivot pin 19. Yet, guide grooves 29, 31 could have mutually different radii of curvature and/or mutually different extensions.

[0043] Moreover, even though in the preferred embodiment of the invention shown in Figs. 3a - 3d each hinge body has a pair of guide grooves provided in the bottom wall and the top wall, respectively, of said hinge bodies, a single groove guide could even be provided for each hinge body.

[0044] Thanks to the asymmetrical configuration of guide grooves 29, 31 of hinge bodies 3, 5 of the hinge according to the invention, the rotary-translational movement of door leaf 13 relative to door frame 11 is not uniform. On the contrary, it is possible to achieve a door leaf movement that in some sections is mainly or only a translational movement, with little or no rotation, and in other sections is mainly or only a rotary movement, with little or no translation.

[0045] More particularly, with the configuration shown in the Figures, during the door opening movement, starting from the closed door configuration (Fig. 3a), initially a mainly translational movement of door leaf 13 in perpendicular direction to the plane of door frame 11 (arrow F), with little rotation (Fig. 3b), will take place.

[0046] As shown in Fig. 3b, thanks to such a substantially translational movement, door leaf 13 will become sufficiently spaced from door frame 11 to enable the subsequent rotation of said door leaf 13, without interference of projecting peripheral edge 13a of the door leaf bearing

the second seal 14 with door frame 11 or interference of said door leaf 13 with projecting peripheral edge 11a of door frame 11 bearing the first seal 12 (Fig. 3c).

[0047] In the end portion of the door opening movement, a mainly rotary movement of door leaf 13 will instead take place, eventually bringing said door leaf 13 to a wholly open position, at 180° relative to door frame 11 (Fig. 3d).

[0048] Conversely, during the door closing movement, initially a mainly rotary movement of door leaf 13 will take place (from the configuration shown in Fig. 3d to that shown in Fig. 3c and then to that shown in Fig. 3b). Instead, in the end portion of the door closing movement, a mainly translational movement in perpendicular direction to the plane of door frame 11 (from the configuration shown in Fig. 3b to the configuration shown in Fig. 3a) will take place, whereby seals 12, 14 will be properly compressed and deformed.

[0049] It will therefore be apparent to the skilled in the art that the concealed hinge according to the invention as disclosed above allows effectively attaining the intended objects.

[0050] Moreover, it will be apparent to the skilled in the art that several changes and modifications can be made in the concealed hinge according to the invention, without thereby departing from the scope of the invention as defined in the following claims.

[0051] In particular, even if the concealed hinge according to the invention is advantageously applicable to exterior doors, the invention is not to be considered for that reason as being limited to such an application. On the contrary, the invention could be applied to other cases in which one or more seals are provided between a movable leaf and the corresponding frame (one could think for instance to the leaf of a fridge door). More generally, the invention could be advantageously applied in all cases in which it is preferable to have a non-uniform rotary-translational movement of the movable leaf relative to the frame.

Claims

1. Concealed hinge (1) of the type comprising a first hinge body (3) adapted to be fixed to a stationary frame, and a second hinge body (5) adapted to be fixed to a movable leaf, wherein said first hinge body (3) and said second hinge body (5) are mutually connected by means of a first hinge arm (15) and a second hinge arm (17) which are rotatably connected by means of a pivot pin (19), said pivot pin (19) defining a pivot axis, wherein a first end (15a) of said first hinge arm (15) is rotatably connected to a rotation pin (21) which is fixedly attached to said first hinge body (3) and the second end (15b) of said first hinge arm (15) is rotatably connected to a sliding pin (25) which is slidably mounted in at least one guide groove (29) provided in said second hinge body (5),

and wherein a first end (17a) of the second hinge arm (17) is rotatably connected to a rotation pin (23) which is fixedly attached to said second hinge body (5) and the second end (17b) of said second hinge arm (17) is rotatably connected to a sliding pin (27) which is slidably mounted in at least one guide groove (31) provided in said first hinge body (3), **characterized in that** said guide grooves (29, 31) of said first and second hinge bodies (3, 5) are curvilinear, **and in that** said at least one guide groove (29, 31) of one of said hinge bodies (3, 5) has its concavity facing said pivot axis of said hinge, and said at least one guide groove (31, 29) of the other one of said hinge bodies (5, 3) has its convexity facing said pivot axis of said hinge.

2. Concealed hinge (1) according to claim 1, wherein said at least one guide groove (31) of said second hinge body (5) has its concavity facing said pivot axis of said hinge, and said at least one guide groove (29) of said first hinge body has its convexity facing said pivot axis of said hinge.

3. Concealed hinge (1) according to claim 1 or 2, wherein said guide grooves (29, 31) of said first and second hinge bodies (3, 5) have a circular arc shape.

4. Concealed hinge (1) according to any of the claims 1 - 3, wherein said guide grooves (29, 31) of said first and second hinge bodies (3, 5) have the same curvature radius.

5. Concealed hinge (1) according to any of the claims 1 - 4, wherein said guide grooves (29, 31) of said first and second hinge bodies (3, 5) have the same extension.

6. Door, of the type comprising a door frame (11) which is stationary and a door leaf (13) which is mounted so as to be movable relative to said door frame (11), **characterized in that** said door leaf (13) is hinged to said door frame (11) by means of one or more hinges (1) according to any of the claims 1 to 5.

7. Door according to claim 6, wherein said door frame (11) has a projecting peripheral edge (11a) adapted to serve as an abutment for said door leaf (13) and a seal (12) mounted on the side of said projecting peripheral edge (11a) facing said door leaf (13).

8. Door according to claim 6 or 7, wherein said door leaf (13) has a projecting peripheral edge (13a) adapted to act as an abutment for said door frame (11) and a seal (14) mounted on the side of said projecting peripheral edge (13a) facing said door frame (11).

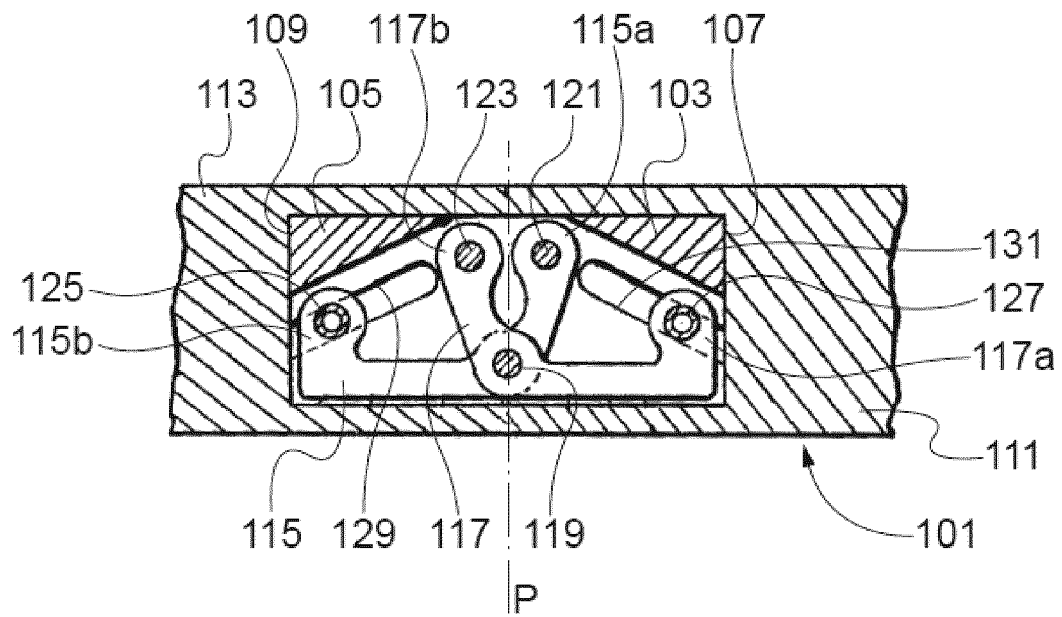


Fig. 1a (PRIOR ART)

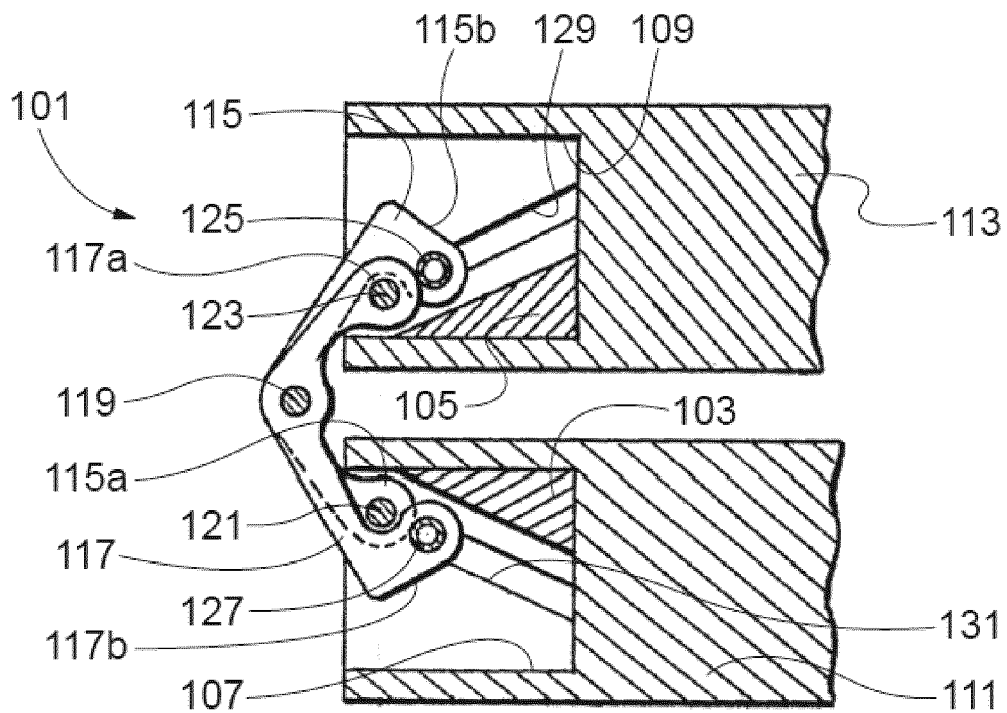


Fig. 1b (PRIOR ART)

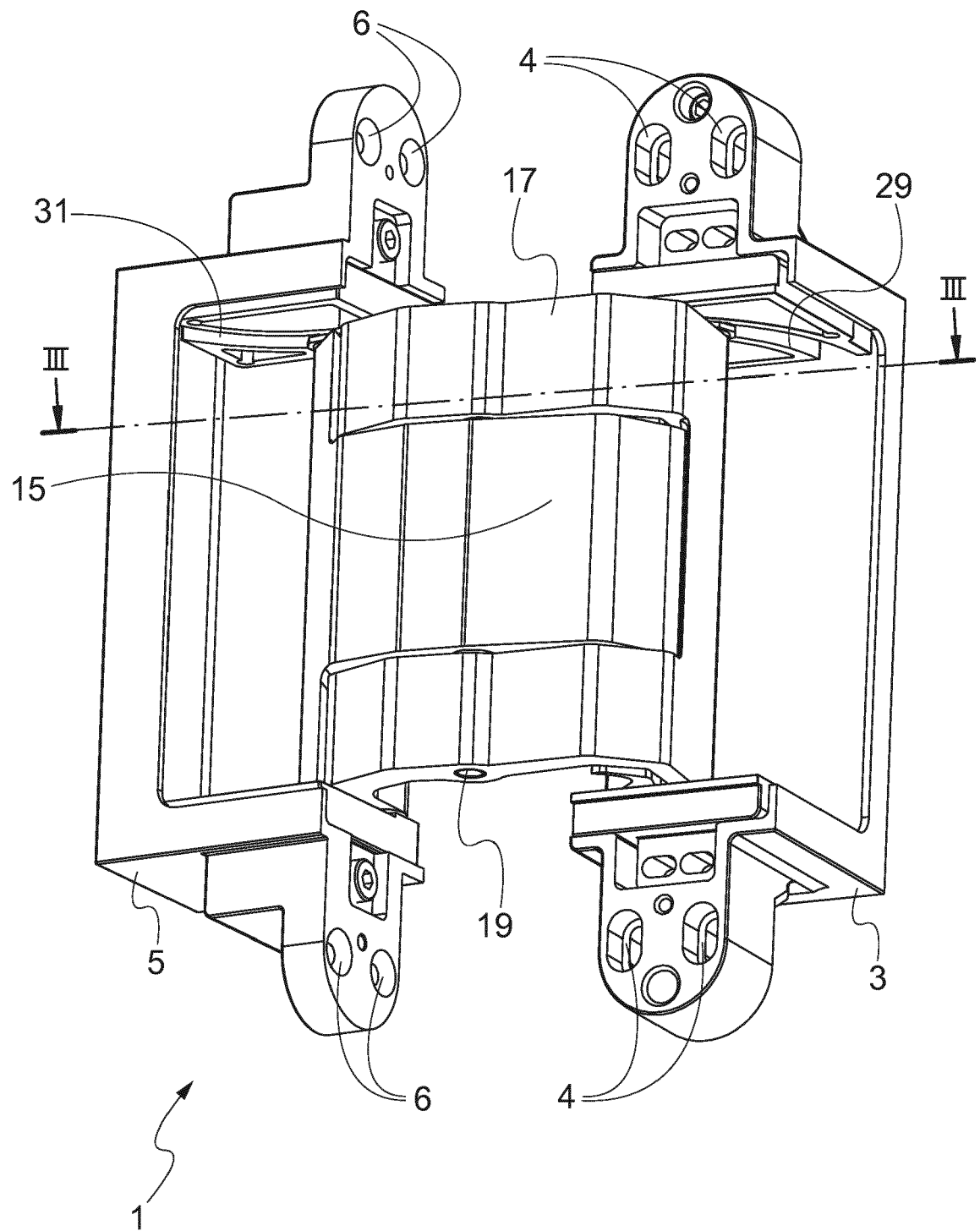


Fig. 2

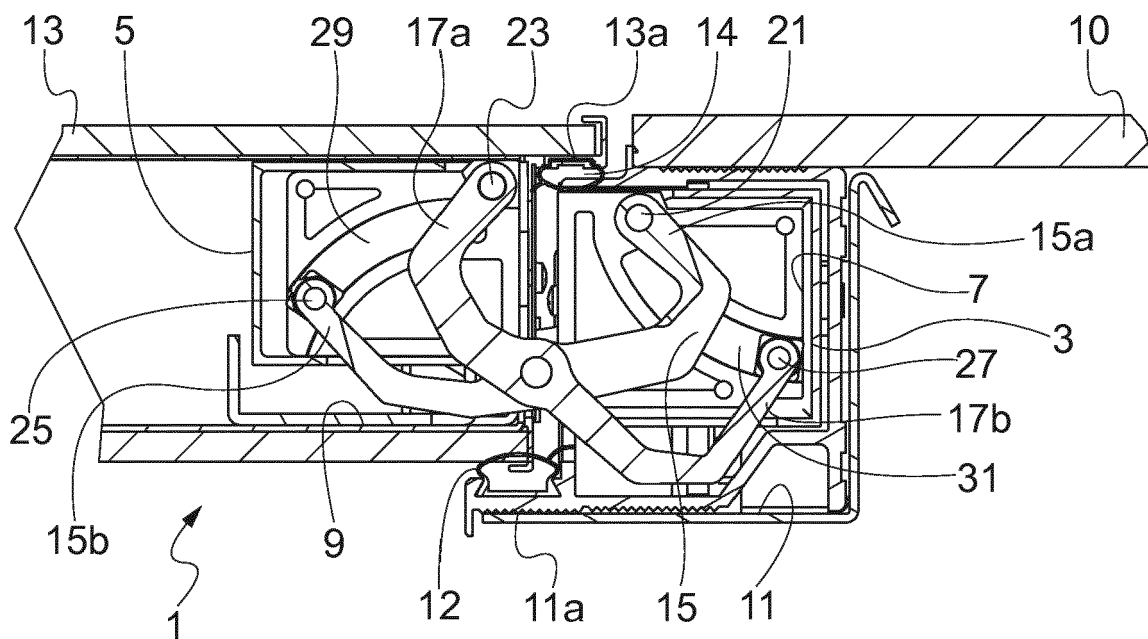


Fig. 3a

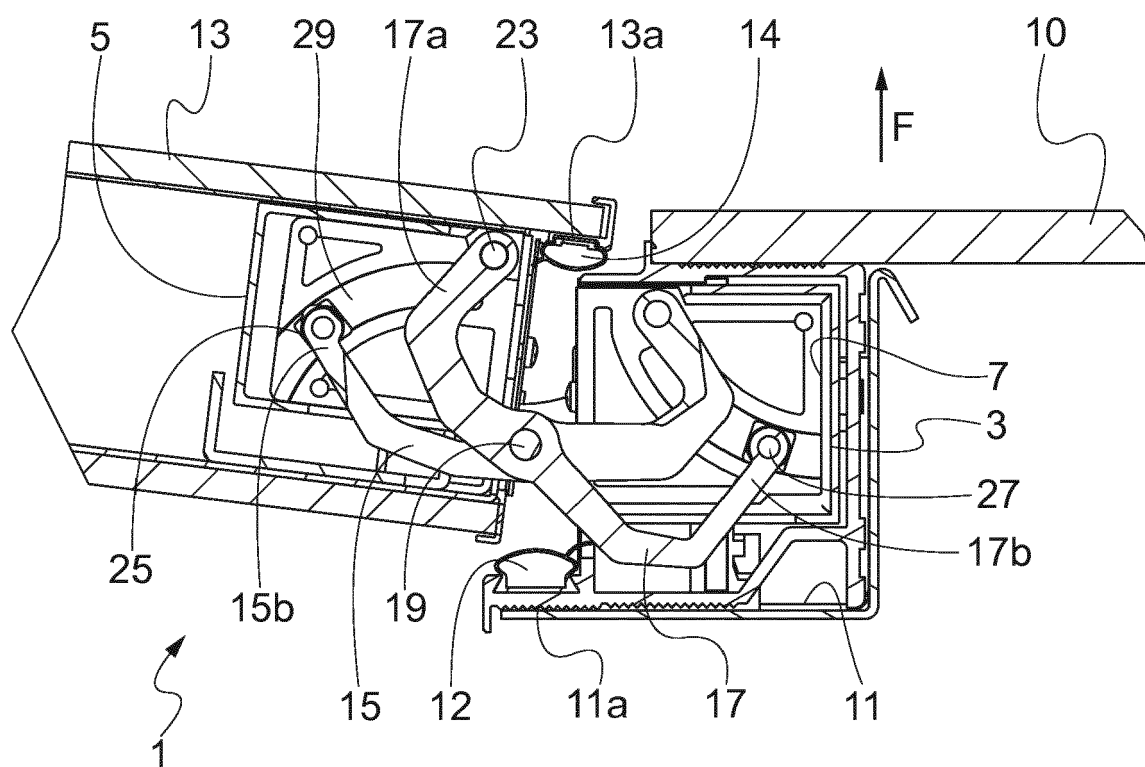
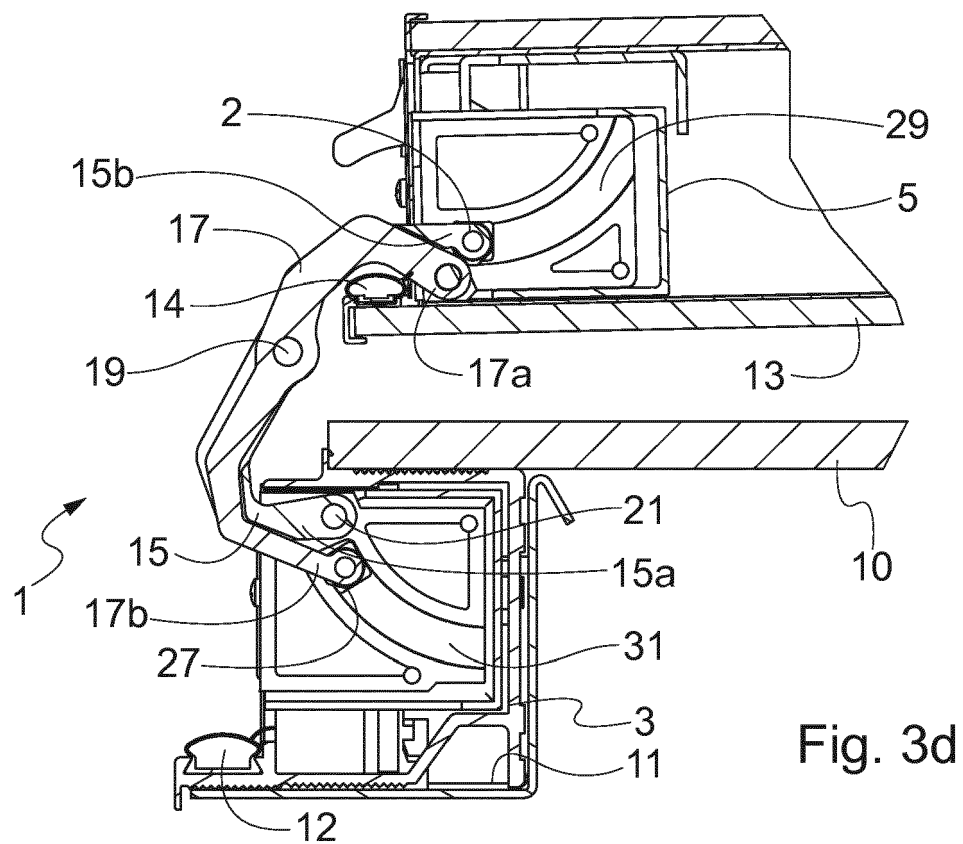
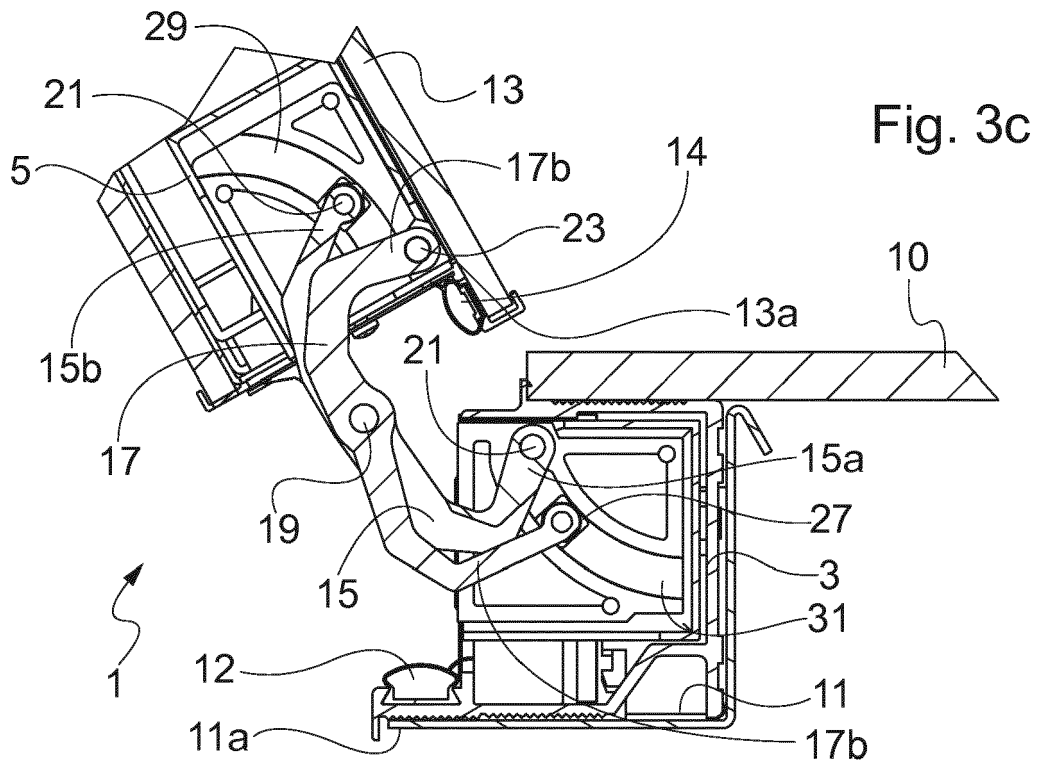


Fig. 3b





EUROPEAN SEARCH REPORT

 Application Number
 EP 16 19 4775

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	* paragraphs [0010], [0012], [0017], [0050] - [0052], [0055], [0056] * * figures 2.1-2.6 *	4	
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A	* paragraphs [0004], [0020] - [0024] * * figures 2a-2c *	3-5	
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A	* page 1, left-hand column, line 55 - right-hand column, line 52 * * figures 1,2 *	3-5,7,8	
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	* page 3, line 29 - page 5, line 21 * * figures 3-5 *		
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 29 March 2017	Examiner Wagner, Andrea
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 03/82 (P04C01)

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

EP 16 19 4775

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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29-03-2017

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