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(71) Applicant: **SFS Group International AG**
9435 Heerbrugg (CH)

(72) Inventors:
- **Cusin, Stefano**
  33170 Pordenone (IT)
- **Ius, Matia**
  33080 Zoppola (IT)
- **Ferrari, Matteo**
  33170 Pordenone (IT)
- **Giust, Mauro**
  33077 Sacile (IT)
- **Pitussi, Massimiliano**
  33097 Spilimbergo (IT)

(54) **DOOR HINGE**

(57) A hinge for pivotably connecting a sash of a door or window to a frame comprises a sash part designed to be attached to a sash, and a frame part intended to be attached to a frame. Said sash part and said frame part are interconnected by a pivot elemend which also defines a pivot axis. The pivoting functionality is being accomplished by the pivot element via three bearing tubes, axially aligned along said pivot axis. The first and the second bearing tube are being fixedly attached to the frame part and the third bearing tube is attached to the sash part. The hinge axis itself providing the axial alignment is being realised by an axial pin extending through all three bearing tubes. Thus the third bearing tube can be be arranged and pivoatably held between the first and second bearing tube with axial play.

The axial pin exhibits an annular recess with a depth t. The third, bearing tube comprises, arranged at it's circumference, a radially aligned threaded hole intended for accomodating a locking screw. Said locking screw again is chosen in length and diameter to engage with the axial pin's annular recess, when mounted in said radially aligned threaded hole, thus locking the pin's axial position relative to the third bearing tube.

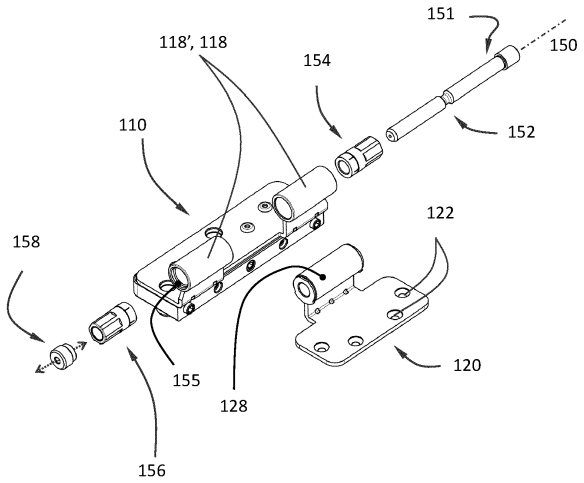

Fig. 1

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Description

[0001] The invention described hereinafter refers to an adjustable monoaxial hinge for heavy load applications (typically up to 150kg) such as aluminium clad wood external doors/windows in a flush-fit design (i.e. the door or window is flush with the frame when closed). Such a hinge has 2D all-mechanical adjustments and allows an easy and aesthetical installation without any need to mill or drill the door aluminum surface (i.e. in case of a door, the outside). Said hinge is installed on the wooden surface behind the aluminum external cover so the outer protective cover remains intact. The inventive hinge design has the advantage that nobody ill-intentioned can break down this hinge when the door/window is closed, because the fixation elements are not accessible from the outside.

BACKGROUND AND PRIOR ART

[0002] The aluminum clad wood doors/windows market is a niche of the wood market with only few dedicated hinges construed for this application. Normally hinges designed for PVC or wood applications are being adapted to this specific application. In the alternative hinges developed from those designs are mounted directly on the outer aluminium surface of the door / window with the disadvantages mentioned above.

[0003] Aluminium clad wood doors/windows are often installed on a building's external side (aluminium is preferred due to its improved resistance against the environment and for safety reasons) while the wood part provides favorable internal aesthetics.

DESCRIPTION OF THE INVENTION

[0004] A hinge basically includes at least 3 elements. A central part defining the pivot axis including a bearing and an axial pin plus two blade shaped or (usually) flat fixing plates; one to connect the pivot part to a sash (sash part) and the other one to mount to a frame (frame part). The sash, in the broadest meaning can be part of a window, a door or any other functionally equivalent part of a building.

[0005] A hinge system according to this invention may include at least two hinges, which is especially suitable for doors of considerable weight, such as doors of wood with an exterior cladding of aluminium or other sheet metal. In the following one hinge of such a hinge system shall be described as inventive hinge. They can be used on either side of a sash (right or left hinged installation) and for any required position.

[0006] Accordingly, a hinge for pivotably connecting a sash of a door or window to a frame comprises a sash part designed to be attached to a sash, and a frame part intended to be attached to a frame. Said sash part and said frame part are interconnected by a pivot elemend which also defines a pivot axis. The pivoting functionality is being accomplished by the pivot element via three bearing tubes, axially aligned along said pivot axis. The first and the second bearing tube are being fixedly attached to the frame part and the third bearing tube is attached to the sash part. The hinge axis itself providing the axial alignment is being realised by an axial pin extending through all three bearing tubes. Thus the third bearing tube can be be arranged and pivoatably held between the first and second bearing tube with axial play. In other words, the free gap between between first and second bearing tube is larger than the length of the third bearing tube to allow for a adjustment along the pivot axis.

[0007] The axial pin exhibits an annular recess with a depth t. Further, the third (i.e. middle) bearing tube comprises, arranged at it's circumference, a radially aligned threaded hole with a diameter d intended for accomodating a locking screw. Said locking screw again is chosen in length and diameter to engage with the axial pin's annular recess, when mounted in said radially aligned threaded hole, thus locking the pin's axial position relative to the third bearing tube.

[0008] In a further embodiment said threaded hole (arranged on the middle bearing tube) defines an axial hole axis along which the said locking screw is movable. Preferably said axis will be arranged in a plane perpendicular to the bearing tube's longitundinal axis and will, further preferred, intersecting this axis. One can now define a distance x along the hole axis between the outer circumference of the third bearing tube (at the location of the threaded hole) and the outer surface of the frame or respective cladding, when the hinge is mounted and in its closed position. This distance x thus marks the available room between the locking screw's threaded hole and the cladding. This distance is relevenat when contemplating how much space is available for using a tool to unscrew the locking screw. As one can understand from this description and the drawings, without this screw one would be able to remove the axial pin and dissassemble the hinge, thus separating e.g. a door from its frame even in a closed and locked state. If one chooses the position of said threaded hole for the locking screw properly, one will not be able to dissassemble the hinge when the door is closed, it will be however easily possible when the door is in its open position. Inventively it has been found that the position of the threaded hole should be chosen such that for x is valid $t < x < 2d$. In other words, the length of the screw is less important than the depth t of the resess and the diameter d of the screw. The most preferred screw used for this locking screw will be a grub screw which can be screwed in flush or even countersunk. Most of those will use a head with a hexagon socket, to be used with a hex wrench or a respective angled tool. The limits given for distance x, a measure for the free space to insert a tool into the socket, will prohibit an easy removal of the grub (locking) screw with standard tools. Depending on the dimensions of the hinge itself, alternativ (more narrow) values for x are $d < x < 1.5\,d$ or $t < x < d$.

[0009] Said hinge can further be construed such that said axial pin is being supported in bearing bushes in said bearing tubes. The bearing bushes may be made from bearing metal, e.g. bronze.

[0010] In a further embodiment a hinge's frame part comprises a bearing plate fixedly connected to the bearing tubes, and a so called box to be fixedly attached to the frame. Said box again houses a cage and a slider. The slider is being held in said cage by adjustment screws allowing for a lateral adjustment transversal to the hinge axis and that the slider is being fixedly attached via fasteners such as rivets to the bearing plate such that bearing plate can be laterally adjusted with respect to the cage. The cage again may comprise a plurality of fixing holes foreseen to accommodate fasteners for fixing the cage to a frame.

[0011] As mentioned above, a hinge according to the present invention is being fixed (normally) to a wooden frame planked with an outer aluminum cladding. The frame will exhibit cut-outs, which can be milled e.g. during manufacturing of the frame. In order to facilitate exact position of the hinge's frame part on the frame the hinge's cage may exhibit at least two positioning pins such as bolt-shaped extensions on a surface of the cage to be in contact with the frame when the hinge has been mounted. Those bolt-shaped extensions will slide into respective bores in the cut-outs. Thus an easy and clear alignment of the hinge is being facilitated.

[0012] In a further embodiment the cage comprises at least one threaded cross hole, arranged transversely to at least one the fixing holes and merging into said fixing hole. The threaded cross hole is prepared for accomodating a safety grub screw. The safety grub screw is intended to block the acess to the fixing screw(s) between frame part and frame. The grub screw can only be accessed when the door is in an open state, not when closed. Even removing the outer aluminum cladding will not help.

[0013] The axis of the threaded cross hole preferably does intersect the axis of the merged fixing hole. In the alternative the axis of the threaded cross hole and the axis of the merged fixing hole may be offset by a third of the diameter of the fixing hole. The protective effect can be achieved by both embodiments, since the safety grub screw will block the access to the fasteners used for attaching the frame part to the frame. The safety grub screws will only be accessible and removable when the door / sash is in a open position.

[0014] As a third safety feature hinge as described above may exhibit a sash part with at least one positioning pin extending from the bearing plate, away from the bearing tube, with a length chosen to be at least 30%, preferably 50% or more of the distance between the pivot axis and the sash part's mounting plane. Even when all screws are being removed connecting the sash part from the sash/door, the positioning pin, accomodated in a respective milled hole in the sash / door will be stuck. The reason is that the hinge only allows for a pivotal movement, however the pin can only be pulled out in a linear movement.

[0015] In a further embodiment one of the first or second bearing tubes of the frame part exhibits an internal thread arranged at it's outer end. This internal thread is being prepared to accommodate a terminal grub screw engaging with the internal thread. Said screw thus acts on a bearing bushing in said bearing tube allowing for axially adjustment of the position of the axial pin. When mounted properly, the hinge can be adjusted in height (sash relative to frame).

FIGURES

[0016] Any reference to upper, lower, lateral, vertical, horizontal and other directions is being given with a position of the hinge in mind mounted on a vertical sash/frame or oriented in a respective way.

Figure 1 shows a hinge 100 in exploded view. Both the sash part 120 and the frame part 110 show bores 114, 122 to be used to mount the hinge 100 to a frame 109 or sash 103 respectively. The pivot axis (hinge axis) 150 is technically realized by a pin 151 which is being axially inserted through three bearing tubes 118, 118', 128, two located on the frame part 110 and one on the sash part 120. The pin 151 is held in bushings 154, 156 on the frame part 110. The pin 151 shows one annular recess 152, which is located, when correctly mounted within the sash part's 110 section of the bearing tube 128. It forms an essential part of the safety feature preventing the pin 151 to be removed unauthorizedly. The position of the sash part 120 of the hinge 100 can be adjusted axially by means of a terminal grub screw 158 which interacts with a respective internal thread 155 in the bearing tube 118' of the frame part 110 of the hinge 100. The adjustment can be realized without unlocking the a.m. safety feature.

Figure 2 shows the frame part 110 of the hinge 100 separately under a different viewing angle. The bushings 154, 156 have been inserted in the respective bearing tubes 118, 118'. Rivets 112 mark the connection point to the slider 140, a functional part described later below.

Figure 3 shows, again in exploded view, that the bearing plate 116 of the frame part 110 of the hinge 100 is being irremovably bolted to the slider 140 by means of connecting rivets 112. Irremovably means in this context "with regular tools" or "without massive invasive means". The slider 140 is surrounded frame-like by a cage 130; slider 140 and cage 130 together are referred to as box 117.

[0017] As seen in figure 4, the slider 140 is supported slidably in one (lateral) direction in said cage 130. The

slider 140 can be shifted by means of lateral adjustment screws 142 within the cage's 130 recess 137. Since the slider 130 is connected with the bearing plate 116 via rivets 112, any adjusting movement of the slider is being transferred directly to the bearing plate 116. By that, the relative distance between a sash 109 and frame 103 can be effectively adjusted. The locking grub screw 134 can then block the relative movement and secure the adjusted position the slider relative to the cage after adjustment has been accomplished.

[0018] It is to be noted, that the "openings for passage of screws for fixing box to frame" 114 as shown in figure 2 are not meant to fixedly connect the bearing plate 116 (Fig. 3) to a frame 109. They only allow access to the fixing holes 136 in cage 130. Figures 3 and 4 clearly show that it is the box 117, notably the cage 130, that is being attached to a frame 109. As will be shown later in figure 12, the cage 130 / box 117 is to be placed in a recess milled out of the (wooden) frame 109. Safety grub screws 132, placed in threaded cross holes 138 of the cage body can block access to the fasteners in the fixing holes 136.

[0019] Figure 5 shows a view on a inventive hinge 100 from the sash 103 / frame 109 side. Both frame part 110 and sash part 120 show positioning pins 124, 119. Their counterparts can be drilled or milled from the frame/sash material e.g. with the aid of a drill template to warrant a correct position within the structural element.

[0020] Figure 6 shows a straight view on a hinge 100 similar to the view of figure 5. This figure is being displayed to show the lateral adjustment range of the slider 140 relative to the cage 130. A gap 114 or 145 respectively mark the clearance left after the slider 140 has been moved to one of the respective outer positions in the cage's 130 recess 137. The arrow shows for both cases where the slider touches the stop.

[0021] Figure 7 shows the adjustment range 106along the pivot axis 150. As mentioned above, this adjustment is being accomplished by means of a terminal grub screw 158 (not visible in Figure 7) interacting with a respective thread 155 foreseen in the bearing tube(s) 118', 118 of the frame part 110. The adjustment can be accomplished by an allen key which matches a respective recess or socket in the grub screw 158. Figure 7 show the respective upper 102 and lower 101 position (arrow) and the gaps 104, 105 representing the vertical adjustment range.

[0022] Figures 8 and 9 display an important safety feature of this inventive hinge design. A grub screw 132 is arranged in the body of the cage 130. The orientation of the threaded hole is inclined, preferably rectancular to the axis of the fixing screw used to attach the cage / box to the frame. In other words, the axis of orientation of the threaded hole (125, cf fig.14) and the axis of orientation for the target position of the fixation screw preferably intersect.

[0023] In other words, after having brought the fixation screw (not shown) between box/cage and frame in the clearance 111 into its final position, the grub screw 132 is being screwed in so far that it will block the access to the fixation screw. It has to be noted, that this effect can also be achieved if both axes of orientation do not perfectly intersect but are offset by a distance which is sufficient to block the insertion of a tool to loosen or extract the fixation screw.

[0024] The grub screw 132 can only be properly removed, if the hinge is in its "open" position. In other words, a burglar trying to dissasemble the hinge to gain access to a building cannot do so by simply using a screwdriver.

[0025] Another safety feature is being shown in figure 10: The bearing tube 128 arranged on the sash part 120 exhibts a threaded cross hole 125 (cf. fig. 14) for a grub screw 126. This grub screw will interact with the annular recess 152 in the hinge pin 151. The position of the cross hole 125 on the bearing tube 128 will be chosen such that it cannot be accessed while the hinge is in the "closed" position, but is accesible in the open position. The grub screw 126 does that way not block the pivoting movement and also not the possibility for the vertical adjustment as shown in figure 7.

[0026] During mounting, the sash part 120 and the frame part 110 will be arranged in such a way that their bearing tubes 118, 118', 128 align and the pin / pivot axis 151 can be inserted. It will be positioned such that the grub screw 126, inserted in the cross hole 125 of the sash part's 120 bearing tube 128 can engage the annular recess 152 in the pin 151. As a third step the terminal grub screw 158 for the vertical adjustment can be inserted in the (lower) end of the frame parts 110 bearing tube 118 or 118'.

[0027] Figure 11 and 12 shall exemplify how the inventive hinge is being installed in a wooden frame 109 / sash 103 cladded with aluminum 108 (sheet metal). As indicated above the frame part's fixation screws (not shown) are being protected by a blocking grub screw(s) 132 as exhibited in figure 9. Dissassembly of the hinge axis (pin) 151 is blocked by the grub screw 126 shown in figure 10. The sash part 103 seems to be removable, because the flat metal plate cannot accommodate a mechanism like the frame part 110 (figures 9, 10). However, the positioning pin 124 shows a considerable length. Even if a burglar removes the fixation screws (sash part 120 to sash 103) he will not be able to flip the sash part 120 along the hinge axis 150 in order to remove the door/window/sash 103. The reason is that the positioning pin 124 will jam in it's aligning hole and will not allow to remove the sash part 120. Figures 11 and 12 also show gaskets 107 arranged between frame 109 and sash 103.

[0028] In order to clarify the function and position of the threaded hole 152 for locking screw 126, figure 13 and 14 aare being used. Figure 13 shows the sash part 120 separately with positioning in 124. The hinge axis 150 lies within a transvese plane 150 defined by the angled part of sash part 120. The threaded hole 125 defines a hole axis 127 which defines an angle β with the transverse plane 123.

[0029] Figure 14 is a view straight on hinge axis 150,

the threaded hole 125 together with hole axis 127 has been shown with its diameter d. hole axis 127 will intersect with hinge axis 150 in bearing tube 128.The distance x is the distance between the outer circumfeerence if the bearing tube 128 at the location of threaded hole 125 and the intersection of hole axis 127 with the surface of outer (aluminum) cladding 108.

[0030] The whole arrangement of the hinge as described above can be realised with manufacturing techniques known in the art, with milled and cold formed parts arranged and welded according to design; screwed, welded, riveted or bolted together as required.

Claims

1. A hinge (100) for pivotably connecting a sash (103) of a door or window to a frame (109), comprising:

   a sash part (120) designed to be attached to a sash (103),
   a frame part (110) intended to be attached to a frame (109) and
   a pivot element interconnecting said sash part (110) and said frame part (120) and defining a pivot axis (150);
   wherein

   - the pivot element comprises three bearing tubes (118, 118', 128), axially aligned along said pivot axis (150); the first and the second bearing tube (118, 118') being fixedly attached to the frame part (110) and the third (128) to the sash part (120);
   - the axial alignment being ensured by an axial pin (151) extending through all three bearing tubes (118, 118', 128); allowing the third bearing tube (128) to be arranged between the first and second bearing tube (118, 118') with axial play;

   characterized in that

   - the axial pin (151) exhibits an annular recess (152) with a depth t; and
   - the third bearing tube (128) comprises, arranged at it's circumference, a radially aligned threaded hole (125) with a diameter d for a locking screw (126);
   - said locking screw (126) is chosen in length and diameter to engage with the axial pin's (151) annular recess (152), when mounted in said radially aligned threaded hole (125), thus locking the pin's (151) axial position relative to the third bearing tube (128).

2. A hinge (100) according to claim 1, wherein

   - the threaded hole (125) defines an axial hole axis (127) along which the the locking screw (126) is movable, and;
   - a distance x is being defined along the hole axis (127) between the outer circumference of the third bearing tube (128) and the outer surface of the frame or respective cladding (108), when the hinge (100) is mounted and in its closed position,

   characterized in that the position of the threaded hole (125) is chosen such that for x is valid $t < x < 2d$.

3. A hinge according to claim 1-2, **characterized in that** said axial pin (151) is being supported in bearing bushes (154, 156) in said bearing tubes (118, 118').

4. A hinge according to claim 1-3, **wherein** the frame part (110) comprises a bearing plate (116) fixedly connected to the bearing tubes (118, 118'), and a box (117) to be fixedly attached to the frame; said box (117) again comprising a cage (130) and a slider (140), **characterized in that** the slider (140) is being held in said cage (130) by adjustment screws (142) allowing for a lateral adjustment transversal to the hinge axis (150) and that the slider is being fixedly attached via fasteners such as rivets (112) to the bearing plate (116) such that bearing plate (116) can be laterally adjusted with respect to the cage (130).

5. A hinge according to claim 4, **characterized in that** the cage (130) comprises a plurality of fixing holes (136) foreseen to accommodate fasteners for fixing the cage (130) to a frame (109)

6. A hinge (100) according to claims 4-5, **characterized in that** cage (130) exhibits at least two positioning pins (119) such as bolt-shaped extensions on a surface of the cage to be in contact with the frame (109) when the hinge (100) has been mounted.

7. A hinge (100) according to claims 4-6, **characterized in that** cage (130) comprises at least one threaded cross hole (138), arranged transversely to at least one of the fixing holes (136) and merging into said fixing hole (136), said threaded cross hole (138) laid out for accomodating a safety grub screw (132).

8. A hinge (100) according to claim 7, **characterized in that** the axis of the threaded cross hole (138) does intersect the axis of the merged fixing hole (136).

9. A hinge (100) according to claim 7, **characterized in that** the axis of the threaded cross hole (138) and the axis of the merged fixing hole (136) are offset by a third of the diameter of the fixing hole (136).

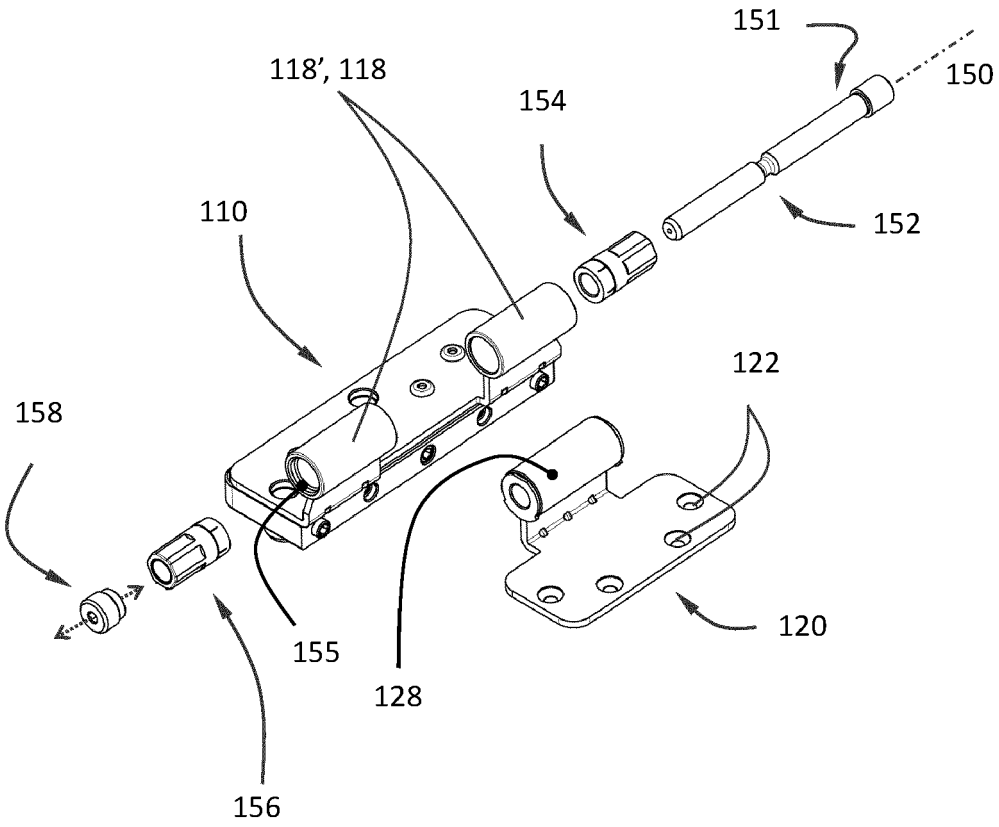
10. A hinge (100) according to claims 1-9, **characterized in that** one of the first or second bearing tubes (118, 118') of the frame part (110) exhibits an internal thread (155) arranged at it's outer end.

11. A hinge (100) according to claim 10, **characterized in that** a terminal grub screw (158) engaged with the internal thread (155) acts on a bearing bushing (156) in the bearing tube (118) to axially adjust the position of axial pin (151).

12. A hinge (100) according to claims 1-11, **characterized in that** the sash part (120) exhibits at least one positioning pin (124) extending from the bearing plate (116) away from the bearing tube (128), with a length chosen to be at least 30%, preferably 50% or more of the distance between the pivot axis and the sash part's mounting plane.

13. A hinge according to claim 2, **characterized in that** for x is valid $d < x < 1.5\ d$.

14. A hinge according to claim 2, **characterized in that** for x is valid $t < x < d$.


151
150
118', 118
154
110
152
122
158
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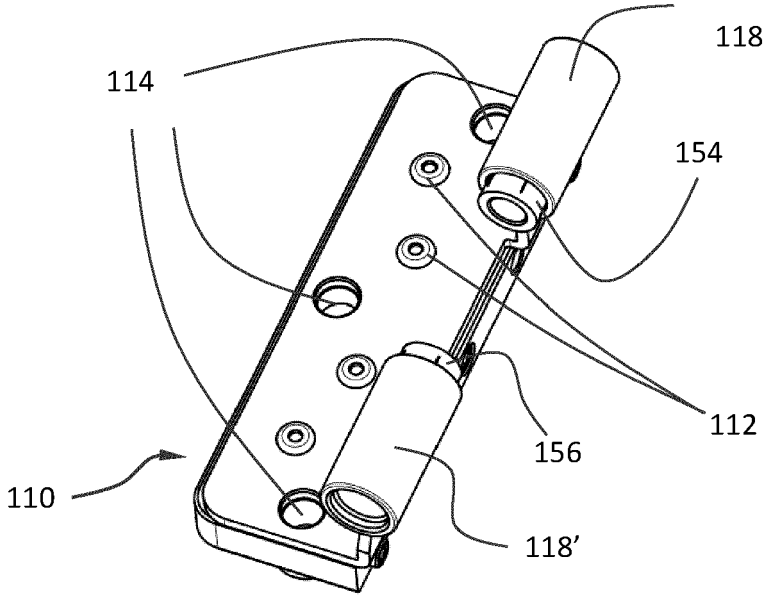
155
128
156

Fig. 1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114
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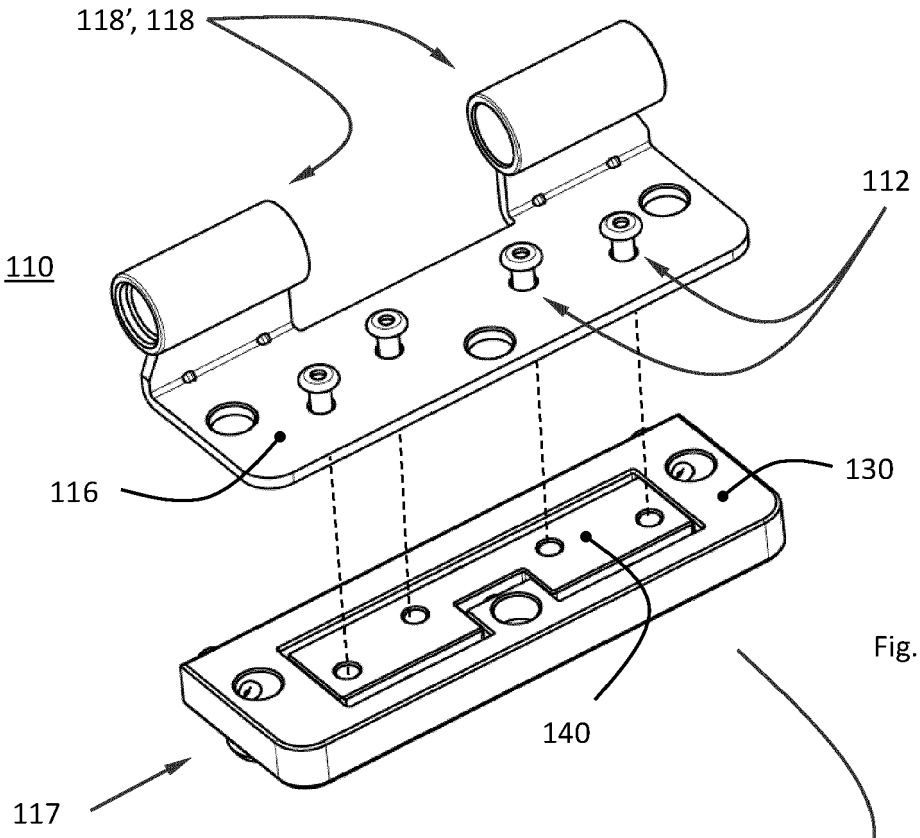
112
156
110
118'

Fig. 2


118', 118
112
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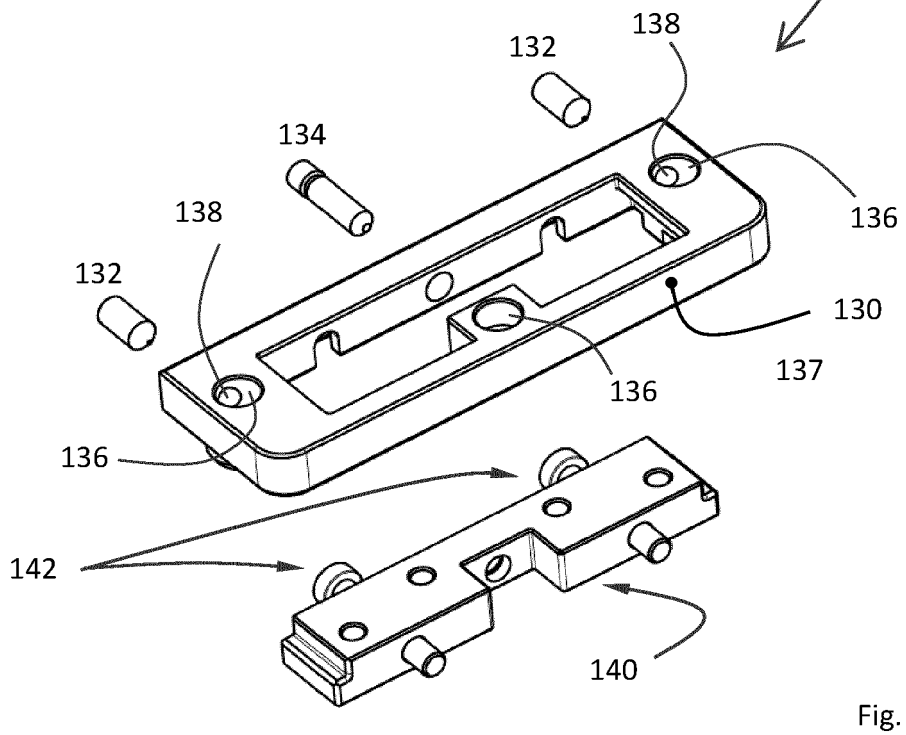
116
130
140
117

Fig. 3


138
132
134
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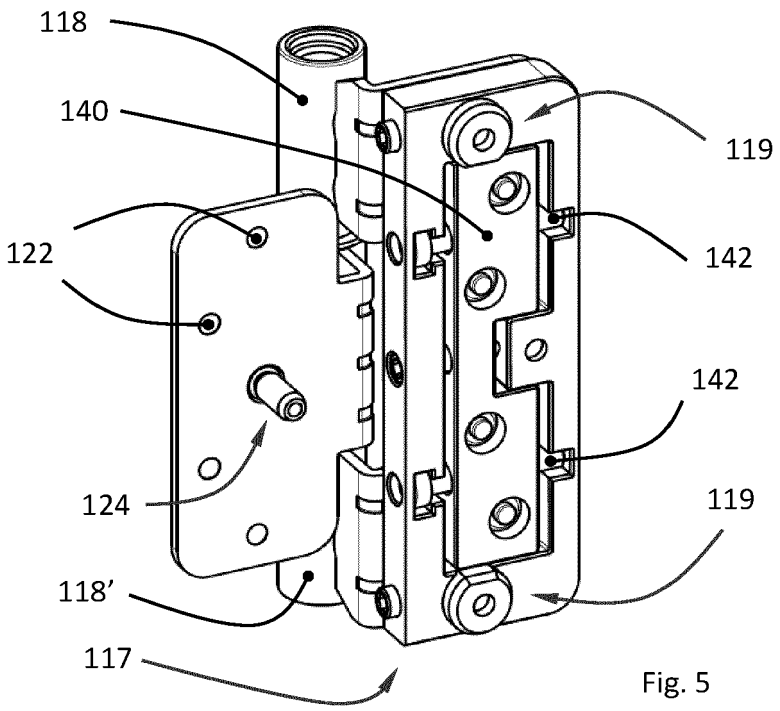
136
142
140

Fig. 4


118
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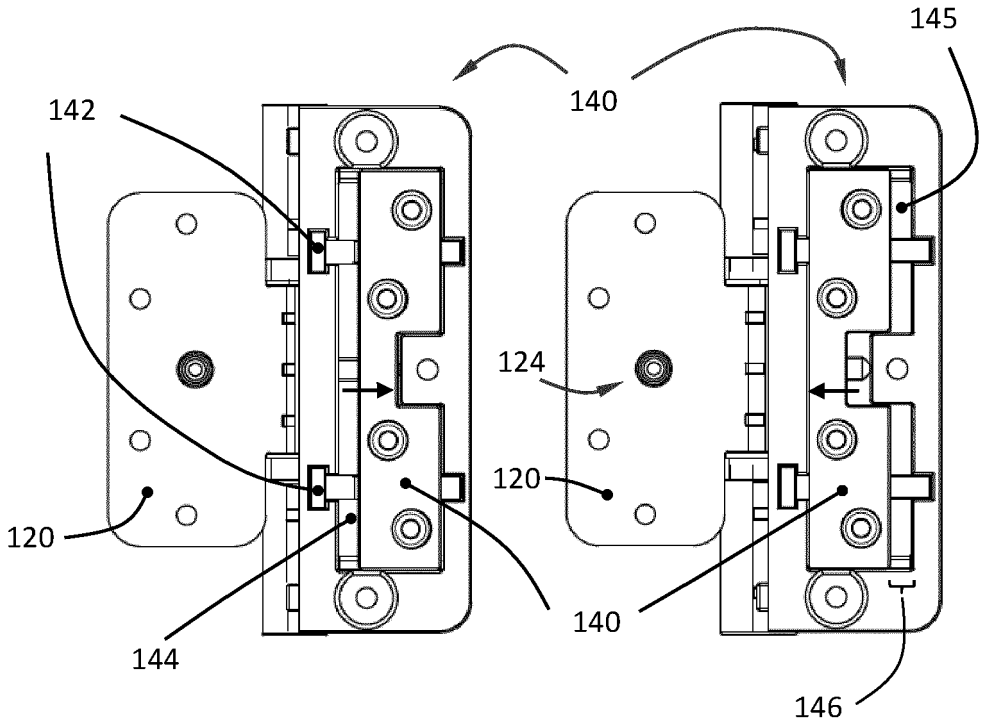
118'
117

Fig. 5


145
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146

Fig. 6

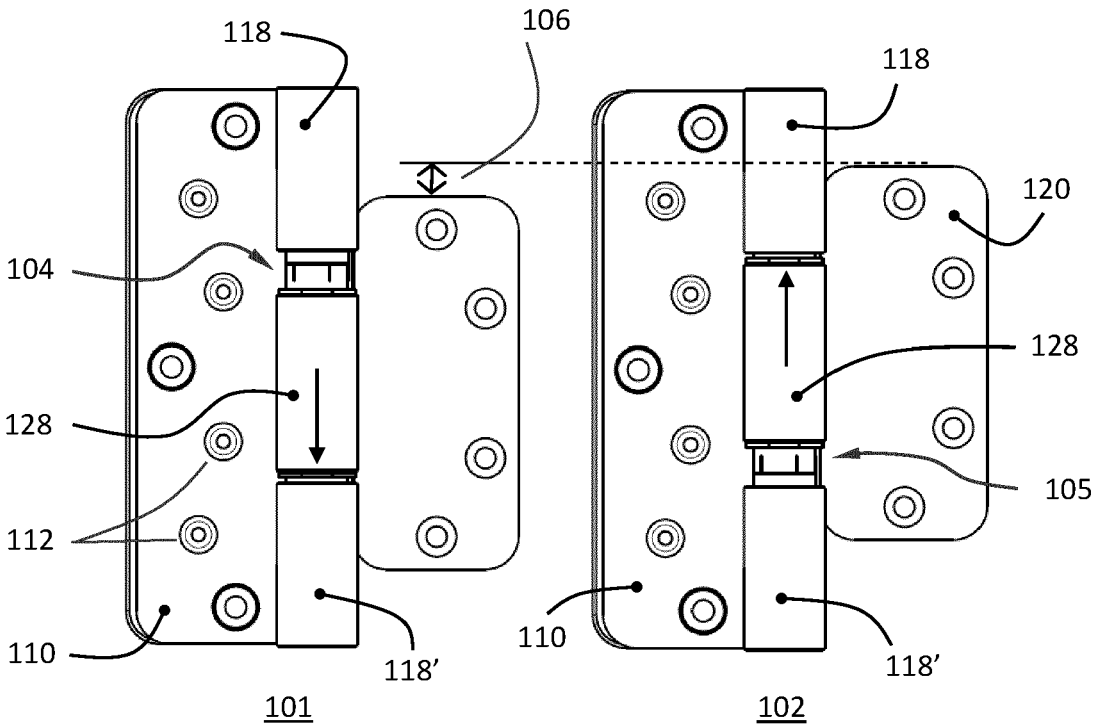

Fig. 7

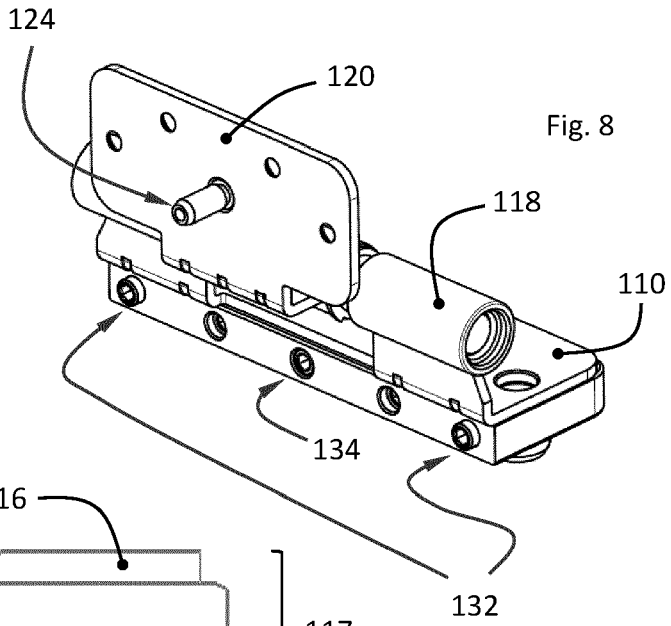

Fig. 8

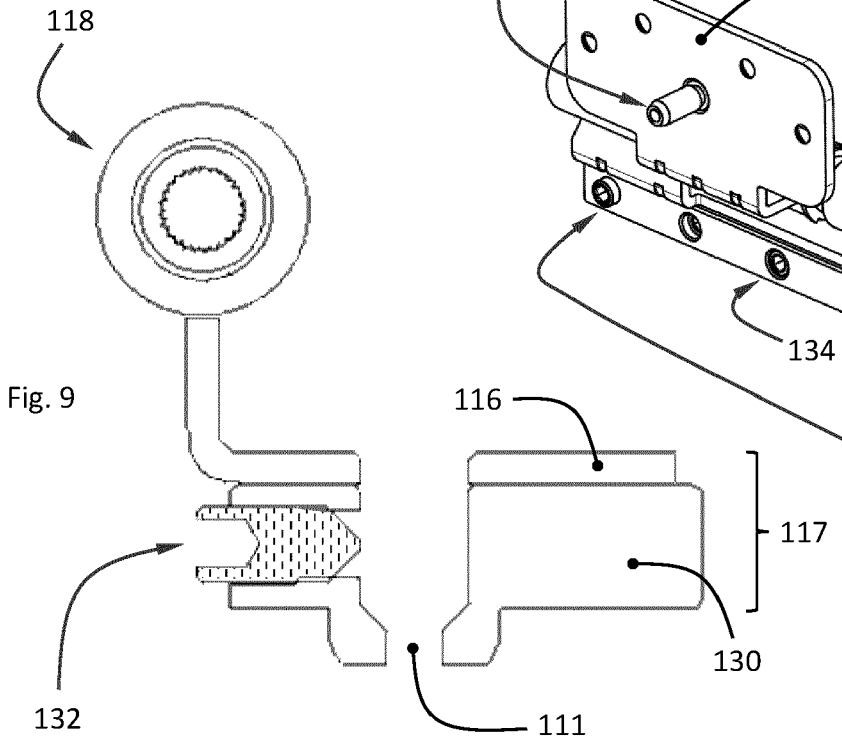

Fig. 9

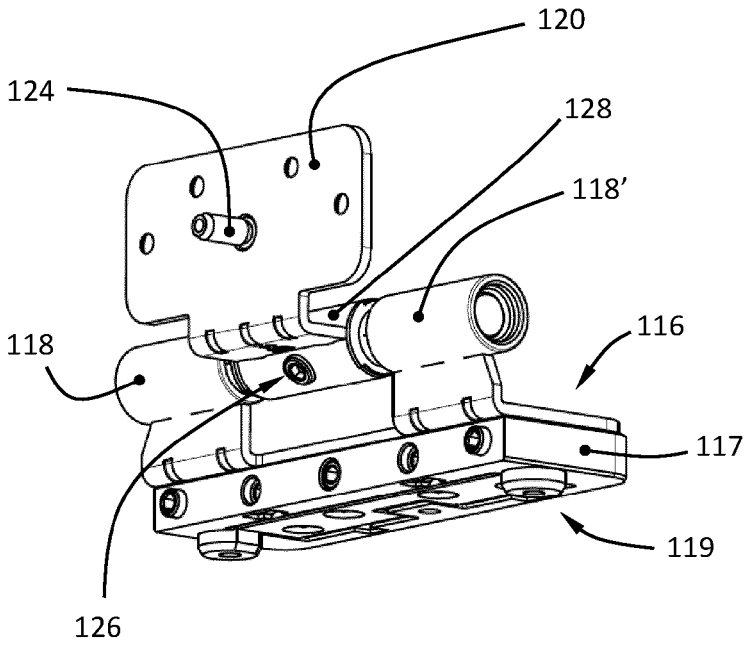

Fig. 10

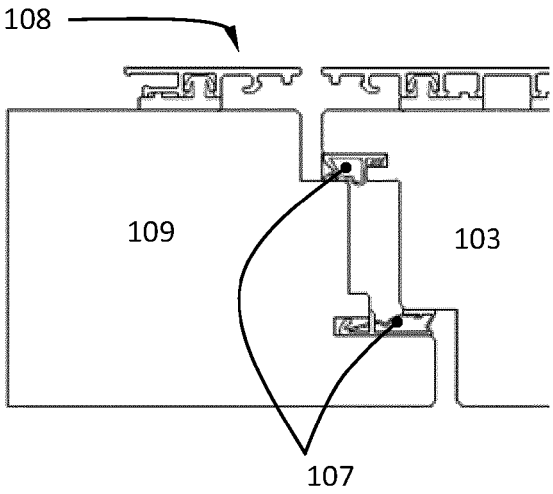

Fig. 11

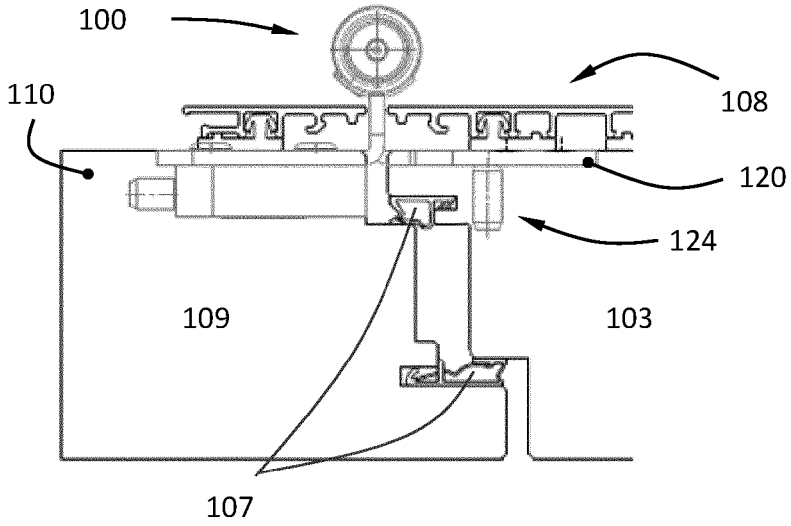

Fig. 12

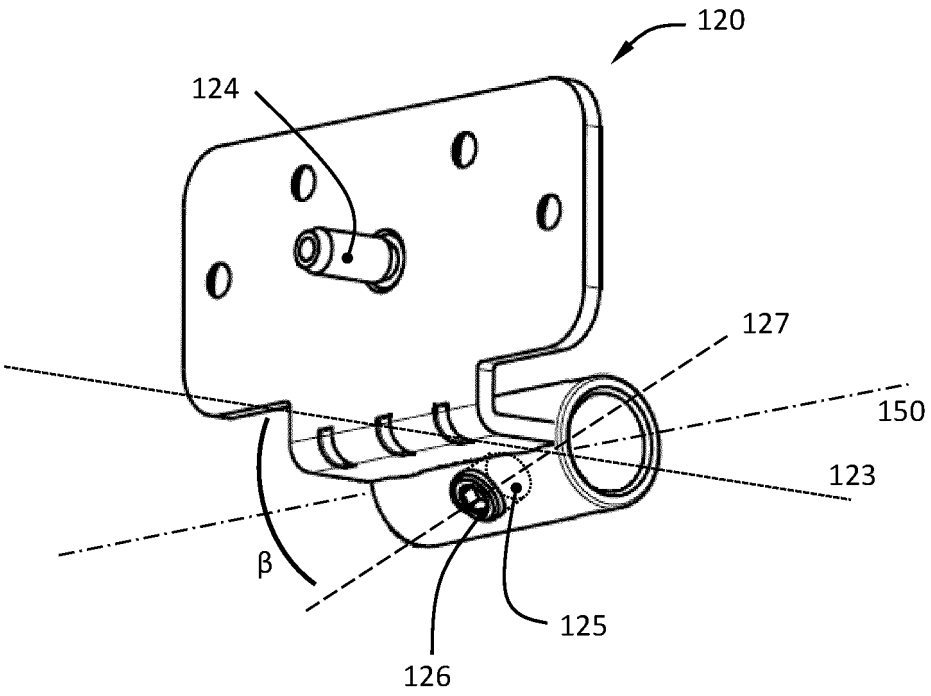

Fig. 13

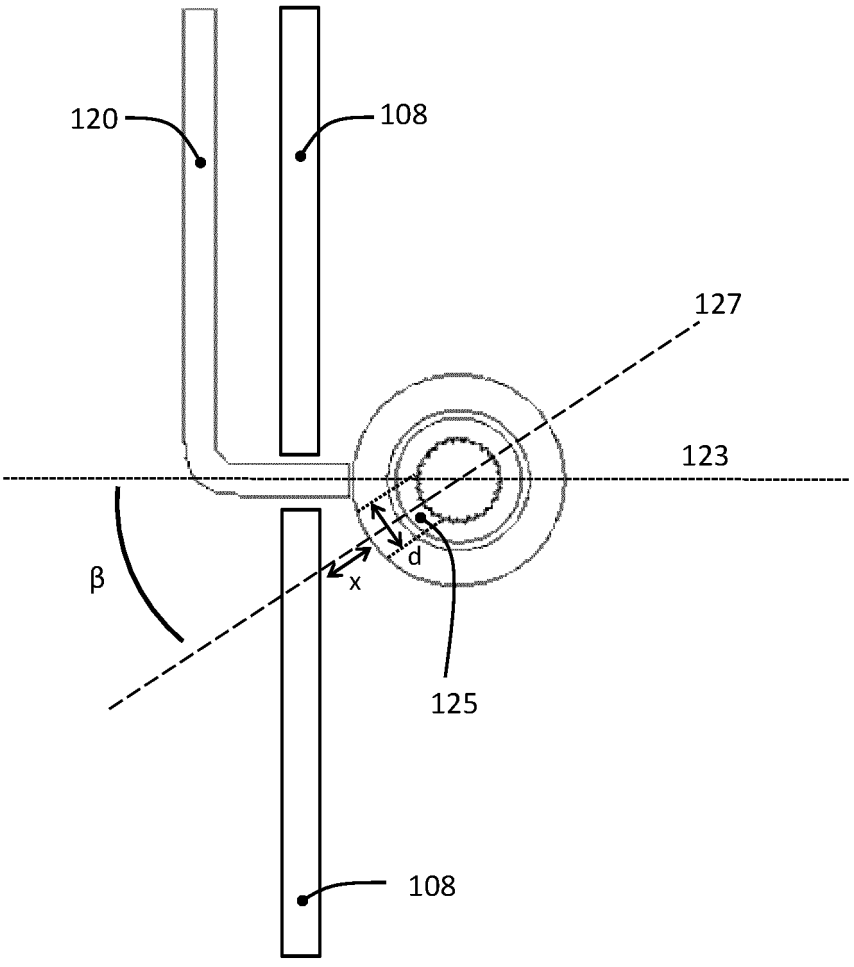

Fig. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 20 21 0799

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	DE 20 2020 002389 U1 (FAPIM S P A [IT]) 6 July 2020 (2020-07-06) * paragraph [0012]; figures *	1-3,10, 11,13,14	INV. E05D3/02 E05D5/12 E05D5/14
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Y	* paragraphs [0032] - [0036]; figure 4 *	4-9	
Y	US 2011/232033 A1 (BARTELS THOMAS [DE]) 29 September 2011 (2011-09-29) * figure 2 *	4-9	
A	JP H06 346654 A (NOGUCHI HARDWARE CO LTD; ISOKAWA SANGYO KK) 20 December 1994 (1994-12-20) * figures *	4-9	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 August 2021	Witasse-Moreau, C

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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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 12-14

   Three knuckles hinge with an axial pin maintained in position with a transverse locking screw, the distance between the locking screw and the frame when the hinge is mounted being limited.

   ---

2. claims: 1, 4-9

   Three knuckles hinge with an axial pin maintained in position with a transverse locking screw, a frame part of the hinge being transversally adjustable.

   ---

3. claims: 1, 10, 11

   Three knuckles hinge with an axial pin maintained in position with a transverse locking screw, the hinge being vertically adjustable at the hinge axis.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 21 0799

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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17-08-2021

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