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(71) Applicant: **Focchi S.p.A.**
47824 Poggio Torriana (Rimini) (IT)

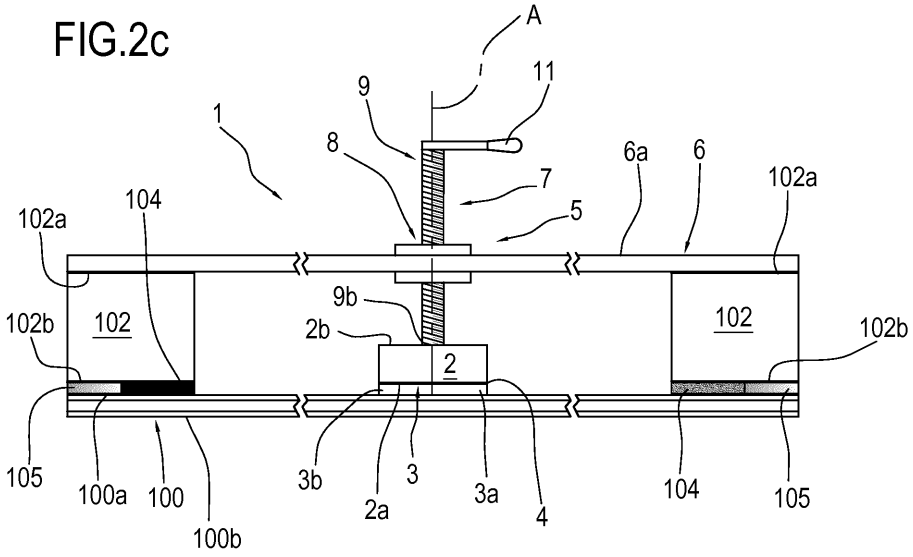
(72) Inventor: **Casadei, Oscar**
47841 CATTOLICA (RIMINI) (IT)

(74) Representative: **Firmati, Leonardo**
Bugnion S.p.A.
Via di Corticella, 87
40128 Bologna (IT)

(54) Method for replacing a glass panel in a curtain wall and anchoring device used for replacement

(57) A method for replacing a panel (100) in a curtain wall (110) of a building (111) comprises the steps of removing a panel to be replaced (112), thereby forming an opening (O) in said curtain wall (110), preparing a replacement panel (100) comprising a first, in use, inner face (100a) and a second, in use, outer face (100b), positioning and fixing the replacement panel (100) at the opening to block it in such a way that said first face (100a) of the panel (100) partly abuts against the second side (102b) of a vertical member (102) and/or of a beam of a load-bearing structure (101) of the curtain wall (110), spreading a layer (104) of sealing material at a joining zone between said first face (100a) of the panel (100) and the side (102b) of the vertical member (102) and/or of the beam. and waiting for a predetermined period of time ΔT for the layer of sealing material (104) to dry. The step of fixing the panel (100) comprises a step of pulling the first face (100a) of the panel (100) or a step of pushing the second face (100b) of the panel (100) using the anchoring device (1) for keeping the first face (100a) abutted against the second side (102b) of the vertical member (102) and/or of the beam during said predetermined period of time ΔT.

FIG.2c



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Description

[0001] This invention relates to a method for replacing a glass panel in a curtain wall and to an anchoring device used for replacement.

[0002] More specifically, the method and device according to the invention apply to structural silicone curtain walls (or facades), that is to say, curtain walls characterized by a metallic supporting frame (defined by a framework of vertical and horizontal members) and curtain panels glued to the frame by means of silicone adhesives in such a way as to hide the frame almost completely.

[0003] The invention is therefore applicable in particular to the sector of building construction and, more specifically, in the non-routine maintenance of buildings, for the replacement of damaged or worn panels of curtain walls. In the prior art, replacement of a pre-existing damaged panel with a new component is a problematic operation, commonly considered critical, because up to now it has been impossible to restore the original structure. Indeed, at present, replacement of the glazing involves the use of special mechanical fixing tools which interact with the panel in order to hold it in place while the sealing material dries but which cannot then be completely removed.

[0004] More specifically, to date, U-shaped fixing point ducts (not present in the original panel) are fitted to the perimeter of the glazing panels and used to fix and seal the glazing to the frame.

[0005] More precisely, a plurality of angular members are riveted to the structure of the building and then bolted to the panel in the duct cavities so as to keep the panel in position.

[0006] This purely mechanical structure remains anchored to the panel and silicone is added solely to achieve air and water tightness. Disadvantageously, this method, besides requiring changes to the structure of the panel and frame, may negatively affect the functionality of the panel owing to the reduction of the silicone layer (as a result of making the duct).

[0007] Moreover, the need to tighten a bolt laterally of the panel forces the designer to maintain a predetermined minimum clearance between the edges of two adjacent panels, and although this is usually a minor problem, it does constitute a design limiting factor.

[0008] Furthermore, it should be stressed that each time a panel is replaced, it is necessary to calculate a different, *customized* number of bolts and ducts as a function of weathering agents and panel size, with considerable complications in terms of design and time.

[0009] Alternatively, to date, another method has been used which provides visually less noticeable results but which is considerably more complex. This method entails making a panel with different sized layers of glass in order to create a indented perimeter (on the inside) where a mounting unit can be fitted for the panel to be bolted.

[0010] The mounting unit is in turn provided with holes for receiving "outside" bolts which, once the panel has been positioned, are tightened from the outside of the building structure.

[0011] Further, to allow tightening (that is, positioning and passage of the bolt) it is necessary to form angular grooves in the glazing, which considerably complicates the production of the glazing, especially considering that the bolts must be placed at different positions, depending on the type and structure of the glazing.

[0012] Disadvantageously, besides entailing non-uniformity in the structure of the building, this necessarily involves preparing the load-bearing structure of the building to receive the above mentioned mechanical tools, such as pins and bolts.

[0013] In other words, from its earliest stage of design and construction, the structure is bound to a precise "renovation" system which must remain available and practicable for the entire life of the building.

[0014] That also means that replacement of glazing is inevitably linked to the knowledge of the building's structural design and setup and if the construction company responsible for replacement is not the same company which originally designed the building, that may be problematical.

[0015] The aim of this invention is to provide a method and a device capable of overcoming the above mentioned disadvantages of the prior art.

[0016] More specifically, the aim of this invention is to provide a method for replacing a glass panel in a curtain wall and an anchoring device which allow the original structure of the curtain wall to be restored.

[0017] Another aim of the invention is to provide a method for replacing a glass panel in a curtain wall and which is quick and easy to implement.

[0018] A further aim of the invention is to provide an anchoring device used for replacing a glass panel in a curtain wall and which is inexpensive to make. These aims are achieved by a method for replacing a glass panel in a curtain wall and having the technical features described in one or more of the claims from 1 to 9 and by a device used for replacing a glass panel in a curtain wall and having the technical features described in one or more of the claims from 10 to 15.

[0019] More specifically, the method comprises a step of removing the original (or pre-existing panel, thereby forming an opening in the curtain wall of the building, followed by a step of preparing a replacement panel comprising a first, in use, inner face and a second, in use, outer face.

[0020] The replacement panel is then positioned at the opening to block it in such a way that the first face of the panel partly abuts against an outer side of a vertical member and/or of a beam of a load-bearing structure of the curtain wall.

[0021] More precisely, the replacement panel is made to abut against the pre-existing vertical member or beam without any auxiliary element being interposed between them (except for sealant or seals).

[0022] The panel is then fixed to the vertical member

and/or beam by means of an anchoring device and, after that (but in some cases also before that), a layer of sealing material is spread at a joining zone between the first face of the panel and the side of the vertical member and/or of the beam.

[0023] After waiting for a predetermined period of time ΔT for the layer of sealing material to dry, the anchoring device is removed, thereby restoring the original structure of the panel, that is, of the curtain wall.

[0024] According to the invention, the step of fixing the replacement panel to the vertical member and/or to the beam comprises a step of pulling the first face of the panel or pushing the second face of the panel using the anchoring device in order to keep the first face in abutment against the second side of the vertical member and/or of the beam during the predetermined period of time ΔT.

[0025] In other words, the method comprises preparing a contact element having a fixed position relative to the required position of the panel.

[0026] In a first embodiment, the contact element is positioned on the inside of the building, partly facing the first face of the panel. A retaining unit is then associated with the contact element to apply a pulling action on the first face of the panel to hold it in position.

[0027] In a second embodiment of the invention, the contact element is positioned on the outside of the building, partly facing the second face of the panel. A pushing unit is then associated with the contact element to apply a pressing action on the second face of the panel to hold it in position.

[0028] More precisely, with reference to the first embodiment, the method comprises a step of fixing the retaining unit to the first face of the replacement panel and then pulling the retaining unit, using suitable pulling means, in such a way as to press the first face of the panel against the second side of the vertical member and/or of the beam of the load-bearing structure.

[0029] A frame is positioned in contact with the first side of the vertical member and/or of the beam to form a contact element facing the first face of the panel. The retaining unit (preferably slidably associated with the frame) is then moved towards the frame and locked in place relative to the frame when the panel exerts a predetermined pressure on the second side of the vertical member and/or of the beam.

[0030] Preferably, the retaining unit and the frame are connected by a threaded coupling or a pawl mechanism.

[0031] With reference to the second embodiment, on the other hand, the method entails fixing a frame to at least one element of the building or of the curtain wall, on the outside and adjacent to the panel to be replaced in such a way as to define the contact element facing the second face of the panel. Preferably, the frame is fixed to at least two elements of the building on opposite sides of the panel to be replaced.

[0032] In this embodiment, the pushing unit is moved away from the frame to push against the second face of the panel and locked in place relative to the frame when the panel exerts a predetermined pressure on the second side of the vertical member and/or of the beam.

[0033] Preferably, both the fixing of the retaining unit to the panel (first embodiment) and the fixing of the frame to the pre-existing element of the building (second embodiment) are accomplished using adhesive fixing means. Alternatively, suction fixing means might be used. Advantageously, that way, after the period of time ΔT for drying the sealing material has elapsed, these means can be removed easily without leaving any trace of panel replacement.

[0034] Preferably, in both embodiments, a plurality of active units (for pushing or retaining) are provided to act on a corresponding plurality of points of the panel, thus distributing the load.

[0035] The above described method is implemented preferably by a specific device for anchoring the replacement panel and also forming a object of the invention.

[0036] The device of the invention is equipped with a frame which can be connected to pre-existing elements of the building (be they vertical members or panels adjacent to the one to be replaced) and with an active unit (for pushing or retaining) extending between at least one first end portion shaped to abut against the panel (against the first or second face, alternatively) and at least one second end portion opposite to the first. The device also comprises movement means operatively interposed between the frame and the active unit for moving the first end portion towards and/or away from the frame (preferably slidably) thereby causing a pushing action on the second face of the panel or a pulling action on the first face of the panel for abutting the first face of the panel against the outer side of the vertical member or beam, keeping the panel in a predetermined position.

[0037] Thus, in a first embodiment of it (corresponding to the first embodiment of the method), the active unit is a retaining unit, whilst in a second embodiment of it (corresponding to the second embodiment of the method), the active unit is a pushing unit.

[0038] It should be noted that the two embodiments (like the two embodiments of the method) are conceptually the same, in that they involve creating a fixed contact element (i.e. the frame) spaced from and facing the panel and providing an active unit to interact with the panel by pulling or pushing, alternatively, along an operating line substantially orthogonal to the panel itself.

[0039] In both embodiments, fixing means are preferably provided which are interposed, alternatively, either between the active unit (or retaining unit) and the first face of the panel, or between the frame (in particular, a joining portion thereof) and at least one element (pre-existing) of the building, on the outside and adjacent to the panel to be replaced.

[0040] Preferably, the fixing means are adhesive means (or, alternatively, suction means) making it possible to restore the original structure of the face, even after the panel has been replaced, by completely remov-

ing the anchoring device.

[0041] In the first embodiment, therefore, the fixing means are associated with the first end portion of the active unit in order to anchor it to the first face of the panel so as to apply a pulling action on the first face. The active unit is thus a retaining unit.

[0042] In this embodiment, the frame extends transversally to the operating line "A" and comprises at least one joining portion which can be abutted against at least a first side of at least one vertical member or beam of the load-bearing structure of the curtain wall and a contact portion which can be positioned facing the first face of the panel.

[0043] The movement means thus form a pulling unit designed to move the first end portion of the retaining unit along the operating line towards the frame so as to abut the first face of the panel against the second side of the at least one vertical member or beam.

[0044] In the second embodiment, the fixing means are associated with the frame to anchor it to at least one element of the curtain wall on the outside and adjacent to the panel to be replaced. The movement means are designed to move the active unit in such a way as to push it against the second face of the panel so that the first face of the panel abuts against the outer side of the vertical member or beam, thereby keeping the panel in a predetermined position. In this embodiment, therefore, the active unit is a pushing unit.

[0045] It should be noted that in this embodiment, the "at least one element of the building, on the outside and adjacent to the panel to be replaced" is preferably a panel adjacent to the one to be replaced.

[0046] In both embodiments, the movement means preferably comprise at least one threaded coupling defined by a threaded pin and a threaded hole, where the pin can move inside the hole in such a way as to drive the active unit along the operating line.

[0047] These and other features of the invention will become more apparent from the following description of a preferred embodiment of it, illustrated purely by way of non-limiting example in the accompanying drawings, in which:

- Figures 1 a and 1 b are perspective views of a damaged curtain wall and of a panel to replace the damaged one using a first embodiment of the anchoring device according to the invention;
- Figures 2a-2d show schematic plan views of successive steps of a first preferred embodiment of the method for replacing a glass panel in a curtain wall according to the invention;
- Figure 3 shows a schematic view of a second embodiment of the anchoring device according to the invention during use.

[0048] With reference to the accompanying drawings, the numeral 1 denotes a device according to this invention for replacing a glass panel in a curtain wall 110.

[0049] The anchoring device 1 is used for replacing one or more glass panels in a building with a curtain wall, in particular of the "structural silicone" type.

[0050] In effect, the term "curtain wall" denotes a particular type of lightweight outer covering which guarantees, by itself or together with the load-bearing structure 101, all the normal functions of an outer wall and which bears no load other than, for example, its own weight and the force of the wind. These loads are transferred to the load-bearing structure through the connections at floors or columns of the load-bearing structure.

[0051] The curtain wall is preferably designed to resist air and water infiltration, wind forces, seismic forces and its own weight.

[0052] The load-bearing structure 101 of the curtain wall 110 is thus the part of the building specifically designed to absorb the external loads and forces incident upon the curtain wall itself during its working life and it consists at least partly of vertical members 102 and beams.

[0053] It should be noted that each vertical member 102 (or beam) has a first side (or inner side) 102a facing the interior of the structure 101 and a second side (or outer side) 102b facing the exterior of the structure.

[0054] The curtain wall then comprises a plurality of juxtaposed panels 100, each connected to the load-bearing structure 101 by means of structural silicone so that no structural element is visible from the outside of the building. The panels 100 are flat (or slightly curved) elements having preferably at least one (and more preferably more than one) glass layer and comprising a first face 100a, or inner face, and a second face 100b, or outer face, opposite to the first face 100a. The first face 100a of the panel 100 abuts against the second side 102b of the vertical member 102 or beam.

[0055] The anchoring device 1 according to the invention is used during replacement of one of the panels in the event of damage or for maintenance purposes, where the pre-existing damaged panel 112 is removed and leaves an opening in the curtain wall 110.

[0056] The device 1 then comprises a frame 6, 26 connectable to pre-existing elements of the building and an active unit 2, 22 extending between at least one first end portion 2a, 22a shaped to abut against the first face 100a or the second face 100b of the replacement panel 100, and at least a second end portion 2b, 22b opposite to the first 2a, 22a.

[0057] Preferably, the active unit 2, 22 is movably associated with the frame 6, 26 to move relative thereto between a rest position and an operating position. More preferably, the active unit 2, 22 is slidably associated with the frame 6, 26 to move relative thereto along an operating line "A" (preferably coinciding with the line of extension of the active unit 2, 22 itself).

[0058] In this regard, the device 1 also comprises movement means 7, 27 operatively interposed between the frame 6, 26 and the active unit 2, 22 for moving the first end portion 2a, 22a towards and/or away from the

frame 6, 26 thereby causing a pushing action on the second face 100b of the panel 100 or a pulling action on the first face 100a of the panel 100. Advantageously, that way, it is possible to make the first face 100a of the panel 100 abut against the outer side 102b of the vertical member 102 or beam, while keeping the panel in a predetermined position.

[0059] Preferably, the movement means 7, 27 comprise at least one threaded coupling 8, 28 defined by a threaded pin 9, 29 and a threaded hole 10, 30. The pin 9, 29 is movable (by rotation) inside the hole 10, 30 to drive the active unit 2, 22 towards or away from the frame 6, 26.

[0060] More precisely, the movement means 7, 27 comprise at least one pin 9, 29 extending along an operating line "A" and having a first, threaded portion 9a, 29a, coupled to a corresponding threaded hole 10, 30 made in the active unit 2, 22 and/or in the frame 6, 26 to move inside the hole 10, 30 itself along the operating line "A".

[0061] That way it is advantageously possible to precisely adjust the pressure of the panel 100 on the vertical member 102, thus guaranteeing that the sealing material dries correctly and holds.

[0062] To allow this pushing or pulling action to be applied to the panel 100, the device 1 also comprises fixing means 3, 23 alternatively (or jointly) interposed between the active unit 2 and the first face 100a of the panel 100 or between the frame 26 and at least one pre-existing element of the building, in particular of the curtain wall 110, (on the outside) adjacent to the panel to be replaced.

[0063] Preferably, the fixing means 3, 23 are adhesive means 3a, 23a.

[0064] More precisely, the adhesive means 3a, 23a comprise a layer of adhesive material interposed alternatively (or jointly):

- between the first end portion 2a of the active unit 2 and the panel 100, and/or
- between the frame 26 (in particular a joining portion 26a thereof) and a pre-existing element of the building (that is, of the curtain wall 110), on the outside and adjacent to the panel to be replaced.

[0065] In the preferred embodiment, this adhesive material is one of the following:

- structural silicone;
- epoxy glue;
- two-sided adhesive;
- other easy-to-remove chemical adhesives.

[0066] An important property of the adhesive material is that it be completely removable from the first face 100a of the panel 100 or from the pre-existing element (preferably the outer face of an adjacent panel) after removing the device 1, so that the original structure of the curtain wall is restored without leaving any trace of replacement of the panel 100.

[0067] Alternatively, the fixing means 3, 23 might be suction means.

[0068] More precisely, in one embodiment not illustrated, the suction means comprise a suction cup or an electric suction cup.

[0069] This embodiment simplifies removal of the retaining unit 2 from the panel 100 or of the frame 26 from the pre-existing element, since there is no need to scrape or remove sticky adhesive.

[0070] However, the use of an adhesive layer, besides being safer, allows considerably reducing the size of the device 1 as a whole and the portion of the panel 100 involved in the pulling action.

[0071] Described below with reference to Figures 1a, 1b, 2a-2d is a first embodiment of the device according to this invention.

[0072] In this embodiment, the fixing means 3 are associated with the first end portion 2a of the active unit 2 in order to anchor it to the first face 100a of the panel 100 so as to apply a pulling action on the first face 100a itself. More precisely, the movement means 7 are designed to apply a pulling action on the active unit 2 and thus on the first face 100a of the panel 100 (causing the first face to abut partly against the second side 102b of the vertical member 102 in order to keep the panel 100 in a predetermined position).

[0073] In this embodiment, therefore, the active unit 2 constitutes a retaining unit. Hereinafter in the description of this embodiment, the terms "active unit" and "retaining unit" are equivalent.

[0074] As already stated, the retaining unit 2 has at least one first end portion 2a and at least one second end portion 2b opposite to the first 2a.

[0075] Preferably, the retaining unit 2 extends between the first end portion 2a and the second end portion 2b, along its operating line "A" which, in use, is transversal, preferably orthogonal, to the inner face (or first face) 100a of the panel 100.

[0076] The first end portion 2a is shaped to abut against the inner face of a replacement panel 100 to be applied to the curtain wall and is, in use, associated (or able to be associated) with the fixing means 3 (in particular adhesive means 23a) by which the retaining unit 2 is fixed to the panel 100.

[0077] More precisely, the first end portion 2a of the retaining unit 2 comprises at least one end edge 4 lying in a plane "B" which, in use, is substantially parallel to the face of the panel 100 to which it must be connected, that is, the first face 100a.

[0078] More specifically, the plane "B" is substantially orthogonal to the operating line "A" of the retaining unit 2.

[0079] Preferably, as already mentioned, the fixing means 3 for fixing the first end portion 2a of the retaining unit 2 are adhesive means 3a.

[0080] Thus, the first end portion 2a of the retaining unit 2 is a substantially flat face to which the adhesive material (or layer of adhesive material) can be applied.

[0081] Preferably, this face is ribbed to facilitate the adhesive grip and improve the safety and performance of the anchoring device 1.

[0082] Preferably, the movement means 7 (together with the frame 6) constitute a pulling unit 5 designed to move the first end portion 2a of the retaining unit 2 along the operating line "A" towards the frame 6 so as to abut the first face 100a of the panel 100 against the outer side 102b of the at least one vertical member 102 or beam.

[0083] Thus, the pulling unit 5 is operatively connected to the second end portion 2b of the retaining unit 2 in order to move it transversely to the inner face 100a of the panel 100 so as to press the inner face 100a of the panel 100 against the vertical member 102 and/or beam of the load-bearing structure 101.

[0084] It should be noted that, according to the method of this invention, if the panel to be replaced is located in a zone of the curtain wall without a vertical member or beam, a temporary vertical member (not illustrated) is installed in place of the structural vertical member 102. Within the spirit of the invention, however, the temporary vertical member fulfils the same function as the structural member.

[0085] The pulling unit 5, being located inside the structure 101, moves the retaining unit 2 towards itself.

[0086] It should be noted that the pulling unit 5 acts along the operating line "A" of the retaining unit 2 (orthogonal to the plane "B"): more precisely, it defines the operating line.

[0087] Advantageously, the panel 100 can thus be held in position (vertical) in abutment against the structural vertical member 101 or beam without mechanically interfering with the panel itself (and with the structure), allowing the original curtain wall to be totally restored.

[0088] It should be noted that the frame 6 extends transversely to the operating line "A" and has at least one joining portion 6a and a contact portion

[0089] The joining portion 6a can be abutted against at least a first side 102a of at least one vertical member 102 or beam of the load-bearing structure 101 of the curtain wall 110. Preferably, there are at least two joining portions 6a to be abutted against two successive vertical members 102 or beams.

[0090] The contact portion, on the other hand, is shaped to face the first face 100a of the panel 100.

[0091] Thus, in the preferred embodiment, the frame 6 is defined by a crosspiece or plate extending transversely (preferably orthogonally) to the operating line "A" (that is, parallel to a plane defined by the panel 100) to come into abutment against one or two vertical members of the structure 101. Preferably, the frame 6 is defined by a crosspiece or plate of a size such that it comes into abutment against two successive vertical members 102 (or beams).

[0092] The movement means 7 are interposed between the retaining unit 2 and the frame 6.

[0093] As mentioned above, the movement means act orthogonally to the plane "B" so as to move the retaining unit 2 along the operating line "A" towards the frame 6 in order to press the inner face 100a of the panel 100 against the vertical member 102 and/or against the beam of the load-bearing structure 101.

[0094] In other words, the frame 6 and the movement means 7 define a first jaw of a vice whose second jaw is defined by the retaining unit 2 and the panel 100 together.

[0095] This "vice" is tightened on the vertical members 102 (or beams) of the structure 101 to hold the panel 100 in position while the silicone dries.

[0096] In order to make the pulling action easily adjustable, the movement means are defined preferably by the aforementioned threaded coupling 8 between the pin 9 and the hole 10.

[0097] In this embodiment, the pin 9 preferably comprises a second portion 9b, opposite to the first portion 9a and rotatable freely relative to the retaining unit 2 (if the hole is made in the frame 6) and/or relative to the frame 6 (if the hole is made in the retaining unit 2).

[0098] In the embodiment illustrated, in order to maximize the working stroke of the anchoring device, the second portion 9b of the pin 9 is axially constrained to the retaining unit 2 and rotatable freely relative to it about an axis corresponding to the operating line "A".

[0099] Preferably, the first portion 9a is associated with a grip unit 11 shaped to allow the pin 9 to be rotated by an operator.

[0100] The first portion 9a is also rotatably and slidably associated with the frame 6, that is, with the crosspiece (by means of the threaded coupling 8). Thus, the threaded hole 10 is made preferably in the crosspiece (or plate) defining the frame 6.

[0101] As schematically illustrated, the hole may be defined by a threaded bush inserted into the frame 6 (that is, into the crosspiece).

[0102] In an alternative embodiment, the contrary might be true, with the second portion 9b axially constrained to the frame 6 and connected by the threaded coupling 8 to the retaining unit 2.

[0103] In a further embodiment, the movement means might comprise two threaded couplings of the pin 9 both with the frame 6 and with the retaining unit 2, where the threads are opposite so that the frame 6 and the retaining unit 2 can be moved towards or away from each other by the same rotation of the pin.

[0104] It should be noted that movement means of another kind are also imaginable.

[0105] For example, the movement means might comprise a pulling portion associated with a free end of a pin 9 (whose other end is connected to the retaining unit) and stop means for holding the pin in position relative to the frame 6.

[0106] The stopping means might, for example, be defined by a pawl mechanism. Whatever the case, the anchoring device is preferably equipped with stopping means (not illustrated) associated with the movement means 7 to hold the latter in the operating position where they keep the panel 100 in abutment against the second

side 102b of the vertical members 102 or beams.

[0107] Described below with reference to Figure 3 is a second embodiment of the anchoring device 1 according to the invention.

[0108] In this embodiment, the fixing means 23 are associated with the frame 26 to anchor it to at least one element "P" of the curtain wall 110 on the outside and adjacent to the panel to be replaced.

[0109] Thus, unlike the preceding embodiment, the fixing means are not associated with the active unit 22 but with the frame 6.

[0110] In the preferred form of this embodiment, the fixing means 23 are adhesive means 3a or suction means associated with the frame 6 and designed to be anchored to the second face (or outer face) of a panel adjacent to the panel to be replaced.

[0111] Thus, in the second embodiment of the invention described here, the frame 6 is, in use, located on the outside of the curtain wall.

[0112] In light of this, the movement means 27 are configured to push the active unit 22 against the second face 100b of the panel 100 so that its first face 100a comes into abutment against the outer side 102b of the vertical member 102, thus keeping the panel 100 in a predetermined position.

[0113] In the second embodiment, therefore, the active unit 22 is a pushing unit. Consequently, hereinafter in the description of this embodiment, the terms "active unit" and "pushing unit" are equivalent.

[0114] In this embodiment, the frame 26 comprises a crosspiece extending transversely to the operating line "A" (that is, parallel to the panel 100) and equipped with at least one joining portion 26a which can be associated with the fixing means 23 and at least one contact portion 26b slidably associated with the pushing unit 22 and able to be placed to face the second face 100b of the panel 100.

[0115] More precisely, the frame 26 has at least one end which is associated with the fixing means 23. Preferably, the frame 26 extends orthogonally to the operating line "A" between two ends, both associated with the fixing means 23.

[0116] Thus, each end at least partly defines a joining portion 26a.

[0117] It should be noted that the frame 26 is structured (that is, shaped to particular dimensions) in such a way that the two ends (that is, the joining portions 26a) can be placed on opposite sides of the panel to be replaced, that is, are fixable to the panels adjacent thereto.

[0118] Each end of the frame 26 is thus preferably shaped to abut against the outer face of a panel adjacent to the one to be replaced and is, in use, associated (or able to be associated) with the fixing means 23 (in particular, adhesive means 23a).

[0119] More precisely, this end has at least one end edge 24 lying in a plane which, in use, is substantially parallel to the face of the panel 100 to which it must be connected, that is, the second face .

[0120] More specifically, the plane is substantially orthogonal to the operating line "A" of the pushing unit 22, that is, parallel to the plane "B".

[0121] Since the fixing means 23 are preferably adhesive means, the ends (or the end) of the frame 26 is defined by a substantially flat face to which the adhesive material (or layer of adhesive material) can be applied. Preferably, this face is ribbed to facilitate the adhesive grip and improve the safety and performance of the anchoring device 1.

[0122] The pushing unit 22, on the other hand, is preferably defined by a slider which is slidably associated with the frame 26 (that is, with the contact portion 26b) to move relative thereto (in particular, through the contact portion 26b) along the operating line "A".

[0123] Preferably, the pushing unit 22 or slider has a first active end 22a (substantially flat) which can be abutted against the second face 100b of the panel 100 and a second end 22b which can be engaged (slidably) with the frame 26 or with the movement means 27.

[0124] Similarly to the first embodiment, the movement means 27 are interposed between the pushing unit 22 and the frame 26.

[0125] As mentioned above, the movement means 27 act orthogonally to the plane of the panel so as to move the pushing unit 22 along the operating line "A" away from the frame 26 in order to press the inner face 100a of the panel 100 against the vertical member 102 and/or against the beam of the load-bearing structure 101.

[0126] In order to make the pushing action easily adjustable, the movement means are defined preferably by the aforementioned threaded coupling 28 between the pin 29 and the hole 30.

[0127] All the features described previously with regard to the threaded coupling 28 in the preceding embodiment can be considered substantially similar and applicable to this embodiment, too.

[0128] Furthermore, as mentioned previously, movement means of another kind are also imaginable.

[0129] For example, the movement means might comprise a pulling portion associated with a free end of a pin 29 (whose other end is connected to the retaining unit) and locking means to tighten the pin in position relative to the frame 26.

[0130] The stopping means might, for example, be defined by a pawl mechanism. Whatever the case, the anchoring device is preferably equipped with stopping means (not illustrated) associated with the movement means 27 to hold the latter in the operating position where they keep the panel 100 in abutment against the second side 102b of the vertical members 102 or beams.

[0131] It is also an object of this invention to provide a method for replacing a panel in a curtain wall 110 of a building, preferably of the structural silicone type.

[0132] This method is preferably, but not exclusively, implemented by means of the anchoring device 1 described up to here.

[0133] This, the method comprises a step of removing

a panel to be replaced 112 (damaged), thereby forming an opening in the curtain wall 110.

[0134] Next, a replacement panel 100 is prepared which comprises a first, in use, inner face 100a and a second face 100b opposite to the first 100a, similarly to what is described previously.

[0135] The replacement panel 100 is then positioned at the opening to block it in such a way that the first face 100a of the panel 100 partly abuts against an outer side 102b (or second side) of a vertical member 102 and/or of a beam of the load-bearing structure 101 of the curtain wall 110.

[0136] More precisely, the replacement panel 100 is made to abut against the pre-existing vertical member 102 or beam without any auxiliary element being interposed between them (except for sealant or seals).

[0137] The panel 100 is then fixed in the required position while keeping the first face 100a in abutment against the second side of the vertical member 102. It should be noted that, operatively, there is preferably a seal 105 between the panel 100 and the vertical member 102.

[0138] A layer 104 of sealing material (preferably structural silicone) is then spread at a joining zone between the first face 100a of the panel 100 and the vertical member 102 and/or the beam.

[0139] Preferably, the seal 105 is located in a zone more on the outer side than the layer 104 of sealing material.

[0140] Advantageously, this allows injecting the sealing material from the interior of the building, with considerable advantages in terms of operating ease and safety.

[0141] The sealing material may be spread before or after the panel 100 has been positioned on the vertical member 102 or beam, but preferably after. This is followed by the step of waiting for a predetermined period of time $\Delta T1$ (depending on the type of silicone) for the layer 104 of sealing material to dry; In the preferred embodiment, the period of time $\Delta T1$ is between 1 and 5 days, preferably between 2 and 4 days, and more preferably, approximately 3 days.

[0142] It should be noted that during the period of time $\Delta T1$ the pulling action on the panel 100 continues to be applied.

[0143] According to the method, once the sealing material is dry, the pulling action is stopped, preferably by removing whatever means were used to apply it, in particular the anchoring device 1.

[0144] According to the invention, the step of fixing the replacement panel 100 to the vertical member 102 and/or to the beam comprises (alternatively) a step of pulling the first face 100a of the panel 100 or a step of pushing the second face 100b of the panel 100 using the anchoring device 1 in order to keep the first face 100a in abutment against the second side 102b of the vertical member 102 and/or of the beam during the predetermined period of time ΔT.

[0145] Thus, the method according to the invention preferably has two alternative (or complementary) embodiments.

[0146] In a first embodiment (preferably implemented by means of the first embodiment of the anchoring device 1), the step of fixing the replacement panel 100 to the vertical member 102 and/or to the beam comprises a sub-step (preferably performed in the factory) of fixing a retaining unit 2 to the first face 100a of the replacement panel 100 followed by a sub-step (performed on site) of pulling the retaining unit 2 in such a way as to press the first face 100a of the panel 100 onto the second side 102b of the vertical member 102 and/or of the beam of the load-bearing structure 101, using a suitable pulling unit 5.

[0147] Preferably, the retaining unit 2 is fixed by spreading a layer 3a of adhesive material between the retaining unit 2 and the first face 100a of the panel 100 and then abutting the retaining unit 2 itself against the panel 100. Next, according to the method, after abutting the retaining unit 2 to the panel 100 (preferably positioned horizontally to take advantage of the force of gravity), there is a step of waiting for a period of time $\Delta T2$ for the adhesive material to dry.

[0148] The replacement panel 100 is then positioned in the opening "O", that is, abutted against the second side 102b of the vertical member 102, in combination with the retaining unit 102 previously fixed to the inner face (or first face) 100a of the panel 100.

[0149] After the predetermined period of time $\Delta T1$ has elapsed, the retaining unit 2 is removed, as is any residual adhesive material still sticking to the first face 100a of the panel 100.

[0150] The residual adhesive material may be scraped off or dissolved chemically.

[0151] It should be noted that, alternatively, the step of fixing the retaining unit 2 to the first face 100a of the replacement panel 100 is accomplished by suction, preferably by means of a suction cup or electric suction cup.

[0152] In that case, the step of removing the retaining unit 2 does not leave any residue on the panel 100, which is immediately restored to its original operating conditions.

[0153] To perform the pulling step, it is preferable to install a pulling unit 5.

[0154] More specifically, the method comprises positioning a frame 6 in contact with the first side 102a of the vertical member 102 and/or of the beam to form a contact element facing the first face 100a of the panel 100 and moving the retaining unit 2 towards the frame 6.

[0155] Preferably, the retaining unit 2 is then locked in the position corresponding to the predetermined condition where the panel 100 in turn applies a predetermined pressure on the outer side 102b of the vertical member 102 and/or of the beam.

[0156] Preferably, this step of positioning the frame 6 comprises placing a crosspiece in contact with two successive vertical members 102 or beams of the load-bearing structure 101.

[0157] It should be noted that the step of moving the retaining unit 2 towards the frame 6 is preferably accomplished by tightening a threaded coupling 8, and more specifically, the threaded coupling described previously. Alternatively, the movement might be accomplished by actually pulling the retaining unit and then locking it in place by means, for example, of a pawl mechanism.

[0158] With reference to a second embodiment (preferably implemented by means of the second embodiment of the anchoring device 1), the step of fixing the replacement panel 100 to the vertical member 102 and/or to the beam comprises a sub-step of preparing a pushing unit 22 to be abutted against the second face 100b of the replacement panel 100 and a sub-step of pushing the pushing unit 22 against the second face 100b in such a way as to press the first face 100a of the panel 100 onto the second side 102b of the vertical member 102 and/or of the beam of the load-bearing structure 101, using suitable pushing means.

[0159] More specifically, the step of pushing the pushing unit 22 is accomplished by fixing a frame 26 to at least one element of the building or of the curtain wall 110 on the outside and adjacent to the panel to be replaced (preferably a panel adjacent thereto) in such a way as to form a contact element facing the second face 100b of the panel 100.

[0160] The step of fixing the frame 26 to the elements of the building or of the curtain wall 110 on the outside and adjacent to the panel to be replaced is accomplished by applying a layer of adhesive material 23a between these elements and a joining portion of the frame 26a.

[0161] The pushing unit 22 is then moved away from the frame 26 against the second face 100b of the panel 100.

[0162] Preferably, the pushing unit 2 is then locked in the position corresponding to the predetermined condition where the panel 100 in turn applies a predetermined pressure on the outer side 102b of the vertical member 102 and/or of the beam.

[0163] The invention achieves the proposed aims and brings significant advantages.

[0164] In effect, by implementing the method according to the invention (preferably by means of the anchoring device described) it is possible to replace the damaged panel and restore the original structure of the curtain wall, that is to say, restoring the solely chemical connection between the load-bearing structure and the panel, without using mechanical fasteners or bolts.

[0165] Moreover, the device necessary to implement the method is very simple to make and does not require any alterations to or preparatory operations on the load-bearing structure or replacement panel.

[0166] In effect, the retaining unit can, advantageously, be positioned in the factory or, in any case, on the ground, by applying the adhesive material and only the "mechanical" pulling step is performed on site (that is, with the panel vertical) when the retaining unit is securely connected to the panel.

Claims

1. A method for replacing a panel (100) in a curtain wall (110) of a building (111), preferably of the type with structural silicone, wherein the curtain wall (110) comprises a load-bearing structure (101) provided with a plurality of vertical members (102) and/or beams, each comprising a first, inner side (102a) and a second, outer side (102b), said method comprising the steps of:

   - removing a panel to be replaced (112), thereby forming an opening (O) in said curtain wall (110);
   - preparing a replacement panel (100) comprising a first, in use, inner face (100a) and a second, in use, outer face (100b), opposite to the first face (100a);
   - positioning said replacement panel (100) at said opening to block it in such a way that said first face (100a) of the panel (100) partly abuts against the second side (102b) of a vertical member (102) and/or of a beam of a load-bearing structure (101) of the curtain wall (110);
   - fixing the replacement panel (100) to said vertical member (102) and/or said beam by means of an anchoring device (1);
   - spreading a layer (104) of sealing material at a joining zone between said first face (100a) of the panel (100) and the side (102b) of the vertical member (102) and/or of the beam;
   - waiting for a predetermined period of time ΔT for the layer of sealing material (104) to dry;
   - removing said anchoring device (1);

   characterized in that said step of fixing the replacement panel (100) to the vertical member (102) and/or to the beam comprises a step of abutting the replacement panel (100) against the pre-existing vertical member (102) or beam and a step of pulling the first face (100a) of the panel (100) or a step of pushing the second face (100b) of the panel (100) using said anchoring device (1) for keeping said first face (100a) abutted against the second side (102b) of the vertical member (102) and/or of the beam during said predetermined period of time ΔT.

2. The method according to claim 1, **characterized in that** the step of fixing the replacement panel (100) to the vertical member (102) and/or to the beam comprises the following sub-steps:

   - fixing a retaining unit (2) to the first face (100a) of the replacement panel (100);
   - pulling said retaining unit (2) in such a way as to press said first face (100a) of the panel (100) onto the second side (102b) of the vertical member (102) and/or of the beam of the load-bearing structure (101), using suitable pulling means.

3. The method according to claim 1 or 2, **characterized in that** said step of pulling the retaining unit (2) comprises the following sub-steps:

- positioning a frame (6) in contact with the first side (102a) of the vertical member (102) and/or of the beam to form a contact element facing said first face (100a) of the panel (100);
- moving said retaining unit (2) towards said frame (6);
- locking the position of said retaining unit (2) relative to said frame (6) when the panel (100) applies a predetermined pressure on the second side (102b) of the vertical member (102) and/or of the beam.

4. The method according to claim 3, **characterized in that** the step of positioning the frame (6) comprises placing a crosspiece in contact with two successive vertical members (102) or beams of the load-bearing structure (101) for forming a clamp in conjunction with said panel (100) and said retaining unit (2).

5. The method according to any one of the preceding claims, **characterized in that** said step of fixing the retaining unit (2) to the first face (100a) of the replacement panel (100) is carried out by applying a layer of adhesive material (3a) between said first face (100a) of the panel (100) and the first end portion (2a) of the retaining unit (2).

6. The method according to claim 1, **characterized in that** the step of fixing the replacement panel (100) to the vertical member (102) and/or to the beam comprises the following sub-steps:

- preparing a pushing unit (22) to be abutted against the second face (100b) of the replacement panel (100);
- pushing said pushing unit (22) on said second face (100b) in such a way as to press the first face (100a) of the panel (100) onto the second side (102b) of the vertical member (102) and/or of the beam of the load-bearing structure (101), using suitable pushing means.

7. The method according to claim 6, **characterized in that** said step of pushing the pushing unit (22) comprises the following sub-steps:

- fixing a frame (26) on at least one external element of the building or curtain wall (110) adjacent to the panel to be replaced, thereby forming a contact element facing the second face (100b) of said panel (100);
- moving said pushing unit (22) away from said frame (26) so that it pushes on said second face (100b) of the panel (100);
- locking the position of said pushing unit (22) relative to said frame (26) when the panel (100) applies a predetermined pressure on the second side (102b) of the vertical member (102) and/or of the beam.

8. The method according to claim 6 or 7, **characterized in that** said step of fixing the frame (26) to the element of the building or of the curtain wall (110) is carried out by applying a layer of adhesive material (23a) between said element and a joining portion (26a) of the frame (26).

9. The method according to claim 7 or 8, **characterized in that** the step of positioning the frame (26) comprises the following sub-steps:

- preparing a crosspiece (26a) with at least one joining portion (26a) and at least one contact portion (26b) slidably associated with said pushing unit (22);
- fixing said joining portion (26a) to at least one external element of the building or of the curtain wall (110) adjacent to the panel to be replaced, in such a way that the contact portion (26b) is facing the second face (100b) of the panel (100).

10. An anchoring device for positioning a replacement panel (100) in a curtain wall (111) of a building of the type with structural silicone, where the curtain wall (111) comprises a load-bearing structure (101) provided with a plurality of vertical members (102) and/or beams, each comprising a first, inner side (102a) and a second, outer side (102b), and said replacement panel (100) comprising a first, in use, inner face (100a), to be abutted against the second side (102b) of said vertical member (102) or beam and a second face (100b) opposite to the first; said device being **characterized in that** it comprises:

- a frame (6, 26) connectable to pre-existing elements of the building;
- an active unit (2, 22) extending between at least a first end portion (2a, 22a) shaped to abut against the first face (100a) or the second face (100b) of the panel (100), and at least a second end portion (2b, 22b) opposite to the first (2a, 22a);
- movement means (7, 27) operatively interposed between the frame (6, 26) and the active unit (2, 22) for moving said first end portion (2a, 22a) towards and/or away from the frame (6, 26) thereby causing a pushing action on the second face (100b) of the panel (100) or a pulling action on the first face (100a) of the panel (100) for abutting said first face (100a) of the panel (100) against the second side (102b) of said vertical member (102) or beam, keeping said panel in a

predetermined position.

11. The device according to claim 10, **characterized in that** it comprises fixing means (3) associated with the first end portion (2a) of the active unit (2) for anchoring it to the first face (100a) of the panel (100) so as to apply, by means of said movement means (7), a pulling action on said first face (100a); said active unit (2) forming a retaining unit (22).

12. The device according to claim 11, **characterized in that** said frame (6) extends transversally to the operating line (A) and comprises at least one joining portion (6a) which can be abutted against at least a first side (102a) of at least one vertical member (102) or beam of the load-bearing structure (101) of the curtain wall (111) and a contact portion () which can be positioned facing said first face (100a) of the panel (100); said movement means (7) forming a pulling unit (5) designed to move the first end portion (2a) of the retaining unit (2) along said operating line (A) towards the frame (6) so as to abut the first face (100a) of the panel (100) against the second side (102b) of said at least one vertical member (102) or beam.

13. The device according to claim 11 or 12, **characterized in that** the first end portion (2a) of the retaining unit (2) comprises at least an end edge (4) lying in a plane (B) transversal to said operating line (A) substantially parallel with the first face (100a) of the panel (100) to which it must be connected; said operating line (A) being orthogonal to said plane (B).

14. The device according to claim 10, **characterized in that** it comprises fixing means (23) associated with the frame (26) for anchoring it to at least one external element of the curtain wall (110) adjacent to the panel to be replaced; said movement means (27) being designed to move the active unit (22) so that it pushes against the second face (100b) of the panel (100) for abutting said first face (100a) of the panel (100) against the second side (102b) of said vertical member (102) or beam, keeping said panel (100) in a predetermined position; said active unit (22) forming a pushing unit (22).

15. The device according to claim 14, **characterized in that** said frame (26) comprises a crosspiece extending transversally to the operating line and provided with at least one joining portion (26a) which can be associated with said fixing means (23) and at least one contract portion (26b) slidably associated with said pushing unit (22) and which can be positioned facing the second face (100b) of the panel (100).

FIG.1a

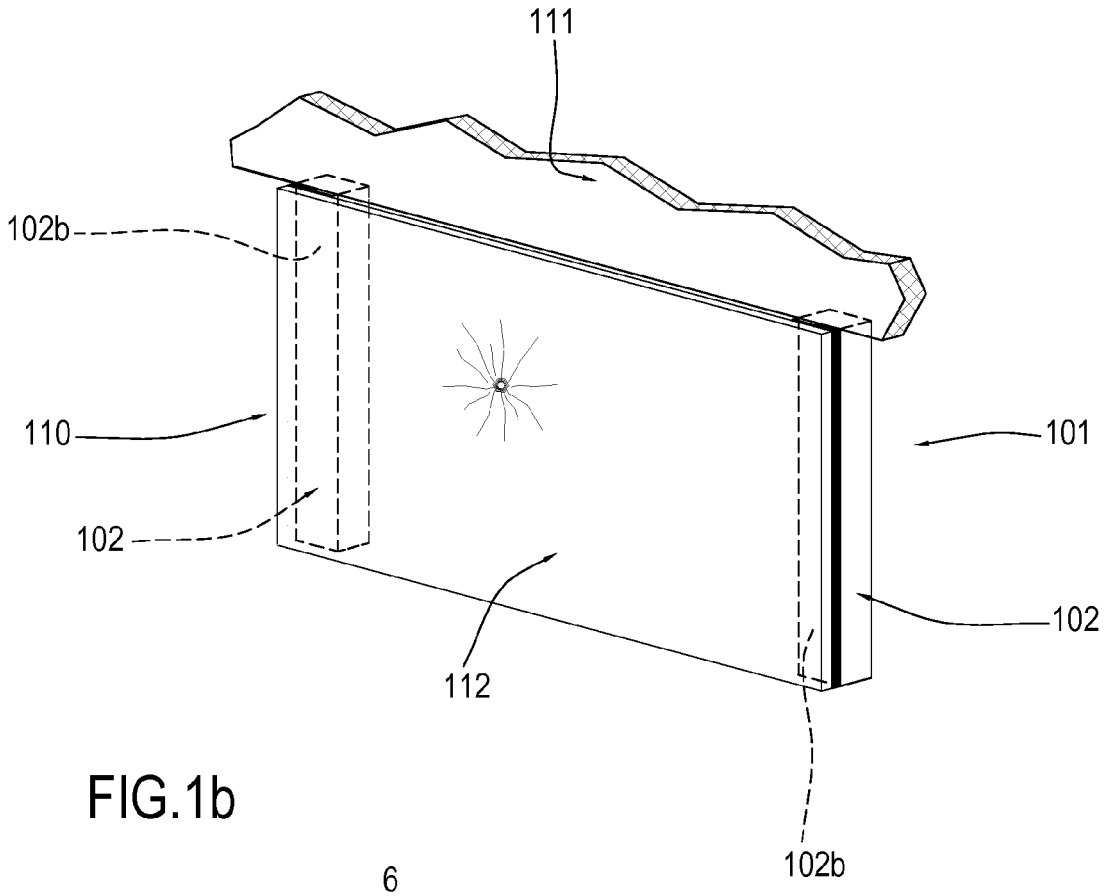

111
102b
110
101
102
102
112
102b

FIG.1b

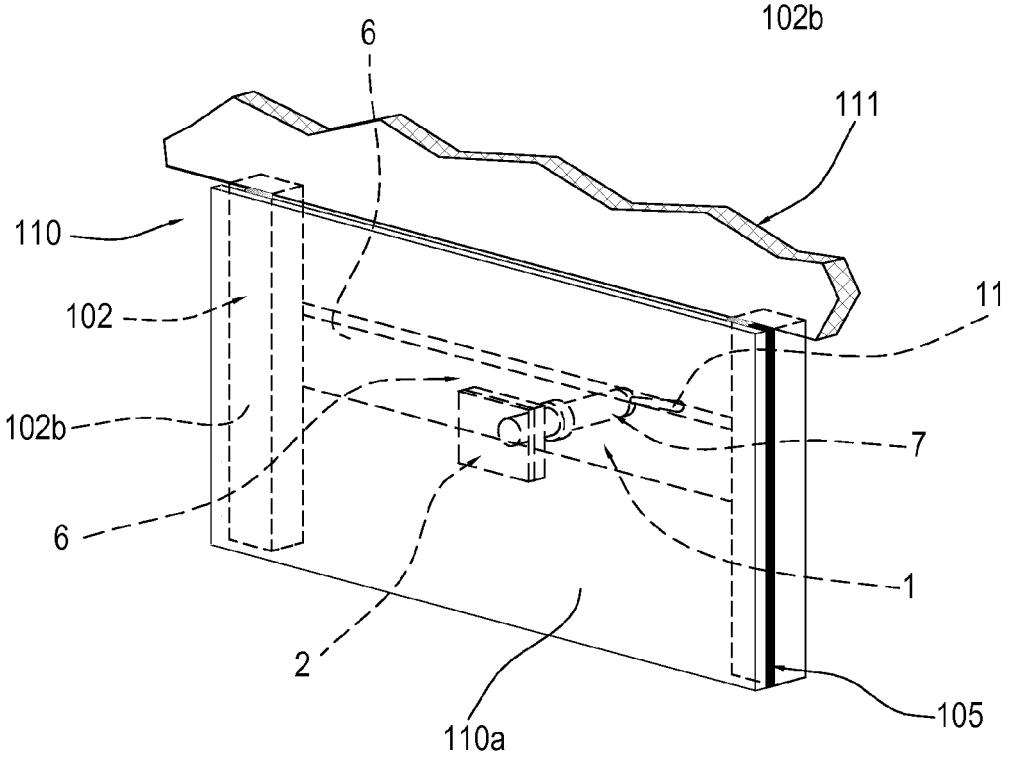

6
111
110
11
102
102b
7
6
1
2
105
110a

FIG.2a

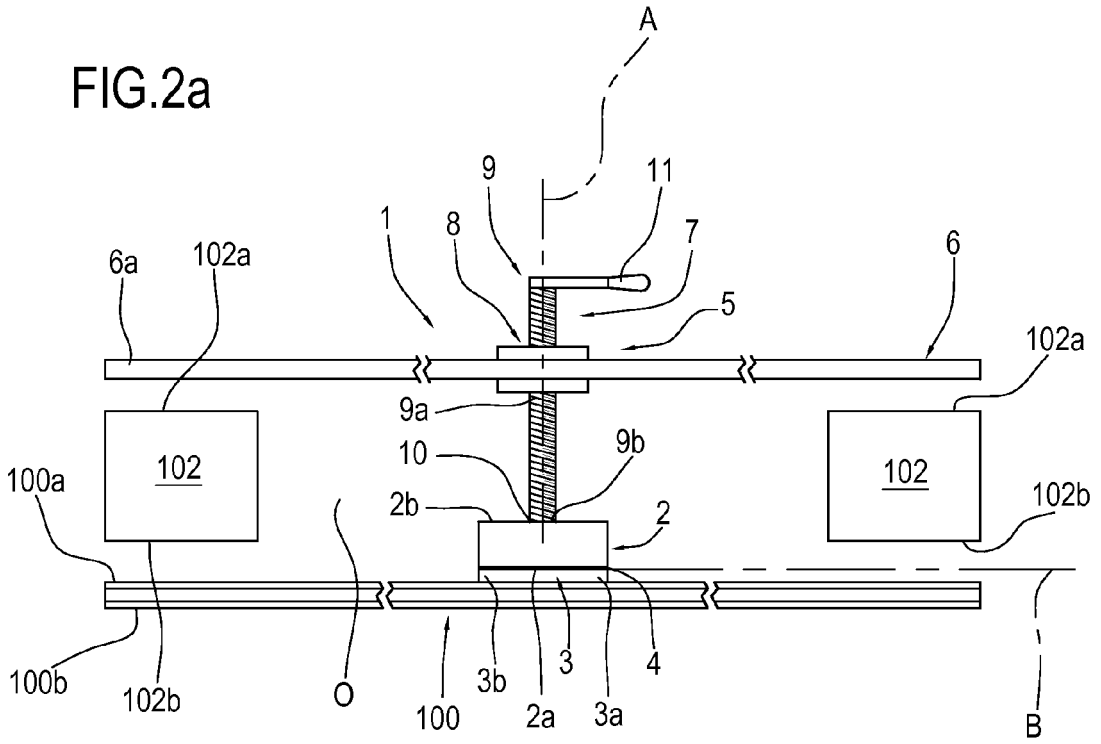

A
9
11
1
8
7
6
6a
102a
5
102a
9a
9b
10
102
102
100a
2b
2
102b
100b
102b
O
100
3b
3
2a
4
3a
B

FIG.2b

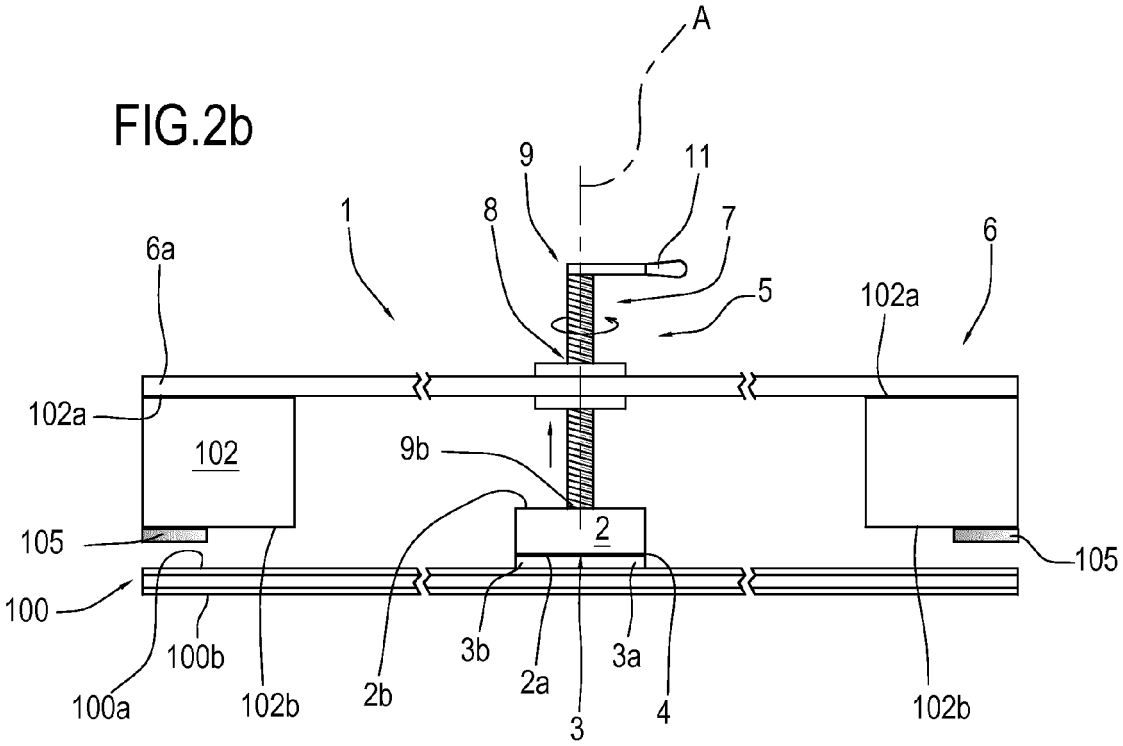
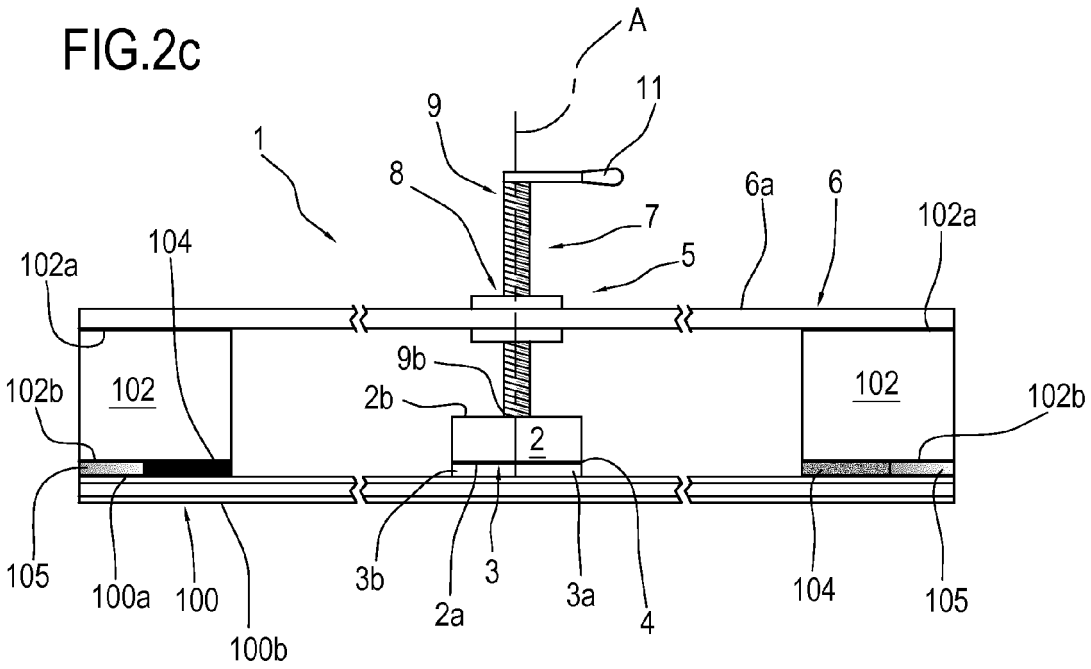

A
9
11
1
8
7
6
6a
5
102a
102a
102
9b
2
105
105
100
100b
3b
2a
3a
100a
102b
2b
3
4
102b

FIG.2c


A
11
9
1
8
6a
6
102a
7
104
5
102a
9b
102b
102
2b
102
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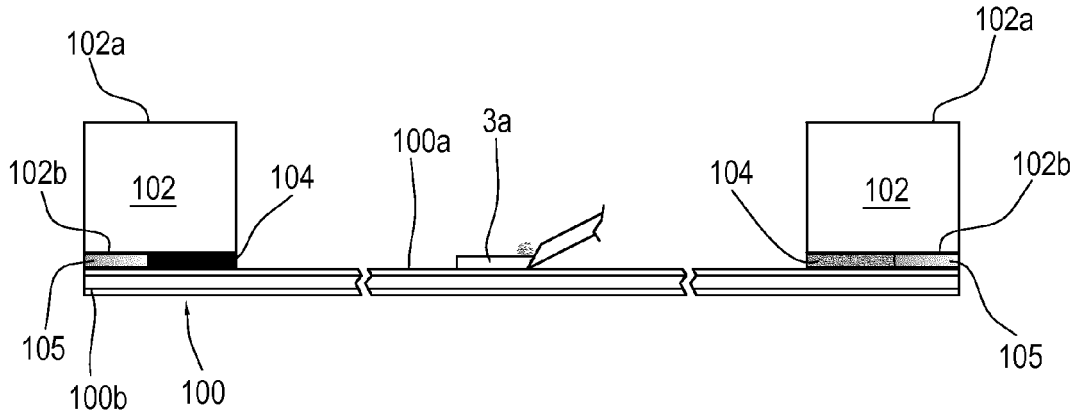
2a
3
3a
4
104
105
100b

FIG.2d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102a
3a
100a
102b
102
104
104
102
102b
105
105
100b
100

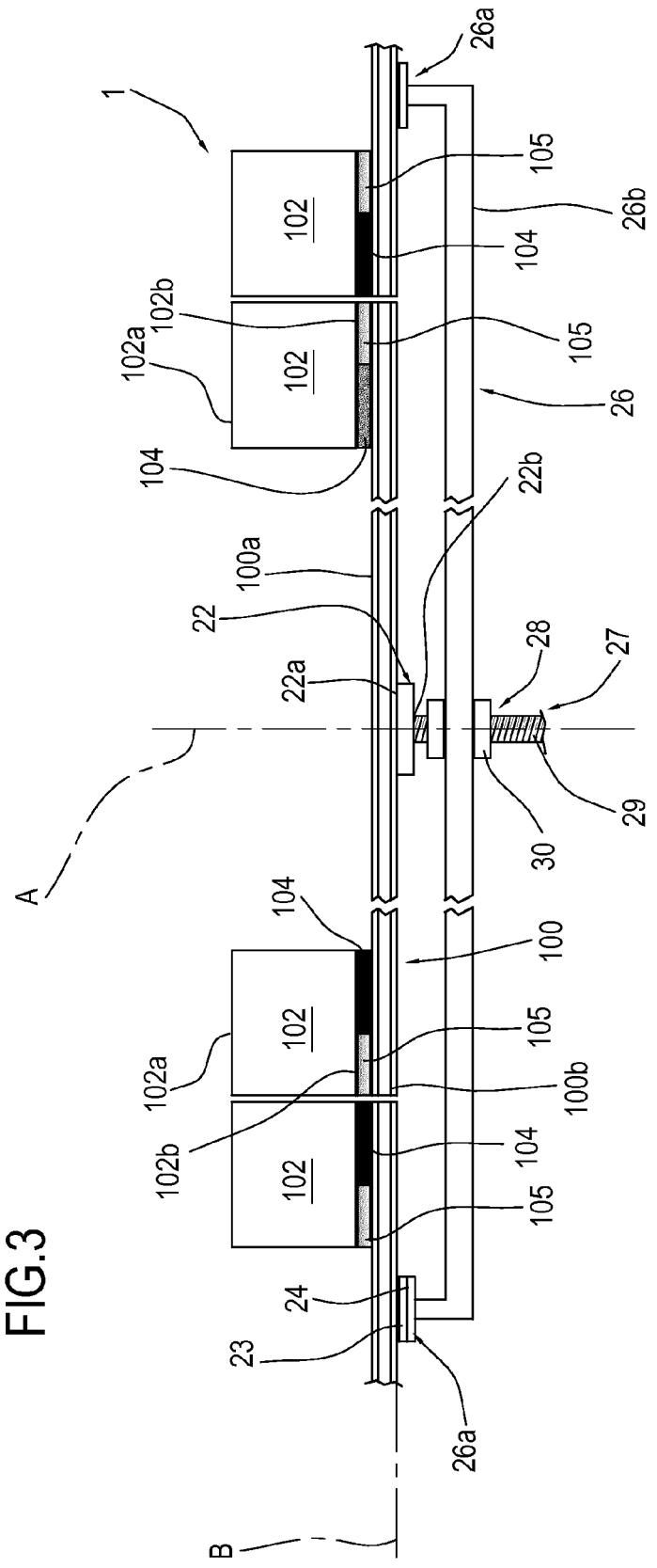
1
26a
105
26b
104
102
102b
102a
105
26
104
22b
100a
22
28
27
22a
29
30
A
104
100
102a
105
100b
102b
104
105
24
23
26a
B

FIG.3