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(71) Applicant: **Barak, Yehuda
42823 Zoran (IL)**

(72) Inventor: **Barak, Yehuda
42823 Zoran (IL)**

(74) Representative: **Petraz, Davide Luigi
GLP Srl
Piazzale Cavedalis, 6/2
33100 Udine (IT)**

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(54) **Hinge assembly**

(57) Adjustable hinge assembly used for hinging a first fixed element (2) and a second movable element (3) and comprising at least two hinge bodies (4, 5, 6), each provided with at least a respective bolt (4a, 5a, 6a) de-

fining a relative fixing axis (X, Y) for the relative fixed (2) or movable (3) element. The hinge bodies (4, 5, 6) are hinged to each other on a hinging axis (I) that does not intersect the fixing axes (X, Y).

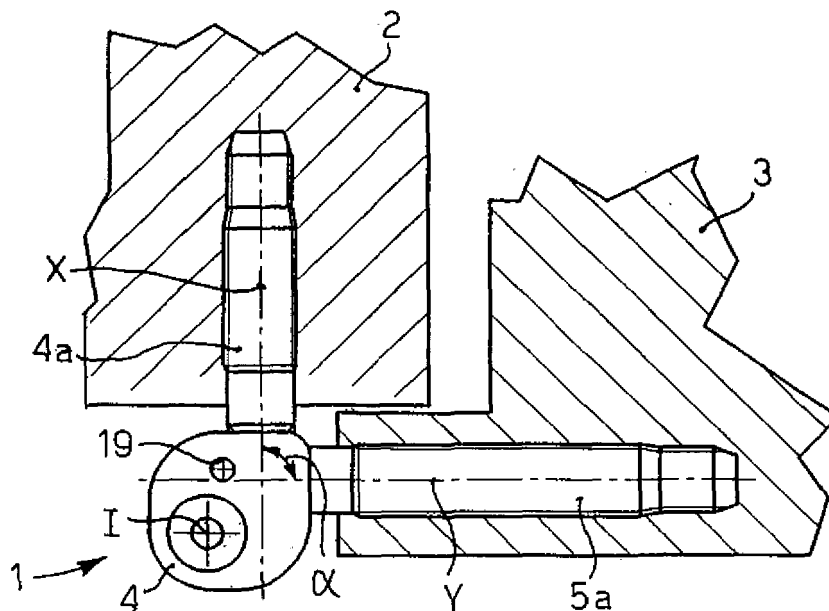


fig. 13

Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of adjustable hinges.

BACKGROUND OF THE INVENTION

[0002] In order to allow for optimal adaptation between hinged plates (e.g. doors, windows, folding walls or the like) and between the frames or walls to which they are hinged, there is a need in adjustment arrangements that will allow to compensate against inaccuracies that may occur between hinged parts during their construction or use. Such adjustment arrangements may be directed to allow for zeroing the distance between the hinged device and the frame or wall to which it is hinged, i.e. such that both parts will stand completely parallel to each other (i.e. with zero degree angle between their planes) in their closed state. Furthermore such adjustment arrangements may be directed to allow for bringing the level of the hinged plate even with that of the wall or frame to which it is hinged, and for bringing the hinged plate centralized between the sides of the frame.

[0003] In one type of adjustable hinges of prior art, the bolts which connect the hinge to the hinged parts form immovable joint with the hinge bodies from which they protrude. Accordingly, an adjustment of the gap between the hinge body and the frame or wall to which it is hinged can be achieved by rotating the bolt with the entire hinge body to which it is immovably joint, clockwise or counter-clockwise inside the threaded hole to which it is screwed. This could be performed only when the hinge bodies are separated from one another (i.e. the hinged is in its disassembled state), and the adjustment is limited to complete (integer) rotations of the bolt.

[0004] Incomplete rotation will result in an inclined orientation of the hinge body, which is inappropriate for re-assembling of the hinge bodies all together after completion of the adjustment.

[0005] In another type of adjustable hinges of prior art, the bolts which connect the hinge to the hinged parts have free infinite rotation in the hinge bodies from which they protrude, thus allow for fine and accurate tuning. Such hinge types consist however of a larger number of separate parts, including the hinge bodies, the bolts, and bolt holder parts that are the elements capturing the bolts in a fixed predetermined location inside the hinge bodies, while allowing their free rotation (without changing their said predetermined location) for adjusting the gap between the hinge and the plate or the frame to which it is attached.

[0006] It is therefore an object of the present invention to reduce the number of components from which an adjustable hinge is assembled, and still allow for fine and accurate tuning of the gap between the hinge and the plate or frame to which it is connected. Such reduction

in the number of component will allow for facilitating the assemblage of the hinge and for reducing its production costs.

[0007] Another object of the present invention is to allow to adjust the hinge, also on all three axes, leaving the hinge assembled on the plate and frame elements which are hinged together.

SUMMARY OF THE INVENTION

[0008] The present invention relates to an adjustable hinge assembly comprising at least two hinge bodies, each provided with at least a respective bolt to attach to the relative element to be hinged, whether it be a fixed part such as a frame or a wall, or a movable part such as a door, a plate or suchlike.

[0009] Each bolt defines a respective fixing axis for the relative element to be hinged.

[0010] The hinge bodies are disposed one on the other and are hinged to each other on a hinging axis.

[0011] According to a characteristic of the present invention, said hinging axis does not intersect said fixing axes but is offset or misaligned with respect to them.

[0012] To be more exact, when the elements to be hinged are in a closed position, and the fixing axes of the at least two hinge bodies substantially form a right angle between them, the hinging axis is in an outer position with respect to said angle.

[0013] This configuration allows to have a hinging axis displaced towards the outside with respect to the elements to be hinged when the latter are in the closed position, with the fixing axes of the bolts disposed closer to the elements to be hinged compared with normal hinges in which the hinging axis intersects the fixing axes.

[0014] This allows to use the hinge with elements hinged to each other, for example a door frame and plate, having a relatively thin thickness while still ensuring an extensive reciprocal rotation of said parts.

[0015] According to another characteristic of the present invention, the hinge assembly comprises a hinge pin (will be referred to hereinafter also as "pivot pin"); at least two hinge bodies at least one of which having (a) a first (vertical) crossing hole, which defines said hinging axis, of a diameter matching that of the pivot pin; (b) at least one second (horizontal) crossing hole (of a predetermined diameter adapted to receiving a connecting bolt) which defines said fixing axis and is disposed in an orientation perpendicular to that of the first one.

[0016] In a first embodiment of the invention, the first vertical crossing hole in which the pin is inserted does not intersect the second horizontal crossing hole in which the fixing bolt is inserted.

[0017] In another embodiment, the first and the second crossing holes are partially intersecting one another forming a junction there between; in this case, the bolt for positioning inside the second (horizontal) crossing hole has a radial groove at a predetermined location along its length (according to the preferred embodiments

the location of the radial groove is next to the head of the bolt); said groove when brought inside the second crossing hole into alignment with the first crossing hole, makes room for the pivot pin to pass through the first crossing hole and across the bolt, thus capturing the bolt which then becomes incapable of linear movement along the second crossing hole, without losing its ability to rotate (thus enabling adjustment of the gap between the hinge body and between the plate or the frame to which it is intended to be secured).

[0018] According to the present invention a plurality of hinge bodies with a plurality of bolts may be nested along one pivot pin, thus forming a multi part hinge with connecting bolts that can be securing the hinge bodies to the hinged plate or to the frame, and tuned to maintain the hinge body in a desired distance from the plate or from the frame to which it is connected. The pivot pin is provided in a length appropriate for holding a predetermined number of hinge bodies including washers (if so wished or so required to eliminate direct friction between hinge bodies or between hinge bodies and the head of the hinge pin) in between, and including (if so wished or so required) closure or stopper means for preventing escape of the pivot pin from the hinge bodies, for keeping the hinge bodies together, or for facilitating the positioning of the pivot pin during assembling the hinge from its separate parts. Such closure or stopper means may comprise any arrangement (e.g. hinge cotter pin) using for securing pin ends as known in the art/, or equivalent. As will be further described in detail, the means for securing the pivot pin from escaping the hinge are not necessarily located at the end of the pivot pin, thus not necessarily requiring protrusion of the pivot pin beyond the upper or lower ends of the hinge bodies.

[0019] The term 'rotation-governing end' relates to a bolt end having a form that enables rotating the bolt using a screwdriver, key (e.g. "Ellen key"), or other tool having a matching form.

[0020] According to one of the preferred embodiments of the present invention the hinge assembly comprises three hinge bodies each having a first and a second crossing holes intersecting one another forming a junction there between, three bolts, and one pivot pin. It is preferably comprising also at least one pin securing element (to prevent the pivot pin escaping from its position during continuous use).

[0021] According to several preferred embodiments the hinge assembly is supplied from its producer to the customer divided to its parts in a disassembled state, wherein the end user (or technician) may assemble it immediately prior to putting it to use.

[0022] According to a variant, each hinge body comprises means to secure, for example through interference, the relative fixing bolt inside it after insertion in the relative hole; the hinge can thus be pre-assembled, for example for storage and transport, limiting to a minimum the number of different pieces, which are reduced to the hinge bodies, normally three, with the relative pre-as-

sembled bolt, and the pin. In this pre-assembled configuration, the assembly of the hinge by the final user is extremely facilitated.

[0023] The present invention further relates to a method for assembling adjustable hinges, comprising (a) inserting bolts having radial groove at a location along their length into horizontal, or second, crossing holes made in corresponding hinge bodies; (b) bringing the radial groove of each bolt into alignment with a vertical, or first, crossing hole made in the respective hinge body and partially intersects the horizontal crossing hole; (c) nesting the hinge bodies along a pivot pin by inserting the pivot pin through the vertical crossing hole of each hinge body one next to another and across the bolts through their radial groove thus capturing the bolts which then become incapable of linear movement along the horizontal, or second, second crossing holes without losing their ability to rotate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

- Fig. 1 is an isometric view of a preferred embodiment of a "three part" hinge assembly according to the present invention, prepared for connecting between a door frame and a door plate.
- Fig. 2 is a typical transverse cross sectional view through a door frame and a door plate connected by a hinge assembly according to the present invention.
- Fig. 3 is an isometric exploded view of a "three part" hinge assembly according to the preferred embodiment of the present invention, comprising eight components as they are spatially configured prior to assembling them into one integral hinge assembly.
- Fig. 4 is an isometric view of the middle hinge body of the hinge assembly of Figure 3, with a partial cross sectional view along its vertical crossing hole.
- Fig. 5 is an isometric view over a horizontal cross section through the upper hinge body of the hinge assembly of Figure 3.
- Fig. 6 is an isometric view over the assembled hinge assembly of Figure 3, with horizontal cross section views through its upper hinge body and through its pivot pin.
- Fig. 7 is an isometric view over the assembled hinge assembly of Figure 3, with a partial cross sectional view along the vertical crossing holes of its three hinge bodies.
- Fig. 8 is an isometric view over the assembled hinge assembly of Figure 3.

- Fig. 9 is an isometric view over the assembled hinge assembly of Figure 8, taken from an opposite direction.
- Fig. 10 is a lateral view of a first variant of the hinge assembly of Figure 1.
- Fig. 11 is a lateral view of a second variant of the hinge assembly of Figure 10.
- Fig. 12 is a plane view of the hinge assembly of Figure 10.
- Fig. 13 is a plane view of the hinge assembly of Figure 12 assembled on a door plate hinged to a door frame.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Fig. 1 is an isometric view of a preferred embodiment of a "three part" hinge assembly 1 according to the present invention, prepared for the connection between a door frame 2 and a door plate 3.

[0026] In the case shown here, the hinge assembly 1 is comprised of (a) three hinge bodies: an upper hinge body 4, a middle hinge body 5, and a lower hinge body 6; (b) three bolts 4a, 5a, and 6a, passing respectively through the three hinge bodies; (c) a pivot pin 7; and (d) a securing screw 8 intending to prevent escape of the pivot pin 7 from the hinge bodies. The upper and the lower hinge bodies 4, 6 are intended to be secured to the door frame 2 and the middle hinge body 5 is intended to be secured to the door plate 3 by rotating the bolts 4a, 6a and 5a into threaded holes 2a, 2b and 3a, respectively. The bolts 4a, 5a, 6a can be rotated using the Ellen key 9 which has a form matching the form of the rotation governing ends of the bolts 4a, 5a, 6a.

[0027] After securing the hinge bodies 4, 5, 6 to the door frame 2 and to the door plate 3, the gaps between the hinge assembly 1 and between the door frame 2 and the door plate 3 could be adjusted in the directions pointed out by arrows A and B, by rotating the bolts 4a, 5a, 6a clockwise (for reducing the gap) or counterclockwise for (increasing the gap), as required for bringing the door plate 3 to its optimal position relative to the door frame 2.

[0028] In one embodiment of the invention, and according to its main characteristic, the hinge bodies 4, 5, 6 have an asymmetric section, substantially circular on the outer side of the angle formed by the elements of the door frame 2 and the door plate 3 in the closed position, and substantially at a right angle, slightly rounded, on the inner side of the frame/plate.

[0029] The first (vertical) crossing holes 4c, 5c, 6c define an axis, or hinging axis I, which does not intersect the axes X, Y, orthogonal to each other, of the fixing bolts 4a, 5a, 6a. To be more exact, the hinging axis I is displaced towards the outside with respect to the right angle α formed by the axes X and Y when the elements 2, 3 are in the closed position (fig. 13).

[0030] This configuration allows to use the hinge assembly 1 also with relatively narrow door frames 2 and

plates 3, while still ensuring a secure assembly and an ample rotation of the door plate 3 with respect to the door frame 2.

[0031] In the hinge assembly according to the invention, because the assembly axes of the bolts and pins are offset, the bolts 4a, 5a, 6a do not completely intersect the pin 7 and their heads 12 protrude from the relative bodies 4, 5 and 6, adjustments both with respect to the frame 2 and to the plate 3, as will be explained in more detail hereafter, can be carried out without needing to dis-assemble the plate 3 and/or the hinge assembly 1.

[0032] Fig. 2 is a typical transverse cross sectional view through a door frame 2 and a door plate 3 connected by a hinge assembly 1 according to the present invention. In this figure, the upper hinge body 4 is seen, connected to the door frame 2 by means of bolt 4a that is secured and adjusted into threaded hole 2a of the door frame. The middle hinge body 5 (hidden in this figure beneath the upper hinge body 4) is connected to the door plate 3 by means of bolt 5a that is secured and adjusted into threaded hole 3a of the door plate. The lower hinge body 6 (hidden in this figure by the upper and middle hinge bodies) is connected to the frame 2 in a similar manner to that of the connection of the upper hinge body 4. The door plate is thus allowed to pivot about the pivot pin 7 between the illustrated closed position, and between an opened position when the plate is moved in the direction of the arrow 10.

[0033] Fig. 3 is an isometric exploded view of a "three part" hinge assembly according to the preferred embodiment of the present invention, comprising eight components as they are spatially configured prior to assembling them into one integral hinge assembly. The hinge assembly is comprised of (a) three hinge bodies: an upper hinge body 4, a middle hinge body 5, and a lower hinge body 6; (b) three bolts 4a, 5a, and 6a; (c) pivot pin 7; and (d) a securing screw 8. Each of the three hinge bodies is provided with a first (vertical) crossing hole 4c, 5c and 6c, respectively, through which the pivot pin 7 can be inserted. Each of the three hinge bodies is further provided with a second (horizontal) crossing hole 4b, 5b and 6b, respectively, through which the bolts 4a, 5a and 6a can be inserted.

[0034] In the embodiment shown in the figures, the first (vertical) and the second (horizontal) crossing holes of each hinge body 4, 5, 6 are partially intersecting one another forming a junction thereof. The intersection point of the first and the second crossing holes can be observed through the first (vertical) crossing hole 4c, 6c of the upper and of the lower hinge bodies 4, 6 and is marked 4d in the upper hinge body 4, and 6d in the lower hinge body 6. A similar intersection point exists in the middle hinge body 5 as well, but cannot be observed in Figure 3. It is seen, however, through the cross sectional view illustrated by Figure 4 (see detail 5d of Figure 4). The bolts 4a, 5a and 6a are intended to pass respectively through the second crossing holes 4b, 5b and 6b of the three hinge bodies 4, 5, 6. Each of the bolts 4a, 5a, 6a

has a radial groove 11 near the bolt head 12. When the bolt 4a, 5a, 6a is in position inside the second (horizontal) crossing hole 4b, 5b, 6b of the respective hinge body 4, 5, 6, the radial groove 11 consolidates with the first (vertical) crossing hole 4c, 5c, 6c at the partial intersection junction between the first and the second crossing holes, to form free passageway for the pivot pin 7. In turn, placement of the pivot pin 7 inside the first crossing hole 4c, 5c, 6c and through the passage provided by the radial groove 11 captures the respective bolt inside the second (horizontal) crossing hole 4b, 5b, 6b without letting it move along the hole. This capturing does not prevent however a free rotation of the bolt 4a, 5a, 6a inside the hole, either for connecting the bolt (into a matching threaded hole located at the door frame 2 or at the door plate 3) or for adjusting the gap between the hinge and between the frame or plate to which it is connected.

[0035] In order to prevent the pivot pin 7 from slipping off the hinge bodies 4, 5, 6 during continuous use of the door, it is provided with a recess 7a intended to be positioned opposite the threaded aperture 4e of the upper hinge body 4. When the pivot pin 7 is in positioned inside the first crossing hole 4c, the securing screw 8 can be screwed inside the aperture 4e until its distal end is stopped by the body of the pivot pin 7 inside the recess 7a. When the distal end of the securing screw 8 reaches inside the recess 7a, escape of the pivot pin 7 off the first crossing hole 4c, 5c, 6c is prevented.

[0036] According to a variant not shown here, the screw 8 is not used and the recess 7a is not made, but a pin 7 is used having a widening in its upper portion, which is clamped through interference against the walls of the vertical hole 4c of the hinge body 4. This solution simplifies the operations to produce the hinge body 1 and further reduces the number of its components.

[0037] In order to facilitate appropriate positioning of the pivot pin 7 inside the first (vertical) crossing hole 4c the pivot pin 7 is provided with a head 7b having a greater diameter than that of the pin 7 itself, such that when the wide head 7b is brought to a contact with the top surface of the upper hinge body 4 the recess 7a reaches an appropriate height inside the first crossing hole 4c to face the aperture 4e.

[0038] Each of the three bolts 4a, 5a and 6a is also provided with a widening 13, for facilitating its proper positioning inside the respective second (horizontal) crossing hole 4b, 5b, 6b. When the bolt 4a, 5a, 6a is inserted inside the second crossing hole 4b, 5b, 6b, its widening 13 engages a matching narrowing at the distal end of the hole 4b, 5b, 6b (see for example detail 4f in Figure 5) which prevents a further movement of the bolt 4a, 5a, 6a inside the hole 4b, 5b, 6b. When the bolt reaches such position, its radial groove 11 consolidates with the first (vertical) crossing hole 4c, 5c, 6c, thus creating free passageway for the pivot pin 7.

[0039] Fig. 4 is an isometric view of the middle hinge body 5 of the hinge assembly 1 of Figure 3, with a partial cross sectional view along its vertical crossing hole 5c,

through which the partial intersection junction 5d between the first crossing hole 5c and between the second crossing hole 5b can be observed.

[0040] Fig. 5 is an isometric view over a horizontal cross section through the upper hinge body 4 of the hinge assembly 1 of Figure 3. A first crossing hole 4c adapted to receiving the pivot pin (see detail 7 of Figure 3) is partially intersecting a second crossing hole 4b through which a bolt (see detail 4a of Figure 3) is to be inserted.

The second crossing hole 4b has a narrowing 4f at its distal end, which is useful for limiting the insertion of the bolt to a predetermined measure. The bolt can pass through the narrowing 4f until its widening (see detail 13 of Figure 3) reaches and contacts the narrowing 4f and blocked thereby. When the bolt is blocked by the narrowing 4f, its radial groove (see detail 11 of Figure 3) consolidates with the first (vertical) crossing hole 4c, thus forming a passageway for the pivot pin (detail 7 of Figure 4). When the pivot pin is in position inside the first crossing hole 4c, it can be secured to prevent its removal, by means of a securing screw (detail 8 of Figure 3) tightened through threaded aperture 4e into a recess (detail 7a of Figure 3) made in the body of the pivot pin. Fig. 6 is an isometric view over the assembled hinge assembly of Figure 3, with horizontal cross section views through its upper hinge body 4 and through its pivot pin 7. In this figure it can be seen how the distal end of securing screw 8 contacts the body of the pivot pin 7 inside the recess 7a for preventing removal of the pivot pin from the hinge bodies. In this Figure it can further be observed how pivot pin 7 passes through the radial groove 11 of bolt 4a, thus capturing the bolt and preventing its linear movement inside the second (horizontal) crossing hole 4b of the upper hinge body 4. Actually, a linear movement of the bolt 4a in the direction indicated by arrow 15 is prevented by the narrowing 4f at the distal end of the second crossing hole 4b that blocks the corresponding widening 13 of the bolt from further movement in that direction. Accordingly, tearing forces that may act on the hinge 1 through a pressure exerted on the door plate 3 in a direction opposite to that indicated by the arrow 15 shall be resisted by both the reacting force between narrowing 4f and bolt widening 13, and the reacting force between the body of the pivot pin 7 and bolt head 12. Forces acting on the hinge in the direction of arrow 15 shall be resisted by the reacting forces between the body of pivot pin 7 and the bolt body 16.

[0041] Fig. 7 is an isometric view over the assembled hinge assembly of Figure 3, with a partial cross sectional view along the first (vertical) crossing holes of its three hinge bodies 4, 5 and 6. In this Figure it can be observed how pivot pin 7 can be positioned properly inside the vertical crossing holes 4c, 5c, 6c, by inserting it from the upper hinge body 4 downwardly, until its wide head 7b is stopped by the top surface of the upper hinge body 4. In such position the pin recess 7a faces the threaded hole (see detail 4e of Figure 3), which is missing in this Figure due to the cross section made in the hinge bodies

4, 5, 6. Through this cross sectional view it is shown how the pivot pin 7 passes through the radial recesses existing behind the heads 12 of the three bolts 4a, 5a and 6a, thus prevents a linear movement of the bolts in either direction.

[0042] Fig. 8 is an isometric view over the assembled hinge assembly of Figure 3. Although the hinge bodies illustrated in the preferred embodiment illustrated by these figures are of two sizes, namely the middle hinge body 5 is of a greater height dimension comparing to the height dimension of the upper 4 and lower 6 hinge bodies, it should be appreciated that they could be designed in other proportions as a matter of design considerations, without departing from the scope of the present invention. For example, according to another preferred embodiment of the present invention, the middle hinge body 5 is of similar dimensions as the upper and the lower ones 4, 6, thus a triplicate of the same component can be produced and serve as the three hinge bodies 4a, 5a, 6a, which may help in reducing manufacturing costs. According to this embodiment the whole hinge 1 may be produced from only three principal components: (a) pivot pin; (b) hinge body (in the required number of units to be nested on the pivot pin); and (c) securing element.

[0043] In case the securing element is a screw (e.g. detail 8 of Figure 3), all the hinge bodies 4, 5, 6 may be provided with a matching threaded aperture in order to keep uniformity of the hinge body as could be desired from logistic perspective, (although only one aperture of the three bodies will be used in order to secure the pivot pin). However, and as known in the art, there is a variety of other options to secure a pin, and according to some of which there is no need in an aperture in any of the hinge bodies. For example, the pivot pin 7 can be designed to protrude a few millimeters from below the lower hinge body 6 and be secured by a grooved springy disk to be mounted on its bottom end by pressure. Another option is to provide the pivot pin 7 with radial groove near its bottom end, adapted to receiving an omega shaped securing spring. Another option is to provide the pivot pin 7 with a crossing aperture near its bottom end, adapted to receiving a securing wire, peg, or split securing pin.

[0044] Fig. 9 is an isometric view over the assembled hinge assembly 1 of Figure 8, taken from an opposite direction. The hinge assembly 1 as depicted in this Figure, as well is in the preceding ones, is for use of doors who open to the left. However and as can be appreciated, it may be assembled for use of right open doors in a similar manner. The only change would be that the middle hinge body will be assembled in an up-side-down orientation to the depicted one, which will result in that the bolt 5a will protrude to the opposite direction (i.e. in 180 degrees to its currently depicted orientation).

[0045] Fig. 10 shows a first variant, wherein between the upper hinge body and the middle hinge body 4, 5 and between the middle and lower hinge body 5, 6, a respective bushing 17 is inserted, coaxial with the pivot pin 7, advantageously made of self-lubricating material, which

reduces the friction and allows a better reciprocal sliding between two adjacent hinge bodies 4, 5, 6.

[0046] Fig. 11 shows a second variant, wherein the bushing 17 comprises two parts 17a, 17b, coupled together through screwing, so as to allow to adjust the distance between two adjacent hinge bodies 4, 5, 6 and hence of the overall height of the hinge assembly 1 along the hinging axis I.

[0047] This embodiment allows to adjust the hinge assembly 1 along the third axis too, and in this case too the adjustment can be performed without needing to dismantle the door plate 3, as already described with reference to the axes X and Y.

[0048] Fig. 12 shows a condition of the hinge assembly 1 wherein the bolts 4a, 5a, 6a are parallel to each other; in this condition the hinge assembly 1 allows to articulate, for example a door plate with respect to a frame between a closed position, in which the plate is parallel to the frame, and an open position, in which the plate 3 is rotated by the desired angle with respect to the frame 2.

[0049] In figures 12 and 13 a variant is also shown in which each of the hinge bodies 4, 5, 6 is provided with a hole 19, substantially parallel to the first vertical crossing holes 4c, 5c, 6c and therefore to the hinging axis I, which interferes with the horizontal holes 4c, 5c, 6c into which the bolts 4a, 5a, 6a are inserted.

[0050] Inside said holes 19 a small retaining cylinder can be inserted, for example made of plastic, which retains the relative bolt 4a, 5a, and 6a through interference after the first insertion inside the relative hinge body 4, 5 and 6.

[0051] In this way, it is possible to achieve a pre-assembly of each hinge body with the relative fixing bolt, which facilitates both storage and transport operations, and also the assembly operation by the final user.

[0052] Other embodiments, however, can also be achieved for the pre-assembly of the bolt with respect to the hinge body, for example a protrusion made on the wall of the horizontal hole 4b, 5b, 6b, or any other suitable solution.

[0053] As can be appreciated, the hinge assembly according to the present invention is advantageous in that it can be produced from a minimum number of components; it can be assembled and adjusted by a door technician in field conditions without disassembling the hinge 1 from the relative elements 2, 3; it could be adapted to the use of a right open door or of a left open door in field conditions; it is modular in that the same components may be used for assembling different number of hinge bodies nested on pivot pins having appropriate dimensions, thus creating hinges of different load capacities from the same basic components; it is massive and lasting since all of its components are held together by the pivot pin itself which is normally made massive due its heavy duty mission for supporting the door.

[0054] According to the preferred embodiment the hinge assembly is made of steel, for example drawn or sintered. However, it can be manufactured from other

metals or alloys as well, as may be allowed according to specific applications to which it can be directed. According to various embodiments of the present invention, and due to the massive construction of the hinge assembly which its entire parts are held together by the massive pivot pin element, the hinge assembly may be constructed even of plastic materials or of composite materials, and still provide reasonable load capacities for various applications. Accordingly, the manufacturing of a hinge according to this invention is not limited to specific materials, and whatever material it is made from, it should be considered within the scope of the present invention.

[0055] The above and other advantages of the hinge assembly of the present invention lead to a meaningful reduction in the production costs of adjustable hinges, and improve the logistic involved in their stock storage and delivery.

Claims

1. Adjustable hinge assembly for hinging a first fixed element (2) and a second movable element (3) and comprising at least two hinge bodies (4, 5, 6), each provided with at least a respective bolt (4a, 5a, 6a) defining a relative fixing axis (X, Y) for the relative fixed (2) or movable (3) element, said hinge bodies (4, 5, 6) being hinged to each other on a hinging axis (I), **characterized in that** said hinging axis (I) does not intersect said fixing axes (X, Y).
2. Adjustable hinge assembly according to claim 1, **characterized in that** said hinging axis (I) is disposed outside with respect to the angle (α) defined by said fixing axes (X, Y) in the closed position of the relative hinged elements (2, 3).
3. Adjustable hinge assembly according to claim 1 or 2, further comprising a pivot pin (7) defining said hinging axis (I); at least one of said two hinge bodies (4, 5, 6) having a first crossing hole (4c, 5c, 6c) of a diameter matching that of the pivot pin (7); at least one second crossing hole (4b, 5b, 6b) in an orientation perpendicular to that of the first one and defining said fixing axis (X, Y), **characterized in that** the first and the second crossing holes (4c, 4b; 5c, 5b; 6c, 6b) are partially intersecting one another forming a junction (4d, 5d, 6d) there between.
4. Adjustable hinge assembly according to claim 3, **characterized in that** said bolt (4a, 5a, 6a) is positioned inside the second crossing hole (4b, 5b, 6b) and has a radial groove (11) at a predetermined location along its length; said radial groove (11), when brought inside the second crossing hole (4b, 5b, 6b) into alignment with the first crossing hole (4c, 5c, 6c), makes room for the pivot pin (7) to pass through the first crossing hole (4c, 5c, 6c) and across the bolt (4a, 5a, 6a), thus capturing the bolt (4a, 5a, 6a), which then becomes incapable of linear movement along the second crossing hole (4b, 5b, 6b) without losing its ability to rotate.
5. Adjustable hinge assembly according to any claim hereinbefore, **characterized in that** said pivot pin (7) is secured to at least one of said hinge bodies (4, 5, 6) by means of a securing element (8) able to be inserted in a corresponding seating (4e) made on the respective hinge body (4) and in a recess (7a) made in the pin (7).
6. Adjustable hinge assembly according to claim 2, 3 or 4, **characterized in that** said pin (7) comprises, in an upper portion, a widening able to cooperate with a segment of inner wall of the crossing hole of one of the end hinge bodies (4 or 6) in order to secure through interference said pin (7) to the corresponding hinge body (4 or 6).
7. Adjustable hinge assembly according to any one of the preceding claims, **characterized in that** between at least two of said hinge bodies (4, 5, 6) at least a spacer element (17) is inserted, with an anti-friction function.
8. Adjustable hinge assembly according to claim 7, **characterized in that** said spacer element (17) is of the self-lubricating type.
9. Adjustable hinge assembly according to claim 7, **characterized in that** said spacer element (17) has an adjustable height to allow to adjust the distance between two adjacent hinge bodies (4, 5, 6).
10. Adjustable hinge assembly according to any one of the preceding claims, **characterized in that** it comprises three hinge bodies (4, 5, 6) each having a first and a second crossing holes (4c, 4b, 5c, 5b, 6c, 6b) intersecting one another forming a junction (4d, 5d, 6d) there between, three bolts (4a, 5a, 6a), and one pivot pin (7).
11. Adjustable hinge assembly according to any one of the preceding claims, **characterized in that** it comprises three hinge bodies (4, 5, 6) each having a first and a second crossing holes (4c, 4b, 5c, 5b, 6c, 6b) intersecting one another forming a junction (4d, 5d, 6d) there between, three bolts (4a, 5a, 6a), one pivot pin (7), and at least one pin securing element (8).
12. Adjustable hinge assembly according to any one of the preceding claims, **characterized in that** it is supplied to a customer divided to its parts in a disassembled state.
13. Adjustable hinge assembly according to any one of

the preceding claims, **characterized in that** it comprises means for pre-assembling the bolt (4a, 5a, 6a) to the respective body (4, 5, 6).

14. Method for assembling adjustable hinges (1), **characterized in that** it comprises the following steps: (a) inserting bolts (4a, 5a, 6a) having radial groove (11) at a location along their length into respective horizontal crossing holes (4b, 5b, 6b) made in corresponding hinge bodies (4, 5, 6); (b) bringing the radial groove (11) of each bolt (4a, 5a, 6a) into alignment with a vertical crossing hole (4c, 5c, 6c) made in the respective hinge body (4, 5, 6) and partially intersecting the horizontal crossing hole (4b, 5b, 6b); (c) nesting the hinge bodies (4, 5, 6) along a pivot pin (7) by inserting the pivot pin (7) through the vertical crossing holes (4c, 5c, 6c) of each hinge body (4, 5, 6) one next to another and across the bolts (4a, 5a, 6a) through their radial groove (11) thus capturing the bolts (4a, 5a, 6a) which then become incapable of linear movement along the horizontal crossing holes (4b, 5b, 6b) without losing their ability to rotate.

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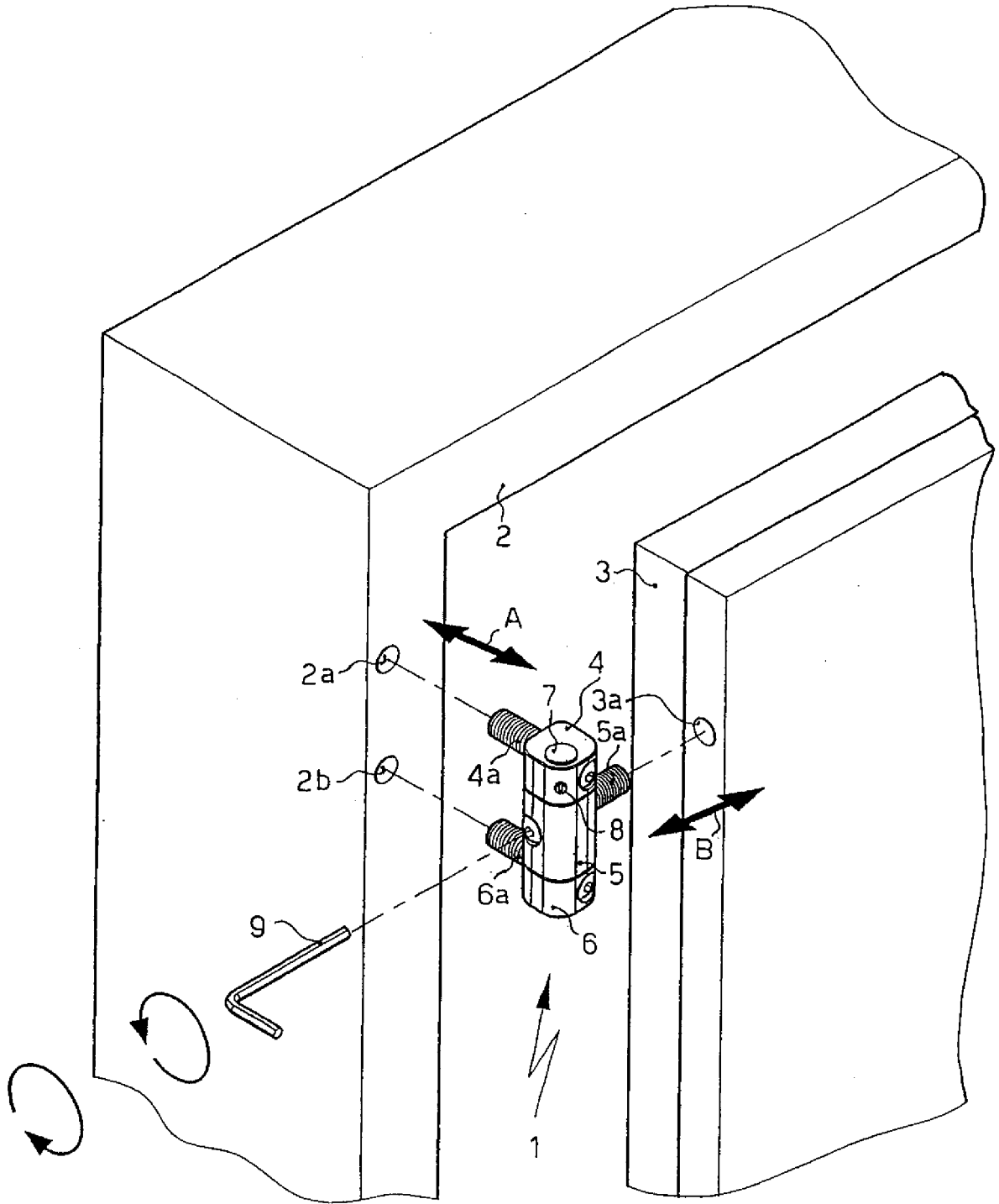


fig. 1

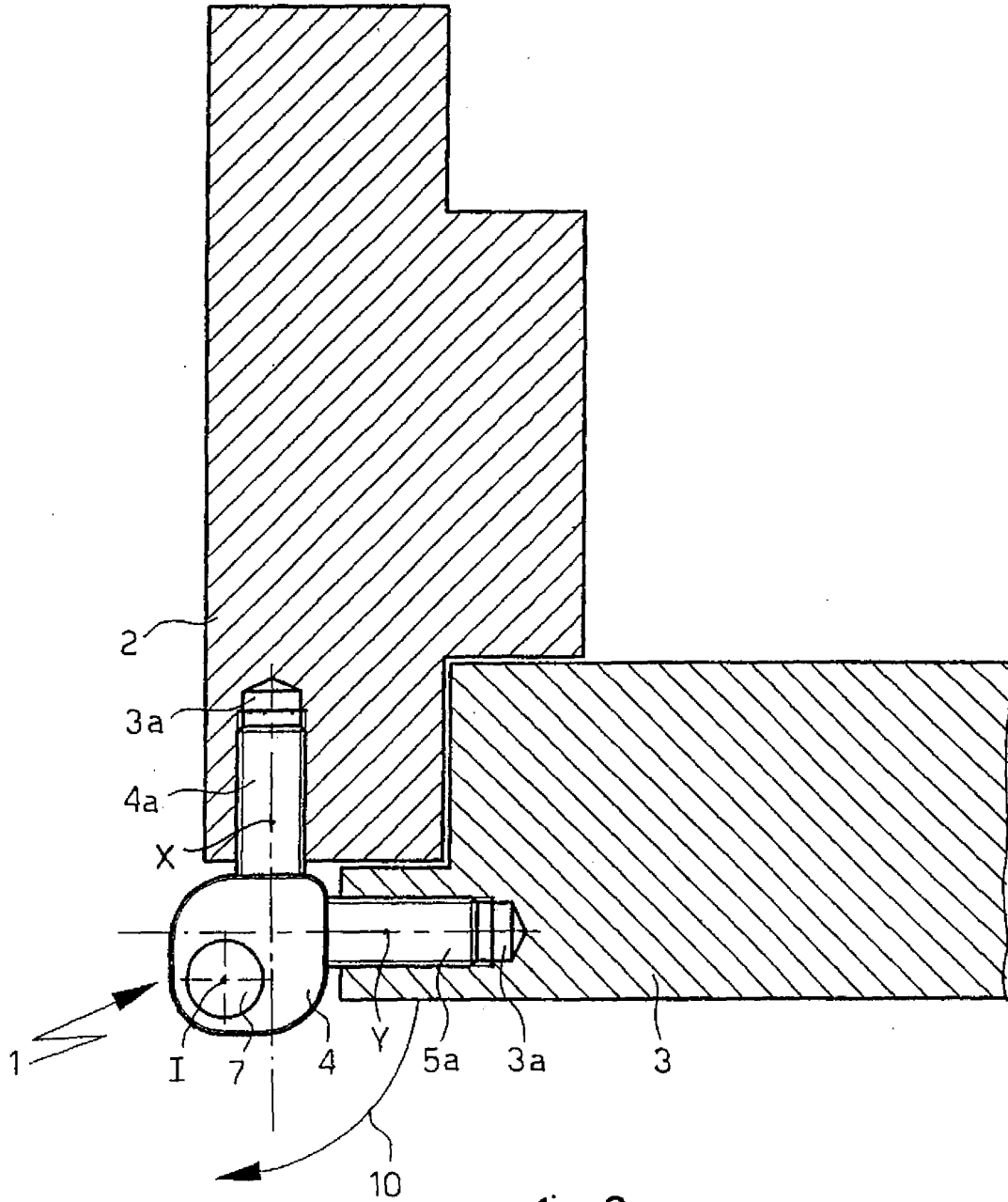


fig. 2

