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(54) Adjustable door hinge for an electrical cabinet

(57) The invention includes an adjustable door hinge for an electrical cabinet with at least a first hinge part that can be fixed to a door pane, and a second hinge part that can be fixed to a door frame and that is rotatable around a hinge axis in relation to the first hinge part, wherein the second hinge part comprises an attachment plate that is, in a fixed state, mounted on the door frame and held by at least two attachment screws to said door frame, and comprises an adjustment screw for adjusting the hinge axis, wherein the adjustment screw is positioned on the attachment plate and distanced from a straight connection line, which line lays in the plane of the attachment plate and connects the center axes of the attachment screws, wherein through the turning of the adjustment screw, the attachment plate tilts around its support area on the door frame and the hinge axis becomes adjusted, and an electrical cabinet comprising at least one of the adjustable door hinge for coupling a door pane to a door frame.

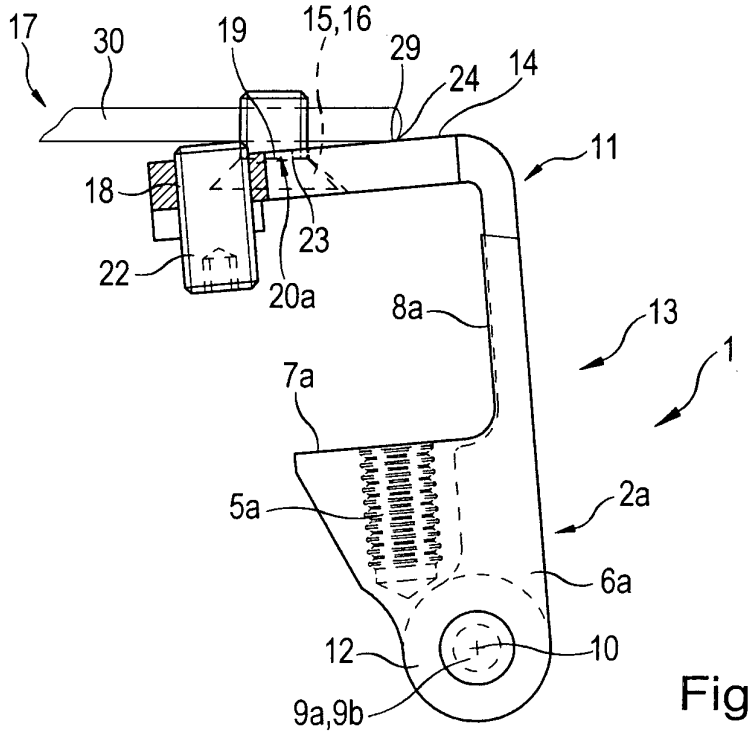

Fig. 6b

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Description

[0001] The present invention refers to an adjustable door hinge for an electrical cabinet with at least a first hinge part that can be fixed to a door pane, and a second hinge part that can be fixed to a door frame, and that is rotatable around a hinge axis in relation to the first hinge part, wherein the second hinge part comprises an attachment plate that is, in a fixed state, mounted on the door frame and held by at least two attachment screws to said door frame, and comprises an adjustment screw for adjusting the hinge axis.

[0002] The present invention also refers to an electrical cabinet comprising said adjustable door hinge.

[0003] Several door hinges in the field of electrical cabinets are known from the state of the art, which hinges are adjustable in such a way that their hinge axes can be adjusted. High standards are set in this field, especially as to the construction of the bearings, as heavy door systems initiating high torques are to be mounted to the electrical cabinets.

[0004] In these systems many complicated parts having a great complexity are used to create adjustment functions. As result of these multi-part constructions, and due to the heavy loads and high frictional forces acting on the door hinges and their bolts over a long operating life, a misalignment of the door pane relative to the door frame follows and finally the whole geometry of the primary construction in these systems is changed.

[0005] Further disadvantages of these systems are that these adjustable door hinge systems are not suitable for doors that open 180° and have, due to many joint patches, low operating safety.

[0006] The adjustable door hinge of the current invention has, therefore, the object of allowing the adjustment of a robust door hinge system which increases the operating safety.

[0007] This object is solved in that the adjustment screw is positioned on the attachment plate and distanced from a straight connection line, which line lays in the plane of the attachment plate and connects the center axes of the attachment screws, wherein through the turning of the adjustment screw, the attachment plate tilts around its support area on the door frame and the hinge axis becomes adjusted.

[0008] This special arrangement of the adjustment screw relative to the attachment screws, and the tilting of the attachment plate, have the effect that the attachment plate can roll smoothly along the door frame during the adjustment of the adjustment screw. Therefore, the second hinge part stays in contact with the door frame during the whole adjustment process. Therewith, the gaps between these two parts, which faces outside, are minimized. Even in the fixed position, when the attachment screws are tightened, the attachment plate fits tightly on the door frame and gaps on the outside are also avoided in this state. Consequently, parts from outside, such as parts of the user's body, i.e. fingers, cannot be caught in the gap between the hinge parts and the door frame during the adjustment or during work on the electrical cabinet. Moreover, due to the absence or the invisibility of gaps between the hinge parts and the body of the electrical cabinet, for instance the door frame, the external appearance is improved.

[0009] Further embodiments and advantages become clear in conjunction with the dependent claims, which are explained as follows:

[0010] A further advantageous embodiment of the invention is that the attachment plate is designed to be fixed to a front face of the door frame, which front face faces to the plane of the door pane in a closed position of the door pane. This has the further advantage that the second hinge part can be connected to a side of the door frame that avoids any limitation of the interior space of the electrical cabinet. The fixture of interior parts of the electrical cabinet is, therefore, not disturbed by any portion of the hinge system.

[0011] Furthermore, an embodiment advantageously includes that in adjusting the adjustment screw from a first, retracted position to a second, extended position, the support area rolls along an edge of the door frame, which edge preferably adjoins the front face in the direction of the outer side of the electrical cabinet. Therewith, it is possible to create a simply-constructed support area for the contact with the adjustable door hinge that requires no separate parts.

[0012] In a further embodiment, it is advantageous when, in the adjustment process of the adjustment screw, the support area forms a rotational center, around which rotational center the attachment plate tilts and the hinge axis pivots. Therewith, a compact rotation of the hinge axis is directly coupled to the tilting of the attachment plate.

[0013] In a further embodiment, it is advantageous that the support area extends substantially parallel to the hinge axis and/or to the straight connection line. Due to this parallel arrangement, the hinge axis turns exclusively in a horizontal direction, which horizontal direction is a direction of movement normal to the hinge axis. The rotation is thus retained through the support area and crosswise movements of the hinge axis, and an inclination of this axis is avoided.

[0014] When, according to a further embodiment, the first hinge part and the second hinge part are advantageously designed to allow a rotation of the door pane from the closed position to an open position of at least 180°, the angle of the door can be comfortably adjusted without being disturbed by the door pane and without separately demounting the door pane from the hinge.

[0015] As per the specs of the invention, an electrical cabinet is advantageously provided with at least one adjustable door hinge, to couple a door pane to a door frame. In a further embodiment, the electrical cabinet advantageously comprises four adjustable door hinges.

[0016] In the following, the invention will be explained in detail through the use of figures in the drawings.

In Fig. 1, an isometric view of the adjustable door hinge, comprising the first hinge part and the second hinge part,

in Fig. 2, an isometric, schematic view of the second hinge part and the door frame, and the connection therebetween,

in Fig. 3, an isometric, schematic view of the first hinge part and the door, and the connection therebetween,

in Figs. 4a-4c, in isometric views, the adjustment of the adjustable door hinge, wherein
Figure 4a shows the loosening step of the attachment screws,
Figure 4b shows the adjustment step of the adjustment screw and the hinge axis, and
Figure 4c shows the tightening step of the attachment screws,

in Fig. 5, a top view of the first and second hinge parts being connected in a plane parallel to the plane of the attachment plate, and

in Fig 6a and 6b, top views of the adjustable door hinge in a plane perpendicular to the hinge axis in a first basic position, and in a second displaced position, are shown.

[0017] The figures are merely schematic and serve only to clarify the understanding of the invention. The same elements are numbered respectively with corresponding reference numbers.

[0018] In Fig. 1, an adjustable door hinge 1 for an electric cabinet is shown for coupling a door pane 3 (shown in Fig. 3), rotatable around a hinge axis 10, to a door frame 17 (shown in Fig. 2), wherein the door frame 17 is held via at least a first hinge part 2a, 2b, and the door pane 3 via a second hinge part 11.

[0019] As can be further seen in Fig. 3, the adjustable door hinge 1 comprises two first hinge parts 2a, 2b, namely a first door pane holder 2a and a second door pane holder 2b, for holding the door pane 3 in position relative to the adjustable door hinge 1. The first and second door pane holders 2a, 2b are, in an assembled condition, fixed to the door pane 3 via door holding screws 4a, 4b. The door holding screws 4a, 4b, one for each door pane holder 2a, 2b, are stuck through through-holes of the door pane 3 into the door pane 3 and are screwed into an inner thread 5a and 5b of a mounting head 6a, 6b of the first door pane holder 2a and the second door pane holder 2b, such that, with their screw head the door holding screws 4a, 4b contact the door pane 3 and push the door pane 3 against the door pane holders 2a, 2b. Each of the inner threads 5a and 5b extend into a first side 7a and 7b of the mounting heads 6a or 6b. When mounted, each of the first and second door pane holders 2a, 2b fits closely via the first side 7a and 7b of the mounting head 6a, 6b against a first side portion 27 of the door pane 3, which portion 27 lies in the plane of the door pane 3. To achieve level contact, the longitudinal axes of the inner threads 5a, 5b of each of the mounting heads 6a, 6b are substantially perpendicular to the first sides 7a and 7b, so that the first sides 7a and 7b are placed substantially parallel to the plane of the door pane 3 in a fixed state. Additionally, each of the mounting heads 6a, 6b of the first and second door pane holders 2a and 2b comprises a second side 8a, 8b that contacts a further second side portion 28 of the door pane 3, wherein the second side 8a, 8b is perpendicular to the first side 7a and 7b. The first sides 7a, 7b and the second sides 8a, 8b of the mounting heads 6a, 6b make contact with the outer form of the door pane 3 and extend in two dimensions, such that the door pane is tightly held in position relative to the first and second door pane holders 2a, 2b.

[0020] As can be seen in combination with Fig. 5, each of the first and second door pane holders 2a, 2b further comprises one pivot bolt 9a, 9b that is coupled to a mounting bore in each mounting head 6a, 6b. Each pivot bolt 9a and 9b is oriented with its longitudinal axis substantially parallel to the plane of the door pane 3 and congruent to the hinge axis 10. The hinge axis 10 is set through the centre axis of a bearing bushing 12 of the second hinge part 11, as further described below.

[0021] The first and second door pane holders 2a, 2b, and thus the door pane 3, are pivotably mounted relative to the second hinge part 11 over said pivot bolts 9a and 9b, wherein the pivot bolts 9a and 9b of the first door pane holder 2a and the second door pane holder 2b are inserted into said bearing bushing 12 of the second hinge part 11 during operation.

[0022] The bearing bushing 12 of the second hinge part 12 is, in turn, connected via a connecting link 13 to an attachment plate 14, which connecting link 13 and attachment plate 14 each have a plate-shaped extension. The attachment plate 14 and the plate-shaped connecting link 13 are substantially oriented perpendicular to each other. What also becomes clear with regard to Figs. 1 and 2 is that the bearing bushing 12, the connecting link 13 and the attachment plate 14 of the second hinge part 11 are formed of one single part, preferably a metal, die-casted part. Further details with regard to the connection between the second hinge part 11 and the door frame 17 can be seen in Fig. 2.

[0023] The second hinge part 11 is, during operation, mounted to the door frame 17 via two attachment screws 15 and 16. Next to the attachment screws 15 and 16, also on the attachment plate 14, an adjustment screw designed as set screw 22 is screwed into an inner thread 18 of the attachment plate 14.

[0024] As can also be seen in Fig. 5, the first and second attachment screws 15, 16 are stuck into through-hole bores 20a, 20b onto the attachment plate 14 and are screwed into inner threads in the door frame 17 to strongly hold the attachment plate 14 onto the door frame

17 by which the screw heads act as support. Each of the first and the second attachment screws 15, 16 fits levelly with a side of their screw heads to the attachment plate 14, against a shoulder portion 19 adjacent to the through-hole bores 20a, 20b. In this embodiment, a plain, conical contact between a conical flange of the screw head of the first and second attachment screw 15, 16 and the conically-shaped shoulder portion 19, is achieved.

[0025] The through-hole bore 20a for supporting the first attachment screw 15 and the through-hole bore 20b for supporting the second attachment screw 15 are each designed as a double hole 20a, 20b. The center axes of the first and second single holes of the double holes 20a, 20b are distanced from each other such that the outer circumferences of the single holes cross each other and one double hole 20a, 20b with two nose portions 23 between the single holes is formed. As the distance between these two nose portions 23 is smaller than the outer diameter of the threaded portion of the attachment screws 15, 16, the attachment screw 15, 16 cannot slide over from the first single hole into the second single hole while still mounted in one of the single holes. A further adjustment option with two further positions is achieved. To change between the positions of the double holes 20a, 20b, the attachment screws 15, 16 have to be unscrewed from the door frame and removed from the first single hole and must than be mounted in the other single hole.

[0026] The center axes of the two single holes of the through-hole bores 20a, 20b and therefore the center axes of the first attachment screw 15 and the second attachment screw 16, when being stuck in the through-hole bores 20a, 20b, are in line with and connected by one straight connection line 21 that is shown in Fig. 5. The connection line 21 is an imaginary line that lies in the plane of the attachment plate 14. An inner thread 18 for receiving the set screw 22 is placed distanced from this straight connection line 21 on a side opposite to the hinge axis - when regarded in the plane of the attachment plate 14. This inner thread 18 extends substantially parallel to the parallel center axes of the through-hole bores 20a, 20b. Moreover, the inner thread 18 for the set screw 22 has a length that is greater than the length of the through-hole bores 20a, 20b.

[0027] The door frame portion 30 of the door frame 17, as can best be seen in Figure 2, to which the attachment plate 14 is mounted, is arranged substantially parallel to the plane of the door pane 3 in the closed position of the door pane 3. The door frame portion 30 has an essentially plane extension. On one side of the door frame portion 30, an edge 29 adjoins that is substantially parallel to the straight connection line 21 and the hinge axis 10, and acts as a pivot axis when the adjustment process, as described below, takes place.

[0028] As can be seen in Figs. 6a and 6b, the frontal end of the set screw 22 can be displaced from a first retracted position (shown in Fig. 6a) to a second extended position (shown in Fig. 6b) to impact the door frame portion 30 and, therefore, adjust the distance between the inner thread 18 and therewith the position of the attachment plate 14 and the door frame 17. With this distance, the angle between the plane of the attachment plate 14 and the door frame 17, as further described below, is adjusted.

[0029] The adjustment process is further explained in the following:

[0030] As can best be seen in Figs. 4a-4c, the adjustment of the adjustable door hinge 1 is achieved through three steps.

[0031] In the first step, which is shown in Fig. 4a, both attachment screws 15, 16 are loosened at the same time or subsequently with a screwdriver. In this case, the attachment screws 15, 16 are right-hand threaded so that they are loosened by turning the screwdriver towards the left. During the loosening process, the distance between the screwhead of the attachment screws 15, 16 and the door frame 17 increases, and, therewith, the attachment plate 14 becomes loosened. Thus, the attachment plate 14 can be freely tilted around the straight connection line 22 in accordance with its contact area on the door frame portion 30.

[0032] In the second step, as shown in Fig. 4b, adjustment takes place by turning the set screw 22 into or onto the inner thread 18 to adjust the correct position of the set screw 22. When turning said set screw 22 sufficiently to the right, the frontal face becomes screwed towards the door frame 17. When turning said set screw 22 sufficiently to the left, the frontal face becomes screwed away from the door frame 17. When turning the set screw 22 sufficiently into the inner thread 18, the frontal face of the set screw 22 begins protruding from the attachment plate's side towards the door frame 17. This protruded frontal face end defines the distance between the inner thread 18 and the door frame 17 in the protruded status.

[0033] As becomes clear with regard to Fig. 6b, in an displaced position of the hinge axis 10, the frontal face of the set screw 22 defines a first contact area of the second hinge part 11 with the door frame portion 30. With a support area 24, where the attachment plate 14 is directly in contact with the door frame portion 30 of the door frame 17, a second contact area is defined.

[0034] Depending on the distance between the frontal face of the set screw 22 and the attachment plate 14, the angle between the plane of the attachment plate 14 and the door frame 17, and therefore, the position of the hinge axis 10, is defined. When the frontal face of the set screw 22 does not protrude from the inner thread 18 on the side of the door frame 17 in a first, basic position, the attachment plate 14 fits plainly on and parallel to the door frame portion 30. In this displaced position the frontal face of the set screw 22 protrudes from the inner thread 18 on the side of the door frame 17 in a second, displaced position, the attachment plate 14 fits with the support area 24 on the edge 29, wherein the door frame portion 30 and the attachment plate 14 are inclined to each other.

[0035] The maximum displacement of the hinge axis

10 thus depends directly on the maximum length of engagement of the set screw 22.

[0036] When having adjusted the correct depth of engagement of the set screw 22 and, therewith, the correct horizontal position of the hinge axis 10, the first and second attachment screws 15, 16, as can be seen in Fig. 4c, are, in a third step, tightened again to guarantee an optimal transfer of the door forces via these attachment screws 15, 16. The frontal face, in this second position, protrudes from the inner thread 18, and is pressed against the door frame portion 30 in this fixed state. The attachment plate 14, in the region next to the inner thread 18, is spaced apart from the door frame portion 30, while the edge 29 of the door frame portion 30 contacts the attachment plate 14 in the support area 24, which support area 24 is, with respect to the straight connection line 21, on a side opposite the inner thread 18.

[0037] Thus, as shown in Figs. 6a and 6b, the attachment plate 14 is adjusted by the set screw 22 by screwing the set screw from the first, basic position, as shown in Fig. 6a, towards the door frame 17 into the second, displaced position, as shown in Fig. 6b, between which two positions, the attachment plate 14 tilts around the straight connection line 21.

[0038] The adjustment process can be conducted with the door pane 3 fixed to the first hinge parts 2a, 2b or with the door pane 3 being removed from the first hinge parts 2a, 2b.

[0039] If an electric cabinet comprises more than one of the hinge systems, the steps as mentioned above are carried out simultaneously for all hinges.

[0040] The optimal number of adjustable door hinges would be four for each electrical cabinet.

Claims

1. An adjustable door hinge (1) for an electrical cabinet with at least a first hinge part (2a; 2b) that can be fixed to a door pane (3), and a second hinge part (11) that can be fixed to a door frame (17) and that is rotatable around a hinge axis (10) in relation to the first hinge part (2a; 2b), wherein the second hinge part (11) comprises an attachment plate (14) that is, in a fixed state, mounted on the door frame (17) and held by at least two attachment screws (15, 16) to said door frame (17), and comprises an adjustment screw (22) for adjusting the hinge axis (10), **characterized in that** the adjustment screw (22) is positioned on the attachment plate (14) and distanced from a straight connection line (21), which line (21) lays in the plane of the attachment plate (14) and connects the center axes of the attachment screws (15, 16), wherein through the turning of the adjustment screw (22), the attachment plate (14) tilts around its support area (24) on the door frame (17) and the hinge axis (10) becomes adjusted.

2. The adjustable door hinge (1) according to claim 1, c**haracterized in that** the attachment plate (14) is designed to be fixed to a front face of the door frame (17), which front face faces to the plane of the door pane (3) in a closed position of the door pane (3).

3. The adjustable door hinge (1) according to any of the preceding claims, **characterized in that** in adjusting the adjustment screw (22) from a first, retracted position to a second, extended position, the support area (24) rolls along an edge of the door frame (17), which edge preferably adjoins the front face in the direction of the outer side of the electrical cabinet.

4. The adjustable door hinge (1) according to any of the preceding claims, **characterized in that** the support area (24) extends substantially parallel to the hinge axis (10) and/or to the straight connection line (21).

5. The adjustable door hinge (1) according to any of the preceding claims, **characterized in that** in the adjustment process of the adjustment screw (22), the support area (24) forms a rotational center around which rotational center the attachment plate (14) tilts and the hinge axis (10) pivots.

6. The adjustable door hinge (1) according to any of the preceding claims, **characterized in that** the first hinge part (2a; 2b) and the second hinge part (11) are designed to allow a rotation of the door pane (3) from the closed position to an open position of at least 180°.

7. An electrical cabinet comprising at least one adjustable door hinge (1) in according to any of claims 1-5 for coupling a door pane (3) to a door frame (17).

8. The electrical cabinet according to claim 7, wherein four adjustable door hinges (1) are arranged below each other for coupling the door pane (3) to the door frame (17).

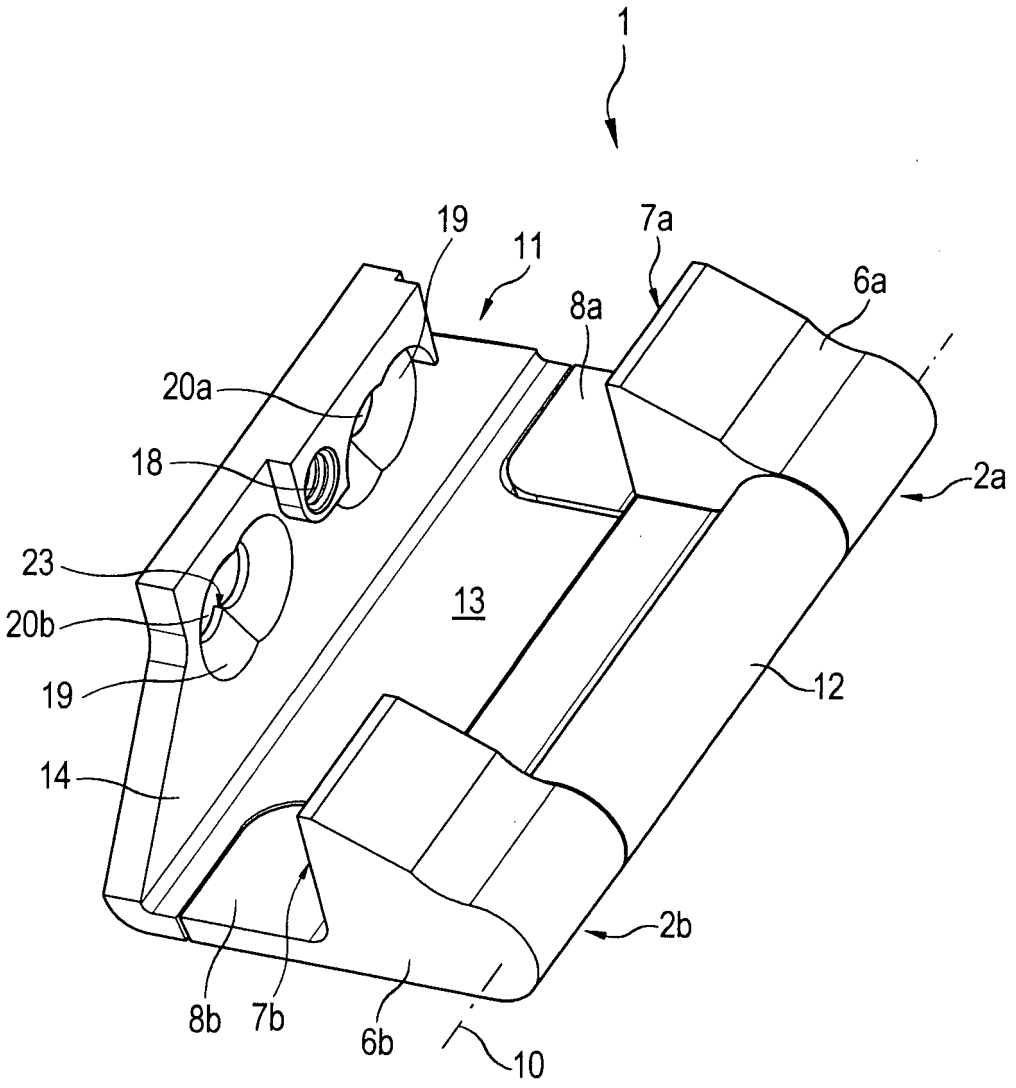

Fig. 1

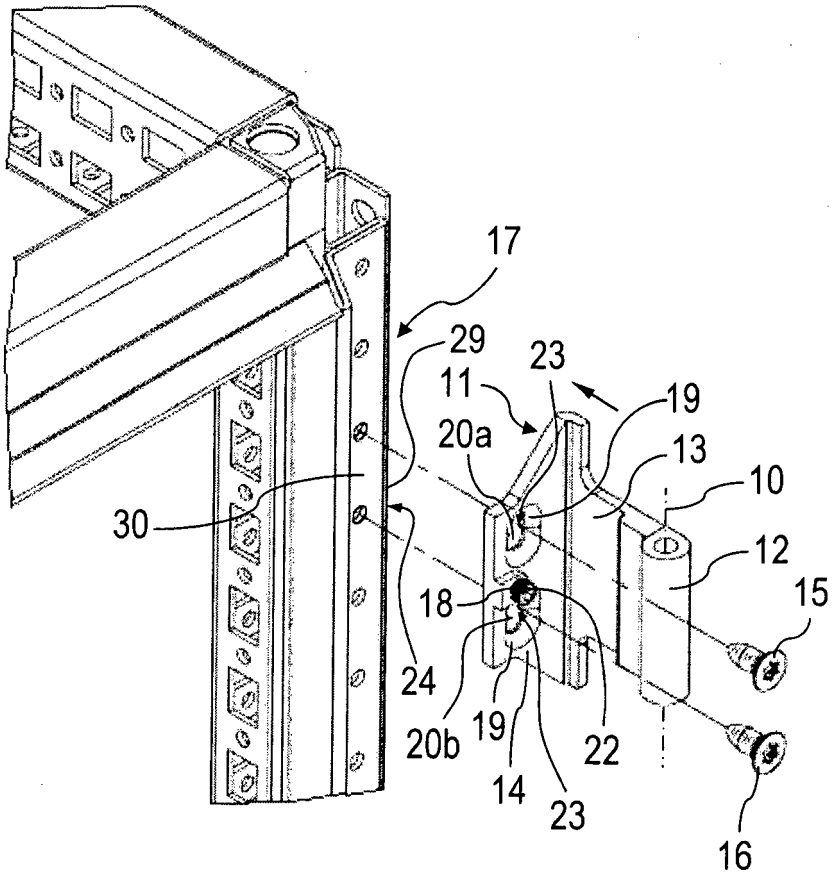

Fig. 2

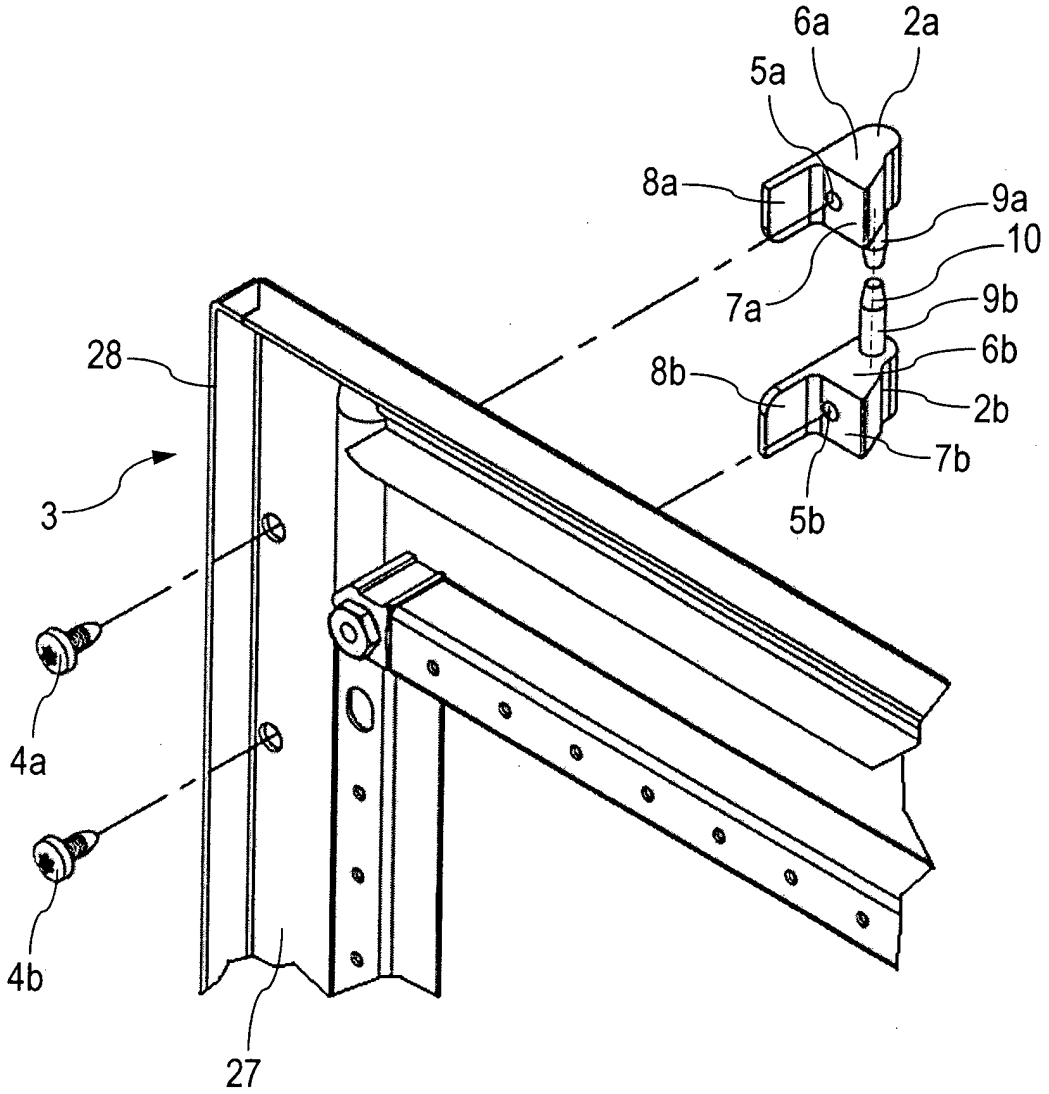

Fig. 3

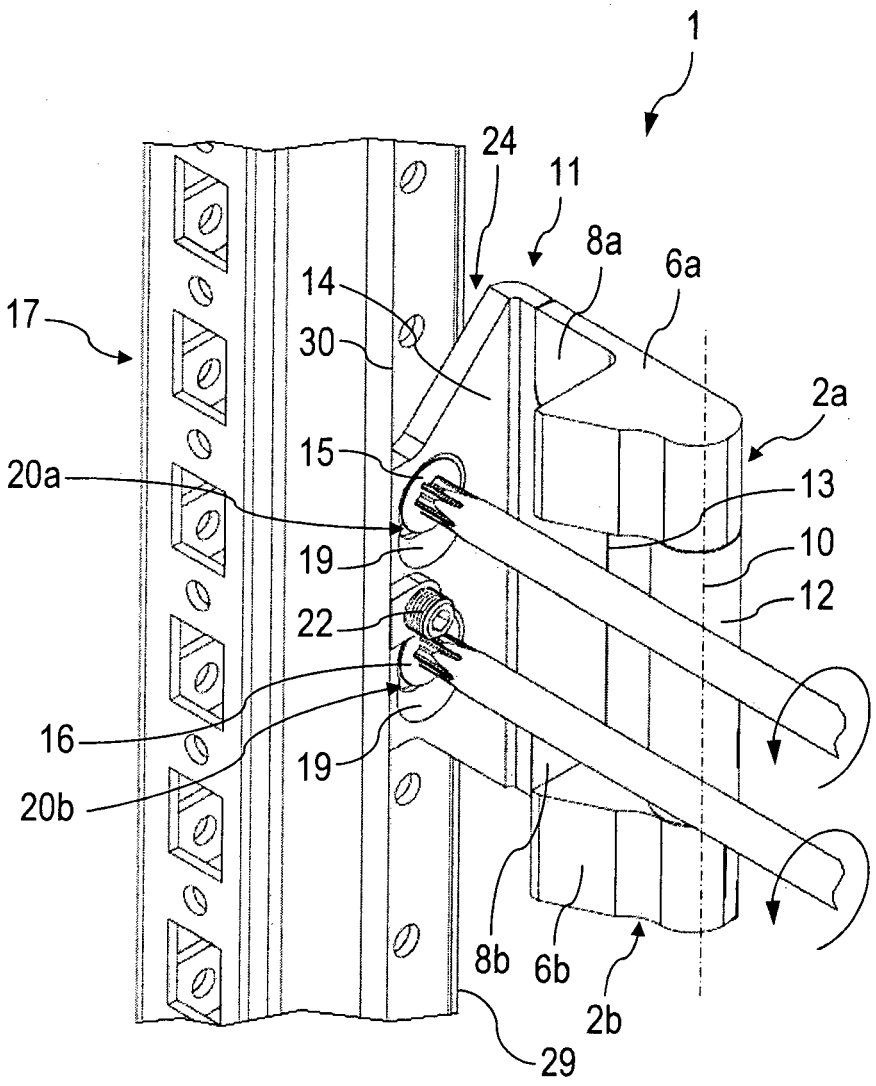

Fig. 4a

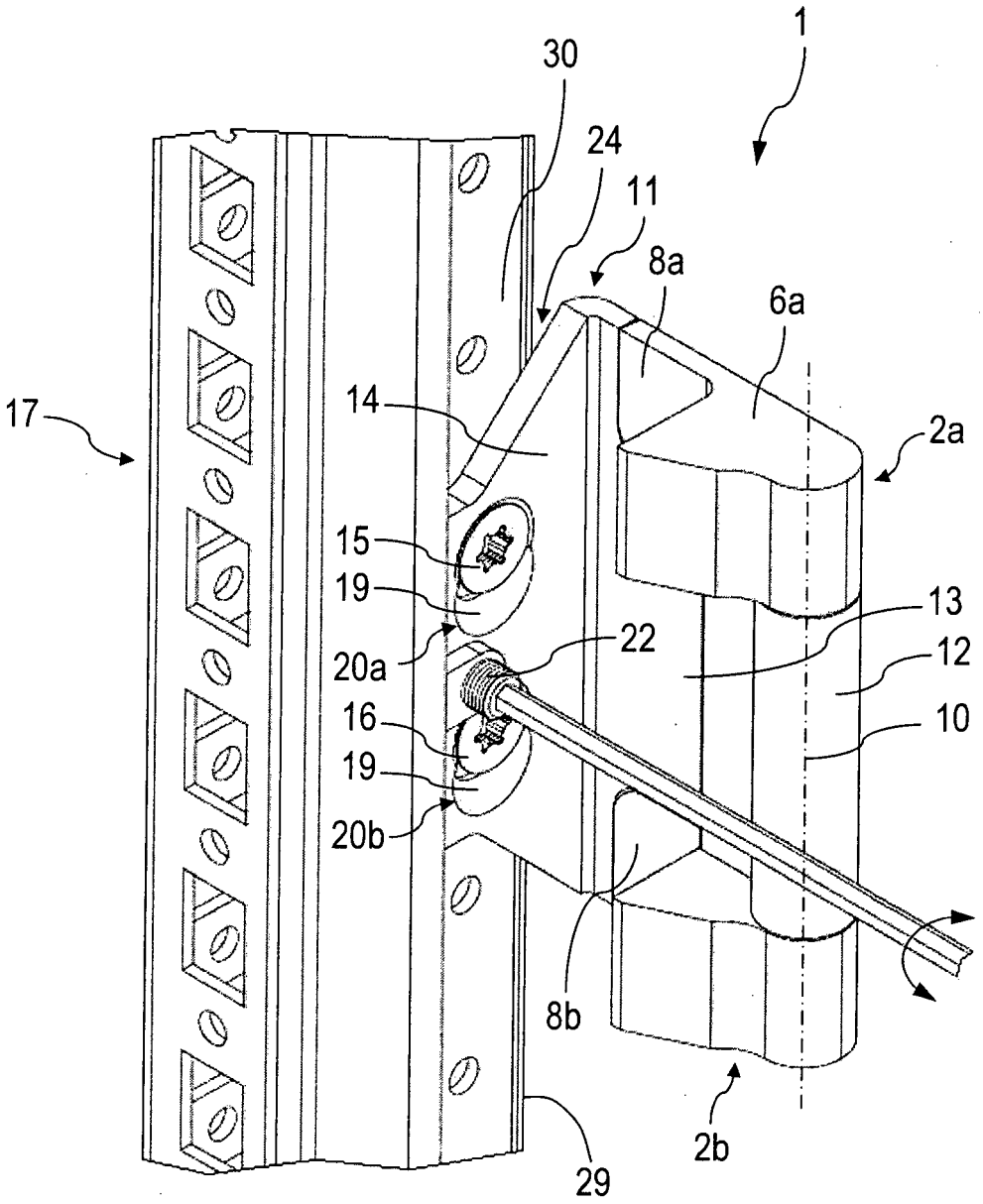

Fig. 4b

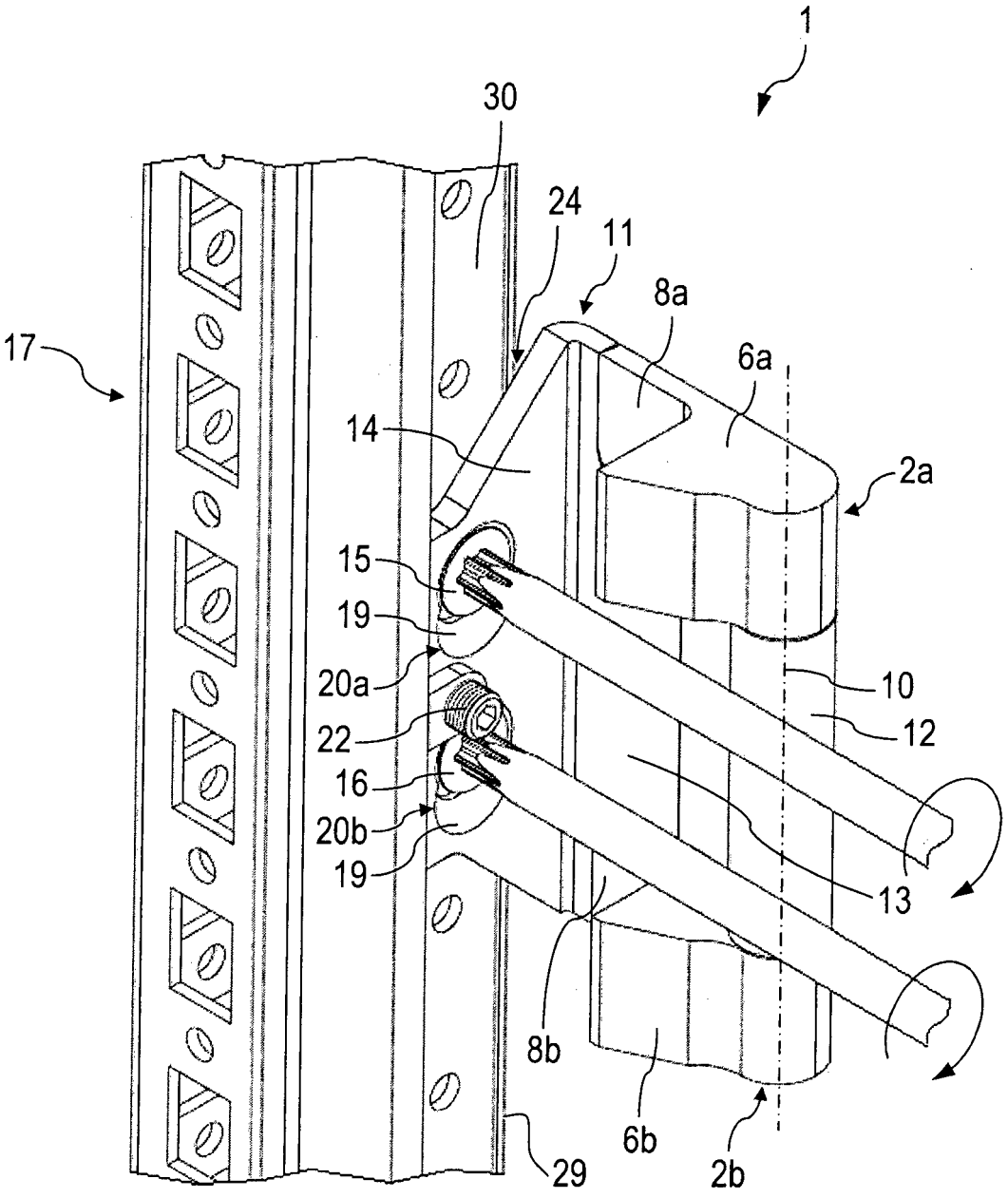

Fig. 4c

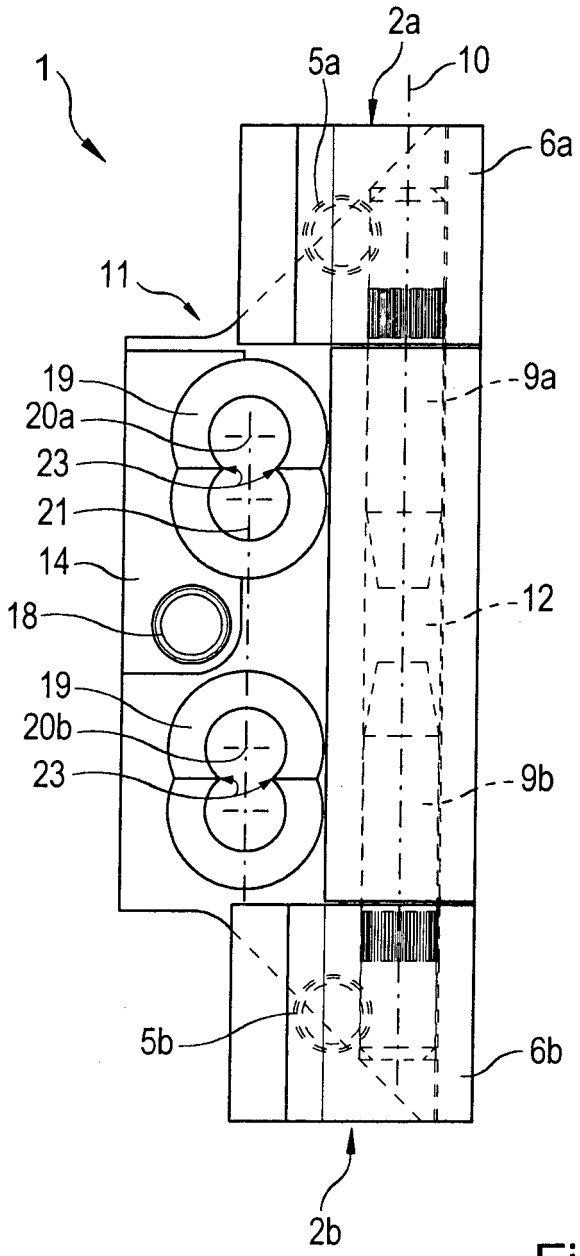

Fig. 5

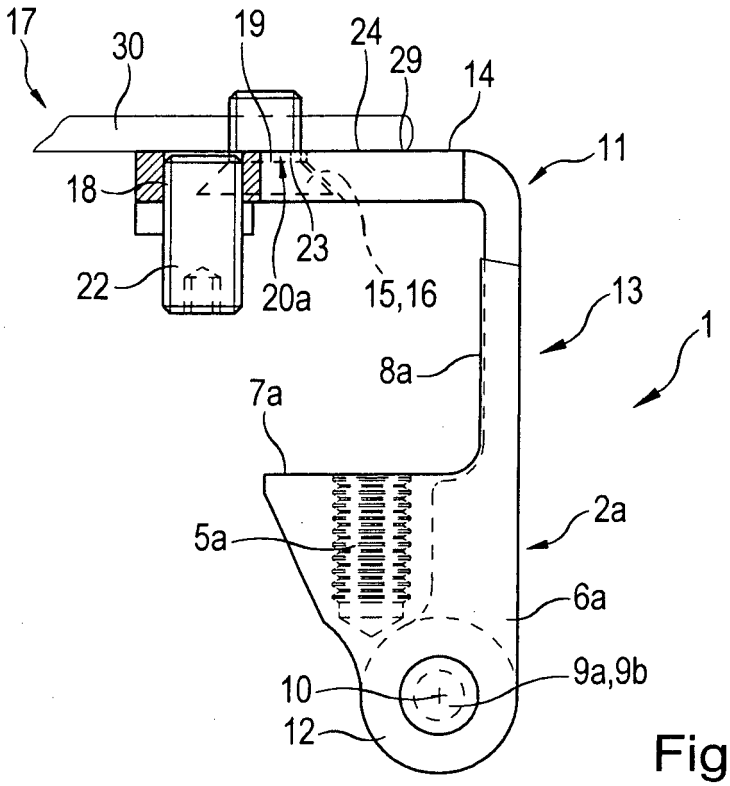
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Fig. 6a

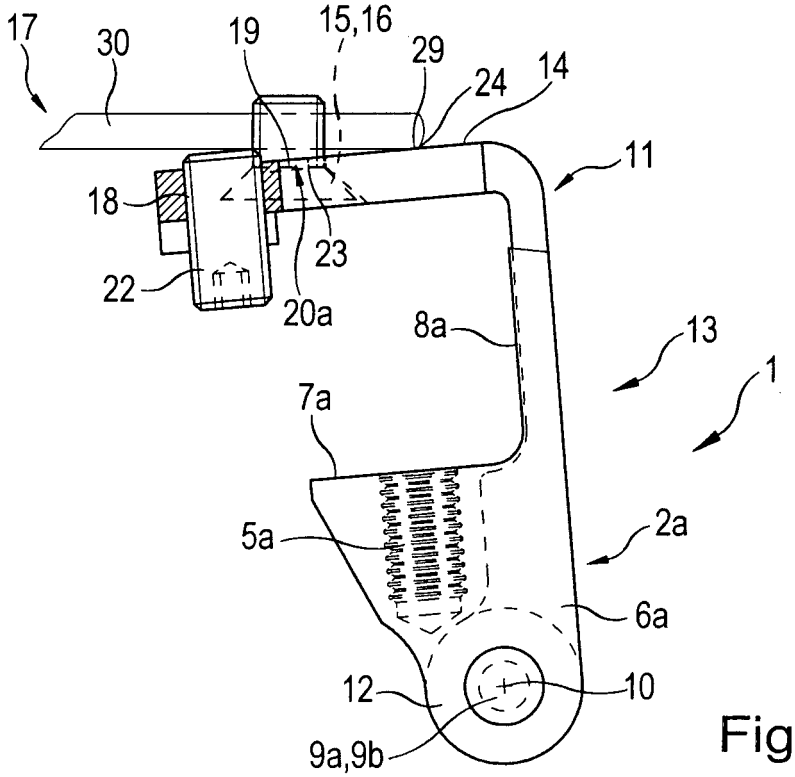
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Fig. 6b

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EUROPEAN SEARCH REPORT

Application Number
EP 12 00 6730

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2005 012153 U1 (HAHN GMBH & CO KG DR [DE]) 14 December 2006 (2006-12-14) * paragraphs [0024], [0025], [0030], [0032]; figures 1-3,6,7 *	1-8	INV. E05D7/04
X	EP 1 124 032 A1 (JUKEN SANGYO [JP] WOODONE CO LTD [JP]) 16 August 2001 (2001-08-16) * paragraph [0041]; figures 3-6 *	1-8	
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			TECHNICAL FIELDS SEARCHED (IPC)
			E05F E05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25 January 2013	Berote, Marc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 00 6730

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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25-01-2013

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