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(54) Hinge fitting having an intermediate member, window comprising such hinge fittings and use of such a hinge fitting

(57) The hinge fitting has a first hinge part (100) for fastening to the frame and a second hinge part (200) for fastening to the sash of a window. The first hinge part (100) comprises a base member (101) and an intermediate member (130), on which a guidance portion is provided integrally. The hinge fitting may have a top member as well. The base member (101) and the top member (110,120) are made of a metal or metal alloy, whereas the intermediate member (130) is made as an integral piece of a plastic material.

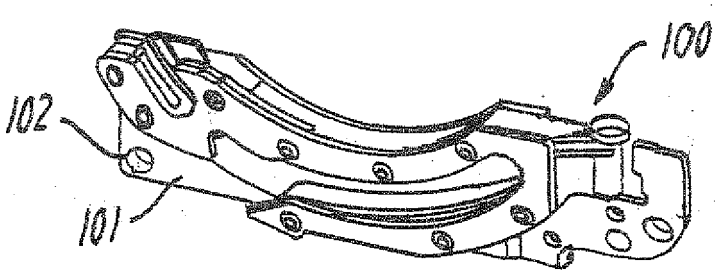

FIG. 1

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Description

[0001] The present invention relates to a hinge fitting for a pivotal window having a frame and a sash, comprising a first hinge part for fastening to the frame and including guide means, said guide means including a plurality of guide parts, and a second hinge part for fastening to the sash and including a slide rail to cooperate with the guide means of the first hinge part.

[0002] Such hinge fittings are well known in the art, examples being shown in, e.g., international published applications Nos. WO 85/02646 and WO 99/28581.

[0003] The hinge fitting is traditionally of a relatively complex design as the structure comprises a large number of metal parts, possibly supplemented by a few parts of a plastic material. As a result, the hinge fitting is able to withstand the forces to which it is exposed in use; however, the costs relating to manufacture and assembly of the hinge fitting are considerable. Furthermore, the hinge fitting should be maintained by lubricating the metal parts occasionally.

[0004] One attempt at reducing the complexity and diminish the need for maintenance is described in WO 01/31155. In this document, a hinge fitting is disclosed, of which the first hinge part to a large extent is made of a hard wearing plastics material, the base plate being integrally formed with guide members. Optionally, the second hinge part including the slide rail is made from a similar material as well.

[0005] On this background it is an object of the present invention to provide a hinge fitting which is more simple and cost-effective to manufacture and assemble, but still possesses sufficient strength.

[0006] This object is achieved by a hinge fitting of the kind mentioned in the introduction and which is furthermore **characterized in that** the first hinge part comprises three main components including a base member, a top member and an intermediate member, at least some parts of said plurality of guide parts being provided integrally on said intermediate member.

[0007] The provision of the three components, of which the guide parts are to a large extent provided integrally on the intermediate member, entails a very simple assembly of the first part of the hinge fitting. Furthermore, the materials used for the base member, the intermediate member and the top member may be chosen according to the actual demands on that particular member, i.e. depending on the type, size and installation conditions of the window, in which the hinge fitting is used. The invention is thus based on the recognition that the not all parts of the first hinge parts are exposed to equally large forces, and it is now possible to provide a hinge fitting with local optimum strength and material characteristics applied individually to each part, i.e. in which a less expensive or more easily manufactured material may be chosen for the parts that are not subjected to large forces.

[0008] Preferably, at least the base member and the top member are made of a metal or metal alloy. By forming the two outer members of such a rigid material the first hinge part is provided with sufficient overall bending and torsional strength.

[0009] The intermediate member may be made of any material that is suitable for providing integral guide pieces, but is in a preferred embodiment made as an integral piece of a plastic material.

[0010] In an advantageous development of this preferred embodiment the intermediate member includes a bottom plate portion, a convex guidance portion, and a guide block portion.

[0011] By forming the intermediate member as an integral plastic part it is possible to include other details as well. Such details may include a cladding supporting portion, and/or one or more upstanding wall portions.

[0012] In principle, the base member, the intermediate member and the top member may be connected to each other in any suitable manner. Preferably, the intermediate member is provided with a plurality of through-going holes, and the intermediate member is connected with the base member and the top member by means of a plurality of rivets extending through said through-going holes.

[0013] In an embodiment, which is particularly simple with respect to manufacturing the intermediate member is formed by moulding.

[0014] The top member, of which only parts are subjected to large forces, may be provided with reinforcing means in the exposed areas. One way of providing the reinforcing means is by forming the top member to include a plate part and a disc part.

[0015] Alternatively, the top member may include a plate part having a portion with increased thickness with respect to the remaining portions of the plate part, or the top member may include a plate part and a flange section, and the flange section may be connected with the base member.

[0016] In order to provide a braking action on the second hinge part and thus on the sash, the first hinge part may be provided with some kind of braking means. The braking means may be incorporated integrally into the first hinge part. However, in an advantageous embodiment, the first hinge part furthermore comprises a lever spring. The presence of a separate lever spring makes it possible to adjust the hinge fitting to the field of application in question. It is also possible to exchange the lever spring in case of wear and tear or in order to adapt the hinge fitting to a change in application conditions.

[0017] Preferably, the lever spring has been subjected to a surface treatment. Such a surface treatment may e.g. protect against rust and/or change the properties of the lever spring.

[0018] In further aspects of the invention, a window including a set of such hinge fittings, and use of such hinge fittings in a window are provided for.

[0019] Further details and advantages will be readily apparent from the subsequent detailed description referring to the schematic drawings, in which

Fig. 1 is a perspective view of the first hinge part of an embodiment of the hinge fitting according to the invention,

Fig. 2 is a perspective view, from another angle, of the first hinge part shown in Fig. 1,

Fig. 3 is an exploded perspective view of the first hinge part shown in Fig. 1,

Fig. 4 is a perspective view of the second hinge part of an embodiment of the hinge fitting according to the invention, and

Figs. 5 to 8 are perspective views of details of the first hinge part in alternative embodiments of the hinge fitting according to the invention.

[0020] In Figs. 1 to 4, the two hinge parts forming a hinge fitting for connecting a sash with a frame of a window are shown. The window is of the pivotal kind, i.e. of the kind having a hinge axis that is positioned at a distance from opposite pieces of the frame and the sash, and is substantially parallel to the opposite pieces. For instance, the hinge axis may be substantially central with respect to opposite pieces of the frame and sash. The first hinge part 100 is intended to be attached to a piece of the frame (not shown) and the second hinge part 200 is intended to be attached to a piece of the sash (not shown either). As will be described in further detail in the following, the first hinge part 100 includes guide means, and the second hinge part 200 includes a slide rail 220 which in a mounted position of the sash with respect to the frame cooperates with the guide means of the first hinge part 100. It is noted that a corresponding, but mirror-inverted hinge fitting is mounted on the opposite pair of frame and sash pieces.

[0021] The first hinge part of the hinge fitting according to the invention comprises three main components: A base member, a top member and an intermediate member, of which the intermediate member is inserted between the top member and the bottom member.

[0022] In the embodiment shown in Figs. 1 to 3, the first hinge part 100 comprises a base member in the form of a base plate 101, a top member including a plate part 110 and a disc part 120, an intermediate member 130, and, additionally, a lever spring 125 and a plurality of rivets 140.

[0023] The base plate 101 forming the base member has a number of apertures 102 and, on its backside, two spigots 103. Referring in particular to Fig. 3 it may be seen that, in the embodiment shown, the spigots 103 are riveted to the base plate 101, however, it is also possible to form the spigots 103 integrally with the base plate 101. The apertures 102 are intended to receive fastening means, such as screws, and the spigots 103 are intended to be inserted into corresponding bores in the frame in order to attach the first hinge part 100 to the frame. The base plate 101 is formed as a plate member made of a metal or metal alloy, such as steel which has been subjected to surface treatment. Eventually, and referring particularly to Figs. 2 and 3, the base plate 101 is provided with a track 104 having substantially the same shape as the guidance. The track 104 is surrounded by a depressed portion 105 and an inclined portion 106.

[0024] Referring in particular to Fig. 3, it is noted that the top member of the embodiment shown in Figs. 1 to 3 is a two-part member including the plate part 110 and the disc part 120. Like the base plate 101, the plate part 110 and the disc part 120 are advantageously provided as plate members made of a metal or metal alloy. For all of the parts of the base member and the top member, it is an essential part of their functioning that they contribute to the overall resistance of the hinge fitting against bending and torsional forces. In principle, they can thus be made from any suitable material matching such demands.

[0025] The plate part 110 has an arc-shaped track 111 having a concave side 112 and a convex side 113 and extends between an inlet end 114 and a bottom end 115. In addition, the track 111 defines an open section 116, which is open in the concave side 112 of the track 111. Between the inlet end 114 and the open section 116, the plate part 110 has a bridge section 117 spanning the gap between the concave side 112 and the convex side 113. Furthermore, a plurality of apertures 118a,118b and 118c is provided for the accommodation of corresponding sets of rivets 140a,140b and 140c of the above-mentioned plurality of rivets 140. The plate part 110 has additional apertures 119 for accommodation of protrusions 141 on the disc part 120. The engagement between the protrusions 141 and the apertures 119 entails that the plate part 110 and the disc part 120 are held together to increase the stability of this part of the top member.

[0026] The disc part 120 is inserted between the plate part 110 and the intermediate member 130. The disc part 120 has an outer edge 120a with a radius of curvature matching the radius of curvature of the convex side 113 of the track 111 such that the outer edge 120a of the disc part 120 is flush with the convex side 113 of the track 111 in the plate part 110.

[0027] Inserted between the base member and the top member is the intermediate member 130, which will now be described with particular reference to Fig. 3.

[0028] In the embodiment shown, the intermediate member 130 is made as an integrally moulded part of a suitable plastic material. Other materials and other manufacturing manners are of course conceivable. The intermediate member 130 comprises a bottom plate portion 131 having an extension corresponding to a substantial part of the base plate 101 forming the base member. The extension and the thickness of the bottom plate portion 131 depend on the geometry of the base member and the top member and in particular on the properties of the material used. To the least, it should be ascertained that a sufficient stability of the intermediate member 130 is obtained, in particular during the assembly of the hinge fitting, but also in use. In the embodiment shown, the thickness of the bottom plate portion 131 is approx. 1 mm. In comparison, the thickness of the base plate 101,

the plate part 110 and the disc part 120 is approx. 2 mm. A number of elements protrude integrally from the bottom plate portion 131, of which some form part of the guide means of the first hinge part 100, some are intended to bridge the gap between the base member and the top member, and some have other functions. These elements will be described with reference to the position they have in Fig. 3, e.g. upper, lower, left-hand, and right-hand. It is to be understood that these references are made with a view to proper description only, as the hinge fitting may assume other orientations in its mounted position.

[0029] A convex guidance portion 132 is formed at the upper side of the bottom plate portion 131. The convex guidance portion 132 has a curved length which in the embodiment shown is somewhat smaller than the convex side 113 of the track 111 in the plate part 110, whereas the width of the convex guidance portion 132 substantially corresponds to that of the corresponding portion of the plate part 110. It is noted that the right-hand end portion of the disc part 120 abuts on the left-hand end portion of the convex guidance portion 132. In the embodiment shown the right-hand end of the convex guidance portion 132 is joined to an upstanding wall portion 135. The height of the upstanding wall portion 135 corresponds to the desired distance between the base member and the top member, i.e. in this case between the base plate 101 and the plate part 110, whereas the height of the convex guidance portion 132 is smaller and corresponds to the distance between the base plate 101 and the disc part 120. At the right-hand end of the bottom plate portion 131, a cladding supporting portion 134 is formed adjacent the right-hand end of the upstanding wall portion 135. The cladding supporting portion 134 is intended for accommodating fastening means, e.g. a screw, for holding the cladding which in the mounted position of the window protects the frame against the weathering. In the left-hand side of the bottom plate portion 131, a guide block portion 133 is formed. The guide block portion 133 forms part of the concave side of the guidance and has a height corresponding to the distance between the top member, i.e. the plate part 110, and the bottom member, i.e. the base plate 101. In the lower side, the bottom plate portion 131 is provided with an upstanding wall portion 137 with a height corresponding in substance to the distance between the plate part 110 and the base plate 101. The upstanding wall portion 137 may contribute to the overall rigidity of the first hinge part 100, but serves also as a protection of the guidance against the intrusion of e.g. fingers and/or dirt.

[0030] Eventually, a plurality of through-going holes 136 is provided in the intermediate member 130. These holes 136 receive the rivets 140 which in the embodiment shown hold the top member, the bottom member and the intermediate member together. However, other connecting or fastening means are conceivable, e.g. screw fastening, gluing or welding, or any suitable combination of these manners of connecting the members.

[0031] In order to provide a braking action during movement of the sash with respect to the frame in a manner known per se, a lever spring 125 is positioned with its folded ends clasped on the outer-most rivets of rivets 140a. The lever spring 125 is preferably made from spring steel, which has been subjected to a surface treatment. The surface treatment may e.g. be in the form of a coating providing or enhancing the desired properties. The surface treatment may e.g. entail a stiffening of the lever spring. For instance, the lever spring may be treated with Benzinal© preventing rust. Depending on the braking action desired and on the geometrical configuration of the slide rail 220 and the guide pin 210 of the second hinge part 200, the lever spring 125 may have other forms and may e.g. protrude slightly with respect to the concave side 112 of the track 111. It is thus possible to adapt the hinge fitting to the field of application, e.g. the size of the window, the presence of auxiliary opening devices and other factors that might have influence on the operation of the window.

[0032] Thus, a guidance having two side walls is formed, of which the convex side wall is constituted by relevant parts of the convex side 113 of the track 111 in the plate part 110, the outer edge 120a of the disc part 120 and the convex guidance portion 132. The concave side wall is constituted by relevant parts of the concave side 112 of the track 111 in the plate part 110, and the lever spring 125 and the guide block portion 133.

[0033] Referring now to Fig. 4, the second hinge part 200 comprises a base plate 201 having a number of apertures 202 for receiving fastening means. The second hinge part 200 may also have, on its backside, spigots to be inserted into corresponding bores in the sash. Furthermore, the second hinge part 200 has means 204 for supporting the cladding, which protects the sash from the weathering.

[0034] The second hinge part 200 includes a number of elements forming part of the hinge connection. These elements comprise: Drive pin 209, guide pin 210 and slide rail 220. The function of these elements will be described in further detail further on. The guide pin 210 is in the embodiment shown formed as a pin member 210a riveted to the base plate 201 and on which a separate bushing 210b has been placed. The slide rail 220 has a first section 220a starting at a hinge pin 221 connected with the base plate 201. In the embodiment shown, the hinge pin 221 is connected with the base plate 201 through two discs 222,223, which in turn are fastened to the base plate 201 by means of rivets 224. Moving from the first section 220a and towards the free end 220c of the slide rail 220, the slide rail 220 has a second section 220b which is substantially arc-shaped. The slide rail 220 may, in a manner known per se, comprise a number of discs, however, other configurations of the parts of the second hinge part 200 are of course conceivable, i.a., the possibility of forming the slide rail as a solid body. In particular, it should be mentioned that the guide pin 210 may be formed as a solid body of another material than

the remaining parts of the second hinge part, or be formed as an exchangeable part. Near the free end 220c of the slide rail 220, a blocking element in the form of a stop pin 230 is provided. The stop pin 230 is movable between two end positions in the transverse direction of the slide rail 220, of which the movement in one direction, viz. to attain a blocking position, takes place automatically. The blocking element may also be in the form of a screw, which is activated manually.

[0035] In the following, the mounting of the sash with respect to the frame will be described. It is noted that the description refers to one hinge fitting only, and it is to be understood that similar actions are performed with respect to the other, mirror-inverted hinge fitting.

[0036] Initially, the frame is installed in the roof in a manner known per se. The sash is then held at an angle with respect to the frame, which entails that the slide rail 220 may be introduced into the guidance of the first hinge part 100. The free end 220c and the stop pin 230 of the slide rail 220 are allowed to pass under the bridge section 117 of the plate part 110. At the passage under the bridge section 117, the protruding portion of the stop pin 230 is accommodated in the track 104. When the slide rail 220 is displaced further along the guidance, the abutment between the protruding portion of the stop pin 230 and the inclined portion 106 entails that the stop pin 230 is pushed gradually in the transverse direction into its blocking position (not shown), in which release of the slide rail 220 from the guidance is prevented, as the stop pin 230 may not pass under the bridge section 117 of the first hinge part 100. In case it is desired to demount the sash with respect to the frame, the securing device is initially deactivated such that the blocking element in the form of a stop pin or a stop screw does not prevent release of the slide rail from the guidance.

[0037] When the sash has been connected with the frame in the above-described manner, the sash may be closed by turning the sash in the closing direction. During the initial part of the closing movement, the sash including the base plate 201 pivots about the hinge pin 221 and during the subsequent part of the closing movement, the guide pin 210 is displaced in the guidance followed by the slide rail 220. The guide pin 210 and/or the slide rail 220 enter into frictional engagement with the lever spring 125, thus providing a braking effect on the closing movement of the sash with respect to the frame. In the position of use of the window, the above-mentioned braking effect entails, i.a., that the sash may be parked, i.e. held substantially stationary, in a desired opening angle with respect to the frame to provide ventilation within a certain interval of the opening angle.

[0038] It is also possible to open the sash even further, e.g. with a view to cleaning the outside of the window. In this case, the sash is moved in the opening direction, whereby the slide rail 220 and the guide pin 210 are displaced in the guidance, until the stop pin 230 is brought into abutment with the bridge section 117. The sash in then pivoted further, whereby the guide pin 210 moves out of the guidance at the open section 116 until the desired opening angle is obtained. Depending on the geometry of other parts of the window, e.g. the cladding and elements forming part of a flashing arrangement, the sash may be opened until almost 180°. In this open position, a substantial part of the sash weight is transferred to the frame at the contact surface between the two discs 222,223 connecting the hinge pin 221 with the base plate 201 of the second hinge part 200, and the top member of the first hinge part 100. In the embodiment shown in Figs. 1 to 3, this contact surface is constituted by edge portions 110b and 120b of the plate part 110 and the disc part 120, respectively. It is thus of great importance that this contact surface is stable.

[0039] In the alternative embodiments of the top member shown in Figs. 5 to 8, means are provided for increasing the strength of this part of the top member.

[0040] In the Fig. 5 embodiment, the top member 150 includes a plate part 151 having a portion 152 with increased thickness with respect to the remaining portions of the plate part 151. The contact surface with the second hinge part 200 is constituted by an edge portion 152b of the increased thickness portion 152.

[0041] In the Fig. 6 embodiment, the top member 160 includes a plate part 161 and a flange section 162. The flange section 162 may as shown be formed integrally with the plate part 161 and has such a length perpendicularly to the plate part 161 that it may be connected with the base member 101. The contact surface with the second hinge part 200 is constituted by the flange section 162 itself. The flange section 162 may also replace one of the rivets.

[0042] In the Fig. 7 embodiment, a reinforcing member corresponding to the disc part 120 of the embodiment of Figs. 1 to 3 is shown. The reinforcing member comprises two disc parts 171,181 of which one disc part 181 has an edge portion 182 protruding over the corresponding edge part 172 of the other disc part 171. The size of the edge portion is sufficient to support the discs 222,223 when the sash of the window is turned as described in the above.

[0043] In the Fig. 8 embodiment, a reinforcing portion is formed on the intermediate member 130, as a wear-resistant part 132 is formed on a protruding arm 132b of the convex guidance portion 132.

[0044] The invention is not limited to the embodiment shown and described in the above, but several modifications are conceivable.

Embodiments:

[0045] Embodiment 1. A hinge fitting for a pivotal window having a frame and a sash, comprising

a first hinge part (100) for fastening to the frame and including guide means, said guide means including a plurality of guide parts, and
a second hinge part (200) for fastening to the sash

and including a slide rail (220) to cooperate with the guide means of the first hinge part (100),
characterized in that the first hinge part (100) comprises three main components including a base member (101), a top member (110,120;150;160) and an intermediate member (130), at least some parts of said plurality of guide parts (132,133) being provided integrally on said intermediate member (130).
Embodiment 2. A hinge fitting according to Embodiment 1, **characterized in that** at least said base member (101) and said top member (110,120; 150,160) are made of a metal or metal alloy.
Embodiment 3. A hinge fitting according to any one of Embodiments 1 or 2, **characterized in that** said intermediate member (130) is made as an integral piece of a plastic material.
Embodiment 4. A hinge fitting according to Embodiment 3, **characterized in that** said intermediate member (130) includes a bottom plate portion (131), a convex guidance portion (132), and a guide block portion (133).
Embodiment 5. A hinge fitting according to Embodiment 4, **characterized in that** said intermediate member (130) includes a cladding supporting portion (134).
Embodiment 6. A hinge fitting according to Embodiments 4 or 5, **characterized in that** said intermediate member (130) includes one or more upstanding wall portions (135,137).
Embodiment 7. A hinge fitting according to any one of Embodiment 3 to 6, **characterized in that** said intermediate member (130) is provided with a plurality of through-going holes (136).
Embodiment 8. A hinge fitting according to Embodiment 7, **characterized in that** the intermediate member (130) is connected with the base member (101) and the top member (110,120;150,160) by means of a plurality of rivets (140) extending through said through-going holes (136).
Embodiment 9. A hinge fitting according to any one of Embodiment 3 to 8, **characterized in that** said intermediate member (130) is formed by moulding.
Embodiment 10. A hinge fitting according to Embodiment 1, **characterized in that** said top member includes a plate part (110) and a disc part (120).
Embodiment 11. A hinge fitting according to claim Embodiment 11, **characterized in that** said top member (150) includes a plate part (151) having a portion (152) with increased thickness with respect to the remaining portions of the plate part (151).
Embodiment 12. A hinge fitting according to Embodiment 1, **characterized in that** the top member (160) includes a plate part (161) and a flange section (162), and that said flange section (162) is connected with the base member (101).
Embodiment 13. A hinge fitting according to Embodiment 1, **characterized in that** the first hinge part (100) furthermore comprises a lever spring (125).
Embodiment 14. A hinge fitting according to Embodiment 13, **characterized in that** the lever spring (125) has been subjected to a surface treatment.
Embodiment 15. A window comprising a frame and a sash, said sash being connected with the frame by means of a set of hinge fittings defining a hinge axis of the window, **characterized in that** said set of hinge fittings includes two hinge fittings as defined in any one of Embodiments 1 to 14.
Embodiment 16. Use of a hinge fitting as defined in any one of Embodiments 1 to 14 in a window comprising a frame and a sash.

Claims

1. A hinge fitting for a pivotal window having a frame and a sash, comprising
a first hinge part (100) for fastening to the frame and including guide means, said guide means including a plurality of guide parts, and
a second hinge part (200) for fastening to the sash and including a slide rail (220) to cooperate with the guide means of the first hinge part (100),
characterized in that the first hinge part (100) comprises a base member (101) and an intermediate member (130) connected to a top member (110,120; 150;160), a convex guidance portion (132) being provided integrally on said intermediate member (130), and that the intermediate member (130) includes a guide block portion (133) and a cladding supporting portion (134).

2. A hinge fitting according to claim 1, **characterized in that** the cladding supporting portion (134) is integral with the guidance portion (132).

3. A hinge fitting according to claim 1 or 2, **characterized in that** at least said base member (101) and said top member (110,120;150,160) are made of a metal or metal alloy.

4. A hinge fitting according to any one of the preceding claims, **characterized in that** said intermediate member (130) is made as an integral piece of a plastic material.

5. A hinge fitting according to any one of the preceding claims, **characterized in that** said intermediate member (130) is provided with a plurality of through-going holes (136).

6. A hinge fitting according to claim 5, **characterized in that** the intermediate member (130) is connected with the base member (101) and the top member (110,120;150,160) by means of a plurality of rivets (140) extending through said through-going holes

(136).

7. A hinge fitting according to any one of claims 1 to 4, **characterized in that** the connection between the top member and the intermediate member is chosen from a selection comprising screw fastening, gluing and welding.

8. A hinge fitting according to any one of the preceding claims, **characterized in that** said intermediate member (130) is formed by moulding.

9. A hinge fitting according to any one of the preceding claims, **characterized in that** said top member includes a plate part (110) and a disc part (120).

10. A hinge fitting according to claim 9, **characterized in that** said top member (150) includes a plate part (151) having a portion (152) with increased thickness with respect to the remaining portions of the plate part (151).

11. A hinge fitting according to any one of claims 1 to 8, **characterized in that** the top member (160) includes a plate part (161) and a flange section (162), and that said flange section (162) is connected with the base member (101).

12. A hinge fitting according to any one of the preceding claims, **characterized in that** the first hinge part (100) furthermore comprises a lever spring (125).

13. A hinge fitting according to claim 12, **characterized in that** the lever spring (125) has been subjected to a surface treatment.

14. A window comprising a frame and a sash, said sash being connected with the frame by means of a set of hinge fittings defining a hinge axis of the window, **characterized in that** said set of hinge fittings includes two hinge fittings as defined in any one of claims 1 to 13.

15. Use of a hinge fitting as defined in any one of claims 1 to 13 in a window comprising a frame and a sash.

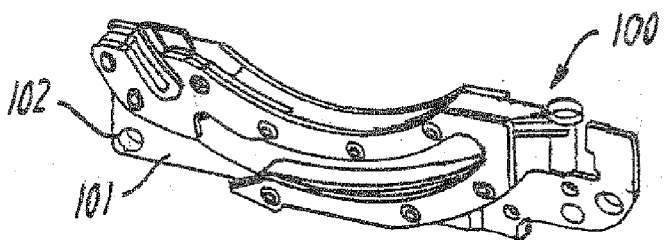

FIG. 1

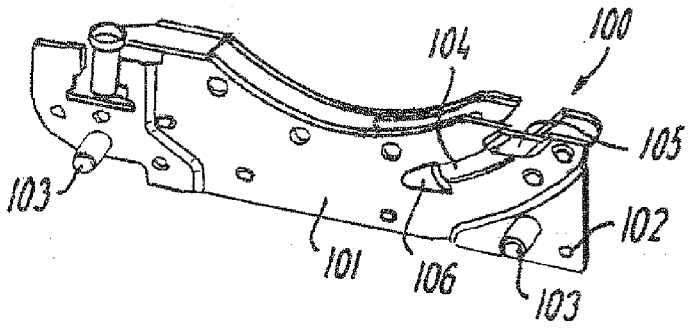

FIG. 2

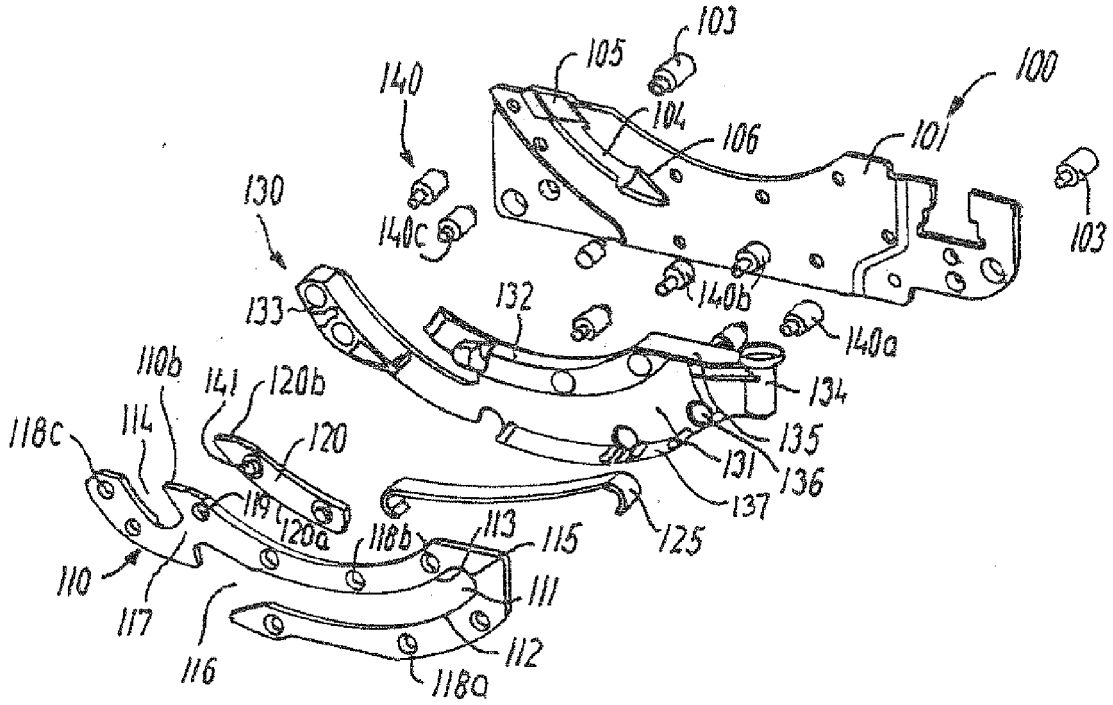

FIG. 3

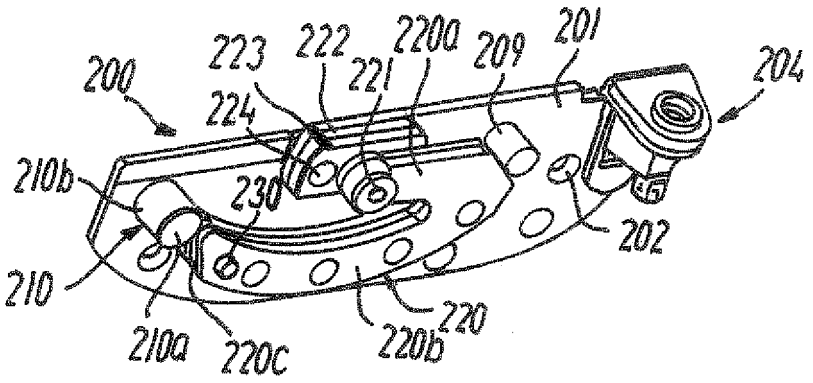

FIG. 4

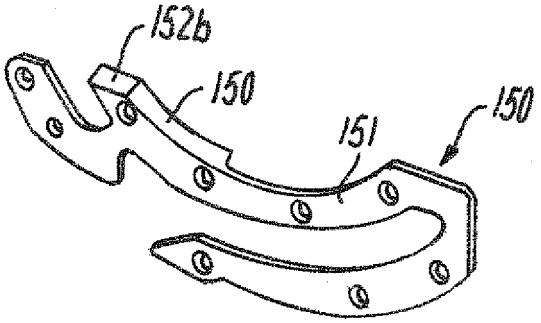

FIG. 5

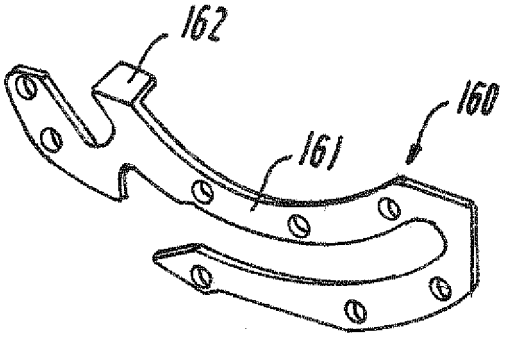

FIG. 6

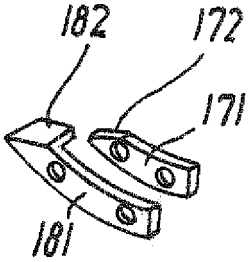

FIG. 7

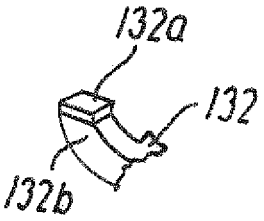

FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- WO 0131155 A **[0004]**