

Concealed Door Hinge And Method Of Installing The Concealed Door Hinge

Field of the Invention

5 The present invention relates broadly to a concealed door hinge and method of installing the concealed door hinge.

Background

10 One of the problems in the door manufacturing industry is the presence of gaps between a door-frame and door-panel. Sometimes, the gaps between a door-frame and door-panel are inconsistent and substantially high (e.g. 5 mm or more) because conventionally, a door-frame is permanently fixed before mounting a respective door-panel with hinges. As such, the presence of conventional door hinges to attach a door-frame and a door-panel create an imminent gap. Moreover, precision mounting cannot be achieved when installing a conventional door-panel and door-frame, because of
15 irregularities in the floor levels. Furthermore, there is no mechanism to adjust the door-frame to reduce the gaps between door-frame and door-panel during installation.

20 Recently, attempts to improve the design of door hinges have resulted in hinges, such as a butt hinge, Soss hinge or a pivot hinge.

25 Butt hinges are commonly used in a door-set of flats and condominiums. However, butt hinges, after installation, are physically seen and cannot be used in frameless designs. Furthermore, butt hinges do not facilitate any adjustment of the door-frame during installation.

30 Though hidden, after installation, Soss hinges are seldom used because the intrinsic mechanical movements of parts tend to allow a door-panel to sag slightly. Furthermore, half of a Soss hinge must be embedded into a door-frame, which cannot facilitate a frameless design. In addition, Soss hinges do not facilitate any adjustment of door-frame during installation.

35 In a pivot hinge, since a door-panel is attached to the door-frame by means of two pivots, one pivot on top while the other pivot at the bottom of a door-panel, structural integrity is compromised. Furthermore, since a metal plate must be installed onto the floor for holding the pivot, dirt and dust are accumulated on the metal plate, making it

unsuitable to be installed in bedrooms and in places within a house or apartment. In addition, pivot hinges do not facilitate any adjustment of door-frame during installation

Furthermore, in a door set installed with conventional hinges, fastening screws that
 5 fasten the hinges to a respective door-frame and door-panel are visible when the door is opened. This adversely affects the aesthetics of door design especially when designing luxurious living homes.

Accordingly, there is a need to provide a door hinge, which seeks to address one or
 10 more of the above problems.

Summary of the Invention

According to a first aspect of the present invention, there is provided a door hinge comprising:

15 a first hinge member and a second hinge member, the first and second hinge members being rotatably movable relative to each other about a pivot axis,

wherein the first hinge member comprises an angle bracket for securing the hinge to a door-frame such that a channel is defined by the angle bracket for accommodating a turning radius of a first proximal edge of the door-panel; and

20 wherein the second hinge member comprises a first mounting plate for securing the hinge to a door-panel at the proximal edge thereof.

The first hinge member may further comprise a second mounting plate at a distal end of the angle bracket, such that the angle bracket together with the second mounting plate
 25 form substantially a U-shape defining said channel.

The first hinge member may further comprise one or more first bearing members at a proximal end of the angle bracket for receiving a spindle.

30 The angle bracket may further comprise two or more continuous flanges, wherein a first flange is connected to the first bearing member at a proximal end of the angle bracket and a last flange intersects the second mounting plate substantially orthogonal to a length of the second mounting plate

The angle bracket may comprise two flanges that are substantially orthogonal to each other, wherein the second flange intersects the second mounting plate substantially orthogonal to a length of the second mounting plate.

- 5 The second flange may comprise through holes for inserting a fastener to fasten the second mounting plate to the door-frame.

The flanges of the angle bracket may be arranged to facilitate accommodating a turning radius of another proximal edge of the door-panel opposite the first proximal edge.

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The above door hinge may further comprise a flexible shield for covering a cavity of the door panel for receiving the first hinge member, wherein a first end of the shield is connected to the first flange and a second end of the flexible shield is connected to the first mounting plate of the first hinge member.

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In a closed position of the door-panel, the flexible shield may collapse between an outer surface of the flanges and the cavity and in an open position of the door-panel, the flexible shield may cover the cavity of the door panel.

- 20 A first end of the flexible shield may be inserted in to a slit located in the first flange and fastened while a second end of the flexible shield may be positioned above a screw hole on the first mounting plate and fastened.

The flexible shield may comprise a flexible material made of plastic or stainless steel.

- 25 The flexible shield may be spray-painted with a paint of the same colour as the door hinge.

The first hinge member may further comprise a fastening plate connected to the second mounting plate for receiving one or more fasteners for securing the hinge to the door-frame.

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The fastening plate may be connected along a length of the second mounting plate and towards an edge of the second mounting plate.

- 35 The second hinge member may further comprise one or more second bearing members for receiving a spindle.

The first mounting plate may be connected to the one or more second bearing members along a length of the first mounting plate and towards an edge of the first mounting plate. Each of the first and second hinge members may be extruded as one part.

- 5 The first mounting plate, second mounting plate and the fastening plate may have a plurality of screw holes that are countersunk for fastening the door hinge to a door panel and the door-frame, using screws. The door hinge may be made of steel.

10 According to a second aspect, there is provided a door set comprising a door-frame and door-panel made of wood, the door set installed using the above door hinge, wherein the door-frame has a fixed part that is attached to a door wall and a movable part, the movable part is adjustable horizontally and vertically after installing the door-panel so that the gap between the movable part of the door-frame and door-panel is substantially reduced.

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The movable part of the door-frame may be fastened to the fixed part by air nails once the final position of the movable part is decided and punctures caused by the air nails is covered with wood putty.

- 20 Any gap between the movable part of the door-frame and the door wall may be hidden using an architrave, the architrave blends with the moving part of the door-panel and flushes with the outer edges of the adjustable door-frame.

25 According to a third aspect, there is provided a door set comprising a door-frame and door-panel, the door set installed using the above door hinge, wherein the door-frame is embedded centrally into a door wall and a pair of opposing L-shaped plates are inserted in between the door-frame and door wall, on either sides, such that one arm of each L-shaped plate forms the terminal portion of the door wall, whereby the door-frame is hidden by the two L-shaped plates and the door wall.

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The material of the door wall adjacent to the of the L-shaped plate may be any one of ordinary plaster, granite, marble, stainless steel or aluminium.

- 35 According to a fourth aspect, there is provided a frameless door set comprising a door-panel installed using the above door hinge, wherein the adjacent wall and the outer layer of the door-panel are stone clad, wherein the body of the door-panel is made of

steel and comprises a plurality of steel ribs and the stone clad layer is formed using a premix of cement, sand and adhesive.

5 The adjacent wall may comprise a pair of clamping plates, one end of which are fixed to an inner wall by a pair of mechanical fasteners, while the other end extend in an outer wall, wherein the extended part of the clamping plates are fastened to the outer edges of an elongate L-shaped metal plate, the L-shaped metal plate having a plurality of mounting holes for fastening respective ones of the door hinges.

10 The door-panel may be operable to open up to an angle of about 120 degrees.

According to a fifth aspect, there is provided a continuous wall comprising a plurality of the above door sets, wherein when each of the door-panels are in closed position, the continuous wall completely conceal the door hinges.

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According to a sixth aspect, there is provided a method of installing a door set comprising a door-panel and a door-frame, the method comprising the steps of:

routing a door-panel to form two or more cavities, each of the cavities for accommodating the above door hinge;

20 fixing a door-frame to a door wall;

fastening the second hinge members of each of the door hinges on a respective portion of the door-frame; and

25 installing the door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective cavities.

30 The method may further comprise a step of installing a flexible shield for covering a cavity of the door panel for receiving the first hinge member, wherein a first end of the shield is connected to the first flange and a second end of the flexible shield is connected to the first mounting plate of the first hinge member.

The method may further comprise the steps of:

inserting an adjustable door-frame on to the door-frame, along the two sides and the top of the door-frame;

35 moving the adjustable door-frame horizontally and vertically towards the door-panel to minimise the gap between the door-panel and the door-frame;

fastening the adjustable door-frame to the door-frame using air nails once final positions of the adjustable door-frame are achieved; and
sealing punctures caused by the air nails.

5 The method may further comprise a step of plugging the gaps existing adjacent to the adjustable door-frame and the wall using an architrave, wherein said architrave blends with the adjustable door-frame and flushes with the outer edges of the adjustable door-frame.

10 According to a seventh aspect, there is provided a method of installing a door set comprising a door-panel and a hidden door-frame comprising the steps of:

routing a door-panel to form two or more cavities, each of the cavities for accommodating the above door hinge;

embedding a door-frame centrally into the door wall;

15 fastening the second mounting plates of the respective door hinges to the door-frame; and

installing the door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective cavities.

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According to an eighth aspect, there is provided a method of installing a frameless door set comprising a stone clad door-panel adjacent to a stone clad wall, the method comprising the steps of:

providing door hinges as described above;

25 providing a stone clad door-panel;

installing a pair of clamping plates into the door wall, one end of which are fixed to an inner door wall by a pair of mechanical fasteners, while the other end extend in to an outer door wall;

30 fastening the extended part of the clamping plates to the outer edges of an elongate L-shaped metal plate;

fastening the second mounting plates of each of the door hinges on a respective portion of the L-shaped metal plate; and

35 installing the stone clad door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective part of the metallic stone-clad panel.

Brief Description of the Drawings

The present invention is further described by way of non-limiting embodiments, with reference to the accompanying drawings, in which:

Figure 1 is an exploded perspective view of a concealed door hinge in accordance with an embodiment;

Figure 2a is a front view of an installation of door-panels with adjustable door-frames using the concealed door hinge of Figure 1;

Figure 2b is a partial sectional view of Figure 2a showing an installation of a door-panel, a door-frame and the concealed door hinge of Figure 1;

Figures 2c-2e are various sectional views of the concealed door hinge of Figure 2b;

Figure 2f is a sectional view of Figure 2a with the door-panels in a closed position;

Figure 2g is a sectional view of Figure 2a with the door-panels in an open position;

Figure 3a is a front view of an installation of door-panels with hidden door-frames using the concealed door hinge of Figure 1;

Figure 3b is a partial sectional view of Figure 3a showing an installation of a door-panel, a hidden door-frame and the concealed door hinge of Figure 1;

Figures 3c-3e are various sectional views of the concealed door hinge of Figure 3b;

Figure 3f is a sectional view of Figure 3a with the door-panels in a closed position;

Figure 3g is a sectional view of Figure 3a with the door-panels in an open position;

Figure 4a is a front view of an installation of a marble/granite clad door-set using the concealed door hinge of Figure 1;

Figure 4b is a partial sectional view of Figure 4b showing an installation of the marble/granite clad door-set and the concealed door hinge of Figure 1;

Figures 4c-4e are various sectional views of the concealed door hinge of Figure 4b;

Figure 4f is a sectional view of Figure 4a with the door-panels in a closed position;

Figure 4g is a sectional view of Figure 4a with the door-panels in an open position;

Figure 5 is an exploded perspective view of a concealed door hinge in accordance with a second embodiment;

Figure 6a is a partial sectional view of an installation of a door-panel, a door-frame and the concealed door hinge of Figure 5;

5 Figure 6b is a partial sectional view of Figure 6a with the door-panel in an open position; and

Figures 6c-6f are various sectional views of the concealed door hinge of Figure 5.

10 **Detailed Description of Preferred Embodiments**

Embodiments of the present invention can help in installing a door-frame and a door-panel in which a hinge and its mounting screws are concealed from sight, which, in turn, can help in improving the building aesthetics.

15 Embodiments of the present invention can assist in reducing gaps between a door-panel and a door-frame by using an adjustable door-frame.

Embodiments of the present invention can assist in achieving a door-panel with a hidden door-frame whereby a variety of finishing materials can be used in the door-wall adjacent to the hidden door-frame which, in turn, can help in improving the building aesthetics.

Embodiments of the present invention can assist in achieving a frameless door-panel suitable for using a stone clad door-panel to blend with the adjacent stone-clad wall, which, in turn, can help in achieving a door set with sufficiently strong and sturdy construction and improved aesthetics.

Figure 1 is an exploded perspective view of a concealed door hinge 100 in accordance with an embodiment.

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The door hinge 100 comprises two hinge members 110, 120, which can move relative to each other about an axis of a pivot 130. The two hinge members 110, 120 and the spindle 130 are made of a hard metal e.g. stainless steel or hardened steel.

35 The hinge member 110 comprises a mounting plate 111 (e.g. having a thickness of about 5 mm, width of about 33 mm and a length of about 137 mm) and an angle bracket

107. The angle bracket 107 forms a channel 117 (e.g. a U-shaped channel) to accommodate the turning radius of a proximal edge 203a of a door-panel 203 (refer to Figure 2b).

- 5 The angle bracket 107 comprises two substantially perpendicular flanges, a first flange 107b (e.g. having a thickness of around 4.5 mm, width of about 28-33 mm, and a length of about 137 mm) and a second flange 107a (e.g. having a thickness of around 4.5 mm, width of about 19 mm, and a length of about 137 mm). The outer surface of the junction of the first and second flanges 107a, 107b is chamfered (e.g. having a dimension of about 4 mm x 4mm) to facilitate the turning radius of another proximal edge 203b, opposite the proximal edge 203a, of a door-panel 203 (refer Figure 2b).

The edge of the first flange 107b is welded at a discrete position on the width of the mounting plate 111, along its length, such that the first flange 107b is substantially perpendicular to the mounting plate 111. The edge of the second flange 107a is welded to a hinge plate 109 e.g. having a thickness of about 3 mm, width of about 7 mm, length of about 127 mm. An edge of the hinge plate 109 has a pair of cylindrical bearings 108 for attaching the hinge plate 109 to a spindle 131 of the rotating hinge 130. Alternatively, each of the two hinge members 110, 120 can be extruded as one part.

20 The mounting plate 111 has a plurality of screw holes 115a, 115b that are used for fastening the mounting plate 111 to a door-frame 201 (refer Figure 2b) by means of e.g. screws or bolts/nuts. In an embodiment, the mounting plate 111 has three screw holes 115a with a diameter of about 7 mm and three screw holes 115b with a diameter of about 5 mm. The screw holes 115a and 115b are positioned on the opposite sides of the mounting plate 111. The screw holes 115a are countersunk with diameter of about 10 mm, while screw holes 115b are countersunk with a diameter of about 8 mm.

30 A stainless steel woodscrew or machine screw can be used for fastening the mounting plate 111 to the door-frame 201 (refer Figure 2b).

In an embodiment, the angle bracket 107 has three through-holes 113 having a diameter of about 12 mm that are positioned to be concentric to the screw holes 115b. These through-holes 113 are used for inserting a fastener (e.g. a crew driver) while fastening the mounting plate to the door-frame 201 (refer Figure 2b).

The hinge member 120 comprises a mounting plate 101 (e.g. having a thickness of about 3 mm, width of about 34 mm and a length of around 127 mm) having a plurality of screw holes 103. In an embodiment, the mounting plate 101 has five screw holes 103 that are positioned in a staggered manner. Each screw hole has a diameter of about 7 mm and countersunk with a diameter of around 10mm.

A hinge plate 105 (e.g. having a thickness of about 3 mm, width of about 7 mm, length of about 127 mm) may be welded to the mounting plate 101. The hinge plate 105 is discretely positioned and substantially perpendicular to the mounting plate 101, along a length of the mounting plate 101. The hinge plate 105 has three cylindrical bearings 108 for attaching the hinge plate 105 to a spindle 131 of the pivot 130.

The pivot 130 comprises an elongate spindle 131 (having e.g. a diameter of about 8 mm), a pair of bearings 133 (having e.g. a diameter of about 14 mm) and a pair of plugs 135. During assembly of the door hinge 100, the two hinge members 110, 120 and the bearings 106, 108, 131 are positioned while the spindle 131 is inserted through them and plugs 135 are plugged on either side to form the door hinge 100.

Figure 2a is a front view of an installation of door-panels 203 with adjustable door-frames using the concealed door hinge 100 of Figure 1.

In the present embodiment, the door-frames 201 and the door-panels 203 can be made of e.g. timber or any suitable wood. Figure 2a shows four door-panels 203 and four door-frames 201, installed above a floor 200, using concealed door hinges 100 (refer Figure 2b). It can be seen that the door-hinges 100 are completely hidden and results in a continuous wall of door-panels.

Figure 2b is a partial sectional view of Figure 2a showing an installation of a door-panel, door-frame and the concealed door hinge 100 of Figure 1

Firstly, a door-panel 203 is prepared before installation, whereby two or more cavities 215 are formed appropriately at the edges of the door-panel 203 using a router. Each of the cavities 215 accommodates a door hinge 100.

Subsequently, a door-frame 201 is fixed to a door wall comprising an inner layer of bricks and mortar 205 and an outer layer of plaster or mortar 207.

After this, the mounting plates 111 of each of the door hinges 100 are fastened, to a recessed portion 210 of a respective door-frame 201 using a plurality of screws 211, by a fastener (e.g. screw driver) inserted via the through holes 113 (refer Figure 1).

- 5 Subsequently, the door-panel 203 is installed whereby the mounting plates 101 are inserted into the respective cavities 215 and a plurality of screws 221 are used to fasten each of the mounting plates 101 of a respective door hinge 100 to the door-panel 203.

10 Subsequently, an adjustable door-frame 209 is inserted into another recessed portion 220, along two side portions and top portion of the door-frame 201. Typically, the adjustable door-frame 209 comprises three individual pieces, one piece corresponding to the top portion of the door-frame 201 and two pieces corresponding to the side portions of the door-frame 201. The three pieces of the adjustable door-frame 209 are moved horizontally towards the two sides and vertically towards the top of the door-
15 panel 201 such that the gap 216 between the door-panel 203 and the door-frame 201 is minimised.

Once the final positions of the three pieces of the adjustable door-frame 209 are decided, air nails are used to fasten the adjustable door-frame 209 to the door-frame
20 203. Punctures caused by the air nails can be covered e.g. with wood putty.

It can be appreciated that the three pieces of the adjustable door-frame 209 not only minimise gaps between the door-panel and the door-frame 201, but also compensates for the irregularities in the level of the floor 200.

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Gaps 214 adjacent to the adjustable door-frame 209 and the wall 207 can be hidden using architraves 213, which blend with the adjustable door-frame and make the outer surface of adjustable door-frame 209 to flush with the wall 205, 207, along the two sides and the top.

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It can be appreciated that the architraves 213 not only hide gaps between the door-panel and the door-frame 201 upon installation of a door set, but also hides any hairline cracks that appear in the door wall 207 adjacent a door-panel 201.

The adjustable door-frame 209 assists in reducing the gap 216 between the door-frame 201 and the door-panel 203 to about 1.5 mm. Furthermore, the gap 216 between the door-frame 201 and the door-panel 203 is consistent throughout.

5 Figures 2c-2e are various sectional views of the concealed door hinge 100 of Figure 2b.

Figures 2c is a sectional view of the concealed door hinge 100 of Figure 2b in a direction of 206 showing the angle bracket 107, mounting plate 111, screw holes 115a, through holes 113, hinge plates 105, 109, plugs 135 and the bearings 106, 108, 133.

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Figures 2d is a sectional view of the concealed door hinge 100 of Figure 2b in a direction of 204 showing the angle bracket 107, mounting plate 111 and screw holes 115a, 115b.

15 Figures 2e is a sectional view of the concealed door hinge 100 of Figure 2b in a direction of 208 showing the mounting plate 101, hinge plate 105 and screw holes 103.

Figure 2f is a sectional view of Figure 2a in a direction of 202 showing *inter alia* the door-panels 203 in a closed position, door walls 205, 207, door-frames 201, 202, 20 concealed door hinges 100 and architraves 213. The outer walls of the door-panels 203 are continuous and without any recesses which enhances the aesthetics.

The door-frames 202 at the centre, in the embodiment, have a slightly different construction compared to the door-frame 201 at the side. The central door-frames 202 25 are cross-shaped having a pair of longer arms 201a and another pair of shorter arms 201b. The edges of the longer arms 201a are parallel to the door wall 205, while the edges of the shorter arms 201b are perpendicular to the door wall 205. Recessed portions 240, 250 are provided between the arms 201a, 201b. The first recessed portion 240 and an adjacent edge of a longer arm 201a form a door rest for the door-frame 203. 30 The second recessed portion 250 is used for mounting a door hinge 100 for mounting an adjacent door-panel 203.

Figure 2g is a sectional view of Figure 2a in a direction of 202 showing *inter alia* the door-panels 203 in an open position, door wall 205, 207, door-frames 201, 202, 35 concealed door hinges 100 and architraves 213. As shown, the angle of rotation 230 of the door-panels can vary up to about 120 degrees.

Optionally, the inner edges of the door-panels 203 can have a shield 223 (e.g. made of flexible plastic or stainless steel) to cover a respective cavity 215 of the door-panel 203 as well as to enhance the appearance of the door hinge 100 when the door-panel 203 is opened. The shield 223 can be spray painted with a paint of the same colour as the door hinge 100.

The mounting screws 211, 221 used in the present embodiment (for mounting e.g. timber door and timber frames) can be e.g. a stainless steel wood screw.

In an embodiment, the mounting screws 211 for fixing the mounting plate 101 can have e.g. a length of about 25 mm, counter sunk head diameter of about 9 mm, and thread diameter of about 5 mm.

In an embodiment, the mounting screws 221 for fixing the mounting plate 101 using screw hole 115a can have e.g. a length of about 25 mm, counter sunk head diameter of about 7.5 mm, and thread diameter of about 4mm. The mounting screws 221 for fixing the fastening plate using screw hole 115b and the mounting screws 211 for fixing the mounting plate 111 can have e.g. a length of about 25 mm, counter sunk head diameter of about 9 mm, and thread diameter of about 5 mm.

The description of Figures 2a to 2g is in general applicable to Figures 3a to 3g.

Figure 3a is a front view of an installation of door-panels 203 with hidden door-frames using the concealed door hinge 100 of Figure 1.

Figure 3b is a partial sectional view of Figure 3a showing an installation of a door-panel, a hidden door-frame and the concealed door hinge 100 of Figure 1.

Firstly, a door-frame 301 is embedded centrally into the door wall 207 and a pair of opposing L-shaped plates 313 are inserted in between the door-frame 301 and door wall 207, on either sides, such that opposing arms of the L-shaped plates 313 form the terminal portion of the door wall 207.

Subsequently, as described above, each of the mounting plates 111 of a respective door hinge 100 are fastened to the door-frame 301 embedded between the two L-

shaped plates. It can be appreciated that the terminal portions of the two L-shaped plates are flush with the wall portion 207.

Alternatively, the door-frame 301 attached with the L-shaped plates 313 on either sides, may be directly mounted to the brick wall 205, before being covered with mortar to form the outer wall 207.

The outer edges of the two L-shaped plates 313 serve as a reference while the brick wall 205 is covered with mortar to form the outer wall 207.

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After this, a door-panel 203 is installed to a respective door-frame 301, whereby the mounting plates 101 are inserted into the respective cavities 215 and a plurality of screws 221 are used to fasten each of the mounting plates 101 of a respective door hinge 100 to the door-panel 203.

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The above embodiment can help in installing a door-panel 203 with a hidden door-frame 301, whereby a wide selection of building materials (e.g. ordinary plaster, granite / marble, stainless steel / aluminium, etc) can replace the ubiquitous doorframes, which, in turn helps in achieving improved building aesthetics.

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Figures 3c-3e are various sectional views, which are identical to Figures 2c-2e.

Figure 3c is a sectional view of the concealed door hinge 100 of Figure 3b in a direction of 306. Figure 3d is a sectional view of the concealed door hinge 100 of Figure 3b in a direction of 304. Figure 3e is a sectional view of the concealed door hinge 100 of Figure 3b in a direction of 308.

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Figure 3f is a sectional view of Figure 3a in a direction of 302 showing *inter alia* the door-panels 203 in a closed position, door wall 205, 207, door-frames 301, 302 concealed door hinges 100 and L-shaped plates 313. The outer walls of the door-panels 203 are next to each other with no door-frames located between each individual door-panels 203 thereby achieving an uninterrupted arrangement of door-panels 203 that continuous and without any recesses which enhances the aesthetics.

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The door-frames 302 at the centre, in the embodiment, have a slightly different construction compared to the door-frame 301 at the side. The central door-frames 302

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are cross-shaped having a pair of longer arms 301a and another pair of shorter arms 301b. The edges of the longer arms 301a are parallel to the door wall 205, 207, while the edges of the shorter arms 301b are perpendicular to the door wall 205. Recessed portions 340, 350 are provided between the two arms 301a, 301b. The first recessed portion 340 and an adjacent edge of a longer arm 301a form a door rest for the door-frame 301. The second recessed portion 350 is used for mounting a door hinge 100 for mounting an adjacent door-panel 203.

Figure 3g is a sectional view of Figure 3a in a direction of 302 showing *inter alia* the door-panels 203 in an open position, door wall 205, 207, hidden door-frames 301, 302, concealed door hinges 100 and L-shaped plates 313. As shown, the angle of rotation 230 of the door-panels can vary up to about 120 degrees.

Optionally, the inner edges of the door-panels 203 can have a shield 223 (e.g. made of plastic or stainless steel) to cover a respective cavity 215 of the door-panel 203 as well as to enhance the appearance of the door hinge 100 when the door-panel 203 is opened. The shield 223 can be spray painted with a paint of the same colour as the door hinge 100.

The explanation for Figures 2a to 2g is in general applicable to Figures 4a to 4g.

Figure 4a is a front view of an installation of door-panels without door-frames using the concealed door hinge 100 of Figure 1.

This embodiment can be advantageously used in places having a granite / marble clad steel door-panels 403 that blend with the surrounding granite / marble or any stone clad wall 401 e.g. in hotel lift lobbies, entrance lobbies etc.

For such door-panels 403, it is desirable to have exquisite aesthetic presentation wherein the wall 401 and the door-panels must be continuous, without hinges in between the door-panels 403.

In such applications, the materials used in the fabrication of the door-panels, which can support a heavy stone clad outer layer, is preferably a hard metal e.g. steel.

Figure 4b is a partial sectional view of Figure 4a showing an installation of the door-panel 403, and the concealed door hinge 100 of Figure 1.

5 The body of the door-panel 403 has a steel plate 407 (e.g. having a thickness of about 1.5 mm) and a plurality of steel ribs 406 (e.g. having a thickness of about 1.5 mm). A stone clad outer layer (e.g. having a thickness of about 15 mm) is fastened to the body of the steel panel 403 using a premix 405 comprising sand, cement and adhesive.

10 The adjacent walls 425, 427 housing the heavy door-panels 403 are also be prepared before installing the door-panels 403. One end of a pair of clamping plates 413, 417 are fixed to the brick wall 425 respectively by a pair of mechanical fasteners 415, 419, such as a screw, a nut and bolt, while the other end of the clamping plates 413, 417 extend in to the sand and cemented layer 427. The extended part of the clamping plates 413, 417 are fastened to the outer edges of an elongate L-shaped metal plate 409 (e.g. steel
15 plate having a thickness of about 6 mm). The L-shaped plate 409 has a plurality of mounting holes for accommodating metal screws.

Firstly, as described above, each of the mounting plates 111 of a respective door hinge 100 are fastened to the L-shaped plate 409 using a plurality of metal screws 411.
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After this, a door-panel 403 is installed, whereby the mounting plates 101 of the door hinge 100 are inserted into the respective cavities 215 and a plurality of metal screws 421 are used to fasten each of the mounting plates 101 of a respective door hinge 100 to the door-panel 403.
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Figures 4c-4e are various sectional views, which are identical to Figures 2c-2e.

Figure 4c is a sectional view of the concealed door hinge 100 of Figure 4b in a direction of 406. Figure 4d is a sectional view of the concealed door hinge 100 of Figure 4b in a
30 direction of 404. Figure 4e is a sectional view of the concealed door hinge 100 of Figure 4b in a direction of 408.

Figure 4f is a sectional view of Figure 4a in a direction of 402 showing *inter alia* the door-panels 403 in a closed position, door wall 425, 427, concealed door hinges 100, L-shaped plates 409, the steel plate 407 and steel ribs 405. The stone clad door-panels
35 403 are next to each other with no door-frames located between each individual door-

panels 403 thereby achieving an uninterrupted arrangement of door-panels 403 that have improved aesthetics.

Figure 4g is a sectional view of Figure 4a in a direction of 402 showing *inter alia* the door-panels 403 in an open position, door wall 425, 427, concealed door hinges 100, L-shaped plates 409, the steel plate 407 and steel ribs 405. As shown, the angle of rotation 430 of the door-panels can vary up to about 120 degrees.

In an embodiment, the mounting screws 421 (e.g. machine screws made of stainless steel) for fixing the fastening plate using screw hole 115a can have e.g. a length of about 25 mm, counter sunk head diameter of about 7.5 mm, and thread diameter of about 4 mm. The mounting screws 421 (e.g. machine screws made of stainless steel) for fixing the fastening plate using screw hole 115b and the mounting screws 411 for fixing the mounting plate 111 can have e.g. a length of about 25 mm, counter sunk head diameter of about 9 mm, and thread diameter of about 5 mm.

Figure 5 is an exploded perspective view of a concealed door hinge 500 in accordance with a second embodiment.

The door hinge 500 comprises of two hinge members 510, 520, which can move relative to each other about an axis of a pivot 530. The first hinge member 510, the second hinge member 520 and the spindle 530 may be made of a hard metal e.g. stainless steel or hardened steel.

The hinge member 510 comprises a mounting plate 511 (e.g. having a thickness of about 5 mm, width of about 22 mm and a length of about 137 mm) and an angle bracket 509. The angle bracket 509 forms a channel 517 (e.g. a U-shaped channel) to accommodate a turning radius of a proximal edge 603a of a door-panel 603 (refer to Figure 6a).

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The angle bracket 509 comprises a plurality of flanges 509a-509f. A proximal end of the angle bracket 509 has a first flange 509a, which is pivotally attached to a spindle 530 through cylindrical bearings 508. The inner surface of the first flange 509a, adjacent to the channel 517, has an inclined (e.g. having an angle of about 45 degrees) surface.

The inner surface of the first flange 509a has one or more screw holes 581, while the outer surface has a slit 529 extending along the length of the hinge 500.

A flat second flange 509b (having a thickness of about 5mm) is attached to the end of the first flange 509a such that the inner surface of the first flange 509a is substantially orthogonal to the inner and outer surfaces of the second flange 509b.

- 5 A flat third flange 509c (having a thickness of about 5mm) is attached to the end of the second flange 509b such that the inner and outer surfaces of the third flange 509c are orthogonal to the mounting plate 511. A flat fourth flange 509d (having a thickness of about 5mm) is attached to the end of the third flange 509c, at an angle (e.g. having an angle of about 10.5 degrees) towards the channel 517. A flat fifth flange 509e (having a thickness of about 5mm) is attached to the end of the fourth flange 509d such that the inner and outer surfaces of the fifth flange 509e are orthogonal to the mounting plate 511.

- 15 The fifth flange 509e terminates orthogonally in to the mounting plate 511 and has a pair of inclined supports 509f, one on either side of the fifth flange 509e. The flanges 509a-509f of the angle bracket 509 are bent and arranged to facilitate the accommodation of the turning radius of another proximal edge 603b of the door panel 603 opposite to the proximal edge 603a (refer Figure 6a). The mounting plate 511 terminates with a substantially orthogonal fastening plate 512 having one or more screw holes 515.

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The screw holes 115 are countersunk with diameter of about 10 mm. A stainless steel woodscrew or machine screw can be used for fastening the fastening plate 512 to a door-frame 601 (refer Figure 6a).

- 25 The hinge member 520 comprises of a mounting plate 501 (e.g. having a thickness of about 3 mm, width of about 34 mm and a length of around 127 mm) having a plurality of screw holes 503. In an embodiment, the mounting plate 501 has five screw holes 503 that are positioned in a staggered manner. Each screw hole 503 has a diameter of about 7 mm and countersunk with a diameter of around 10mm. In addition, the mounting plate 501 has two or more holes 571 for inserting e.g. one or more metal screws (refer Figure 6a).

- 35 A hinge plate 505 (e.g. having a thickness of about 5 mm, width of about 7 mm, length of about 127 mm) may be welded to the mounting plate 501. The hinge plate 505 is discretely positioned and substantially perpendicular to the mounting plate 501, along

the length of the hinge 500. The hinge plate 505 has three cylindrical bearings 508 for attaching the hinge plate 505 to a spindle 531 of a pivot 530.

Alternatively, the two hinge members 510, 520 may be extruded as one part.

5

The pivot 530 comprises an elongate spindle 531 (having e.g. a diameter of about 8 mm), a pair of bearings 533 (having e.g. a diameter of about 14 mm) and a pair of plugs 535. During assembly of the door hinge 500, the hinge members 510, 520, and the bearings 506, 508, 533 are positioned while the spindle 531 is inserted through them and plugs 535 are plugged on either side to form the door hinge 500.

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Figure 6a is a partial sectional view showing an installation of a door-panel, door-frame and the concealed door hinge 500 of Figure 5.

15 Firstly, a door-panel 603 is prepared (e.g. at the manufacturing site) before installation, whereby two or more cavities 515 are formed appropriately at the edges of the door-panel 503 using a router. Each of the cavities 515 accommodates a door hinge 500.

Subsequently, the mounting plates 501 are inserted into their respective cavities 515 and a plurality of screws 621 are used to fasten each of the mounting plates 501 of a respective door hinge 500 to the door-panel 503.

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After this, a flexible shield 660 (e.g. made of flexible plastic or stainless steel) is installed, whereby one end 660d of the flexible shield 660 is inserted in to the slit 529 of the first flange 509a and one or more grub screws 680 are used to fasten one end 660d of the shield 660 to the first flange 509a. The other end of the flexible shield 660a is positioned over the screw hole 571 of the mounting plate 501 and one or more screws 670 are used to fasten the other end 660a of the shield 660 to the mounting plate 501.

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30 In an embodiment, the flexible shield 660 has four continuous strips 660a-660d. The first strip 660a and the second strip 660b fold orthogonally to accommodate into its respective position inside a cavity 615. The second strip 660b is more rigid than the other strips 660a, 660c, 660d so that it abuts against the inner surface of a proximal edge 603b of the door panel 603. The third strip 660c extends from the rigid second strip 660b and terminates in a fourth strip 660d. The fourth strip 660d is inserted into the slit 529 on the first flange 509a before being fastened by one or more grub screws 680.

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The flanges 509a-509f of the angel bracket are formed such that there is sufficient clearance (between the outer surface of the angel bracket 509 and the inner surface of a proximal edge 603b of the door panel 603) for maneuvering and accommodating the flexible shield 660 when the door-panel 603 is opened and closed. In Figure 6a, the flexible shield 660 is seen in a collapsed position i.e. when the door-panel 603 is closed.

It can be appreciated that the installation of the shield 660 onto the hinge 500 makes it possible to cover a respective cavity 515 of the door-panel 603, which helps in enhancing the appearance of the door hinge 500 when the door-panel 503 is opened. Furthermore, the fastening screws 621 and 670 of the door hinge 500 are not visible when the door-panel 603 is opened. The shield 660 can be spray painted with a paint of the same colour as the door hinge 500. The assembly of door-panel 603 and the door hinges 500 makes it easier for installation into a door-frame 602 in an installation site.

At the installation site, a guide plate 690 is fixed to the wall 605 or to the door-frame 602 using one or more screws 691. The guide plate 690 is a reference while plastering the adjacent door wall 607. After this, a door-frame 602 is fixed to a door wall (605, 607). A portion of the door frame 602 (corresponding to the mounting plate 511) is chiseled away using e.g. a wood chisel and the fastening plates 512 are positioned appropriately on the door frame 602 before being fastened by mounting screws 631 via the through holes 513 (refer Figure 5).

Subsequently, an adjustable door-frame 609 is inserted onto the fastening plate 512, along two side portions and a top portion of the door-frame 601. Typically, the adjustable door-frame 609 comprises three individual pieces, one piece corresponding to the top portion of the door-frame 601 and two pieces corresponding to the side portions of the door-frame 601. The three pieces of the adjustable door-frame 609 are moved horizontally towards the two sides and vertically towards the top of the door-panel 601 such that the gap 616 between the door-panel 603 and the door-frame 601 is minimised.

Once the final positions of the three pieces of the adjustable door-frame 609 are decided, air nails are used to fasten the adjustable door-frame 609 to the door-frame 603. Punctures caused by the air nails can be covered e.g. with wood putty.

It can be appreciated that the three pieces of the adjustable door-frame 609 not only minimise gaps between the door-panel and the door-frame 601, but also compensates for the irregularities in the level of the building floor level.

5 Gaps 614 adjacent to the adjustable door-frame 609 and the wall 607 can be hidden using an architrave 613, which blends with the adjustable door-frame 609 and makes the outer edges of the adjustable door-frame 609 to flush with the wall 607, along the two sides and the top.

10 The adjustable door-frame 609 helps in reducing the gap 616 between the door-frame 601 and the door-panel 603 to about 1.5 mm. Furthermore, the gap 616 between the door-frame 601 and the door-panel 603 is consistent throughout.

15 It can be appreciated that the architraves 613 not only hide gaps between the door-panel and the door-frame 601 upon installation of a door set, but also hides any hairline cracks that appear in the door wall 607 adjacent a door-panel 601.

20 Figure 6b is a partial sectional view of Figure 6a with the door-panel 603 in open position clearly showing the four continuous strips 660a-660d of the flexible shield 660 in an extended position.

Figures 6c-6f are various sectional views of the concealed door hinge 500 of Figure 5.

25 Figure 6c is a sectional view of the concealed door hinge 500 in a direction of 620.
Figure 6d is a sectional view of the concealed door hinge 500 in a direction of 640.
Figure 6e is a sectional view of the concealed door hinge 500 in a direction of 630.
Figure 6f is a sectional view of the concealed door hinge 500 in a direction of 650.

30 The mounting screws 211, 221 used in the present embodiment (for mounting e.g. timber door and timber frames) can be e.g. a stainless steel wood screw.

In an embodiment, the mounting screws 211 for fixing the mounting plate 101 can have e.g. a length of about 25 mm, counter sunk head diameter of about 9 mm, and thread diameter of about 5 mm.

In an embodiment, the mounting screws 221 for fixing the fastening plate using screw hole 115a can have e.g. a length of about 25 mm, counter sunk head diameter of about 7.5 mm, and thread diameter of about 4mm. The mounting screws 221 for fixing the fastening plate using screw hole 115b and the mounting screws 211 for fixing the mounting plate 111 can have e.g. a length of about 25 mm, counter sunk head diameter of about 9 mm, and thread diameter of about 5 mm.

Load tests performed indicates that each concealed hinge 100, 500 can carry a load of 150 kg without any deformation. Therefore, a plurality of door hinges 100, 500 can fulfill the mechanical and structural integrity of door designs.

The invention is not limited the above embodiments. However, those skilled in the art will recognize that the invention can be practiced, with modification, in the light of the information contained herein without departing from the scope of the invention.

Claims

1. A door hinge comprising:
 - 5 a first hinge member and a second hinge member, the first and second hinge members being rotatably movable relative to each other about a pivot axis, wherein the first hinge member comprises an angle bracket for securing the hinge to a door-frame such that a channel is defined by the angle bracket for accommodating a turning radius of a first proximal edge of the door-panel; and
 - 10 wherein the second hinge member comprises a first mounting plate for securing the hinge to a door-panel at the proximal edge thereof.
2. The door hinge as claimed in claim 1, wherein the first hinge member further comprises a second mounting plate at a distal end of the angle bracket, such that the
15 angle bracket together with the second mounting plate form substantially a U-shape defining said channel.
3. The door hinge as claimed in claim 2, wherein the first hinge member further comprises one or more first bearing members at a proximal end of the angle bracket for
20 receiving a spindle.
4. The door hinge as claimed in any one of claims 3, wherein the angle bracket comprises two or more continuous flanges, wherein a first flange is connected to the first bearing member at a proximal end of the angle bracket and a last flange intersects the
25 second mounting plate substantially orthogonal to a length of the second mounting plate
5. The door hinge as claimed in claim 4, wherein the angle bracket comprises two flanges that are substantially orthogonal to each other, wherein the second flange intersects the second mounting plate substantially orthogonal to a length of the second
30 mounting plate.
6. The door hinge as claimed in claim 5, wherein the second flange comprises through holes for inserting a fastener to fasten the second mounting plate to the door-frame.

7. The door hinge as claimed in claim 4, 5 or 6, wherein the flanges of the angle bracket are arranged to facilitate accommodating a turning radius of another proximal edge of the door-panel opposite the first proximal edge.
- 5 8. The door hinge as claimed any one of claims 4 to 7, further comprising a flexible shield for covering a cavity of the door panel for receiving the first hinge member, wherein a first end of the shield is connected to the first flange and a second end of the flexible shield is connected to the first mounting plate of the first hinge member.
- 10 9. The door hinge as claimed in claim 8, wherein in a closed position of the door-panel, the flexible shield collapses between an outer surface of the flanges and the cavity and in an open position of the door-panel, the flexible shield covers the cavity of the door panel.
- 15 10. The door hinge as claimed claim 8 or 9, wherein a first end of the flexible shield is inserted in to a slit located in the first flange and fastened while a second end of the flexible shield is positioned above a screw hole on the first mounting plate and fastened.
- 20 11. The door hinge as claimed any one of claims 8 to 10, wherein the flexible shield comprises a flexible material made of plastic or stainless steel.
12. The door set as claimed in any one of claims 8 to 10, wherein the shield is spray-painted with a paint of the same colour as the door hinge.
- 25 13. The door hinge as claimed in any one of the preceding claims, wherein the first hinge member further comprises a fastening plate connected to the second mounting plate for receiving one or more fasteners for securing the hinge to the door frame.
- 30 14. The door hinge as claimed in claim 13, wherein the fastening plate is connected along a length of the second mounting plate and towards an edge of the second mounting plate.
- 35 15. The door hinge as claimed in claim any one of the preceding claims, wherein the second hinge member further comprises one or more second bearing members for receiving a spindle.

16. The door hinge as claimed in claim 15, wherein the first mounting plate is connected to the one or more second bearing members along a length of the first mounting plate and towards an edge of the first mounting plate.

5 17. The door hinge as claimed any one of the preceding claims, wherein each of the first and second hinge members are extruded as one part.

18. The door hinge as claimed any one of claims 2 to 17, wherein the first mounting plate, second mounting plate and the fastening plate have a plurality of screw holes that
10 are countersunk for fastening the door hinge to a door panel and the door-frame, using screws.

19. The door hinge as claimed any one of the preceding claims, wherein the door hinge is made of steel.

15 20. A door set comprising a door-frame and door-panel made of wood, the door set installed using a door hinge as claimed any one of the preceding claims, wherein the door-frame has a fixed part that is attached to a door wall and a movable part, the movable part is adjustable horizontally and vertically after installing the door-panel so
20 that the gap between the movable part of the door-frame and door-panel is substantially reduced.

21. The door set as claimed in claim 20, wherein the movable part of the door-frame is fastened to the fixed part by air nails once the final position of the movable part is
25 decided and punctures caused by the air nails is covered with wood putty.

22. The door set as claimed in claim 20 or 21, wherein any gap between the movable part of the door-frame and the door wall is hidden using an architrave, the architrave blends with the moving part of the door-panel and flushes with the outer
30 edges of the adjustable door-frame.

23. A door set comprising a door-frame and door-panel, the door set installed using a door hinge as claimed any one of claims 1 to 19, wherein the door-frame is embedded centrally into a door wall and a pair of opposing L-shaped plates are inserted in between
35 the door-frame and door wall, on either sides, such that one arm of each L-shaped plate

forms the terminal portion of the door wall, whereby the door-frame is hidden by the two L-shaped plates and the door wall.

24. A frameless door set comprising a door-panel installed using a door hinge as claimed any one of claims 1 to 19, wherein the adjacent wall and the outer layer of the door-panel are stone clad, wherein the body of the door-panel is made of steel and comprises a plurality of steel ribs and the stone clad layer is formed using a premix of cement, sand and adhesive.

25. The frameless door set as claimed in claim 24, wherein the adjacent wall comprises a pair of clamping plates, one end of which are fixed to an inner wall by a pair of mechanical fasteners, while the other end extend in an outer wall, wherein the extended part of the clamping plates are fastened to the outer edges of an elongate L-shaped metal plate, the L-shaped metal plate having a plurality of mounting holes for fastening respective ones of the door hinges.

26. The frameless door set as claimed in any one of claims 20 to 25, wherein in the door-panel is operable to open up to an angle of about 120 degrees.

27. A continuous wall comprising a plurality of door sets as claimed in any one of claims 20 to 26 wherein when each of the door-panels are in closed position, the continuous wall completely conceal the door hinges.

28. A method of installing a door set comprising a door-panel and a door-frame, the method comprising the steps of:

routing a door-panel to form two or more cavities, each of the cavities for accommodating a door hinge as claimed in any one of claims 1 to 19;

fixing a door-frame to a door wall;

fastening the second hinge members of each of the door hinges on a respective portion of the door-frame; and

installing the door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective cavities.

29. The method of installing a door set as claimed in claim 28, the method further comprising a step of installing a flexible shield for covering a cavity of the door panel for

receiving the first hinge member, wherein a first end of the shield is connected to the first flange and a second end of the flexible shield is connected to the first mounting plate of the first hinge member..

- 5 30. The method of installing a door set as claimed in claim 28 or 29, further comprising the steps of:

inserting an adjustable door-frame on to the door-frame, along the two sides and the top of the door-frame;

- 10 moving the adjustable door-frame horizontally and vertically towards the door-panel to minimise the gap between the door-panel and the door-frame;

fastening the adjustable door-frame to the door-frame using air nails once final positions of the adjustable door-frame are achieved; and

sealing punctures caused by the air nails.

- 15 31. The method of installing a door set as claimed in any one of claims 28 to 30, further comprising a step of plugging the gaps existing adjacent to the adjustable door-frame and the wall using an architrave, wherein said architrave blends with the adjustable door-frame and flushes with the outer edges of the adjustable door-frame.

- 20 32. A method of installing a door set comprising a door-panel and a hidden door-frame comprising the steps of:

routing a door-panel to form two or more cavities, each of the cavities for accommodating a door hinge as claimed in any one of claims 1 to 19;

embedding a door-frame centrally into the door wall;

- 25 fastening the second mounting plates of the respective door hinges to the door-frame; and

installing the door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective cavities.

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33. A method of installing a frameless door set comprising a stone clad door-panel adjacent to a stone clad wall, the method comprising the steps of:

providing door hinges as claimed in any one of claims 1 to 19;

- 35 providing a stone clad door-panel installing a pair of clamping plates into the door wall, one end of which are fixed to an inner door wall by a pair of mechanical fasteners, while the other end extend in to an outer door wall;

fastening the extended part of the clamping plates to the outer edges of an elongate L-shaped metal plate;

fastening the second mounting plates of each of the door hinges on a respective portion of the L-shaped metal plate; and

5 installing the stone clad door-panel by inserting the first mounting plates of each of the door hinges into the respective cavities and fastening the first mounting plates to the respective part of the metallic stone-clad panel.

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