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(54) FLUSH-FACE PANEL FOR USE AS AN ELEVATOR DOOR SCIENCE REFERENCE LIBRARY

(71) We, HARRIS PREBLE COMPANY, a corporation organised and existing under the laws of the State of Illinois, United States of America, of 4608 West 20th Street, Cicero, Illinois, 60650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a flush-face metal panel, and more particularly to a flush-face metal or panel which is fabricated substantially entirely by welding and to a method of producing such a panel. The present invention further relates to an elevator door comprising such a panel and in particular, to a freight elevator door.

Vertically slidable doors used for closing the openings of elevator shafts in buildings and warehouses, which doors are fire proof and form protection from spreading fire through elevator shafts from one floor in the building to another floor thereof, are well known and have been in extensive use for years. Horizontally divided, or single section vertically moving counterbalanced freight elevator doors have found extensive use. In many modern buildings, the freight elevators are positioned whereby they open into office space or other locations in which the elevator doors occupy a conspicuous portion of a wall. Freight elevator doors typical of the prior art have been made from metal panels which are riveted or bolted to the frame work or which contain external welds of one sort or another which present an unsightly appearance.

Elevator doors which include an angle metal frame, the panel opening of which has been closed either with corrugated metal panels, metal sheathed wooden panels, or heavy metal plates of one sort or another are well known and have been described in the prior art, such as United States Patent Specification No. 1,678,196. The use of very

heavy metal plates to provide a rigid door structure is also known, but such an elevator door is extremely heavy. While the added weight of a thick metal plate can be compensated for through the use of counterbalanced doors, such doors are more expensive to produce and require heavier fittings to accomplish the counterweighting. On the other hand, the use of light metal stock to produce the panels results in a condition known as "oil canning" as hereinafter defined. "Oil canning" is manifested in relatively flexible panels, wherein sections of the panels tend to pop in and out of the vertical plane, to produce an aesthetically undesirable panel while at the same time, producing a lightweight tinny or booming sound when the door is closed or opened or when the door scrapes the hatch wall because of tight or limited operating space.

It is theorized that "oil canning" occurs when a section of a panel has an area slightly larger than the section to which the panel is affixed. When this condition occurs, the panel warps within sectionalized areas of the overall vertical door plane, creating a non-planar inward divergence in some areas and, conversely, a nonplanar outward divergence in other areas. The resulting inward or outward protrusions can be reversed by depressing the area toward the overall vertical door plane, but it will usually pop out on the other side of the vertical plane. This condition is similar to the condition seen in a lightweight can filled with oil. The term "oil canning" as used herein is defined as an undesirable warping, buckling or distortion which may be aggravated by existing thermal conditions.

It is an object of the present invention to provide a metal panel, which has a flush face substantially free of fastener heads, opposed seams and exposed frames, and a method of making the same.

According to one aspect of the present

invention there is provided a flush face metal panel, suitable for use as a door, effectively free of "oil canning" (as hereinbefore defined), which panel comprises a flat metal face plate having a thickness of at least 0.090 inches and a metal frame comprising a rectangular member, at least two reinforcing members and at least one stiffening member, the rectangular member and the reinforcing members being formed of metal angle, the face of one flange of which metal angle being fixed to the metal face plate and the other flange of which extends away from the metal face plate, the reinforcing members and the stiffening member(s) lying within and respectively substantially parallel to adjacent sides of the rectangular member, the stiffening member(s) lying between adjacent reinforcing members and between the reinforcing members and the sides of the rectangular member substantially parallel thereto, wherein the metal face plate is welded to one side of the frame to form a flush face free of fastener heads, exposed seams and exposed frame.

According to a second aspect of the present invention there is provided a method of making a flush face metal panel, suitable for use as a door, effectively free of "oil canning" (as hereinbefore defined), which panel comprises a flat metal face plate having a thickness of at least 0.090 inches and a metal frame comprising a rectangular member, at least two reinforcing members and at least one stiffening member, the rectangular member and the reinforcing members being formed of metal angle, the face of one flange of which metal angle being fixed to the metal face plate and the other flange of which extends away from the metal face plate, the reinforcing members and the stiffening member(s) lying within and respectively substantially parallel to adjacent sides of the rectangular member, the stiffening member(s) lying between adjacent reinforcing members and between the reinforcing members and the sides of the rectangular member substantially parallel thereto, which method comprises welding the frame to one side of the metal face plate in the following sequence:—

a) spot welding all reinforcing members and the two (first) sides of the rectangular member substantially parallel thereto to the metal face plate in sequence starting with one (first) side of the rectangular member, working across the metal face plate, and finishing with the second (first) side of the rectangular member,

b) spot and arc welding a central portion of the two (second) sides of the rectangular member by spot welding central portions of the two (second) sides of the rectangular

member to the face plate, which central portions extend between two reinforcing members, and thereafter arc welding ends of the two reinforcing members to the respective central portion, and

c) working progressively outwardly from the central portions towards both sides of the (first) sides of the rectangular member substantially parallel to the reinforcing members, by spot and arc welding all other portions of the two (second) sides of the rectangular member in turn lying between two reinforcing members and/or between a reinforcing member and a (first) side of the rectangular member substantially parallel to the reinforcing members in sequence in a manner similar to the welding of the central portion by spot welding portions of the two (second) sides of the rectangular member lying between two reinforcing members or lying between a reinforcing member and the (first) side of the rectangular member substantially parallel to the reinforcing members to the face plate and thereafter arc welding ends of the portions to the pair of adjacent reinforcing members or to adjacent (first) sides of the rectangular member substantially parallel to the reinforcing members at the corners thereof,

d) arc welding a central stiffening member lying between two reinforcing members to the two reinforcing members and thereafter tack welding the central stiffening member to the face plate, and

e) working progressively outwardly from the central stiffening member towards both of the (first) sides of the rectangular member substantially parallel to the members, by arc and tack welding all stiffening members in turn lying between two reinforcing members and/or between a reinforcing member and the (first) sides of the rectangular member substantially parallel to the reinforcing members in sequence in a manner similar to the welding of the central stiffening member by arc welding a stiffening member lying between the two reinforcing members or between the reinforcing member and a (first) side of the rectangular member and thereafter tack welding the stiffening member to the face plate.

The present invention may provide a flush-face metal elevator door, which flush-face facilitates painting, decorating and otherwise covering the door to match the surrounding wall and make it as unobtrusive as possible. The present invention may provide a door which is strong and rigid, which meets the ASTM fire codes, and is rated by Underwriters Laboratories, Inc. as suitable for class B openings, and which may be economically fabricated, but which presents a monolithic flush face which can be painted. More particularly, the present

invention enables a relatively lightweight elevator door to be provided which is substantially free of "oil canning", but which may be economically produced by a welding process.

For a better understanding of the present invention and to show how the same may be put into effect reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 shows an elevational view of the back, or elevator shaft side, of a metal panel of the present invention for use as an elevator door,

Figure 2 is an expanded, fragmentary vertical section taken at line 2—2, showing the details of the construction of the elevator door, and

Figure 3 is a fragmentary perspective view showing the details of the corner of the rectangular frame in the elevator door face plate.

In the preferred embodiment of the invention, one half of a horizontally divided pair of elevator doors is shown in Figure 1, generally at 110. Basically the door comprises a face plate 112, more particularly described below, which is welded to a frame, the outer portion of which is a rectangle, shown generally at 114. The rectangular frame comprises two vertical members 116 and 118 and two horizontal members 120 and 122. The rectangular frame members are preferably made of angular steel wherein one flange extends substantially parallel to the wall of the elevator shaft and the other flange extends inwardly into the shaft away from the face of the door. Preferably the members which make up the rectangular frame are welded together at the corners E, F, G and H to form the rectangle. The rectangular frame 114 should be made of heavy gauge steel, preferably mill rolled steel sections, in order to provide substantial structural rigidity to the door.

In order to provide additional rigidity the frame structure also includes a pair or more of vertical reinforcing members 124 and 126 which are likewise preferably made from heavy gauge mill rolled steel angle sections and are disposed with one flange parallel to the wall of the elevator shaft and the other flange extending away from the face of the door. Preferably the vertical reinforcing members 124 and 126 are welded at their ends to the horizontal members 120, and 122 at A, B, C and D. The vertical reinforcing members 124 and 126 divide the face panel 112 into 3 or more sub-panels to produce the desired rigidity and reduce the "oil canning" tendency of the face panel.

While it is generally contemplated that a single pair of vertical reinforcing members, as is shown in the drawings, will provide

adequate support, when the width of the elevator doors exceeds about 8 feet, 2 pairs of vertical reinforcing members should be used. When the width of the door exceeds about 12 feet, 3 pairs of vertical reinforcing members may be used. Alternatively, when it is necessary to produce doors wider than 12 feet, two smaller doors may be affixed together, side-by-side to make a wider door, or 4 doors may be affixed together 2 by 2 to form a larger door.

The remaining essential frame member comprise the horizontal stiffening members or stiffeners 128, 130 and 132. As is shown in Figure 1 these members 128, 130 and 132 span the width of the elevator door at about the centre, thus dividing the face panel 112 into 6 or more sub-panels. Preferably the horizontal stiffeners are welded at their ends to the vertical members 116, 124, 126 and 118 at I, J, K, L, M and N. As is shown in Figure 2, the horizontal stiffeners are preferably made of formed angle metal stock, and are affixed to the face plate 112 with the apex of the angle 134 oriented away from the face plate 112 and the flanges 135 of the angle in contact with the face plate 112. Although the horizontal stiffeners may be fabricated from right angle metal with flanges of different or the same dimensions, it is preferred to use 120° angle metal with equal length flanges, as is shown in Figure 2, since the 120° angle conforms to the elevator safety code (ANSI-A 17.1d 1970).

As was mentioned above, the face plate must be essentially monolithic metal, preferably steel. It is necessary that the steel face plate be thick enough that it's surface is not penetrated or damaged by a MIG spot weld. Further, it has been found that the face plate must have a thickness greater than 14 gauge (0.0747 inches) in order to avoid the "oil canning" problem. While the preferred thickness of the face plate used in the present invention is about 12 gauge or 0.1046 inches, it is contemplated that plates having a thickness of at least 13 gauge or at least about 0.090 inches will substantially avoid the "oil canning" problem. While there is no upper limit on the thickness insofar as the "oil canning" problem is concerned, as a practical matter, any metal thicker than 10 gauge or 0.1345 inches is not preferred because of increasing weight and cost with no particular benefit obtained by the added thickness.

While the present invention contemplates that face plates used on the doors will be essentially monolithic and planar, the present invention also contemplates that the face plate may have openings for vision panels and other hardware as required and as are customary in the art. However, the present invention contemplates that the face plate of the elevator door will be

substantially free from fastener heads of any type, exposed seams such as exposed welding seams, and exposed frame pieces and parts.

5 In manufacturing the elevator doors of the present invention, it is essential that the welding be carried out in a particular order and under certain conditions in order to avoid the problem of "oil canning". The
10 welding must be carried out under conditions in which the welding heat is dissipated promptly, since buckling (and "oil canning") of the relatively thin face plate will occur if a substantial area of the plate becomes heated and then further welding
15 operations take place. It postulated that a face plate which is heated over a substantial area will expand and if it is welded while in the expanded state, buckling or at least
20 internal stressing will occur when the plate is cooled. In order to carry out the welding processes and allow time for the heat to dissipate, the inventors have devised a process by which the welding steps are
25 carried out in a required order. It has been found empirically that when the welding steps are carried out in the order described below, that the heat is permitted to dissipate adequately to prevent buckling of the face
30 plate. If the required order is not followed, buckling or internal stressing occurs, which is manifested in an "oil canning" effect which is aesthetically undesirable.

35 Before the welding sequence is started, it is preferred that the members of the rectangular frame (166, 118, 120, and 122) and the vertical reinforcing members (124 and 126) be fitted and securely clamped to the face plate 112. Basically the welding
40 sequence, which is shown in Figure 1 in some detail, commences by MIG spot welding the vertical members 116, 124, 126 and 118 to the face plate 112, starting at one end and working across the door. The
45 center portion of horizontal members 120 and 122, (the portion between the pair of vertical reinforcing members 124 and 126) are next MIG spot welded to the face plate. The vertical reinforcing members 124 and
50 126 are then MIG arc welded to the horizontal members 120 and 122 at the ends of the vertical reinforcing members at A, B, C and D. Next, one end portion of both of the horizontal members 120 and 122 of the
55 rectangle are MIG spot welded to the face plate 112 and are MIG arc welded to the vertical member adjacent thereto that in 116 at E and F to form the corners of the rectangular frame. Then, the other end
60 portion of both horizontal members 120 and 122 are MIG spot welded to the face plate 112, followed by MIG arc welding the corners, that is welding the horizontal members 120 and 122 to the vertical
65 member 118 at G and H. Finally, the

horizontal stiffeners 128, 130 and 132 are MIG arc welded to the vertical members 116, 124, 126 and 118, starting with the centre horizontal stiffener 130 at I and J, then the horizontal stiffener at one end, that is, 128 at M and N and the horizontal stiffener at the other end, that is, 132 at K and L. The horizontal stiffeners are then MIG welded, as is shown in Figure 2, at 152 and 154 whereby the flanges 135 are MIG tack welded to the face plate. The MIG tack welds for the horizontal stiffener are shown by the numbered X's 45 through 62 on Figure 1. Preferably, the balance of the MIG tack welds shown on Figure 1 by a series of X's on vertical members 124 and 126 and those shown as unnumbered X's around the rectangle are also added. The MIG rack welds shown by the X's, while not essential, are desirable to reduce the noise, which can be characterized as a tinny sound, created between the face plate and the frame members. A vertical section of the MIG tack welds is shown in Figure 2 at 150, 152, 154 and 156.

In the preferred embodiment, the spot welds are produced in the order shown in Figure 1 as numbers 1 through 44 inclusive, with the MIG arc welds carried out as described above. Thus in the preferred process, the welding sequence is:

- a. MIG spot weld the vertical members (spots 1 through 28)
- b. MIG spot weld the centre portion of the horizontals (spots 29 through 32).
- c. MIG arc weld centre panel corners (arc welds A, B, C and D)
- d. MIG spot weld one end portion of the horizontals (spots 33 through 38)
- e. MIG arc weld rectangle corners (arc welds E and F)
- f. MIG spot weld other end portion of the horizontals (spots 39 through 44)
- g. MIG arc weld rectangle corners (arc welds G and H)
- h. MIG arc weld ends of centre horizontal stiffener (arc weld I and J)
- i. MIG tack weld centre horizontal stiffener (tacks 45 through 50)
- j. MIG arc weld ends of end one horizontal stiffener (arc welds K and L)
- k. MIG tack weld end horizontal stiffener (tacks 51 through 56)
- l. MIG arc weld ends of other horizontal stiffener (arc welds M and N)
- m. MIG tack weld other end horizontal stiffener (tacks 57 through 60)
- n. MIG tack weld remaining locations marked X, in any sequence.

It will be obvious to those skilled in the art that a greater or fewer number of spot welds may be used and that the optimum number of welds used is determined by the size of the door and the penetration of the weld into the face plate. The present

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invention is not limited to the precise number of welds shown and described in the preferred embodiment, but the general sequence of welding operations described above must be used to obviate the "oil canning" problem.

The frame members are attached together, although not necessarily prior to attachment to the face plate, through the use of MIG arc welds A through N. The frame members are fitted in such a manner, as is shown in Figure 3, so as to present a substantially planar surface to which the face plate 112 can be welded. The frame members are attached, as is shown in Figure 3, through the use of MIG arc welded butt joints 140, 142, and 144. Since this portion of the door is not exposed when the elevator door is in normal use, the aesthetics of this welding process is not critical and the common form of MIG arc welding is quite satisfactory.

The face plate must be welded to the frame preferably using metal-inert gas (MIG) spot welds. The preferred form of MIG spot welding, in which the heat used and the time of the weld are controlled, gives sufficiently accurate control to form a spot weld which will pierce through the frame and penetrate into the rear of the face plate without burning through the face plate. It is essential that the welding apparatus and conditions be adjusted to avoid burning through the face plate, since a burn will produce a marred surface which is undesired, and which defeats the objectives of the present invention. The depth of the spot welds ideally used are shown in Figure 2 at spot weld 146 and 148. Desirably the frames 120 and 122 are penetrated and the weld melts approximately the full thickness of face plate 112.

While it is not preferred, the frame joints may be welded using welding techniques other than MIG arc welding, such as continuous short arc welds. Also it is possible to use untimed tack welds rather than MIG tack welds at the points indicated by the X's on the drawing. The MIG welding technique is preferred because of its easy control, reproducibility, and high quality.

It has been found that the shielding gas used in the MIG welding is important since it controls penetration to some extent. Preferably, an inert gas comprising approximately 75% argon and 25% carbon dioxide is preferred. Other inert gases may be used.

Preferably, the welding process is carried out by placing the monolithic face plate on a heat sink means, such as a copper topped table, preferably fitted with clamps. It has been found that copper, which is an excellent conductor of heat, tends to carry

the heat away from the face plate. This prevents any large section of the face plate from becoming heated and expanding and also aids in obviating burn throughs. Additionally, it has been found that the MIG welds do not stick to copper, so that an occasionally burn through will not weld the door to the table, or the jig.

While it is possible to use heat sink metals other than copper, such as aluminum, and to use additional cooling means such as water or carbon dioxide, it has been found that a copper topped jig table, in which the copper thickness is approximately $\frac{1}{4}$ inch is perfectly adequate.

Further, in carrying out the MIG spot welding process, it is preferable that the frame be held tightly against the face plate during the welding operation. This will permit the frame to firmly bond to the face plate and to obviate the possibility of "oil canning", booming, and burn through.

Additionally, it is usually desirable to use MIG tack welds, as are shown in Figure 1 by a series of X's, to further affix the plate 112 to the framework 114. MIG tack welds are also shown in Figure 2 at 150, 152, 154, and 156.

The process of the present invention can be used to fabricate elevator doors of any conventional metal. While the usual door is produced from hot rolled steel, stainless steel can similarly be used. It is contemplated that the present invention would be useful in producing an aluminum door. Although an aluminum door would not pass a fire test, it is desirable where spark prevention or certain corrosion resistant surfaces are necessary.

As will be known to those skilled in the art, freight elevator doors, and particularly horizontally divided freight elevator doors must meet standards of strength and durability not required of ordinary doors. In such doors it is conventional to provide the top edge of the lower door with a trucking still which must accommodate substantial loads being trucked across the top of the door on to the elevator platform. These loads are actually supported from the opposite ends or the sides of the elevator door and it is essential that the load be accommodated without any distortion, either temporary or permanent of the door per se. The strength standards required of the doors is determined by the elevator capacity and type loading as is shown in ANSI-A17.1d.

WHAT WE CLAIM IS:—

1. A flush face metal panel, suitable for use as a door, effectively free of "oil canning" (as hereinbefore defined), which panel comprises a flat metal face plate having a thickness of at least 0.090 inches

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invention is not limited to the precise number of welds shown and described in the preferred embodiment, but the general sequence of welding operations described above must be used to obviate the "oil canning" problem.

The frame members are attached together, although not necessarily prior to attachment to the face plate, through the use of MIG arc welds A through N. The frame members are fitted in such a manner, as is shown in Figure 3, so as to present a substantially planar surface to which the face plate 112 can be welded. The frame members are attached, as is shown in Figure 3, through the use of MIG arc welded butt joints 140, 142, and 144. Since this portion of the door is not exposed when the elevator door is in normal use, the aesthetics of this welding process is not critical and the common form of MIG arc welding is quite satisfactory.

The face plate must be welded to the frame preferably using metal-inert gas (MIG) spot welds. The preferred form of MIG spot welding, in which the heat used and the time of the weld are controlled, gives sufficiently accurate control to form a spot weld which will pierce through the frame and penetrate into the rear of the face plate without burning through the face plate. It is essential that the welding apparatus and conditions be adjusted to avoid burning through the face plate, since a burn will produce a marred surface which is undesired, and which defeats the objectives of the present invention. The depth of the spot welds ideally used are shown in Figure 2 at spot weld 146 and 148. Desirably the frames 120 and 122 are penetrated and the weld melts approximately the full thickness of face plate 112.

While it is not preferred, the frame joints may be welded using welding techniques other than MIG arc welding, such as continuous short arc welds. Also it is possible to use untimed tack welds rather than MIG tack welds at the points indicated by the X's on the drawing. The MIG welding technique is preferred because of its easy control, reproducibility, and high quality.

It has been found that the shielding gas used in the MIG welding is important since it controls penetration to some extent. Preferably, an inert gas comprising approximately 75% argon and 25% carbon dioxide is preferred. Other inert gases may be used.

Preferably, the welding process is carried out by placing the monolithic face plate on a heat sink means, such as a copper topped table, preferably fitted with clamps. It has been found that copper, which is an excellent conductor of heat, tends to carry

the heat away from the face plate. This prevents any large section of the face plate from becoming heated and expanding and also aids in obviating burn throughs. Additionally, it has been found that the MIG welds do not stick to copper, so that an occasionally burn through will not weld the door to the table, or the jig.

While it is possible to use heat sink metals other than copper, such as aluminum, and to use additional cooling means such as water or carbon dioxide, it has been found that a copper topped jig table, in which the copper thickness is approximately $\frac{1}{4}$ inch is perfectly adequate.

Further, in carrying out the MIG spot welding process, it is preferable that the frame be held tightly against the face plate during the welding operation. This will permit the frame to firmly bond to the face plate and to obviate the possibility of "oil canning", booming, and burn through.

Additionally, it is usually desirable to use MIG tack welds, as are shown in Figure 1 by a series of X's, to further affix the plate 112 to the framework 114. MIG tack welds are also shown in Figure 2 at 150, 152, 154, and 156.

The process of the present invention can be used to fabricate elevator doors of any conventional metal. While the usual door is produced from hot rolled steel, stainless steel can similarly be used. It is contemplated that the present invention would be useful in producing an aluminum door. Although an aluminum door would not pass a fire test, it is desirable where spark prevention or certain corrosion resistant surfaces are necessary.

As will be known to those skilled in the art, freight elevator doors, and particularly horizontally divided freight elevator doors must meet standards of strength and durability not required of ordinary doors. In such doors it is conventional to provide the top edge of the lower door with a trucking still which must accommodate substantial loads being trucked across the top of the door on to the elevator platform. These loads are actually supported from the opposite ends or the sides of the elevator door and it is essential that the load be accommodated without any distortion, either temporary or permanent of the door per se. The strength standards required of the doors is determined by the elevator capacity and type loading as is shown in ANSI-A17.1d.

WHAT WE CLAIM IS:—

1. A flush face metal panel, suitable for use as a door, effectively free of "oil canning" (as hereinbefore defined), which panel comprises a flat metal face plate having a thickness of at least 0.090 inches



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and a metal frame comprising a rectangular member, at least two reinforcing members and at least one stiffening member, the rectangular member and the reinforcing members being formed of metal angle, the face of one flange of which metal angle being fixed to the metal face plate and the other flange of which extends away from the metal face plate, the reinforcing members and the stiffening member(s) lying within and respectively substantially parallel to adjacent sides of the rectangular member, the stiffening member(s) lying between adjacent reinforcing members and between the reinforcing members and the sides of the rectangular member substantially parallel thereto, wherein the metal face plate is welded to one side of the frame to form a flush face free of fastener heads, exposed seams and exposed frame.

2. A panel according to Claim 1, wherein the frame comprises a rectangular member, adjacent sides of the rectangular member being of different lengths, at least one pair of reinforcing members lying substantially parallel to the short sides of the rectangular member, and at least one stiffening member, the stiffening member(s) lying substantially parallel to the long sides of the rectangular member.

3. A panel according to Claim 2, wherein the frame comprises one pair of reinforcing members.

4. A panel according to Claim 1, 2 or 3, wherein all members of the frame are joined by metal-inert gas welding.

5. A panel according to any one of the preceding claims, wherein the metal face plate has the same overall dimensions as the rectangular member.

6. A panel according to any one of the preceding claims, wherein the metal face plate is about 0.1046 inches thick.

7. A panel according to any one of the preceding claims, wherein the metal face plate is welded to the frame with metal-inert gas spot welds.

8. A panel according to Claim 7, wherein the metal face plate is welded to the rectangular member and the reinforcing members by metal-inert gas spot welds.

9. A panel according to Claim 8, wherein the metal face plate is welded to the stiffening member(s) by metal-inert gas tack welds.

10. A panel according to any one of the preceding claims, wherein the metal face plate has an opening for a vision panel or other required hardware.

11. A panel according to any one of the preceding claims, wherein the stiffening member(s) are of metal angle with both flanges in contact with the metal face plate.

12. A panel according to Claim 11,

wherein each stiffener member comprises 120° metal angle.

13. A method of making a flush face metal panel, suitable for use as a door, effectively free of "oil canning" (as hereinbefore defined), which panel comprises a flat metal face plate having a thickness of at least 0.090 inches and a metal frame comprising a rectangular member, at least two reinforcing members and at least one stiffening member, the rectangular member and the reinforcing members being formed of metal angle, the face of one flange of which metal angle being fixed to the metal face plate and the other flange of which extends away from the metal face plate, the reinforcing members and the stiffening member(s) lying within and respectively substantially parallel to adjacent sides of the rectangular member, the stiffening member(s) lying between adjacent reinforcing members and between the reinforcing members and the sides of the rectangular member substantially parallel thereto, which method comprises welding the frame to one side of the metal face plate in the following sequence:—

a) spot welding all reinforcing members and the two (first) sides of the rectangular member substantially parallel thereto to the metal face plate in sequence starting with one (first) side of the rectangular member, working across the metal face plate, and finishing with the second (first) side of the rectangular member,

b) spot and arc welding a central portion of the two (second) sides of the rectangular member by spot welding central portions of the two (second) sides of the rectangular member to the face plate, which central portions extend between two reinforcing members, and thereafter arc welding ends of the two reinforcing members to the respective central portion, and

c) working progressively outwardly from the central portions towards both sides of the (first) sides of the rectangular member substantially parallel to the reinforcing members, by spot and arc welding all other portions of the two (second) sides of the rectangular member in turn lying between two reinforcing members and/or between a reinforcing member and a (first) side of the rectangular member substantially parallel to the reinforcing members in sequence in a manner similar to the welding of the central portion by spot welding portions of the two (second) sides of the rectangular member lying between two reinforcing members or lying between a reinforcing member and the (first) side of the rectangular member substantially parallel to the reinforcing members to the face plate and thereafter arc welding ends of the portions to the pair of adjacent reinforcing members or to the



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adjacent (first) sides of the rectangular member substantially parallel to the reinforcing members at the corners thereof,

5 d) arc welding a central stiffening member lying between two reinforcing members to the two reinforcing members and thereafter tack welding the central stiffening member to the face plate, and

10 e) working progressively outwardly from the central stiffening member towards both of the (first) sides of the rectangular member substantially parallel to the reinforcing members, by arc and tack welding all stiffening members in turn lying

15 between two reinforcing members and/or between a reinforcing member and the (first) sides of the rectangular member substantially parallel to the reinforcing members in sequence in a manner similar to the welding of the central stiffening member by arc welding a stiffening member lying

20 between the two reinforcing members or between a reinforcing member and a (first) side of the rectangular member and thereafter tack welding the stiffening member to the face plate.

25 14. A method according to Claim 13, wherein all spot welds are made using metal-inert gas welds.

30 15. A method according to Claim 13 or 14, wherein the panel comprises a flat metal face plate having a thickness of from 0.090 to 0.1345 inches and a metal frame comprising a rectangular member, two

35 reinforcing members and at least three stiffening members, the rectangular member having adjacent sides of differing lengths, the reinforcing members lying substantially parallel to the short sides of the rectangular member.

16. A method according to Claim 13, 14 or 15, wherein the tack welding is metal-inert gas welding.

17. A method according to any one of Claims 13 to 16 wherein the metal-inert gas welds are made using an inert gas comprising argon.

18. A method according to Claim 17, wherein the inert gas is about 75% carbon and about 25% carbon dioxide.

19. A method according to any one of Claims 13 to 18, wherein the metal face plate is in contact with a heat sink during the welding operation.

20. A method according to Claim 19, wherein the heat sink is a copper topped table.

21. A flush-face metal panel substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

22. A method of making a flush-face metal panel substantially as hereinbefore described with reference to the accompanying drawing.

23. An elevator door comprising a flush-face metal panel according to any one of Claims 1 to 12 and 21 and/or whenever made by the method of Claims 13 to 20 and 22.

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