Dec. 27, 1966 D. C. S. KEMP ETAL 3,294,276

STRUCTURAL MEMBERS AND CABINETS UTILIZING SUCH MEMBERS

Filed March 13, 1964 2 Sheets-Sheet 1

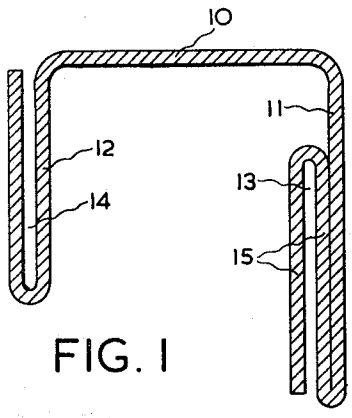



FIG. 1

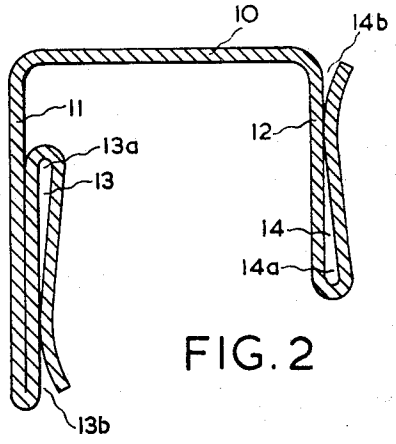



FIG. 2

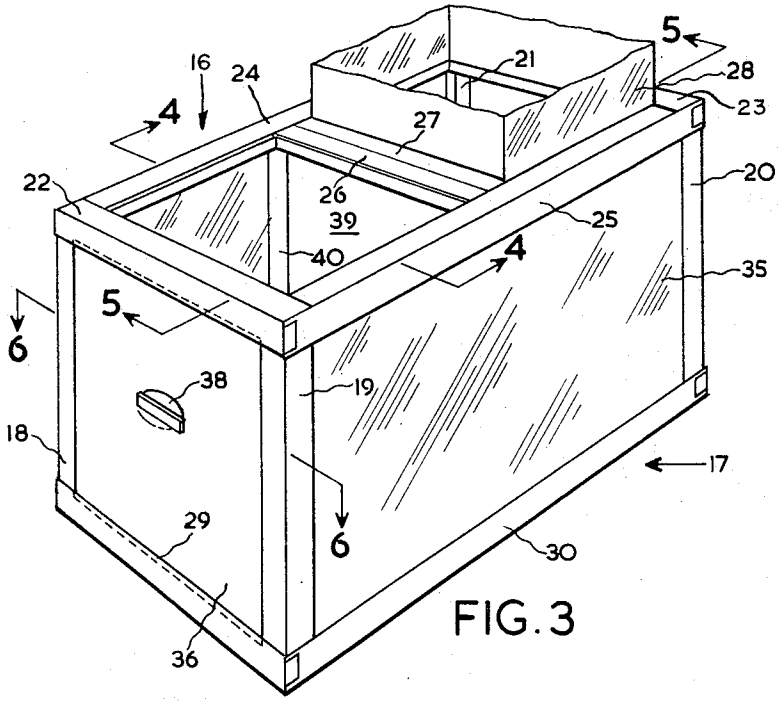



FIG. 3

INVENTORS
DAVID C.S. KEMP
JOHN W. STRONG
BY: Church & Rogers
PATENT AGENTS

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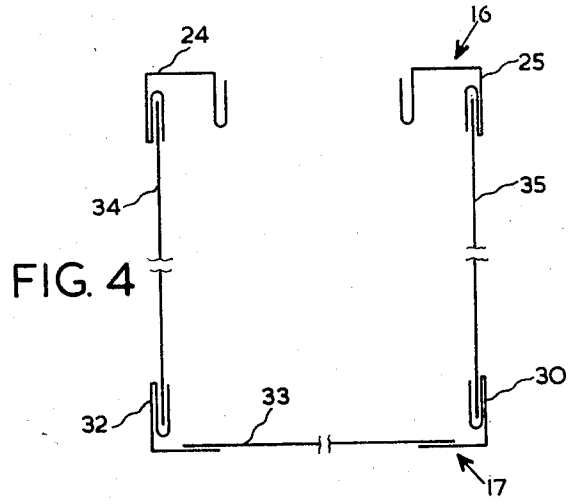



FIG. 4

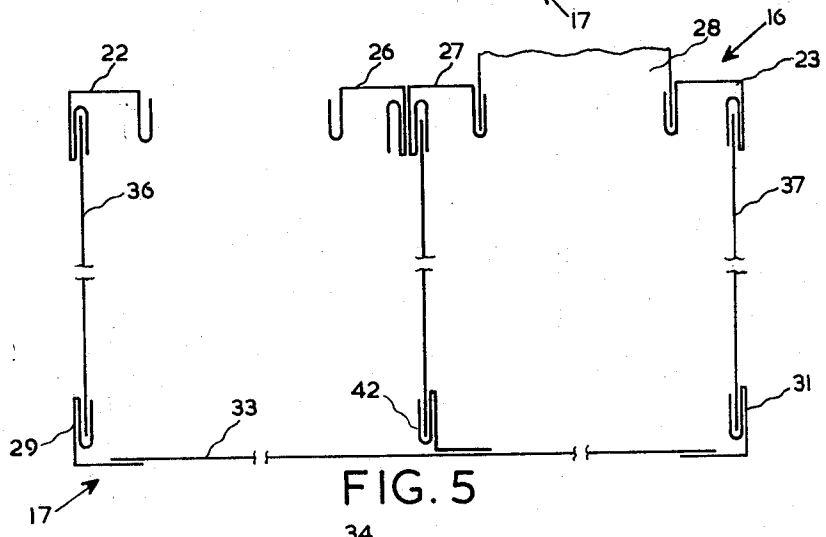



FIG. 5

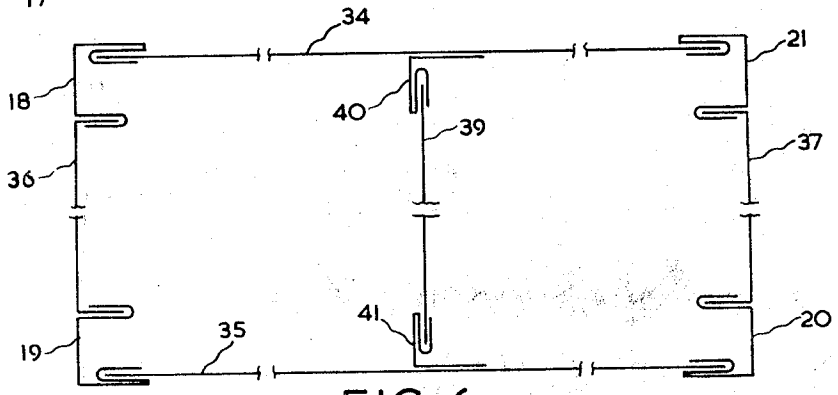



FIG. 6

INVENTORS
DAVID C. S. KEMP
JOHN W. STRONG
BY: Church & Rogers
PATENT AGENTS

United States Patent Office

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# STRUCTURAL MEMBERS AND CABINETS UTILIZING SUCH MEMBERS

David C. S. Kemp, Orillia, Ontario, and John W. Strong, Hamilton, Ontario, Canada, assignors to Bartaco Industries Limited, Stoney Creek, Ontario, Canada

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The present invention is concerned with improvements in or relating to structural members and structures such as frameworks and cabinets utilising such structural members. The invention relates especially, but not exclusively, to metal cabinets for oil or gas furnaces.

Structural members, frame structures and cabinets formed from bent and folded sheet metal are used extensively in products for both domestic and industrial use, because of the wide variety of shapes and sizes that are possible, using relatively simple equipment to give products that combine simplicity, ease of construction, strength and good appearance. A particular example of such a product is the cabinet for oil or gas furnaces, which must be of good appearance to please the domestic purchaser, must be strong and capable of production in a wide variety of sizes, and yet be relatively inexpensive to produce to meet the intense competition in the field.

It is an additional requirement of a furnace cabinet that it be readily assembled and dismounted, since it frequently is installed in locations where the largest access opening is substantially smaller than the cabinet when assembled. For this reason, and for reasons of general cost, it is desirable to provide a cabinet that, as far as possible, does not use screws in its assembly. For example, each screw must be provided with at least two predrilled holes, and with the manufacturing tolerances usual for such constructions, it is often extremely difficult for the assembler to align the holes so that the screws can be inserted.

It is an object of the present invention to provide a new structural member.

It is another object of the invention to provide a new structural member that has particular utility in its employment in the frame and post members of a cabinet.

It is a further object of the invention to provide a new frame structure.

It is a further object of the invention to provide a new frame structure that has particular utility in adapting a cabinet to receive one or more trunk members in sealing engagement therewith.

It is a further object of the invention to provide a new cabinet construction.

It is a further object of the invention to provide a new cabinet construction that can readily be assembled from relatively few different components without the use of screws for fastening the components together.

According to the present invention there is provided a new structural member comprising a relatively flat-bottomed U-section main channel having one leg of the section longer than the other, the said longer leg being provided at the inner face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said longer leg, the longer leg channel opening in a direction away from the main channel base, and the said shorter leg being provided at the outer face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said shorter leg, the shorter leg channel opening in a direction towards the main channel base.

Such a structural member is readily and economically



formed by longitudinal folding of an elongated strip of metal.

Also according to the present invention there is provided a frame structure comprising a square or rectangular shaped open framework formed by connecting together at their ends four structural members of the invention with the shorter leg channels of all the members opening in the same direction.

Further according to the invention there is provided a cabinet comprising a top frame and corner posts all constructed of structural members of the invention, a bottom frame of a modified member employing the long side leg and base of the main channel of the said structural members, and appropriate side panels, the whole being capable of assembly without the use of screws.

Structural members, a framework and a cabinet that are specific embodiments of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings wherein:

FIGURES 1 and 2 are respective transverse cross-sections of two different structural members in accordance with the invention.

FIGURE 3 is a perspective view of a cabinet in accordance with the invention and incorporating a frame structure in accordance with the invention, and FIGURES 4, 5 and 6 are plane cross-sections of the cabinet of FIGURE 3, taken respectively on the lines **4—4**, **5—5** and **6—6** thereof.

Since FIGURES 4, 5 and 6 are plane sections no attempt is made to show background to these sections, since it is believed that such background may confuse and not clearify the construction. Moreover, it will be appreciated that, as is usual when showing cross-sections through sheet material, the thickness of the material must be exaggerated for clarity of illustration.

Referring now to FIGURE 1, there is shown therein the cross-section of a structural member in accordance with this invention. The member comprises a main channel of relatively flat-bottomed U-cross-section having a base **10**, a longer leg **11** and a shorter leg **12**. The longer leg is provided at the inner face thereof with a channel **13** adapted to receive therein the edge of a sheet, which when inserted in the channel will have its general plane parallel to the general plane of the longer leg. This longer leg channel is open for the reception of such a sheet in a direction which will be specified herein as away from the channel base. The shorter leg is provided at its outer face with a channel **14** similar to the longer leg channel, this shorter leg channel also being adapted to receive therein the edge of a sheet which, when inserted in the channel, will have its general plane parallel to the general plane of the shorter leg. This shorter leg channel opens in the opposite direction to the longer leg channel, which opposite direction will be specified as away from the channel base.

The structural member illustrated is particularly useful for furnace casings, and is formed in a continuous process, using known types of metal-forming machines, from a roll of a flat elongated strip of metal. In a typical forming process the two edges of the flat strip are turned to form the two channels **13** and **14**, and thereafter the parts of the strip forming the legs are turned through opposite angles of ninety degrees each, the part **15** of the longer leg including the channel **13** being turned through one hundred and eighty degrees until it is against the remainder of the longer leg. If the structural member is to be produced in other material, e.g., plastic or aluminium, and/or by methods other than rolling, then the longer leg can be produced without the portion thereof of double thickness.

In the embodiment of FIGURE 1, both of the channels

13 and 14 are of the same width, and they are both of substantially constant width over their full depth. Moreover, this width is made such that the associated sheet or panel can readily be inserted in the channel and will not have any appreciable play in the channel. It is a normal economical practice to use sheets or panels of the same material from which the structural members are made. The embodiment of FIGURE 2 differs from that of FIGURE 1 in that the width of each channel decreases progressively from the closed end 13*a* and 14*a* respectively towards the open end, so that a panel can only be inserted therein by exerting a force and separate the two sides of the channel. With this second embodiment therefore the channels themselves also constitute means for positively engaging and retaining a sheet member inserted therein. It will also be noted that the width of each channel increases in the neighbourhood of its entrance 13*b* and 14*b* respectively to provide a mouth that facilitates entrance of a sheet member into the channel.

In the specific preferred embodiments described the two channels are of substantially the same depth, and the shorter leg channel 14 extends substantially the full length of the shorter leg, but in other embodiments the channels may differ somewhat in depth, although they should be of substantial depth relative to the length of the legs, because of their function of receiving and retaining sheet members by their edges. Moreover, the shorter leg and the base are of substantially the same dimensions.

In a specific embodiment fabricated from 22 gauge sheet metal the depth of the two channels and width of the base member are in the neighbourhood of ¾ inch, while the length of the longer leg is in the neighbourhood of 1¼ inch. More generally, in a preferred range of embodiments the depth of the shorter leg channel is at least half the length of the shorter leg, the length of the shorter leg is not less than half the length of the base and not more than one and a half times the length of the base, the length of the longer leg is not less than the length of the base and not greater than twice the length of the base, and the ratio of the lengths of the leg channels is not more than 2:1 and preferably is not more than 3:2, this ratio being of course 1:1 in the embodiments illustrated herein.

Referring now to FIGURES 3 to 6, a cabinet in accordance with the invention, and fabricated from structural members in accordance with the invention, comprises a rectangular-shaped, open-top frame 16, a similar-shaped bottom frame 17, and four corner posts 18 to 21 extending between the top and bottom frames.

The top frame consists of two shorter pieces 22 and 23 and two longer pieces 24 and 25, of the structural member, each of which has the shorter leg cut away near to its two ends, so that the members can be overlapped and joined by spot welding together the channel bases at the places of overlap. The channel of the long leg is also cut away near the ends, so that the remainder of the leg can be bent around the end of the butting member to strengthen the joint between them. In this embodiment the two longer pieces 24 and 25 have parts of the shorter legs cut away near to their middles, so that two additional shorter pieces 26 and 27 can be inserted in the resulting gaps and joined to the remainder of the framework by spot welding the channel bases together. These two additional members have their longer legs abutting. Such a framework provides two apertures, which in this embodiment are approximately of square shape, each aperture being formed by four of the structural members, and all four of which have their shorter leg channels opening in the same direction. It will be apparent therefore that a sheet metal trunk member such as 28, of the same transverse cross-section as the respective aperture can readily be mounted on the casing, by engaging the edges of its sides at one end in the associated four shorter leg channels.

When the cabinet is a furnace casing the two trunk members may be the hot air discharge trunk and the cold air delivery trunk, and they may be fitted into the casing apertures and retained therein without the need for fastening screws.

It is not commercially desirable to use the same structural member for the bottom frame, and instead the frame is formed from four members 29 to 32 of modified transverse cross-section, consisting of the longer leg and the base of the structural member of the invention. The four members with the channel removed at both their ends have their ends overlapped, and are joined by spot welding together the overlapping parts of the bases. A flat sheet 33 constituting the lower face of the cabinet is fastened at its edges to the bases of the four modified members. The four corner posts each have part of the two channels removed at both ends, to at least the depth of the said channels in the structural members. The two larger side panels of the cabinet are constituted by two flat sheets 34 and 35, all four edges thereof being inserted in the longer leg channels of their associated frame members and end posts. The two smaller side panels (or end panels) 36 and 37 also constitute access doors to the cabinet interior, and each is constituted by a sheet having its two side edges turned at ninety degrees to the general plane of the panel (see FIGURE 6) so as to be engageable in the shorter leg channels of the two associated corner posts. The length of each panel is greater than the opening which it closes, but is smaller than the distance between the closed ends of the two opposite longer leg channels; therefore, for example, the upper edge of the door panel can be engaged in the longer leg channel of the member 22, and the panel then pushed up until its lower edge can be engaged in the channel of the member 29, the door can now be lowered until its turned side edges engage the upper edge of the member 29. The door panel 36 may be provided with a handle 38 to facilitate its manipulation.

When used as a furnace enclosure the cabinet must have its interior divided into two approximately equal size compartments, and this is done by means of a centre panel 39 having its upper edge engaged in the longer leg channel of one of the additional pieces 26 and 27, in this embodiment the piece 27. The other three edges of the panel are engaged in the longer leg channels of three members 40 to 42, of the modified section fastened respectively to the two side panels 35 and 36 and the floor panel 33. This panel 39 may be characterised as having its edges engaged in, but not fully inserted in, the associated channels, so that it may undergo substantial changes in size and shape, e.g., because of variations in its temperature, without applying any forces to other parts of the cabinet and causing the unpleasant "working" noises that are characteristic of some previously known furnace cabinet constructions.

If the cabinet is disassembled it will be found to consist of the two frames, the four end posts, the four side panels and the centre panel, and it will be apparent that all of these members are relatively thin and/or narrow as compared with the dimensions of the assembled cabinet, so that they may be passed through an access opening of relatively small dimensions.

To assemble the cabinet the bottom frame 17 is laid on the ground or its prepared foundation, the ends of the four corner posts 18 to 21 are fitted into the corners of the frame, and the two larger side panels 35 and 36 are engaged in their associated longer leg channels 13. The centre panel 39 is placed in position, and the top frame 16 is pushed into place, with the upper ends of the corner posts fitted into its corners, and the larger side and the centre panels engaged in their respective longer leg channels. With the top frame fitted in place it is found that the cabinet is quite rigid, and will remain assembled under normal usage without the use of any separate fastening means, such as metal screws or nuts and bolts. The door panels 36 and 37 and the air trunks may be fitted thereafter. It will be appreciated that in most furnace constructions one of the end panels will not

constitute a door, but instead will serve to support a burner extending into the associated compartment of the cabinet.

It will now be apparent that the present invention provides a new structural member and a new frame member that are readily adaptable to the fabrication of useful commercial structures, as well as a cabinet construction that is easily and inexpensively fabricated from a relatively few number of similar parts, and can be assembled without the need of separate fastening means.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

**1.** A structural member comprising a relatively flat-bottomed U-section main channel having one leg of the section longer than the other, the said longer leg being provided at the inner face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said longer leg, the longer leg channel opening in a direction away from the main channel base, and the said shorter leg being provided at the outer face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said shorter leg, the shorter leg channel opening in a direction towards the main channel base.

**2.** A structural member as claimed in claim **1**, wherein the width of the said longer and shorter leg channels is substantially the same dimension as thickness of sheet material from which the member is formed.

**3.** A structural member as claimed in claim **1**, wherein the width of each of the said longer and shorter leg channels decreases progressively from the closed end of the channel toward the open end thereof to provide means for engaging and retaining in each channel a sheet member inserted in the respective channel.

**4.** A structural member as claimed in claim **3**, wherein the width of each leg channel increases in the neighbourhood of the mouth of the channel to facilitate the insertion of a sheet member into the respective channel.

**5.** A structural member as claimed in claim **1**, wherein the said two leg channels are of approximately the same depth, the said shorter leg channel extending substantially the full depth of the said shorter leg.

**6.** A metal structural member formed by longitudinal folding of an elongated strip of metal, the said strip being folded to form a relatively flat-bottomed U-section main channel having one leg of the section longer than the other, the metal of the said longer leg being folded inwardly of the channel back toward the bottom of the main channel to be against the longer leg, and having its free edge returned away from the bottom of the main channel to form at the inner face of the longer leg a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said longer leg, the resultant longer leg channel opening in a direction away from the main channel base, and the metal of the said shorter leg being folded outwardly of the channel in the direction back toward the bottom of the main channel base to form a shorter leg channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said shorter leg, the shorter leg channel opening in the said direction towards the main channel base.

**7.** A frame structure comprising a square or rectangular shaped open framework formed by connecting together at their ends four structural members all of the same relatively flat-bottom U-cross-section constituting a U-section main channel having one leg of the section longer than the other, the said longer leg being provided at the inner face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said longer leg, the longer leg channel opening in a direction away from the main channel base, and the said shorter leg being provided at the outer face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said shorter leg, the shorter leg channel opening in a direction towards the main channel base, the said shorter leg channels of all of the said structural members opening in the same direction.

**8.** A frame structure as claimed in claim **7**, and comprising also a square or rectangular cross-section trunk member formed from sheet material and having the edges of the side-members thereof at one of its ends engaged respectively in the four shorter leg channels of the said four structural members.

**9.** A frame structure as claimed in claim **7**, and comprising also two more of the said structural members of the same cross-section as the four first-mentioned structural members, the additional members being disposed back to back and extending between two parallel ones of the four first-mentioned structural members to provide a frame structure having two apertures therein, each of the said apertures being of square or rectangular cross-section and each being constituted by four of the said structural members having the said shorter leg channels facing in the same direction.

**10.** A frame structure as claimed in claim **9**, and comprising also two trunk members, each of square or rectangular cross-section, formed from sheet material and each having the edges of the side members thereof at one of its ends engaged respectively in the four shorter leg channels of the four structural members constituting the respective aperture.

**11.** A cabinet comprising a square or rectangular shaped top frame, a similar shaped bottom frame, and four corner posts between the top and bottom frames, the top and bottom frames each being formed by connecting together at their ends four structural members all of the same cross-section, the four structural members of the top frame and the four corner posts all being of the same relatively flat bottom U-cross-section constituting a U-section main channel having one leg of the section longer than the other, the said longer leg being provided at the inner face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said longer leg, the longer leg channel opening in a direction away from the main channel base, and the said shorter leg being provided at the outer face thereof with a channel adapted to receive therein the edge of a sheet member having its general plane at least approximately parallel to the general plane of the said shorter leg, the shorter leg channel opening in a direction towards the main channel base, said shorter leg channels of the four members of the top frame all opening in the same direction, each associated pair of corner posts having their longer leg channels with their open ends facing each other, and the said bottom frame being formed of members of cross-section constituted by the longer leg and the base of the main channel of the above described structural members constituting the top frame and side posts, the said bottom frame members all having their channels opening toward the top frame, and the cabinet comprising two side panels each having two opposite edges engaged in two longer leg channels of the respective two corner posts and two other edges engaged in longer leg channels of the top and bottom frames, and two other side panels each having at least two edges engaged in two shorter side channels of the respective two corner posts.

**12.** A cabinet as claimed in claim **11**, wherein each of the corner posts has the said longer and shorter leg channels removed at its ends to enable the said ends to engage within the channels of the associated top and bottom frames.

13. A cabinet as claimed in claim 11, and comprising also two more of the said structural members of the same cross-section as the members of the top frame, the additional members being disposed with their longer leg channels adjacent and opening inwardly of the cabinet and extending between two parallel ones of members of the top frame to provide a top frame having two apertures therein, each of the said apertures being of square or rectangular cross-section and each being constituted by four of the said structural members having the said shorter leg channels facing in the same direction.

14. A cabinet as claimed in claim 13, and comprising three members of the same cross-section as the bottom frame members and mounted in the interior of the cabinet with their longer leg channels facing toward each other, the cabinet also comprising a sheet member dividing the cabinet interior into two compartments, having three of its edges engaged but not fully inserted in the longer leg channels of the said members, and its fourth edge engaged but not fully inserted in the longer leg channel of one of the said additional members of the top frame.

15. A cabinet as claimed in claim 11, and comprising also for each aperture in the top frame a trunk member of cross-section corresponding to the shape of the aperture, each trunk member being formed from sheet metal and having the edges of the side members thereof at one of its ends engaged respectively in the four shorter leg channels of the four structural members constituting the respective aperture.



16. A cabinet as claimed in claim 13, and comprising also for each aperture in the top frame a trunk member of cross-section corresponding to the shape of the aperture, each trunk member being formed from sheet metal and having the edges of the side members thereof at one of its ends engaged respectively in the four shorter leg channels of the four structural members constituting the respective aperture.

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LOUIS G. MANCENE, *Primary Examiner.*

JAMES R. GARRETT, *Examiner.*