United States Patent

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[33] **Great Britain**
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Jan. 21, 1969, Great Britain, No. 3,272/69;
Jan. 21, 1969, Great Britain, No. 3,270/69;
Mar. 14, 1969, Great Britain, No. 13,438/69; July 23, 1969, Great Britain, No. 36,913/69; Sept. 4, 1969, Great Britain, No. 43,861/69

[54] **REFRIGERATOR CABINETS**
13 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** ..... **220/9 F,** 220/14, 220/15
[51] **Int. Cl.** **B65d 25/18**
[50] **Field of Search** ..... 220/9 F, 9 G, 10, 14, 15

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Attorney—Frank R. Trifari

ABSTRACT: A refrigerator cabinet having walls of a sandwich construction formed by an inner lining, an outer surface and an insulating body of foamed polyurethane plastic formed in situ therebetween. Channel-shaped breaker strips surround the opening of the cabinet and seal an edge of the insulation. Spacer means are arranged between the inner lining and outer surface so as to keep them spaced apart and properly located during the fabrication of the sandwich construction.

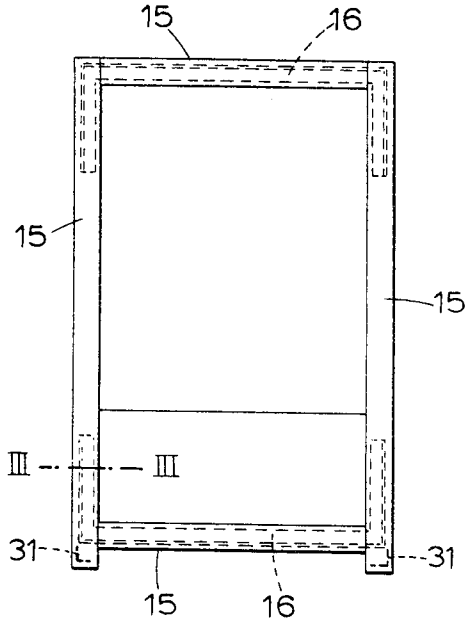

FIG. 1.

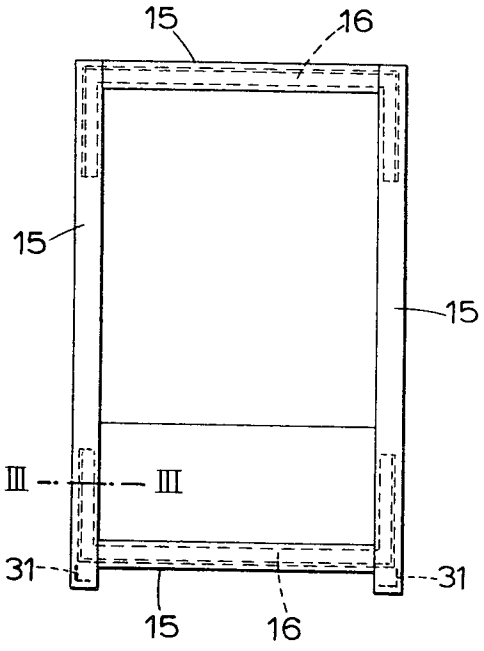

FIG. 2.

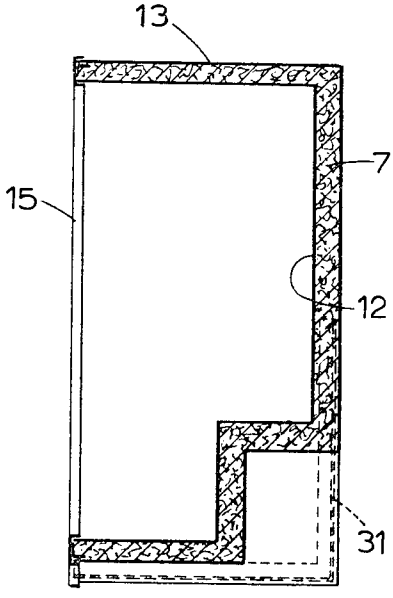

FIG. 3.

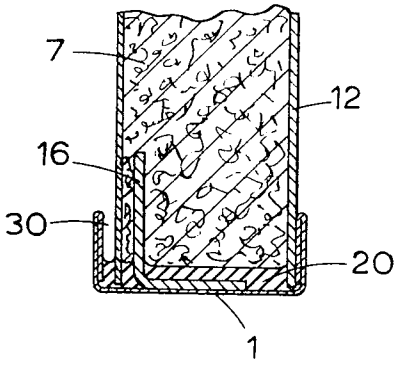

FIG. 4.

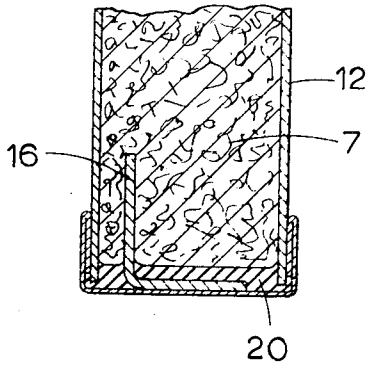

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FIG. 5.

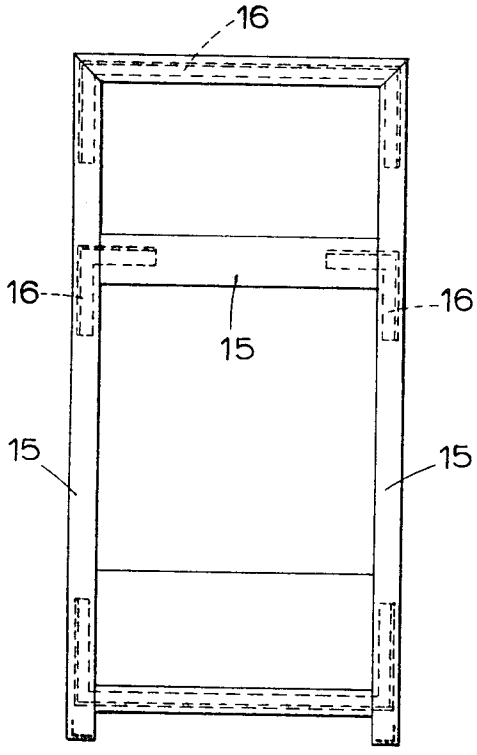

FIG. 6.

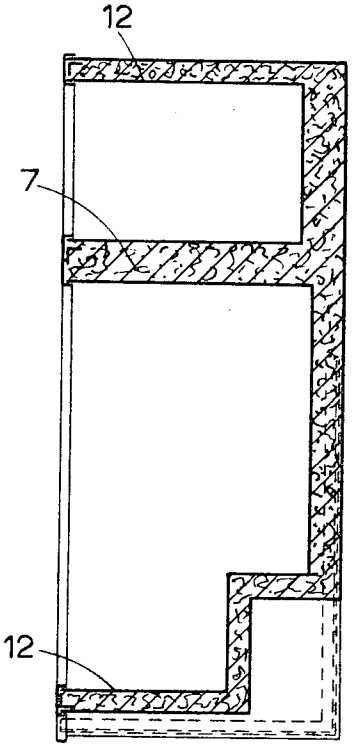

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FIG. 7.

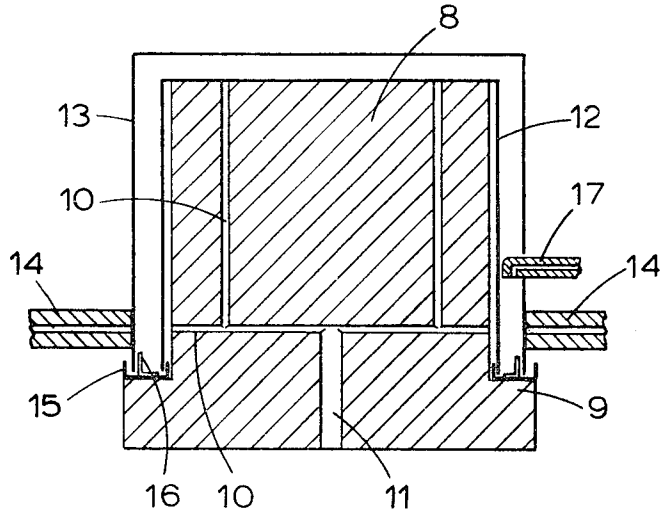


FIG. 8.

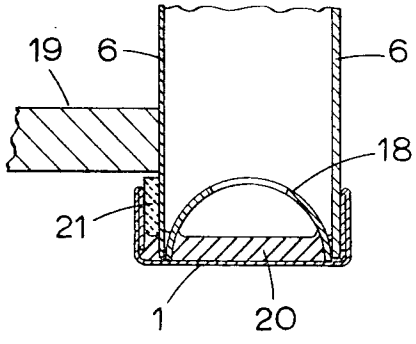


FIG. 10.

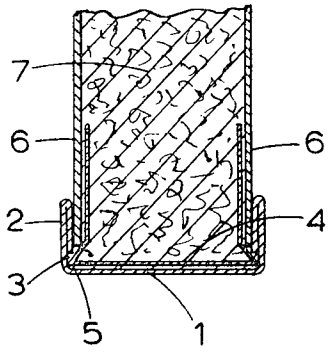
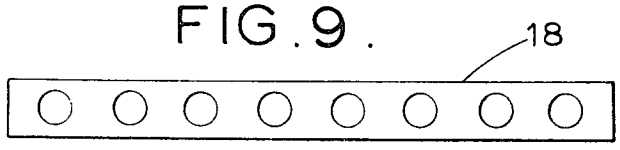


FIG. 9.



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REFRIGERATOR CABINETS

This invention relates to refrigerator cabinets. It relates specifically to a refrigerator cabinet having a sandwich construction which is insulated by a layer of foamed plastics material which is formed in situ between two surface layers. One type of plastics material that has been used for this purpose is a polyurethane foam. The surface layers on either side of the foam insulation are usually arranged to terminate on an open side of the cabinet at a place where a refrigerator door can be fitted.

Because of the very mobile nature of the liquid plastics material before the foaming takes place and the internal pressures generated during the foaming operation, it is usually also necessary for various sealing materials such as adhesive tape to be applied along all the edges of the surface layers to prevent their movement and also to prevent any serious leakage of the foam. The sealing of the edges in this way has to be carried out by hand which operation can be laborious and time consuming. If, in spite of this precaution, any leakage of liquid or foam should take place then it usually is extremely difficult or impossible to clean the edges of the cabinet after the foaming operation before the next state in the production of the refrigerator can be carried out.

I have now found a method of fastening the edges of the surface layers in a positive manner which gives a considerable improvement in their fluid-tightness and considerably reduces the need to apply additional sealing materials. There is also a reduced risk of the leakage of foam.

According to the invention, there is disclosed a refrigerator cabinet including a plastics foam insulating body which is formed in situ between inner and outer surface layers, the inner and outer layers being located prior to introduction of the foam, by locating means which also provides a seal at an edge of the layer when the foaming material is introduced. The locating means may additionally provide a fluidtight seal of the edge of the foam during operation of the refrigerator.

Preferably, the locating means comprises a locking medium which may be adhesively secured to or mechanically locked in a rigid breaker strip.

Elongated reinforcement pieces may be caused to be embedded in the foam insulating material during the foaming operation and conveniently when these reinforcement pieces are required to be positioned near to a breaker strip, they may in addition be fixed to the strip before the foaming operation by means of the locking medium. Reinforcement pieces may also be used to bridge any breaks in the continuity of the breaker strip along an edge of the cabinet.

By way of example, embodiments of the invention will be further described with reference to the accompanying drawings in which:

FIGS. 1 and 2 are front and side views respectively of one model domestic refrigerator cabinet according to the invention,

FIG. 3 is a part section on the line III—III of FIG. 1,

FIG. 4 is a cross-sectional view corresponding to FIG. 3 that might be used in a different embodiment,

FIGS. 5 and 6 are front and side views respectively of a two-compartment domestic refrigerator cabinet,

FIG. 7 is a cross-sectional view of an assembly jig for a refrigerator cabinet,

FIG. 8 is a cross-sectional view of a breaker strip with a different form of sealing means,

FIG. 9 is a resilient spacer for the breaker strip of FIG. 8,

FIG. 10 shows a cross-sectional view of a different form of locating and sealing means.

FIGS. 1 and 2 are front and side views respectively of a domestic refrigerator cabinet constructed in accordance with the invention. The refrigerator cabinet comprises an inner lining 12 made from a plastics material in the form of a thin sheet, an outer container 13 made from cardboard which was laminated with aluminum foil on its external surfaces, breaker strip sections 15, elongated steel reinforcements 16 and plastics foam insulation material 7. The plastics foam insulation material 7 was produced in situ between the inner lining

12 and the outer container 13 to form a strong and lightweight construction for the cabinet in the manner already described. Suitable locking medium which will be described later in further detail was applied to the interior of the breaker strip to provide location of the outer layers of the foamed sandwich. It was found convenient also to use this medium for attaching reinforcement pieces 16 to the breaker strip so that these would become rigidly joined thereto and eventually the remaining portions of the reinforcement pieces would become embedded in the plastics foam material which was subsequently introduced.

FIG. 3 shows a breaker strip 1 having a reinforcement piece 16 attached to it by means of the locking medium 20. The particular breaker strip section shown in FIG. 3 also included a groove 30 which was formed by use of a spacer member in a manner to be described and which was intended for receiving a finishing panel for the refrigerator cabinet if necessary. It is not of course essential to the present invention that the provision for adding finishing panels should be included. For example, if the outer container of the foam sandwich construction was likely not to be seen when the refrigerator was in service, it could be constructed of a thin and inexpensive material or of course if a more substantial construction was required it could be of steel or a material having a plastics surface. In these instances the groove 30 would not be required and the breaker strip construction with the reinforcement piece 16 in place could then be similar to that depicted in FIG. 4.

In the particular construction of refrigerator cabinet depicted in FIGS. 1 and 2, the breaker strips butt together at the four corners of the door opening of the cabinet and the inner flanges of the vertical breaker strips are cut away at the points where the vertical breaker strips join the horizontal ones. The elongated reinforcement pieces 16 are thus enabled to join together two breaker strips lying at right angles across the butt joint. When the reinforcement pieces 16 were suitably secured to the breaker strips by means of the locking medium 20, a strong joint was formed across the breaker strips and these joints and the ends of the breaker strips could be sealed with a suitable sealing compound so that there will be no tendency for leakage of the plastics foam material during the foaming operation. The reinforcement pieces 16 thus bridged the corners along the top and bottom edges of the door opening of the cabinet and these reinforcements thus provided rigidity to the cabinet and also suitable locations into which for example screws may be inserted for enabling door hinges for the cabinet to be rigidly mounted thereon.

There was also a further steel reinforcement 31 which is shown more clearly in FIG. 2 and which helped to stiffen the back corner of the refrigerator cabinet. This reinforcement acted also as a mounting bracket for enabling a plate carrying a refrigerator cooling unit to be suitably fixed and it also enabled a firm base for the refrigerator cabinet to be provided.

Alternative constructions of refrigerator cabinet are depicted in FIGS. 5 and 6 which show respectively front and side views of a two-compartment domestic refrigerator cabinet. The reinforcement pieces in this construction are arranged in a way essentially similar to that of the cabinet just described but it will be noticed that at the uppermost corners of the front of the refrigerator the breaker strips are joined to one another by a mitered joint. This kind of joint is equally suitable for construction from the breaker strips and may also be suitably strengthened by the reinforcement pieces 16. It was found in practice that the use of a reinforcement piece attached to a breaker strip by means of the locking medium already described provided a suitable and strong way of joining breaker strips and may thus be used in various different constructions of opening which would be suitable for mounting a cabinet door.

The operation of assembling the inner lining, the outer container and the breaker strips to form a suitable container for the foam insulation of the refrigerator cabinet was effected in the assembly jig depicted in FIG. 7. The assembly jig comprised a plug 8 which had a shape similar to that of the interior

of an inner lining of the required cabinet and this was mounted on a platform **9** which surrounded the plug. The plug **8** included vacuum passages **10** which opened onto interior faces of the plug walls and these were connected through a vacuum line **11** to a suitable vacuum pump. When an inner lining for a refrigerator cabinet was placed over the plug **8**, the application of vacuum to the faces of the plug ensured that the inner lining was drawn closely against the plug so that an accurate formed inner wall to the refrigerator cabinet would be produced during the foaming operation. Similarly, when an outer container **13** was placed over the inner lining **12** on the assembly jig, portions of the outer container **13** could be pulled outwards against a vacuum member **14** so that the correct shape of the outer container would also be maintained during a period sufficient to permit the locking medium to be inserted and become effective.

In the production of a refrigerator cabinet having a foamed sandwich construction on this jig, first an arrangement of breaker strips **15** defining a suitable opening for a door of the refrigerator was assembled on the platform **9** in the manner already described. An inner lining **12** for the refrigerator cabinet was then fitted over the plug **8** and the edges of the inner lining were suitably located within the breaker strips **15**. An outer container **13** for the required refrigerator cabinet was then placed over the inner lining previously positioned on the plug **8** and the edges of the outer container were similarly located within the breaker strips **15**. When vacuum was applied to the vacuum line **11** and the vacuum member **14**, the inner lining and outer container of the cabinet were drawn into the correct positions to provide suitably accurate dimensions for the cabinet to be produced. A predetermined quantity of a liquid polyurethane resin to constitute the locking medium was then injected by means of a nozzle **17** through a hole formed in the outer container **13** and during the injection operation the nozzle was tilted about its axis to distribute the resin along the length of the breaker strip in the cavity between the inner lining and outer container. There were rubber plugs (not shown) on the assembly jig to prevent the liquid resin flowing out at any open ends of the breaker strips. Additional quantities of the resin were then injected similarly along the further lengths of breaker strip. The resin quickly solidified to form a hard body which was locked within the breaker strip and effectively sealed the edges of the inner lining and outer container.

The assembly formed in this way was then transferred to a suitable foaming jig and plastics material for forming the foam was poured into a filling hole in the outer container at the top of the foaming jig. Immediately after the filling operation, the plastics material started to foam in situ between the inner lining and outer container and this space was very quickly filled with a dense volume of foam which adhered to the inner lining, the outer container and the locking medium in the breaker strips **15** and on hardening it formed a rigid foam sandwich. After solidification of the foam had eventually occurred, the filling hole was sealed over with a portion of adhesive tape to protect the foam structure within the sandwich against the entry of moisture. The hardened foam body was removed from the foaming jig and then formed a rigid and lightweight cabinet construction including a breaker strip surrounding a door opening, to enable the further stages in the assembly of the refrigerator to be effected.

FIG. **8** depicts a breaker strip **1** in a cross-sectional view showing a different form of sealing means for the layers **6** of a foam sandwich which is to be produced and this sealing means can avoid the need to have the locking medium along the whole length of the breaker strips. This Figure also shows a different means for locating the layers which can avoid the need for vacuum to be applied to an assembly jig. In this Figure, the two layers **6** of the foam sandwich which is to be produced are held apart at their lower edges which lie within the confines of the breaker strip **1** by means of a resilient spacer **18** formed of a strip of plastics material, in this case a length of PVC sheet which is perforated along its length. The resilient spacer **18** acted to press the lower edges of the layer **6** against the side flanges of the breaker strip when the spacer had been inserted and the spring pressure exerted by the spacer was generally sufficient to prevent leakage of plastics foam material during the foaming operation. When assembled in a jig therefore, the spacer **18** both sealed and pressed the layers **6** outwards so that for example the left-hand layer **6** will be pressed against a locating member **19** of the assembly jig to ensure that the outer layers will be held in their correct positions during the foaming operation to enable an accurately dimensioned refrigerator cabinet to be constructed. FIG. **8** thus shows means for locating the layers **6** of the foam sandwich which is an alternative to the method already described and can have advantages since it at least partially avoid the need to use a locking medium in the breaker strip.

The locking medium **20** may for example be a component of the synthetic resin compound which is to form the plastics foam of the sandwich and thus might be a liquid polyurethane resin which is subsequently curved. Alternatively the locking medium **20** could be a layer of liquid bitumen which also would solidify and then hold the layers **6** in their required locations during the foaming operation. It is not essential that the locking medium **20** should actually adhere to the inner surface of the breaker strip **1** since once the layers **6** have become locked in the medium **20**, the portions of the medium which are within the gaps **3** on the breaker strip will provide a dovetailing action which will effectively hold the medium **20** and the layers **6** of the sandwich to the breaker strip.

If it is intended to construct a refrigerator cabinet having provision for inserting decorative or finishing panels along the walls of the cabinet then it may be required to provide an additional groove along the length of the breaker strip for receiving an edge of the separate finishing panel. This groove may be provided by inserting a spacer member **21** just inside the side flange **2** of the breaker strip so that the outer layer **6** will still be supported but will be held a short distance away from the inner wall of the side flange **2**. After the foaming operation has been carried out, the spacer member **21** can be removed from the breaker strip and this then will have been provided with a groove along its length which will be suitable for receiving an edge of a finishing panel of this should be required to be fitted to the refrigerator cabinet.

The use of the resilient spacer **18** thus partially overcomes the need to apply the locking medium **20** along the whole length of the breaker strip, but of course the locking medium **20** might still be needed at intervals to maintain proper location of the parts.

FIG. **9** shows a portion of the resilient spacer **18** in greater detail. The holes along the length of the spacer **18** are for the purpose of allowing a free expansion of the plastics foam material during the foaming process and of ensuring that the foam material penetrates throughout the whole volume of the space between the layers **6**.

FIG. **10** shows a cross-sectional view illustrating an alternative means for locating the inner and outer layers with respect to the breaker strip which avoids the need to use a locking medium. The breaker strip **1** comprised a rigid channel of sheet steel covered with a thin outer film of polyvinyl chloride plastics material which had been laminated to the steel before this was formed into the channel section. The breaker strip **1** had two side flanges **2**, the tops of the flanges being bent over and folded back on themselves so that there was a double thickness of steel in the flange except for a small gap **3** at the bottom of the flange. A flexible channel section **4** was then formed in a separate operation from a rigid polyvinyl chloride sheet material which was fairly flexible when in the form of a thin sheet. The channel **4** was roughly of U-shaped form with flexible sidewalls but had projections **5** which were directed outwards from a base of the channel **4**. The flexible channel **4** was so dimensioned that it would fit within the breaker strip **1** and be clipped firmly therein by reason of the springy nature of the channel **4** when the projections **5** on this channel were suitably located within the gaps **3** of the breaker strip **1**. When

a length of the flexible channel 4 was fitted in this way within the breaker strip 1 it became quite firmly secured to the breaker strip since the projections 5 could not easily be pulled past the thicker upper portions of the side flanges. Portions of thin sheet material forming the edges of the inner lining and outer container of a refrigerator cabinet of sandwich construction were now inserted between the walls of the flexible channel 4 and the breaker strip 1 on each side of the breaker strip. The layer 6 was thus supported against the rigid side flanges 2 of the breaker strip and a wall of the flexible channel 4 then lay parallel to and in close contact with the layer. This layer 6 constituted perhaps the inner lining of the cabinet and a further layer 6 was then fitted similarly in place to form the outer container of the cabinet. When a suitable foaming plastics material was admitted to the space between the layers 6, a plastics foam was formed which filled the space between the layers 6 and solidified to form a firm sandwich construction. The pressure developed by the foaming process tended during this stage to push the layers 6 against the side flanges 2 of the breaker strip 1. The pressure of foaming also tended to cause the foam to creep round the walls of the flexible channel 4 in an attempt to pass below the bottom edges of the layers 6. The flexibility of the walls of channel 4 however caused the walls to become squeezed against the inner sides of the layers 6 so that a sealing action occurred which prevented any significant flow of the plastics foam material out of the sandwich construction. When the plastics foam material set to a solid foam body 7, this filled the whole space between the layers 6 forming a rigid foam sandwich. The inner portions of the flexible channel 4 including the projections 5 also became completely filled with the solid foam so that the flexible channel 4 was now locked firmly within the breaker strip 1. The adhesive properties of the foam also ensured that the outer layers 6 and the walls of the flexible channel 4 were firmly attached to the foam so that breaker strip and the resulting foam sandwich were now firmly secured together to form a particularly rigid and lightweight structure.

The foregoing descriptions of embodiments of the invention have been given by way of example only and a number of modifications may be made without departing from the scope of the invention. For instance, it is not essential that the breaker strip is made of a plastics-coated steel sheet and in suitable circumstances this might be formed from an extrusion of a plastics material such as polyvinyl chloride. In this instance the extrusion might be made to include an insert of paramagnetic material if it was required that a refrigerator cabinet door incorporating a magnetic door gasket was subsequently to be fitted to the cabinet. The layer of locking medium which is inserted into the channel of the breaker strip to provide location of the outer layers of the foam sandwich may be selected from a number of suitable materials including bitumen, polyurethane resin, polyester resin, epoxy resin or other plastics material which can be applied as a liquid and will set or cure to form a solid material. One characteristic required in this solid material is that it should have a compressive strength which is greater than that of the foam plastics material comprising the cabinet insulation.

What is claimed is:

1. A refrigerator cabinet comprising an inner lining, an outer surface, and an insulating body of foamed plastic material formed in situ between the inner lining and outer surface thereby forming a sandwich construction having the shape of an open container, a breaker strip arranged along the edges of the sandwich construction about the opening so as to provide a means for properly aligning and locating the inner lining and outer surface during fabricating of the sandwich construction and so as to provide a seal at the edge of the foam during its introduction to the sandwich construction and a fluidtight seal at the edge of the foam when the cabinet is in use as a refrigerator, said inner lining and outer surface being secured in the breaker strip by a locking medium prior to the introduction of foam.

2. The refrigerator cabinet according to claim 1 further comprising a resilient spacer strip arranged between the inner lining and outer surface when placed in the breaker strip so as to space the inner lining and outer surface apart before the locking medium is introduced.

3. The refrigerator cabinet according to claim 2 wherein said locking medium is a synthetic resin compound.

4. The refrigerator cabinet according to claim 3 wherein the synthetic resin compound is one of the components of the plastic foam to be introduced as the insulating body between the inner lining and outer surface.

5. The refrigerator cabinet according to claim 2 further comprising means attached to said breaker strip for supporting an outer finishing panel to be mounted on the outer surface.

6. The refrigerator cabinet according to claim 1 further comprising a channel-shaped member having flexible sidewalls supported within said breaker strip so as to provide means for spacing and supporting therein the inner lining and outer surface.

7. The refrigerator cabinet according to claim 6 wherein said channel-shaped member is secured to said breaker strip.

8. The refrigerator cabinet according to claim 7 wherein said channel-shaped member is mechanically secured to the breaker strip.

9. The refrigerator cabinet according to claim 1 further comprising a reinforcement member located along the edge of said sandwich construction and at least partially embedded within said foam.

10. The refrigerator cabinet according to claim 9 wherein said reinforcement member is secured to said breaker strip.

11. The refrigerator cabinet according to claim 10 wherein said reinforcement member is secured to said breaker strip by a locking medium formed of a synthetic resin compound introduced between the inner lining and outer surface prior to the introduction of foam during the fabrication of the sandwich construction.

12. The refrigerator cabinet according to claim 11 wherein said reinforcement member is arranged so as to bridge any breaks in the continuity of said breaker strip along the edge of the sandwich construction.

13. The refrigerator cabinet according to claim 12 wherein said reinforcement member is a metal strip of L-shaped cross section.

* * * * *