May 17, 1960 R. E. GOULD 2,936,598

REFRIGERATING APPARATUS

Filed June 14, 1957 2 Sheets-Sheet 1

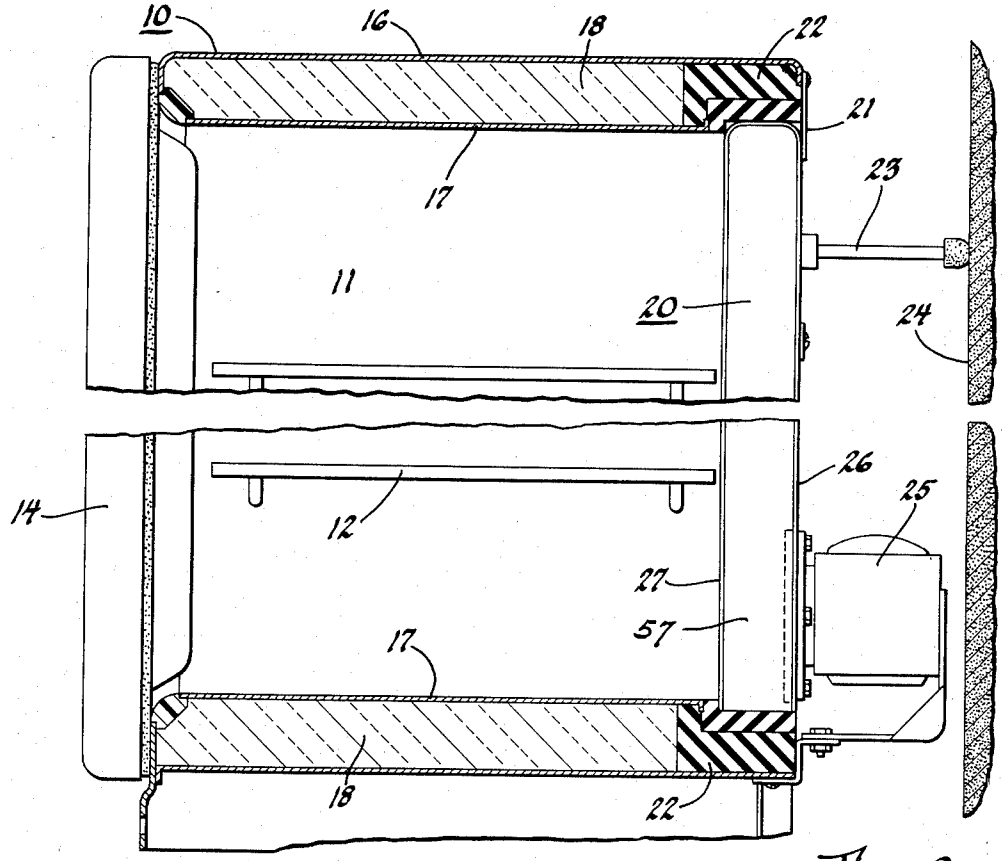


Fig. 2

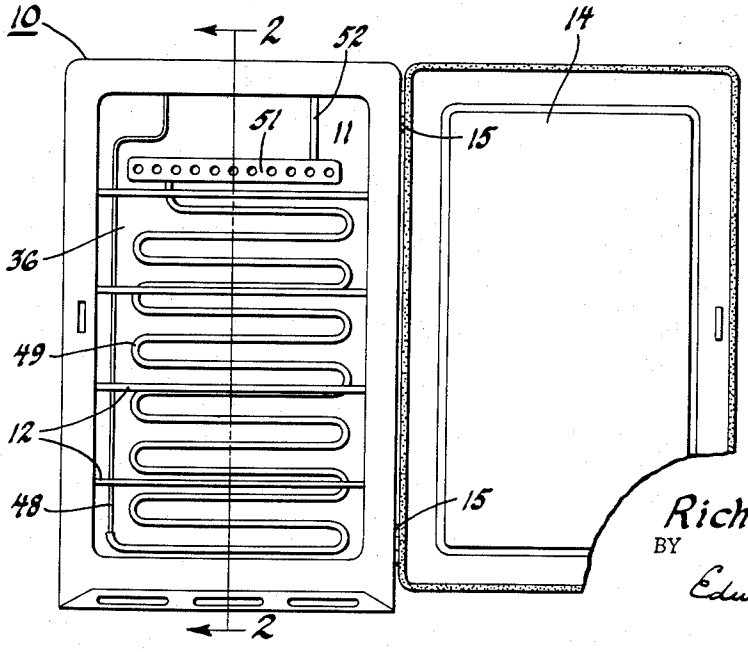


Fig. 1

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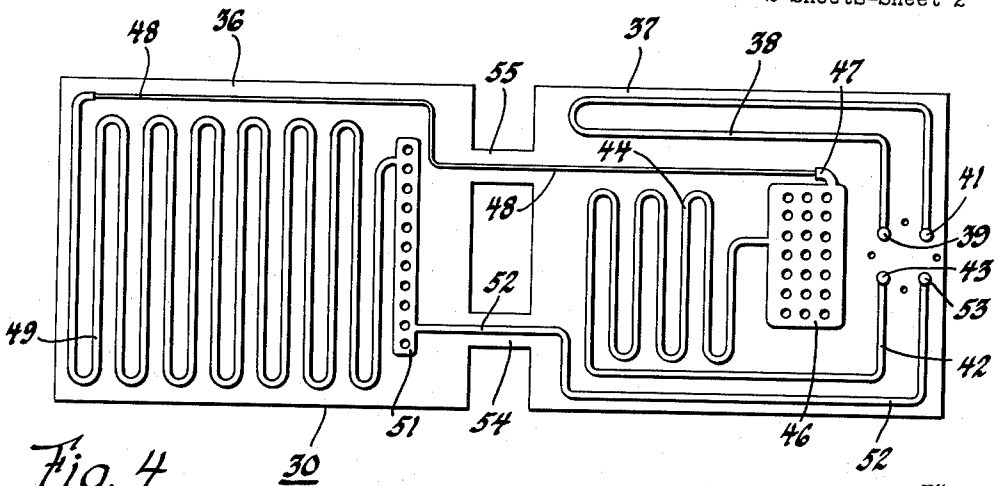


Fig. 4

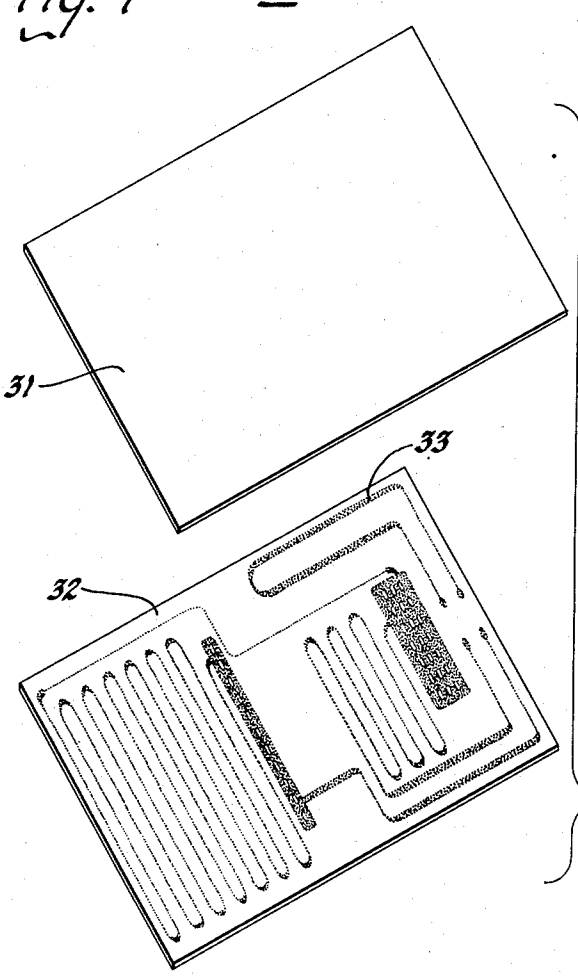


Fig. 3

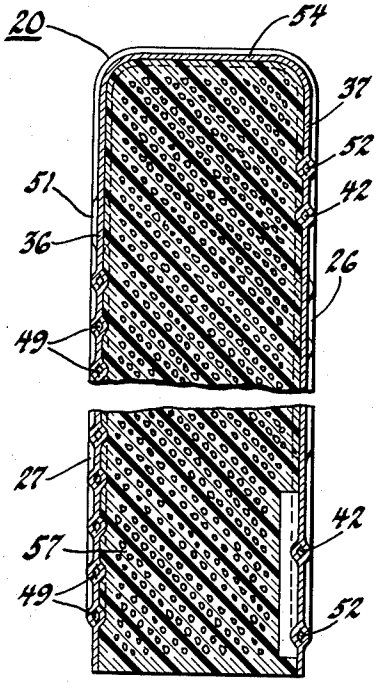


Fig. 5

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REFRIGERATING APPARATUS

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Application June 14, 1957, Serial No. 665,730

4 Claims. (Cl. 62—298)

This invention relates to refrigeration and particularly to a refrigerating apparatus wherein a complete refrigerating system is removable as a unit from a refrigerator cabinet.

The advent of roll pressure bonded or welded sheet metal heat exchangers for refrigerating systems renders it convenient to form a refrigerant condenser and a refrigerant evaporator as a unitary or one-piece plate member and to removably associate such a member with a refrigerator cabinet. Others have provided several versions of this idea and I propose an improvement in the art pertaining thereto which simplifies construction, reduces manufacturing costs and renders the removable unit compact and easy to handle.

An object of my invention is to provide a simple, novel refrigerator construction wherein a complete closed refrigerating system may be installed and removed therefrom as a unit without requiring disconnecting of pipes or conduits.

Another object of my invention is to construct a closed refrigerating system in the form of a unitary insulated plug or slab-like structure or portion which when removably installed in a wall opening of a refrigerator cabinet provides an insulated wall part of the cabinet with opposite flat surfaces of the plug-like structure serving as an evaporator element for cooling air interiorly of a food storage compartment in the refrigerator cabinet and a condensing element ambient the cabinet for cooling refrigerant in the refrigerating system.

A further object of my invention is to provide for the removable installation of a complete closed refrigerating system with a refrigerator cabinet wherein the installation is such as to render substantially the entire height of the cabinet usable for the storage of food therein.

In carrying out the foregoing objects it is a still further and more specific object of my invention to provide a refrigerator cabinet with a removable unitary self-sustaining insulated slab-like portion refrigerating system wherein a plate evaporator and a plate condenser of the system are interfacially bonded directly to opposite sides of the slab by substantially rigid synthetic resin insulating material between the plate elements.

Further objects and advantages of the present invention will be aparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a front view of a refrigerator cabinet having my invention embodied therein and showing the cabinet door open;

Figure 2 is an enlarged broken fragmentary vertical sectional view through the refrigerator cabinet disclosed in Figure 1 and is taken on the line 2—2 thereof;

Figure 3 is a perspective view showing metal sheets used in the manufacture of a pressure welded one-piece plate member of the present invention with a pattern of stop weld material on one of the sheets;

Figure 4 is a plan view of the present pressure welded plate member after passages have been formed therein and showing the member trimmed and ready to be bent for the purpose of my invention; and

Figure 5 is an enlarged broken sectional view of a slab-like portion or structure showing insulating material bonded to opposed interfacial parts of the bent one-piece member of the present invention.

Referring to the drawings, I show in Figure 1 thereof a refrigerating apparatus including a refrigerator cabinet 10 having a plurality of insulated walls forming a food storage compartment 11 in the cabinet. Compartment 11 extends substantially entirely from the bottom to the top of cabinet 10 and has a plurality of vertically spaced apart food supporting shelves 12 mounted therein in any suitable or conventional manner. A front access opening for compartment 11 is normally closed by an insulated door structure 14 pivotally mounted, by hinges 15, upon cabinet 10 for horizontal swinging movement relative thereto. The top, bottom and side walls of cabinet 10 are formed by an outer metal shell 16 and an inner metal liner 17 having any suitable or desirable insulating material 18 disposed therebetween (see Figure 2). Liner 17 may be supported in cabinet 10 in any suitable maner as is now conventional in the art. Food compartment 11 is also provided with an aperture or opening at its back which is normally closed by a removable plug member or slab-like insulated wall structure, generally represented by the reference numeral 20, constructed in accordance with my invention and to be hereinafter more fully described. The plug member or slab-like wall portion 20 of cabinet 10 is removably secured thereto by clamps or the like 21 and is mounted in a composite rubber-like frame 22 forming a part of walls of the cabinet. The surface of frame 22 adjacent peripheries of plug or slab 20 and engaged or abutted thereby are preferably soft or semi-soft and resilient, while other portions thereof are rigid for structural strength, so that when the plug or slab is assembled to cabinet 10 the rear opening in food compartment 11 will be sealed. A suitable spacer 23 secured to the back of cabinet 10 spaces the plug or slab structure 20 and consequently the cabinet from a room wall 24 so as to provide a flue at the back of the refrigerator for upward circulation of air over the outer face of member 20 (see Figure 2). The air may flow rearwardly across the bottom of cabinet 10 and thence upwardly through the flue.

The refrigerating system associated with cabinet 10 in the present disclosure comprises the removable slab-like wall portion or unitary structure 20 including a sealed casing 25 containing a motor and a compressor driven thereby (not shown), a condenser 26 and an evaporator 27 formed in a one-piece roll pressure welded plate member 30 (see Figure 4) as will be presently described. In addition to supporting casing 25 from the condenser portion of the refrigerating system this casing may, if desired, be further supported from cabinet 10 by suitable brackets or the like when the refrigerating system is associated with the cabinet. In order to provide a plurality of refrigerant passages in member 30 this member is manufactured in accordance with methods illustrated and described in the George R. Long Patent #2,662,273 and in the Clifford H. Wurtz Patent #2,712,-736. Thus in Figure 3 of the attached drawings a pair of aluminum alloy sheets or plates 31 and 32 are shown with a predetermined design of stop weld material 33 applied to or coated on one of the metal plates. This stop weld material may consist of a liquid suspension of collodial graphite, ground oyster shells and sodium silicate. The two plates 31 and 32 are superimposed one upon the other and passed between a pair of heated pressure rollers to apply a roll fusion operation thereto for bonding or welding the plates to one another as is fully described in the Long patent just referred to. The

thickness of the sheets or plates is reduced and they are welded together along contacting surfaces thereof at all points except where the plates have been precoated with the stop weld material 33 to provide the composite homogeneous member 30 (see Figure 4). The fusion or pressure welding operation greatly elongates the plates 31 and 32 but does not materially widen them so the pattern of the stop weld material 33 applied to the one plate must be foreshortened accordingly as shown in Figure 3. After this operation has been completed the composite flat plate member 30 is placed between two blocks or heavy plates having flat surfaces throughout most of their working faces. The internal unbonded portions in plate member 30, formed by the pattern of the stop weld material 33, are dilated while being located between the heavy blocks or plates to provide passages within a first portion 36 and a second portion 37 of the plate member. This dilation can be carried out in accordance with the disclosure and description contained in the James W. Jacobs et al. Patent #2,779,168, dated January 29, 1957, so as to form refrigerant passages of different internal diameter to provide various elements of the refrigerating system in the one-piece plate member 30. By reference to Figure 4 of the drawings it will be noted that a passage 38 extends from and returns to circular enlargements 39 and 41 along the second portion 37 of member 30 and provides same with a super heat removing duct therein. A passage 42 extends from a circular enlargement 43 along portion 37 of member 30 and connects with a tortuous refrigerant condenser duct means 44. The condenser duct means 44 connects with a refrigerant receiver manifold 46 having a short outlet passage 47 extending therefrom. The fine or narrow line of stop weld material 33 (see Figure 3) provides a passage or refrigerant flow restrictor 48 of smaller diameter or capillary size as compared to all other passages in the member 30 and this restrictor passage 48 extends from passage 47 in portion 37 of the plate member over into the first portion 36 thereof and connects with an inlet end of a tortuous passage 49 which provides a refrigerant expansion duct means or evaporator for the refrigerating system. The outlet end of duct means or passage 49 communicates with an accumulator 51 having a passage 52 leading therefrom, extending across second portion 37 of member 30 and connected to a circular enlargement 53. Portions of the plate member 30 are cut out or trimmed (see Figure 4) to provide web means or two webs 54 and 55 between the first and second portions 36 and 37 of the flat roll pressure welded member. The capillary passage 48 extends through web 55 and the gaseous refrigerant passage 52 extends through web 54.

In order to provide the insulated plug or slab-like wall structure portion 20 for closing the opening in the back of compartment or chamber 11 of cabinet 10 and to incorporate a closed refrigerating system in or on the wall 20 I bend flat plate member 30 along two lines intermediate ends thereof. For example the webs 54 and 55 of member 30 are bent on a line extended across portion 37 of the member substantially at the one side edge of the trimmed away parts of this member and on another line extended across the first portion 36 of member 30 substantially at the other side edge of the trimmed away parts thereof. This spaces the portions 36 and 37 of member 30 apart in parallel relationship and positions the portions 36 and 37 so that they are substantially coextensive with one another. The condenser 26, formed by the passage 44, of the refrigerating system is disposed along the one side of slab-like structure 20 and the evaporator 27, formed by the tortuous passage 49, is disposed on the other side thereof (see Figure 5). After a side of the circular enlargements 39, 41, 43 and 53 have been drilled out so as to permit communication of inner portions of the motor-compressor casing 25 with passages in member 30 and mounting of this casing thereon in the manner disclosed and fully described in the Jacobs et al. patent hereinbefore referred to, insulating material 57 is placed between the substantially parallel first and second portions 36 and 37 of the bent metal member. This substantially isolates the portions 36 and 37 or the evaporator 27 and condenser 26 from one another. Insulating material 57 is preferably of a foam type insulation bonded to opposed interfacial surfaces of portions 36 and 37 of member 30. In other words, the plate-like evaporator 27 and the plate-like condenser 26 of the insulated slab or wall portion is interfacially bonded directly to opposite sides of slab structure 20 by the insulating material 57 therebetween. The insulation 57 is formed in one piece by any suitable material such as polystyrene which is rigid or semi-rigid and provided by foaming the polystyrene whereby an impervious layer or shell, depicted by the cross section thereof in the drawings, surrounds the foamed inner mass of insulation. This layer or shell is of a suitable synthetic resin wherein it bonds to the foamed polystyrene and to member 30 of slab structure 20 to provide a unitary construction. A suitable adhesive material may be coated on the opposed interfacial surfaces of the first and second flat portions of member 30 if necessary to cause bonding of the layer or shell of synthetic resin thereto. While the foamed insulation 57 may be a polystyrene modified resin foam it is preferably of a polyisocyanate modified resin foam such as a reaction product of an alkyd resin and a polyisocyanate. Other synthetic resin-type foams well known in the art and having the desirable rigidity, insulating and bonding properties may be used to provide the self-sustaining cabinet wall portion. The unitary slab or plug structure 20 with the casing 25 secured thereto may be assembled onto or associated with the refrigerator cabinet 10 as hereinbefore described whereby to provide same with a removable unitary closed refrigerating system including an evaporator exposed to the interior of food storage chamber or compartment 11 for cooling same and a condenser on the outside of the cabinet.

The sealed casing 25 may be provided with passageways and port openings to accommodate elements of a motor-compressor unit of the type shown in the Francis I. Rataiczak Patent #2,420,442, dated May 13, 1947. In this type of unit the compressed refrigerant is first directed out of the casing 25 into the super heat removing or precooling duct 38 in the present member 30 and is then returned to the interior upper portion of casing 25. The refrigerant is again directed out of casing 25 into the refrigerant condenser duct 44 where it is cooled and liquefied and collects in receiver 46. Liquid refrigerant flows under the control of capillary restrictor duct 48, through the web 55 of member 30, into the refrigerant expansion duct means or passage 49, exposed to the interior of chamber 11 of cabinet 10, whereby it absorbs heat and vaporizes. The heat absorbed by the refrigerant in evaporator 49 is removed from foods and air in chamber 11 of cabinet 10 so as to cool the interior of this chamber. Vaporous or gaseous refrigerant leaving the duct means 49 is conducted back into the casing 25 by way of return duct 52.

By incorporating elements of a refrigerating system in a one-piece metal member and clamping a sealed motor-compressor casing directly to this member I eliminate the use of separate conduits or pipes ordinarily extended between various spaced apart elements of a refrigerating system. Furthermore by making the refrigerating system as an integral part of a substantially flat insulated wall slab or plug, forming a removable self-sustaining wall portion of a refrigerator cabinet, elements of the system do not occupy valuable food storage space within the compartment of a refrigerator cabinet. I provide a unitary refrigerating system structure wherein substantially parallelly extending heat absorbing and heat dissipating plate elements thereof are located within a

food storage compartment of a refrigerator cabinet and at the exterior thereof respectively and are effectively insulated from one another. The arrangement herein disclosed provides a compact low-cost refrigerating system for a refrigerator cabinet which is bodily removable therefrom.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In combination, a refrigerator cabinet provided with insulated walls forming a food storage compartment therein having an opening, means for closing said opening, said means comprising a one-piece pressure welded plate member of a refrigerating system having passages formed therein and being bent into substantially a U-shape intermediate end thereof to provide spaced apart coextensive parallel first and second leg portions, insulating material between and interfacially bonded to said portions of said member whereby to provide a unitary insulated slab-like wall structure, said wall structure being removably secured to said cabinet at the opening in said compartment, the passages in said first portion of said member forming refrigerant expansion duct means on one side of said wall structure directly exposed to air in said compartment and providing an evaporator for cooling the interior thereof, the passages in said second portion of said member forming refrigerant condensing duct means on the other side of said wall structure exposed to air ambient said refrigerator cabinet, said refrigerant condensing duct means being connected with said refrigerant expansion duct means by a passage in the bight part of said pressure welded member, and the bonding of said insulating material to said leg portions of said U-shaped member trying them together and serving without the aid of additional means to prevent separation thereof from one another.

2. In combination, a refrigerator cabinet provided with insulated walls forming a food storage compartment therein having an opening, a refrigerating means for closing said opening, said refrigerating means comprising a one-piece pressure welded plate member and a compressor, said plate member having passages formed therein and being bent into substantially a U-shape intermediate ends thereof to provide spaced apart coextensive parallel first and second leg portions, insulating material between said portions of said member and foamed therein to interfacially bond the leg portions thereof to one another whereby to provide a unitary insulated slab-like wall structure, said wall structure being removably secured to said cabinet at the opening in said compartment, the passages in said first portion of said member being directly exposed to air in said compartment and providing said refrigerating means with an evaporator for cooling the interior of said compartment, the passages in said second portion of said member providing said refrigerating means with a condenser, said condenser being connected with said evaporator by a passage in the bight portion of said

pressure welded member, said condenser, said evaporator and said compressor being connected in series flow relationship, said compressor being directly secured to said second leg portion of said U-shaped member within the horizontal plane of said wall structure, and the bond of said insulating material to said leg portions of said U-shaped member tying them together and preventing separation thereof under weight of said compressor.

3. A refrigerator including a cabinet provided with a food storage compartment having an opening therein, a refrigerating system associated with said cabinet including a slab-like structure closing the opening in said compartment, said structure comprising a double walled pressure welded plate member bent intermediate its ends into a substantially U-shape to provide spaced apart coextensive first and second parallel leg portions, a rigid foam type insulating material between and bonded to said leg portions whereby to prevent separation thereof, one of said leg portions of said plate member having refrigerant passages formed therein providing an evaporator of said refrigerating system exposed to the interior of said food compartment for cooling same, the other of said leg portions of said plate member also having refrigerant passages formed therein providing a condenser of said refrigerating system exposed to air ambient said refrigerator cabinet, and said condenser being connected with said evaporator by a passage formed in the bight part of said member.

4. A refrigerator including a cabinet provided with a food storage compartment having an opening therein, a refrigerating system associated with said cabinet including a unitary slab-like structure closing the opening in said compartment, said structure comprising opposed double walled pressure welded together metal plate members spaced apart and having substantially coextensive portions, an insulating material foamed and set between said metal plate members into a rigid layer bonded to the coextensive portions thereof to form said unitary slab-like structure, the inner metal plate member of said slab-like structure having refrigerant passages formed therein providing an evaporator of said refrigerating system exposed to the interior of said food compartment for cooling same, the outer metal plate member of said slab-like structure also having refrigerant passages formed therein providing a condenser of said refrigerating system exposed to air ambient said refrigerator cabinet, said condenser communicating with said evaporator through a passage formed in means included as a part of said unitary slab-like structure, and the bonding of said insulating material to said portions of said metal plate members tying them together and serving without the aid of additional means to prevent separation thereof from one another.

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