Dec. 29, 1936. C. G. MUNTERS 2,065,608

HEAT INSULATING CABINET

Filed Nov. 20, 1933 2 Sheets-Sheet 1

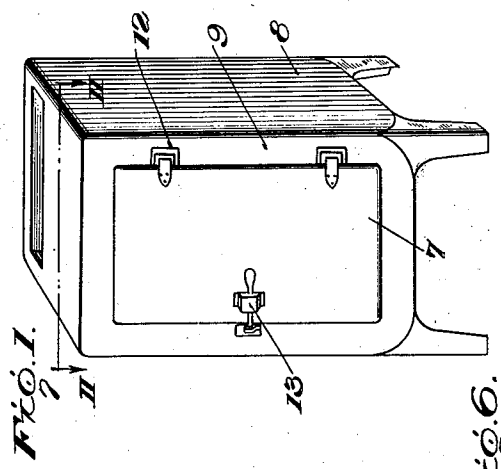

Fig. 1.

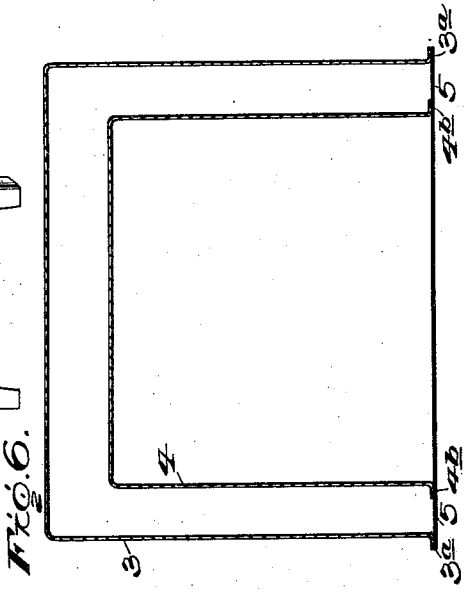

Fig. 6.

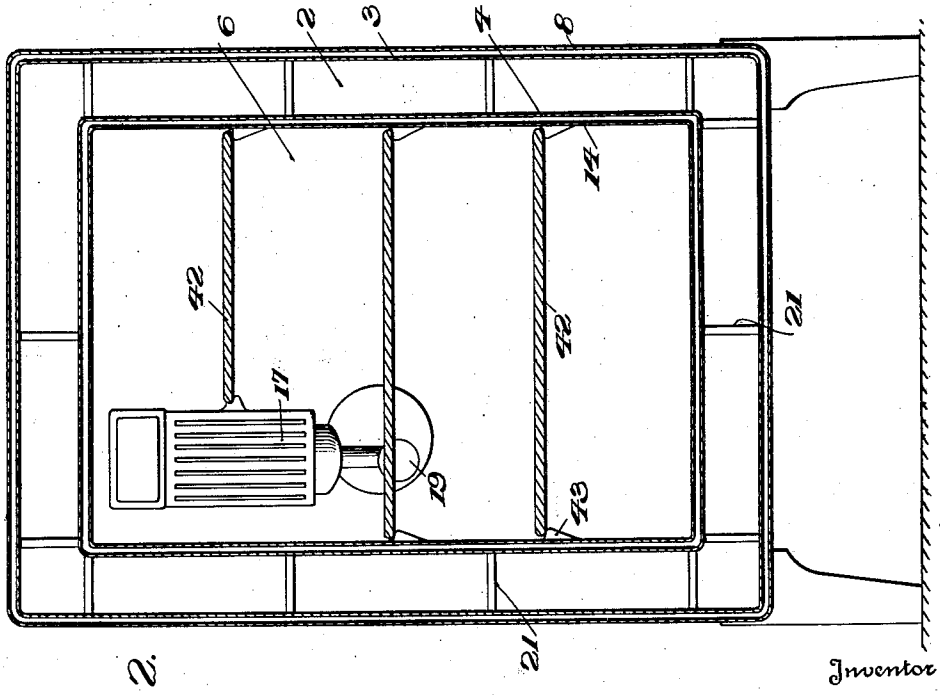

Fig. 2.

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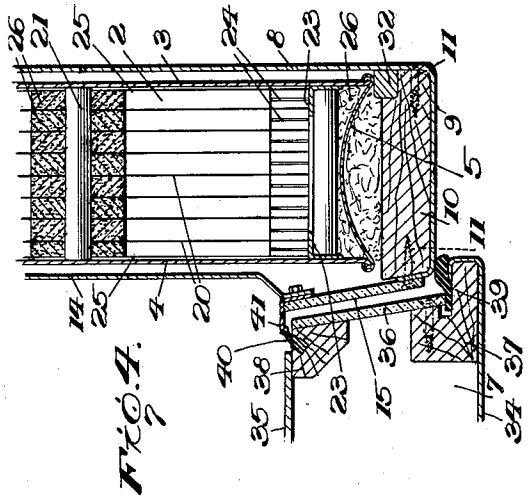

Fig. 4.

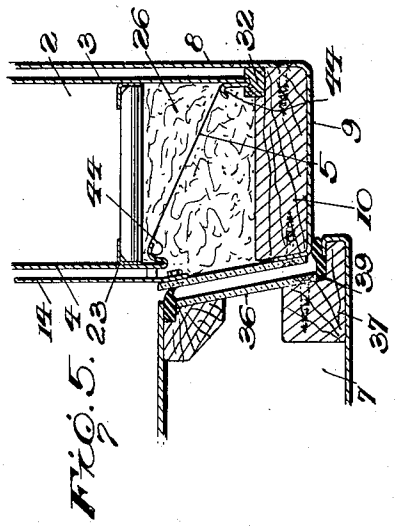

Fig. 5.

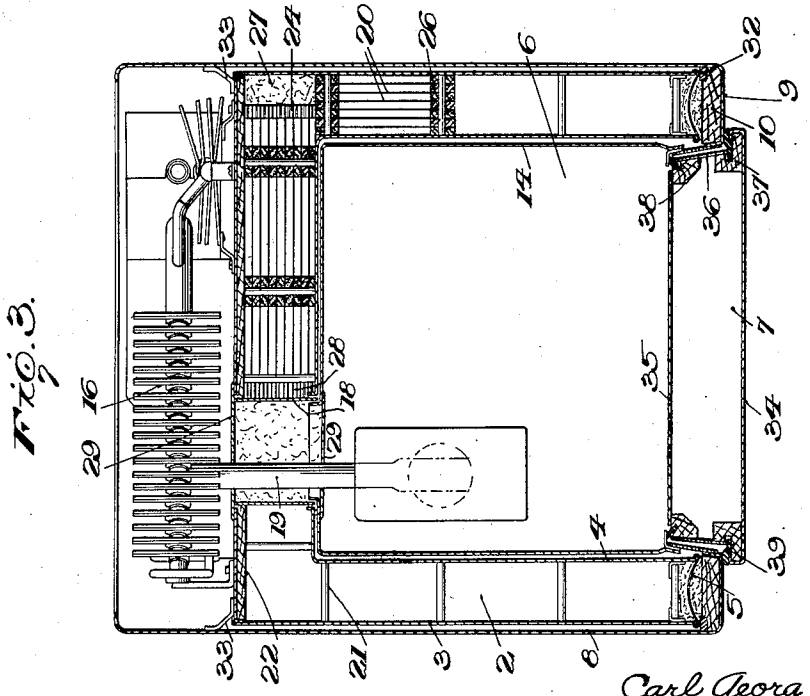

Fig. 3.

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UNITED STATES PATENT OFFICE

2,065,608

HEAT INSULATING CABINET

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Application November 20, 1933, Serial No. 698,911
In Sweden November 25, 1932

11 Claims. (Cl. 220—9)

This invention relates to cold or heat retaining cabinets of the type wherein the insulation consists of one or more closed containers within which is disposed means adapted to counteract heat transmission by convection and radiation.

It has heretofore been proposed to insulate cabinets by providing two substantially parallel-walled vessels, one disposed inside of the other and defining between the same the space which contains the means for preventing transmission of heat by radiation and convection, and to obtain the strength necessary to resist variations in pressure arising within such insulating container by making the walls of the latter curved.

It is an object of the present invention, among other things, to provide an improved heat insulation for cabinets of such type which is simple in construction, relatively inexpensive to manufacture, easy to assemble and highly efficient in operation.

Another object of this invention is to provide a device of the type set forth which enables the use of relatively thin flat plate material in the construction of the walls of the insulating container, thereby reducing the weight of the latter.

Other objects will appear as the description of the invention proceeds.

For convenience of description the invention will be discussed with particular reference to its embodiment in a refrigerator, but it is to be expressly understood that a refrigerator has been selected merely as typical of any suitable heat or cold retaining cabinet, as the invention can be employed in any construction which is designed to minimize the transfer of heat between the interior and exterior of a cabinet of whatever size.

Generally stated, a cabinet embodying the present invention is composed of two main parts, the insulating container, constructed as a special element, and the casing which provides the exterior and interior walls of the apparatus and within which walls the insulating container is disposed. Consequently the insulating container can be constructed separately from the casing and inserted into the casing in its finished condition.

As the insulating container is fully covered and protected by the casing, the container can be constructed of very thin material, a certain amount of deformation of the container walls under variations of pressure being permissible inasmuch as such deformation has no effect upon the exterior appearance of the apparatus. The outer walls of said casing may be suitably painted or otherwise provided with any other suitable cover, and these walls can be finished or covered in a manner that would not be permissible if the paint or other covering had to be applied to walls subject to deformation under variations of pressure.

Between the insulating container and the casing is disposed suitable packing which is introduced between those walls or parts which have the same, or practically the same, temperature, to the end that circulation of air between the spaces between the casing and the container which are of different temperatures is prevented, while direct heat transmission by the packing from a warm wall or part to a cold wall or part is avoided.

The present invention has the further advantage that the means for mounting the door which closes the front aperture of the apparatus, including the hinges, the lock, etc., can be disposed on the casing and not on the insulating container.

The invention is capable of receiving a variety of mechanical expressions, some of which are shown on the accompanying drawings which illustrate by way of example certain embodiments of the present invention, but it is to be expressly understood that the invention is not restricted to the illustrated embodiments, as other embodiments will readily suggest themselves to those skilled in the art in the light of the more detailed description of the invention herein made in conjunction with said drawings, and therefore reference is to be had to the appended claims for a definition of the limits of the invention.

Referring in detail to the drawings wherein the same reference characters are employed to designate corresponding parts in the several figures,

Fig. 1 is a perspective view of a refrigerating cabinet embodying the present invention;

Fig. 2 is a vertical section of the cabinet, taken parallel to the front wall thereof along the line II—II of Fig. 1, but on a larger scale;

Fig. 3 shows on the same scale a horizontal section through the cabinet and also illustrates part of foil packs in the insulating container, the remainder being omitted for the sake of clearness;

Fig. 4 is a detail of the structure of Fig. 3 on a still larger scale;

Fig. 5 shows a further embodiment which includes a somewhat modified construction of the front edge of the insulation; and

Fig. 6 is a schematic view illustrating a pre-

ferred manner of connecting the front or connecting wall of the insulating container to the lateral walls thereof.

As shown, the insulating container 2 is in the form of a hermetically closed compartment formed between an outer vessel 3 and an inner vessel 4, each of which has one side left open but the remaining five sides formed integral or integrally united in any suitable way. Inner vessel 4 is designed to be telescoped within vessel 3 as clearly illustrated by the diagrammatic section of Fig. 6, and the front edges of said vessels 3 and 4 are connected by a wall 5 which is hermetically sealed to the vessels 3 and 4 in any suitable way to complete the enclosure between said vessels 3 and 4. The preferred construction, however, is illustrated schematically in Fig. 6 wherein, as shown, vessel 3 is provided with an outwardly extending flange 3*a*, and vessel 4 is provided with an outwardly extending flange 4*b*. Wall 5 is suitably welded to said flange 3*a*, preferably by electric welding between rolling elements; and with the parts in the relationship shown in Fig. 6, wall 5 is similarly attached to flange 4*b*. Before closing said insulating container, however, the means for preventing heat transmission by radiation and convection and a charge of gas of low heat conductivity which are preferably used are introduced into the spaces between the walls of vessels 3 and 4. The insulating element thus formed is designed to surround the interior 6 of the refrigerator on all sides except at the front where a door 7 is provided.

Insulating element 2 is enclosed in a protecting casing 8, preferably formed of plate. At the front, casing 8 has a flange 9 behind which is inserted a wooden frame 10 fastened thereto in any suitable way, as by means of screws 11. This frame aids in giving the necessary strength to the casing 8, and also provides means for attaching the hinges 12 and the locking device 13 of the door 7.

In assembling, the insulating container 2 is slid into the casing 8 through its rear side, and is then suitably retained therein against displacement, as by means of angle irons 33 which may be suitably attached to the wall of the casing 8. A suitable packing 32, preferably of rubber, is interposed between the frame 10 and the forward edge of the outer wall 3, and is preferably mounted on the frame 10. The angle irons 23 holding the insulating container 2 firmly against said packing 32, and thereby circulation of the relatively warm air which fills the space between the wall of the casing 8 and the wall of the vessel 3 to the inner side of the insulating container is prevented. Additionally, as the wall of casing 8 is in direct heat transmitting relation with only the outer or relatively warm wall of said container, direct heat transmission between said casing and the inner or relatively cool wall of the insulating container is avoided. Alternatively packing strips can be provided at the front of the refrigerator between the inside wall 4 of the insulating container and the vessel 14 instead of between the outside wall 3 and the casing 8 as illustrated at 32, or packing strips can be employed at both places. The space between the frame 10 and wall 5 may also be filled with any suitable material, such as crinkled paper or the like, to prevent convection currents within this space.

The walls of the refrigerating chamber 6 are preferably formed by an inner vessel or liner 14 which is connected to the casing 8, as by means of strips 15, preferably formed of bakelite or other suitable material having low heat conductivity. Said strips 15 are suitably connected to the frame 10 or the flange 9, at their outer edges, and to the edge of the vessel 14 at their inner edges, and as said strips are formed of material of poor heat conductivity heat transmission from the outer casing 8 to the walls of the refrigerating compartment 14 is minimized. The foregoing construction also encloses the insulating container 2 on all sides so that a complete dust protecting cover for said container is provided.

The refrigerating apparatus 16 is mounted within the rear portion of the casing 8 in any suitable way and consists, in the embodiment illustrated, of an absorption refrigerating machine including an evaporator 17 which may be inserted into its operative position through an aperture 18 provided in the rear wall of the insulating container 2. When the refrigerating apparatus is mounted in position, its heat exchanger 19 lies within the aperture 18 as shown in Fig. 3. The details of the refrigerating apparatus form no part of the present invention and therefore further illustration and description thereof are believed to be unnecessary.

The outside and inside walls 3 and 4 of the insulating container may be made of any suitable material, preferably steel plate of from 0.5 to 0.75 mm. in thickness. Wall 5 is preferably composed of a metal alloy of low heat conductivity on the order of 0.15 mm. in thickness. While the wall 5 is preferably connected to the vessels 3 and 4 in the manner above described, it is to be understood that said walls may be connected by soldering or by any other suitable process adapted to provide gas-tight joints. As above explained, the space between said walls 3 and 4 preferably contains suitable means to prevent heat transmission by convection and radiation, such means in the present case preferably consisting of bright metal foils 20, of aluminum or the like, arranged parallelly and preferably formed into readily insertible units as hereinafter described, and said space is also preferably charged with a gas having low heat conductivity, for instance dichloro-difluoro-methane.

Stay bolts 21 are preferably provided between the walls 3 and 4 to prevent undue deformation of the walls under variations of pressure arising either from within or from without the insulating container. These variations in pressure arise partly from changes of atmospheric pressure and partly from variations in temperature inside of the insulating container. When filling the insulating container 2 with gas, which can be done according to the method disclosed in my Patent No. 1,969,621, granted August 7, 1934, and entitled Heat insulations, sub-atmospheric pressure may be produced within the insulating container 2, for example on the order of 150 to 200 mm. below atmospheric pressure, so that the variations of pressure above referred to will not be sufficient to ever raise the pressure within the insulating container above atmospheric pressure. Under these conditions the pressure acting on the exterior of the insulating container 2 will always be the greater, and therefore the stay bolts 21 need not be fixed to the walls of the container 2, as the pressure acting exteriorly on the container 2 will hold the walls thereof pressed against said stay bolts 21. At the same time the walls 3 and 4 of said insulating container will maintain their relatively plane form even though made of thin plate as above described.

Said stay bolts 21 are preferably made of material of poor heat conductivity, such as wood, and are distributed at suitable distances from each other over all of the sides of the insulating container, so that the wall 4 of the interior vessel is supported by the stay bolts 21 and its position relatively fixed. The stay bolts 21 provided in the rear wall of the insulating container have to resist the exterior pressure acting from the front on the interior vessel 4 and on the wall 5. Wall 5, in order to prevent heat leakage through the same as far as possible, should be made of relatively thin material as above described, and therefore it is not able to prevent relative movement between the vessels 4 and 3 under the excess pressure which acts on the rear wall of the vessel 4 and tends to slide said vessel into the interior of vessel 3. Therefore, it is important that the staying of the rear portion of the insulating container be effective not only to prevent deformation thereof but also to prevent displacement of vessel 4 when said insulating container is being filled with gas. To this end additional means are provided for reinforcing the rear portion of the insulating container. As shown a suitable reinforcing member 22, preferably of ply wood board, is suitably mounted upon the rear wall of the vessel 3 and, as shown in Fig. 3, a number of stay bolts 21 are provided around the edge of the vessel 4. Atmosphere pressure acting on the rear wall of vessel 4 and upon wall 5 is therefore transmitted to the stay bolts 21 and to the reinforcing member 22 at the rear of the vessel 3 without deformation or bending out of the rear wall of the latter. Hence vessel 4 maintains the desired relation with respect to vessel 3 during charging of the intermediate space with gas as well as afterwards.

The wall 5 may be made of somewhat greater width than the distance between the walls 3 and 4 so that after the charging of the container 2 with gas the excess pressure acting on the outside of wall 5 will cause it to be curved inwardly to the form shown in Fig. 4. Due to this curved shape the stress in said wall under variations of pressure is of little importance. At the same time the forward edge of the insulating container is relatively weak due to the fact that wall 5 is relatively thin and flexible, and therefore it is desirable to provide special reinforcing means for the forward edge of said container. As shown in Fig. 4 angle irons 23 are preferably provided along the front edges of the walls 3 and 4 and stay bolts 21 are suitably mounted on said angle irons.

The foils 20 disposed in the insulating container are supported and assembled in any suitable way. Preferably they are mounted on frames 24, which may be constructed of corrugated cardboard or the like and suitably connected to the edges of the foils so as to assemble the same into packs of suitable size and shape, corresponding to the size and shape of the respective chambers in the insulating container into which they are to be inserted. In order to prevent convection currents within the gas layers or cells defined by said foils the distance between the foils is preferably approximately 4 mm. This spacing is of importance for those portions of the insulation where the foils are arranged vertically, but the horizontally disposed foils may be arranged at a somewhat greater distance apart, in order to save foils, since gas layers formed by horizontal foils have little tendency to set up convection currents. In order to prevent convection currents being set up between the different gas layers existing between the foils, the borders of the foil packs may be pasted with paper or the like so that no communication exists between the cells between the respective foils. The foils are provided with suitable holes to correspond with the stay bolts 21, and packing rings 26, of felt or the like, are preferably provided around said holes in order to prevent convection currents being set up between the different gas layers or cells lying between said foils.

In manufacturing the foil packs, the foils may be suitably protected by frames 25, preferably of cardboard, which also give the necessary strength to the packs. In the embodiment illustrated the rear portion of the insulating container is provided with a separate foil pack while the foils for the other sides of the insulating container are wound on a rectangular cardboard frame 25 and provided with a number of layers corresponding to the thickness of the space which is to be occupied, thereby forming a single pack for the four sides of the container which is then slid into the container with the stay bolts 21 inserted in the holes in the foils. If preferred, however, separate foil packs can be made for each side of the element, a construction which has the advantage that the holes in the foils for the stay bolts 21 can be stamped out simultaneously by means of a single pattern.

The foil pack provided for the rear portion of the insulating container does not extend entirely to the sides of vessel 3, as otherwise a direct contact would exist between the wall 3 and said pack and heat could thereby be transmitted along the foils to the interior of the refrigerating chamber. The space 27 between the edge of the foil pack and the wall 3 is preferably filled with suitable material, such as crinkled paper or the like, and which may be sprinkled with metal powder if preferred, so as to prevent convection currents being set up in the spaces 27. Crinkled paper or the like may also be provided at all other portions where otherwise vacant spaces would be left between the foil packs and the side walls of the insulating container.

Aperture 18 is shown as closed at its opposite ends by disks 29, and the space not occupied by the heat exchanger 19 may be filled with any convenient insulating material such as crinkled paper or the like. Said disks 29 may be conveniently made of the same material as used for the wall 5. Packing rings 28 of felt, strips of corrugated cardboard or the like, are preferably provided between the foils around said wall 18 in order to prevent convection currents being set up between the gas layers between said foils at this point.

The door 7 may or may not be filled with gas of low heat conductivity but it preferably contains means to prevent transmission of heat by convection and radiation, such as a foil pack of the same character as provided in the insulating container. The foils need not be placed as close to each other in the door as in the insulating container if gas of low heat conductivity is not used, as air does not have the same tendency to set up convection currents as does the heavier gas such as is preferably used in the insulating container. If preferred, however, the door can also be constructed as a hermetically enclosed insulating container and charged with a gas of low heat conductivity. As shown the door is composed of an outside plate 34 and an inside plate 35 con-

nected at the edges by strips 36 of material of low heat conductivity, for instance bakelite. Said plates and strips are suitably attached to wooden frames 37 and 38, as by means of screws. A rubber packing strip 39 is preferably provided between the frame 37 and strip 36 so that when the door is closed said packing will press against the flange 9 of the casing 8. The inner edge of the door may also be provided with a rubber packing strip 40 fastened to the framework 38 and designed to press against a flange 41 which may be suitably connected to the strip 15 or the edge of the vessel 14. By this means the door will make a tight contact with the casing at two portions and prevent leakage of air therepast.

The vessel 14 is preferably formed of rustproof steel and the interior thereof may be provided with shelves 42 resting upon supports 43.

In the embodiment shown in Fig. 5 the inside wall 4 of the insulating container 2 is shorter than the outside wall 3 so that the wall 5 is inclined to both of said walls. It has been found that some heat transmission can take place from the front of the refrigerator through wooden frame 10 to the wall 4 and then into the refrigerating chamber 6. To avoid this heat transmission, wall 4 is terminated short of the frame 10 and the space between the wall 5 and the casing surrounding the insulating container is filled with suitable insulating material, such as crinkled paper or the like, whereby heat transmission to the wall 4 is materially decreased. Wall 5 may be connected to the walls 3 and 4 in any suitable way, as by welding, and if preferred a strip 44 of thicker plate may be provided upon each of walls 3 and 4 for the attachment thereto of the thin plate 5, said strips protecting the thin plate during welding.

From the foregoing it will be understood that the walls connecting the relatively warm and cold parts of the refrigerator and the staying members throughout are made of material of low heat conductivity. As the insulating container is also formed as a closed element containing means for preventing convection and radiation as well as a gas having a low heat conductivity, this construction makes it possible to decrease heat leakage between the exterior and interior of the refrigerator to a relatively small amount as compared with constructions heretofore employed. At the same time the construction of the refrigerator in the form of an exterior casing surrounding a hermetically closed insulating container which in turn encloses a refrigerating chamber has important advantages from a manufacturing standpoint. The insulating container can be manufactured and charged with gas as a separate element, ready for installation as a unit in the refrigerator. Relatively thin material may be used in the construction of the walls of the insulating container because, when assembled in the casing, the container walls are entirely enclosed and protected. Hence danger of damage thereto or leakage therefrom is eliminated since these walls do not form any part of the exterior of the refrigerator. Also said walls can be permitted to deform inwardly to a certain extent, to the limits permitted by the stay bolts, without spoiling the appearance of the refrigerator. The members 21 which stay or support the walls of the insulating container may consist of small disks or blocks of suitable material such as pressed cardboard, masonite or the like of suitable thickness to correspond to the distance between the foils, and said members may be conveniently pasted upon the foils and be placed against each other so as to form a pile of the thickness of the foil pack. Then, when the foil pack is inserted, said pile of disks perform the same function as the stay bolts 21.

The vacuum existing in the insulating container may if desired be lower than the limits above mentioned. This is especially true if the refrigerator is to be used in places far above sea level or where the atmospheric pressure is materially below the normal pressure at sea level. If the vacuum in the insulating container were only 150 to 200 mm. lower than normal atmospheric pressure, i. e. 760 mm. of mercury, it might happen that at a high altitude the pressure within the insulating container would exceed atmospheric pressure. To avoid such contingency a lower interior pressure may be initially provided. Instead of thus lowering the interior pressure within the container below that normally desirable, the stay bolts may be connected to the walls of the insulating container by means of screws, bolts or the like applied thereto from the outside. Alternatively, the stay bolts may carry disks of larger diameter than the bolts adapted to engage with guides of angle irons or the like connected to the walls when the foil packs are slid into the container, so that said disks interengage with said guides to positively fasten the stay bolts to the walls 3 and 4. With this construction, no special holes need be made in the walls 3 and 4 in order to secure the stay bolts positively thereto. When the stay bolts are thus positively connected to the walls 3 and 4, the vacuum in the container may be relatively low even when the refrigerator is to be used under relatively low atmospheric pressures.

It is to be expressly understood that the invention is not limited to embodiments heretofore described and illustrated in the drawings, as various other constructions will now suggest themselves to those skilled in the art and various changes may be made in the details of construction, arrangement, proportion, etc., without departing from the spirit of the invention. Reference is therefore to be had to the appended claims for a definition of the invention.

What is claimed is:—

1. A refrigerating or heat retaining cabinet including in combination a protecting casing having exterior and interior walls, and an insulating element consisting of a hermetically closed container formed of telescoped vessels operatively connected into a hermetically closed container constituting a separate unitary element insertable into said casing between said exterior and interior walls, said container having the front edges of said inner and outer vessels connected by a relatively thin curved wall.

2. A refrigerating or heat retaining cabinet including in combination a protecting casing having exterior and interior walls, an insulating element consisting of a hermetically closed container formed of telescoped vessels operatively connected into a hermetically closed container constituting a separate unitary element insertable into said casing between said exterior and interior walls, said container having the forward edge of its inner vessel terminating rearwardly of the forward edge of its outer vessel and said inner and outer walls connected by a strip of relatively thin metal disposed obliquely with respect to said inner and outer walls.

3. A cabinet including an outer casing and a liner assembled to form a self sustaining unit

with spaced walls about the sides of said cabinet, the spaces between said walls opening toward one side of the cabinet, and said outer casing having an opening in its side toward which such spaces open, and an insulating unit constructed to be freely insertable into and removable from said cabinet and having wall portions projecting into the spaces between the walls at the sides of said cabinet.

4. A refrigerator cabinet including an outer casing and a liner assembled to form a self sustaining unit, the outer casing being open at one side and the casing and liner forming side wall compartments opening towards the open side of the casing, and a preformed insulation unit telescoped into said side wall compartments, the parts being so proportioned as to permit free telescoping action.

5. A refrigerator cabinet including an outer casing and a liner assembled to form a self sustaining unit, the outer casing being open at one side and the casing and liner defining side wall compartments opening towards the open side of the casing, a preformed insulation unit telescoped into said side wall compartments, the parts being so proportioned as to permit free telescoping action, and means for detachably securing the insulation unit in applied position.

6. A cabinet including a protecting casing formed as a self sustaining unit with exterior and interior spaced walls providing compartments at its sides for receiving insulation therebetween, and an insulating structure formed as an independent unit and of a size and shape to be positioned between said spaced walls and with portions thereof located in said compartments, said casing having an opening through which said insulating unit is freely insertable.

7. A refrigerator cabinet comprising an outer casing and a liner assembled to form a self sustaining unit with side wall compartments open toward the back of the cabinet, the outer casing being provided with an opening at its rear and an independently formed insulating unit having side wall portions for reception into said side wall compartments and a portion connecting said side walls, the parts being proportioned to permit free telescoping action, and insulating means disposed between portions of said units for maintaining them in spaced relation.

8. A refrigerator cabinet including an outer casing and a liner assembled to form a self sustaining unit, the outer casing being open at the back of the cabinet and the casing and liner defining side wall compartments opening towards the back opening, an independently formed insulation unit having side walls freely insertable into the side wall compartments, each of said units being formed of telescoped shells connected at their forward edges, and insulating means for maintaining the forward edges of said units relatively spaced.

9. A refrigerator cabinet including inner and outer casings assembled to form a self sustaining unit with spaced side walls having compartments for insulation therebetween, said outer casing having an opening in its back, an independently formed insulating unit freely insertable through said opening into position between said spaced walls, said insulating unit being formed of spaced outer and inner plate members and a cross member connecting said plate members and constituting a hindrance to heat flow, and an abutment adjacent the front of the cabinet within the space for insulation for positioning the insulating unit and constituting a packing for preventing access of warm air to said cross member.

10. A refrigerator cabinet including inner and outer casings assembled to form a self sustaining unit with side walls having insulation space therebetween and an opening in the back of the outer casing, an independently formed insulation unit freely insertable between said spaced walls through the opening in the outer casing, said insulation unit being made up of spaced outer and inner plate members and a cross member interconnecting said plate members and constituting a heat flow hindrance, and yieldable packing at the front of the insulation space.

11. A refrigerator cabinet comprising spaced inner and outer casings forming a self sustaining unit having a cooling chamber and with a door opening affording access to said cooling chamber, an insulating unit disposed between said walls and made up of spaced nested shells having their forward edges adjacent the door opening interconnected by thin metal strips of poor heat conducting capacity, and means for preventing atmospheric air from coming in contact with said strips.

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