

Sept. 8, 1942.

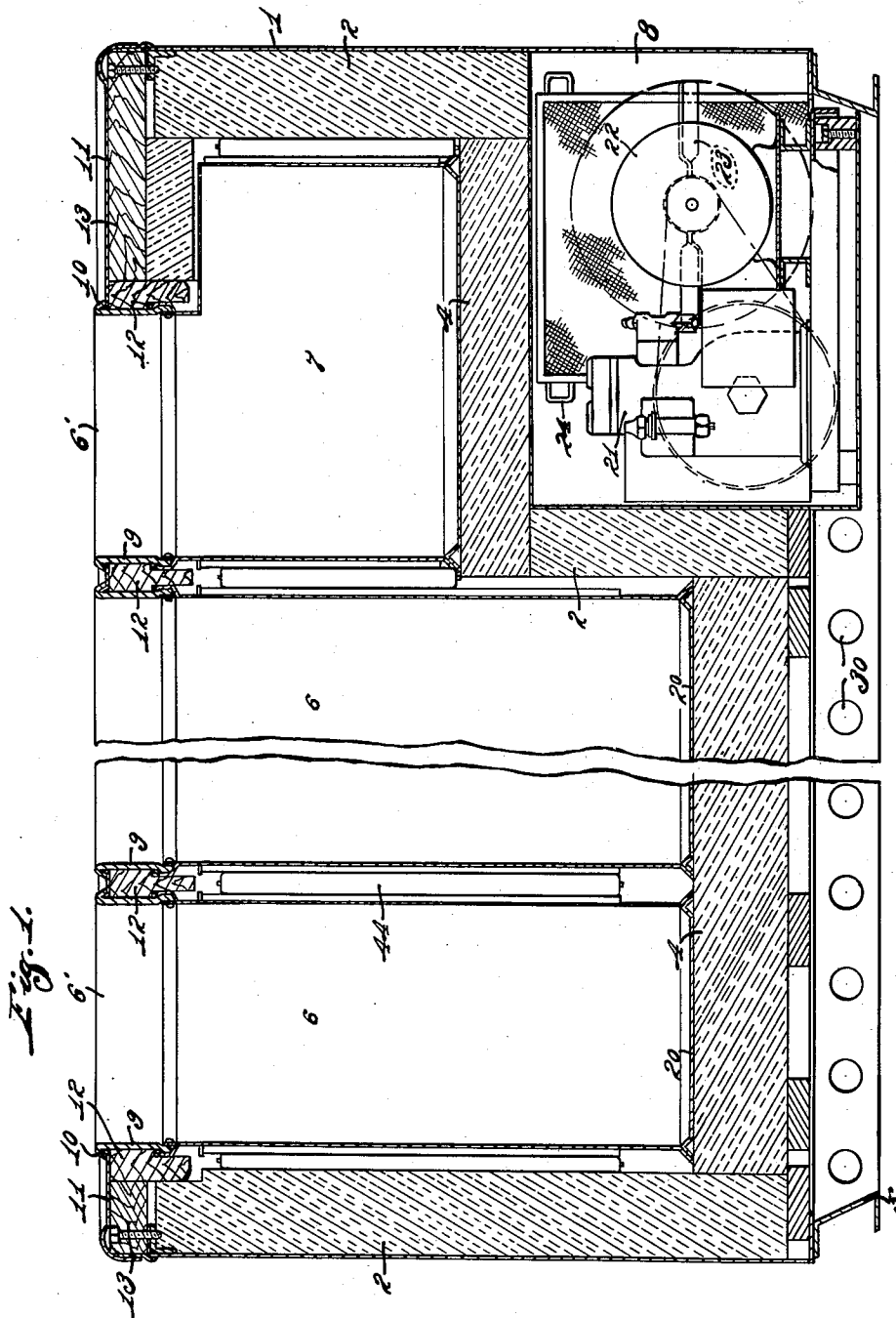
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2,295,113

REFRIGERATOR

Filed July 15, 1939

5 Sheets-Sheet 1



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Fig. 2.

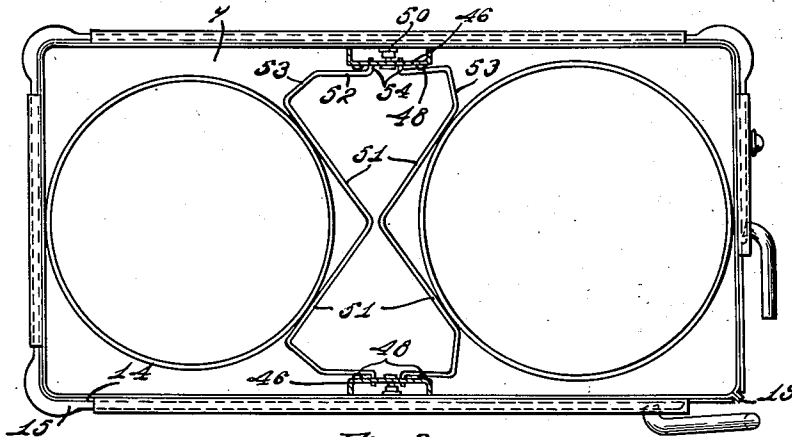


Fig. 3.

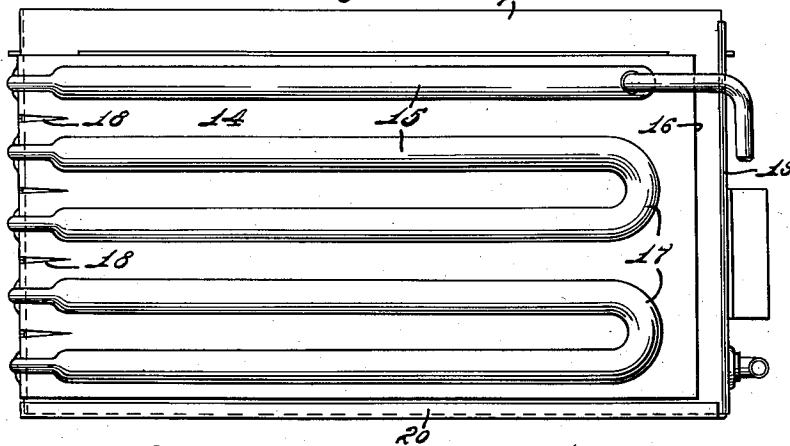


Fig. 4.

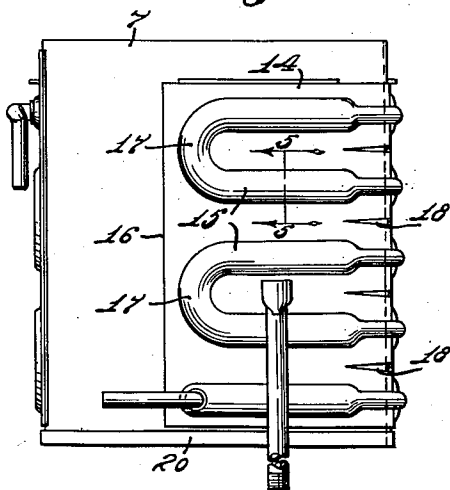
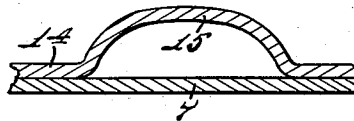


Fig. 5.



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Fig. 6.

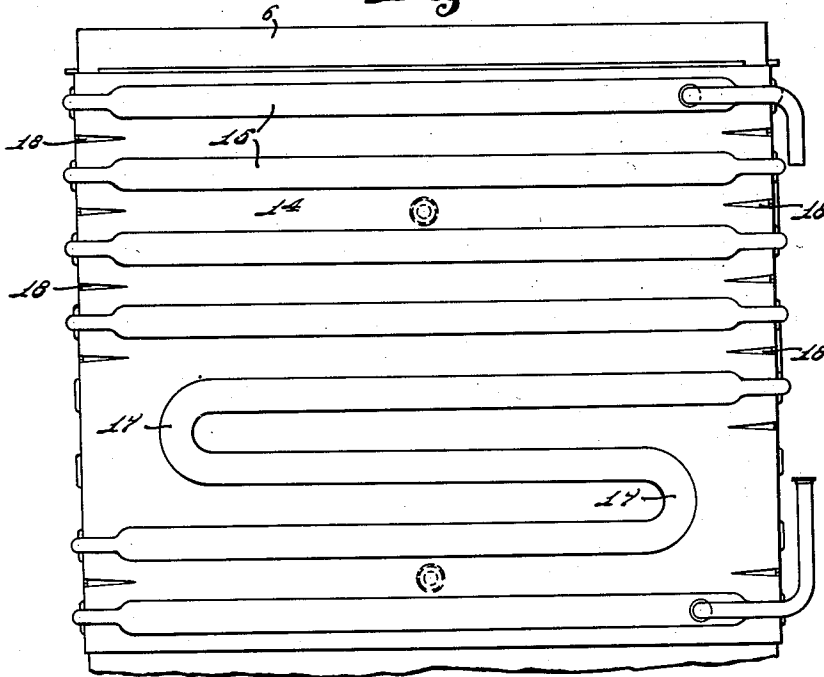
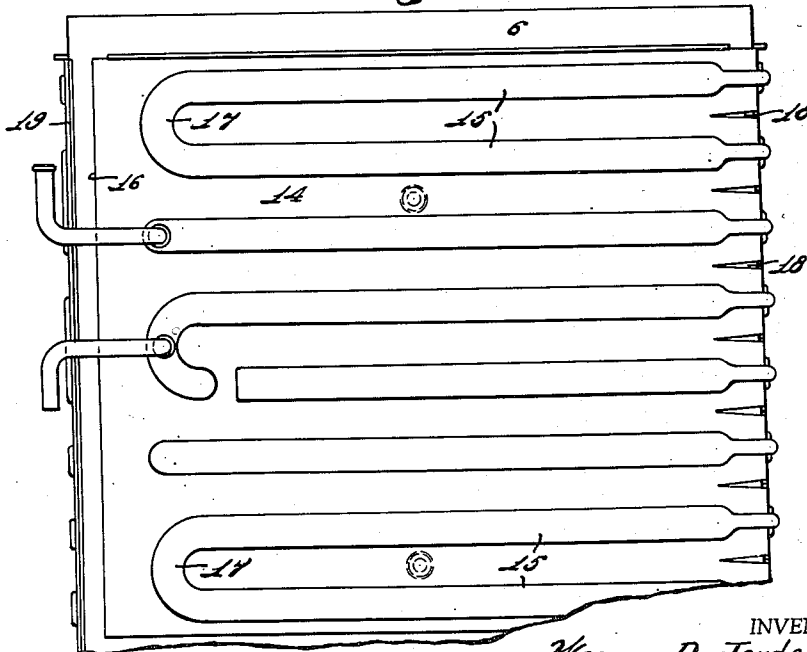


Fig. 7.



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Fig. 8.

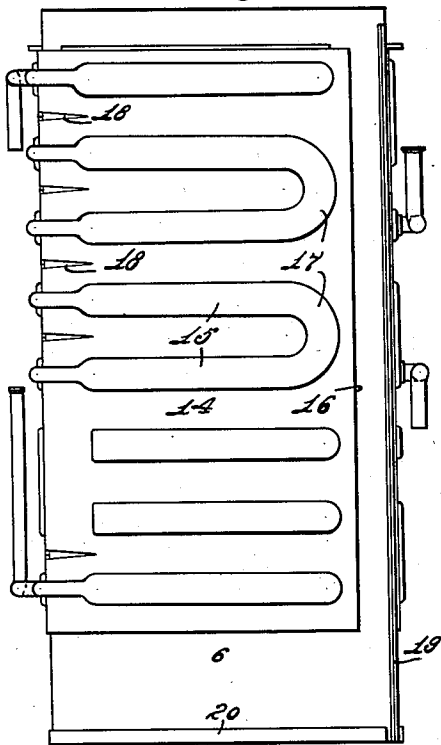


Fig. 9.

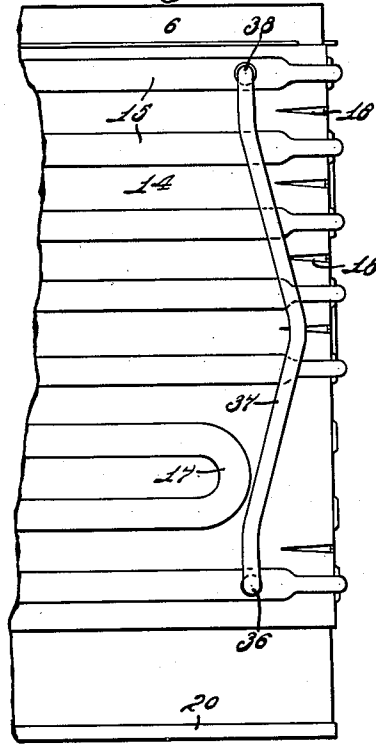


Fig. 10.

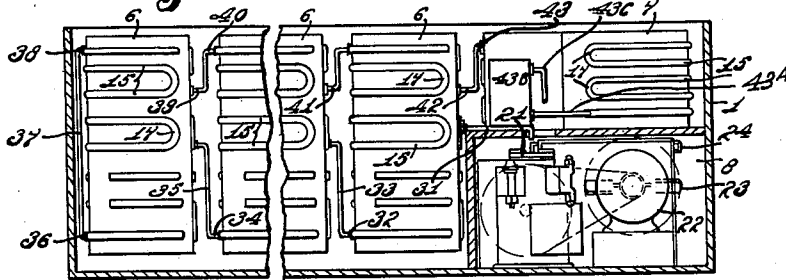
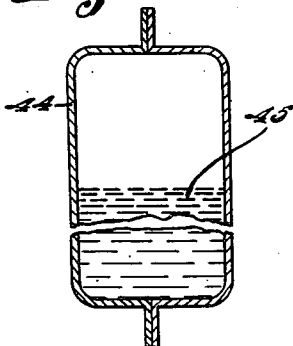


Fig. 11.



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Fig. 12.

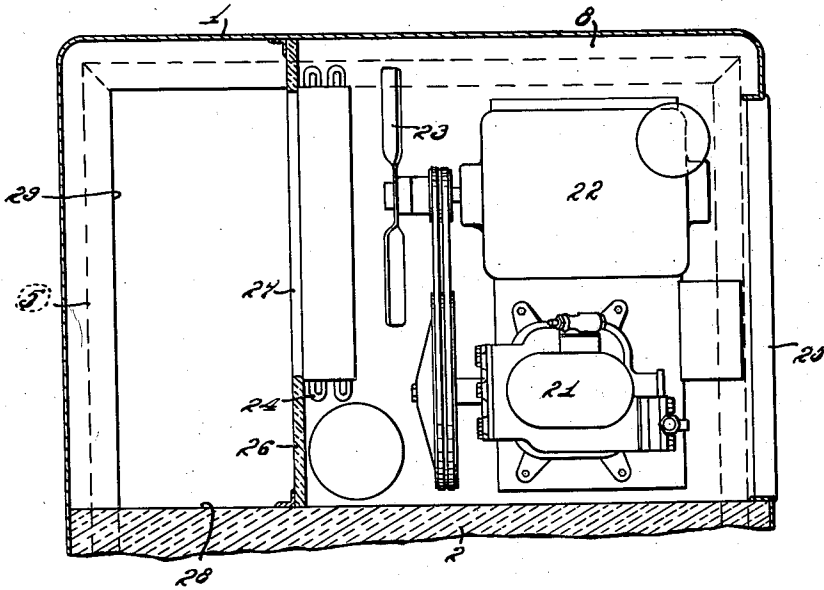


Fig. 13.

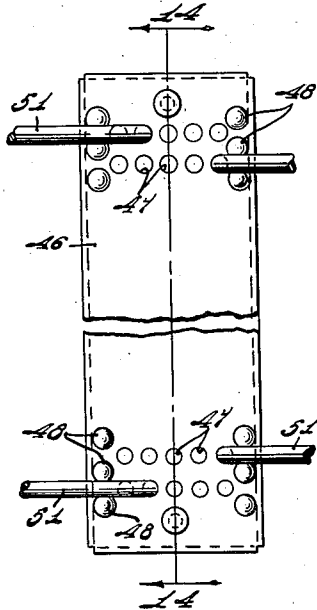
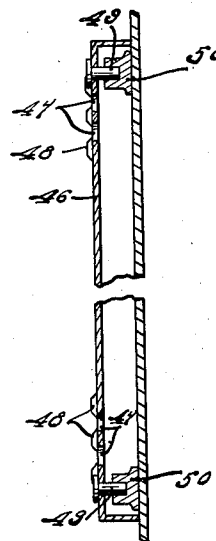


Fig. 14.



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UNITED STATES PATENT OFFICE

2,295,113

REFRIGERATOR

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Application July 15, 1939, Serial No. 284,680

13 Claims. (Cl. 62—95)

The invention relates to improvements in refrigerators and particularly to refrigerators of the type wherein mechanical refrigeration is provided for maintaining the storage compartments cold.

The invention has for one of its objects the improvement in the construction of the cooling surface or evaporator of the refrigerator whereby these evaporators may be more intimately associated for heat transfer with the storage compartments, whereby the same may be more readily manufactured and whereby the cost of the manufacture of the same may be materially reduced.

Another object of the invention is the provision of means whereby the temperature of the storage compartments may be maintained at a more even point.

In the commercial art, as heretofore provided, where the storage compartments are comparatively deep, there has always been the difficulty of the top of the storage compartment, which is necessarily repeatedly opened, having a relatively warm zone and the bottom of the compartment being relatively of a low temperature. In order to maintain the temperature in the upper part of the compartment at a proper point, the temperature at the lower part of the compartment has been maintained at a point too low to be satisfactory.

It is one of the objects of the invention to overcome this difficulty.

Another object of the invention is to provide means whereby the circulation of the cooling air through the condenser of the mechanical refrigerating apparatus may be more readily accomplished.

Other objects and advantages of the invention will appear more fully in the accompanying specification and claims.

For the purpose of illustrating the invention, an embodiment thereof is shown in the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of a refrigerator embodying the invention;

Fig. 2 is a plan view of a storage compartment and its accompanying evaporator;

Fig. 3 is a side elevation thereof;

Fig. 4 is a detail of one corner of the same;

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 4, showing a detail of the evaporator coils;

Figs. 6 and 7 are side elevations of the storage compartments and their associated evaporator coils;

Figs. 8 and 9 are end views thereof;

Fig. 10 is a schematic view of the refrigerant circuit;

Fig. 11 is a longitudinal sectional view of a hold-over cartridge;

Fig. 12 is a horizontal section, looking down upon the mechanical refrigeration compartments

Fig. 13 is a detail front elevation of one of the container holder locking plates; and

Fig. 14 is a sectional view on the line 14—14 of Fig. 13.

In the embodiment illustrated, there is provided a cabinet having suitable outer panels 1 and having the interior suitably insulated by cork insulating panels 2. Also, the bottom of the cabinet is provided with suitable insulating cork or other insulating material panels 4. This cabinet is supported upon a base 5 which may take the form of channel with web inclined inwardly, extending around the four sides of the cabinet and, as is illustrated in the specific structure, recession of the base from the cabinet wall is intended to provide toe room and for decorative purposes.

Arranged within the cabinet are suitable refrigerated sleeves or storage compartments 6, in the present structure four are illustrated, and these storage compartments may have a rectangular form, open at the top 6'.

One of the containers 7 has the same opening at top but is somewhat wider and shallower, so changed to provide space below for the mechanical refrigerating apparatus arranged in a compartment 8 in the cabinet.

The tops of the several sleeves are fastened rigidly to a frame having members 12 surrounding each sleeve and these in turn are rigidly fastened to a top structure 13, which is demountably attached to the outer cabinet wall 1, thus holding all sleeves rigidly spaced within the cabinet 1 and insulation 2.

The top of the cabinet is covered with a metal plate 11 having a flange turned down on all sides for fastening to the cabinet wall and openings over each sleeve with flanges turned up around the openings. To make an air tight and heat insulating connection between sleeves and top, a rectangular breaker strip member 9 is provided at each hole, having a groove at the upper edge which locks over the flange of the metal top and at the bottom is forced tightly against the sleeve by a metal band held in place by screws passing through band, breaker strip, sleeve edge and into the frame 12.

By this construction, the opening between the sleeves and top is practically sealed against entrance of air or moisture.

Suitable covers (not shown) are adapted to close the openings through the tops of the containers 6 and 7 under normal conditions.

Each sleeve 6 comprises an inner tank of the full sleeve dimensions, and hermetically sealed thereto on four sides, an outer sheet in which channels have been formed so that, when sealed to the inner tank, refrigerant passages are formed. The outer sheet extends only where it is desired to apply refrigeration. In practice the channels 15 are formed lengthwise of the outer sheet while flat, with connecting channels 17 between lengthwise channels so as to form a continuous tube of several of the upper lengthwise channels, and a similar continuous tube of channels below, this sheet being welded gas tight to the inner tank wall while flat, then folded to rectangular form, meeting edges flanged and joined as at 19 and bottom 20 inserted.

In order that the channels formed in the outer sheet shall not collapse when the double sheet is folded into rectangular form, the channel is formed somewhat deeper and narrower at the fold points than in straight sections and to provide for this deeper forming, the outer sheet is slit as at 18 at the fold point between adjacent channels so that the draw may be made without undue stretching of the metal. By thus providing a deep channel at the fold points an unrestricted passage for refrigerant is provided around the sleeve corners.

The tank 7 is formed in the same manner as are the tanks 6 with the exception that the tank 7 is somewhat shallower and wider but with the same top opening and a cover over the extension of the sleeve beyond the opening, this construction allowing for the space requirement of the condensing unit compartment 8 below.

The refrigerating mechanism comprises the usual compressor 21 driven from a suitable electric motor 22 on the shaft of which is mounted a fan 23 adapted to circulate the air through the condenser 24. The construction of the refrigerating unit is similar to that of any of the well-known commercial types of refrigerating units and need not be described in detail. This unit is mounted in compartment 8 in the cabinet with the condenser 24 at the rear, covering an opening 27 in the wall 26 which divides compartment 8 from plenum chamber 28. This plenum chamber goes to the floor and communicates with the space below the cabinet. It will be remembered that the cabinet as a whole is supported on the base 5 and thereby raised above the floor level so that the bottom of the compartment 28 opens beneath the cabinet and the base 5 is provided with suitable openings 30 on the sides. There is thus provided a clear path for the passage of air through holes 30 in base, through plenum chamber 28, through condenser of the refrigerating equipment and to suction fan 23, and easy egress for the air over and around motor and compressor through outlet grille 25, without the necessity of providing inlet or outlet openings in rear or end walls of the cabinet. Furthermore, the arrangement is such that air drawn through the condenser must be ejected from compartment 8 through grille 25 and cannot pass again through the condenser, with loss in cooling effect, as would be true if the air passage were not so definitely defined.

The circuit for the passage of the refrigerant 75

through the tubes of each sleeve is illustrated more particularly in Fig. 10. Each sleeve except the shallow sleeve 7 over the condensing unit has its refrigerant passages broken into two circuits, several tubes in a continuous top coil and the balance of the tubes in a bottom coil. The shallow sleeve has a single coil only. Connections are so made that refrigerant from the condensing unit goes through the lower coils of all deep sleeves in series, first, and returns through the top coils in series the last pass being through the single shallow sleeve coil. In each coil the refrigerant enters the top channel and leaves from the bottom channel.

Referring to Fig. 10, refrigerant from condensing unit enters lower coil of first deep sleeve at 31, leaves at 32, enters lower coil of next sleeve to left through tube 33 and leaves at 34, enters next sleeve through tube 35 and leaves at 36, then rises to top coil of left end sleeve through tube 37 to inlet 38, leaves at 39, enters top coil of next sleeve at 40, leaves at 41, enters top coil of next sleeve, leaves at 42 and enters single coil of shallow sleeve at 43, leaving at 43A to enter a sump or low side accumulator 43B, and thence returns by 43C to the compressor.

By using a "split" circuit as above we gain a substantial advantage in evenness of temperature from top to bottom of the sleeves and from end to end of the cabinet which can readily be understood by considering the effect of pressure drop through the evaporator tubes. The refrigerant pressure and resulting temperature will be a maximum where refrigerant enters the evaporator, and a minimum at the exit, the reduction in temperature being progressive through the several coils.

To equalize top and bottom temperatures we make the top coils of the several sleeves carry the coldest refrigerant, thus neutralizing the effect of frequent lid openings. It is not sufficient to apply all refrigeration in the top half as has been the practice with some designers. With round containers for stored goods, convection currents might equalize top and bottom temperatures but with small, closely spaced packages it is necessary also to refrigerate the lower half, but to a less degree. The lower coil carrying warmer refrigerant accomplishes this result.

It has been the practice in the past to pass refrigerant through sleeve coils progressively from end to end of the cabinet, with a progressively lower average temperature of sleeve toward the outlet end. This we avoid by reversing the direction of flow of refrigerant through bottom and top coils. At one end the temperature difference between top and bottom coil will be a maximum and at the other end a minimum, but the average temperature of applied refrigeration will be constant in all sleeves.

By the above mentioned "split" circuit of refrigerant tubes, we obtain a substantially equal temperature top to bottom of each container and end to end of the cabinet.

The shallow sleeve circuit is not split because more users prefer one sleeve at a substantially colder temperature than the others, permitting all tubes of that sleeve to be in one coil at the coldest end of the circuit.

Interposed between and at the outside ends of the different containers are what might be termed "hold-over" cartridges 44 which comprise relatively thin sealed tanks containing a eutectic solution 45 such as sodium chloride, ammonium chloride or other solution. During normal opera-

tion of the refrigerator, the freezing solution within the cartridges will become frozen and will be maintained in this frozen state until, through a failure of the refrigerating apparatus, refrigeration is no longer provided in the evaporators and the melting of the frozen solution within these tanks will be sufficient to maintain a low temperature in the containers for a time, during which the fault can be remedied.

When it is desired to store ice cream or other goods in round containers in the storage compartments, we provide means for preventing lateral displacement of said containers. Ordinarily these containers are about half the depth of the sleeve and are stored two deep. To prevent movement of the containers while ice cream is dipped, we provide four resilient can holder bars 51 in each sleeve, two at center height of the top tier of cans and two at center height of the bottom tier, and two can holder bar side plates, 46, each provided with four series of holes into which the ends of the four can holder bars may enter, and at the edges of the side plates we strike up projections 48 just above and below each series of openings to hold the bars horizontal by centering that part of the bar parallel to the face of the plate, between two projections. The plates are supported on opposite sides of the sleeve by means of pins 49 which enter socket members 50 secured to the sleeve wall.

The resilient bars 51 are so bent as to press the cans to the ends of the sleeve and by inserting the bar ends in the correct holes in the plates, cans of varying diameter may be held with equal pressure, or if packages are stored the bars may be turned down, out of the way.

We claim as our invention:

1. A combined storage receptacle and evaporator for refrigerators comprising a substantially rectangular inner sleeve having a closed bottom and an outer sleeve having channels or corrugations former therein extending horizontally thereof and inter-connected to provide two continuous refrigerant passages between the inner and outer sleeve, said outer sleeve having a gas-tight conjunction with the inner sleeve between and outside of said corrugations and having incisions in the material thereof between and parallel with the corrugations at the bend points of the outer sleeve.

2. A combined storage receptacle and evaporator for refrigerators comprising a substantially rectangular inner sleeve formed of sheet metal and having a closed bottom and an outer sleeve formed of sheet metal having channels formed therein extending horizontally thereof and inter-connected to provide two continuous refrigerant passages between the inner and outer sleeve, said outer sleeve being welded to the inner sleeve between and around said corrugations to form a gas-tight joint between the outer and inner sleeve and the metal of the outer sleeve having slits therethrough extending parallel with the corrugations and located at the bend points of the sleeve.

3. A combined storage receptacle and evaporator for refrigerators comprising a substantially rectangular inner sleeve formed from a single sheet of metal having its abutting edges welded and having a closed bottom and an outer sleeve formed from a single sheet of channelled metal welded to the inner sleeve on 4 sides and between the corrugations to provide a gas-tight joint between the corrugations and to form refrigerant passages between the sleeves, said outer

sleeve having expanded slits therethrough extending parallel with the corrugations and located at the bend points of the sleeve.

4. A refrigerating system comprising in combination an evaporator arranged in heat exchange relation to the compartment to be cooled and comprising an upper coil and a lower coil and a condensing unit, the connections between said coil and condensing unit being such as to cause the refrigerant to pass through the lower coils from top to bottom and thence to the upper coil and through this upper coil from top to bottom.

5. A refrigerating system comprising in combination an insulated box, a plurality of storage chambers within that box, a refrigerant coil or passage around the upper portion of each chamber and a refrigerant coil or passage around the lower portion of each chamber, a condensing unit, with connections between the coils and to the condensing unit such as to cause refrigerant to pass first through the coils around the lower portions of the several chambers in series, then through the coils around the upper portions of the several chambers in series in reverse order.

6. A refrigerating system comprising in combination an insulating enclosure, a plurality of storage chambers within said enclosure, an upper refrigerant coil encircling each chamber, a lower refrigerant coil encircling each chamber, each coil making two or more circuits around its chamber, a condensing unit, connections between condensing unit and coils, and between coils being such as to cause refrigerant to pass through the lower coils of all chambers in series, then through the upper coils of all chambers in reverse series, and such that the refrigerant flow is downward through the several turns of each individual coil.

7. A refrigerating system comprising in combination a condensing unit, a plurality of containers each comprising an inner sleeve substantially rectangular in form and having a closed bottom and a corrugated outer sleeve secured upon the inner sleeve and having a gas-tight connection therewith between and around the corrugations, said corrugations being interconnected and so disposed as to provide an upper and a lower coil on each container, the connections between the condensing unit and the coils and between the coils being such as to cause the refrigerant to initially pass through the lower coils of all containers in series and thence through the upper coils of all containers in series in reverse order prior to its return to the condensing unit.

8. A refrigerating system comprising in combination a condensing unit a plurality of evaporators, each evaporator comprising an upper and lower coil, the connection between said coils and the condensing unit, being such as to cause the refrigerant to pass through the lower coils of the evaporators in series and then through the upper coils of the evaporators in series in reverse order prior to its return to the condenser.

9. A refrigerating system comprising in combination a condensing unit a plurality of evaporators, each evaporator comprising an upper and lower coil, the connections between said coils and condensing unit being such as to cause the refrigerant to pass through the lower sets of coils in series from top to bottom of each coil and then pass through the upper sets of coils in reverse series from top to bottom of each coil prior to its return to the condensing unit.

10. A refrigerating system comprising in com-

bination a condensing unit a plurality of combined containers and evaporators each comprising an inner sleeve and a corrugated outer sleeve surrounding said inner sleeve, the corrugations being inter-connected to provide two sets of refrigerant passages independent of one another, the connections between said condensing unit and said container evaporators being such that the refrigerant will be caused to flow through the lower set of inter-connected corrugations of each of the containers in series and then through the upper set of inter-connected corrugations of each of the containers in series.

11. In a refrigerating system, an insulating housing containing a plurality of closely spaced storage chambers including avaporator coils in heat exchange relation to the interior of said storage chambers, a condensing unit connected to said coils, thin holdover tanks structurally independent of said chambers disposed between adjacent chambers and at the sides or ends of the chambers adjacent to the insulating housing, and a salt solution within said tanks.

12. In a refrigerating system, an insulated housing containing a plurality of rectangular

metal storage chambers, the walls of which include evaporator coils, a condensing unit connected to said coils, thin metallic holdover tanks structurally independent of said chambers disposed between the chambers and containing eutectic salt solution selected to freeze above a predetermined temperature and to melt below the temperature at which products to be stored in the chambers would be injured by failure of the condensing unit to supply refrigeration.

13. A combined storage receptacle and evaporator for refrigerators including a substantially rectangular inner sleeve and an outer sleeve having channels or corrugations formed therein extending horizontally thereof an inter-connected to provide refrigerant passages between the inner and outer sleeve, said outer sleeve having a gas-tight connection with the inner sleeve between and outside of said corrugations and having incisions in the material thereof between and parallel with the corrugations at the bend points of the outer sleeve.

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