Jan. 4, 1944. W. R. HAINSWORTH 2,338,284

REFRIGERATOR

Filed July 19, 1932 3 Sheets-Sheet 1

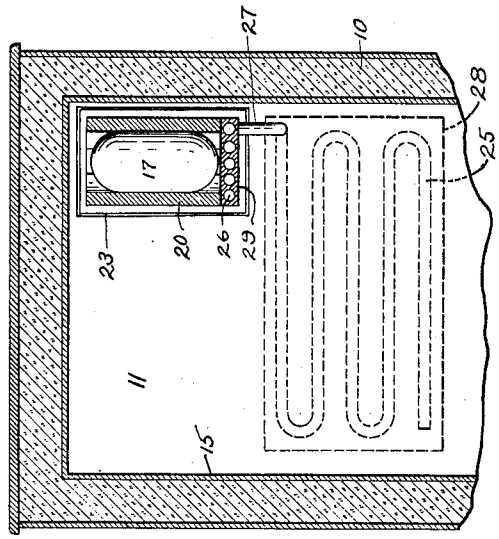


Fig. 2.

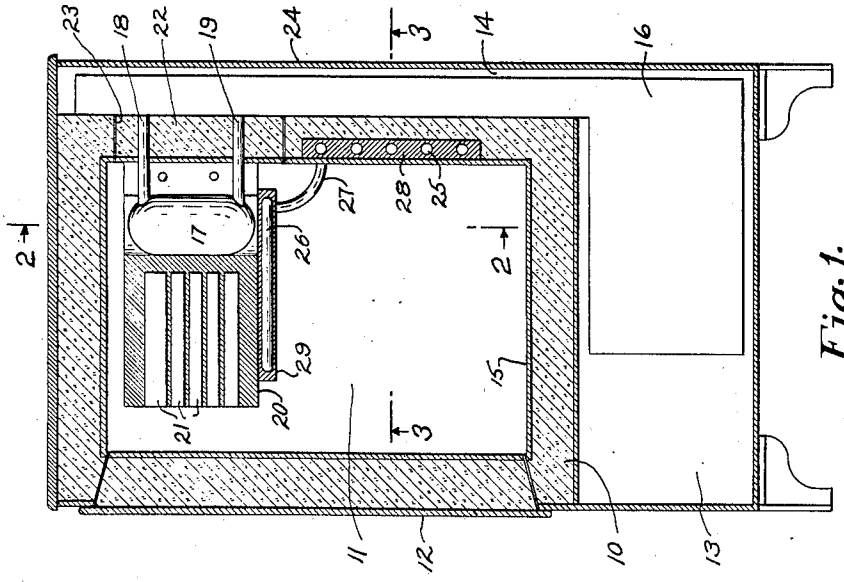


Fig. 1.

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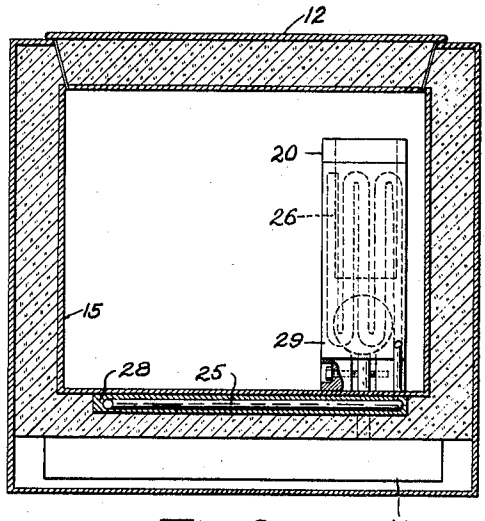


Fig. 3.

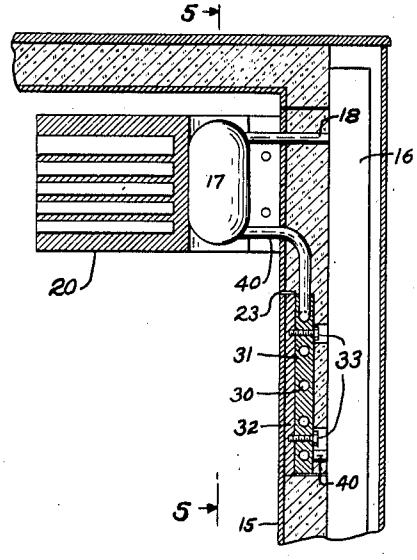


Fig. 4.

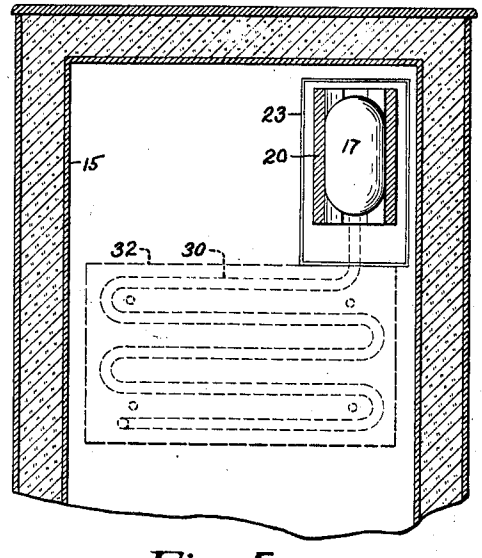


Fig. 5.

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REFRIGERATOR

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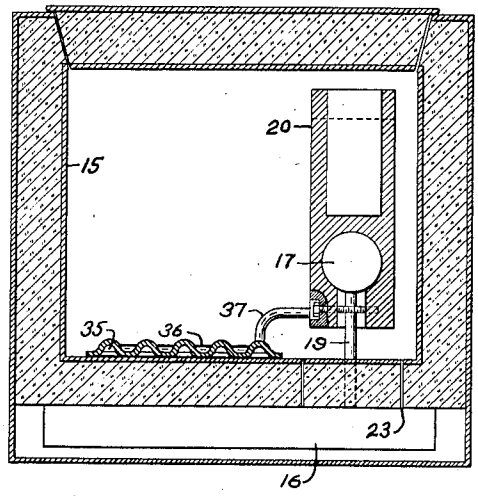


Fig. 8.

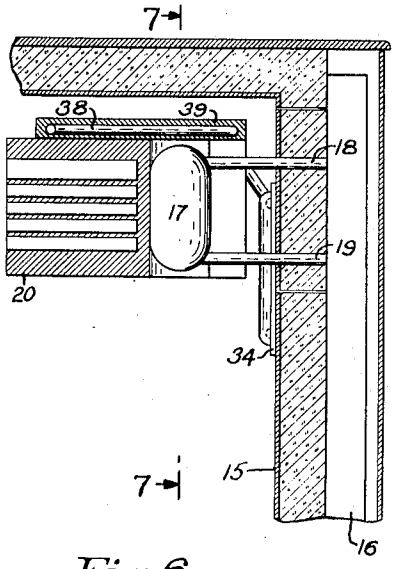


Fig. 6.

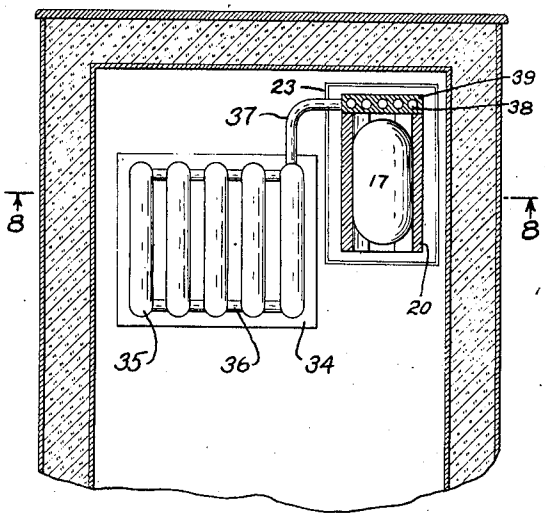


Fig. 7.

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Patented Jan. 4, 1944 2,338,284

UNITED STATES PATENT OFFICE

2,338,284

REFRIGERATOR

William R. Hainsworth, Larchmont, N. Y., assignor, by mesne assignments, to Servel, Inc., a corporation of Delaware

Application July 19, 1932, Serial No. 623,323
Renewed April 17, 1935

27 Claims. (Cl. 62—89)

This invention relates to refrigerators and more particularly to those for household use.

In household refrigerators it is usually necessary to provide for freezing ice cubes and also cooling air in the storage compartment to a temperature suitable for the preservation of comestibles. Obviously, freezing water and cooling air require different forms and arrangements of the cooling element which, to a necessarily limited extent, must be incorporated in one design when a single cooling element or evaporator is utilized. For instance, the cooling element must have sufficient surface for contact with the ice trays and be maintained at a temperature sufficiently low for the freezing of water, and at the same time present a sufficient amount of surface for adequate heat transfer from the air. Furthermore, it must be located within the food storage compartment in a manner to allow adequate circulation of the air.

In accordance with this invention a small cooling element or evaporator may be used, insulated from the storage compartment, if desired, to prevent frosting, thereby attaining quicker freezing of water in the ice trays adapted to be contained in the freezing chamber of the cooling element. This also results in more storage space for a given gross volume of cabinet. Furthermore, the cooling element may be located very near to a wall or corner of the cabinet, which affords a further saving in space.

Also in accordance with this invention, freezing of the ice cubes may be effected at a low temperature and the air cooled at a higher temperature, giving greater efficiency of unit operation without any reduction in storage space due to the use of large finned surfaces otherwise necessary.

The above is accomplished by utilizing the metal liner of a refrigerator cabinet for cooling the storage compartment. This also presents the advantage that there is less tendency toward decreased air circulation due to overcrowded shelves, the cooling surface being extended over the inner walls of the cabinet rather than localized in a small evaporator at the top of the storage compartment.

This invention further contemplates a refrigerator comprising a cabinet and refrigerating apparatus removably assembled therewith as a unit, the evaporator or cooling element forming a part of the unit and located within the storage compartment when the cabinet and apparatus unit are assembled, and heat transfer from the liner being accomplished by means of a permanent secondary cooling system having its heat absorbing portion in heat exchange relation with the liner and its heat rejecting portion positioned so as to be in heat exchange relation with the primary cooling element when the cabinet and apparatus unit are assembled. This invention may also be carried out by providing the refrigerating apparatus unit with two cooling elements or a single cooling element in two sections, one of which is positioned within the storage compartment and the other in heat exchange relation with the liner when the cabinet and apparatus unit are assembled.

This invention will be more thoroughly understood by reference to the following description taken in connection with the accompanying drawings, in which,

Fig. 1 shows schematically, in vertical section, a refrigerator contemplated by this invention;

Fig. 2 is a section taken on line 2—2 in Fig. 1;

Fig. 3, a section taken on line 3—3 in Fig. 1;

Fig. 4, a vertical section showing a modified cooling element arrangement;

Fig. 5, a section taken on line 5—5 in Fig. 4;

Fig. 6, a vertical section showing a further cooling element modification;

Fig. 7, a section taken on line 7—7 in Fig. 6; and

Fig. 8, a section taken on line 8—8 in Fig. 7.

Referring to the embodiment of this invention illustrated in Figs. 1, 2, and 3, a refrigerator cabinet is provided with a food storage compartment 11 closed by walls of heat insulating material 10 and made accessible by a heat insulated door 12. The inside of the storage compartment is lined with a metal shell 15 which is preferably porcelained on the inside to provide a durable and sanitary surface. In the lower part of the cabinet, directly below the storage chamber, is an apparatus compartment 13 from the rear of which there extends upwardly to the top of the cabinet a narrow chamber 14 at the rear of the storage compartment.

A refrigerating apparatus unit 16 is merely indicated in outline as this invention does not involve any particular form of refrigerating unit, any type known in the art being employed. If the apparatus is to be cooled by air, openings, not shown, may be provided in the bottom of chamber 13 and the top of chamber 14 affording a flue draft as well known in the art. For suitable refrigerating apparatus, reference may be had to Patent No. 1,838,041, C. E. Ploeger et al., which discloses a unit of the compression type,

or Patent No. 1,836,719 to Alvar Lenning, which discloses a unit of the absorption type.

For purposes of this description there is indicated a refrigerating apparatus unit of the continuous absorption type. The evaporator 17 is connected to the apparatus unit through conduits 18 and 19 and is provided with an aluminum casting 20 herein referred to as a chilliator. This is secured in good thermal contact to the evaporator and provided with recesses 21 for the reception of trays containing water for freezing ice cubes.

Integrally with the refrigerating unit there is provided a wall section or closure member 22 through which extend the evaporator connections 18 and 19. This wall section is adapted to fit within and close an opening or window 23 in the wall of the storage compartment 11 when the refrigerating unit is mounted in position. In practice it is usual to make the rear wall 24 of the cabinet removable so that the refrigerating apparatus including the wall section 22, evaporator 17, and chilliator 20, may be readily inserted or removed as a unit.

In the present embodiment of this invention the refrigerator cabinet is provided with an integral secondary cooling system which comprises coils 25 and 26 connected by conduit 27. The lower coil 25 is preferably embedded in a metal block 28 which is secured in good thermal contact with the liner 15 of the storage compartment 11. The upper coil 26 is also cast in a metal block 29 which is located in such a position as to be in thermal contact with the chilliator 20 when the refrigerating unit is assembled in the cabinet as illustrated. Obviously, better thermal contact will be obtained by drawing together the metal block 29 and the chilliator 20 by bolts or other securing devices, not shown.

The secondary system formed by the coils 25 and 26 and conduit 27, which is preferably formed of a single tube, is supplied with a secondary cooling fluid and hermetically sealed. In this system, as well known in the art, cooling fluid evaporates in the lower coil 25 and condenses in the upper coil 26, the condensate returning to the lower coil by gravity through conduit 27. This cycle is due to the temperature difference maintained by the cold chilliator 20, which is in thermal exchange relation with the upper coil 26, relative to the warmer air in contact with the liner 15 which receives heat by leakage into the cabinet and from the substances being refrigerated. Thus the liner 15 is cooled by heat transfer through the secondary system to the chilliator 20.

Due to the fact that the chilliator 20 does not cool the storage compartment except through the secondary cooling system it does not require extensive heat radiating surface and therefore may be made as small as desired, the dimensions being limited only by the size and number of ice cube trays to be accommodated. Furthermore, the chilliator may be provided with a heat insulating covering, not shown, to prevent frosting, and located very close to a corner of the cabinet to allow the maximum storage space in the compartment 11.

In the embodiment illustrated by Figs. 4 and 5, this invention is carried out without the use of a secondary cooling fluid. The evaporator 17 and chilliator 20 are the same as previously described and the inlet connection to the evaporator from the refrigerating unit 16 is through conduit 18. However, in the outlet connection 40 from the bottom of the evaporator 17 to the refrigerating apparatus 16 there is provided an additional cooling element in the form of a coil 30 embedded in a cast metal block 31. Through this coil passes the cool gas from the evaporator as it flows in conduit 40. As best shown in Fig. 4, the liner 15 adjacent the window or opening 23 is provided with a backing member 32 which may be formed by a metal block brazed or welded in place. The metal block 31 in which is embedded the cooling coil 30 is adapted to be positioned against the fixed block 32 when the refrigerating unit is assembled in the cabinet and may be secured thereto by bolts 33 to insure good thermal conduction. Obviously this embodiment is only illustrative and the invention may be readily carried out by utilizing separate evaporators, an evaporator in two sections, or any known type of two-temperature evaporator.

Referring to the modification illustrated in Figs. 6, 7, and 8, the arrangement is the same as in Fig. 1 except that in place of the secondary evaporating coil 25 embedded in the block 28 there is provided an equivalent evaporator formed by a pressed metal sheet 34 formed with corrugations 35 interconnected by channels 36. The pressed metal sheet 34 is placed against the liner 15 and brazed or welded around the edges and between the corrugations, thereby closing the open side of the grid pressed in the sheet and forming a secondary evaporator which is connected through conduit 37 to the upper condensing coil 38 embedded in a cast metal block 39. The latter is located in such a position as to be in good thermal contact with the chilliator 20 when the refrigerating unit is assembled in the cabinet. Obviously the pressed metal sheet forming the secondary evaporator may be located on either the inside or outside of the liner 15. If located on the inside it should be porcelained together with the liner.

It will be obvious to those skilled in the art that various other changes may be made in the construction and arrangement without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the following claims.

I claim:

1. A refrigerator comprising a cabinet having a thermally insulated storage compartment, a liner of heat conducting material for said compartment, heat conducting means including said liner, and refrigeration apparatus including a cooling element adapted to receive ice freezing trays, said refrigeration apparatus being removably assembled as a unit with said cabinet in such a manner that said cooling element extends within said storage compartment and is in thermal exchange relation with said heat conducting means.

2. A refrigerator comprising a cabinet having a food storage compartment, a liner of heat conducting material forming the inner wall surface of said compartment, a secondary heat transfer system having a heat absorbing portion and a heat rejecting portion, said heat absorbing portion being in thermal contact with said liner so that heat is conducted from air in said compartment through said liner to said heat absorbing portion, and refrigeration apparatus including a cooling element having chambers for ice freezing molds or the like, said apparatus being removably assembled as a unit with said cabinet so that said cooling element and said heat re-

jecting portion are in thermal exchange relation.

3. A refrigerator comprising a cabinet having a heat insulated compartment provided with a metallic liner forming the inner wall surface thereof, said cabinet having a door affording access to said compartment, a secondary evaporating-condensing system having an evaporating portion and a condensing portion, said evaporating portion being in thermal contact with said liner so that heat from air in said compartment is conducted through said liner to said evaporating portion, and refrigeration apparatus including a cooling element in heat exchange relation with said condensing portion, said cooling element being positioned and arranged in said cabinet so that said door affords access thereto.

4. A refrigerator comprising a cabinet having a compartment bounded by a wall of heat conducting material, a sealed pipe coil containing a cooling fluid and having a lower portion and an upper portion, said lower portion being in thermal contact with said wall so that heat from air in said compartment is conducted through said wall to said coil, and refrigeration apparatus including a cooling element, said apparatus being removably assembled as a unit with said cabinet so that said cooling element is in thermal exchange relation with said upper coil portion.

5. A refrigerator comprising a cabinet having a compartment, a metallic liner forming the inner wall surface of said compartment, a pipe coil embedded in a body of metal secured to said liner so that heat from air in said compartment flows through said liner to said coil, a second coil embedded in a second body of metal and connected to said first coil, said coils forming a sealed circuit for a secondary heat transfer fluid, and refrigeration apparatus including a cooling element, said apparatus being removably assembled as a unit with said cabinet so that said cooling element is in thermal contact with said second body of metal containing said second coil.

6. A refrigerator comprising a cabinet having a compartment, a lining of heat conducting material forming the inner wall surface of said compartment, refrigeration apparatus including a cooling element having two portions, one portion of said cooling element having a chamber for ice freezing molds or the like, said apparatus being removably assembled as a unit with said cabinet so that said first portion of the cooling element extends within said compartment and the other portion is in thermal contact with said lining so that heat from air in said compartment flows through said lining to said other portion of the cooling element.

7. A refrigerator comprising a cabinet having a storage compartment, a metallic liner forming the inner wall surface of said compartment, a cooling element having a chamber for ice freezing molds or the like, and a second cooling element in thermal contact with said liner so that heat from air in said compartment flows through said liner to said second cooling element, said cooling elements being removably assembled as a unit with said cabinet.

8. A refrigerator comprising a cabinet having a compartment, said cabinet having a door affording access to said compartment, a liner of heat conducting material forming substantially the whole inner wall surface of said compartment, a pressed metal sheet secured to said liner to form with a portion of said liner a chamber of a height appreciably less than the height of said compartment, a conduit connected to said chamber and forming therewith a sealed circuit for heat transfer fluid, and a cooling element in thermal exchange relation with said conduit, said cooling element being positioned and arranged in said cabinet so that said door affords access thereto.

9. A refrigerator comprising a cabinet having a thermally insulated compartment, a metallic liner forming the inner wall surface of said compartment, a pressed metal sheet secured to said liner to form with a portion thereof a chamber, a conduit connected to said chamber and forming therewith a sealed system for heat transfer fluid, and refrigeration apparatus including a cooling element having a chamber for ice freezing molds or the like, said apparatus being removably assembled as a unit with said cabinet and said cooling element being in thermal exchange relation with said conduit.

10. A refrigerator comprising a cabinet having a compartment, a liner of heat conducting material forming the inner wall surface of said compartment, a system for heat transfer fluid having a heat absorbing portion and a heat rejecting portion, said heat absorbing portion being formed by pressed sheet metal secured to said liner and forming with a portion thereof a fluid chamber of a height appreciably less than the height of said compartment, and refrigeration apparatus including an evaporator within said compartment and in thermal exchange relation with said heat rejecting portion.

11. A refrigerator comprising a cabinet having a compartment, a metallic liner forming the inner wall surface of said compartment, a sealed system for heat transfer fluid having a heat absorbing portion and a heat rejecting portion, said heat absorbing portion being of a height appreciably less than the height of said compartment and formed as a fluid chamber between a portion of said liner and a member secured thereto, and refrigeration apparatus including a cooling element within said compartment and in heat exchange relation with said heat rejecting portion.

12. A refrigerator comprising a cabinet having a compartment, a metallic liner forming the inner wall surface of said compartment, a sealed circuit for heat transfer fluid having a heat rejecting portion and a heat absorbing portion, said heat rejecting portion being formed by a pipe coil in a metal casting and said heat absorbing portion being of a height appreciably less than the height of said compartment and formed as a fluid chamber between a portion of said liner and pressed sheet metal secured thereto, said heat rejecting portion being adapted to be arranged in thermal exchange relation with the cooling element of a refrigeration unit.

13. A refrigerator comprising a cabinet having a thermally insulated compartment, a liner of heat conducting material forming the inner wall surface of said compartment, a sealed system for heat transfer fluid having a heat absorbing portion and a heat rejecting portion, said heat absorbing portion being in heat exchange relation with said liner so that heat from air in said compartment is conducted through said liner to said heat absorbing portion, and refrigeration apparatus including a cooling element wholly within said compartment and in heat exchange relation with said heat rejecting portion.

14. In a refrigerator provided with an opening in one of its walls and a metal shell enclosing a chamber for the storage of goods to be cooled;

the combination with said shell of an evaporator arranged to maintain refrigerant in good thermal contact with said shell, a condenser connected with said evaporator, a closure structure including a cooling element arranged in position to absorb heat from said condenser and pipes connected to said cooling element for conducting refrigerant to and from the same; said opening being of such size and so related to said condenser, and said pipes extending from said cooling element in such direction that said element may be moved through said opening into or out of said position without disconnecting said pipes from said element.

15. A structure as defined in claim 14 in which said condenser and said cooling element are not structurally connected with each other.

16. A refrigerating machine including a cabinet having thermally insulated walls providing a compartment to be cooled, a liner for said compartment, and means including an evaporator comprising a sheet of metal secured face to face with said liner for cooling said compartment, said sheet having indentations therein providing a plurality of refrigerant passages between said sheet and said liner, one of said passages serving as a connection to which other passages are joined at their upper ends to provide parallel paths of flow for refrigerant.

17. A refrigerating machine including a cabinet having thermally insulated walls providing a compartment to be cooled, a liner for said compartment, and means including an evaporator arranged within said walls and comprising a sheet of metal secured face to face with said liner for cooling said compartment, said sheet having indentations providing a plurality of refrigerant passages of which two serve as lateral connections to which other vertically extending passages are joined at their upper and lower ends.

18. A refrigerating machine including a cabinet having thermally insulated walls providing a compartment to be cooled, a liner for said compartment, and means including an evaporator comprising a sheet of metal secured face to face with said liner for cooling said compartment, said evaporator comprising a cross flow connector and refrigerant conduits arranged between said sheet and said liner, said conduits being joined to said connector to provide parallel paths of flow for the refrigerant.

19. A refrigerator comprising a cabinet having a substantially rectangular storage compartment accessible at the front by means of a door and having heat conducting material forming the side, top, bottom, and rear inner walls of said compartment, and refrigeration apparatus including a first cooling element and a second cooling element, said first cooling element being disposed wholly within said storage compartment and having one or more spaces to receive trays for freezing ice cubes and the like, and said second cooling element being associated with said first cooling element and in thermal contact with said rear wall over an area which is appreciably less than the area of said rear wall so that heat from air in said compartment is conducted at a temperature gradient in all of said inner walls to said second cooling element.

20. A refrigerator comprising a cabinet having a thermally insulated storage compartment accessible by means of a door and having a metallic liner forming the inner walls of said compartment, and refrigeration apparatus including a first cooling element and a second cooling element, said first cooling element being disposed wholly within said storage compartment and having one or more spaces to receive trays for freezing ice cubes and the like, and said second cooling element being associated with said first cooling element and in thermal contact with said liner at a place farthest removed from said door and over an area which is appreciably less than the height, width and depth of said compartment so that heat from air in said compartment is conducted to said second cooling element at a temperature gradient in a major part of said liner.

21. A refrigerator as set forth in claim 20 in which said second cooling element is formed by a member so formed and secured to said liner as to hold refrigerant fluid in contact with the liner over said contact area.

22. A refrigerator comprising a cabinet having a thermally insulated storage compartment, a liner of heat conducting material forming the inner walls of said compartment, and refrigeration apparatus including a first cooling element and a second cooling element, said first cooling element being disposed wholly within said storage compartment and having one or more spaces to receive trays for freezing ice cubes and the like, and said second cooling element being associated with said first cooling element and in thermal contact with said liner over an area which is appreciably less than the height, depth and width of said compartment so that heat from air in said compartment is conducted to said second cooling element at a temperature gradient in a major part of said liner.

23. A refrigerator as set forth in claim 22 in which said second cooling element is formed by a member constructed and arranged to hold refrigerant fluid in contact with said liner over said contact area.

24. A refrigerator as set forth in claim 22 in which said second cooling element is formed by a corrugated metal sheet secured face to face with said liner in a manner to hold refrigerant fluid in contact with the liner.

25. A refrigerator comprising a thermally insulated storage compartment having a metallic liner, refrigeration apparatus including a first cooling element and a second cooling element, said first cooling element being disposed wholly within said storage compartment and having one or more spaces to receive trays for freezing ice cubes and the like, said second cooling element forming part of a heat transfer circuit containing refrigerant and having a portion in thermal exchange relation with said first cooling element, and said second cooling element including a metal sheet secured face to face with said liner and formed to provide a receptacle for holding refrigerant fluid in contact with said liner, said metal sheet extending over an area appreciably less than the height of said compartment.

26. A refrigerator comprising a cabinet having a thermally insulated storage compartment, said cabinet having a door affording access to said compartment, a liner forming the inner wall surface of said compartment, said liner being formed of material of good thermal conductivity, a heat transfer circuit containing a heat transfer fluid having a heat abstracting portion and a heat rejecting portion, said heat abstracting portion being in thermal contact with said liner so that heat abstracted from air in said storage compartment flows through said liner to said heat abstracting portion, and a cooling element in heat exchange relation with said heat reject-

ing portion, said cooling element being positioned and arranged in said cabinet so that said door affords access thereto and being removable therefrom without disturbing said heat transfer circuit.

27. A refrigerator comprising a cabinet having a thermally insulated storage compartment, a liner of heat conducting material forming the inner wall surface of said compartment, structure segregating one part of said compartment from the remaining part thereof, said cabinet having a door affording access to said one part and also said remaining part of said compartment, a refrigerating unit including a cooling element, an evaporator containing a refrigerant, said evaporator being in direct heat transmitting relation to said liner for transmitting cooling effect thereto, said liner having an extended surface and utilized for transmitting cooling effect to said remaining part of said storage compartment, a condenser connected to said evaporator and forming therewith a heat transfer circuit, said condenser having a removable connection with said cooling element, said cooling element being effective to transmit cooling effect to said heat transfer circuit when in functioning relationship with said condenser, whereby said evaporator is effective to produce cooling effect, said cooling element being disposed within said storage compartment and utilized to effect cooling of said one part of said compartment, said cooling element constituting a part of a unit removable from said cabinet, and said heat transfer circuit being arranged to remain in its structural and cooling effect transmission relationship to said storage compartment upon removal of said unit of which said cooling element forms a part.

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