

Sept. 12, 1933.

H. B. HULL

1,926,384

REFRIGERATING APPARATUS

Original Filed Feb. 27, 1931 3 Sheets-Sheet 1

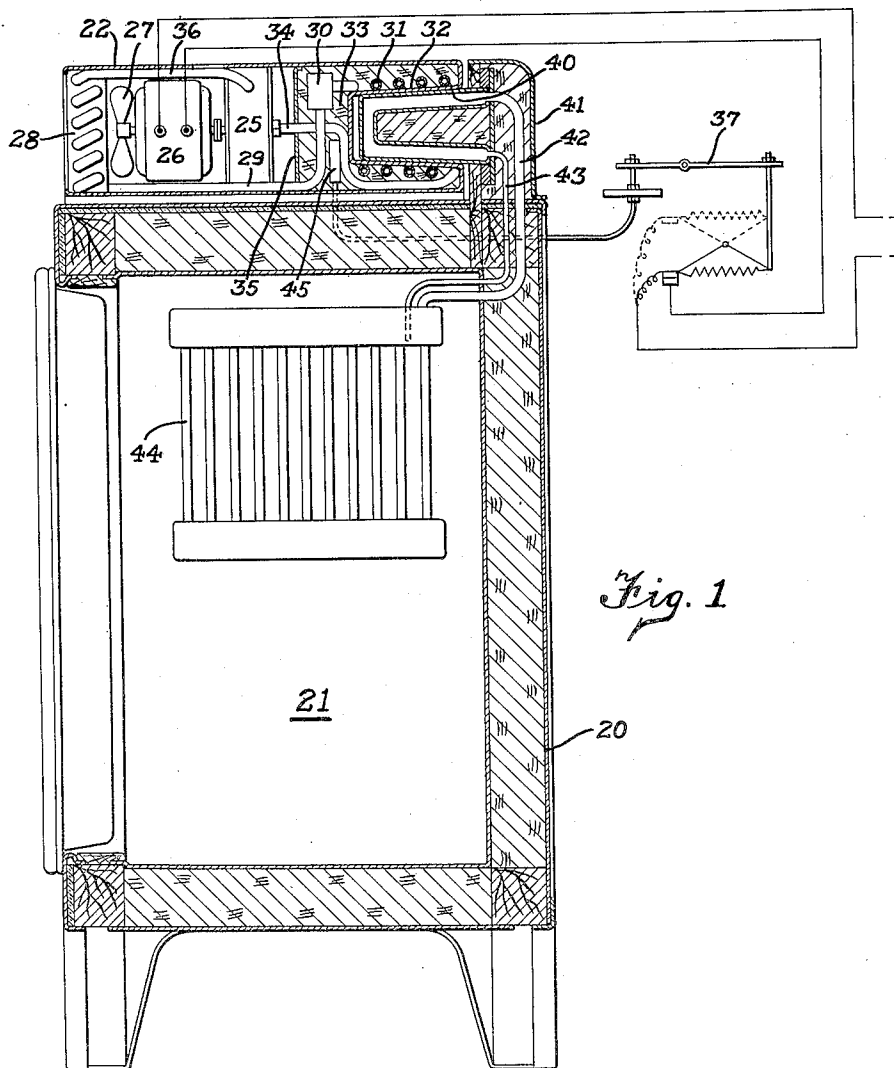


Fig. 1

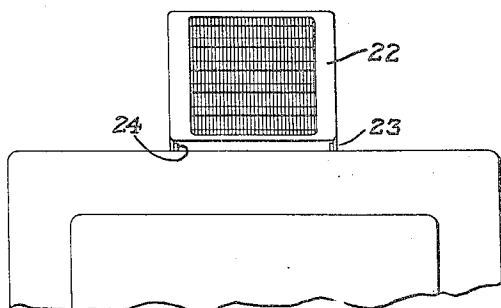


Fig. 2

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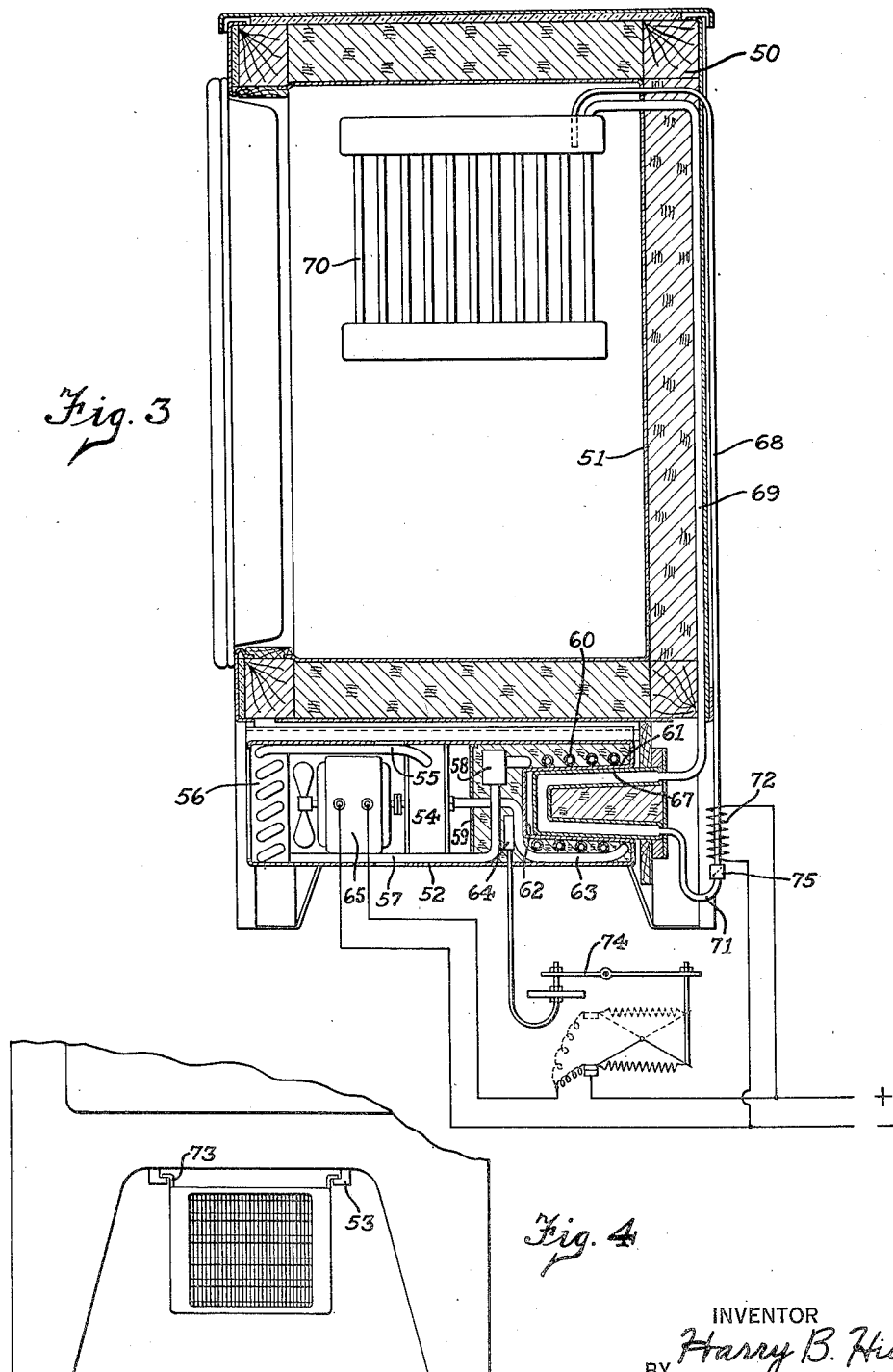
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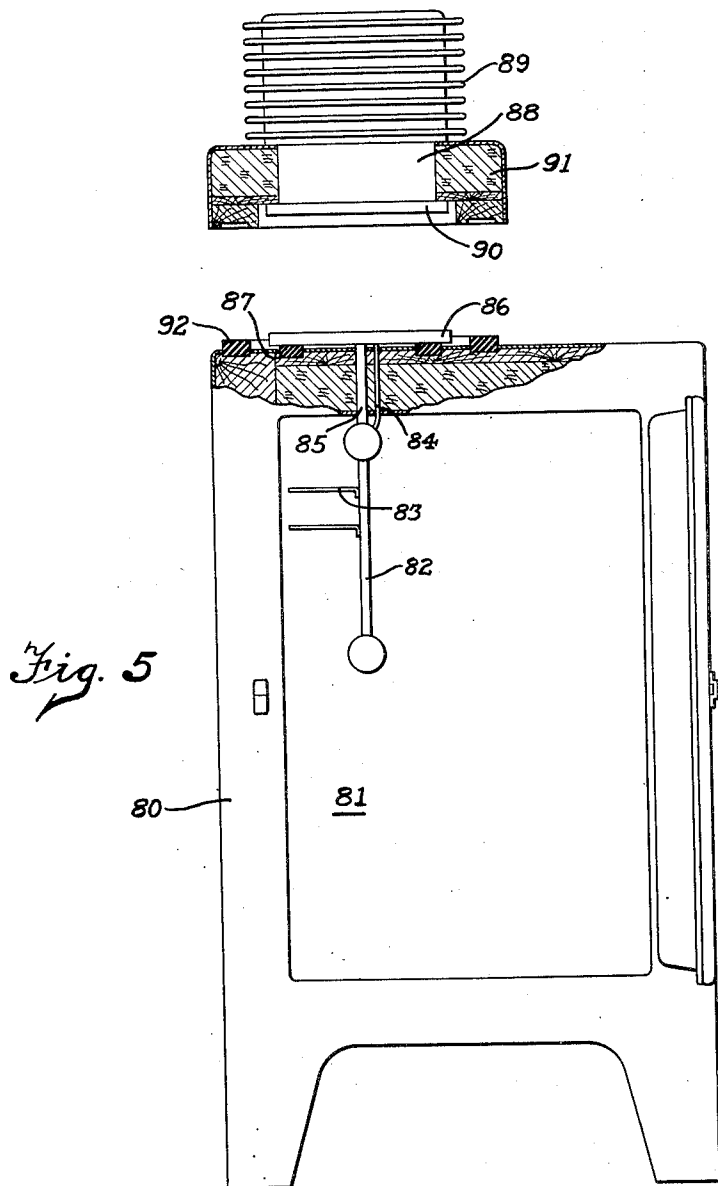


Fig. 5

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

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Renewed September 28, 1932

19 Claims. (Cl. 62—116)

This invention relates to refrigerating apparatus and more particularly to a refrigerator having its moving refrigerating parts removable as a unit.

5 Some refrigerators have been built wherein the entire refrigerating system is removable as a unit so that if any part of the system becomes out of order, the entire system can be removed and shipped back to the factory for repair.
10 There are several objectionable features to such a construction. One is that such a unit is comparatively large, bulky, difficult to handle and easily injured because of the fact that the evaporator for cooling the food storage compartment, which in such a system must necessarily be a
15 part of the unit, depends from the upper portion of the unit through the top of the cabinet into the food storage compartment and necessarily must have a large amount of surface exposed within the compartment for proper cooling. Another objectionable feature is that the evaporator must be kept close to the remainder of the system.

20 Consequently, one of the objects is to provide an improved refrigerator having a compact removable unit containing all the moving parts of the refrigerating system and having the evaporator for cooling the food storage compartment separate from the removable unit.
25

30 Another object of the invention is to provide an improved refrigerator wherein the removable unit may be located in any desired location independently of the location of the cooling unit for the food compartment.

35 Another object of the invention is to provide an improved refrigerator having a primary refrigerant circuit built into a compact removable unit and an efficient secondary refrigerant circuit having no moving parts but dependent upon
40 the primary circuit.

45 Further objects and advantages of the present invention will be apparent 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:

Fig. 1 is a sectional view of the preferred form of the invention;

50 Fig. 2 is a fragmentary view of the upper portion of the front of the cabinet shown in Fig. 1;

Fig. 3 is a sectional view of a modified form of the invention;

55 Fig. 4 is a fragmentary view of the lower portion of the front of the cabinet shown in Fig. 3, and

Fig. 5 is a view partially in section of another modified form of the invention.

Referring to the drawings and more particularly to Fig. 1, there is shown a refrigerator cabinet 20 having a food storage compartment 21
60 therein.

According to the present invention there is provided a secondary refrigerant circuit including an evaporator in the food storage compartment which is permanently located in the cabinet and there is also provided a primary refrigerant circuit including an evaporator built into a compact removable unit.

Upon the top of the refrigerator cabinet is a removable primary unit comprising a primary
70 refrigerant circuit mounted within a sheet metal drawer 22. The drawer 22 is provided with runners 23 which cooperate with the guides 24 to hold the drawer in proper position on the top of the cabinet. Within the drawer 22 is a compressor 25 which is directly driven by an electric motor 26 positioned in front of the compressor 25. The electric motor is provided with a fan 27 upon
75 the front end of its rotor shaft for drawing air through the condenser 28. The compressor 25 compresses the refrigerant, preferably sulphur dioxide and forwards it through the conduit 36 to the condenser 28 where the compressed refrigerant is liquefied by the cooling air provided by the fan 27 and this liquefied refrigerant is
80 conducted through the conduit 29 to an expansion valve 30 mounted in an insulated compartment within the rear of the drawer 22. The rear compartment is divided off from the front compartment by a partition 35 and the entire portion of the drawer rearward from the partition is filled with a suitable insulating material, such as granulated cork which is packed about the refrigerating elements within the rear compartment. The liquid refrigerant passing through
85 the expansion valve 30 enters the evaporating coil 31 which is in thermal contact with and coiled about a tapered sleeve 32 which is supported by the rear wall of the drawer 22. This tapered sleeve 32 has its smallest end forward and its largest end at the rear of the drawer 22, the smallest end of the sleeve is closed by a front wall 33 but the outer end of the sleeve is open. The refrigerant being under a reduced pressure within the expansion coil 31, vaporizes because of the absorption of heat and is returned to the compressor through the inlet conduit 34.

A thermostatic bulb 45 is mounted at the end of the evaporating coil 31 to control the operation of the electric motor 26 through the switch
100 110

means 37 to provide intermittent operating and idle periods of the compressor according to the temperature within the evaporating coil 31.

The secondary refrigerant circuit is provided for cooling the food storage compartment of the refrigerator cabinet 20. This secondary circuit is provided with a suitable fluid, preferably a volatile refrigerant but a liquid such as brine or alcohol may also be used under proper conditions, if desired. The secondary circuit has a cooling or condensing portion which comprises a double wall frusto-conical boss 40 which normally fits within the tapered sleeve 32 of the drawer 22. The frusto conical boss 40 is supported by an insulated supporting member 41 at the back of the cabinet 20. This supporting member 41 is preferably of such a size and shape so as to harmonize with the drawer 22. Liquid and gas carrying conduits 42 and 43 respectively preferably connect the upper and lower portion of the space between the walls of the frusto conical boss 40 to an evaporating or cooling unit 44 which is supported within the food storage compartment 21 of the refrigerator cabinet 20. These conduits preferably pass through the insulating supporting member 41 and the top and rear walls of the cabinet 20. Where a volatile refrigerant is used circulation is maintained in the secondary refrigerant circuit because the warm gaseous refrigerant will rise through the conduit 42 to the cooling or condensing portion 40 comprising the frusto conical boss where the warm gaseous refrigerant will be cooled, which liquefied refrigerant will flow downwardly through the liquid conduit 43 into the evaporator 44. If a liquid is used in the secondary circuit, a thermosiphon system will provide the circulation.

Preferably an inert gas is introduced into the secondary refrigerant circuit to control the minimum evaporation temperature within said circuit after the manner shown and described in the Gase et al Patent 1,371,235. By controlling the minimum evaporating temperature so that it is kept above 32° F. freezing of food or frosting of the evaporator may be avoided.

The primary unit may be removed merely by pulling the drawer forward and a new or replacement drawer substituted by sliding it rearward upon the guideways. The complementary frusto-conical surfaces of the tapered sleeve and the frusto-conical boss wedge together and fit tightly so that the surfaces are in close contact. In this manner the thermal conduction between the evaporator of the primary circuit and the condenser of the secondary circuit is made highly efficient.

In Fig. 3 there is shown a modification in which the primary unit, that is the drawer, is placed at the bottom of the cabinet. A cabinet 50 is shown having a food storage compartment 51 therein. The drawer 52 is provided with out-turned flanges 73 which engage the ledges 53 (see Fig. 4) fastened to the bottom of the cabinet to slidably support the drawer. The drawer 52 is arranged in a manner similar to the drawer 22 and is provided with a compressor 54 where the refrigerant, preferably sulphur dioxide, is compressed and forwarded through the conduit 55 to the condenser 56, positioned in the front part of the drawer, where the refrigerant is liquefied and conducted through the conduit 57 to the expansion valve 58.

The rear portion of the drawer is divided from the front portion by the partition 59. The expansion valve 58 and the expansion coil 60 are

positioned within this rear compartment. The expansion coil 60 is in thermal contact with and coiled about a tapered sleeve 61. This tapered sleeve 61 has its smallest end forward and its largest end at the rear of the drawer 52. The smallest end of the sleeve is closed by a front wall 62 but the rear end of the sleeve is open. The sleeve 61 is supported by the rear wall of the drawer. Liquefied refrigerant passing through the expansion valve 58 enters the expansion coil 60 where it is under a reduced pressure and vaporizes because of the absorption of heat. The vaporized refrigerant within the expansion coil 60 is returned to the compressor through the return conduit 63. The rear compartment is filled with a suitable insulating material such as granulated cork. A thermostatic bulb 64 is mounted upon a portion of the return conduit 63 and connected to a switch means 74 to control the operation of the electric motor 65 which is directly connected to the compressor 54 to provide intermittent operating and idle periods according to the temperature of the thermostatic bulb 64. By such a thermostatic control the expansion coil is kept filled with liquid refrigerant.

A secondary refrigerant circuit is provided for cooling the food storage compartment 51 of the refrigerator cabinet 50. This secondary circuit is provided with a volatile refrigerant. The secondary refrigerant circuit has a condensing portion which comprises a double wall frusto-conical boss 67 which is supported by the frame work beneath the food storage compartment 51. The frusto-conical boss normally fits within the tapered sleeve 61 of the drawer 52. Liquid and gas carrying conduits 68 and 69 respectively, preferably connect the upper and lower portion of the space between the walls of the frusto-conical boss 67 to an evaporating unit 70 which is supported within the food storage compartment 51 of the refrigerator cabinet 50.

In this modification it is necessary to provide special means for carrying the refrigerant, which is liquefied in the condenser portion, that is the frusto-conical boss 67, and for this purpose the liquid conduit 68 is provided with a goose neck 71 at its lower end and an electric heater 72 immediately above the goose neck. A check valve 75 is provided for preventing the flow of liquid refrigerant from the liquid conduit 68 back into the condenser portion 67. This electric heater 72 evaporates a small portion of the condensed refrigerant and thus lifts the remainder of the liquid in the liquid conduit 68 by the vapor lift principle. The liquid refrigerant within the evaporating unit 70 vaporizes because of the absorption of heat and is drawn down through the gaseous conduit 69 by the action of the condenser 67. For this modification it is preferable to use some light refrigerant such as ammonia or ethyl chloride.

In Fig. 5 there is shown a third modification which is somewhat simpler than the first and second described modifications. In Fig. 5 there is shown a refrigerator cabinet 80 having a food storage compartment 81 therein. A cooling unit 82 is supported within the food storage compartment 81 and is provided with a plurality of ice tray shelves 83 for supporting ice trays and for freezing ice cubes therein. This cooling unit 82 is a part of the secondary refrigerant or fluid circuit. This cooling unit is connected by the liquid and gaseous conduits 84 and 85 respectively with a flat condensing plate 86 which

is resiliently supported upon rubber blocks 87 upon the top of the cabinet 80. This condensing plate 86 is of course hollow and has refrigerant or fluid passages therein for the secondary re-

frigerant circuit. embodiment, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A refrigerator comprising a cabinet having a food storage compartment therein, a unitary primary refrigerant circuit removably mounted outside of the food storage compartment, said circuit including a compressor, a condenser and an evaporator, a secondary circuit having a portion within the food storage compartment for cooling the food storage compartment, and a portion fixed to said cabinet and in thermal contact with the evaporator of said first circuit.

2. A refrigerator comprising a cabinet having a food storage compartment therein, a unitary primary refrigerant circuit removably mounted outside of the food storage compartment, said circuit including a compressor, a condenser and an evaporator, a secondary circuit storage compartment for cooling the food storage compartment, a secondary condenser fixed to a wall of said cabinet and in thermal contact with the evaporator of the primary circuit, and conduits connecting the secondary evaporator and the secondary condenser.

3. A refrigerator including a cabinet having a compartment therein to be kept cool, a unitary primary refrigerant circuit removably mounted upon the cabinet outside of said compartment, said primary circuit having a liquefying portion and a cooling portion, a secondary fluid circuit having a portion within the compartment for keeping the compartment cool and a portion fixed to said cabinet and having a conducting surface in thermal contact with the cooling portion of said primary circuit for cooling the fluid within the secondary circuit.

4. A refrigerator including a cabinet having a compartment therein to be kept cool, a unitary primary refrigerant circuit removably mounted upon the cabinet outside of said compartment, said primary circuit having a liquefying portion and a cooling portion having a metal surface, a secondary fluid circuit having a portion within the compartment for keeping the compartment cool and a portion fixed to said cabinet and having a metal surface in direct metallic thermal contact with a cooperating metal surface upon the cooling portion of the primary circuit.

5. A refrigerator including a cabinet containing a compartment to be kept cool, a unitary primary refrigerant circuit slidably supported by said cabinet, said unitary primary circuit including a liquefying portion and an evaporating portion, said evaporating portion having a metal contact surface, a secondary fluid circuit having a portion within said compartment for keeping said compartment cool and a contact portion having a metal contact surface with a complementary contour to fit the metal contact surface of the primary circuit.

6. A refrigerator including a cabinet containing a compartment to be kept cool, a unitary primary refrigerant circuit slidably supported by said cabinet, said unitary primary circuit including a liquefying portion and an evaporating portion, said evaporating portion having a conical metal contact surface, a secondary fluid circuit having an evaporating portion within said compartment for keeping said compartment cool, and a condenser portion having a conical metal contact surface with a complementary contour to fit the metal contact surface of the primary circuit.

The primary unit including the primary refrigerant circuit consists of a sealed motor-compressor unit 88 which is surrounded by a condensing coil 89 and which has a plate type evaporator 90 at its bottom portion which has a lower contact surface which is adapted to rest upon the upper contact surface of the condenser plate 86. For the purposes of illustration the primary unit is shown lifted up from its position on top of the cabinet. The evaporator 90 is surrounded by a suitable insulated supporting member 91 which is adapted to rest upon the rubber sealing ring 92 to resiliently support the primary refrigerant circuit and to take a portion of the weight of the primary unit off the condenser plate 86. The rubber sealing ring 92 surrounds the condenser plate 86 and making contact with the insulating member 91, seals the evaporator 90 and the condensing plate 86 from the atmosphere and thus prevents frosting thereof.

The primary refrigerant circuit may be provided with any suitable control device, for example one which is shown in the previous modifications. The cooling action of the evaporator 90 is transferred by a metallic contact of the contacting surfaces to the condenser plate 86 which cools and condenses the refrigerant in the secondary refrigerant circuit and this condensed refrigerant flows down through the liquid pipe 84 to the cooling unit 82 where the refrigerant vaporizes and absorbs heat from the food storage compartment 81 and the ice trays upon the shelves 83 and this vaporized refrigerant passes upwardly through the gas conduit 85 back to the condenser plate 86. The secondary refrigerant circuit may be supplied with any suitable liquid or any suitable refrigerant.

It will be seen that particularly in the modification of Fig. 5 a very simple system is provided. The primary refrigerant circuit is easily removed from the refrigerator cabinet and may be easily shipped to a repair station. While the original primary refrigerant circuit is at the repair station, a duplicate may be supplied in its place. In this manner repairs may be made under a most favorable condition and yet the owner of the refrigerator need not be inconvenienced because of the need of such repairs.

There are no moving parts in the secondary systems of any of the modifications. Hence there is no necessity for the repair of the secondary system or any other part of the refrigerator except the primary unit. The removal of the primary unit is attended with little difficulty. In the first and second modifications the primary unit is mounted in a drawer which easily slides out similarly to a table drawer. In the third modification, the primary unit is merely lifted off the top of the cabinet.

The primary units in each case are very compact and easily shipped, either for initial installation or for repair purposes. The evaporator of the primary circuit is compactly built into the removable primary unit while the larger cooling unit of the secondary circuit need not be removed from the cabinet. The primary unit and the cabinet may be shipped separately for initial installation.

While the form of embodiment of the invention as herein disclosed constitutes a preferred

7. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit contained in a drawer slidably supported by said cabinet, said primary circuit having a liquefying portion and an evaporating portion, said evaporating portion having an exposed contact surface at one end of said drawer, a secondary fluid circuit having a portion exposed within said compartment for keeping said compartment cool, and a contact portion attached to said cabinet having a complementary contact surface to fit against said contact surface at the end of said drawer.
8. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit supported by said cabinet, said primary circuit having a liquefying portion and an evaporating portion having a contact surface, a secondary fluid circuit having a portion disposed within said compartment for keeping said compartment cool, and a contact portion having a complementary contact surface, said contact surfaces being adapted to fit together, said contact surface of said primary circuit resting upon said complementary contact surface of said secondary circuit.
9. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit supported by said cabinet, said primary circuit having a liquefying portion and an evaporating portion beneath said liquefying portion, said evaporating portion having a contact surface on its under side, a secondary fluid circuit having a portion disposed within said compartment for keeping said compartment cool, and a contact portion having a complementary contact surface, said complementary contact surface being exposed upon an upper surface of said cabinet, said unitary primary circuit resting upon the upper surface of said cabinet with said contact surface of said primary circuit resting upon said contact surface of said secondary circuit.
10. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit supported by said cabinet, said primary circuit having a liquefying portion and an evaporating portion having a contact surface, a secondary fluid circuit having a portion disposed within said compartment for keeping said compartment cool and a contact portion having a complementary contacting surface, said contact surfaces being adapted to fit together, said contact portion of said secondary circuit being resiliently supported by said cabinet, and a resilient sealing ring surrounding said contact portion and sealing the evaporating portion of the primary circuit and the contact portion of the secondary circuit from the atmosphere, said resilient sealing ring supporting a portion of the weight of said primary circuit and said contact portion supporting the remainder of the weight of said primary circuit.
11. A refrigerator including a cabinet having therein a compartment to be kept cool and a secondary refrigerant circuit having an evaporator within said compartment and a condenser portion resiliently mounted upon the top of said cabinet, said condenser portion and said evaporator being connected through the walls of the cabinet, a resilient sealing ring surrounding the condenser portion of said secondary circuit, a unitary primary circuit having a liquefying portion and an evaporating portion, said evaporating portion having a contact surface adapted to contact with the complementary contact surface of said condenser portion of said secondary circuit, said primary refrigerant circuit being adapted to rest upon the resilient sealing ring surrounding the condenser portion of the secondary circuit and also upon the condenser portion of the secondary circuit.
12. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary sealed primary circuit having a liquefying portion and an evaporating portion having a contact surface, said primary refrigerant circuit being resiliently supported upon the top of said cabinet, and thermal conducting means having a contact portion in thermal contact with the contact surface of the evaporating portion of the primary circuit and having a portion within the compartment for cooling said compartment.
13. A refrigerator including a refrigerator compartment containing a compartment to be kept cool, a unitary primary refrigerant circuit contained in a drawer slidably supported by said cabinet, said drawer containing an evaporator with an exposed contact surface at one end of the drawer, a compressor positioned in front of said evaporator, an electric motor positioned in front of said compressor and directly connected to which a fan mounted upon the front end of said motor shaft, a condenser mounted in front of the fan at the front end of the drawer, and means in thermal contact with said contact surface of said evaporator for cooling said compartment of said refrigerator.
14. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit contained in a drawer slidably supported by said cabinet beneath said compartment, said primary circuit having a liquefying portion and an evaporating portion, said evaporating portion having an exposed contact surface at one end of said drawer, a secondary fluid circuit having a portion exposed within said compartment for keeping said compartment cool, a contact portion attached to said cabinet having a contact surface fitting against said contact surface at the end of said drawer and means for lifting liquid within said secondary circuit from said contact surface to said portion exposed within said compartment.
15. A refrigerator including a cabinet having therein a compartment to be kept cool, a unitary primary refrigerant circuit contained in a drawer slidably supported by said cabinet beneath said compartment, said primary circuit having a liquefying portion and an evaporating portion, said evaporating portion having an exposed contact surface at one end of said drawer, a secondary fluid circuit having a portion exposed within said compartment for keeping said compartment cool, a contact portion attached to said cabinet having a contact surface fitting against said contact surface at the end of said drawer, and means for circulating a fluid through said secondary fluid circuit.
16. A refrigerating apparatus including a cabinet having a compartment therein to be cooled, a refrigerant circuit including an evaporator arranged in heat exchange relationship with the compartment and operatively connected to a condenser, said condenser having a heat dissipating portion outside said compartment, a second refrigerant circuit including a heat dissipating element and a heat absorbing element disposed exteriorly of said compartment, the heat dissipating portion of said condenser being in heat exchange

relationship with the heat absorbing element of said second named refrigerant circuit, and said second named refrigerant circuit being removable as a unit from said first named refrigerant circuit.

17. A refrigerating apparatus including a cabinet having a compartment therein to be cooled, a refrigerant circuit including an evaporator arranged in heat exchange relationship with the compartment and operatively connected to a condenser, said condenser having a heat conducting surface outside said compartment, a second refrigerant circuit including a heat dissipating element and a heat absorbing element disposed exteriorly of said compartment, the heat conducting surface of said condenser being in intimate thermal contact with the heat absorbing element of said second named refrigerant circuit, and said second named refrigerant circuit being removable as a unit from said first named refrigerant circuit.

18. A refrigerating apparatus including a cabinet having a compartment therein to be cooled, a refrigerant circuit including an evaporator arranged in heat exchange relationship with the compartment and operatively connected to a condenser, said condenser having a heat dis-

sipating portion outside said compartment, a second refrigerant circuit including a heat dissipating element and a heat absorbing element supported by said cabinet and disposed exteriorly of said compartment, the heat dissipating portion of said condenser being in heat exchange relationship with the heat absorbing element of said second refrigerant circuit, and said second named refrigerant circuit being removable as a unit from said first named refrigerant circuit and said cabinet.

19. A refrigerating apparatus including a cabinet having a compartment therein to be cooled, a refrigerant circuit including an evaporator disposed within the compartment and operatively connected to a condenser outside said compartment, a second refrigerant circuit including an evaporator and a condenser supported by a horizontal wall of said cabinet and disposed exteriorly of said compartment, the condenser of said first named refrigerant circuit being in intimate thermal contact with the evaporator of said second named refrigerant circuit, and said second named refrigerant circuit being removable as a unit from said first named refrigerant circuit.

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CERTIFICATE OF CORRECTION.

Patent No. 1,926,384.

September 12, 1933.

HARRY B. HULL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 94, claim 2, strike out the words "said circuit including a compressor, a condens-"; and line 96, after "circuit" insert the words having a secondary evaporator within the food; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of November, A. D. 1933.

F. M. Hopkins

(Seal)

Acting Commissioner of Patents.