March 16, 1943. L. W. ATCHISON 2,314,190

REFRIGERATING APPARATUS

Filed Feb. 21, 1941

Fig. 1.

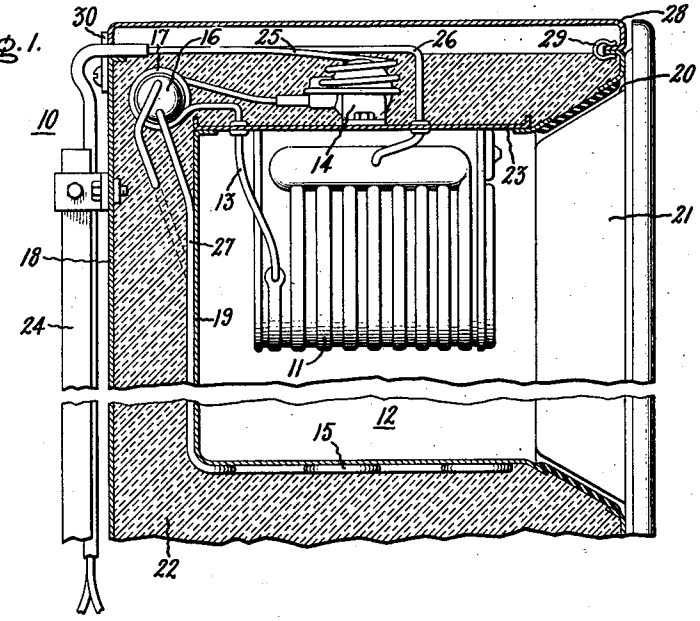


Fig. 2.

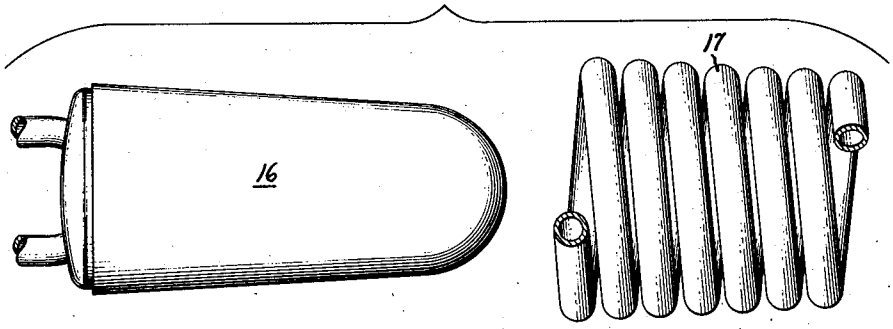


Fig. 3.

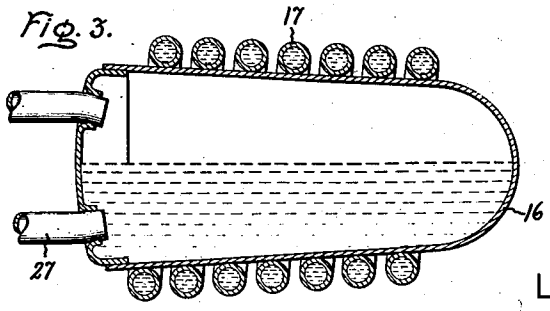
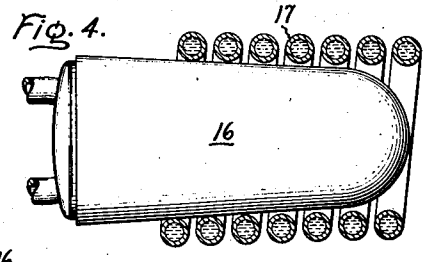


Fig. 4.



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REFRIGERATING APPARATUS

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6 Claims. (Cl. 62—115)

This invention relates to refrigerating apparatus and more particularly to refrigerating apparatus of the primary-secondary type.

It is an object of my invention to provide refrigerating apparatus of the primary-secondary type having an improved arrangement for the exchange of heat between the primary and secondary systems.

It is another object of my invention to provide refrigerating apparatus of the primary-secondary type in which the primary and secondary systems are readily separable.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing, in which Fig. 1 is a partial view, partly in section, of a refrigerator cabinet of the domestic type embodying the principles of my invention; Fig. 2 is an exploded, enlarged view of the parts comprising the heat exchanger illustrated in Fig. 1; Fig. 3 is a view in section illustrating the heat exchanger of Figs. 1 and 2 in the assembled relationship; and Fig. 4 is a different embodiment of my invention.

In accordance with my invention, I have provided a refrigerator 10 of the domestic type having a primary refrigerant system including an evaporator or cooling element 11 disposed in the upper portion of the food storage compartment 12 of the cabinet. In order to conduct refrigerant to the evaporator or cooling element, there is provided a conduit 13 for conveying a suitable refrigerant from a suitable flow controlling means, such as a float chamber 14, or a capillary tube, to the cooling element according to the load requirements. Any suitable control may be employed. There is also provided a secondary refrigerant system comprising a cooling portion 15 and a condensing portion 16. The condensing portion 16 of the secondary system and a portion 17 of the conduit 13 are disposed in intimate heat exchange relationship. The arrangement briefly described above is advantageous in that the transfer of heat between the secondary system and the section 17 of the primary system immediately preceding the admission of the refrigerant to the cooling unit 11 results in an increased amount of vaporized refrigerant supplied to the cooling unit and accordingly provides a greater injector capacity for the primary system. In addition, such refrigerant is furnished through the flow controlling means to the cooling unit only according to load requirements so that the secondary system functions proportionally to the load because heat is exchanged only when the refrigerator load requires cooling by the primary evaporator.

By arranging one of the portions, as the condensing portion 16 of the secondary system, in the form of a chamber or closed receptacle and forming the other portion 17 into a spiral coil, as by forming conduit 13 into a coil, disposed in good thermal relationship with the portion 16 and preferably arranging at least one of the portions with a generally tapered or conical surface, there is provided an arrangement in which the maximum heat exchange is achieved between the primary and secondary systems and yet the primary system may be removed from or placed in heat exchange relationship with the secondary system in a very simple manner so that the primary system may be removed from or introduced into the cabinet without disturbing the secondary system.

Describing my invention in greater detail, I have provided a refrigerator cabinet including a thermally insulated cabinet 10 having a compartment 12 for the storage of food. An access opening 20 in the front wall thereof is arranged to be closed by a thermally insulated door 21 suitably hinged to the front of the cabinet. The cabinet walls comprise an outer liner or casing 18 and an inner shell or lining 19, the space therebetween being filled with a suitable thermal insulating material 22 in order to minimize the transfer of heat between the interior and exterior of the cabinet. The top wall of the cabinet comprises a top liner 23 suitably secured in position and a cover 28 with thermal insulating material therebetween.

The evaporator 11 of the primary system is connected in the refrigerant circuit of a refrigerating machine including a motor compressor unit arranged in a machinery compartment, preferably below the food storage compartment 12. The complete details of the motor compressor unit and the refrigerating circuit have been omitted from the drawing for purposes of clarity. It is believed sufficient to state that refrigerant is supplied to the evaporator or cooling unit 11 from the condenser 24 through a liquid line 25 and float chamber 14 and the conduit 13. Vaporized refrigerant is returned to the motor compressor unit through a suction line 26, a portion of which is shown in Fig. 1.

During the operation of the primary system, the air in the upper portion of the compartment 12 is cooled by the cooling element and circulated downwardly, the warm air in the lower portion of the cabinet rising to take its place, the circulating air absorbing heat from the articles within the cabinet.

In a household refrigerator, it is frequently desirable to place closed containers therein for maintaining a relatively high humidity in order to prevent the dehydration of certain foods such as vegetables, for example. Frequently, such receptacles are placed adjacent the bottom wall of the food storage compartment. In many refrigerators of the domestic type now on the market, such storage receptacles are slidably supported in the lower portion of the food storage space. Because of the amount of space occupied by such receptacles only a limited circulation of air will take place therearound and there is therefore decreased cooling capacity available to absorb heat entering the food compartment through the lower portions thereof. It is, therefore, desirable to provide some arrangement for lowering the temperature of the lower portion of the inner liner 19. I have found that the additional cooling required may be obtained effectively by providing a secondary system including a liquid vaporizing cooling portion 15 secured in good thermal relationship to the bottom wall of the inner liner as by soldering, for example, and a second portion for condensing the vaporized refrigerant arranged in good heat exchange with a portion of the primary system. While I have illustrated in the drawing a particular arrangement of the cooling portion with respect to the inner liner, it will be understood that the cooling portion of the secondary system may be disposed wherever supplemental cooling is required.

In the embodiment of the invention illustrated in the drawing, I provide a closed conduit which is provided with a plurality of turns to form the cooling portion 15 secured to the bottom wall of the inner liner. The container or conduit is partially filled with vaporizable liquid refrigerant, not shown, so that the turns of the cooling portion 15 are maintained flooded therewith. During operation of the refrigerating machine, liquid in the cooling portion will be vaporized and the vapor will rise through the upright portion of the conduit into the condensing portion of chamber 16. The condensing portion of the secondary system is formed of a material having relatively good heat conducting characteristics and may be made in any desired form. I have found it most satisfactory to construct the chamber with at least a portion of the surface thereof slightly conical or tapered. As thus seen in Figs. 2 and 3, the gaseous refrigerant collects in the upper portion of the tank. The vaporized refrigerant in the condensing portion 16 will be cooled by the heat exchange with the portion or section 17 of the primary system and will be liquefied, the liquid returning to the lower portion of the closed system through a conduit 27. Thus, heat is carried away from the vapor rising from the lower portion of the conduit and the cooled liquid returning tends to supplement the cooling of the lower portion of the liner.

In order to maintain the portions 16 and 17 of the secondary and primary systems, respectively, in good heat exchange relationship, I have shown a portion of the conduit 13 formed into a spiral coil. The coil is made from a relatively resilient and flexible material which also has good heat conducting characteristics, as copper tubing. Preferably, one or both of the portions is formed, as by tapering, in such a way that the turns 25 of the coil portion 17 engage the other portion successively during the assembly of the system. By forcing the first turn of the coil to assume a larger diameter, the next turn will tend to be drawn into a position of smaller diameter to compensate for the expansion of the first turn, thereby drawing successive turns into close engagement. Therefore, slight inaccuracies in the formation of the coil portion will be neutralized and good contact between portions will be enhanced. If the coil portion is tapered, or conical, or if both portions are tapered, it is desirable that the larger end thereof first engage the other portion. If desired, all turns of the coil may be nominally of the same diameter, in which case it is preferable to taper the tank or chamber to permit successive engagement with the turns of the coil portion as described above. Thus, in Fig. 4 there is illustrated an embodiment of my invention in which both portions 16 and 17 are generally conical, the surface of the tank 16 having a greater slope than the slope of the coil portion 17. However, if desired, the portions 16 and 17 may be so dimensioned that all contacting surfaces engage at substantially the same time. Thus, in the arrangement illustrated in Figs. 2 and 3, the slope of the spiral portion 17 is the same as the slope of the condensing portion or tank 16.

In assembling a cabinet according to my invention, I first arrange the outer casing and the inner liner in their proper places with the insulating material therebetween and the conduit forming the secondary system secured to the outside of the lining 19. The refrigerating machine is assembled separately, the cooling unit 11 being suitably secured to the top liner 23 of the cabinet. The evaporator or cooling unit is then lowered through the upper end of the cabinet and the top liner suitably secured to the inner liner 19. The portions 16 and 17 of the secondary and primary systems are then suitably joined together in intimate thermal association by forcing the portion 16 into wedging engagement with the spiral coil 17 until all the turns of the spiral portion 17 are in engagement with the conical surface of the tank 16. Insulation is then placed across the top of the cabinet and the cover 28 is then applied, the inturned flanges of the cover and the outer casing being engaged by a spring clip as indicated by the numeral 29 at the front edge of the cabinet and the rear end of the cover being suitably secured to the outer liner 18 as by means of member 30 suitably secured to the cover and the outer case.

While I have illustrated the heat exchange portions of the primary and secondary systems in the insulation space between the walls of the cabinet, it will be understood that the heat exchange may take place at any suitable point between the condensing portion and the primary system.

While the condensing portion 16 or the portion 17 of the primary system or both are preferably tapered as previously explained, it is within the scope of my invention and obvious to those skilled in the art either or both portions 16 and 17 may be tapered or not as desired.

While I have described an embodiment of my

invention in connection with a household refrigerator, other applications will readily be apparent to those skilled in the art. For example, the portions 16 and 17 of the heat exchanger need not be circular in cross section in all embodiments of my invention. I do not, therefore, desire my invention to be limited to the particular construction shown and described and I intend in the accompanying claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condensing portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being in the form of a spiral coil the turns of which are free to move relative to each other, said coil being removably disposed in intimate thermal engagement with the other of said portions.

2. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condenser portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being formed of material which is also relatively resilient and disposed in a coil having intimate thermal engagement with the other of said portions, one of said portions being shaped to provide a wedging action between the turns of said coil and the other of said portions when said portions are moved into engagement with each other.

3. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condenser portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being formed of material which is also relatively resilient and flexible and disposed in a coil having intimate thermal engagement with the other of said portions, and one of said portions being shaped to provide a wedging action between the turns of said coil and the other of said portions when said portions are moved into engagement with each other.

4. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condensing portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being disposed in a spiral coil having intimate thermal engagement with the other of said portions, at least a part of the other of said portions being provided with a generally conical surface, said portions being so dimensioned that the turns of said coil engage said conical surface successively as said portions are moved into engagement with each other.

5. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condensing portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being disposed in a spiral coil having intimate thermal engagement with the other of said portions, at least one of said portions being generally conically shaped and so dimensioned that the larger end of the coil first engages the surface of the other of said portions during the assembly thereof.

6. Refrigerating apparatus comprising a primary and a secondary refrigerant system, means for transferring heat between said systems, said means comprising a condenser portion in said secondary system and a portion of said primary system in heat exchange relationship therewith, said portions being formed of relatively good heat conducting material, one of said portions being formed of material which is also resilient and flexible and disposed in a coil having intimate thermal engagement with the other of said portions, one of said portions being so arranged and constructed that the turns of said coil are caused successively to engage said other portion with a wedging action as said portions are moved into engagement with each other.

LEONARD W. ATCHISON.