Nov. 29, 1960 H. A. EHRENFREUND 2,961,851

REFRIGERATION APPARATUS

Filed March 12, 1958 2 Sheets-Sheet 1

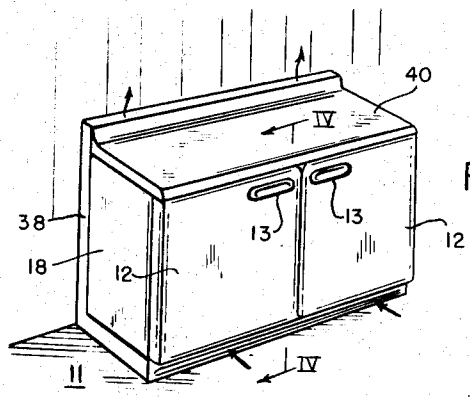


FIG. 1.

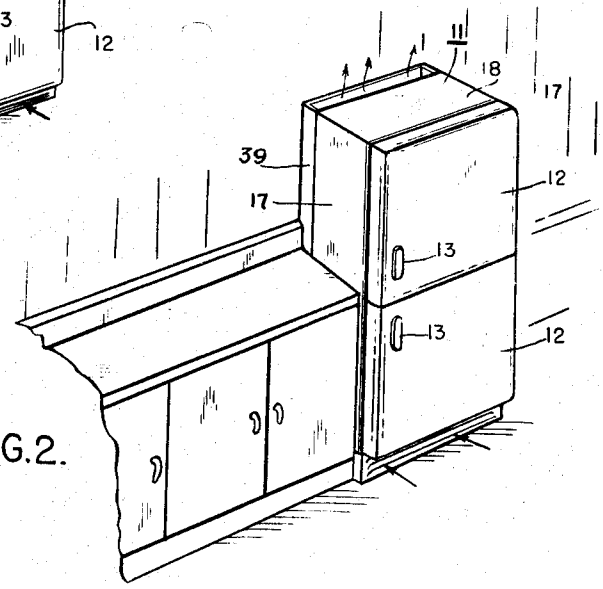


FIG. 2.

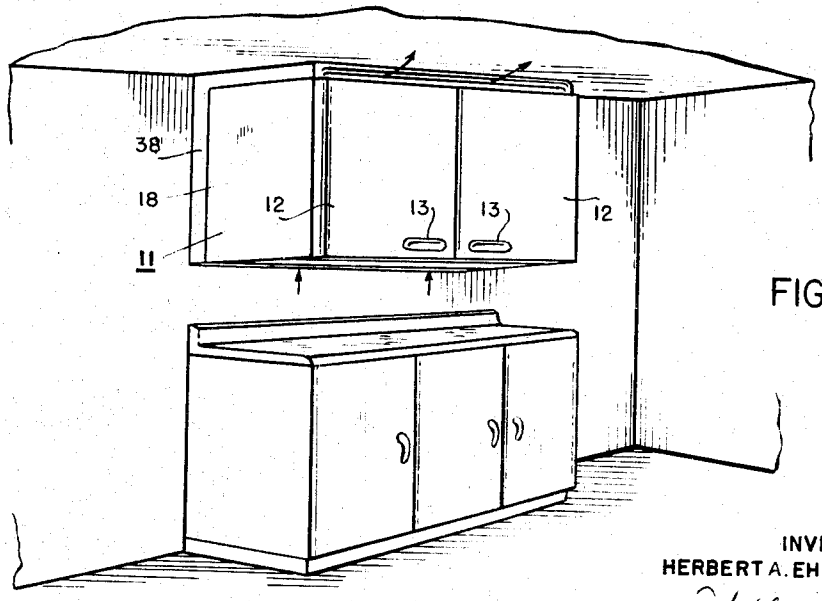


FIG. 3.

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FIG. 4.

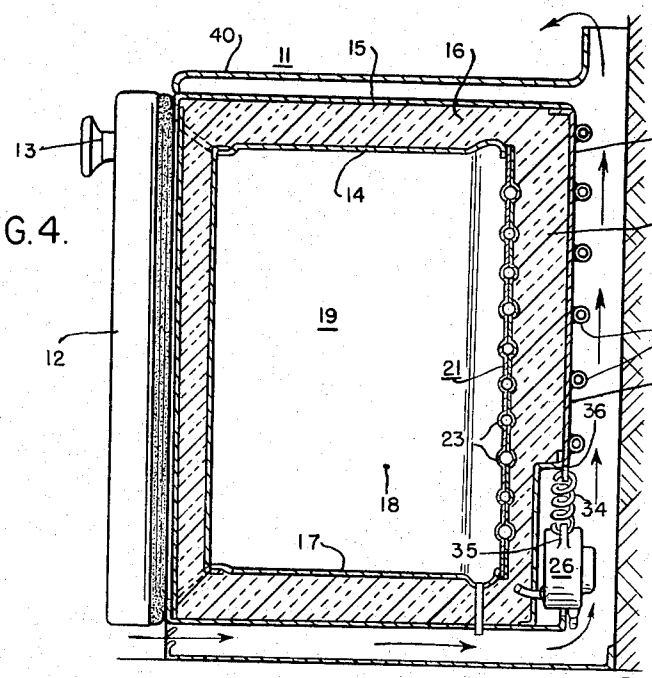
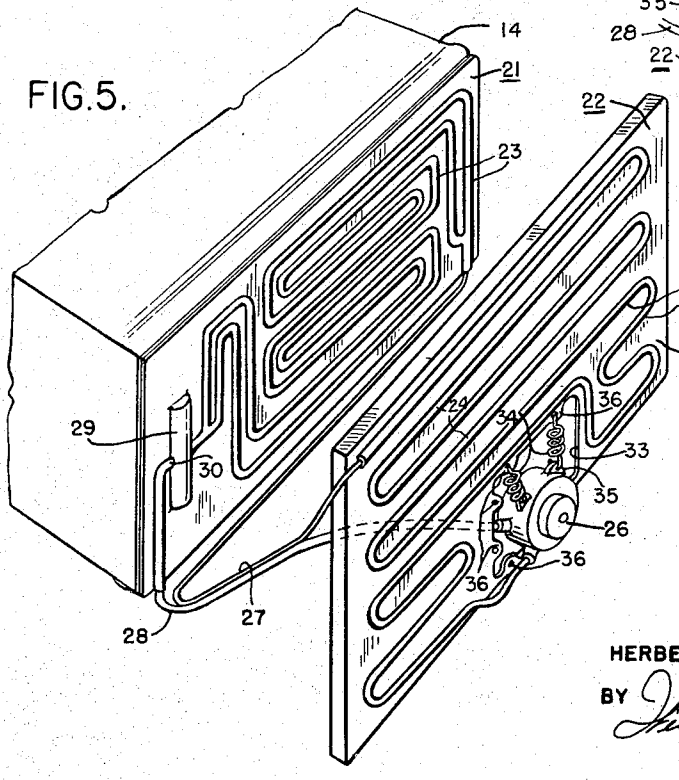


FIG. 5.



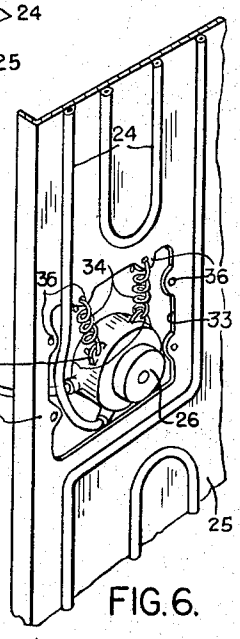


FIG. 6.

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REFRIGERATION APPARATUS

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5 Claims. (Cl. 62—448)

This invention relates to refrigeration apparatus and more particularly to an improved refrigerating system and an improved system mounting arrangement for changeable attitude refrigerator cabinets.

There are numerous types of domestic refrigerator cabinets being sold today and, generally, each cabinet type or style is intended to be installed in a particular attitude, i.e. in a particular position relationship to the walls and floor of the room in which it is installed, as well as in a particular position relationship with respect to adjacent or nearby cabinet structures. This invention envisions manufacturing a single refrigerator cabinet type, or style, which is adaptable to a number of different installations requiring the cabinet to be placed in different attitudes. It can be readily appreciated that the operations of the manufacturer can be simplified and its costs reduced by producing a single adaptable refrigerator capable of meeting the requirements of several installations, instead of producing a specially designed and constructed refrigerator for each installation.

More particularly, this invention permits a box-like refrigerator to be constructed which can be installed as a horizontal, under-the-counter facility; as an upright free-standing or built-in facility; or as an elevated, wall-mounted, or overhead cabinet, facility. Moreover, the construction of this new refrigerator is such that the transition from one installation to another can be quickly and easily made with but minor changes or adjustments being required for the refrigerator cabinet and the refrigerating system therefor.

The invention contemplates providing the refrigerator with a refrigerating system in which the evaporator or cooling unit is adapted to function in the several attitudes in which the cabinet can be installed. Since the pump or motor-compressor unit of a compression refrigerating system generally must be maintained in one particular attitude in order to function properly and efficiently, the invention further contemplates mounting the pump on the refrigerator cabinet structure by means of a changeable supporting system which permits the attitude of the pump to be changed with respect to the cabinet so that the pump can be positioned in its required operating attitude for each installation of the cabinet.

Other features and advantages of the invention will appear from the following detailed description thereof in which reference is made to the accompanying drawings wherein:

Fig. 1 illustrates, in perspective, a refrigerator constructed in accordance with this invention and installed as an under-the-counter facility;

Fig. 2 illustrates, in perspective, the refrigerator installed as a freestanding, upright facility;

Fig. 3 illustrates, in perspective, the refrigerator installed as a wall mounted, overhead facility;

Fig. 4 is a vertical sectional view through the refrigerator installation of Fig. 1, taken as indicated by the line IV—IV in Fig. 1;

Fig. 5 is an exploded perspective view of the refrigerating system for the improved refrigerator; and,

Fig. 6 is a partial perspective view of the refrigerating system shown in Fig. 5, but illustrating the pump mounting for the refrigerator when installed as shown in Fig. 2.

This invention is intended to find particular usefulness in connection with refrigerator cabinets of the type that are generally found in private residences and which are installed in the kitchen of the residence. Such refrigerators are required to decoratively blend with other cabinets and appliances in the kitchen and different users have different tastes and ideas as to the type of installation they require in order ot obtain maximum usefulness and the most pleasing appearance from their refrigerator. The refrigerator cabinet shown in the drawings and identified generally by the reference numeral **11** offers sufficient flexibility in installation to satisfy many of these tastes and ideas of the numerous users. Exteriorly, the cabinet **11** presents a more or less conventional appearance since it is box-like in configuration and has a pair of access doors **12** hingedly mounted on the front of the cabinet and which are equipped with handles **13**.

The under-the-counter installation of Fig. 1 is illustrated in greater detail in Fig. 4, wherein the construction of the cabinet **11** and the refrigerating system therefor are illustrated. The cabinet structure **11** includes inner and outer shells designated **14** and **15**, respectively, which are separated by heat insulation **16**, and side walls **17** and end walls **18** surrounding a storage compartment **19**. In accordance with this invention, the cabinet rear wall **20** is formed by two plate-like heat exchanger units **21** and **22** which are separated by the heat insulation **16**. The inner heat exchanger **21** functions as a cooling unit for extracting heat from the compartment **19**. This heat exchanger **21** is the evaporator portion of a compression refrigerating system, the condensing portion of which comprises the outer heat exchanger **22**. The evaporator **21** is sealed to the rear edge of the cabinet inner shell **14**, and the condenser **22** is sealed to the rear edge of the outer shell **15**; forming a substantially moisture impervious enclosure for the compartment **19**.

The evaporator **21** is preferably formed of a pair of metal sheets having embossed portions which define refrigerant flow passages **23** therein. The condenser **22** also includes refrigerant flow passages which are provided by a serpentine tube **24** which is attached to a metal sheet **25**.

Refrigerant is circulated through the passages of the evaporator **21** and the condenser **22** by a pump, or motor compressor unit, **26**. In operation, the pump **26** delivers compressed refrigerant vapor to the condenser **22**, wherein heat is dissipated from the refrigerant, which liquefies and flows through a capillary restrictor tube **27** into the evaporator **21**. The refrigerant vaporizes in the evaporator **21**, absorbing heat from the compartment **19** and is returned by way of a suction conduit **28** to the pump **26**. To insure the return of gaseous fluid only to the pump **26**, a surge tank, or vessel **29**, is disposed in the refrigerant circuit at the outlet end of the evaporator passages **23**. The tank **29** functions to trap liquid refrigerant that is pumped through the evaporator **21**.

The evaporator **21** and the surge tank **29** are so constructed and arranged with respect to one another so as to be capable of functioning in any one of several attitudes that they may assume when the refrigerator cabinet **11** is placed in various installations. It will be noted from Figs. 4 and 5 that the evaporator **21** is disposed in a substantially vertical plane, parallel to the vertical rear wall **20** of the cabinet. The evaporator will, therefore, remain in this vertical plane even though the refrigerator is tilted to the several different attitudes in which the refrigerator can be installed. Several features of construction of the evaporator **21** assure that it will

function in this manner. In the first place, the surge tank 29 is an elongated vessel disposed substantially parallel to the end walls 18 of the cabinet 11. The refrigerant outlet for the tank 29, which is indicated at 30, is disposed substantially midway between the ends of the tank 29 so that there is substantially equal internal volume above and beneath the outlet 30 when the refrigerator is disposed in the attitude illustrated in Figs. 4 and 5. It can readily be appreciated that the tank 29 can be inverted without appreciably affecting its ability or capacity to trap liquid refrigerant issuing from the evaporator passages 23.

It will also be noted from Fig. 5 that the middle of the tank 29 is disposed substantially on a line that divides the total volume of the refrigerant passages 23 into two equal portions. Thus, but little change will be made in the refrigerant flow characteristics through the evaporator 21 when the refrigerator is installed in such a manner that the evaporator 21 is inverted from the position shown in Fig. 5.

The evaporator 21 will also function when tilted 90° clockwise from the position shown in Fig. 5. Disposing the evaporator 21 in this attitude places the surge tank 29 above the evaporator passages 23, in which position it remains effective to prevent the return of liquid refrigerant to the pump 26. The tank 29 is of sufficient width to prevent refrigerant liquid flowing out of the evaporator passages 23 from passing upwardly through the tank outlet 30 even though the tank is in a substantially horizontal attitude.

It can thus be seen that the evaporator 21 is capable of functioning, in cooperation with the surge tank 29, in the position illustrated in Figs. 4 and 5, which corresponds to the under-the-counter installation for the refrigerator, such as shown in Fig. 1; is also capable of functioning in an inverted attitude, such as it would assume when the refrigerator is installed in a wall mounted installation such as shown in Fig. 3; and will also function when tilted 90° from the position shown in Fig. 5, which is the attitude that it assumes when the refrigerator is installed upright, as shown in Fig. 2.

A conventional motor compressor unit for refrigerators, and this is the type employed as the pump 26, generally must be maintained in a predetermined attitude or in one of a limited number of attitudes in order to function properly. This is so because such units generally have their internal parts lubricated by a supply of oil disposed in a sump in the lower portion of the unit. Tilting the pump results in displacement of this body of oil, with the consequent loss of lubrication for the motor and compressor parts. In accordance with this invention, however, proper operation of the pump 26 is assured because the pump 26 is mounted on the refrigerator cabinet 11 in such a manner as to permit its attitude relative the cabinet to be changed as the cabinet attitude is changed, to insure that the pump 26 will always be in its attitude for proper operation.

The changeable, or adjustable, supporting means for the pump 26 is illustrated in Figs. 4 through 6 of the drawings. In accordance with the invention, the pump 26 is resiliently suspended within an opening 33 in the condenser sheet 25 by means of a pair of helical springs 34. The springs 34 have hook-like ends which engage upright ears 35 on the pump 26 and hook into eyelets 36 formed in the edge of the mounting opening 33. Three edges of the opening 33 are provided with pairs of these mounting eyelets 36 so that the pump 26 can be suspended in any one of three positions relative the refrigerator cabinet 11. Fig. 5 illustrates the manner in which the pump 26 is supported when the refrigerator cabinet 11 is installed as shown in Fig. 1. When the cabinet is installed as shown in Fig. 3, the pump 26 is inverted with respect to the cabinet and the support springs 34 therefor are hooked through the pair of eyelets 36 which are opposite the eyelets in which the springs are hooked in Fig. 5. Fig. 6 illustrates the third mounting position of the pump 26 with respect to the cabinet and which is employed when the refrigerator cabinet is installed as shown in Fig. 2.

Referring again to Figs. 1, 2 and 3, it will be noted that the locations for the handles 13 near the upper inner edge of each door 12 renders the handles useful for all three of the different installations illustrated, and no change in mounting of the handles 13 need be made when changing the refrigerator from one type of installation to another. The location of the hinge supports for the door 12 should, however, be changed when changing from a horizontal installation, such as shown in Figs. 1 and 3, to an upright installation, such as shown in Fig. 2, or vice versa. The installations of Figs. 1 and 3 require the hinge axis to be located along the edge of the cabinet end walls 18, whereas the installation shown in Fig. 2 requires the hinge axis to be located along the edge of one of the cabinet side walls 17.

Some specially adapted accessories may be required for the cabinet 11 for different installations. For example, the rear wall 20 of the cabinet 11 should be spaced from the wall of the room in which the cabinet is installed, in order to permit air to flow over the condenser 22 to carry away heat. Thus, the installations of Figs. 1 and 3 include an L-shaped air channel 38, which may be the same for both installations, and which provides a path for air around the the cabinet 11 and over the condenser 22. The cooling air path for the under-the-counter installation of Fig. 1 is shown in Fig. 4, and the direction of air flow is indicated by arrows. Likewise, in Fig. 3, the arrows indicate the path of condenser cooling air. A somewhat narrower and longer air channel 39, as shown in Fig. 2, is provided for the upright installation shown in this figure of the drawing. In addition, the refrigerator cabinet 11, when installed as shown in Figs. 1 and 4, may have a counter top 40 placed on the upper surface thereof.

From the foregoing, it will be apparent that this invention enables a refrigerator to be constructed which is capable of being installed in more than one attitude, thus eliminating the need for manufacturing several different refrigerator models, one for each installation requirement.

While but one form of the invention has been described, it will be apparent to those skilled in the art that changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a refrigerator adapted for alternative installation in more than one attitude, a box-like cabinet structure defining a storage compartment, a refrigerating system for cooling said compartment, said refrigerating system comprising a condenser, an evaporator and a pump connected in closed, series-flow relationship, said pump being adapted to operate in but one attitude, and means for supporting said pump on said cabinet structure, said supporting means permitting the attitude of said pump with respect to said cabinet structure to be altered, whereby said pump can be made to assume its said one attitude when said cabinet structure is placed in any of the attitudes in which it is adapted to be installed.

2. In a refrigerator adapted for alternative installation in more than one attitude, a box-like cabinet structure defining a storage compartment, said cabinet structure including one wall that is vertically arranged in each of the attitudes that the refrigerator is adapted to be installed, an evaporator for cooling said compartment, said evaporator being of plate-like configuration and being arranged substantially parallel to said one wall of the cabinet structure, said evaporator being adapted to function in more than one attitude, a condenser, a pump for circulating refrigerant through said condenser and said evaporator, said pump being adapted to oper-

ate in but one attitude, and means for supporting said pump on said cabinet structure, said supporting means permitting the attitude of said pump with respect to said cabinet structure to be altered whereby said pump can be made to assume its said one attitude when said cabinet structure is placed in any of the attitudes in which it is adapted to be installed.

3. In a refrigerator adapted for alternative installation in three attitudes, a box-like cabinet structure defining a storage compartment, said cabinet structure having one wall thereof that is vertically disposed in all three of the attitudes in which the refrigerator is adapted to be installed, an evaporator having refrigerant passages therein and adapted for cooling said compartment, said evaporator being of plate-like configuration and being disposed in said cabinet structure substantially parallel to said one wall, said evaporator having a surge tank connected to the outlet of the refrigerant passages therein, said surge tank comprising an elongated vessel having refrigerant outlet means communicating therewith substantially midway between the ends thereof, said tank being disposed between one edge of said evaporator and the refrigerant passages in the evaporator on a line dividing the internal volume of said passages into two substantially equal portions, a condenser, a pump for circulating refrigerant through said condenser and said evaporator, said pump being adapted to operate in but one attitude, and means for supporting said pump on said cabinet structure, said supporting means permitting the attitude of said pump with respect to said cabinet structure to be altered whereby said pump can be made to assume its said one attitude when said cabinet structure is placed in any of the attitudes in which it is adapted to be installed.

4. In a refrigerator, a box-like cabinet structure defining a storage compartment, a refrigerating system for cooling said compartment, said refrigerating system comprising an evaporator having refrigerant passages therein, a condenser having refrigerant passages therein, a pump for circulating refrigerant through said condenser and said evaporator, and conduit means connecting said pump, said condenser and said evaporator in a closed, series-flow circuit, said evaporator having a surge tank connected to the outlet of the refrigerant passages therein, said surge tank comprising an elongated vessel having

refrigerant outlet means communicating therewith substantially midway between the ends of the tank, said tank extending substantially parallel to one side of said cabinet structure and having its outlet disposed on a horizontal line dividing the internal volume of the refrigerant passages of said evaporator into two substantially equal portions, the construction and arrangement being such as to permit said refrigerator to be installed for operation in either one of two attitudes, one of which is the inverse of the other, said one side of said cabinet structure being arranged vertically in both of said attitudes.

5. In a refrigerator, a box-like cabinet structure defining a storage compartment, a refrigerating system for cooling said compartment, said refrigerating system comprising an evaporator having refrigerant passages therein, a condenser having refrigerant passages therein, a pump for circulating refrigerant through said condenser and said evaporator, and conduit means connecting said pump, said condenser and said evaporator in a closed, series-flow circuit, said evaporator having a surge tank connected to the outlet of the refrigerant passages therein, said surge tank comprising an elongated vessel having refrigerant outlet means communicating therewith substantially midway between the ends thereof, said tank extending substantially parallel to one side of said cabinet structure between said one side and the said refrigerant passages of said evaporator, and along a line dividing the internal volume of the refrigerant passages of said evaporator into two substantially equal portions, the construction and arrangement being such as to permit said refrigerator to be installed for operation in either one of three attitudes, two of which are relative inverse attitudes in which said one side of said cabinet structure is arranged vertically, and a third attitude 90° angularly displaced from each of said first two attitudes and in which said one side of said cabinet structure is uppermost.

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