Oct. 28, 1941. H. E. BLOOD 2,260,825

REFRIGERATING APPARATUS

Filed June 3, 1939 2 Sheets-Sheet 1

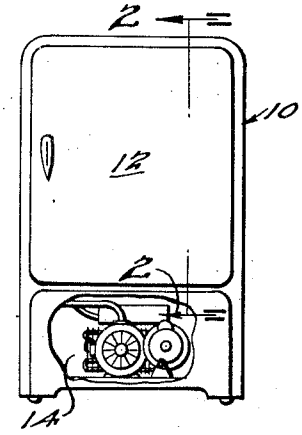


FIG. 1.

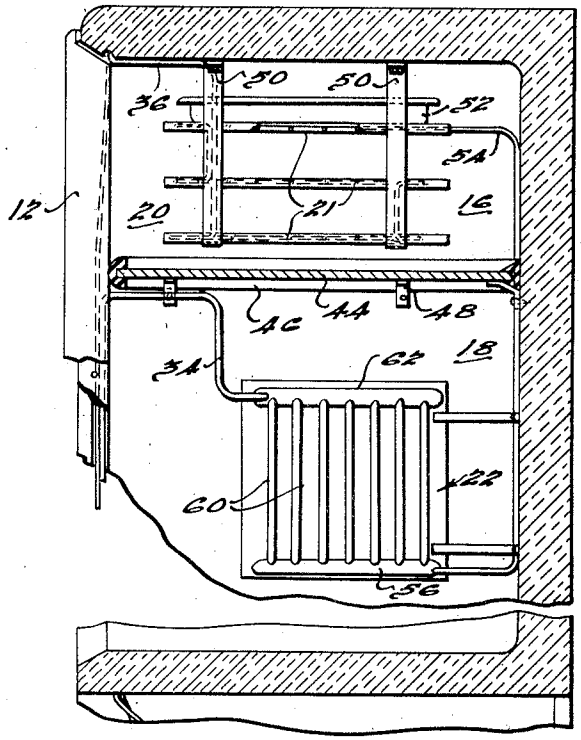


FIG. 2.

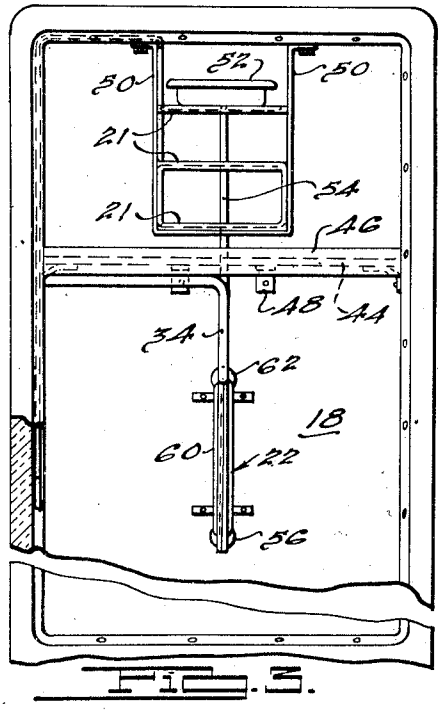


FIG. 3.

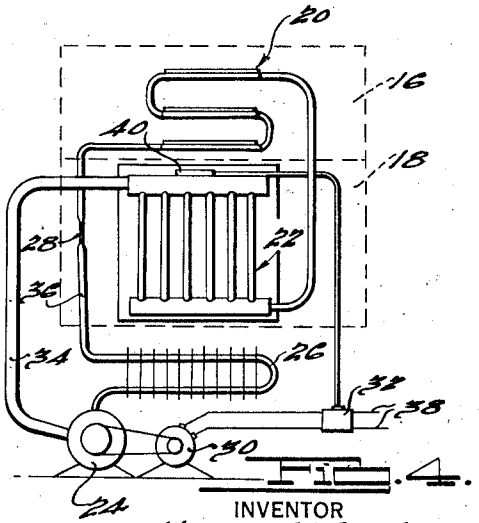


FIG. 4.

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REFRIGERATING APPARATUS

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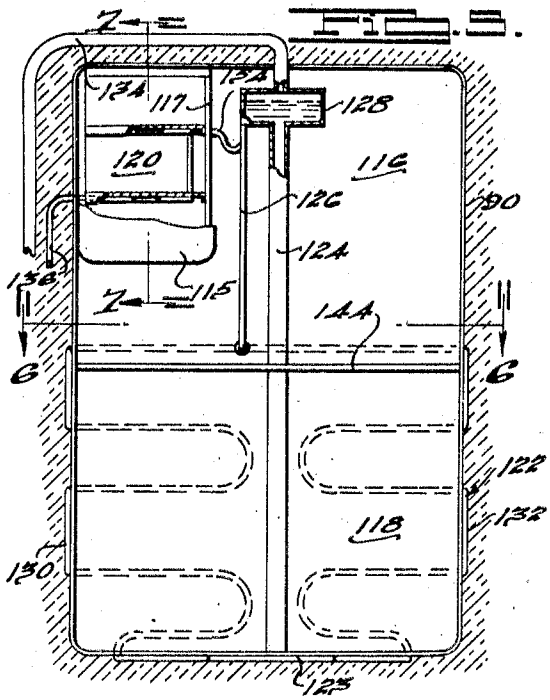


FIG. 3.

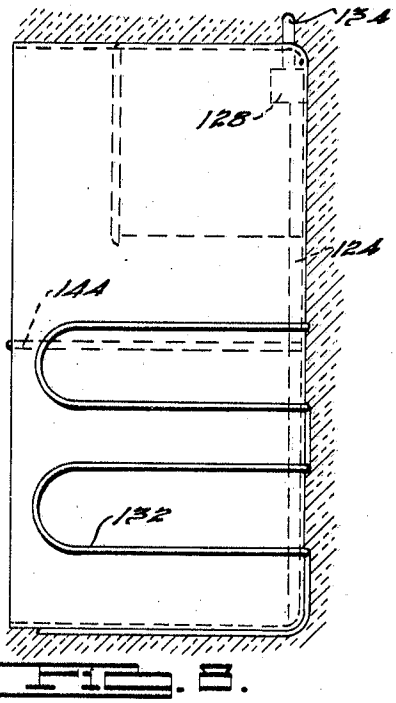


FIG. 4.

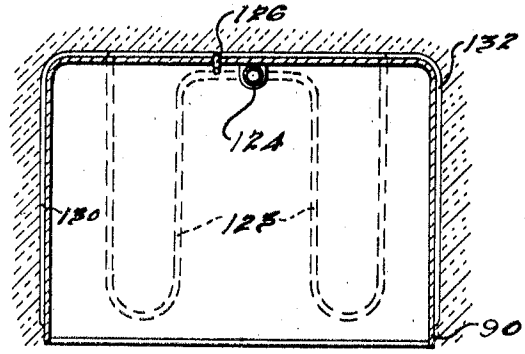


FIG. 5.

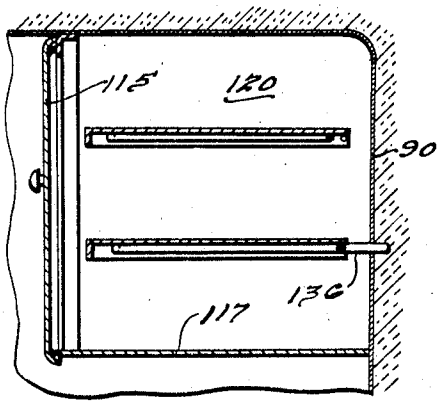


FIG. 2.

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2,260,825

REFRIGERATING APPARATUS

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Application June 3, 1939, Serial No. 277,207

3 Claims. (Cl. 62—116)

This invention relates to the art of refrigeration and has reference to a novel construction and arrangement of the "low side" of a refrigerating system with respect to a provision compartment.

My invention contemplates the provision of a heat insulated compartment divided into two or more parts in combination with a heat absorbing element operatively associated with each of said parts in such a manner as to produce optimum temperature and humidity conditions for the storage of food stuffs or other materials within such parts.

The invention in the form selected for purposes of illustration is particularly adapted for use as a household refrigerator although it is contemplated that my invention has general utility in the art of refrigeration.

A principal object of my invention is to provide refrigerating apparatus which is particularly adapted for storing different types of provisions under different temperature and humidity conditions.

Another object of the invention is to provide refrigerating apparatus of the so-called "two-temperature" type which is cheaper in construction and more efficient in operation than many of the constructions heretofore known to the art.

Another object of the invention is to provide a novel and highly useful form of construction for refrigerators of the household type.

Another object of the invention is to provide a new and highly useful arrangement of the "low side" of a refrigerating system with respect to a heat insulated compartment divided into several parts, portions of the "low side" being associated with each of said parts in such a way as to produce different temperature and humidity conditions in one part than is produced in any of the other parts.

For a better understanding of my invention reference may now be had to the following specification taken in conjunction with the accompanying drawings of which there are two (2) sheets and wherein:

Fig. 1 is a front elevational view of a refrigerator of the household type, certain parts thereof being broken away;

Fig. 2 is a vertical sectional view taken in a plane along the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a front elevational view, with parts omitted or broken away, of the heat insulated provision compartment illustrated in Fig. 2;

Fig. 4 is a diagrammatic illustration of one form of refrigerating system designed for use in connection with my invention;

Fig. 5 is a front elevational view of a heat insulated compartment illustrating a modified form of the invention;

Fig. 6 is a horizontal sectional view taken in a plane along the line 6—6 of Fig. 5 and looking in the direction of the arrows;

Fig. 7 is a vertical section taken in a plane along the line 7—7 of Fig. 5 and looking in the direction of the arrows; and

Fig. 8 is a side elevational view of the provision tank lining and the refrigerant coils associated therewith.

Referring now to Fig. 1 there is illustrated a household refrigerator comprising a heat insulated cabinet 10 providing a storage or provision compartment closed by the door 12 and an apparatus compartment 14. As diagrammatically illustrated in Fig. 4, the storage or provision compartment may be divided into two separate compartment 16 and 18, the compartment 16 having arranged therein an evaporator 20 and the compartment 18 having arranged therein an evaporator 22. The evaporators 20 and 22 may, as illustrated, be connected in series and comprise the "low side" of a refrigerating system which includes a compressor 24, a condenser 26, a refrigerant expansion control 28, an electric motor 30 and a thermally operated switch 32. The compressor, condenser and motor may be arranged in the apparatus compartment and connected by suction line 34 and liquid line 36 to the evaporators or heat absorbing elements 20 and 22. In the particular form of refrigerating system illustrated, liquid refrigerant is supplied under the control of a refrigerant expansion control 28 to the evaporator 20 and thence in series to the evaporator 22 while vaporous refrigerant from the evaporators is returned through suction line 34 to the intake side of the compressor. The circuit 38 of the motor 30 is controlled by the switch 32 and the switch in turn may be operated by a thermostatic element 40 thermally associated with one of the evaporators, such as evaporator 22, so as to operate the system in such a way as to maintain the temperature of the evaporators within certain predetermined limits.

Referring now to Figs. 2 and 3, the cabinet 10 may be constructed so as to provide a large heat insulated compartment, the access to which is closed by door 12. The compartment may be divided by a partition 44 so as to form compartments 16 and 18. Partition 44 may be of glass,

metal or any other suitable material and preferably is provided with a large peripheral rubber bead or gasket 46 which has sealing engagement with the side and rear walls of the heat insulated compartment and also with the interior face of the door so as to completely separate or prevent air circulation between the compartments 16 and 18 when the door 12 is closed. On the other hand, if desired, the bead 46 of the partition 44 may have a loose fit with the inside walls of the compartment so as to permit a small amount of air circulation between the compartments 16 and 18 when the door 12 is closed. The partition 44 preferably is formed of transparent material, such as glass, and is removably supported at several different elevations, such as by a plurality of clips 48 fastened to the side walls of the compartment, thereby permitting the removal or adjustment of such partition 44, if desired.

The evaporator 20 may consist of a plurality of shelves 21 through the coils of which refrigerant is circulated. The shelves 21 may be supported, as illustrated, from the upper wall of the cabinet by means of a pair of brackets 50. Shelves 21 are primarily adapted to support liquid holding trays, such as ice trays, and the refrigerant coils of the shelves 21 extend back and forth on the underside of each of the shelves so as to provide a comparatively large amount of heat exchange surface between the refrigerant in the coils and the material in the trays 52. Refrigerant under the control of the refrigerant expansion control 28 is supplied to the bottom shelf 21 by the liquid line 36 and from the bottom shelf 21 refrigerant flows in series through the coils of the upper shelves and thence is conducted by conduit 54 to a bottom header 56 of the evaporator 22. The evaporator 20 includes a sufficient amount of refrigerant coil or refrigerated surface to cool the air in the compartment 16, as well as whatever provisions may be stored therein.

The evaporator 22, arranged within the lower compartment 18, may consist of a vertically arranged plate having refrigerant ducts or passages formed therein and arranged within the compartment 18 in such a manner that the air therein will circulate in heat exchange with both sides thereof. Evaporator 22 may consist of a pair of sheet metal plates preformed to provide refrigerant ducts 60 connecting lower header 56 with upper header 62. Suction line 34 is connected to the upper header 62 for returning vaporous refrigerant and oil entrained therein to the intake side of the compressor 24.

The evaporator 22 preferably may be operated at a temperature level of from 19 to 29° F. and should be of such size as to maintain the temperature within the compartment 18 in the neighborhood of 35 to 45° F., although, it is appreciated that the evaporator 22 may be operated at any desired temperature level.

The evaporator 20 may be operated at a temperature level of from 0 to 10° F. and be of such size relative to that of the compartment 16 so as to maintain the temperature thereof from 15 to 25° F., although, it is appreciated that the evaporator 20 may be operated at any other temperature to give any desired temperature effect in the compartment 16. If desired, the evaporator 20 may be shielded from the circulating air within the compartment 16 so as to prevent such air from coming into contact with the material in the trays 52. This would be particularly desirable if the partition 44 were removed under which conditions, of course, the temperature within the entire compartment would be substantially the same. It is also contemplated that the evaporators 20 and 22 may be operated at substantially the same temperature level either with or without the partition 44 being arranged in place. With the partition 44 arranged in the position illustrated, and with the evaporators 20 and 22 operating at substantially the same temperature level, it would be possible, for instance, to obtain different humidity conditions within the compartments 16 and 18. However, it is considered preferable to operate the evaporators 20 and 22 at different temperature levels, as previously indicated, so as to obtain different temperature and humidity conditions within each of the compartments 16 and 18.

One manner in which the evaporators 20 and 22 may be operated at the same suction pressures but at different temperatures in the system illustrated is by using a binary refrigerant in the system, each component thereof boiling or evaporating at a different temperature. For example, a solution or mixture of one or more refrigerant components such as 90 to 95%, by weight, of sulphur dioxide (SO_2) and 5 to 10%, by weight, of dichlorodifluoromethane (CCl_2F_2). A system such as the one illustrated in Fig. 4 and charged with a refrigerant such as the binary refrigerant previously indicated will operate to produce refrigeration at a lower temperature in the evaporator 20 than the temperature at which refrigeration will be produced in the evaporator 22. This is so because the refrigerant solution or mixture in evaporator 20 will contain a higher percentage of the more volatile component than is present in the solution or mixture in the evaporator 22, thereby causing the refrigerant in evaporator 20 to boil at a lower temperature than that at which the refrigerant solution or mixture will boil in the evaporator 22. The temperature differential between the evaporators 20 and 22 may be controlled or varied by using different percentages of the components in the refrigerating system.

The refrigerant medium in circulating through the system is delivered in liquid form to the evaporator 20 wherein a percentage of each of the components of the refrigerant will vaporize in going through the coils of the evaporator 20 and the remainder of the mixture or solution, together with the gas generated in the evaporator 20, will be delivered to the evaporator 22. The evaporators 20 and 22, it will be observed, are operated at substantially the same suction pressure. In the evaporator 22, the remainder of the liquid refrigerant is vaporized and all of the refrigerant vapor is thence returned through suction line 34 into the intake side of the compressor. In the condenser, all of the refrigerant vapor is converted into liquid form.

While I have illustrated one particular form of two-temperature refrigerating system, I contemplate that other forms of two-temperature systems may be used although I believe the form illustrated to be more efficient and more useful in connection with the particular arrangement of the evaporators relative to the provision compartment than other types of two-temperature systems.

In the modification illustrated in Figs. 5 to 8, the tank 90, which forms the lining of the heat insulated compartment, may be provided internally thereof with a partition 144 which co-

operates with the walls thereof to provide compartments 116 and 118. A door, such as the door 12 of Fig. 2, is adapted to close the access opening to the compartments 116 and 118. The partition 144 may be arranged in a manner similar to that described in connection with partition 44 of Fig. 2. In Fig. 5, the evaporator 120, which is generally similar in construction to the evaporator 20, is arranged within the upper left hand corner of the upper compartment 116 and shielded from the circulating air therein by partition 117 and closure member 115. The partition 117 preferably cooperates with the adjacent walls of the tank lining 90 to enclose the space within which evaporator 120 is arranged and access to this space may be had through closure member 115 which may be pivotally supported in any suitable way.

The evaporator 122 for cooling the space within the compartment 118 may consist of coils of tubing 130 and 132 intimately secured to the outside of the tank lining 90 at the sides and back thereof adjacent the bottom and on the bottom thereof. The tank 90 preferably is constructed of metal and the tubing preferably is soldered or firmly clamped to the tank 90 so as to provide good heat transfer therebetween, the tank 90 forming an extended heat exchange surface. It will thus be seen that refrigerant ducts are arranged on four sides of the compartment 118, namely, the back, the two sides and the bottom thereof and heat is absorbed from the space within the compartment through the walls of the tank 90.

The evaporator 122 includes, in addition to the ducts or tubing previously referred to, a down leg 124 and an up leg 126. The down leg 124 is vertically arranged and extends between an upper header 128 and the lowermost coil 123 of the evaporator 122 for supplying liquid refrigerant to the bottom thereof. The evaporator 122 includes two parts or sections of tubing 130 and 132 which are connected to the bottom coil 123 so as to receive refrigerant therefrom and through which coils 130 and 132 refrigerant flows upwardly due, in part, to the evolution of refrigerant vapor within the coils 130 and 132. At the upper ends, the coils 130 and 132 are connected to the bottom of the up leg 126 which terminates in communication with the interior of header 128. Liquid refrigerant is supplied to the evaporator 120 by liquid line 136 and from the evaporator 120 refrigerant is supplied by conduit 154 to the up leg 126. Refrigerant vapor generated in the shelves of the evaporator 120, upon entering up leg 126 tends to cause a circulation of liquid refrigerant upwardly through such leg and into the header 128. Down leg 124 is sufficiently large so as to permit refrigerant vapor bubbles to by-pass the liquid refrigerant therein without impeding the flow thereof, and in leg 124 the flow of liquid refrigerant is downward from header 128 to the bottom coil 123. Refrigerator vapor generated in both of the evaporators 120 and 122 collects in the upper part of header 128 and is returned by suction line 134 to the intake side of the compressor. I contemplate using in the evaporators 120 and 122 the same refrigerant as may be used in connection with the embodiment illustrated in Figs. 1 to 4, that is, a binary refrigerant consisting of two or more refrigerant components which will operate to produce refrigeration at one temperature level within the evaporator 120 and at a somewhat higher temperature level within the evaporator 122. Preferably, the refrigerant expansion control which regulates the supply of liquid to the evaporators 120 and 122 operates to maintain a liquid level in the header 128 as indicated. The construction of evaporator 120 may be essentially the same as the evaporator 20 illustrated in Fig. 2. The space within the compartment 116 in the construction illustrated in Figs. 5 to 8 will be cooled principally by the transfer of heat through the partition 117 to the refrigerant within the evaporator 120. Of course, if the legs 124 and 126 are arranged inside the tank lining 90, as illustrated, the refrigerant within these legs will also absorb some heat from the compartment 116.

The evaporator 120 is preferably operated at such a temperature level as to provide a low temperature storage compartment within the enclosed space within which the evaporator 120 is arranged, while the evaporator 122 is operated at such a temperature level as to produce temperature and humidity conditions within the compartment 118 particularly suitable for storing food stuffs, that is, at a temperature level of between 35 to 40° F. and with a relative humidity of approximately 75%. The temperature of the compartment 116 may be either higher or lower than that of the compartment 118 depending upon the rate at which heat may be absorbed therefrom by the evaporator 120 and through the partition 117.

While I have illustrated one form of two-temperature system in connection with the modification illustrated in Figs. 5 to 8, I contemplate that other types of two-temperature systems may be used although I believe that the one illustrated is preferable due to the efficiency thereof. Of course, the temperature spread between the evaporators 120 and 122 may be varied as indicated in connection with the modification illustrated in Figs. 2 to 4, and also the temperature at which the compartments 116 and 118 are operated may be varied by increasing or decreasing the amount of heat exchange surface exposed to the air within the compartments.

While the invention has been described with some detail, it is to be understood that the description is for the purpose of illustration only and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

I claim:

1. Refrigerating apparatus comprising a heat insulated compartment, a refrigerating system including a pair of evaporators adapted to absorb heat at different temperature levels, the evaporator operating at the lower temperature being arranged in the upper part of said compartment and the other evaporator being arranged at an elevation below that of said lower temperature evaporator, means for supplying liquid refrigerant medium to said lower temperature evaporator, said medium being made up by placing together refrigerants having different volatility and retaining said different volatility after being placed together, a connection between said evaporators for supplying liquid refrigerant from said lower temperature evaporator to the other of said evaporators, said connection including a vertically disposed duct of relatively large diameter having its lower end communicating with the evaporator of higher temperature and terminating at its upper end in a vapor accumu-

lating chamber whereby bubbles forming in the downwardly directed portion of said series connection may pass upwardly to said header without disturbing the downward flow of liquid refrigerant to the evaporator of higher temperature, and an exhaust connection for said chamber above the level of liquid refrigerant adapted for connection to the inlet side of the refrigerant compression unit.

2. Refrigerating apparatus comprising a heat insulated compartment, a refrigerating system including a pair of evaporators arranged in series and adapted to operate at substantially the same suction pressure, one of said evaporators comprising at least one refrigerated shelf and being adapted to operate at a lower temperature than the other of said evaporators, means for supplying liquid refrigerant medium to said one of said evaporators, said medium being made up by placing together separate refrigerants having different volatility and characterized by the fact that said refrigerants retain said different volatility after being placed together, the other of said evaporators including a refrigerant duct thermally associated with a metallic wall at the sides and back of said compartment and having a header, a connection between said header and the bottom of said duct for supplying liquid refrigerant thereto, and another connection between the upper part of said duct and said header, a liquid refrigerant supply tube communicating with said other connection, and means for separating the space in which said refrigerated shelf is arranged from the remaining space in said compartment.

3. Refrigerating apparatus comprising a heat insulated tank, a pair of evaporators arranged in series and adapted to operate at substantially the same suction pressure, one of said evaporators being located in the upper portion of said tank and adapted to operate at a relatively low temperature and the other of said evaporators being located in the lower portion of said tank and adapted to operate at a relatively higher temperature, the series connection between said evaporators including a vertical duct of relatively large diameter terminating at its upper end in a header located above the outlet of said upper evaporator, means for supplying liquid refrigerant medium to the inlet of said upper evaporator, said refrigerant medium being made up by placing together two different refrigerants having spaced boiling ranges and characterized by the fact that said refrigerants retain said different boiling ranges after being placed together, a refrigerant suction tube communicating with the upper end of said header above its liquid refrigerant level, and a liquid refrigerant tube inter-connecting the outlet of said lower evaporator and that part of said series connection between the upper evaporator and said header whereby the vaporized refrigerant from both of said evaporators may accumulate in said header for exhaust purposes and whereby bubbles forming in the downwardly directed portion of said series connection may pass upwardly to said header without impairing the downward flow of liquid refrigerant.

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