

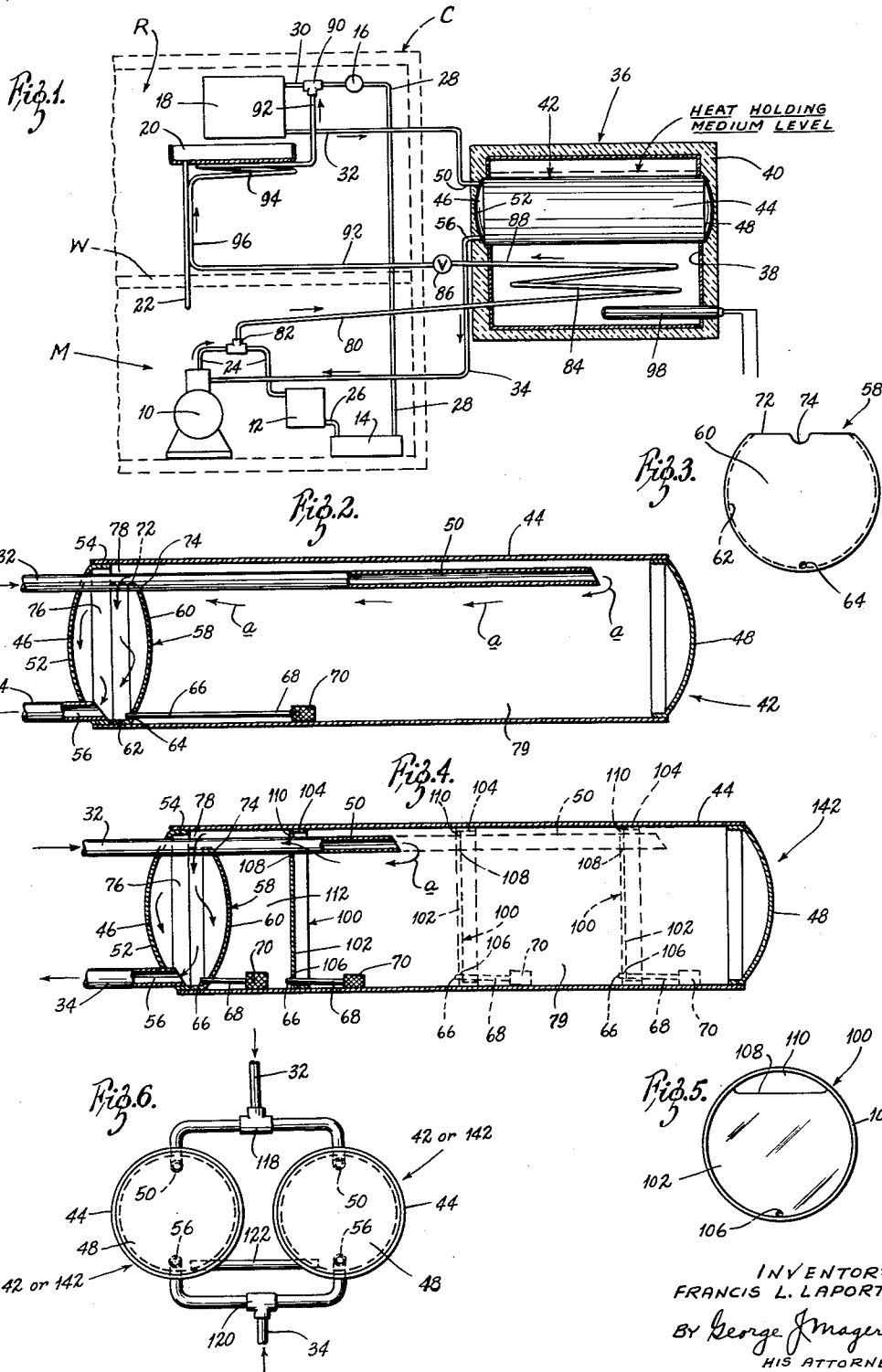
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REFRIGERATOR DEFROSTING MEANS

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REFRIGERATOR DEFROSTING MEANS
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The present invention relates to mechanical refrigeration, and is primarily directed to the provision of novel means adapted to be incorporated in a conventional refrigerating system for defrosting the evaporator when necessary, and for facilitating normal refrigeration, by effecting the vaporization of the refrigerant returning to the compressor from the evaporator.

Generally speaking, the instant invention is an improvement over the disclosures in U.S. Patents Nos. 2,641,908 and 2,645,101, both granted to Louis F. La Porte and assigned to the inventor herein.

As set forth in said patents, it is common knowledge that the refrigeration industry has long sought a simple and inexpensive defrosting arrangement which may be integrated with a conventional refrigerating system, and the primary object of this invention is to provide such an arrangement.

A further object is to simultaneously provide improved means for retarding the return flow of liquid refrigerant from the evaporator to the compressor a sufficient length of time to effect the vaporization thereof, thus facilitating both refrigerating and defrosting operations.

To this end, the present invention contemplates the interdisposition, between the compressor and evaporator in an otherwise conventional system, of a combined liquid refrigerant flow-retarding and vaporizing unit through which said refrigerant must travel enroute to the suction side of the compressor, said unit including barrier or baffle means for temporarily trapping within the tank of said unit, liquid refrigerant enroute from the evaporator to said compressor. The unit referred to is suspended in an insulation-covered container, the latter containing a medium having heat-holding properties, and which surrounds said unit. Means are provided for automatically heating said medium during normal compressor operations, so that the liquid flow-retarding and vaporizing unit is subjected to heat at all times, as will appear. The changeover of the system from refrigerating to defrosting operation is accomplished by the manipulation of a single valve from closed to open position, without requiring shutting off of the compressor. Means are also provided for delivering heat to the drain pan and its associated discharge pipe during defrosting cycles.

Features and objects of the invention not specifically noted, will be apparent or referred to in the detailed description to follow with reference to the accompanying drawing, wherein the invention is partly diagrammatically, and partly structurally illustrated.

In said drawing:

FIGURE 1 is a diagrammatical presentation of a refrigeration system wherein the preferred embodiment of the present invention is incorporated;

FIGURE 2 is a view in vertical section illustrating the structural details of a liquid refrigerant flow-retarding and vaporizing unit constructed in accordance with the concepts of the invention;

FIGURE 3 is a detail view of a curved baffle member included in the FIGURE 2 unit;

FIGURE 4 is a view similar to FIGURE 2 illustrating the incorporation in the liquid refrigerant flow-retarding and vaporizing unit of one or more planar baffle members in combination with a curved baffle member;

FIGURE 5 is a detail view of one of the planar baffle members; and

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FIGURE 6 is a view demonstrating an arrangement for incorporating a pair of liquid flow-retarding and vaporizing units in a refrigeration system of relatively great capacity.

With reference now particularly to FIGURE 1, the refrigeration system there shown includes a compressor 10, a condenser 12, a receiver 14, an expansion valve 16, an evaporator 18, a drain pan 20, and a drain discharge pipe 22.

All of these schematically illustrated elements are conventional, as is the discharge line 24 between the compressor 10 and condenser 12, the conduit 26 between said condenser and the receiver 14, the liquid line 28 leading from the receiver to the expansion valve 16, the evaporator coil inlet line 30, the evaporator coil outlet line 32, and the compressor suction line 34.

Suggested by means of broken lines and generally designated C, is a refrigerator cabinet or the like wherein the thus far enumerated components of the system are located. Said cabinet is divided into an upper or refrigerated space compartment indicated R, and a lower or compressor mounting compartment indicated M, by means of a separation wall W. It will of course be understood that this FIGURE 1 arrangement is an exemplary one only. In other words, the compressor 10 may for example, be located outside the cabinet C if desired.

It is believed that the operation of the thus far described conventional refrigeration system is well understood, but a brief explanation will be given. Although not illustrated, it is understood that the present system includes one of the well known thermal-responsive devices for controlling the compressor. Thereafter, assuming that the temperature in compartment R rises above a specific degree, said device will effect compressor operation. As a result, refrigerant in vapor form is withdrawn from the evaporator 18 via outlet line 32 and suction line 34 into compressor 10, where it is compressed and thereupon discharged to the condenser 12 via line 24. From the condenser, the refrigerant now in liquid form, is delivered to the receiver 14 via conduit 26. From the receiver 14, the refrigerant in liquid form is metered through the expansion valve 16 via line 28, thence into the evaporator coil via inlet line 30.

As the ambient warmth about the evaporator in compartment R is absorbed by the refrigerant as is understood, the latter becomes vaporized, and in that form is withdrawn to return to the compressor as explained, thus repeating the refrigerating cycle. When the temperature in compartment R has been lowered to the degree called for by the thermal-responsive device, the latter effects the shutting off of the compressor.

During these cycles of normal compressor operation, the moisture prevalent in the ambient atmosphere settles upon and is gradually transformed into a layer or layers of frost, which increasingly accumulate on the external surfaces of the evaporator. As is well understood, unless these layers of frost are removed from time to time, the efficiency of any refrigeration system will eventually be reduced to a point where its operation is noneffective.

The present invention contemplates no change in the conventional refrigeration system thus far considered. It does contemplate however, the incorporation in such system, of novel means whereby the normally employed refrigerant or cooling agent may also serve selectively as the defrosting agent, without requiring cessation of compressor operations.

Numerical 36 designates as a whole, a heat storage unit that in accordance with the concepts of the present invention is located exteriorly of the cabinet C. The unit 36 includes a metallic container 38 of any desired configuration filled to the proper level with a medium hav-

ing heat-holding properties. Preferably, the container is encased in insulation 40 whereby heat losses are minimized. Numeral 42 designates in its entirety, a combined liquid refrigerant flow-retarding and vaporizing unit submerged in the heat holding medium within container 38, and suitably supported in such disposition by the latter as shown, or otherwise.

The unit 42 includes a cylindrical tank body 44 that, as viewed for example in FIGURE 2, is provided with a left end closure cap 46, and a right end closure cap 48. Said unit further includes what will hereinafter be termed the discharge segment 50 of the evaporator outlet line 32, that extends through the left end closure cap 46 to terminate short of the right end closure cap 48, as illustrated. For a reason to appear, it is here noted that the body portion 52 of the closure cap 46 is curved or arcuately formed as shown, and has an annular flange portion 54 the external periphery of which corresponds with the internal periphery of the tank body 44.

Numeral 56 designates what will hereinafter be termed the intake segment of the compressor suction line 34 that also extends through the cap 46 to terminate slightly beyond the arcuate body portion 52 of the latter as shown. Preferably, but not necessarily, the segments 50 and 56 terminate obliquely as illustrated, whereby discharge and intake openings respectively of greater area are provided, as should be manifest.

With particular reference also to FIGURE 3, an element that will hereinafter be termed a curved baffle member 58, is seen to include an arcuately formed body portion 60 having a laterally projecting substantially annular flange portion 62, the external periphery of which corresponds with the internal periphery of the tank body 44. Centrally at the lowermost region thereof, the body portion 60 has formed therein a small aperture 64 which is adapted to receive the discharge end 66 of a bleeder or metering tube 68, the inlet end of which is encased in a fine mesh screen member 70. At the top, a segment of the baffle member 58 is removed, and provided in the thus formed horizontal upper marginal edge 72 thereof is a semicircular recess 74, that as seen in FIGURE 2, accommodates the discharge segment 50.

As clearly shown also in FIGURE 2, the opposed edges of the closure cap flange 54 and of the baffle flange 62 are contiguously disposed within the tank 44 whereby to form a vapor chamber 76, the entrance 78 to which is provided on either side and above the segment 50 by the disposition of the upper marginal edge 72 of the baffle member 58 relatively to the cylindrical wall of said tank. The baffle member 58 further defines between it and the closure cap 48 a vaporizing compartment designated 79. It is here noted that the unit 42 is sealed throughout by brazing or otherwise to provide against any loss of refrigerant, as should be understood.

Reverting once more to FIGURE 1, numeral 80 designates a vapor line teed into the compressor discharge line 24 as at 82. It is noted that the line 80 is upwardly inclined, and merges into the lowermost convolution of a coil 84 submerged in the heat holding medium within the container 38 of the unit 36.

Leading from the uppermost convolution of coil 84 to a manually or mechanically operable valve 86 outside the heat storage unit 36 is a conduit 88, and leading from said valve to a T fitting 90 in the evaporator inlet line 30 is what will be termed a hot gas line 92. Intermediate said valve and T fitting, the hot gas line 92 has formed therein a coil 94 that is in contact with the drain pan 20, and a segment 96 that is disposed contiguously to the drain pipe 22.

Numeral 98 designates a suitable electric heating device submerged in the lower region of the container 38. The device 98 may be controlled by manual or automatic means, and it is to be understood that this device typifies appropriate heating means that may be employed dur-

ing a defrosting operation as will be explained hereinafter.

A slightly modified combined liquid refrigerant flow retarding and vaporizing unit is illustrated in FIGURE 4 and designated 142. It includes in addition to the previously described and similarly designated elements, a planar baffle member 100. Shown per se in FIGURE 5, this baffle member includes a flat body portion 102 integral with an annular laterally projecting flange portion 104. Centrally adjacent the lowermost region thereof, said body portion 102 is provided with an aperture 106, that similar to the aperture 64 in the curved baffle member 58, receives the discharge end 66 of a bleeder or metering tube 68. At the top, a segment of the body portion 102 is removed to provide, between the thus formed upper marginal edge 108 of said body portion and the flange 104, an opening 110 through which the discharge segment 50 of the evaporator coil outlet line 32 extends.

With the incorporation of a baffle member 100, the vaporizing compartment 79 is subdivided, whereby to provide a secondary vaporizing chamber 112 adjacent the thus resultant primary vapor chamber 76, as demonstrated in said FIGURE 4. Also, as clearly suggested in broken lines, the vaporizing compartment 79 may be further subdivided by the incorporation of additional baffle members 100, and dimensioning the length of the discharge segment 50 of the evaporator outlet line accordingly.

In what the refrigeration industry considers a large installation, the present invention contemplates the incorporation of more than a single liquid refrigerant flow-retarding and vaporizing unit 42 or 142 in the heat storage unit 36.

Such an arrangement should be obvious from an inspection of FIGURE 6, where it is seen that the evaporator outlet line 32 would be teed as at 118, into a pair of discharge segments 50, and the compressor suction line 34 would be teed as at 120, into a pair of intake segments 56. Preferably, one or more refrigerant level equalizing tubes 122 would be provided to establish fluid communication between the lowermost regions of the adjacent units.

Operation

Normally, the valve 86 is closed and the system functions in the conventional manner previously described. Consequently during refrigeration operations, a portion of the heat laden high pressure refrigerant vapor discharged from the compressor 10 passes upwardly via the vapor line 80 into the unit 36, thereupon condenses, and then returns in liquid form to the discharge line 24 by gravity, thus to flow on to the condenser 12.

In other words, some of the compressed heat laden refrigerant in vapor form travels upwardly in line 80 and into coil 84, and after giving up its heat and condensing, also simultaneously travels downwardly in said line in liquified state. As a result, the heat storage medium in the unit 36 is automatically heated during each cycle of compressor operation, the heat extracted from coil 84 being thus accumulated or stored within the container 38. The heating means 98 is inoperative during normal refrigeration operations.

In accordance with the teachings of this invention, the refrigerant withdrawn in mingled liquid and vapor form from the evaporator via outlet line 32 is first discharged into unit 42, whence it proceeds via suction line 34 to the compressor 10 as will be explained with reference particularly to FIGURE 2.

As the vapors of the refrigerant are drawn into the tank 44, they discharge from the segment 50, and as suggested by the arrows *a*, proceed via entrance 78 into vapor chamber 76, thence into the intake segment 56 of the compressor suction line 34. Liquids such as oil, alcohol, or other additives that are usually found in a refrigera-

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tion system and circulate through the system during its running cycles, are not readily vaporizable, wherefore these liquid ingredients of the refrigerant will gravitate toward and be temporarily trapped in the bottom of the tank. Permanent trapping of such liquids in the unit 42 is obviated by the metering tube 68 which establishes fluid communication between the vaporizing compartment 79 and the vapor chamber 76. The rate of flow through said tube is unaffected by the increase or decrease of pressures within the unit 42, since both the inlet and outlet ends thereof are subjected to like pressures within the tank.

The protective screen 70, attached to the inlet end of tube 68, prevents entrance therein of any extraneous matter which would tend to clog said tube. Any refrigerant liquid passing through the tube 68 is also vaporized, or at least atomized, to join the previously described flow of vapors into chamber 76 and proceed onward with them to the compressor via the suction line 34.

It should therefore be manifest, that during normal refrigeration cycles, the present invention includes: means for insuring against the flow of liquid refrigerant slugs to the compressor; means for permitting non-vaporizable fluids to circulate within the system; means for building up in the heat storage unit 36 an available supply of heat for use in defrosting as will appear; and means for simultaneously condensing a portion of the compressed high pressure heat laden gas enroute to the condenser from the compressor.

Assuming now that the evaporator 18 requires defrosting, the valve 86 would be opened, whereby the refrigerant would flow as the FIGURE 1 arrows indicate. That is to say, the compressor discharge would now travel via line 24, T 82, and vapor line 80, through the coil 84 and into the conduit 88. In passing through coil 84 and conduit 88, the vaporized refrigerant will be superheated by the accumulated heat in the heat holding medium. If desirable, and in order to accelerate the defrosting, the auxiliary heating means 98 may be activated. The valve 86 being open, the superheated vapors will flow onward through the hot gas line 92 and T 90 into the evaporator coil inlet 30, after having passed also through the hot gas line segment 96 and drain pan coil 94.

As the superheated vapors circulate through the segment 96 along the drain pipe 22, thence through the coil 94 in contact with the drain pan 20, and thence through the evaporator coil, the heat in said vapors is transferred to the elements enumerated whereby to melt the frost that had accumulated thereon. As a result, the refrigerant leaves the evaporator in mingled vapor and liquid form via outlet line 32 to be discharged into the unit 42, where it is subjected to the action previously described before being delivered to the compressor for repetitions of the cycle until defrosting is complete. At such time, the valve 86 would be closed, whereby the system will revert to normal refrigeration operation. Should the auxiliary heating means have been employed, it would now be de-activated.

With reference to the FIGURE 4 embodiment of the liquid refrigerant flow-retarding and vaporizing unit, it should be apparent that the provision of one or more baffle members 100 tends to maintain the highest refrigerant level in the vaporizing compartment 79, and successively lower levels leftwardly therein with a minimum level in the secondary vaporizing chamber 112. With this arrangement, the vapors will flow through successive openings 110 to the entrance 78 of the vapor chamber, and the metering tubes 68 will in turn function as explained hereinbefore.

From the foregoing description augmented by an inspection of the drawing, it should be manifest that the present invention provides simple yet highly efficient means that may be incorporated in an otherwise conventional refrigeration system, whereby the manipula-

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tion of a valve automatically effects the changeover from a refrigerating to a defrosting system, and vice versa.

The invention obviously admits of modifications without departing from the principles thereof. Therefore the invention is not to be limited to the precise details illustrated and described, the scope thereof being defined in the claims hereunto appended.

What is claimed is:

1. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without shutting off the compressor, said means including: a container partially filled with a medium having heat-holding properties; a coil submerged therein for automatically heating said medium during refrigeration operations; a liquid refrigerant flow-retarding unit submerged in said medium and interposed in the suction line between the evaporator coil and the compressor for vaporizing liquids in the refrigerant flowing from the evaporator to the compressor during defrosting operations, said unit comprising a metallic tank sealed at both ends by arcuate cap members and incorporating a curved baffle member that divides said tank into a vapor chamber and a vaporizing compartment; a discharge segment of the evaporator coil outlet line extending into said vaporizing compartment for discharging refrigerant in mingled liquid and vapor form from the evaporator thereinto; an intake segment of the compressor suction line extending into said vapor chamber; a metering tube the inlet end of which is encased in a fine mesh screen member for preventing the ingress of extraneous matter therein from the lowermost region of said vaporizing compartment, and the outlet end of which is supported in said curved baffle member in fluid communication with the vapor chamber in consequence whereof vaporized or at least atomized liquid ingredients of the refrigerant discharged into said vaporizing compartment flow onwardly to the compressor via said intake segment of the suction line; an entrance opening into said vapor chamber for vapors flowing from the vaporizing compartment, said opening being formed in consequence of a segment removed from said curved baffle member at the top thereof; and at least one planar baffle member interpolated between the curved baffle member and one of said cap members whereby to subdivide the vaporizing compartment; each planar baffle member including: a flat body portion provided centrally adjacent the lowermost region thereof with an aperture for the reception of one end of a metering tube; an annular laterally projecting flange integral with said body portion for mounting the baffle in said compartment; and an opening formed in said body portion at the top for establishing communication between adjacent subdivisions of said compartment, and for accommodating the discharge segment of the evaporator coil outlet line which extends therethrough.

2. In a refrigeration system of the character described, said system including an evaporator, an evaporator outlet line, a compressor, and a compressor suction line, means for retarding the flow of liquids and simultaneously providing for the free flow of vapors present in refrigerant flowing from the evaporator to the compressor, said means comprising in combination: a cylindrical tank sealed at one end by a first arcuate cap member and at the opposite end by a second arcuate cap member; a curved baffle member within the tank in spaced relationship relatively to the first closure cap, said baffle member dividing the tank interiorly into a first and a second compartment, and having a segment thereof removed at the top whereby to define with the adjacent wall portion of the tank a communicating opening between said compartments; a discharge segment forming the end of the evaporator outlet line extending through the first closure cap and said opening to terminate at a high level in the second compartment short of the second closure cap; an intake segment forming one end of the suction line extending

through the first closure cap to terminate at a low level in the first compartment short of the baffle member; and a metering tube disposed at the bottom in the tank, one end of said tube extending through an aperture provided therefor in the lowermost region of the curved baffle member to terminate in the first compartment, the opposite end of said tube extending into the second compartment and being encased in a fine mesh screen member.

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