June 16, 1953 L. F. LA PORTE 2,641,908

REFRIGERATOR DEFROSTING MEANS

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Fig.1.

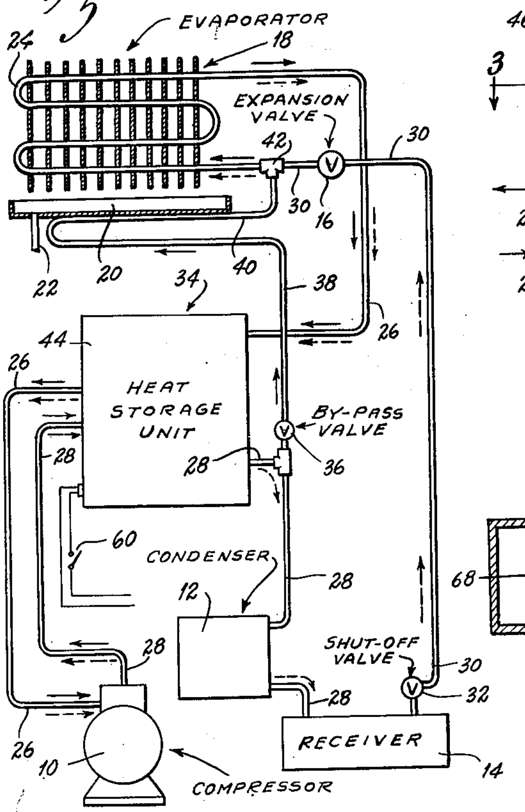


Fig.2.

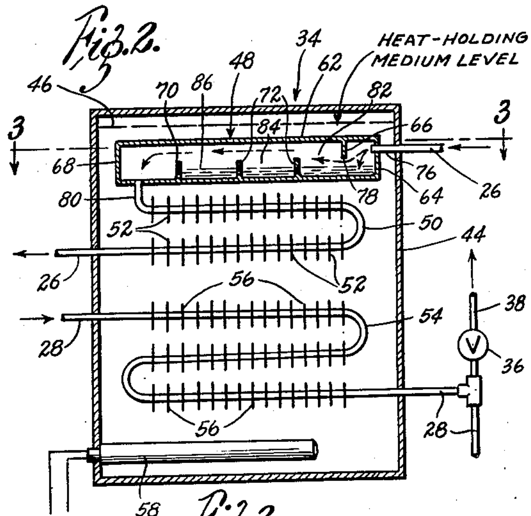


Fig.3.

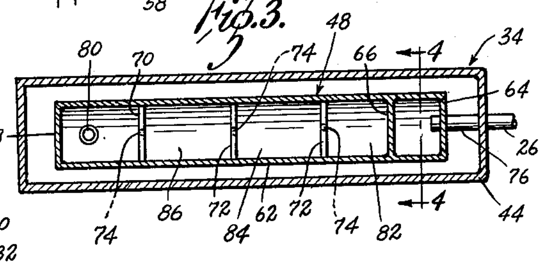


Fig.4.

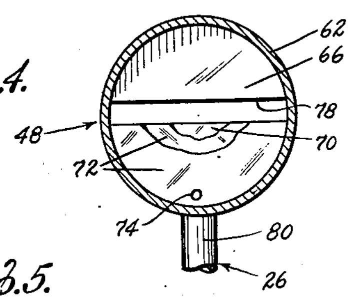


Fig.5.

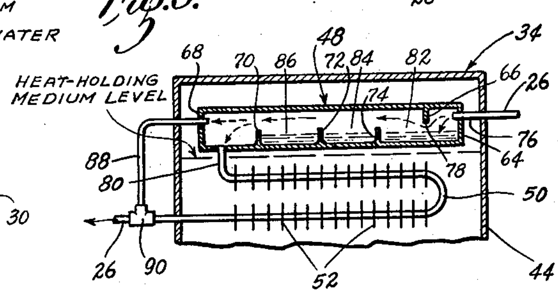
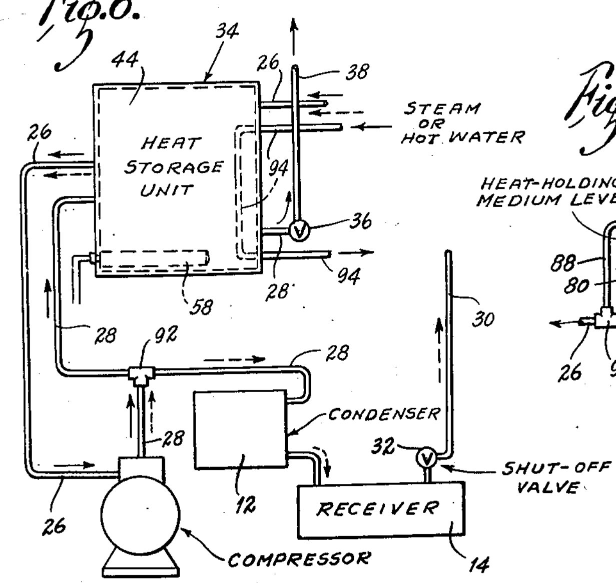


Fig.6.



INVENTOR:
LOUIS F. LAPORTE,

BY Geo J Mager

HIS ATTORNEY

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REFRIGERATOR DEFROSTING MEANS

Louis F. La Porte, Wellston, Mo., assignor to Francis L. La Porte, Burlingame, Calif.

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10 Claims. (Cl. 62—115)

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The present invention pertains generally to mechanical refrigeration, and more particularly to improved means adapted to defrost evaporators, or cooling units of refrigerator systems.

The defrosting problem has plagued the refrigeration industry for a long time, and numerous attempts have been made to solve this problem in the past.

A few of the prior art methods and apparatus have achieved a measure of success. Most of them however, have been tried and then discarded for one reason or another, the principal reasons being that the defrosting operations required too much time, or that the apparatus provided proved too complicated and so on.

The primary object of this invention is to provide a method whereby the defrosting of evaporators, whether of the finned type, plate type, or bare pipe coil construction, can be accomplished rapidly and efficiently.

A further object is to provide simple, rather than complicated means for attaining the primary object aforesaid.

Another object is to provide means for defrosting a drain pan simultaneously with the defrosting of an evaporator, so that water which drips from the latter may flow freely from the refrigerated space, as is understood.

Broadly, the instant invention contemplates the incorporation in a conventional refrigeration system, of a novel heat storage unit interposed between the compressor and the evaporator; a liquid flow retarding device enclosed within said unit; a by-pass valve in the discharge line of the compressor for diverting the gasses passing therethrough to the evaporator in a preheated condition during a defrosting operation; and other novel features associated with these elements for attaining the objects of the invention, as will appear.

The invention is partly diagrammatically, and partly structurally illustrated in the accompanying drawing, and the arrangement of the various parts which are combined to attain the objectives thereof will be more clearly understood from the description to follow with reference to said drawing, in which:

Fig. 1 is a diagrammatical illustration of a conventional refrigeration system incorporating the preferred embodiment of the present invention;

Fig. 2 is a view in vertical section illustrating details of the novel heat storage unit of the invention;

Fig. 3 is a horizontal sectional view, on an enlarged scale, taken on line 3—3 in Fig. 2, and particularly illustrating details of a liquid flow retarding device enclosed within the said heat storage unit;

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Fig. 4 is a vertical sectional view, on a further enlarged scale, through said retarding device, the view taken on line 4—4 of Fig. 3;

Fig. 5 is a fragmentary view, similar to Fig. 2 wherein is illustrated an additional feature that may be included in the liquid flow retarding device; and

Fig. 6 is a fragmentary view similar to Fig. 1, portraying an alternate arrangement.

With particular reference now to Fig. 1, the conventional refrigeration system shown includes a compressor 10, a condenser 12, a liquid receiver 14, an expansion valve 16, and an evaporator 18. The latter is of the finned type coil construction, although it is to be understood as previously pointed out, that the invention is applicable to other evaporator types.

Numeral 20 indicates a drain pan with which is associated a discharge conduit 22. The evaporator coil is designated by numeral 24, the suction or intake line of the compressor by numeral 26, and the compressor discharge line by numeral 28.

The liquid line leading from the receiver tank to the expansion valve is indicated by numeral 30. The usual shut-off valve is designated 32.

Usually as well known, the assembly including the evaporator, drain pan, and expansion valve is mounted in the space to be cooled, whereas the assembly including the compressor, condenser, and receiver is located remotely therefrom.

While it is taken for granted that the operation of the conventional system illustrated and thus far described is well understood, a brief summary is not believed to be objectionable prolix at this point.

Thus, assuming that the temperature of the space to be cooled has risen above a predetermined degree, any of the well known thermal responsive devices will cause the compressor to start. As a result, refrigerant in vapor form is withdrawn from the evaporator via line 26, compressed, thereupon delivered to the condenser 12 still in vapor form, and thence to receiver 14 in liquid form, via line 28.

Assuming that valve 32 is open, the refrigerant in liquid form is metered or fed through the expansion valve 16 and into the evaporator coil 24. The ambient warmth or heat about the evaporator being absorbed by the refrigerant as is understood, the latter is vaporized, and in that form returned to the compressor via suction line **26** to repeat the cycle until the temperature of the space to be cooled causes the thermal responsive device to shut off the compressor. The circuit described is indicated by the broken line arrows in Fig. 1.

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 portions 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 normal 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 normal compressor operations.

Referring again to Fig. 1, numeral **34** indicates generally a heat storage unit, **36** a by-pass valve, **38** a vapor line, and **40** a loop portion formed in the latter. The upper end of the vapor line is in communication with the inlet portion **41** of the evaporator coil by means of a **T** fitting **42**, as shown.

The incorporation of the non-conventional elements just enumerated will, when necessary or desired, cause the refrigeration system to supply preheated gas vapors to the evaporator for defrosting the same in a manner to be explained later.

With particular reference now to Figs. 2 and 3, the heat storage unit **34** includes a tank **44** containing a heat holding fluid the upper level of which is indicated at **46**. It may be water or other selected medium.

Submerged in said fluid medium, and mounted in any suitable manner within container **44**, is a liquid flow retarding device generally indicated by numeral **48**. Also submerged, and disposed beneath said device, is a loop or coil portion **50** formed in suction line **26**. Preferably but not necessarily, coil portion **50** is provided with a plurality of heat transfer fins **52** as shown. For descriptive purposes, coil **50** will sometimes be termed the suction coil hereinafter.

Also submerged, and disposed in said container below suction coil **50**, is a coil portion **54** formed in discharge line **28**. This coil portion is also preferably provided with heat transfer fins designated **56**. For descriptive purposes, coil **54** will sometimes be termed the discharge coil hereinafter.

A suitable electric heating device **58** is submerged in the lowermost region of the tank. This device may be controlled by manual or automatic means, as suggested by switch **60** in Fig. 1.

The liquid flow retarding device **48**, as will appear, is of prime importance. As shown in the drawing it comprises a cylinder **62**, closed at either end, and interposed in suction line **26** between coil **50** and that portion of said line extending from the tank **44** to the evaporator.

In horizontally spaced relation to the inlet end wall **64** of cylinder **62**, is an upper baffle plate **66** which, as seen to best advantage in Fig. 4, extends downwardly to a plane slightly above the horizontal centerline of the cylinder.

In horizontally spaced relation to the outlet end wall **68** of cylinder **62**, is a lower baffle plate **70** which, as also seen to best advantage in Fig. 4, extends upwardly to a plane slightly below the horizontal centerline of the cylinder.

Interposed between these two baffles, and in spaced relation thereto and to one another, is a plurality of lower baffle plates **72**, two being shown in the drawing. The intermediate baffles are identical with the baffle **70**, and each of the lower baffles is provided with a small orifice or bleeder **74**, preferably formed therein adjacent the lowermost portion thereof.

As portrayed in Fig. 2, delivery portion **76** of suction line **26** enters the device **48** through wall **64**, in a plane above the bottom marginal edge **78** of non-perforate baffle **66**. Near the outlet end of the device, portion **80** of said suction line depends from the lowermost region of cylinder **62**, between end wall **68** and perforate baffle **70**.

It is noted that by opening valve **36**, the compressor discharge gases may be directed into line **38**. It is also noted that said valve may be manually, mechanically or electrically operated.

In normal refrigerating operation, said valve is closed so that the high pressure refrigerant discharged from the compressor passes through the discharge coil portion **54** of line **28**, thence on to condenser **12**.

In this manner, most of the heat inherent in the compressed discharged refrigerant is absorbed by the fluid heat holding medium in tank **44**. The transfer of heat from coil **54** to the liquid is abetted by the fins **56**, as is understood.

Thus, it should be manifest that during each compressor operation, heat extracted from the discharge line is stored, or accumulated, within the tank **44**. It is noted that in such normal operation, the heating device **58** is inoperative.

From coil **54**, the thus partially liquefied refrigerant proceeds to the condenser **12**, thence to receiver **14**, and thereafter, via cold liquid line **30** and metering valve **16**, to the coil **24** as is understood, but on its return to the compressor via suction line **26**, it again travels through the heat storage unit **34**.

In other words, the refrigerant, in mingled vapor and liquid form, passing from the evaporator first enters the liquid flow retarding device **48**, then travels through suction coil **50**, whence it continues on to the compressor **10** in completely vaporized form, as will now be explained with particular reference to Figs. 2 to 4.

As previously noted, the liquid flow retarding device **48** is immersed within container **44** in the uppermost region thereof.

As the mingled vapor and liquid body of refrigerant is drawn into device **48** through portion **76** of suction conduit **26**, it impinges upon the baffle **66**. The vapors pass quickly beneath the bottom marginal edge **78** of said baffle into coil **50** as indicated by the Fig. 2 broken line arrows, thence to compressor **10** in the usual manner.

The non-vaporized or liquid portion of the refrigerant however, is either deflected downwardly from the baffle **66**, or drops by gravity from portion **76** of the suction line into compartment **82** defined longitudinally of cylinder **62** by end wall **64**, and right hand intermediate lower baffle **72**.

Bearing in mind that cylinder **62** is immersed in a body of heated fluid, a considerable quantity of this non-vaporized refrigerant is quickly transferred into vapor form to rise and proceed onwardly through coil **50** to the compressor. The residue simultaneously flows into compartment 84 via orifice 74 in the right hand baffle 72.

As the residue of non-vaporized refrigerant flows through compartment 84, a considerable quantity thereof is quickly transformed into vapor form to rise and proceed onwardly through coil 50 to the compressor. Any remaining non-vaporized refrigerant simultaneously passes into compartment 86 via orifice 74 in the left hand baffle 72, thence to the suction coil 50 via orifice 74 in baffle 70, and on to compressor 10 in a now vaporized state.

From the foregoing, it should be evident that the device 48, in conjunction with the coil 50, provides for the complete vaporization of the refrigerant enroute to the compressor from the evaporator. The orifices 74 prevent the flow of any liquid slugs to the compressor, the orifice in the baffle 70 preferably being of a more minute diameter than the others.

Assuming now that the evaporator requires defrosting, valve 36 is opened whereby gases from both the compressor and the condenser will flow into line 38. Opening of valve 36, starts the defrosting cycle, which continues as long as said valve is open.

That is to say, the cycle continues uninterruptedly until defrosting is complete, whereupon closing of valve 36 will again place the system in condition to resume normal refrigeration operation.

The defrosting circuit is indicated by full line arrows in Fig. 1, and will be further described with reference also to Fig. 2. After manipulation of valve 36 to open or defrost position, the high pressure gases from the compressor pass through the heat storage unit via line 28, coil 54, valve 36, line 38, loop 40, T 42 and into the evaporator coil 24.

As the preheated gas circulates through the loop 40 and coil 24, it is partially condensed. That is to say, the heat inherent in the vapors is transferred to the evaporator and the drain pan whereby to melt frost which had accumulated thereon. As a result, the refrigerant leaves the coil in a partially liquid state and proceeds via suction line 26 to the device 48 in the heat storage unit.

As previously explained in detail, passage of the refrigerant through heat storage unit 34 completely reevaporates the same. Thus it leaves said unit and proceeds via line 26 to the compressor in the form of vapors, to repeat the cycle until the defrosting operation is brought to an end.

Should it be desired to accelerate the defrosting operation, additional heat may be supplied to the liquid in container 44 by the electrical heating device 58. In that event, switch 60 may be closed prior to manipulating the valve 36 to defrost position.

It is noted that discharge coil 54 has a dual role. In other words, during normal refrigerating cycles, said coil serves to supply heat to the storage tank; during defrost cycles, said coil serves to extract heat therefrom and transfer same to the vapors enroute to the evaporator from the compressor.

That is to say, when the system is operating normally, each time the compressor goes on, refrigerant vapor is compressed and in passing through said coil on its way to the condenser, it supplies heat to the fluid within tank 44.

However, immediately following the opening of by-pass valve 36, pressures within the entire system tend to equalize. As a result, the compressor at such time functions in the manner of a circulating pump, so that the gases discharged there-

from and into coil 54 contain comparatively little heat. As these vapors continue to advance through said coil toward the evaporator, additional heat is absorbed by them from the previously stored heat in the tank, augmented if desired, by heat generated by the device 58.

In other words, during normal refrigerating cycles, coil 54 supplies heat to the tank for storage; during defrosting cycles, said coil withdraws previously stored heat from the tank.

From the foregoing, it should be manifest that the present invention provides a simple, highly efficient method and means for rapid defrosting operations without turning off the compressor.

It should also be evident, that the incorporation in a conventional refrigerating system of the heat storage unit 34, and particularly the liquid flow retarding device 48 thereof, will increase the efficiency of the system in normal operation.

The invention obviously admits of modifications without departing from the principles thereof. For example, in some installations, the coil 40 beneath the drain pan may be eliminated.

And, as shown in Fig. 5, the device 48 may be provided with a vapor tube 88, one end of which enters cylinder 62 at a high level, the other end being connected into suction line 26 by a T fitting 90 outside the tank.

With this arrangement, some of the vapors will by-pass coil 50. It may also not be necessary to immerse the liquid flow retarder 48 in the heat-holding medium, as this view indicates.

The invention also contemplates heating the fluid in tank 44 by means other than the discharge line. In that case, and with reference to Fig. 6, it is noted that compressor discharge line 28 leads both to coil 54 and to condenser 12, there being a T fitting 92 interposed in the line as shown.

Numeral 94 indicates diagrammatically a coil submerged in the heat-holding medium. Either steam or hot water may be circulated through this coil to maintain the fluid within tank 44 at desired temperature.

Again, coil 94 may be dispensed with, and the medium heated entirely by one or more electrical heating devices 58. The invention also contemplates, assuming the fluid in tank 44 to be water, that heat may be supplied by providing for a constant or intermittent flow of hot water into and thereafter out of the tank.

Except for the slight differences pointed out, the system illustrated in Fig. 6 is identical with that shown in Fig. 1, and the same reference numerals have been applied to corresponding parts. Obviously however with this arrangement, the sole purpose of coil 54 is to preheat the gas vapors enroute to the evaporator coil during a defrost operation.

In normal operation the discharge gas travels directly to the condenser, and thence through the system and back to the compressor as in the Fig. 1 embodiment.

During a defrost cycle, with valve 36 open to line 38, the discharge gas travels onward to the evaporator coil 24 and thence through the system and back to the compressor in the identical manner described at length hereinbefore with respect to the Fig. 1 embodiment of the invention.

What I claim is:

1. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for

maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a second coil submerged in the liquid and formed in the suction line of said compressor, a flow retarding device of the character described interposed in the suction line within the container between the second coil and the evaporator for vaporizing the refrigerant passing therethrough from said evaporator, a vapor line in communication at one end with the inlet portion of the evaporator coil, and a normally closed valve on the other end of the vapor line and in communication with the compressor discharge line for diverting the normal flow of discharge gases into said vapor line.

2. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a second coil submerged in the liquid and formed in the suction line of said compressor, a flow retarding device of the character described interposed in the suction line within the container between the second coil and the evaporator for vaporizing the refrigerant passing therethrough from said evaporator, and a valve for diverting the normal flow of discharge gases from said compressor to a vapor line in communication at its lower end with said valve, and at its upper end with the inlet portion of the evaporator coil.

3. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a plurality of heat transfer fins on said coil, a second coil submerged in the liquid and formed in the suction line of said system, a plurality of heat transfer fins thereon, a flow retarding device of the character described interposed in the suction line within the container between the second coil and the evaporator for vaporizing the refrigerant passing therethrough from said evaporator, and a valve for diverting the normal flow of discharge gases from said compressor to a vapor line in communication at its lower end with said valve, and at its upper end with the inlet portion of the evaporator coil.

4. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a plurality of heat transfer fins on said coil, a second coil submerged in the liquid and formed in the suction line of said system, a plurality of heat transfer fins thereon, a flow retarding device of the character described interposed in the suction line within the container between the second coil and the evaporator for vaporizing the refrigerant passing therethrough from said evaporator, a valve for diverting the normal flow of discharge

gases from said compressor to a vapor line in communication at its lower end with said valve, and at its upper end with the inlet portion of the evaporator coil, and an auxiliary electrical heating device submerged in the liquid beneath the first coil aforesaid.

5. In combination with a refrigeration system including a compressor, a condenser, and an evaporator with associated drain pan, means for defrosting said evaporator and pan without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a plurality of heat transfer fins on said coil, a second coil submerged in the liquid and formed in the suction line of said compressor, a plurality of heat transfer fins thereon, a flow retarding device of the character described interposed in the suction line within the container between the second coil and evaporator for vaporizing the refrigerant passing therethrough from said evaporator, and a valve for diverting the normal flow of discharge gases from said compressor to a vapor line in communication at its lower end with said valve, and at its upper end with the inlet portion of the evaporator coil, said vapor line having formed therein a loop portion adapted to engage a portion of said drain pan.

6. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for temporarily converting a portion of said system into a defrosting system, said means including a heat storage unit in the form of a sealed container at least partially filled with a quantity of liquid maintained at a high temperature, a first finned coil formed in the compressor discharge line and submerged in said liquid, a second finned coil formed in the compressor suction line and submerged in the liquid, a flow retarding device of the character described interposed in the suction line aforesaid between the second coil and the evaporator also submerged in the liquid for vaporizing the refrigerant passing through said device from said evaporator, and a valve in communication with the compressor discharge line for diverting the discharge gases which normally flow from the compresor via said line toward the condenser into a conduit leading from said valve to the inlet portion of the evaporator coil.

7. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for temporarily converting a portion of said system into a defrosting system, said means including a heat storage unit in the form of a sealed container at least partially filled with a quantity of liquid, a first finned coil formed in the compressor discharge line and submerged in said liquid for normally transferring thereto the heat inherent in the hot gases passing through the coil, an auxiliary electrical heating device submerged in the liquid below said coil to further heat said liquid when desirable, a second finned coil formed in the compressor suction line and submerged in the liquid, a flow retarding device of the character described interposed in the suction line aforesaid between the second coil and the evaporator also submerged in the liquid for vaporizing the refrigerant passing through said device from said evaporator, and a valve in communication with the compressor discharge line for diverting the discharge gases which nor-

mally flow from the compressor via said line to the condenser into a conduit leading from said valve to the inlet portion of the evaporator coil.

8. The defrosting means set forth in claim 1 wherein the heat-supplying means for maintaining said liquid at a high temperature includes a coil submerged in said liquid, said coil having an inlet portion and an outlet portion each projecting through and beyond said container whereby steam may be circulated through said coil.

9. The defrosting means set forth in claim 1 wherein the heat-supplying means for maintaining said liquid at a high temperature includes a coil submerged in said liquid, said coil having an inlet portion and an outlet portion each projecting through and beyond said container whereby hot water may be circulated through said coil.

10. In combination with a refrigeration system including a compressor, a condenser, and an evaporator, means for defrosting said evaporator without turning off the compressor, said means including a container at least partially filled with a quantity of liquid, heat-supplying means for maintaining said liquid at a high temperature, a first coil submerged in the liquid and formed in the discharge line of said compressor, a second coil submerged in the liquid and formed in the suction line of said compressor, a flow retarding device of the character described inter-

posed in the suction line within the container between the second coil and the evaporator for vaporizing the refrigerant passing therethrough from said evaporator, a vapor tube the upper end of which is in fluid communication with said flow retarding device above the horizontal centerline of the latter and the lower end of which is connected into the suction line outside the container, and a valve for diverting the normal flow of discharge gases from said compressor to a vapor line in communication at its lower end with said valve, and at its upper end with the inlet portion of the evaporator coil.

LOUIS F. LA PORTE.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,196,546	Jacobson	Aug. 29, 1916
1,816,159	Smith	July 28, 1931
2,042,462	Hahn	June 2, 1936
2,196,707	Nelson et al.	Apr. 9, 1940
2,351,140	McCloy	June 13, 1944
2,452,102	Cocanour	Oct. 26, 1948
2,481,469	Brown	Sept. 6, 1949
2,516,093	Ruff	July 18, 1950
2,526,032	La Porte	Oct. 17, 1950
2,530,440	Nussbaum	Nov. 21, 1950