

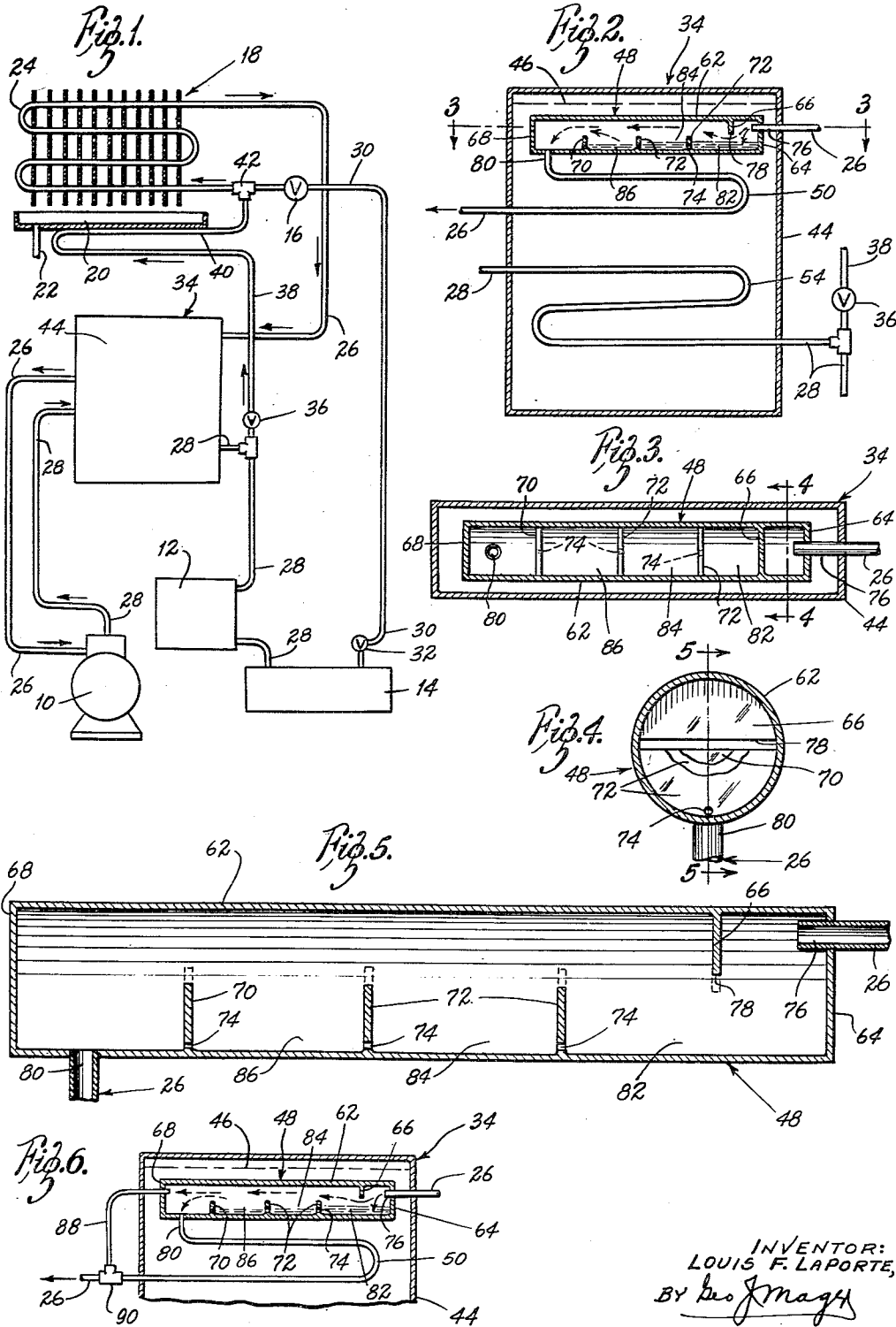
Jan. 4, 1955

L. F. LA PORTE

2,698,522

REFRIGERATOR DEFROSTING MEANS

Filed Jan. 21, 1953



INVENTOR:
LOUIS F. LAPORTE,
BY *h. o. magh*
HIS ATTORNEY

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2,698,522

REFRIGERATOR DEFROSTING MEANS

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

Application January 21, 1953, Serial No. 332,249

7 Claims. (Cl. 62—117.55)

The present invention pertains generally to mechanical refrigeration, and more particularly to improved means whereby the defrosting of evaporators, whether of the finned type, plate type, or bare pipe coil construction, can be accomplished rapidly and efficiently.

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

The subject matter of the present invention was originally disclosed in my copending parent application, Serial Number 182,971, filed on September 2, 1950, now Patent No. 2,641,908.

Broadly, that application discloses 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, and a by-pass valve in the discharge line of the compressor for diverting the gases passing through said line to the evaporator in a preheated condition during a defrosting operation.

The present invention is a continuation-in-part of the aforesaid application and the designated patent that matured therefrom, and is directed particularly to the novel liquid flow retarding device therein disclosed.

Broadly, said device includes a cylinder closed at both ends; an upper baffle plate spaced inwardly from one end wall and extending downwardly in the cylinder to a selected plane; and one or more lower baffle plates spaced inwardly from the other end wall and extending upwardly in the cylinder to a selected plane. The upper baffle plate is impermeate; each lower baffle plate is provided with a small orifice formed in the lowermost region thereof.

The prime objective of the device is to sufficiently restrict or retard the flow of refrigerant deliverable thereto via a conduit at one end, and dischargeable therefrom via a conduit at the other end, so that when subjected to heat, complete vaporization of the refrigerant is effected.

Because of the continuation-in-part status obtaining as above noted, only those views of the patent which are believed necessary for a complete understanding of the instant invention have been reproduced in the accompanying drawing, wherein

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

Fig. 2 is a view in vertical section illustrating a heat storage unit including the flow retarding device of the present 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 the liquid flow retarding device enclosed within the said heat storage unit;

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

Fig. 5 is a vertical sectional view taken longitudinally of the device on the line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary view, similar to Fig. 2 wherein is illustrated an additional feature that may be included in the liquid flow retarding device.

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. 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

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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, the drain pan, and the expansion valve is mounted in the space to be cooled, whereas the assembly including the compressor, the condenser, and the 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 objectionably 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, is 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, as is understood.

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 non-effective.

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 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. Submerged in said fluid medium, and mounted in any suitable manner within container 44, is the liquid flow retarding device which embodies the concepts of the instant invention and which is generally indicated by numeral 48. Also submerged, and disposed beneath said device, is a loop or coil portion 50 formed in the suction line 26. Also submerged, and disposed in said container below the suction coil 50, is a coil 54 formed in compressor discharge line 28.

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 both ends, and interposed in suction line 26 between the coil 50 and that portion of said line extending from the tank 44 to the evaporator 18.

In horizontally spaced relation to the inlet end wall 64 of cylinder 62, is an upper baffle plate 66 which extends downwardly within the cylinder to a plane slightly above the horizontal centerline of said cylinder, as clearly shown particularly in Fig. 5. It is noted however, that the designated plane is not critical, and that the plate 66 may extend below said centerline if desired, as the broken lines suggest.

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. 5, extends upwardly within the cylinder to a plane slightly below the horizontal centerline of the cylinder. It is noted however, that the designated plane is not critical, and that the plate 70 may extend above said centerline if desired, as the broken lines suggest.

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, the 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, and is in fluid communication therewith 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. 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. Thus, it should be manifest that during each compressor operation, heat extracted from the discharge line is stored, or accumulated, within the tank 44.

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, the refrigerant 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 the suction conduit 26, it impinges upon the baffle 66. The vapors pass quickly beneath the bottom marginal edge 78 of said baffle and onward 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 transformed into vapor form to rise and proceed onwardly via outlet 80 and 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 to also proceed onwardly to the compressor. Any remaining non-vaporized refrigerant simultaneously passes into compartment 86 via orifice 74 in the left hand intermediate baffle 72, thence to the outlet 80 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, provides for the complete vaporization of the refrigerant en route 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, as illustrated in Fig. 5.

Assuming now that the evaporator requires defrosting, valve 36 is opened, whereby gases from both the com-

pressor 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 24 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 re-evaporates 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.

From the foregoing, it should be manifest that simple, highly efficient means for rapid defrosting operations without turning off the compressor are provided.

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, will increase the efficiency of the system in normal operation, and that said device plays a vital role during a defrosting operation also.

In other words and as hereinbefore explained, the novel baffle arrangement of the device 48 automatically, so to speak, impedes the passage of the refrigerant through the cylinder 44 sufficiently to allow for the complete vaporization of said refrigerant as it proceeds from the inlet to the outlet end of said cylinder.

In the slightly modified embodiment of the invention illustrated in Fig. 6, a vapor tube 83 is provided. The upper end of tube 83 extends through an opening formed in the outlet wall 68 of cylinder 62 at a high level, and the lower end of said tube is connected into the suction line 26 as by a T fitting 90.

With this arrangement, some of the vapors will flow directly into said vapor tube, whereas the remainder will flow into the suction line, whereby vapor fluidity will be facilitated.

From the foregoing it should be evident that the liquid flow retarding device of the instant invention includes novel means for attaining its objectives in a highly efficient manner. It is to be understood that the precise details of construction illustrated and described have been given in an exemplary rather than in a limiting sense, and that the invention contemplates all modifications which may fall within the scope of the appended claims.

What I claim is:

1. In combination with a refrigeration system of the character described including a storage unit containing a heat holding fluid, a device submerged in said fluid for retarding the flow of liquid refrigerant en route from the evaporator to the compressor of said system, said device including: an elongated cylinder closed at both ends; means for introducing said refrigerant at a high level into one end of the cylinder; one or more lower baffle plates for dividing the interior of the cylinder into a plurality of adjoining compartments; an upper baffle plate for directing the introduced refrigerant downwardly into the first one of said compartments; orifice means in the lowermost region of each lower baffle plate for establishing fluid communication between adjacent compartments; and means for withdrawing the refrigerant at a low level from the last one of said compartments.

2. The device set forth in claim 1 wherein the upper baffle plate extends downwardly in said cylinder to a plane in proximity to the longitudinal centerline thereof, and wherein the lower baffle plates extend upwardly in said cylinder to a plane also in proximity to said centerline.

3. In combination with a refrigeration system of the character described including a storage unit containing a

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heat holding fluid, a device submerged in said fluid for retarding the flow of refrigerant en route from the evaporator to the compressor of said system comprising: a cylinder closed at both ends; an upper baffle plate in spaced relation to one end of the cylinder extending downwardly therein to a selected plane relative to the longitudinal centerline of the cylinder; at least one lower baffle plate in spaced relation to the other end of the cylinder extending upwardly therein to a selected plane relative to said centerline whereby to divide said cylinder into a first and a second compartment; means for introducing said refrigerant into the cylinder between the upper plate and the adjacent end of the cylinder, said refrigerant striking against the baffle and being deflected downwardly into said first compartment; an orifice provided in the lowermost region of the lower baffle plate for metering said refrigerant from the first into the second compartment; and means for withdrawing refrigerant from said second compartment.

4. In combination with a refrigeration system of the character described including a storage unit containing a heat holding fluid, a device submerged in said fluid for retarding the flow of refrigerant en route from the evaporator to the compressor of said system comprising: a cylinder closed at both ends; an upper baffle plate in spaced relation to one end of the cylinder extending downwardly therein to a selected plane relative to the longitudinal centerline of the cylinder; a lower baffle plate in spaced relation to the other end of the cylinder extending upwardly therein to a selected plane relative to said centerline; at least one intermediate baffle plate between said upper and lower plates extending upwardly in the cylinder to a selected plane relative to said centerline whereby to divide said cylinder into adjoining first and second vaporizing compartments and a vapor compartment adjoining said second compartment; means for introducing said refrigerant into the cylinder between the upper baffle plate and the adjacent end of the cylinder, said refrigerant striking against said plate and being deflected downwardly into said first compartment; an orifice provided in the lowermost region of the intermediate baffle plate for metering refrigerant from the first into the second compartment; an orifice provided in the lowermost region of said lower baffle plate for metering refrigerant from the second into the vapor compartment; and means for withdrawing refrigerant from said vapor compartment.

5. The device of claim 4 wherein the orifice in the lower baffle plate is of a more minute diameter than that of the orifice in the intermediate baffle plate.

6. In a refrigerant flow retarding device of the character described: an elongated horizontally disposed cylinder; a wall closing the inlet end of the cylinder; a wall

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closing the outlet end of the cylinder; an upper vertical baffle plate in spaced relation to the inlet end wall and extending downwardly in the cylinder to a plane in proximity to the horizontal centerline thereof; an opening formed in said inlet end wall in a plane above the bottom marginal edge of the baffle plate to receive one terminal portion of a first conduit, whereby refrigerant in mingled vapor and liquid form drawn into the cylinder via the conduit will impinge against said baffle plate to deflect the liquid portion of the refrigerant downwardly in the cylinder; a lower vertical baffle plate in spaced relation to the outlet end wall and extending upwardly in said cylinder to a plane in proximity to the horizontal centerline thereof; a plurality of similar lower baffle plates interposed between said upper and the first-named lower baffle plate in spaced relation thereto and relatively to one another; an orifice formed in each of the lower baffle plates in the lowermost region thereof; and an opening to receive one terminal portion of a second conduit, said opening being formed in the bottom portion of the cylinder between said outlet end wall and the first-named lower baffle plate aforesaid.

7. In a refrigerant flow retarding device of the character described: an elongated horizontally disposed cylinder; a wall closing the inlet end of said cylinder; a wall closing the outlet end of said cylinder; an opening to receive one terminal portion of a first conduit formed in said inlet end wall in a plane above the horizontal centerline of the cylinder; an upper vertical baffle plate in spaced relation to the inlet end wall and extending downwardly in the cylinder to a plane above the horizontal centerline thereof; a lower vertical baffle plate in spaced relation to the outlet end wall and extending upwardly in said cylinder to a plane in proximity to the horizontal centerline thereof; a plurality of similar lower baffle plates interposed between said upper and the first-named lower plate in spaced relation thereto and relative to one another; an orifice formed in each of the lower baffle plates in the lowermost region thereof; an opening to receive one terminal portion of a second conduit, said opening being formed in the bottom portion of the cylinder between said outlet end wall and the first-named lower baffle plate aforesaid; and an opening formed in said outlet end wall above the horizontal centerline of the cylinder to receive one terminal portion of a third conduit the other terminal portion of which is in fluid communication with the second conduit aforesaid.

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