

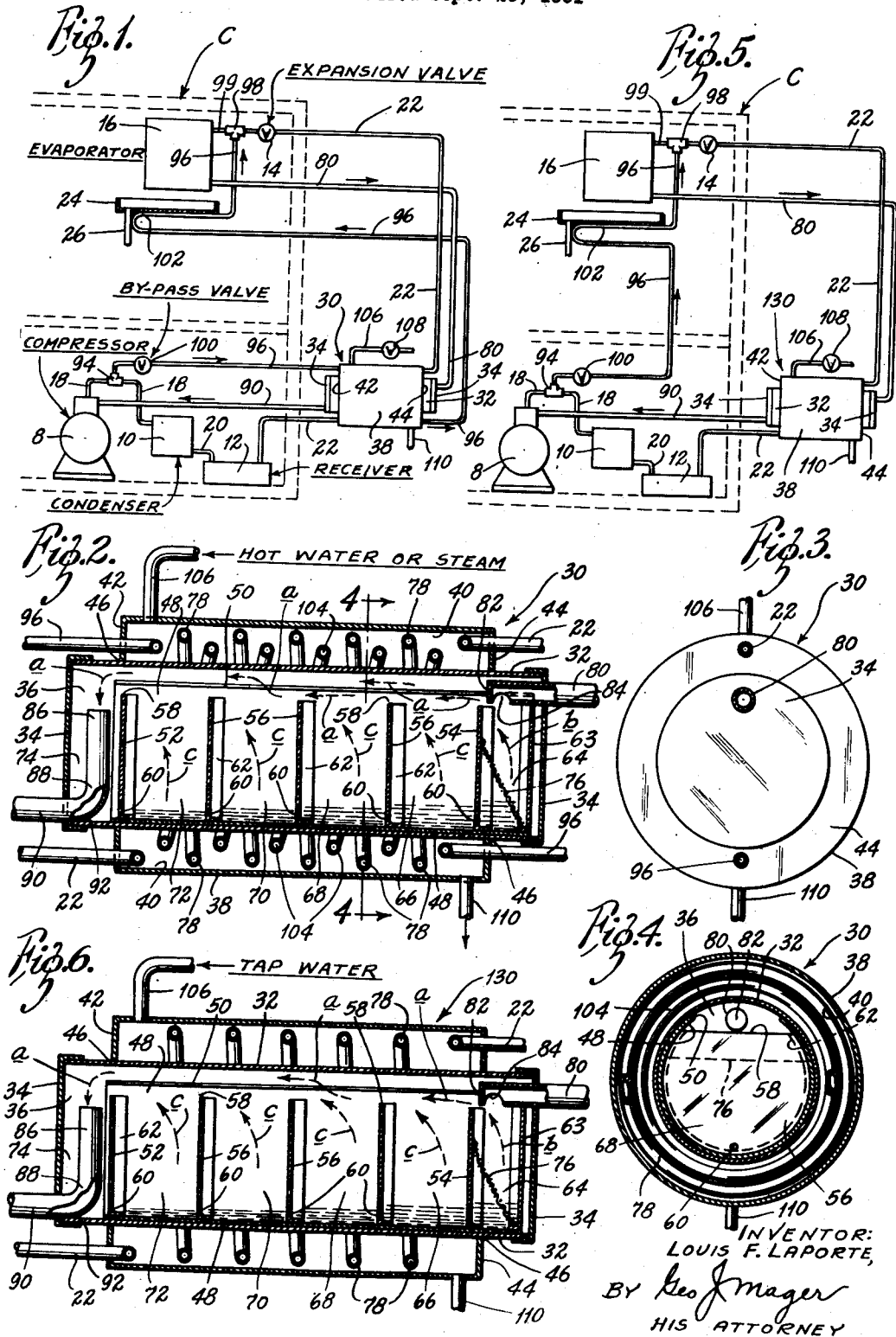
July 14, 1953

L. F. LA PORTE

2,645,101

DEFROSTING ARRANGEMENT IN REFRIGERATION SYSTEM

Filed Sept. 25, 1951



INVENTOR:
LOUIS F. LA PORTE,
BY *Geo J. Mager*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,645,101

DEFROSTING ARRANGEMENT IN
REFRIGERATION SYSTEMLouis F. La Porte, Rolla, Mo., assignor to
Francis L. La Porte, Burlingame, Calif.

Application September 25, 1951, Serial No. 248,246

13 Claims. (Cl. 62-117.55)

1

The present invention relates to mechanical refrigeration, and is primarily directed to the provision of a system which includes conventional refrigerating apparatus, and in addition includes novel means for defrosting the evaporator, and means for completely vaporizing the return or suction refrigerant before it reaches the compressor during defrosting operations or cycles.

It is common knowledge that the refrigeration industry has long sought a simple, inexpensive system incorporating an efficient defrosting arrangement.

Numerous attempts have been made in the past to provide such a system, as the prior art indicates. It is said in the industry however, that most of these prior art systems or devices are either impractical, too complicated, or from a manufacturing standpoint, too expensive.

The primary object of this invention therefore, is to overcome the disadvantages inherent in the prior art. To this end, the invention contemplates the interposition between the compressor and the evaporator of an otherwise conventional system, of a novel combined liquid flow retarding and vaporizing assembly, and a valve controlled condenser by-pass or vapor line, as will appear.

During normal refrigerating cycles, the present system operates in the usual manner, except that in its travel from the compressor to the evaporator, and conversely in its return travel from the evaporator to the compressor, the refrigerant in the system passes through the combined liquid flow retarding and vaporizing assembly aforesaid.

When it becomes necessary to remove therefrom the frost accumulated on the evaporator during normal refrigerating cycles, the only requisite is to temporarily open two valves incorporated in the system, said valves being closed during refrigerating cycles.

In the accompanying drawing, the invention is partly diagrammatically and partly structurally illustrated. The arrangement of the various elements, which combine to attain the aims and objects of the invention, will be more clearly understood from the description to follow with reference to said drawing, wherein:

Fig. 1 is diagrammatical illustration of a refrigeration system having incorporated therein the present invention;

Fig. 2 is longitudinal vertical sectional view disclosing the structural details of the novel combined liquid flow retarding and vaporizing assembly of the invention;

Fig. 3 is a right end elevational view of said assembly;

2

Fig. 4 is a transverse vertical sectional view taken on line 4-4 in Fig. 2;

Fig. 5 is a view similar to Fig. 1, showing a slightly modified arrangement;

Fig. 6 is a view similar to Fig. 2, modified to correspond with said Fig. 5 arrangement.

With particular reference now to Fig. 1, the refrigeration system is more or less diagrammatically illustrated, and includes a compressor 8, a condenser 10, liquid receiver tank 12, an expansion valve 14, and an evaporator 16, all of conventional design.

For illustrative purposes, this apparatus is shown mounted in an ordinary refrigerator cabinet suggested by broken lines, and designated C, it being understood that the said cabinet also exemplifies other enclosures equipped with a refrigeration system. It is also to be understood that the evaporator 16 may be of the finned coil type, or of the plate type, and so on.

The discharge line from the compressor to the condenser is designated by the numeral 18; numeral 20 indicates the condenser outlet line leading to the receiver 12; the liquid line leading from the latter is designated 22; a drain pan disposed below the evaporator is designated 24; and numeral 26 indicates the drain pipe.

With reference now also to Figs. 2, 3, and 4, the combined liquid flow retarding and vaporizing assembly of the invention is indicated generally by the numeral 30. As Fig. 1 indicates, this assembly is preferably located outside cabinet C, and it is to be understood that any suitable supporting means therefor may be employed.

The assembly 30 includes a first cylindrical or inner shell 32, sealed at each end by a closure or cap member 34, whereby to provide an elongated chamber 36; and a second cylindrical or outer shell 38 of larger diameter and concentrically disposed about the first shell, whereby to provide an annular chamber 40 about the latter, along the major portion of its length.

At the left, shell 38 terminates in a vertical end wall 42, and at the right in a vertical end wall 44, as best seen in Fig. 2. These end walls, as also there clearly shown, have horizontally aligned central openings 46 through which shell 32 extends.

Positioned in chamber 36 is a sheet metal insert member 48, which as seen to best advantage in Fig. 4, is substantially annular in transverse cross-section, there being an opening 50 provided in the upper peripheral portion thereof. With reference also to Fig. 2, it is seen that opening 50 extends from end to end of the insert, being formed by the removal of a segment from the insert along the top thereof.

Adjacent the left end of insert 48, and rigidly secured thereto, is a vertical baffle plate 52, there being a similar baffle plate 54 adjacent the right end of said insert.

Interposed between said baffle plates, in spaced relation thereto and to one another, is a series of intermediate baffle plates 56.

As Figs. 2 and 4 demonstrate, all of the baffle plates are identical. Each is of substantially circular configuration with a segment removed at the top, so as to provide a transverse upper marginal edge 58 in a plane considerably above the longitudinal centerline of the assembly 30. An orifice 60 is provided in each baffle preferably in the lowermost region thereof, and each baffle is preferably provided with a peripheral flange 62 to facilitate mounting in the insert member 48.

A closure plate 63 is provided for the right end of the insert member. This plate is similar to the baffle plates, but is imperforate, not being provided with an orifice.

From the foregoing it should be apparent that chamber 36 is, so to speak, subdivided into a plurality of compartments. In the illustrated embodiment there are six compartments, but obviously, their number may vary.

Beginning at the right and progressing to the left, compartment 64 is defined by closure plate 63 and baffle plate 54; compartment 66 is defined by baffle 54 and the first of the baffle plates 56; compartment 68 by the first and second baffle plates 56; compartment 70 by the second and third baffle plates 56; compartment 72 by third baffle plate 56 and left end baffle plate 52; and compartment 74 is defined by baffle plate 52 and left end closure member 34. An angularly positioned filter, such as a fine mesh screen 76 is provided in compartment 64 as shown.

Numeral 78 indicates a coil formed in a portion of liquid line 22 within annular chamber 40 of the assembly 30. The convolutions of coil 78, as Fig. 4 particularly illustrates, lie in proximity to the inner periphery of shell 38, for a reason to appear. Line 22 enters said shell through an opening in left end wall 42, passes therefrom through an opening in right end wall 44, and then continues on to the evaporator coil inlet, with expansion valve 14 interposed, as is understood and shown.

The return or suction line from the evaporator coil outlet is indicated by numeral 80, and leads to the assembly 30. After passing through right end closure 34, as shown in Fig. 2, line 80 extends into chamber 36 to terminate in a closed vertical end 82 adjacent the upper marginal edge 58 of baffle 54. An opening 84 is formed in the terminal portion of line 80 contiguous to end wall 82, and above compartment 64.

With this arrangement, it is manifest that the suction conduit from the evaporator to the compressor is non-continuous. In other words, as will appear in the description of the operation hereinafter, the return or suction gas, after being discharged via opening 84 into chamber 36, enters the upwardly extending hollow arm portion 86 of an elbow 88, which constitutes the inlet end of the final return or suction conduit 90 which leads from assembly 30 to compressor 8. An orifice 92 is provided in the elbow in proximity to the lowermost peripheral segment of shell 32.

Connected into the discharge line 18 of the compressor by means of a T fitting 94, is a tube or conduit which will hereinafter be termed a vapor line. This vapor line 96, extends from

said T fitting to another T fitting 98, whereby fluid communication between compressor discharge line 18 and evaporator coil inlet 99 may be established during a defrosting operation by the manipulation of by-pass valve 100, as will be explained. It is here noted that valve 100 may be operated either manually, electrically, or by any other suitable mechanical means.

With reference again to Figs. 1 and 2, it is seen that vapor line 96 passes first through end wall 42 of shell 38 to enter chamber 40, then through end wall 44 to leave said chamber and continue on to T 98, with an intermediate loop portion 102 thereof in heat transfer relationship with both the pan 24 and its associated drain pipe 26.

That portion of conduit 96 within chamber 40 of shell 38 is in the form of a coil 104 the convolutions of which surround shell 32.

Numeral 106 designates a conduit provided for the admission of either water or steam into the heating chamber 40 under the control of a valve 108; numeral 110 designates a pipe for conducting the water or steam from said chamber.

It is here noted, that all of the openings through which any of the conduits or lines referred to enter or leave assembly 30 are sealed, as are the openings 46 in end walls 42 and 44.

In the slightly modified form of the invention illustrated in Figs. 5 and 6, vapor line 96 does not pass through the assembly 130, and consequently also, coil 104 is dispensed with. In all other respects, the arrangement is identical with that disclosed hereinbefore, and the same reference characters designate the similar elements.

Operation

The operation relative to the Fig. 1 through 4 embodiment will now be described.

During normal refrigeration cycles, assuming that the temperature in the space to be cooled has risen above a desired degree, any of the conventional thermal responsive devices will cause the compressor to start, as is understood.

As a result, refrigerant in vapor form is withdrawn from the evaporator via line 80 into the assembly 30, specifically into chamber 36 of shell 32, being discharged thereinto through opening 84.

As suggested by the broken line arrows *a*, the vapor proceeds to the left above the baffle plates and enters the upwardly extending hollow arm 86 of elbow 88, and is drawn into compressor 8 via final suction or return conduit 90.

From the compressor, the now high pressure refrigerant passes to condenser 10, valve 100 being closed. From the condenser, the refrigerant now in substantially liquid form is delivered via line 20 to receiver 12, and thence via line 22 through assembly 30, specifically through coil portion 78 in chamber 40.

From said assembly, the refrigerant in liquid form is metered or fed through expansion valve 14 into the inlet portion 99 of the evaporator coil.

As the refrigerant circulates through the evaporator coil, the ambient warmth is absorbed by the refrigerant, as is understood, so that the latter is vaporized and returns in vapor form to the assembly 30, for repetitions of the cycle, until the thermal device stops the compressor, as is understood.

In the course of these cycles of normal compressor operation, the moisture prevailing in the space being cooled is drawn toward and settles upon the evaporator. Thus, a layer or layers of frost increasingly accumulate on the exterior of the evaporator.

5

Eventually, the accumulation of frost will hamper the efficiency of the refrigeration apparatus, so that it becomes imperative to defrost the evaporator.

Assuming that such is the case, it is only necessary to open valves 100 and 108, whereupon the refrigerant follows the path indicated by the arrows in Fig. 1. Thus with valve 100 open, the compressor discharge gas now bypasses the condenser and travels via line 18, T fitting 94, and vapor line 96 through the assembly 30, specifically through coil 104 in chamber 40, and thence from said assembly to T 98 and into inlet of the evaporator coil. Enroute to said T, the vapor passes through portion 102 of line 96 which is in heat transfer relationship with drain pan 24 and pipe 26.

Now as the vaporized refrigerant passes through coil 104, the hot water or steam, flowing into chamber 40 via line 106 and out of said chamber via pipe 110, superheats the refrigerant whereby defrosting is accelerated.

That is to say, the thus completely vaporized and superheated refrigerant, circulating via line 96 from coil 104 through portion 102 of said line and into the inlet end 99 of the evaporator, quickly melts the frost which had accumulated on the latter, and simultaneously prevents the resultant drippings from freezing in the drain pan.

The heat inherent in the superheated refrigerant having been transferred to the evaporator coil and drain pan, the refrigerant leaves the evaporator via conduit 80 and proceeds to the assembly 30, in mingled vapor and liquid form.

The refrigerant upon entering chamber 36, impinges against closed end wall 82 of suction line 80, the liquid being thereby deflected downwardly into compartment 64 through screen 76. Some of the liquid also drops by gravity directly through opening 84 into said compartment, but the vapors travel onwardly to the left as suggested by broken line arrows *a*.

All of the liquid necessarily passes through screen 76, so that any scale or other extraneous matter, which may have found its way into the liquid, is trapped, whereby clogging of the orifices 60 is obviated.

It is noted that at this time, the hot water or steam entering and leaving chamber 40 surrounds inner shell 32, so that the body of the latter is being heated. Much of this heat is transferred to the insert 48 and the baffle plates. Consequently, a considerable quantity of the non-vaporized liquid entering compartment 64 is quickly vaporized, and rising as suggested by broken line arrow *b*, joins the vapor stream suggested by arrows *a*, above the upper edge 58 of baffle plate 54.

Simultaneously, the remaining non-vaporized liquid flows through orifice 60 in said baffle plate to enter compartment 66 where a portion of it is vaporized, and rising above the upper edge 58 of baffle plate 56, as suggested by broken line arrow *c*, also joins said vapor stream.

This vaporization is repeated successively in compartments 68, 70, and 72 as is understood, so that all except perhaps a negligible residue of the returning refrigerant will have been completely vaporized before it can enter compartment 74 via orifice 60 in baffle plate 52. Obviously however, should it happen that such negligible residue would reach the latter compartment, it would quickly evaporate also.

From the foregoing, it should be manifest that

6

during a defrosting operation, all of the refrigerant in vapor form is drawn into the open upper end portion 86 of the final return or suction conduit 90, and thereupon returned to compressor 8 for repetitions of the cycle.

In other words, the system will function in a defrosting capacity as long as valves 100 and 108 are allowed to remain open. When defrosting is complete, closing both said valves will cause the system to revert to the normal refrigeration operation previously explained.

Obviously, unless outlet pipe 110 is actually a drain, water will be trapped in chamber 40 following a defrosting operation. Upon resumption of normal refrigeration operations, freezing of said water will be obviated by the provision of coil 78. In other words, there is sufficient heat in the refrigerant enroute from receiver 12 to the expansion valve for this purpose. Similarly, coil 104 will prevent the freezing of any water or condensate in chamber 40 in the event of hot water or steam failure during a defrosting operation.

From the foregoing, it should be evident that the invention provides a simple, efficient refrigeration system adapted to attain all of its objectives. The valve controlled means for superheating the compressor discharge vapors enroute to the evaporator during defrost cycles is of great value when quick defrosting is required, or desired. The longitudinal opening 50 formed in the insert member provides an unrestricted path for the vapor flow through chamber 36.

With reference to the final return conduit 90, whereas the drawing illustrates its terminal end portion within shell 32 to be in the form of an elbow, the latter may obviously be dispensed with should said conduit lead into chamber 36 from the bottom of said shell. It is also noted, that under certain conditions, the left end baffle plate 52 and the intermediate baffle plates 56 may be dispensed with.

The operation of the slightly modified embodiment illustrated in Figs. 5 and 6 should be obvious. The arrows in Fig. 5 indicate the refrigerant flow during defrosting cycles.

In this embodiment, the superheating of vapors in line 96 is dispensed with, so that defrosting operations are accomplished more slowly.

Therefore, ordinary tap water, instead of steam or hot water, may be introduced into chamber 40 of assembly 130 via line 106 during defrosting, for vaporizing the liquid in the returning refrigerant. Following a defrosting operation and resumption of normal refrigerating operations, freezing of water trapped in said chamber will be obviated by the presence of coil 78.

The invention as illustrated and described may obviously be modified without departing from the characteristic principles thereof. Therefore, it is to be understood that the scope of the invention is limited only by the appended claims.

What I claim is:

1. In a refrigeration system including a compressor, a condenser, a receiver, an expansion valve, an evaporator, and conduit connections between them for circulating a refrigerant: a combined liquid flow retarding and vaporizing assembly interposed in the conduit connections between the compressor and the evaporator; said assembly including a first or inner cylindrical shell sealed at either end by a closure member to provide an elongated chamber within the shell; a second or outer cylindrical shell of larger diameter concentrically disposed about said first

7

shell and having end walls whereby to provide a sealed annular chamber about the latter shell along the major portion of its length; a metallic insert member positioned in said elongated chamber and having rigidly secured thereto an end plate and a plurality of vertical baffle plates in spaced relation to one another whereby to subdivide said elongated chamber into a plurality of compartments; an orifice formed in each baffle plate in the lowermost region thereof for establishing fluid communication between adjacent compartments; means for introducing refrigerant returning from the evaporator into one of the compartments of said elongated chamber; means provided in the said compartment for preventing extraneous matter in the refrigerant clogging the orifices in the baffle plates; means for heating said elongated chamber by the introduction of a selected fluid medium into said annular chamber and about said inner shell; and means for delivering refrigerant from said chamber to said compressor.

2. The combined liquid flow retarding and vaporizing assembly of claim 1 wherein said metallic insert member is substantially annular in transverse cross-section; and wherein an opening is provided in the upper peripheral portion of the insert member, said opening extending from end to end thereof, and being formed by the removal of a segment from said insert along the top thereof.

3. The combined liquid flow retarding and vaporizing assembly of claim 1 wherein each of the plurality of said baffle plates is of substantially circular configuration with a segment removed at the top so as to provide a transverse upper marginal edge in a plane considerably above the longitudinal centerline of said assembly; and wherein each baffle plate is provided with a peripheral flange adapted to facilitate the mounting thereof in the said metallic insert member.

4. The combined liquid flow retarding and vaporizing assembly of claim 1 wherein the means for introducing refrigerant returning from the evaporator into one of the compartments of said elongated chamber comprises a suction conduit leading from said evaporator to said elongated chamber, said conduit passing through one of the closure members of said inner shell to terminate in a vertically disposed end wall for deflecting liquid portions of said refrigerant downwardly into said compartment; and an opening formed in the terminal portion of said line contiguous to said vertically disposed end wall for allowing some liquid portions of said refrigerant to drop by gravity into the compartment aforesaid.

5. The combined liquid flow retarding and vaporizing assembly of claim 1, wherein the means for delivering the refrigerant from said elongated chamber to said compressor comprises a final suction conduit leading from the chamber to said compressor, said conduit passing through one of the said closure members of said inner shell to terminate in an elbow including an open ended arm portion extending upwardly in one of said compartments; and an orifice provided in the elbow in proximity to the lowermost segment of the inner shell aforesaid.

6. In a refrigeration system of the character described: means for diverting the high pressure refrigerant vapors, normally passing from the compressor to the condenser, into a vapor conduit connected at its one end into the compressor discharge line and at its other end into the inlet

portion of the evaporator coil; a combined liquid flow retarding and vaporizing assembly as defined in claim 8 interposed in the system between the compressor and the evaporator, said vapor conduit passing through the annular chamber included in said assembly; a coil formed in said conduit the convolutions of the coil being disposed in said annular chamber; and means for superheating the vapors passing through said coil by the controlled flow of a hot fluid medium into and out of said chamber.

7. In a refrigeration system of the character described: means for diverting the high pressure refrigerant vapors, normally passing from the compressor to the condenser, into a vapor tube connected at one end into the compressor discharge line and at its other end into the connection between the evaporator coil and the expansion valve; a combined liquid flow retarding and vaporizing assembly as defined in claim 8 interposed in the system between the compressor and the evaporator, said vapor tube passing through the annular chamber included in said assembly; a coil formed in said tube the convolutions of the coil being disposed in said annular chamber; means for superheating the refrigerant passing through said coil by the controlled flow of a hot fluid medium into and out of said chamber; and a loop portion formed in said vapor tube between said assembly and the evaporator, said loop portion being in heat transfer relationship with the drain pan structure associated with said system.

8. In a refrigeration system of the character described, including a liquid line leading from the receiver to the evaporator: a combined liquid flow retarding and vaporizing assembly as defined in claim 8 interposed in the system between the compressor and the evaporator, said liquid line passing through the annular chamber included in said assembly; and a coil formed in said liquid line the convolutions of said coil being disposed in said chamber.

9. In a refrigeration system of the character described, means for vaporizing all of the liquid in the mingled vapor and liquid refrigerant returning via the suction line to the compressor during defrosting cycles, said means comprising: a combined liquid flow retarding and vaporizing assembly interposed in said line between the evaporator and the compressor, said assembly including a first cylindrical shell closed at either end to provide an elongated chamber within the shell; a substantially annular metallic insert member positioned in said chamber, said member being open at the top throughout its length; a vertical end closure plate and a plurality of vertical baffle plates mounted in the insert member in spaced relation to thereby subdivide said chamber into an inlet compartment, an outlet compartment, and at least one intermediate compartment; an orifice provided in each baffle plate in the lowermost region thereof to establish fluid communication between adjacent compartments; filter means in the inlet compartment for preventing passage of impurities in the liquid to any of said orifices; a closed end on the extremity of one segment of said suction line which projects into said elongated chamber above the inlet compartment; an opening provided in the bottom periphery of said extremity adjacent said closed end; an open end on the extremity of another segment of said suction line which projects into said elongated chamber at the bottom of the outlet compartment; an orifice formed in the latter segment adjacent the lowermost region of said

chamber; a second cylindrical shell provided with end walls and concentrically disposed about said first shell to provide an annular chamber about the latter shell; and means controlled by a valve for introducing a selected fluid medium into said annular chamber for effecting the transfer of heat from said fluid medium to the elongated chamber.

10. The combined liquid flow retarding and vaporizing assembly of claim 1, wherein the means for delivering the refrigerant from said elongated chamber to said compressor comprises a final suction conduit leading from the chamber to said compressor, said conduit passing upwardly through said shell to terminate in an open ended section extending upwardly in one of said compartments; and an orifice provided in said section in proximity to the lowermost segment of the inner shell aforesaid.

11. In a refrigeration system including a compressor, a condenser, a receiver, an expansion valve, an evaporator, and conduit connections between them for circulating a refrigerant; a combined liquid flow retarding and vaporizing assembly interposed in the conduit connections between the compressor and the evaporator; said assembly including a first or inner cylindrical shell sealed at either end by a closure member to provide an elongated chamber within the shell; a second or outer cylindrical shell of larger diameter concentrically disposed about said first shell and having end walls whereby to provide a sealed annular chamber about the latter shell along the major portion of its length; a metallic insert member positioned in said elongated chamber and having rigidly secured thereto an end plate and a vertical baffle plate in spaced relation to the end plate whereby to divide said elongated chamber into a first and a second compartment; an orifice formed in the baffle plate in the lowermost region thereof for establishing fluid communication between the said compartments; means for introducing refrigerant returning

from the evaporator into the first compartment of said elongated chamber; means provided in said first compartment for preventing extraneous matter in the refrigerant clogging the orifice in said baffle plate; means for heating said elongated chamber by the introduction of a selected fluid medium into said annular chamber and about said inner shell; and means for delivering refrigerant from said chamber to said compressor.

12. The combined liquid flow retarding and vaporizing assembly of claim 11, wherein the means for delivering the refrigerant from said elongated chamber to said compressor comprises a final suction conduit leading from the chamber to said compressor, said conduit passing through one of the said closure members of said inner shell to terminate in an elbow including an open ended arm portion extending upwardly in said second compartment; and an orifice provided in the elbow in proximity to the lowermost segment of the inner shell aforesaid.

13. The combined liquid flow retarding and vaporizing assembly of claim 11, wherein the means for delivering the refrigerant from said elongated chamber to said compressor comprises a final suction conduit leading from the chamber to said compressor, said conduit passing upwardly through said shell to terminate in an open ended section extending upwardly in said second compartment; and an orifice provided in said section in proximity to the lowermost segment of the inner shell aforesaid.

LOUIS F. LA PORTE.

References Cited in the file of this patent UNITED STATES PATENTS

Number	Name	Date
2,323,511	Baker	July 6, 1943
2,430,960	Soling	Nov. 18, 1947
2,553,657	La Porte	May 22, 1951
2,611,587	Boling	Sept. 23, 1952