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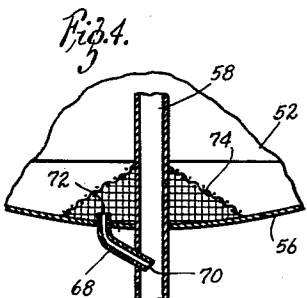
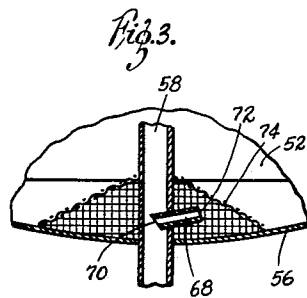
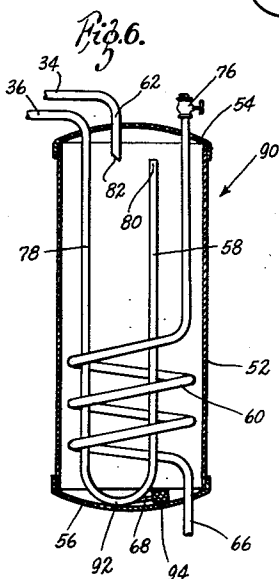
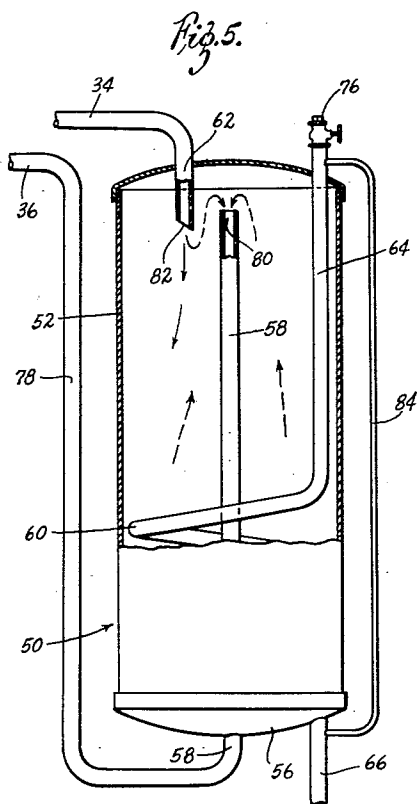
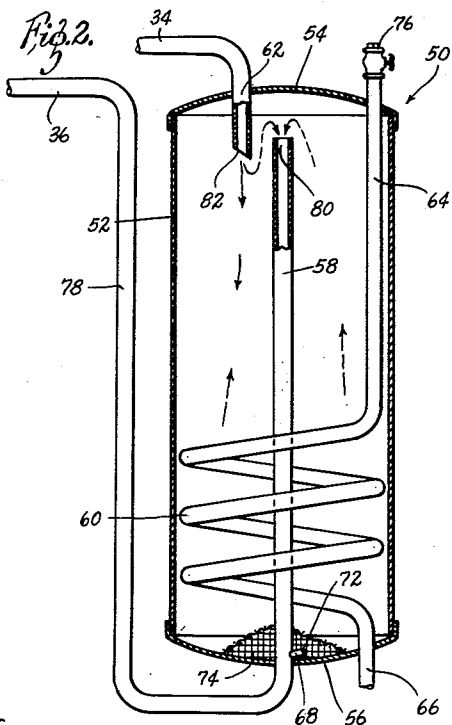
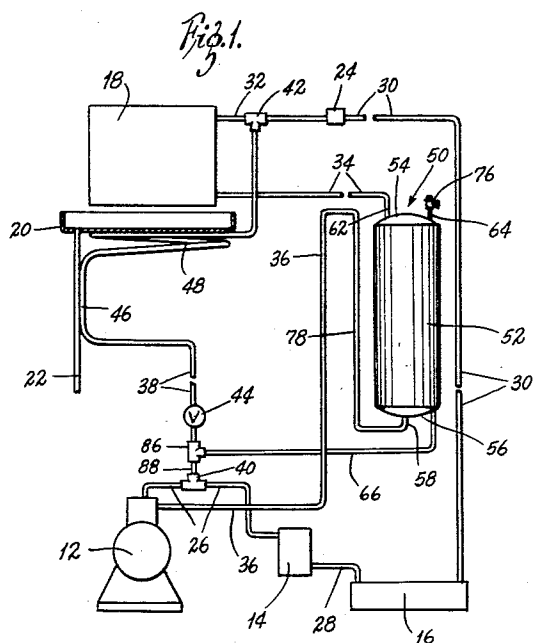
F. L. LA PORTE

3,012,414

REFRIGERATION APPARATUS WITH LIQUID TRAPPING MEANS

Filed May 9, 1960

2 Sheets-Sheet 1



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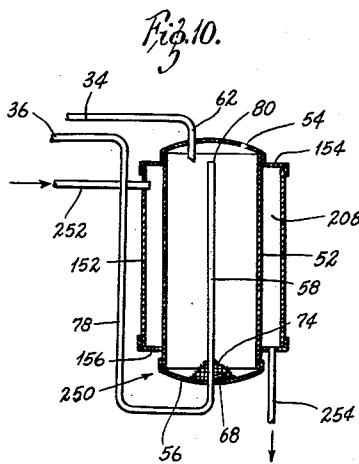
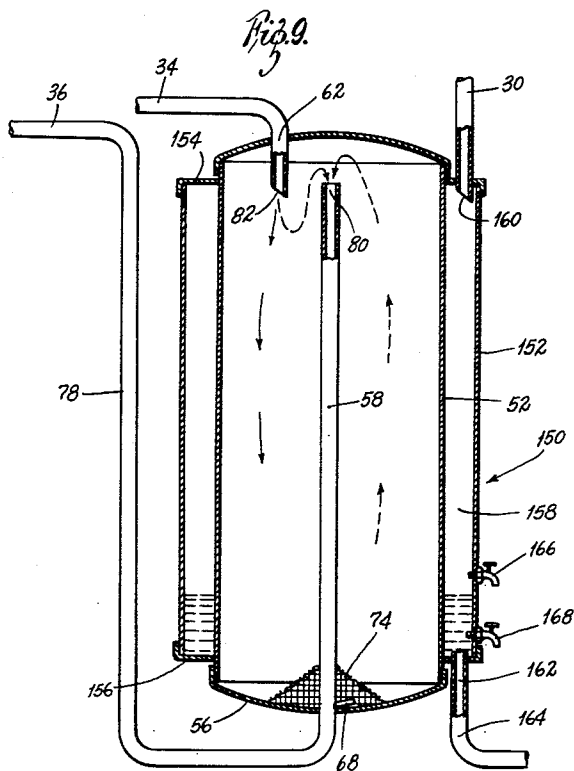
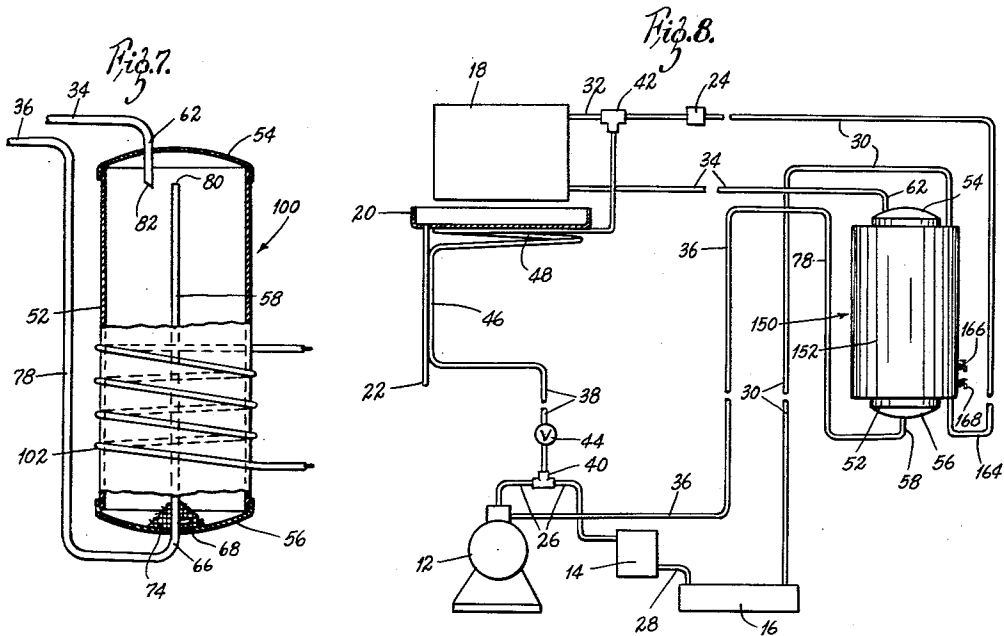
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REFRIGERATION APPARATUS WITH LIQUID TRAPPING MEANS

Filed May 9, 1960

2 Sheets-Sheet 2



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3,012,414 REFRIGERATION APPARATUS WITH LIQUID TRAPPING MEANS

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15 Claims. (Cl. 62-275)

The present invention relates to mechanical refrigeration, and is primarily directed to the incorporation in an otherwise generally conventional apparatus, of novel means adapted to increase the operational efficiency of said apparatus during a refrigerating cycle, during a defrosting cycle, and during the change-over interval that transpires between a refrigerating cycle and a defrosting cycle, and vice-versa.

More specifically, the present invention is directed to novel and improved means for incorporation in conventional refrigeration apparatus of the type that also includes means for defrosting the evaporator and its drain pan by what has come to be known as the hot gas method, whereby to increase the efficiency of said apparatus. The present application is a continuation-in-part of my pending application, Serial No. 19,338, filed April 1, 1960.

In the course of a defrosting cycle effected by the hot gas method, a considerable quantity of refrigerant is condensed in the evaporator. From the evaporator this refrigerant flows onwardly to the compressor in mingled liquid and vapor form.

One of the principal objects of the present invention is to provide novel means for temporarily trapping the liquid portion of said refrigerant on its way to the compressor, while at the same time providing for the free onward flow of the vapor portion thereof toward said compressor.

It is well known that in order to neutralize the acids therein, and to obviate freezing of moisture that may find its way into the expansion valve or similar metering device normally included in refrigeration apparatus, the refrigerant circulated contains a small quantity of fluid additives and oil. These additives also facilitate smooth operation of the compressor, provided they do not enter the intake side thereof in globules, or what are referred to in the refrigeration art as "slugs."

It is therefore another object of the present invention to associate with the means aforesaid, means adapted to atomize these additives and liquid refrigerant by syphoning or metering them into the high velocity vapor stream enroute to the compressor, thereby obviating the prevalent disadvantage of what it termed "slugging the compressor."

To this end the present invention provides a liquid refrigerant trap including metering and vaporizing means that is interpolated in the system incorporating the refrigeration apparatus. The refrigerant passes through said trap both during refrigerating and defrosting cycles as will appear. Fluid additives of the character referred to hereinabove are actually non-vaporizable at the temperature wherein the apparatus operates, wherefore the atomization of said additives is of prime importance.

A further object of this invention is to provide means for supplying heat to the temporarily trapped liquid refrigerant, whereby to accelerate vaporization thereof in the course of normal refrigerating cycles of operation.

Another object of the invention is to provide means for supplying heat to the temporarily trapped liquid refrigerant to accelerate vaporization thereof in the course of defrosting cycles of operation.

It is also an object of the invention to provide means for supplying heat to the temporarily trapped liquid refrigerant whereby to accelerate vaporization thereof during the reverse cycle change-over interval obtaining between refrigerating and defrosting cycles.

An additional object of the invention is to provide means for obviating the flow toward the compressor of extraneous matter that may develop in the refrigerant.

Features and advantages provided by the invention in addition to those outlined above, will be more comprehensively set forth in the detailed description to follow with reference to two sheets of drawing that accompany this specification. Broadly, each embodiment of the invention illustrated in these drawings includes: an elongated preferably cylindrical tank that is sealed at both ends; a vapor tube, open at the top and extending upwardly in the tank; a small metering tube extending into the vapor tube at one end, and being in fluid communication at its opposite end with the space in the tank about said vapor tube; a perforate protective device disposed in the tank about the last named end of the metering tube; a conduit leading from the lower end of the vapor tube to the compressor; and a depending elbow segment formed on the free end of the evaporator coil outlet line, said segment extending into the tank at a high level as will be explained in more detail with reference to the drawings aforesaid.

In said drawings:

FIGURE 1 is a diagrammatical representation of generally conventional refrigeration apparatus having incorporated therein a liquid refrigerant trap and re-evaporator unit constructed in accordance with the teachings of the present invention;

FIGURE 2 is a vertical sectional view taken centrally through said trap and re-evaporator unit;

FIGURE 3 is a sectional reproduction on an enlarged scale, of a fragmentary portion of FIGURE 2;

FIGURE 4 is a view similar to FIGURE 3 illustrating a slightly modified arrangement;

FIGURE 5 is a view similar to FIGURE 2 presenting a slightly modified liquid refrigerant trap and re-evaporator unit;

FIGURE 6 is a view similar to FIGURE 2 presenting a further modified trap unit;

FIGURE 7 is a view, partly in section and partly in elevation, demonstrating schematically the application of electrical heat to external surfaces of a liquid refrigerant trap and re-evaporator unit;

FIGURE 8 is a view similar to FIGURE 1, illustrating the incorporation of a partially encased liquid refrigerant trap and re-evaporator unit in generally conventional refrigeration apparatus;

FIGURE 9 is a vertical sectional view taken centrally through the said unit shown in FIGURE 8; and

FIGURE 10 is a view similar to FIGURE 9 illustrating schematically an arrangement whereby the temperature of said partially encased unit may be raised in consequence of the circulation therethrough of a heated fluid medium.

The conventional apparatus illustrated diagrammatically in FIGURES 1 and 8 includes a compressor 12, a condenser 14, a receiver 16, an evaporator 18, a drain pan 20 that is disposed beneath the evaporator, a drain pipe 22 for said pan, and an expansion valve or other suitable liquid metering device 24. The discharge line leading from the compressor 12 to the condenser 14 is designated 26; the condenser outlet line leading to the receiver 16 is designated 28; and numeral 30 indicates the liquid line leading from the receiver 16 toward the device 24. The evaporator coil inlet line is designated 32; the outlet line of said coil is designated 34; and the compressor intake or suction line is designated 36. As a general rule, the assembly comprising the compressor, condenser, and receiver is located remotely from the space to be cooled, the assembly comprising the evaporator, its drain pan, and the metering device being located within said space.

The functioning of a refrigeration system including the conventional apparatus thus far described is well under-

stood. In operation, assuming that the temperature of the space to be cooled had risen above a desired degree, energization of the compressor 12 would be effected responsive to a suitable thermal device installed in the vicinity of the evaporator. In consequence of compressor operation, refrigerant in mingled vapor and liquid form is withdrawn from the evaporator 18 via suction line 36. The refrigerant thus delivered to the intake side of compressor 12 is compressed, and in resultant heated or vapor form, is then discharged via line 26 to the condenser 14. From the condenser, the refrigerant now in liquid form, proceeds onward via line 28 to the receiver 16, and thence via line 30 through the metering device 24 into the evaporator coil inlet line 32 for a repetition of the described cycle.

In the course of its passage through the coil of the evaporator 18, the refrigerant, when absorbing the ambient warmth about said evaporator, simultaneously draws thereonto the atmospheric moisture present in the space being cooled. This moisture settles on the external surfaces of the evaporator and gradually freezes, whereby to envelop this element in layers of frost that increase in density each time the compressor operates during normal refrigeration cycles. As is well understood, when in consequence of repeated refrigeration cycles of operation, the accumulated layers of frost become so dense as to hamper the efficiency of the system, defrosting of the evaporator and drain pan assembly is required.

In order to meet this requirement, the hereinabove described conventional refrigeration system has incorporated therein a defrosting arrangement in accordance with the concepts of the present invention. To this end, a conduit that will be termed a vapor line 38, is connected into the discharge line 26 of the compressor by means of a T fitting 40. The vapor line 38 extends from the fitting 40 to a T fitting 42, so that fluid communication between said line 26 and the evaporator coil inlet 32 may be established during a defrosting operation by bringing the valve 44 into open status. Normally, that is during refrigerating cycles, this valve is in closed status so that the compressor discharges directly into the condenser. Operation of the valve 44 may be effected manually, mechanically or electrically. The vapor or "hot gas" line 38 may have formed therein a loop portion 46 that contacts the drain pipe 22, and a coiled portion 48 that lies contiguously to the drain pan 20 as shown.

In order to initiate a defrosting operation without disturbing the normal operability of the compressor, the valve 44 would be placed in open status. Consequently, the hot discharge gases from the compressor would bypass the condenser and travel via vapor line 38 to the evaporator coil inlet 32. Following completion of a defrosting operation, the valve 44 would again be placed in closed status, whereby the system would revert to normal refrigerating operability.

With particular reference now to FIGURES 1 through 3, numeral 50 designates generally a liquid refrigerant trap and re-evaporator unit incorporated in a refrigeration system of the character described above. The unit 50 includes a cylindrical tank 52 that is hermetically sealed at both ends by means of arcuately contoured cover members 54 and 56. The tank 52 is vertically disposed, and in this concept of the invention, would be located in proximity to the compressor.

The unit 50 further includes a vapor tube 58 that is disposed within the tank 52; a coil 60 disposed within said tank about a portion of said vapor tube; a depending segment 62 constituting the remote end of the evaporator coil outlet line 34; an upwardly extending tube 64 in communication at its lower end with the uppermost convolution of the coil 60; a conduit 66 leading from the lowermost convolution of the coil 60 toward the compressor 12; a metering tube 68 rigidly supported, at what will be termed its delivery end 70, from the vapor tube 58, and having its free or intake end 72 disposed in proximity to

the lowermost region of the tank; a perforate protective shield 74, illustrated as being of meshed wire construction, enveloping said metering tube; a purge valve 76 mounted on the upper extremity of the tube 64; and a return bend section 78 connecting the suction line 36 and the vapor tube 58. As illustrated, said return bend section 78 is disposed outside the tank 52.

With attention directed particularly to FIGURE 2, it will be observed that the upper end 80 of the vapor tube 58 is disposed in a plane above that of the lower end 82 of the evaporator coil outlet line segment 62, and the upper end of the return bend section 78 joins the suction line 36 in a plane that lies above said upper end 80 of the vapor tube.

A slightly modified metering tube disposition is illustrated in FIGURE 4. The FIGURE 4 arrangement is similar to that disclosed in FIGURE 3, the difference being that the metering tube 68 is for the most part, disposed externally of the tank 52. Thus as shown, the delivery end 70 thereof extends into the vapor tube 58 at a point below the lower cover member 56, and the intake end 72 extends through said cover member and terminates within the tank.

Shown in FIGURE 5 and identified by the numeral 84, is a slender pipe that may be incorporated in the unit 50 to increase its efficiency, as will be explained hereinafter.

In the FIGURE 1 arrangement, the conduit 66 leading from the coil 60 connects into a T-fitting 86, and a conduit 88 is interposed between the T-fitting 40 and said fitting 86, the conduit 88 being of course a segment of the vapor tube 38.

A slightly modified liquid refrigerant trap and re-evaporator unit, also designed for incorporation in the FIGURE 1 system, is illustrated in FIGURE 6 and designated generally by the numeral 90. In this exemplification, the return bend section 78 is disposed within instead of outside the tank 52, and is contoured to include a semicircular segment 92 that is disposed in the lowermost region of said tank, and merges into the lower end of the vapor tube 58. The coil 60 surrounds both the vapor tube 58 and the perpendicular portion of said return bend section 78, as shown. The metering tube 68 projects into the semicircular segment 92, and the intake end thereof is enveloped by a perforate protective shield 94.

A modified liquid refrigerant trap and re-evaporator unit generally designated by the numeral 100, is illustrated in FIGURE 7. Elements included in the unit 100 that have been hereinbefore described are identified by corresponding reference numerals. It will be observed that in accordance with the concepts of the present invention, externally applied heating means typified by the electrically heated coil 102 that is wound about the tank 52, may be included.

The liquid refrigerant trap and re-evaporator unit appearing in FIGURES 8 and 9 is generally designated 150. In this construction the major portion of the tank 52 is encased within a cylindrical shell 152, the upper and lower ends of the shell being sealed by means of closure members 154 and 156 as shown. Extending through the upper closure member 154 and projecting into the annular chamber 158 about the tank 52, is the terminal segment 160 of the liquid line 30. Extending through the lower closure member 156 and projecting slightly into said chamber 158, is the terminal segment 162 of a liquid line continuation 164 leading to the device 24. Two vertically spaced test cocks 166 and 168 are provided in the lower portion of the shell 202, for a reason to appear.

A modification of the FIGURE 9 unit is illustrated in FIGURE 10 and designated by the numeral 250. The unit 250 would be incorporated in the refrigeration apparatus in a manner similar to that with respect to the unit 50. That is to say, the liquid line 30 would extend from the receiver 16 to the device 24, as demonstrated in FIGURE 1. Numeral 252 indicates a pipe extending into the annular chamber 208 at a high level for de-

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livering a heated fluid medium thereinto, and numeral 254 indicates a pipe extending into said chamber at a lowermost level for draining said medium therefrom. The nature of the heated fluid medium delivered into the chamber 208 via the pipe 252 and drained therefrom via the pipe 254, may vary. In other words, either heated refrigerant, oil, or water could be employed.

Operation

The operation of the FIGURE 1 refrigeration apparatus having the unit 50 incorporated therein, and the advantages accruing from this arrangement will now be described.

As hereinbefore noted, the unit 50 would be located in proximity to the compressor. It is further noted that said unit should be so installed that the bottom of the tank 52 would lie in a plane above the compressor, and that preferably, the line 66 would incline slightly downwardly toward the T-fitting 86.

During normal refrigerating cycles, with the valve 44 closed, partially vaporized refrigerant drawn from the evaporator 18 discharges into the tank 52 via the depending segment 62 of the evaporator coil outlet line 34. The liquid and non-vaporizable constituents of the refrigerant drop to the bottom of the tank, whereas the vapors are drawn into the open upper end 80 of the vapor tube 58 and on to the compressor 12 via the return bend section 78 and suction line 36.

As is well understood, in a conventional system the compressed and thus further heated vaporized refrigerant is discharged from the compressor into the condenser, whence in liquid form, it continues on to the receiver. In accordance with the concepts of the present invention however, most of the hot vapors leaving the compressor serve to heat the unit 50 prior to their ultimate delivery to the condenser in liquid form.

In other words, although some of the compressor discharge gases pass onwardly to the condenser 14 in the usual manner, a quantity of these gases will flow instead, via fitting 40, conduit 88, fitting 86 (valve 44 being in closed status), and conduit 66, into the coil 60. Said gases give up their heat thereto as they proceed through the convolutions of said coil and its extension 64, and thus condensing, return by gravity in liquid form to the line 26 and on to the condenser 14. It should therefore be apparent that in accordance with the concepts of the present invention, a quantity of the hot compressor discharge gases proceed onwardly to the coil 60 from the conduit 26 via the components of the system numerically designated above, and concurrently return by gravity in liquid state via the same components to said conduit 26 for delivery to the condenser 14.

It should thus be apparent that the unit 50 serves in the capacity of an auxiliary condenser. Although not shown in the drawings, a cover of insulation may be applied to the tank 52 if desired. The purge valve 76 is normally closed both during refrigeration and defrosting operations. It may be opened from time to time whereby to permit the escape of any air that may have accumulated in coil 60 and its extension 64. The venting arrangement 84 shown in FIGURE 5 may be incorporated to facilitate the simultaneous counter-flow of vaporized and liquified refrigerant through the coil 60. Oil, alcohol, or other fluid additives that collect in the lowermost region of the tank are drawn into the vapor tube 58 via the metering tube 68, and are atomized by the action of the high velocity vapor stream flowing past the end 70 of said tube. Consequently these additives are drawn into the compressor in what will be termed spray form. The perforate device 74 serves to shield the metering tube 68 against the entrance of any extraneous matter thereinto.

During a defrosting cycle, initiated by manipulating the valve 44 to open position, the hot compressor discharge vapors will bypass the condenser 14 to flow via

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line 26, fitting 40, conduit 88, fitting 86, vapor line 38, and fitting 42, into the evaporator coil inlet 32. In passing through the coil thereof, the vapors give up their heat and thereby defrost the evaporator, as is understood. Leaving the evaporator 18, the refrigerant now in mingled liquid and vapor form is delivered to the tank 52 via the depending end segment 62 of the evaporator coil outlet line 34. The liquid refrigerant thus is temporarily trapped in said tank, whereas the vapors continue on to compressor 12, flowing freely into the open upper end 80 of the vapor tube 58.

Inasmuch as in the course of a defrosting operation, a considerable quantity of refrigerant is condensed in its passage through the evaporator coil, immediate vaporization of the trapped liquid refrigerant will obviously accelerate and facilitate said operation. It will be remembered that in the course of the refrigerating cycles which would normally precede a defrosting cycle, the coil 60 and its extension 64 is being heated, wherefore some of the trapped liquid refrigerant will vaporize during the concurrent defrosting operation. Simultaneously, some of the trapped liquid refrigerant and the therein contained fluid additives will be siphoned into the vapor tube via the metering tube 68 for atomization.

As the end of a defrosting operation approaches, a considerable amount of liquid refrigerant may be trapped in the tank 52. However, just as soon as the changeover from defrosting to refrigerating operation is effected by closing the valve 44, most of the hot compressor discharge gases immediately enter the coil 60 as previously described, thus quickly vaporizing the trapped liquid refrigerant.

In clarification of the immediately preceding paragraph, it is to be noted that some hot compressor discharge gases flow to the coil 60 at all times, both during refrigeration and defrosting cycles of operation. However, the condensing pressure in the coil 60 during normal refrigerating cycles would be considerably higher than it would be during the time period immediately following the manipulation of the valve 44 to open status. That is to say, when the valve 44 is in closed status, normal condensing temperature builds up in the coil 60 and is maintained therein so long as said valve remains in closed status. However, when the valve 44 is manipulated to open status, the condensing pressure in the coil 60 drops, because then the compressor operates primarily as a refrigerant circulating pump. Therefore, the liquid refrigerant that was trapped in the tank 52 during the course of a defrosting cycle, will be vaporized in consequence of the hot compressor discharge gases that flow into the coil 60 when, with the valve 44 in closed status, the normal refrigeration cycles of operation are resumed and remain in progress.

The operation of the slightly modified liquid refrigerant trap and re-evaporator unit 90 shown in FIGURE 6 is identical with that described relatively to the unit 50. An additional advantage afforded by this construction is that it provides for heating the entire return bend 78 during normal refrigerating cycles, thus at least initially accelerating the re-evaporation of the trapped liquid refrigerant during a subsequent defrosting cycle. The venting arrangement 84 may be incorporated in this unit also, if desired.

A modified liquid refrigerant trap and re-evaporator unit 100 that is heated by externally applied means is exhibited in FIGURE 7. Typifying the external application of heat to the tank 52 independently of the refrigeration apparatus is an electrically heated coil 102 that is wound about, and in external contact with, said tank. It is of course to be understood that this showing is exemplary only. That is to say, the coil 102 may encompass the tank 52 from the bottom to the top thereof. Again, one or more electrically heated elements other than a coil may be employed to apply heat to said tank, and so on.

With attention directed to FIGURES 8 and 9, the illustrated liquid refrigerant trap and re-evaporator unit 150 includes a cylindrical shell 152 that encases the major portion of the tank 52. The shell 152, with its upper and lower closure members 154 and 156 respectively, provides an annular chamber 158 about said tank. This chamber functions as an auxiliary condenser and liquid receiver that is adapted to provide a highly efficient heat exchange arrangement between low temperature refrigerant vapors enroute to the compressor 12 from the evaporator 18, and liquid refrigerant enroute to the device 24 from the receiver 16. As illustrated, during refrigeration cycles the liquid line 30 discharges into the chamber 158 from the top via the segment 160. The apparatus is charged with a sufficient quantity of refrigerant to maintain the liquid level in said chamber between the test cocks 166 and 168 as shown. This body of liquid refrigerant is sub-cooled in consequence of its heat transferring contact with the tank 52. With this arrangement, the receiver 16 contains little or no refrigerant in liquid form, inasmuch as the refrigerant that has been liquified by the condenser 14 is drawn rapidly through said receiver and into the annular chamber 158 of the unit 150, where it is sub-cooled. As a result, the receiver 16 contains mostly refrigerant in compressed vapor form, and some of this refrigerant also is drawn into the chamber 158 together with the liquid refrigerant, where it is quickly condensed and joins the body of liquid refrigerant in the lower portion of said chamber. During a defrosting operation, this body of liquid remains in static condition, in consequence of the automatic closing of the metering device, and the unit 150 operates in the manner hereinbefore described.

It is noted that with the unit 150 incorporated therein, the apparatus of FIGURE 8 would function in a highly efficient manner even were the receiver 16 eliminated entirely, in which event the line 28 would connect directly into the line 30.

The FIGURE 10 embodiment of the invention discloses a liquid refrigerant trap and re-evaporator unit 250 that includes the sealed shell 152. This construction demonstrates exemplarily, a concept wherein heat may be applied to the tank 52 by means of a heated fluid medium that would be introduced into said chamber via a line 252, and drained therefrom via a line 254. The unit 250 also operates in the manner hereinbefore described, as should be apparent.

From the foregoing description augmented by an inspection of the drawings, it is believed that a comprehensive disclosure of the present invention, its mode of operation, and its advantages should be manifest.

The invention as illustrated and described may obviously be further modified without departing from the characteristic principles thereof. Wherefore, it is to be understood that changes in the form of the elements, or rearrangement of them in a manner readily apparent to those skilled in this art, are contemplated as within the scope of the present invention set forth in the claims hereunto appended.

What is claimed is:

1. In combination with a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: means for trapping the liquid portion and the non-vaporizable oil and additive constituents of the mingled liquid and vaporized refrigerant enroute to the compressor from the evaporator during both normal refrigerating and defrosting cycles, said means comprising a vertically disposed tank interposed in the suction line of said system; a vertically disposed vapor tube extending upwardly in said tank providing for the unrestricted flow of the vapor portion of said refrigerant toward said compressor, the lower end of said tube being connected into the suction line of the compressor; means for vaporizing the vaporizable constituents of the trapped liquid refrigerant comprising a coil disposed within said tank about

said tube and having its lowermost convolution in fluid communication with the discharge side of the compressor; means for atomizing the non-vaporizable constituents of the trapped liquid refrigerant aforesaid, said atomizing means consisting of a metering tube having its discharge end rigidly secured to said vapor tube and projecting slightly thereinto, and having its intake end and projecting into the space thereabout in the lowermost region of said tank; and a perforate shield enveloping said intake end of the metering tube whereby to prevent entry of extraneous matter in the trapped liquid thereinto.

2. In combination with a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: means comprising a sealed tank for temporarily trapping the liquid portion and the non-vaporizable oil and additive constituents of the mingled liquid and vapor refrigerant passing from the evaporator to the compressor during a defrosting operation, said tank being interposed in the suction line of the system; means for supplying heat to said tank whereby to vaporize the vaporizable constituents of the temporarily trapped liquid portion of refrigerant aforesaid, said means comprising a coil disposed within said tank and having its lowermost convolution in communication with the discharge side of the compressor; a vapor tube extending upwardly in said tank and terminating at a high level therein for withdrawing vaporized refrigerant from the tank and into said suction line for delivery to the compressor; and means for atomizing non-vaporizable constituents of the trapped liquid portion of refrigerant aforesaid by siphoning them into the high velocity vapor stream passing through the vapor tube enroute to the compressor, said means comprising a metering tube disposed in the lowermost region of the tank and having one end thereof extending into said vapor tube, and the other end thereof extending into the trapped liquid refrigerant aforesaid.

3. In combination with a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: means comprising a sealed tank for temporarily trapping the liquid portion and the non-vaporizable oil and additive constituents of the mingled liquid and vapor refrigerant passing from the evaporator to the compressor during a defrosting operation, said tank being interposed in the suction line of the system; means for supplying heat to said tank whereby to vaporize the vaporizable constituents of the temporarily trapped liquid portion of refrigerant aforesaid, said means comprising a coil disposed within said tank and having its lowermost convolution in communication with the discharge side of the compressor; a vapor tube extending upwardly in said tank and terminating at a high level therein for withdrawing vaporized refrigerant from the tank and into said suction line for delivery to the compressor; means for atomizing non-vaporizable constituents of the trapped liquid portion of refrigerant aforesaid by siphoning them into the high velocity vapor stream passing through the vapor tube enroute to the compressor, said means comprising a metering tube disposed in the lowermost region of the tank and having one end thereof extending into said vapor tube, and the other end thereof extending into the trapped liquid refrigerant aforesaid; and perforate means enveloping the last named end of said metering tube for preventing entrance thereinto of extraneous matter that may be present in the trapped refrigerant.

4. In a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: the combination therewith recited in claim 3 wherein the coil is disposed in said tank about the vapor tube, and wherein the uppermost convolution of said coil terminates in an upward extension projecting above the top of said tank and having a purge valve mounted on the upper end thereof, said purge valve being normally closed, but being adapted when opened to allow the escape

therefrom of any air that may have accumulated in the coil and said upward extension thereof.

5. In combination with a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: means comprising a sealed tank for trapping the liquid portion and the non-vaporizable oil and additive constituents of the mingled liquid and vapor refrigerant passing from the evaporator to the compressor during a defrosting operation, said tank being interposed in the suction line of the system; means for supplying heat to said tank whereby to vaporize the vaporizable constituents of the trapped liquid portion of refrigerant aforesaid, said means comprising a coil disposed within said tank and having its lowermost convolution in communication with the discharge side of the compressor; a vapor tube extending upwardly in said tank and terminating at a high level therein for withdrawing vaporized refrigerant from the tank and into said suction line for delivery to the compressor; means for atomizing non-vaporizable constituents of the trapped liquid portion of refrigerant aforesaid by siphoning them into the high velocity vapor stream passing through the vapor tube enroute to the compressor, said means comprising a metering tube disposed in the lowermost region of the tank and having one end thereof extending into said vapor tube, and the other end thereof extending into the trapped liquid refrigerant aforesaid; and perforate means enveloping the last named end of said metering tube for preventing entrance thereinto of extraneous matter that may be present in the trapped refrigerant, said means for supplying heat to the tank comprising an electrically heated coil that is wound about said tank.

6. In combination with a refrigeration system including means for defrosting the evaporator and its drain pan by the hot gas method: means comprising a sealed tank for trapping the liquid portion and the non-vaporizable oil and additive constituents of the mingled liquid and vapor refrigerant passing from the evaporator to the compressor during a defrosting operation, said tank being interposed in the suction line of the system; means for supplying heat to said tank whereby to vaporize the vaporizable constituents of the temporarily trapped liquid portion of refrigerant aforesaid, said means comprising a coil disposed within said tank and having its lowermost convolution in communication with the discharge side of the compressor; a vapor tube extending upwardly in said tank and terminating at a high level therein for withdrawing vaporized refrigerant from the tank and into said suction line for delivery to the compressor; means for atomizing non-vaporizable constituents of the trapped liquid portion of refrigerant aforesaid by siphoning them into the high velocity vapor stream passing through the vapor tube enroute to the compressor, said means comprising a metering tube disposed in the lowermost region of the tank and having one end thereof extending into said vapor tube, and the other end thereof extending into the trapped liquid refrigerant aforesaid; and perforate means enveloping the last named end of said metering tube for preventing entrance thereinto of extraneous matter that may be present in the trapped refrigerant, said means for supplying heat to the tank comprising a sealed shell encasing the major portion of the tank whereby to provide a chamber thereabout, said chamber serving to receive thereinto at an upper level a heated fluid medium discharged therefrom at a lower level.

7. In refrigeration apparatus including a compressor, a condenser, a receiver, an evaporator, conduit connections between them for circulating refrigerant, and a valve controlled vapor line for defrosting the evaporator and drain pan by the hot gas method, a liquid refrigerant trap unit interposed in the conduit connections between the evaporator and the compressor, said unit including: a vertically disposed tank sealed at both ends by means

of arcuately contoured upper and lower cover members; a depending segment formed on the end of the evaporator coil outlet conduit extending downwardly through the upper cover member into said tank; a vapor tube extending upwardly through the lower cover member into said tank, the open upper end of the vapor tube being disposed in a plane slightly below the interior surface of said upper cover member; a return bend section connecting the lower end of the vapor tube into the suction conduit of the compressor; a metering tube supported at one end from the vapor tube in the lowermost region of the tank and having its free end extending into the trapped liquid refrigerant collected in said region; a perforate shield about said metering tube for preventing extraneous matter in the trapped liquid refrigerant from entering said metering tube; and electrically heated means disposed in contact with the external surfaces of said tank.

8. In refrigeration apparatus including a compressor, a condenser, a receiver, an evaporator, conduit connections between them for circulating refrigerant, and a valve controlled vapor line for defrosting the evaporator and its drain pan by the hot gas method, a liquid refrigerant trap and re-evaporator unit interposed in the conduit connections between the evaporator and the compressor, said unit including: a vertically disposed tank sealed at both ends by means of arcuately contoured top and bottom cover members, a depending segment formed on the end of the evaporator coil outlet conduit extending downwardly through the top cover member into said tank; a vapor tube extending upwardly through the bottom cover member into said tank, the open upper end of the vapor tube lying in a plane slightly below that of the interior surface of said top cover member; a return bend section connecting the lower end of the vapor tube into the suction conduit of the compressor; a metering tube supported at one end from the vapor tube in the lowermost region of the tank; a perforate shield about said metering tube for preventing extraneous matter in the trapped liquid from entering thereinto; a coil within the tank terminating in an upward extension projecting through and beyond said upper cover member; a purge valve operably mounted on the upper end of said extension; and a conduit depending from the coil and extending through said bottom cover member, said conduit being in constant fluid communication with the compressor discharge conduit whereby some of the compressor discharge gases flowing to the condenser are first diverted into and give up their heat to said coil, and thereafter return in liquid state by gravity via said depending conduit to the compressor discharge conduit aforesaid.

9. In refrigeration apparatus including a compressor, a condenser, a receiver, an evaporator, conduit connections between them for circulating refrigerant, and a valve controlled vapor line for defrosting the evaporator and drain pan by the hot gas method, the liquid refrigerant trap and re-evaporator unit set forth in claim 8 wherein the return bend section connecting the lower end of the vapor tube into the suction conduit of the compressor is disposed exteriorly of the tank.

10. In refrigeration apparatus including a compressor, a condenser, a receiver, an evaporator, conduit connections between them for circulating refrigerant, and a valve controlled vapor line for defrosting the evaporator and drain pan by the hot gas method, the liquid refrigerant trap and re-evaporator unit set forth in claim 8 wherein the return bend section connecting the lower end of the vapor tube into the suction conduit of the compressor is disposed interiorly of the tank.

11. In refrigeration apparatus including a compressor, a condenser, a receiver, an evaporator, conduit connections between them for circulating refrigerant, and a valve controlled vapor line for defrosting the evaporator and drain pan by the hot gas method, the liquid refrigerant trap and re-evaporator unit set forth in claim 8, and a slender pipe in fluid communication at its upper end ad-

jacent to the upper cover member with the projecting portion of said coil extension, and at its lower end adjacently the lower cover member with the projecting portion of said depending coil segment, whereby to facilitate the counterflow of vaporized and liquified refrigerant through said coil.

12. For incorporation in refrigeration apparatus of the character described that includes means for defrosting the evaporator and its drain pan by the hot gas method; a liquid refrigerant trap and re-evaporator unit including in combination: an elongated preferably cylindrical tank that is sealed at both ends; a vapor tube open at the top and extending upwardly in the tank; a small metering tube supported from said vapor tube at the lowermost region of the tank in fluid communication at one end with the vapor tube and at its opposite end with the space in the tank; a conduit including a return bend section leading from the lower end of the vapor tube to the intake side of the compressor that is included in said apparatus; an elbow or downturned segment formed on the free end of the evaporator coil outlet line that is also included in said apparatus, said segment extending into the tank from the top and terminating in a plane disposed slightly below that wherein the open upper end of said vapor tube terminates; and means for utilizing the vaporized compressor-discharge refrigerant to supply said unit with heat in the course of normal refrigerating operations of said apparatus.

13. For incorporation in a refrigeration system that includes means for defrosting the evaporator and its drain pan by the hot gas method, a liquid refrigerant trap and re-evaporator unit including in combination: an elongated preferably cylindrical tank that is sealed at both ends; a vapor tube open at the top and extending upwardly in the tank; a small metering tube supported from said vapor tube in the lowermost region of the tank, said metering tube being in fluid communication at one end with the vapor tube and having its free opposite end extending into the space in the tank thereabout; a perforate protective shield about said free end thereof for preventing entry of extraneous matter into the metering tube; a conduit including a return bend section leading from the lower end of the vapor tube to the intake side of the compressor included in said apparatus; an elbow or downturned segment formed on the free end of the evaporator coil outlet line included in said apparatus, said segment extending into the tank from the top and terminating in a plane disposed below that wherein the open upper end of said vapor tube terminates; a sealed shell encasing the major portion of said tank to provide an annular chamber thereabout; and means for circulating a heated fluid medium through said chamber whereby to heat said tank.

14. For incorporation in refrigeration apparatus of the character described that includes means for defrosting the evaporator and its drain pan by the hot gas method, a liquid refrigerant trap and re-evaporator unit including

in combination: an elongated preferably cylindrical tank that is sealed at both ends; a vapor tube, open at the top and extending upwardly in the tank; a small metering tube supported from said vapor tube in the lowermost region of the tank, said metering tube being in fluid communication at one end with the vapor tube and at its opposite end with the space in the tank thereabout; protective means about the last named end of the metering tube to prevent extraneous matter in the liquid refrigerant from entering thereinto; a conduit including a return bend section leading from the lower end of the vapor tube to the intake side of the compressor included in said apparatus; an elbow or downturned segment formed on the free end of the evaporator coil outlet line included in said apparatus, said segment extending into the tank from the top and terminating in a plane disposed slightly below that wherein the open upper end of said vapor tube terminates; a sealed shell encasing the major portion of said tank to provide an annular chamber thereabout; and means formed in the liquid line leading from the receiver to the expansion valve also included in said apparatus providing for the flow of refrigerant into said chamber and therefrom.

15. For incorporation in a refrigeration system that includes means for defrosting the evaporator and its drain pan by the hot gas method, a liquid refrigerant trap and re-evaporator unit including in combination: an elongated preferably cylindrical tank that is sealed at both ends; a vapor tube, open at the top and extending upwardly in the tank; a small metering tube supported from said vapor tube in the lowermost region of the tank, said metering tube being in fluid communication at one end with the vapor tube and at its opposite end with the space in the tank about said tube; a conduit including a return bend section leading from the lower end of the vapor tube to the intake side of the compressor included in said apparatus; an elbow or downturned segment formed on the free end of the evaporator coil outlet line included in said apparatus, said segment extending into the tank from the top and terminating in a plane disposed slightly below that wherein the open upper end of said vapor tube terminates; a sealed shell encasing the major portion of said tank to provide an annular chamber thereabout; means formed in the liquid line leading from the receiver to the expansion valve also included in said apparatus providing for the flow of refrigerant into said chamber and therefrom; and means for determining the normal level of liquid in said chamber, said means comprising two vertically spaced test cocks provided in the lower portion of said shell.

References Cited in the file of this patent

UNITED STATES PATENTS

2,440,146	Kramer	Apr. 20, 1948
2,953,906	Quick	Sept. 27, 1960