June 7, 1949. P. A. SIDELL 2,472,729

REFRIGERATION SYSTEM

Filed April 11, 1940 2 Sheets-Sheet 1

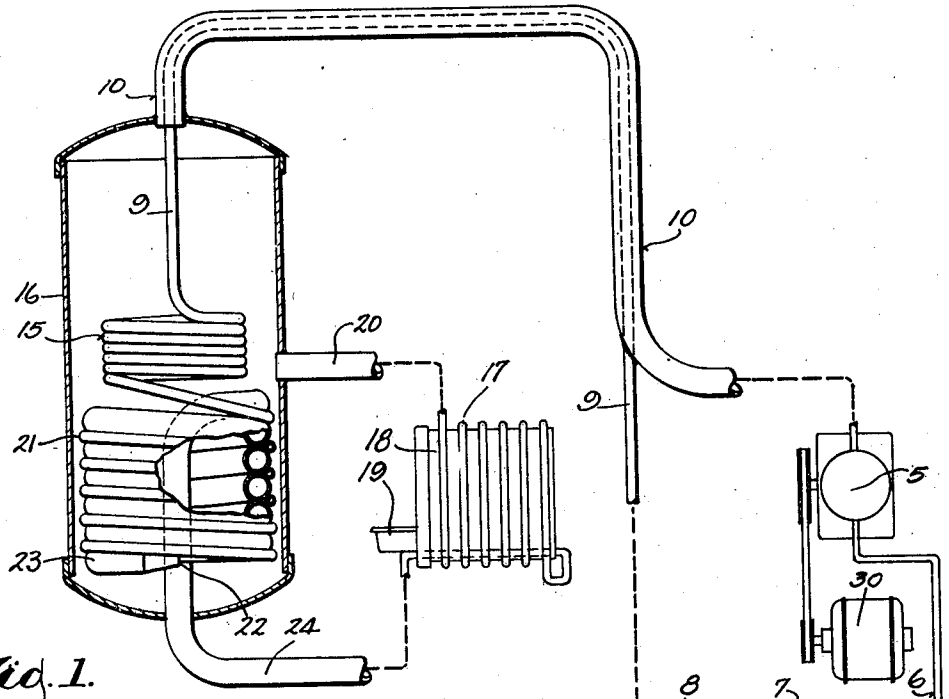


Fig. 1.

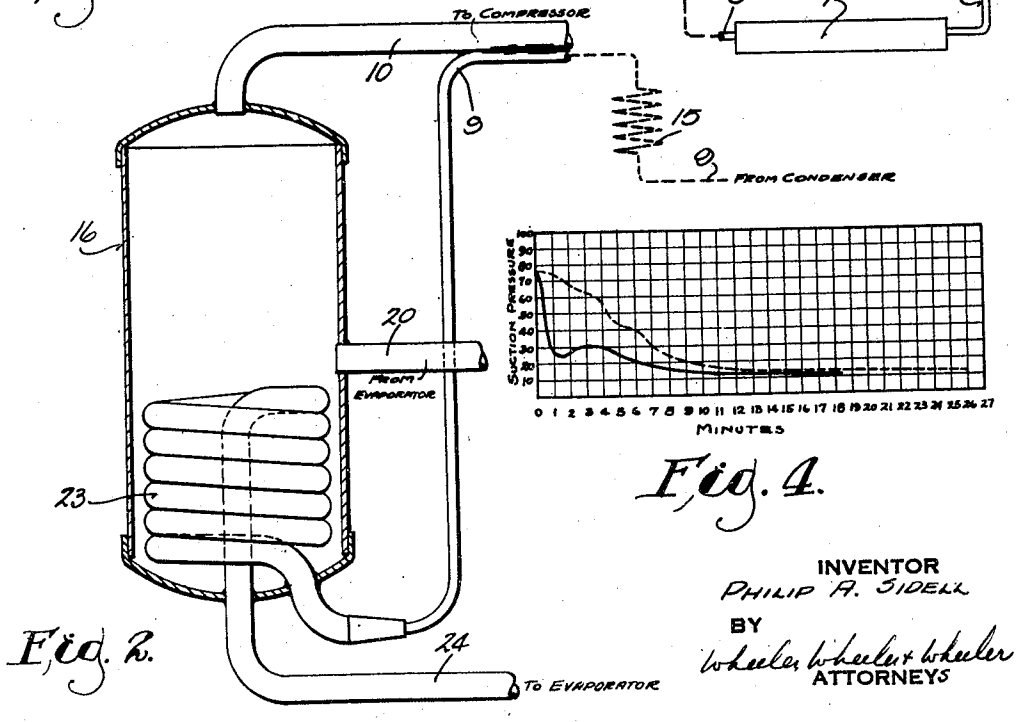


Fig. 2.

Fig. 4.

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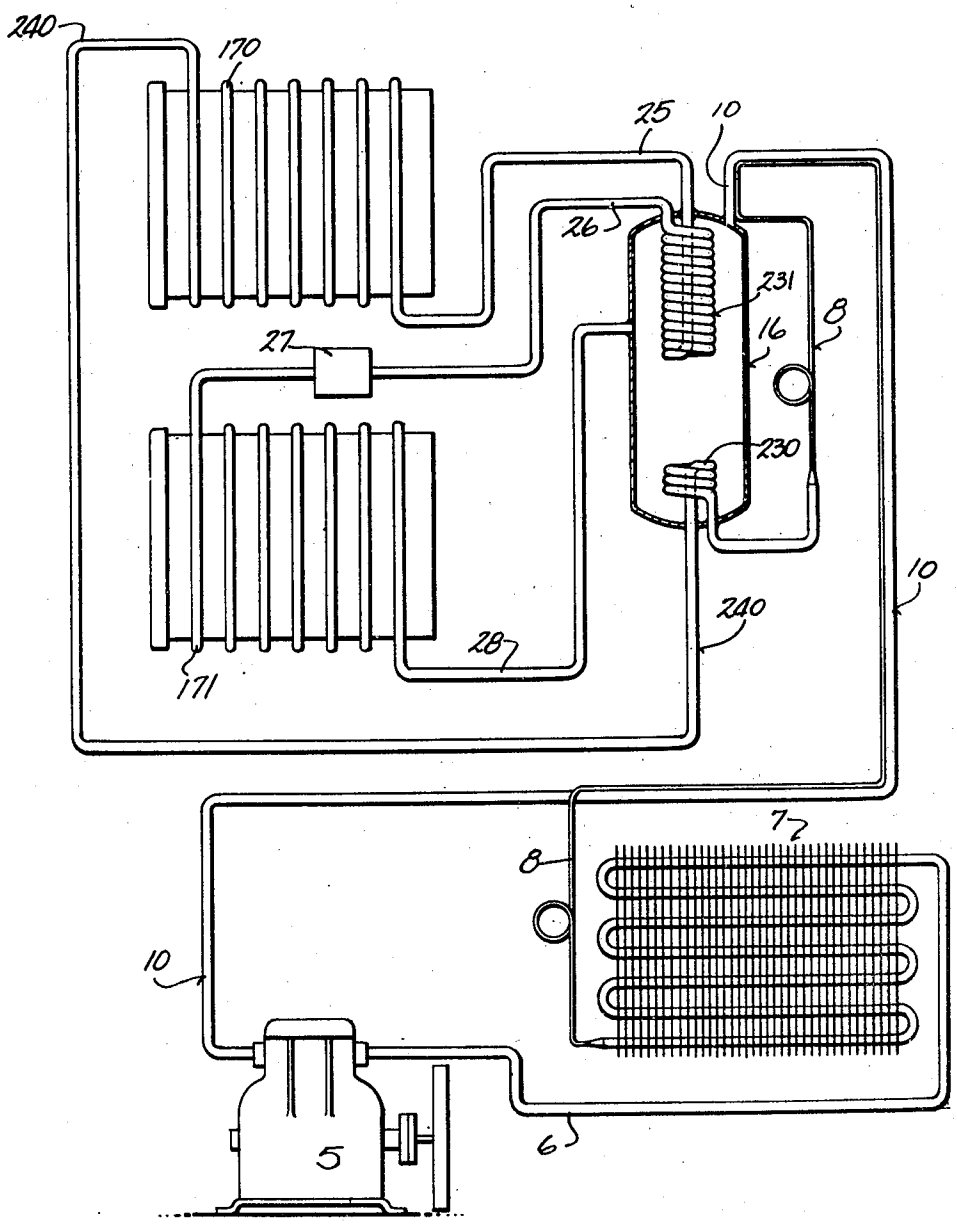


Fig. 3.

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2,472,729

REFRIGERATION SYSTEM

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Application April 11, 1940, Serial No. 329,140

18 Claims. (Cl. 62—8)

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This invention relates to improvements in refrigeration systems.

It is the primary object of the invention to provide a refrigeration system which will operate both during the normal cycle and during "pull down" with sufficiently increased efficiency so that it is possible safely to use a smaller motor than has otherwise been deemed necessary, thereby effecting substantial economies in the first cost of the refrigerating mechanism and in the operation thereof.

More specifically stated, it is an object of the invention to provide an equalizing system for heat transfer between the refrigerant admitted to the low pressure side of the system and the refrigerant leaving the low pressure side of the system, thus, in effect, thermally short circuiting the evaporator under certain circumstances, for the purpose of sharply reducing back pressures and automatically varying the effective evaporator surface. The proportionate capacities of the high pressure and low pressure sides of the system are determined in accordance with normal operating conditions and, in the absence of my invention, the conditions existing during "pull down" have the same effect as if the amount of heat absorbed in the evaporator were greatly increased in comparison to the amount of heat radiated in the condenser. By providing for thermal exchange between the refrigerant entering the evaporator and that leaving the evaporator, it is my object to provide means for automatically controlling the effective ratio of heat absorption to heat radiation as between the low and the high pressure sides of the system in accordance with the requirements, thereby enabling a materially smaller motor to operate the compressor without overload.

It is a further important object of the invention to isolate and insulate a substantial quantity of liquid refrigerant enroute to the evaporator and, by such insulation, to preserve this stored quantity of refrigerant in liquid form during the period when the compressor is not in operation for immediate delivery to the evaporator when the compressor starts in operation, whereby to prevent the evaporator from being starved during this portion of the cycle and to enable normal cycling to commence almost immediately when the compressor is started. For the purpose of thus isolating and insulating a quantity of refrigerant in liquid form, I preferably employ this same heat exchanger or equalizer which, by reason of its form, construction, and location, is protected from the temperatures to which it would otherwise be exposed and is adapted to retain a reserve supply of low pressure liquid refrigerant, at substantially the temperature existing at the evaporator outlet. With respect to this feature I have as my objective the completion of the refrigerating cycle in less time and with less power and consequently with greatly increased efficiency as compared with conventional practice, and the maintenance of a larger percentage of the liquid refrigerant in the evaporator, particularly during the initial stages of normal compressor operation and thus obtain a more effective and uniform utilization of evaporator surface.

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It is my further object to provide a refrigerating system which may be used in a household refrigerator or otherwise to enable the freezing of water in the ice trays of the evaporator without overload and without starving the evaporator.

Other objects of the invention will be apparent to those skilled in the art on the basis of the following disclosure.

In the drawings:

Fig. 1 is a diagrammatic view of a refrigerating system in which one embodiment of my improved surge tank equalizer is shown on an enlarged scale in vertical section, the remainder of the system being shown on a smaller scale in plan.

Fig. 2 is a fragmentary view showing a vertical section through the surge tank and illustrating the preferred embodiment of my improved surge tank equalizer.

Fig. 3 is a diagrammatic view of a modified embodiment of the invention as adapted for use in a system using evaporators at two separate temperatures, supplied with refrigerant by a single compressor and condenser, the evaporators, compressor and condenser being shown in side elevation and the surge tank in vertical section to expose the equalizer coils therein contained.

Fig. 4 is a chart showing comparative time-pressure diagrams of refrigerating systems which use my improved organization in comparison with those which do not.

Like parts are identified by the same reference characters throughout the several views.

The refrigerating system generally is of the well known type in which the parts outside of the refrigerator cabinet comprise a compressor 5 supplying refrigerant through pipe 6 to a condenser 7.

From the condenser 7 the refrigerant passes into the refrigerator compartment through a pipe 8 which includes, preferably within the compartment, a capillary tube constituting a preferred

form of flow impeding or restricting device at 9 which may be disposed within or bonded to the refrigerator return pipe 10 from the compartment to the compressor. The capillary tube preferably has a coil at 15 which, in the construction shown in Fig. 1, is within the separating chamber or surge tank 16 from the upper portion of which pipe 10 leads. In the construction shown in Fig. 2 the coil 15 is located outside of the separating chamber. In the construction shown in Fig. 1 a part of the capillary tube 9 is inside of pipe 10. In the construction shown in Fig. 2 the capillary tube 9 is bonded to the outside of the pipe 10.

In the ordinary refrigerating system of this type the capillary tube usually is directly connected to the evaporator coil 17, such coil usually being wound around the chamber 18 which receives the ice trays such as that shown at 19, partly in position. From the evaporator coil 17 it is conventional for the returning refrigerant to pass through pipe 20 into a separating chamber 16 and thence through pipe 10 to the compressor to complete the circuit.

In accordance with the present invention I provide an equalizer or heat exchange coil receiving liquid from the condenser and disposed within the separating chamber preferably below the connection of the evaporator outlet. This coil constitutes a low pressure trap for the liquid refrigerant delivered by the capillary tube 9 and the disposition of the coil within the surge tank insulates it from the temperature of the refrigerator cabinet (mere insulation being sufficient to accomplish some of the objectives of this invention) and also, in accordance with other objects of the invention, provides for heat exchange between the incoming refrigerant and that which is in the surge tank, and which, when vaporized, may pass through suction pipe 10 back to the compressor.

In the construction shown in Fig. 1 the capillary tube 9, after being formed into a coil at 15, is shaped to provide a helix 21 which at 22 discharges into a helix 23 comprising tubing of larger diameter, the helical coils 21 and 23 being interengaged and preferably bonded in intimate relation as shown. From the tip of the larger helical coil 23 the tube comprising such coil passes downwardly through the coil and out of the surge tank 16 at 24 to the evaporator coil 17.

In the construction shown in Fig. 2 the capillary tube 9 terminates externally of the surge tank 16, discharging directly into the larger pipe comprising coil 23 from which the pipe returns at 24 to the evaporator in the manner shown in Fig. 1. This construction, being simple and very effective, is preferred.

In the construction shown in Fig. 3 the compressor 5 delivers refrigerant through pipe 6 to the condenser 7 and the condenser output passes through the capillary tube 9 to a small coil 230 corresponding to coil 23 in Fig. 2. Thence the tube 240 leads to the evaporator coil 170 which discharges through pipe 25 into the larger coil 231, the coils 230 and 231 being both located within the surge tank or accumulator 16.

From coil 231 pipe 26 leads through a control valve 27 of some sort (usually a pressure reducing valve), to a second evaporator 171 from which pipe 28 returns the refrigerant to the surge tank. From the surge tank it flows through pipe 10, bonded to the capillary tube 9, back to the compressor 5 as above described.

The operation of the devices shown in Figs. 1 and 2 is as follows, referring first to the condition which exists during "pull down" after the system has long been idle.

Operation during pull down

When the system has long been idle no refrigerant ordinarily exists in liquid form within the system (although in some systems it is possible for some of the refrigerant to still be in a liquid state). All of the refrigerant is vaporized, part of the vapor having been absorbed in the oil of the compressor. The remainder is distributed under uniform pressure in all parts of the system.

When the motor 30 which drives compressor 5 is set in operation the compressor starts to withdraw gas from the low side of the system and deliver the gas to the condenser in the high side of the system. Until sufficient back pressure is built up in the high side to condense the gas, the refrigerant flows in gaseous form through the capillary tube to the expansion coil in the low side of the system. There is a tendency for the pressure and the temperature to rise in the high side of the system for the reason that the capillary tube can handle less refrigerant by weight when the refrigerant is in gaseous form than when the refrigerant is in liquid form.

All of the parts of the system being warm, there is a tendency in prior systems of this character for the first liquid refrigerant to re-evaporate before being delivered from the capillary and, after the capillary is filled with liquid refrigerant, such refrigerant tends to evaporate at the entrance to the evaporator without filling the evaporator. And on passing through the evaporator the refrigerant vapor tends to become excessively superheated due to the warm condition of the evaporator and box. Since the proportions of the system are not designed to handle such excess superheat, the capacity of the capillary tube tends to be far short of that needed to handle the heat picked up in the warm cabinet and the warm evaporator. Thus the evaporator is starved, and the head pressure in the condenser becomes and remains high, thus overloading the motor. Suction pressure also remains high.

In contrast with this operation of previous devices of this type, the presence of the heat exchange or equalizer coil in the surge tank protects from the heat of the cabinet the first liquid refrigerant supplied through the capillary coil. This first liquid refrigerant evaporates in the coil 23 in the surge tank, thus absorbing the superheat from the gaseous refrigerant in the tank, retarding emission of gas from oil trapped in the surge tank, and leaving the free gaseous refrigerant for delivery to the compressor under conditions more closely approaching those of normal operation. As explained above, the equalizer provides what may be regarded as a thermal by-pass for the evaporator and, in effect, reduces the absorption surface of the evaporator to a negligible amount during this "pull down" period. In consequence the suction pressure in the low pressure side of the system rapidly falls to conditions approaching normal operation, preventing head pressure from becoming excessive, and reducing the temperature in the high pressure side, with the result that condensation is effected more easily without motor overload, and a smaller motor may be used without danger of overload. Effective evaporator surface is automatically added as fast as it can be handled

In Fig. 4 the dotted line curve represents the

actual conditions of operation of a system of this character which does not employ the present invention, and the full line curve shows the rapid reduction in pressure effected when the system of this invention is used. The vertical dimension on this chart indicates pounds pressure in the low side and the horizontal dimension indicates minutes of elapsed time during the "pull down" tests. All parts of the circuit were identical with the exception that in making the test represented by the full line, the apparatus included the heat exchange coil in the surge tank, while in the test represented by the broken line there was no such coil used.

The normal cycle of operation

In the various devices herein disclosed it is true in each case that during the normal cycle the efficiency is increased by the functioning of the equalizer coil as a trap. It is, of course, understood that the motor is turned off and on by the usual switch (not shown) to suit the requirements of the device in which the refrigerator system is used. When the unit stops, the pressures are equalized as in the prior art. However, what liquid refrigerant is on the high side of the system is forced into the equalizer coil and the evaporator, and because of the fact that the equalizer coil is insulated within the surge tank, a substantial portion of the liquid refrigerant will remain in liquid form in this coil and whatever gas comes over from the condenser is apt to be recondensed in the equalizer coil by the refrigerant in the surge tank. Therefore, during the off cycle, the equalizer coil will remain substantially full of liquid refrigerant.

Before the motor cuts in again, most or all of the refrigerant in the evaporator is apt to have been evaporated.

When the compressor starts, instead of blowing vapor into the evaporator until such time as the pressure builds up in the condenser to liquify the refrigerant, as has heretofore been the case, the first vapor arriving through the capillary tube displaces the body of liquid refrigerant stored in the transfer coil and forces the liquid refrigerant ahead of the vapor into the evaporator where it immediately initiates the cooling portion of the cycle. As fast as the vapor arrives from the capillary into the heat exchange coil in the surge tank, it tends to condense in the heat exchange coil by the surplus refrigerant liquid in the surge tank. The boiling of such liquid increases the pressure in the low side of the system, thereby more adequately supplying the compressor and making possible its running a greater percentage of its time at a higher suction pressure, thus bringing about greater efficiency while at the same time a continuous supply of liquid refrigerant to the evaporator is maintained. Thus the system starts off almost immediately at full operating efficiency, and a very much shorter operating period is required to effect a given amount of refrigeration at the evaporator. Not only is the evaporator supplied with liquid refrigerant immediately upon the start of the motor but, due to the fact that the refrigerant continues to be substantially all liquid, the effective absorption surface is greatly increased as compared with the situation which has heretofore existed in which the refrigerant reaching the evaporator has been partially gaseous.

In making ice the same advantages are achieved. When a tray such as that shown at **19** is placed in shell **18**, it is usually directly superimposed on that section of the continuous evaporator coil which is closest to the supply, as shown in Fig. 1. The absorption of heat from the water flashes the liquid in this normally coldest portion of the coil immediately into a gas and the gas then tends to blow out the liquid refrigerant into the surge tank from the remainder of the evaporator coil. This causes the evaporator to start the cycle in a starved condition in which it is substantially filled with gas. Where the present invention is employed, however, the refrigerant liquefied and stored in the heat exchange coil is immediately available to replace that which has been blown from the evaporator by the insertion of the tray of water. Consequently the evaporator does not start the cycle in a starved condition but is immediately and continuously thereafter supplied with liquid refrigerant by the heat exchange coil which uses the surplus refrigerant in the surge tank to condense any gaseous refrigerant arriving through the capillary.

As above indicated, it is not necessary that the capillary itself should enter the surge tank as shown in Fig. 1, and I therefore prefer to use in the surge tank a heat exchange coil comparable in cross section to the tube constituting the evaporator, as shown in Fig. 2 and Fig. 3.

Fig. 3 shows an adaptation of the invention exemplified by an arrangement in which two different evaporators are desired to operate at differing temperatures. The principle involved, however, is equally applicable to a single continuous tube evaporator from an intermediate portion of which the tube is led through a heat exchange coil in the surge tank.

As shown in Fig. 3, the evaporator **170**, which is first supplied with refrigerant, operates at the higher temperature. Notwithstanding the fact that no sharp reduction in temperature is effected in this evaporator, there will nevertheless inevitably be some evaporation of refrigerant and in consequence, the tube being continuous, the gaseous refrigerant would, but for this invention, be carried along with the remaining liquid refrigerant to the second evaporator through the reduction valve **27** which controls the temperature of differential. In the second evaporator, but for this invention, the presence of gas would reduce the effective surface in evaporator **171**, thereby requiring that this evaporator be made larger in order to get an effective area comparable to that in evaporator **170**.

However, the present invention makes use of the fact that in such systems a sufficient amount of refrigerant is used so that there is a surplus of liquid refrigerant available to pass over into the surge tank **16** where the gas is separated from the remaining liquid and returned to the compressor. This surplus has not heretofore been used since its boiling off in the surge tank produces little or no useful refrigerating effect.

Since the second evaporator **171** operates at a lower temperature than evaporator **170**, the surplus refrigerant delivered to the surge tank is at the lowest temperature of the system. To this temperature the heat exchange coil **231** is exposed and consequently when the refrigerant containing bubbles of gas arrives in the heat exchange coil **231** from the first evaporator **170**, the heat of the gaseous refrigerant is immediately transferred to the surplus liquid refrigerant in the surge tank, causing a portion of this surplus refrigerant to evaporate and pass to the compressor. Thus substantially all of the refrigerant delivered through pipe **26** to the reducing valve and the second evaporator **171** is in liquid form, that por-

tion originally evaporated having been recondensed. This greatly increases the effective surface of the second evaporator and in effect bypasses all the heat absorbed in the first evaporator directly to that refrigerant which is leaving the surge tank for the compressor. The arrangement further results in the prompt establishment of higher pressures at the compressor inlet at the start of each cycle, thereby permitting the unit to operate with greater efficiency.

The above description applies to any two or more evaporators regardless of whether or not they are continuous.

It will be readily understood by those skilled in the art that the two evaporators 170 and 171 may, if the reducing valve 27 be omitted, be regarded as a single evaporator with the heat exchange coil 231 in series with the first and second parts of the evaporator tube at an intermediate point. Such single tube evaporators are useful in air conditioning and for other purposes, and the advantages are the same as those above described in that the heat absorbed by the vaporization of refrigerant in the first section of the continuous tube evaporator is by-passed across the second section, thereby enabling the second section to operate with much greater efficiency on a re-condensed refrigerant. A higher percentage of liquid is maintained throughout the evaporator during the operating cycle and the necessary surplus of refrigerant which has heretofore performed no useful result in the surge tank or accumulator is now made effective to perform this additional function.

I claim:

1. In a refrigerating system, the combination in series connection of a compressor, a condenser, a capillary tube, a heat exchange coil of larger cross section than the capillary tube and into which said capillary tube discharges, a continuous tube evaporator into which said heat exchange coil discharges, a separating chamber in communication with the evaporator outlet and having a portion for reception of liquid refrigerant enclosing said heat exchanging coil, and a return conduit leading from the upper portion of the separating chamber to the compressor.

2. A device of the character described, comprising in series connection a compressor, a condenser, a capillary tube, a refrigerant trap connected to receive fluid from the capillary tube outlet, an evaporator into which said trap is adapted to discharge liquid refrigerant, a surge tank adapted to receive and store surplus liquid refrigerant from the evaporator in heat exchange relation to said trap, and a return conduit from the upper part of the surge tank to the compressor, said trap being in open communication with the evaporator and adapted for the storage of liquid refrigerant without substantial heat absorption during a limited period when the compressor is inoperative and for the delivery of such liquid refrigerant to the evaporator promptly upon the initiation of compressor operation following such limited period.

3. In a refrigerating system, the combination in closed circuit connection of a compressor, a condenser, a capillary tube, an evaporator having series connected coil portions for heat absorption, an intervening heat exchange member connecting two of said coil portions, pressure reducing means in series with said heat exchange member between said coil portions whereby said coil portions operate at differing temperatures, and a surge tank into which said evaporator discharges and which is provided with a return circuit to the compressor, said heat exchange member being disposed within the surge tank.

4. In a refrigerating system, the combination with a compressor, a condenser and a capillary tube in series, of a trap adapted to receive refrigerant from said tube, means insulating said trap against thermal absorption, an evaporator into which said trap freely discharges, said evaporator comprising a continuous coil having at an intermediate point a heat exchange member, a surge tank in which said heat exchange member is located and into which said evaporator discharges, said surge tank being adapted to serve as a separating chamber for liquid and vapor discharged into it from the evaporator and a return connection from the vapor containing portion of the surge tank to the compressor.

5. In a refrigerating system, the combination in a closed circuit of a compressor, a condenser, a plurality of series connected evaporators, and a surge tank, together with a heat exchange coil within the surge tank connected in series between two successive evaporators, and means also connected in series between said two successive evaporators for causing said evaporators to operate at a temperature differential.

6. A refrigerator system comprising the combination with a series connected compressor, condenser, and capillary tube, of a heat exchange trap element into which said tube discharges, an evaporator element with which said trap element communicates, a heat exchange member with which said evaporator element is connected, a reducing valve, and a second evaporator element connected in series to receive refrigerant from said heat exchange member, and a surge tank into which said second evaporator element discharges and within which said trap element and said heat exchange element are both disposed, together with a return conduit from said surge tank to said compressor.

7. In a refrigerating system having in series a compressor, condenser, evaporator, separator chamber and a suction duct connecting the separator chamber with the compressor, said elements being proportioned and adapted to maintain a supply of liquid refrigerant in the lower portion of the separating chamber during normal operation, the combination therewith of an expansion unit located in the separating chamber below the normal level of liquid refrigerant therein, a flow restricting permanently open connection between the condenser and said expansion unit, and a substantially unrestricted feeding connection between said unit and the evaporator.

8. In a refrigerating system having in closed circuit a series of elements including a compressor, a condenser, a capillary tube, an evaporator, a separator chamber, and a suction duct connecting the upper portion of the separator chamber with the compressor inlet, said elements being proportioned for maintenance of a continuous supply of liquid refrigerant in the separator chamber during operation of the system, the combination, with said elements, of a low pressure heat exchanging element located in said separating chamber below the normal level of liquid refrigerant therein, said heat exchanging element having an inlet connected with the discharge end of the capillary tube and having its outlet in substantially open communication with the inlet of the evaporator.

9. In refrigerating apparatus including liquefying means and an evaporator, the combination

therewith of return connections from said evaporator to said liquefying means including a separating chamber, supply connections leading from said liquefying means to said evaporator including permanently open pressure reducing means and a feeder between said pressure reducing means and the evaporator and in substantially unrestricted communication with the evaporator whereby to deliver low pressure refrigerant substantially directly to the evaporator, said liquefying means being operable at a rate to maintain a portion of said separating chamber supplied with liquid refrigerant, said feeder being in intimate heat exchange relation to said chamber portion whereby low pressure refrigerant in said feeder may equalize its temperature with refrigerant in said chamber, said liquefying means including a compressor normally operated intermittently and adapted when operated to establish a pressure differential across said feeder and evaporator whereby the commencement of compressor operation results in immediate delivery from the feeder to the evaporator of liquid refrigerant maintained liquid in said feeder by liquid refrigerant in said separating chamber.

10. In a refrigerating system of the compressor, condenser and evaporator type, in which normal operation requires intermittent operation of the compressor, the combination with the evaporator inlet, of means in substantially open communication with the evaporator for delivering to the evaporator upon each resumption of compressor operation, a supply of low pressure liquid at substantially the lowest temperature attained in the system during compressor operation, said means comprising a trap for low pressure liquid refrigerant in series connection with said inlet, and means for maintaining said trap at said temperature during the off cycle.

11. In a refrigerating system of the compressor, condenser and evaporator type, in which normal operation requires intermittent operation of the compressor, the combination with the inlet end of a tubular evaporator, of means for delivering to the evaporator upon each resumption of compressor operation, a supply of low pressure liquid at substantially the lowest temperature attained in the system during compressor operation, said means including a thermally insulated low pressure storage chamber in free communication with the evaporator inlet and in series between the condenser and said inlet.

12. In a refrigerating apparatus of the compressor, condenser, evaporator type, the combination of a flooded separator chamber connected with the evaporator outlet, a feeder for the evaporator in unrestricted communication therewith, and a capillary comprising a permanently open pressure reducing connection between the condenser and the feeder, said feeder being located in the liquid containing lower portion of the separator chamber and the parts and available supply of refrigerant being proportioned for substantial feeder submergence in the separator chamber liquid during normal operating conditions of compressor action and inaction, the capillary being connected to a lower portion of the feeder and an upper portion of the feeder having a pipe in open communication with the evaporator, whereby said feeder constitutes a gravity trap from which liquid refrigerant is immediately delivered to the evaporator upon compressor action.

13. In a refrigerating system, the combination with a compressor and a condenser in operative connection with the compressor, of an evaporator, a low pressure return conduit from the evaporator to the compressor including one passage of a heat exchanger, a low pressure feeder for the evaporator comprising another passage of said heat exchanger in thermally conductive relation to at least a portion of said return conduit at said first mentioned passage, and a restrictor conduit comprising pressure reducing means leading from the condenser to said feeder, said feeder, including the second mentioned passage of said heat exchanger, being substantially at evaporator pressures.

14. In a refrigerating system, the combination with a compressor, condenser, and evaporator in closed circuit connection, of a low pressure refrigerant storage means connected in series between the evaporator and the compressor, a second low pressure refrigerant storage means in heat exchange relation to the first such means and constituting a feeder for the evaporator in permanently open and unrestricted communication therewith, and a pressure reducing permanently open restrictor, said restrictor and said second refrigerant storage means being connected in series with each other between the condenser and the evaporator, said compressor normally operating intermittently and said feeder comprising a gravity trap for the immediate delivery of refrigerant to the evaporator upon compressor operation, the refrigerant so delivered being at the temperature of refrigerant in said first low pressure storage chamber.

15. A refrigerating system comprising in combination a compressor normally operating intermittently, a condenser, an evaporator, a return pipe from the evaporator to the compressor including a separating chamber having a reservoir portion for the storage of liquid refrigerant, a connection between the compressor and the condenser, an evaporator feeder within the reservoir portion of the separator chamber, whereby refrigerant in the feeder is in intimate heat exchange relation to liquid refrigerant in the reservoir portion of the separator, means including a capillary tube affording constantly open communication from the condenser to the bottom of the feeder, the top of the feeder being in permanently open and unrestricted communication with the evaporator whereby the feeder constitutes a gravity trap from which liquid refrigerant will be delivered upon the operation of the compressor, said feeder being at evaporator pressure.

16. The structure defined in claim 15, in which the feeder comprises a helical coil in series connection between the capillary and the evaporator, said coil being appreciably larger than the capillary whereby to offer no substantial resistance to flow and to maintain liquid refrigerant substantially at the pressure of the evaporator inlet.

17. The device set forth in claim 15, in which said capillary includes a coiled portion in heat exchange relation to the reservoir portion of said separator, said refrigerating system and the amount of refrigerant therein contained being proportioned to maintain normally a substantial volume of liquid refrigerant in the reservoir portion of said separator for heat exchange with said feeder and the capillary coil portion.

18. In the art of operating a refrigerating system of the type having a compressor, a condenser, a series type evaporator and a continuously open restricted connection between said condenser and evaporator, the method of substantially prevent-

ing evaporator liquid blow-through due to the passage of hot gas from the condenser to the evaporator during periods of compressor idleness, which comprises collecting liquid refrigerant forced from the discharge side of the evaporator by pressure of hot condenser gas, and condensing said hot gas at it flows from the condenser toward the evaporator during the off cycle of compressor operation by passing such gas in heat exchange relation with the collected liquid.

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