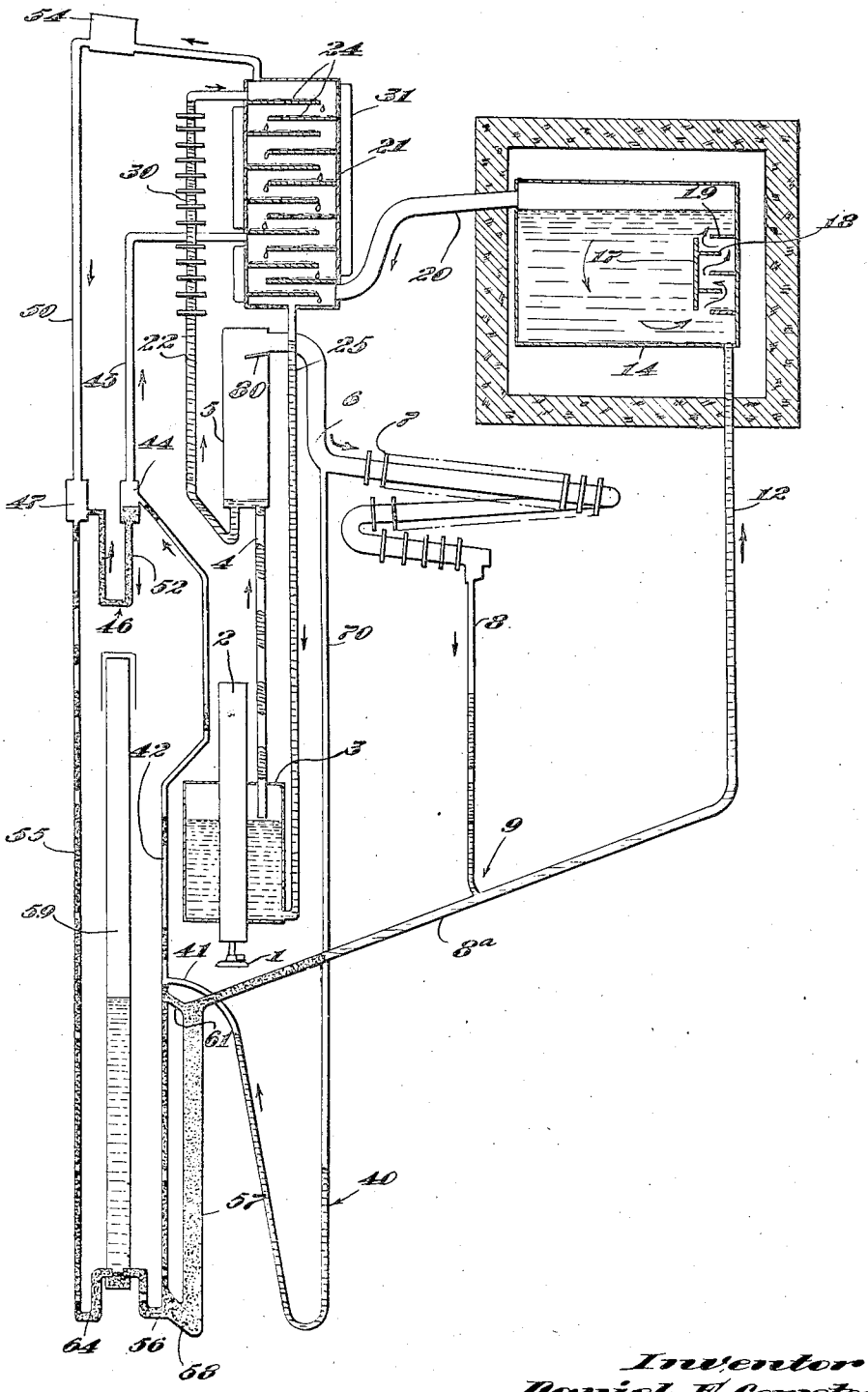
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ABSORPTION SYSTEM

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ABSORPTION SYSTEM

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19 Claims. (Cl. 62—119)

This invention relates to heat exchange systems such as absorption refrigerating systems, and more particularly to continuously operable apparatus of this character.

Heretofore most small absorption refrigerating systems in practical use have been of the cyclic or intermittently operable type, depending upon check valves, automatic controls or the like to afford alternate periods of absorption and distillation of refrigerant with consequent non-uniformity in refrigerating effect, while some larger continuously operating systems have involved the use of mechanical boiler feed pumps. More recently continuously operable systems wthout moving parts have been developed employing an inert gas to avoid the use of valves, a liquid pump or the like. The latter systems, although avoiding cyclic action, the undependable check valves and moving parts of the types previously provided, have been objectionable in having a comparatively low efficiency and in necessitating the maintenance of fluids at high pressures, which pressures have been likely to rise to undesirable if not dangerous extremes if the normal flow of cooling water to the condenser and absorber is interrupted.

The present invention is designed to obviate these disadvantages and to afford a more efficient refrigerating system which may be continuously operable at pressures so low that dangerous extremes in the same would not result even if the flow of cooling water should be interrupted. In fact, systems constructed in accordance with the present invention may be air cooled, the practical necessity for water cooling being obviated.

Furthermore, a system of this character is adapted to utilize liquid columns to balance pressure differences between different parts of the system. With properly selected fluids these columns may be of moderate height and accordingly the system may be quite compact. Thus, for example, the preferred refrigerant may have a vapor pressure in the condenser which does not differ by more than a few inches of mercury from its vapor pressure in the cooler; accordingly the height of the liquid column or columns arranged to balance this pressure difference need not be excessive.

In order to permit the operation of a refrigerating system under these conditions, it preferably may have internal pressures which are less than atmospheric pressure; accordingly, unless the system is perfectly sealed against leakage of gas there will be some tendency for air or other fixed gases to find their way into the same. While it is mechanically possible to make a system of this character which is practically free from gas leakage, it is difficult to make apparatus of this character under conditions of commercial production which may be transported and used under ordinary conditions of household service or the like for an indefinite period without having some accumulation of fixed gases in the same. Therefore, in accordance with this invention means are provided to exhaust fixed gases from the system to ensure the continuance of satisfactory low pressures within the same. For this purpose, I preferably combine with the refrigerating system a purger of the type shown and disclosed more particularly in my copending application Serial No. 198,715, filed June 14, 1927. Thus a suitable heavy liquid such as mercury is propelled through an auxiliary circuit in a part of which it entrains bodies of fixed gas and exhausts the same to the atmosphere or any suitable gas receiving region. This purging means preferably is arranged to return to the main circuit the major portion of the working fluids which may pass into the auxiliary circuit with the non-condensable gases and also to return stray particles of the heavy liquid from the refrigerating circuit to the purger circuit.

In the accompanying drawing, the figure is a schematic illustration of a refrigerating system embodying my invention.

The accompanying drawing which affords a convenient illustration of the invention, shows a heating factor 1 which imparts energy to the system and which may conveniently be a gas burner provided with an upstanding flue 2. A generator 3 containing a solution of absorbent and refrigerant liquids is arranged about the lower portion of the flue. A duct 4 is juxtaposed to the latter and extends downwardly into the upper part of the generator, preferably having its lower end disposed substantially at the normal surface of the liquid contained in the same; thus in the actual operation of the apparatus this liquid level alternately rises above and is depressed below the end of pipe 4 so that slugs of the liquid solution and bodies of vaporized refrigerant are alternately propelled upwardly out of the absorbent-refrigerant solution in the generator. Additional refrigerant is vaporized out of the liquid slugs during their passage up duct 4 due to the heat received from the flue.

The upper end of duct 4 is joined to a separating chamber 5 which is connected to a downwardly inclined duct 6, the latter being provided with suitable cooling means, such as fins 7, to comprise a refrigerant condenser. A baffle or deflector 80 is disposed adjoining the mouth of duct 6 to prevent the entrance of liquid from pipe 4.

Liquefied refrigerant from the condenser flows downwardly through a pipe 8 which preferably is of restricted diameter and forms one leg of a trap 9, passing to a vertically disposed pipe 12 that forms the other leg of the trap. The upper end of pipe 12 is connected to the bottom of the cooler

or evaporator 14. The cooler may be of the general type disclosed in the copending application of Ernest W. Wescott, No. 163,371, filed January 25, 1927. For example the cooler has a vertically disposed partition or baffle 17 which carries deflector plates 18 that are arranged in staggered relation to deflector plates 19 mounted upon the wall of the cooler; these plates being arranged above the outlet of pipe 12 so that refrigerant rising from the same toward the surface of the liquid contained within the cooler follows a tortuous path defined by the deflector plates. Furthermore, the arrangement of the baffle 17 tends to induce a secondary circulation of the refrigerant mixture within the evaporator itself as will be more fully described.

A downwardly inclined duct 20 connects the cooler with the absorber 21, which receives a weak absorbent solution from the pipe 22 that connects the lower portion of the separating chamber 5 with the upper portion of the absorber. Thus, refrigerant vapor tends to be drawn from the surface of liquid in evaporator 14 to the absorber 21 and the region surrounding the evaporator is cooled. The lifting of the absorbent in tube 4 and its movement upward through the pressure balancing column in pipe 22 permits it to flow downwardly over the staggered plates 24 in the absorber 21. The lower end of the latter is connected to the lower portion of generator 3 by a pipe 25 containing a pressure balancing column of a strong absorbent-refrigerant mixture. Cooling fins 30 and 31 may be arranged around the pipe 22 and the absorber 21 respectively to lower the temperature of the solution and thus to cause the absorption of refrigerant by the absorbent flowing downwardly over plates 24.

While substantially pure refrigerant vapor may pass into the condenser duct 6 and thence through pipe 12 into the evaporator, stray particles of absorbent may also be carried into the refrigerant condenser and the cooler. Due to the arrangement of the baffles or deflector plates 18 and 19 in the cooler, however, there is a circulation and mixture of the incoming liquid from pipe 12 with the solution within the evaporator so that the latter tends to contain a more or less uniform solution. The lowering of the temperature of the surface layer of the liquid due to evaporation causes a downward flow from the surface which is counteracted by the upward flow about the plates 18 and 19, as designated by the arrows. This auxiliary liquid circuit within the evaporator itself, which is of the general character provided for in copending application Serial No. 163,371 is enhanced when the refrigerant liquid is lighter than the other constituents of the mixture within the cooler, for example, lighter than the absorbent. Such a mixture is advantageous when the refrigerant has a comparatively high freezing point and its mixture with the absorbent or other constituent has a lower freezing point so that, due to the mixture of the liquids in the cooler, freezing of the same is avoided. With refrigerants which do not freeze at the temperature of the cooler and which therefore do not require a non-volatile mixture, non-circuital types of coolers may be used. In order to avoid the collection of excess absorbent in the evaporator, I place the pipe 20 (or, if preferred, another pipe may be used for this purpose) just above the normal surface of liquid within the cooler so that undue accumulation in the cooler causes spilling of liquid over into the absorbent circuit.

In the generator-absorber circuit, the slugs of liquid are lifted in the tube 4 due to the pressure of the boiler 3 being higher than that in the separating chamber 5 and condenser 6, it being evident that the pressure imposed by the weight of the column in pipe 4 plus the pressure thereabove substantially balances the pressure within the generator. The liquid column in pipe 22 substantially balances the difference between the pressure in the absorber 21 and the separating chamber 5, it being evident that the pressure in the separating chamber plus the weight of the liquid column in the adjoining leg of the trap which connects the same to pipe 22 balances the pressure due to the weight of the liquid column in the latter plus the vapor pressure within the absorber. The pressure in the separating chamber 5 is sufficient to lift liquid through pipe 22 to the absorber. The liquid column which forms in pipe 25 obviously has a height added to the pressure in the absorber which will permit it to balance the boiler pressure and as additional increments of the absorbent-refrigerant solution collect in the pipe 25, liquid will be returned from the lower end of the same to generator 3.

When water or other liquid of similar volatility is used as a refrigerant, the difference between its vapor pressure at the condenser temperature, for example around 40° C., and at the evaporator temperature, for example around 0° C., is quite moderate so that a liquid column balancing this liquid pressure may be of reasonable height and the apparatus may be reasonably compact. It is further evident that the liquid columns in pipes 25, 12 and 22 are effective in permitting a difference between the evaporator and absorber pressures on one hand and the boiler and condenser pressures on the other, so that certain portions of this system which contain vapor at different pressures may be arranged at different relative heights corresponding to these differences in pressure; however, the vapor connections can, of course, be raised or lowered practically as desired, so that the system has considerable flexibility in the arrangement of its component parts quite aside from the dimensions of the same which are determined by the choice of a proper refrigerant and absorbent.

A variety of refrigerant and absorbent liquids may be utilized in a system of this character, for example water and sulfuric acid have suitable affinity for each other and yet the water readily may be boiled out of the sulfuric acid. For example, a fairly strong solution of water in sulfuric acid has a vapor pressure at absorber temperature which will be less than the vapor pressure of the water at the evaporator temperature. Furthermore, the difference between the vapor pressure of water at the temperature of the cooler and at the temperature of the condenser is moderate and may be balanced by a liquid column of moderate height; when sulfuric acid is used as an absorbent the walls of the system preferably are formed of glass, porcelain, lead or other material which is substantially non-corrosive in the presence of or resistant to the action of sulfuric acid.

Strong solutions of caustic potash or soda with or without glycerin also may be used as absorbents when the cooler temperature does not have to be low. The various combinations of absorbents and refrigerants referred to in the copending application of Eastman A. Weaver, Serial No. 339,053, filed February 11, 1929, may also be used in a system of the character disclosed herein,

such liquids being substantially non-corrosive, organic liquids which have suitable degrees of affinity for each other, more specifically weakly acidic and alkaline compounds, of which examples are for the absorbent; propionic, butyric valerianic, oleic, and caproic acids; and for refrigerant: diethylamine, triethylamine, methanolamine, allylamine and propylamine. Volatile acidic refrigerants like formic and acetic acids may also be used with less volatile alkaline absorbents such as the ethanolamines.

If apparatus of the character disclosed herein employs sulfuric acid as an absorbent, it ordinarily will be so constructed that there is practically no tendency for non-condensable gases to collect therein. However, with other liquids such as those named above the apparatus ordinarily will be so constructed that continued maintenance of low pressure therein depends upon the exclusion of fixed gases which tend to enter the system. Accordingly I prefer to arrange a purger of the general character disclosed in my copending application Serial No. 198,715 in combination with an absorption system of the character herein disclosed. For this purpose I preferably shunt a portion of one of the working fluids of the system for a high to a low pressure portion thereof, utilizing this shunted portion of the liquid in causing the circulation of an auxiliary liquid such as mercury through a suitable purger circuit which permits the entrainment and exhaustion of non-condensable gases from the system. Many suitable expedients may be utilized to permit the shunting of only a limited amount of one of the working fluids; for example, a comparatively long pipe of restricted diameter may be employed to provide high frictional resistance to the flow of fluid and so that only a comparatively small portion thereof passes through the shunt.

In the present embodiment of the invention I prefer, however, to employ a pipe 70 of restricted diameter which is connected to the lower part of pipe 6 adjoining the separating chamber 5. Since only a small portion of the refrigerant will have condensed by the time that it reaches the entrance to pipe 70, the major portion of the refrigerant will pass this pipe as a vapor being condensed in the main portion of the condenser and thence passing to the cooler. Pipe 70 preferably is continued downwardly into a trap 40, the opposite leg 41 of which is connected to a lifter tube 42 that forms part of the auxiliary heavy liquid circuit. Lifter tube 42 also is of restricted diameter or of capillary dimensions, i. e. of such a small diameter that successive slugs of liquid will entirely occupy the cross-sectional area thereof. The upper end of this capillary tube is connected to a separating chamber 44 from which a vapor pipe 45 extends to the absorber 21, while a pipe 52 forming one leg of a trap 46 is connected to the lower portion of the chamber. The upper part of the leg 41 of trap 46 may be disposed adjoining the burner 1, or it may merely be exposed to atmospheric warmth. The condensed refrigerant which collects at the lower end of tube 70 is subjected to the relatively high pressure of the condenser duct 6 so that the liquid level in the opposite leg 41 of the trap ordinarily may be in the vicinity of the burner, while the upper end of lifter tube 42 is at the low pressure of the absorber. Accordingly, there is a tendency for vapor to pass from the surface of the liquid in pipe 41 to the separating chamber 44 and thence to the absorber. This vaporization will occur due to the low pressure in the absorber and the tendency of the refrigerant to be drawn to the absorbent therein, and it may be aided by the heat received by the tube 41.

Even when the apparatus is not operating some of the heavy liquid, e. g. mercury, will be located in tube 42 above its connection with pipe 40. Accordingly vapor from the latter will lift mercury through the tube to the chamber 44, this vapor flowing through pipe 45 into absorber 21 while the mercury collects in the lower portion of chamber 44, piling up upon one side of the trap 46. The opposite leg of the latter is connected to an entraining chamber 47, the upper portion of which is connected to a pipe 50 that is adapted to receive fixed gases from a portion of the system where such gases ordinarily collect, for example, the upper part of the absorber 21. Since ordinarily fixed gases will collect in either the absorber or the refrigerant condenser, it is desirable to arrange means for carrying the fixed gases from one to the other so that all of the fixed gases which find their way into the system ultimately will pass to the absorber and thence to the purger. For this purpose, as previously indicated, the tube 8 is of restricted diameter, i. e. so small that successive slugs of liquid will entrain bodies of non-condensable gas therebetween should any of the latter occur within the condenser. This gas rises from the lower end of tube 8 through the duct 12 and thence to the top of the cooler, passing through duct 20 to the absorber.

Preferably a chamber 54 may be located in the upper portion of pipe 50, the part of that pipe between the chamber and absorber being of restricted diameter. Thus the chamber 54 tends to form a reservoir for the collection of non-condensable gases and the small diameter of the connection between that chamber and the absorber permits only a limited diffusion of the refrigerant vapor into the non-condensable gases there collected.

The lower portion of chamber 47 is connected to a tube 55 which also is of capillary dimensions so that successive increments of mercury spilling over from the trap 46 pass down through the tube 55 as separate liquid pistons, entraining bodies of gas and vapor from the chamber 47 and pipe 50 therebetween.

The lower end of tube 55 is connected through a trap 64 with the lower part of a standpipe 59. This standpipe preferably contains a column of liquid, i. e., refrigerant or refrigerant and the heavy liquid, and its upper end is exposed to the atmosphere or connected to a suitable gas collecting vessel. Preferably standpipe 59 has a sufficient height to permit the liquid column contained therein to vary in height to compensate for variations in barometric and internal pressures. A trap 56 connects the lower portion of the standpipe with the lower end of lifter tube 42, thus permitting the recirculation of heavy liquid through that pipe while permitting entrained gas to rise through the liquid column in the standpipe.

A duct 57 of much larger diameter parallels the lower portion of tube 42. The lower end of the tube is joined to duct 57 by a downwardly inclined connection 58 and the upper end of the duct is joined to the tube by a similar connection 61. The upper end of duct 57 is also joined to a pipe 8ª which has a general upward inclination with its upper end joined to the lower portion of pipe 8.

As additional quantities of heavy liquid passing downwardly through pipe 55 collect at the bottom of standpipe 59, the pressure therein is raised and mercury passes over through trap 56 into tube 42, rising in the same to the connection with duct 41 where the upper portion of the mercury column is broken off by vapor received from that duct to be lifted as a separate slug to the separating chamber 44. If refrigerant vapor rather than non-condensable gases is entrained between the heavy liquid globules in tube 55, this vapor tends to be compressed as it passes down through the tube which is exposed to the cooling effect of the air. Accordingly refrigerant thus entrained usually is liquefied when it arrives at the bottom of standpipe 59.

It is evident that when a sufficient quantity of refrigerant thus collects in the standpipe, the height of the liquid column contained therein will rise sufficiently to permit refrigerant liquid from the lower end thereof to pass through trap 56 to the tube 42, this liquid rising in the latter tube and passing into separating chamber 44. Due to the heat received from the flue and the low pressure at the upper part of the tube, the refrigerant vapor thus received from the standpipe 59 may be vaporized before it reaches the separating chamber. However, any refrigerant which is still in its liquid phase when reaching this chamber will be drawn to the absorbent solution in the absorber 21 and thus returned to the main refrigerant circuit.

Obviously duct 57 which parallels the lower portion of tube 42 and which has its upper and lower ends connected thereto contains the heavy auxiliary liquid such as mercury, the arrangement of the tube and duct being such that the refrigerant will rise only in the small tube and so that the large tube which contains a larger body of the heavy liquid will serve to prevent material change in the effective level of the heavy liquid in this portion of the apparatus even when a plurality of refrigerant globules or bubbles are passing upwardly in the tube. Thus violent changes in pressure conditions within the system or radical displacement of the heavy liquid is avoided. The tube 8^a is arranged to collect particles of the heavy liquid which may stray into the main refrigerant circuit and to return the same to the auxiliary circuit. Since the tube 70 is of capillary size any mercury straying to the same will eventually be entrained between bodies of refrigerant and due to the difference in pressure at opposite sides of the trap 40 will be lifted through tube 41 to the lifter pipe 42 and thence return to the auxiliary heavy liquid circuit.

It is thus evident that non-condensable gases may be exhausted to the atmosphere, rising through the liquid in standpipe 59, and that the major portion of the working fluids which stray to the auxiliary purger circuit become liquefied before they reach the standpipe and are automatically returned to the main circuit of the system. As a matter of fact the exhaustion of the working fluids in this manner is so small that it may continue for long periods of time without appreciably affecting the operation of the system.

I claim:

1. Absorption refrigerating apparatus utilizing a refrigerant having a vapor pressure less than atmospheric pressure at 0° C., said apparatus comprising a substantially gas-tight fluid circuit, and means associated therewith automatically to exhaust non-condensable gases from the system to permit the maintenance of low pressures therein, said means including a heavy auxiliary fluid, means to lift said fluid to a point of gas entrainment, a tube of capillary dimensions arranged to receive alternate slugs of heavy liquid and bodies of gas from this point and to vent the same to a region of separation from which the gas is exhausted and the heavy liquid is recirculated.

2. The art of low pressure refrigeration comprising circulating a refrigerant of low vapor pressure from a region of high pressure where it is condensed to a region of low pressure where it is vaporized to produce a low temperature, shunting a portion of the refrigerant from said circuit to lift a heavy liquid, entraining non-condensable gases from the circuit between globules of the heavy liquid, exhausting the gas to the atmosphere while returning the heavy liquid to the point of entrainment.

3. Refrigerating apparatus including a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, said apparatus employing a refrigerant of low vapor pressure whereby the cooler may normally be at subatmospheric pressure, and means for removing non-condensable gases from the system, said means including a duct connected to the condenser and to the cooler through which a portion of the refrigerant is shunted, means for utilizing the energy of the fluid flowing through said duct to lift an auxiliary liquid, a fluid duct arranged to collect non-condensable gases, and a tube connected thereto wherein globules of the second liquid entrain said gas, said tube being connected to a gas receiving region.

4. A refrigerating system comprising a refrigerant circuit, a condenser, a cooler and a vapor drawing factor, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, means for supplying a heavy liquid to an upwardly extending portion of said passage whereby the heavy liquid is lifted, and a downwardly extending tube of capillary dimensions adapted to receive the lifted heavy liquid, said tube being arranged to receive non-condensable gases from the system to be entrained by the heavy liquid, the lower end of the tube being arranged to vent the entrained gases into a liquid column, the upper end of the latter being exposed to a gas receiving region, and means connecting the latter with the means for supplying the heavy liquid to the upwardly extending duct.

5. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, an auxiliary circuit containing mercury, said fluid passage and circuit having a tube portion of small diameter in common when the shunted refrigerant lifts slugs of the mercury, another portion of said auxiliary circuit comprising a tube of small diameter having its upper end arranged to receive mercury

globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and mercury.

6. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common where the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, a portion of said passage being arranged to cause the gradual flow of refrigerant therethrough.

7. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler and an absorber, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said system, said means comprising a fluid passage connected to the condenser and absorber to receive a portion of the condensed refrigerant from the former, means associated with said passage for effecting the vaporization of refrigerant flowing through the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common where the refrigerant vapor lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid.

8. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, means in said passage opposing the flow of liquid therethrough but permitting the refrigerant to be drawn back to the low pressure portion of its circuit as a vapor, a heavy liquid circuit, said fluid passage and circuit having a portion in common comprising a tube of small diameter where the vaporized refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid.

9. In combination a low pressure refrigerating system including a suitable fluid circuit, a factor for imparting energy to the system to circulate fluid therethrough and means for removing non-condensable gases from the system, said means comprising a fluid shunt connected to said circuit so that fluid flows therethrough in parallel to the fluid flow in the circuit as a result of the energy received from said factor, a heavy liquid circuit having a tube portion of small diameter in common with said shunt, where globules of the heavy liquid are lifted by the fluid flowing through the shunt, another portion of said heavy liquid circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid.

10. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing neon-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common where the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, a portion of said passage being arranged to cause the gradual flow of refrigerant therethrough said passage being connected to a high pressure portion of the refrigerating system where refrigerant is mostly in vapor phase and partially in liquid phase and being arranged to receive the liquefied portion only of the refrigerant.

11. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common where the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, a portion of said passage being arranged to cause the gradual flow of refrigerant therethrough, said passage being connected to a high pressure portion of the refrigerating system where refrigerant is mostly in vapor phase and partially in liquid phase and being arranged to receive the liquefied portion only of the refrigerant, said passage including a trap where the liquefied refrigerant collects and is vaporized as it passes to the portion in common with the heavy liquid circuit.

12. In combination a low pressure refrigerating system, including refrigerant circuit, means to remove non-condensable gases from the circuit to permit the maintenance of low pressure therein, said means being adapted to collect and exhaust non-condensable gases and means associated therewith for returning to the circuit refrigerant that strays to the gas removing means, a downwardly extending tube of capillary dimensions adapted to receive globules of heavy liquid, a pipe supplying non-condensable gases

from the system to the tube to be entrained by the heavy fluid, a gas reservoir in the pipe, the portion of the pipe between the reservoir and system being of restricted diameter to impede diffusion, the lower end of the tube being arranged to vent the entrained gases into a liquid column, and means connecting the latter with the means for supplying the heavy liquid to the tube.

13. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common when the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, and means connected to said tube to return stray refrigerant to the refrigerant circuit, said means including a column of refrigerant having its lower end connected to the lower end of said tube, and a return pipe also connecting the lower portion of this column to the common part of the passage and thus to the refrigerant circuit, whereupon an excess of the refrigerant collecting in the column forces liquid from its lower end into the return pipe.

14. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common when the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, and means connecting the refrigerant circuit to the heavy liquid circuit for returning stray heavy liquid from the former to the latter.

15. Absorption refrigerating apparatus employing a refrigerant having a low vapor pressure at room temperature, and a suitable absorbent, said apparatus employing liquid columns to balance pressure differences therein, and means associated therewith for preventing the collection of non-condensable gases in the system, said means comprising an auxiliary liquid circuit having liquid columns to balance pressure differences therein and including a tube of capillary dimensions in which gas is entrained and from which it is exhausted.

16. In refrigerating apparatus of the absorption type, the method which comprises the distillation of the vapor of a refrigerant having a boiling point in the vicinity of 0° C. from a suitable refrigerant-absorbent mixture, condensing the refrigerant with a stray absorbent constituent, conducting the resulting condensate to a cooler, and withdrawing refrigerant vapor from the cooler by absorption in a weak absorbent-refrigerant solution, while maintaining sufficient absorbent mixed with the refrigerant in the cooler to prevent freezing in the latter and returning excess absorbent from the cooler to said weak solution.

17. A refrigerating system comprising a refrigerant circuit, a low pressure portion of the circuit including a cooler, a high pressure portion of the circuit including a condenser and pressure-balancing means between said portions of the circuit, means for removing non-condensable gases from said circuit, said means comprising a fluid passage connected to the high and low pressure portions of the circuit to shunt a portion of the refrigerant from the same, a heavy liquid circuit, said fluid passage and circuit having a portion in common where the shunted refrigerant lifts the heavy liquid, another portion of said circuit comprising a tube of small diameter having its upper end arranged to receive heavy liquid globules and gas bodies pocketed therebetween and its lower end arranged to effect the separation of the gas and heavy liquid, a portion of said passage being arranged to cause the gradual flow of refrigerant therethrough, said passage being connected to a high pressure portion of the refrigerating system where refrigerant is mostly in vapor phase and partially in the liquid phase and being arranged to receive the liquefied portion only of the refrigerant, said passage including a trap where the liquefied refrigerant collects and is vaporized as it passes to the portion in common with the heavy liquid circuit, said trap being of capillary dimensions so that stray heavy liquid will be entrained by refrigerant in the same and thus returned to its own circuit.

18. The art of low pressure refrigeration comprising circulating a refrigerant of low vapor pressure from a region of high pressure where it is condensed to a region of low pressure where it is vaporized to produce a low temperature, shunting a portion of the refrigerant from said circuit to lift a heavy liquid, entraining non-condensable gases from the circuit between globules of the heavy liquid, exhausting the gas to the atmosphere while returning the heavy liquid to the point of entrainment, and returning to the heavy liquid stray particles thereof that pass into the refrigerant circuit.

19. Absorption refrigerating apparatus comprising an absorber-generator-condenser-evaporator circuit, said circuit including a liquid column between the condenser and evaporator, said column containing condensed refrigerant with some absorbent mixed therewith and balancing the pressure difference between the evaporator and condenser while supplying said mixture to the cooler, and an inclined duct between the evaporator and absorber arranged to permit an excess of liquid in the former to flow into the absorber to prevent the collection of an excess of absorbent in the evaporator.

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