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PURGE SYSTEM FOR REFRIGERATIVE CIRCUITS

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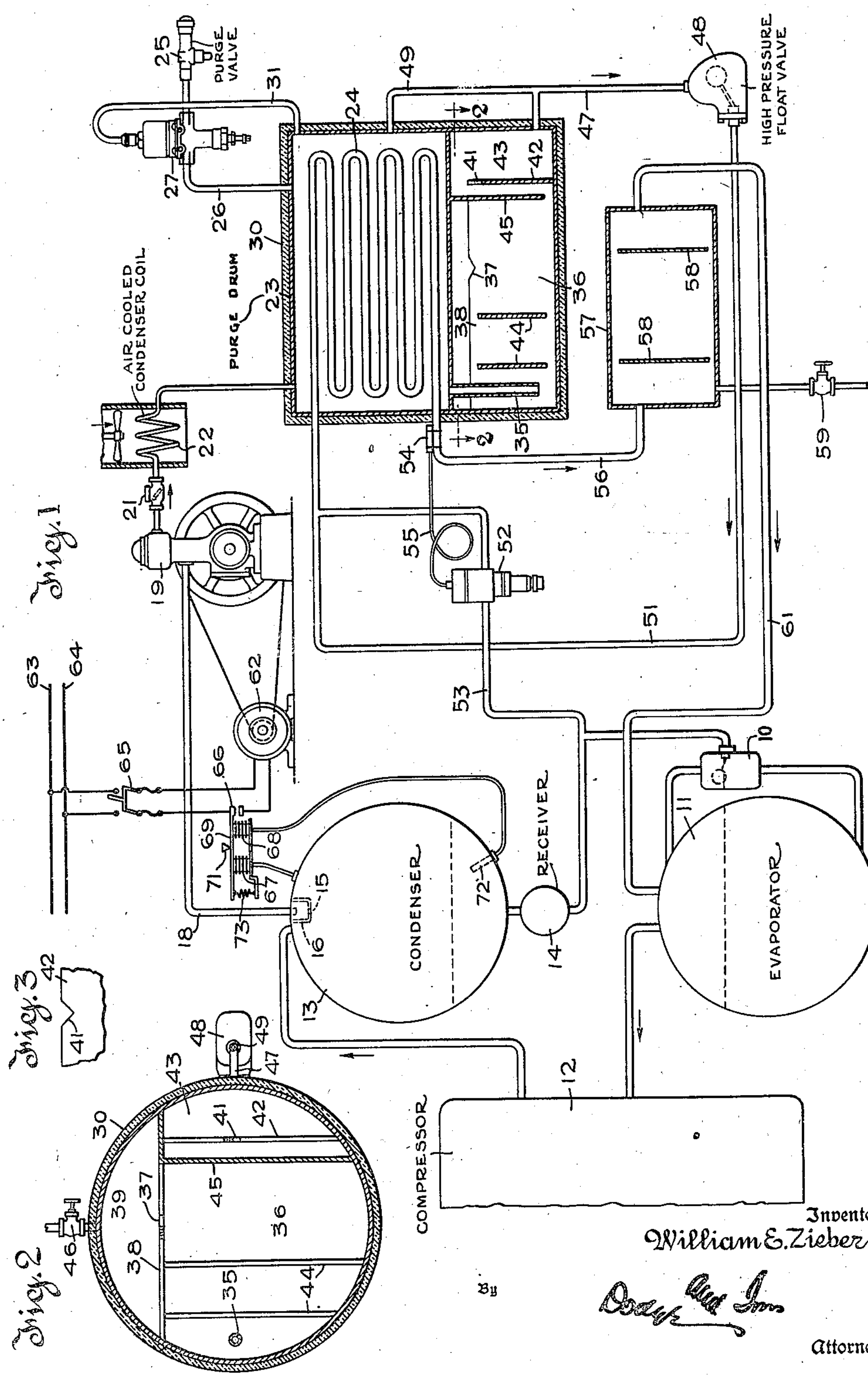

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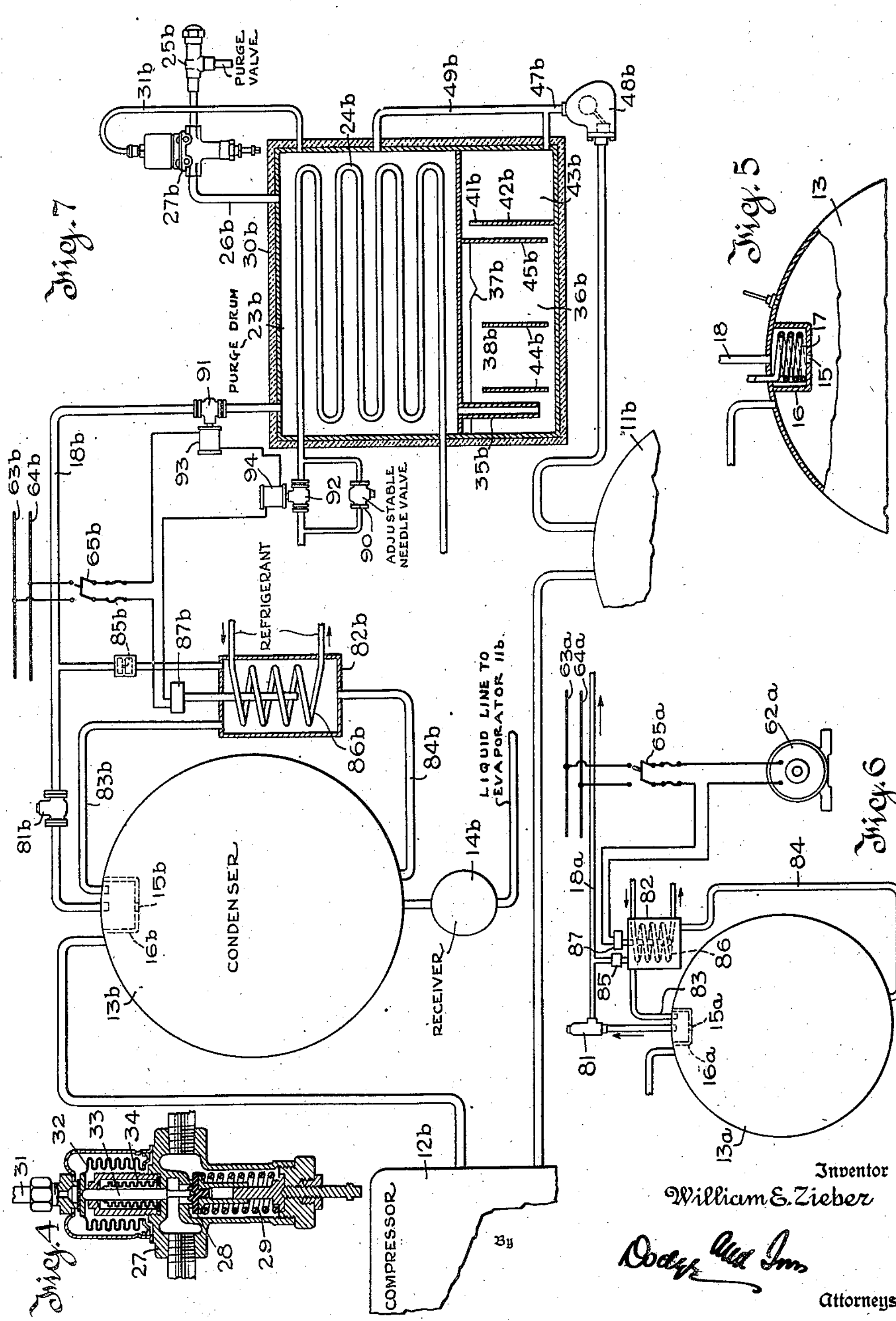

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PURGE SYSTEM FOR REFRIGERATIVE CIRCUITS

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13 Claims. (Cl. 62—115)

This invention relates to refrigeration and particularly to purging systems for use with refrigerative circuits. While the invention can be arranged for manual control, a feature is the provision of automatic means which render manual control unnecessary and which respond to conditions within the system indicating the need of the purging operation.

The invention is of marked utility in connection with refrigerants of the Freon class and generally with refrigerants with which lubricating oil is freely miscible, particularly those in which the miscibility is characteristic of all degrees of oil concentration. Where this is the case, gravity separation of the lubricant from the refrigerant is impracticable so that special provision must be made for the desired separation. Refrigerants having this character of miscibility with the oil are typified by the Freon group and the discussion will be based on the use of Freon simply as examples and without implying any necessary limitation to this particular field. Freon is a trade name, and various types of the general class are distinguished by numbers as F-11, F-12, etc.

The invention is useful in any refrigerating plant in which the evaporator, or both evaporator and condenser operate below atmospheric pressure, and hence are subject to in-leakage of air and water vapor during normal operating periods. Leakage, of course, is not a normal function but it cannot always be prevented. In an air conditioning system, to take one familiar example, the evaporator is commonly operated at a temperature near the freezing point of water from which it follows that the evaporator pressure is substantially higher than the pressures encountered in the general range of refrigerative work. Where this is the case and where the condenser is cooled by water at ordinary temperatures, the pressure range through which the compressor works, that is, the pressure differential between the evaporator and the condenser, is limited. From this, it follows that if the compressor is to operate efficiently, air and other non-condensible gases must be eliminated from the circuit as completely as is reasonably practicable.

With certain refrigerants commonly used in air conditioning the operating pressure ranges are rather low so that there is a tendency for atmospheric air to enter the refrigerative circuit. Since atmospheric air always contains some water vapor, the entrance of air is attended with the entrance of water in the vapor phase. The operation of most compressors is such as to cause mixture of some lubricating oil with the refrigerant. The invention provides for the segregation of such oil from the refrigerant. The segregation of the oil is automatic but its removal from the circuit is preferably under manual control.

The operation of the purging system for separating and rejecting the air is fully automatic. The separation of the water is automatic, the quantity is not great enough to render automatic discharge worth the extra complication.

To embodiments of the invention are shown, one involving the use of a small secondary reciprocating compressor to withdraw refrigerant, air and water vapor from the condenser and deliver them to a secondary condenser, and the other involving the use of a secondary condensing coil operated at a temperature so low as to make the use of a compressor unnecessary. Such a low temperature condensing coil forming part of the purge device is peculiarly desirable in plants where a low temperature cooling liquid or a low temperature refrigerant is rendered available by extraneous means because low temperature permits efficient purging. Elimination of the secondary compressor, in plants in which the main compressor is of the centrifugal type, permits elimination of the oil separator. Reciprocating compressors are likely to contaminate the refrigerant with oil and their elimination reduces the oil problem practically to the vanishing point.

Two types of automatic control for the purge device are disclosed, and either may be used with either of the two embodiments just mentioned. These two controls are characterized, one by a rather wide control range which ordinarily gives sufficiently precise control, and the other by a very narrow control range, which is required in cases where temperature and pressure in the main condenser are rather low and condensation of water vapor in the condenser may occur unless a precise purge control is afforded. Low condenser temperatures are encountered in known types of circuit in which cascade cooling is used, i. e., cooling of the main condenser by an auxiliary refrigerating circuit.

Generally stated, according to the invention, a mixture of refrigerant vapor, water vapor and air is drawn from the main condenser and delivered to a secondary purging condenser which is operated at a lower temperature than the main condenser. If this temperature is sufficiently low, no secondary compressor is needed, but in most cases, it is desirable to use a compressor to withdraw refrigerant vapor with air and water vapor from the main condenser and deliver them under elevated pressure to the secondary condenser. In this secondary or purge condenser, the refrigerant is liquefied almost completely so that the minimum practicable quantity of refrigerant is discharged from the condenser with the purged air and other non-condensable gases. It is impracticable (because of the law of partial pressures) to liquefy all of the refrigerant. The liquefied refrigerant is returned to the system after a gravity separation of water therefrom, and on its way back to the system may be fed through the evaporative cooling coil of the secondary or purge condenser. In this condenser the oil is deposited and flows to a baffled oil-separator which may be drained from time to time. The vaporous refrigerant, thus freed of air, water and oil returns to the low side of the main circuit.

The automatic control puts the purge circuit into operation whenever air is present in the condenser in excess of a chosen proportion.

When the purge device operates, air mixed with a minimum quantity of refrigerant is discharged from the circuit. All water is separated from the liquid refrigerant and discharged. The refrigerant (including, if desired, some drawn from the main condenser) is freed of oil and returned to the low pressure side of the main refrigerative circuit. As stated, except for draining off of the oil and of the water, each of which is required at relatively long intervals, the operation of the system is completely automatic.

Preferred embodiments of the invention will now be described by reference to the accompanying drawings.

In the drawings:

Fig. 1 is a diagram, partly in section, showing the embodiment using a secondary compressor, and a controller of the differential pressure type.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view of the weir notch through which the liquid refrigerant flows.

Fig. 4 is a sectional view of a protective valve used on the air vent line.

Fig. 5 is a fragmentary view of the local cooler associated with the purge offtake from the condenser.

Fig. 6 is a fragmentary view showing a modified control of the precisely acting type applied to the structure of Fig. 1.

Fig. 7 is a view similar to Fig. 1 showing a modified construction in which the secondary compressor is omitted.

Embodiment of Figs. 1–5

The main refrigerative circuit comprises an evaporator 11 of any type, a compressor 12 of any type (but here assumed to be of the centrifugal type), drawing vaporous refrigerant from evaporator 11 and delivering it at higher pressure to condenser 13 which ordinarily would be of the water-cooled shell and tube type. Any cooling medium can be used in the condenser.

Refrigerant liquefied in the condenser collects in the receiver 14 from which it is fed to the evaporator 11 by any suitable controlling means conventionally indicated at 10.

Communicating freely with the vapor space in condenser 13 by port 15 is a cooled purge-offtake chamber 16 (see Fig. 5). This is cooled by any means such as coil 17 through which a cooling fluid is circulated. The purpose is to cool chamber 16 below condensing temperature and thus stimulate a free flow of non-condensable gases (chiefly air) to the chamber and thence to the offtake. The cooling fluid may, for example, be condenser cooling water on its way to the main water spaces of the condenser 13, and hence cooler than the condenser, but this is a matter of detail.

The purge offtake line 18 leads from chamber 16 to the intake of secondary compressor 19 which discharges through check valve 21 and air-cooled condenser 22 to the purge drum 23 in which is mounted the secondary condensing coil 24. The condenser 22 is merely an economizer and may be omitted. The check valve 21 is important because it prevents reflux of water to the compressor 19 when the latter stops. This water has been found to have serious corrosive action upon the compressor if allowed to flow back to the compressor when the latter stops. To the same end the pipe connections from check valve 21 to purge drum 23 are made small so that high flow rates (say 1,000 ft. per minute or more) are had, the purpose being to sweep water droplets toward drum 23 and prevent retention of slugs of water in the piping.

Coil 24 is fed with liquid refrigerant and operates at substantially the pressure and temperature of evaporator 11, as will later appear. It condenses the major portion of the refrigerant entering drum 23. The air and a small amount of uncondensed refrigerant discharges through the loaded relief valve 25 which controls air vent pipe 26.

The relief valve 25 can be used alone, but because such valves sometimes fail to seat tightly, a protection valve 27 is interposed between drum 23 and valve 25. The structure of the protection valve is shown in Fig. 4, and since the valve is of known mechanical construction (but heretofore used for a wholly different purpose) only a brief description is needed.

The valve proper 28 opens in the direction of flow toward valve 25. It is loaded in a closing direction by coil compression spring 29. The spring loading is opposed by pressure in drum 23 communicated through tube 31 to bellows 32, causing the bellows to react in a valve opening direction on stem 33 which engages the valve 28. Bellows 34 form a packless seal for stem 33. The loading of spring 29 is adjustable and is so set that the valve 28 closes except when purging pressures exist in drum 23, at which time it opens and transfers vent control to the loaded vent valve 25. Valve 27 will close tightly at other times. Hence valve 25 will not weep continuously even though its seat should become scored.

The valve 25 is simply a spring loaded relief valve set to open when chamber 23 is at purging pressure, and by purging pressure is meant a pressure substantially higher than the pressure corresponding to the temperature of the coil 24 as determined by the thermo-dynamic properties of the refrigerant used in circuit 11, 12, 13, 14.

This can be illustrated by a practical example. Assume that the refrigerant is F–11 and that the evaporator 11 operates to cool water to 40° F. The evaporator 11 would operate at a pressure of about 6 lbs. per sq. in. absolute and the condenser would operate at about 10 lbs. gage, assuming cooling water at about 90° F. With the connections as shown in Figure 1, the refrigerant in the coil 24 would be evaporating under a pressure of about 6 lbs. per sq. in. absolute and consequently would be at a relatively low temperature. The compressor 19 when operating would boost the pressure from the 10 lbs. gage existing in the condenser 13 to a pressure between 75 and 90 lbs. gage in the shell 23. It is this relatively high pressure in the shell 23 and the relatively low temperature of the coil 24 which ensures a low partial pressure of F-11 in the shell 23 and ensures a minimum discharge of the refrigerant through the valve 25, which is adjusted to open only in the relatively high pressure range above suggested.

Refrigerant liquefied in drum 23 passes by dip pipe 35 to the gravity separation chamber 36, shown formed as a downward extension of drum 23. The entire structure is insulated to minimize the entrance of heat, such insulation being indicated at 30. The arrangement of chamber 36 will be clear from a consideration of Figs. 1, 2 and 3.

There is a water overflow weir comprising a weir notch 37 in partition 38 controlling flow to water collecting sump 39. There is a refrigerant overflow weir comprising a weir notch 41 in partition 42 controlling flow to refrigerant collecting chamber 43.

Since the refrigerant is assumed to have a higher specific gravity than water, the notch 37 is slightly higher than notch 41. To facilitate gravity separation in chamber 36 at least one vertical cross baffle 44 is used. Two baffles are shown and their function is to suppress turbulence caused by the entrance of liquid through dip pipe 35. The bottom edge of baffle 44 is above the bottom of chamber 36 and the top edge is slightly below the bottom of notch 37. Thus notch 37 skims water off. The rate of horizontal liquid flow in chamber 36 should be low, say six to twelve inches per minute. Refrigerant, thus freed of water, passes below a dip partition 45 to reach weir notch 41. Any freely miscible oil would travel with the refrigerant.

Water is drained away from sump 39 by manually opening valve 46. Float control of valve 46 would be an unnecessary complication since the amount of water to be discharged is small. However, the discharge from chamber 43 is float controlled, the drain line 47 leading to a high side float valve 48. A pressure equalizing connection 49 to the vapor space in purge drum 23 is provided. A float valve similar to 48 could replace valve 46, and such a substitution would involve only mechanical skill.

Refrigerant passing through valve 48 is led by line 51 to the entrance (upper) end of coil 24 which is carefully designed to drain all oil precipitated therein to its lower discharge end. This oil might, for example, enter the system at the reciprocating secondary compressor 19. The system need not withdraw oil with refrigerant from condenser 13 where compressor 12 is of the centrifugal type, since contamination of refrigerant by oil does not occur to any appreciable extent in such compressors. However, if the main compressor is of the reciprocating type some of the oil which might then become mixed with refrigerant would pass from condenser 13 through expansion valve 52, about to be described, and would be separated by the oil separator 57.

Since the refrigerant passing valve 48 is insufficient to supply the demands of coil 24, an automatic expansion valve 52 of the superheat control type is interposed in a connection 53 between receiver 14 and the entrance end of coil 24. The thermal bulb 54 is applied to the discharge end of coil 24 and is connected by capillary tube 55 with the controlling mechanism of valve 52. The parts are so arranged according to known principles that valve 52 will supply make up refrigerant to coil 24 at rates such that refrigerant leaving the coil and affecting the temperature of bulb 54 will be slightly superheated.

Refrigerant leaving coil 24 and oil draining therefrom pass by connection 56 to one end of oil separator drum 57 which has baffles 58 for arresting oil droplets and a manually operable normally closed oil drain valve 59. The other end of the drum is connected by line 61 with evaporator 11, i. e., to the low side of the main refrigerating circuit. As stated, the system can operate to remove oil from the main condenser 13. Thus the invention provides for recovery of some but not all of the oil entering the main condenser. Since the valve 52 is always effective to feed coil 24, some oil separation is occurring from time to time irrespective of the cycling of the purge device as long as the main compresser operates.

The purging circuit above set forth is active only when conditions in the condenser are such as to require purging. This is evidenced by rise of condenser pressure unduly above the pressure corresponding to the temperature of liquid refrigerant in the condenser. At such times the compressor 19 is operated. At all other times the compressor is inactive.

Compressor 19 is driven by electric motor 62 which receives current from lines 63, 64 through normally closed switch 65. A control switch 66 operated by opposed bellows motors 67, 68 reacting upon lever 69 which is fulcrumed at 71 starts and stops motor 62 according to conditions in condenser 13. Bellows motor 67 which acts in a switch closing direction is subject to pressure in the vapor space in condenser 13. Bellows motor 68 which acts in a switch opening direction is connected with a thermostatic bulb 72 submerged in liquid refrigerant in condenser 13 and containing a volatile liquid, conveniently of the same composition as the liquid refrigerant, so as to have identical thermal characteristics. A spring 73 gives a moderate opening bias to the switch.

Such a switch will run motor 62 and compressor 19 whenever condenser pressure is out of line with the temperature at which the condenser is operating. The device cannot be arranged for very precise control but is commercially satisfactory.

Precise control, Fig. 6

When comparatively precise control is desired, the control mechanism illustrated in Figure 6 is used in lieu of the parts 66 to 73 inclusive. In Figure 6 only sufficient mechanism is illustrated to make clear how the precise control mechanism is substituted, and parts which are identical with parts in Figure 1 are given the same reference numerals used in Figure 1 but with the distinguishing letter *a*.

A loaded valve 81 is interposed between line 18*a* which is the suction line to the secondary compressor, and the chamber 16*a* which is in free communication with the vapor space in the condenser 13*a* by way of the non-restricting opening 15*a*. The valve 81 is adjusted to produce a small pressure drop between the chamber 16*a* and the suction line 18*a*, the purpose being to ensure that when the secondary compressor is running the suction line 18*a* will be maintained at a pressure below the pressure in the condenser 13*a*.

A drum 82 is in free communication with the chamber 16*a* by way of the pipe 83. It is important that this pipe be large enough to permit free flow. The drum 82 is also connected at its bottom with the liquid space in the condenser

13a by way of the pipe 84. The drum 82 is in restricted communication with the suction line 18a by way of the choke 85 so that when the secondary compressor runs there is retarded flow from the drum 82 to the suction line 18a.

In the drum 82 is a refrigerating surface or coil 86 which must be operated at a temperature below, usually at least 20 to 25 degrees below, the lowest temperature which is ever maintained in the condenser 13a. It is convenient to refrigerate this coil by evaporating liquid refrigerant in the coil, but cold water or brine may be circulated through it.

Details of the supply and return connections to the coil 86 are not illustrated because they would be conventional in any event and are subject to wide variation.

A thermostatic switch of the insertion type is illustrated at 87. The thermally responsive element extends axially through the chamber 82 so as to be subject to the temperature of gaseous medium in that chamber. The thermostatic switch 87 is adjusted to close on fall of temperature to a value below temperature in condenser 13a and preferably only a few degrees above the temperature at which the coil 86 is maintained. The thermostatic switch 87 controls the motor 62a which is the driving motor of the secondary compressor.

Assume now that the motor 62a and the secondary compressor driven thereby are not running. Because the coil 86 is at a lower temperature than the condenser 13a, vaporous refrigerant will enter freely through the pipe 83, condense in the drum 82 and drain through the pipe 84. Whatever the temperature of the coil 86 may be, refrigerant would enter and condense at a rate sufficient to absorb the entire refrigerating effect of the coil. Thus the temperature of gaseous media in drum 82 is that corresponding to the pressure in condenser 13a and nothing happens so long as no air is present. If air be present in the condenser 13a it will enter the drum 82 with the vaporous refrigerant and will accumulate in that drum. Ultimately the concentration of air will become such that little vaporous refrigerant can enter, condensation of refrigerant in drum 82 is reduced, and the coil 86 becomes effective to reduce the temperature of the gaseous media in drum 82. This fall of temperature ultimately causes thermostatic switch 87 to start the motor 62a.

When this happens the secondary compressor will draw vaporous refrigerant and air in substantial quantity through the valve 81 and in limited quantity through the choke 85.

The flow capacity of choke 85, the pressure differential imposed by the valve 81, and the volume of the chamber 82 are so coordinated that the chamber 82 will not be too rapidly swept free of air. If the secondary compressor could draw freely from the drum 82 this drum would be quickly freed of air and the motor 62a would promptly be shut down by the thermostatic switch. The purpose of the choke 85 and the loaded valve 81 is to ensure that air will be drawn from the drum 82, but at a rate so retarded that a purging pump out of sufficient duration will occur.

The reason for the more precise operation of the control shown in Figure 6 will be readily apparent. At those times when the secondary compressor is not operating, the refrigerative effect of coil 86 induces flow of refrigerant and air mixed therewith from the condenser 13a to the drum 82 and since only the refrigerant is condensed in this drum, the air concentration in the drum 82 rises rapidly so that it greatly exceeds the concentration in the drum 13a. Thus the thermostatic switch 87 is rendered sensitive to even a small concentration of air in condenser 13a because this small concentration leads to a much higher concentration in the drum 82. This is not true of the control shown in Figure 1 because the bellows 67 and 68 are directly responsive to conditions in the condenser 13a without any intensification or concentrating effect.

Modified embodiment, Fig. 7

In this figure the control of Figure 6 is shown. Parts identical with Figures 1 and 6 are given the same identifying numeral with the letter *b*.

To operate such a system there must be some means (cold brine or volatile refrigerant) for cooling the coil 24b to a sufficiently low temperature to ensure efficient operation. The secondary compressor 19 is omitted because low temperature implies low pressure in drum 23b. Connection 18b leads directly to purge drum 23b to which flow occurs because the drum is always below condenser pressure.

An electrically operated valve 91 of limited flow capacity controls this connection, is normally closed and opens when winding 93 is excited. The flow of cooling medium through coil 24b is desirably (but not necessarily) controlled by a similar electrically operated valve 92 which is normally closed and opens when winding 94 is excited. An adjustable by-pass 90 permits limited flow past valve 92 when the latter is closed so that coil 24b is never completely inactive. The reduction of flow through coil 24b is simply in the interests of economy. Thermostatic switch 87b closes the circuit through windings 93, 94 when temperature in drum 82b falls below a chosen value. The important function is that valve 91 (and valve 92, if used) shall open when purging is needed, i. e., when temperature in drum 82b falls below a chosen value.

An important relationship is that the total condensing capacity of coil 24b when valve 92 is open shall exceed the flow capacity by way of the valve 91, so that coil 24b when active will cause a decided pressure drop in drum 23b.

The arrangement described is simply a convenient one of several which might be devised by persons skilled in the art to secure the desired result. The control used in Figure 1 is obviously adaptable.

As in the device of Figure 6, valve 81b is set for a moderate pressure drop between condenser 13b and line 18b, and its setting is coordinated with the volume of chamber 82b and flow capacity of choke 85b to ensure properly sustained purging.

Float valve 48b delivers recovered refrigerant directly to evaporator 11b in the preferred arrangement, illustrated. This is practicable for two reasons; the coil 24b is here illustrated as cooled by extraneous means, so the refrigerant need not be fed to that. No oil separator drum such as the part 57 of Figure 1 is here required in view of the omission of the secondary compressor, and the assumed use of a main compressor of the centrifugal type.

Consideration of Figure 7 will indicate that the resistance of the back pressure valve 81b, the flow resistance through connection 18b and valve 91 and the pressure range required for operation of the valves 27b and 25b impose the requirement that the valve 25b must open at some pressure lower than the pressure in the main condenser **13b**.

To ensure a good partial pressure relationship as to air and gas discharging through valve **25b** it is desirable that the coil **24b** operate at a low temperature.

To assume a practical example and without implying any limitation to the values stated, it will be assumed that the condenser **13b** is operated at 10 lbs. per sq. in. gage and the purge valve **25b** opens at approximately 2 lbs. gage. The coil **24b** at whatever low temperature it is operated, should have a condensing capacity so related to the flow capacity of valve **91** for vaporous refrigerant that in the absence of air in drum **23b** a pressure will be established in the purge drum **23b** lower than the opening pressure of valve **25b**, here assumed to be 2 lbs. gage.

Under these conditions if air is present in the condenser **13b** and causes the mechanism in the drum **82b** to open the valves **91** and **92**, air will accumulate in the purge drum **23b**. Thus pressure which would initially be below the setting of the valve **25b** would gradually rise with the increasing concentration of air and the consequently reduced condensing effect of coil **24b** until the valve **25b** would open. This opening would occur only when the air concentration in the drum **23b** is considerable. As a practical matter, the opening of the valve **25b** is intermittent, the opening of the valve serving to reduce the air concentration and its resulting closure initiating a new increase of concentration.

General considerations

The valve **25** in the arrangement of Fig. 1 will also open and close for similar reasons at times. When the compressor **19** starts the air concentration will be high and valve **25** may remain open continuously for a considerable period but in time, and before compressor **19** shuts down, the air concentration will have been reduced so that valve **25** will close and open alternately, the open periods tending to become shorter because the rate of delivery of air to drum **23** diminishes.

Both the embodiments of Figs. 1 and 7 have in common the idea of controllable purging circuits in response to condenser conditions, and the incorporation in the purge circuit of cooling means and a pressure operated purge valve which coact to ensure purging flow at times when the air is present to the practicable maximum and vaporous refrigerant is present only to the practicable minimum in the mixture in drum **23b**.

Two embodiments of the purge circuit and two specifically different control mechanisms have been described, with the idea of illustrating the underlying principles. Various other specifically different arrangements employing the broad principles of the invention can be worked out, so that the specific embodiments herein described in considerable detail should be taken as illustrative and in no sense as limiting. The scope of the invention is defined solely in the claims.

Any purge system is intended to remove from a refrigerative circuit foreign gases, particularly non-condensable gases. In most circuits, air will make up the major portion of any mixture of non-condensable gases likely to be encountered. Consequently, the term "air" is used in the specification and in certain of the claims as typifying the non-condensable gas to be purged.

The invention is not limited to purging air and the claims are not intended to be limited to air, the word "air" being used in a loose sense as typifying any non-condensable gas or mixture of non-condensable gases which might be present in the refrigerative circuit, and the claims should be interpreted on this understanding.

What is claimed is:

1. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a loaded vent valve controlling flow from said drum and set to open when pressure in the drum exceeds a definite value; refrigerative means serving to cool gases in said drum to a temperature which for said refrigerant is substantially lower than that corresponding to said pressure; means for returning condensed refrigerant from said drum to said circuit; means for delivering from the condenser to the drum, at a pressure higher than the setting of said vent valve, vaporous refrigerant, and air when air is present in the condenser; and a controller responsive to the presence of air in the condenser and including a thermally responsive element, said controller serving to control the last named means.

2. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a loaded vent valve controlling flow from said drum and set to open when pressure in the drum exceeds a definite value; refrigerative means serving to cool gases in said drum to a temperature which for said refrigerant is substantially lower than that corresponding to said pressure; means for returning condensed refrigerant from said drum to said circuit; means for delivering from the condenser to the drum, at a pressure higher than the setting of said vent valve, vaporous refrigerant, and air when air is present in the condenser; and means responsive to pressure-temperature relations in the condenser serving to control the last named means.

3. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a loaded vent valve controlling flow from said drum and set to open when pressure in the drum exceeds a definite value; refrigerative means serving to cool gases in said drum to a temperature which for said refrigerant is substantially lower than that corresponding to said pressure; means for returning condensed refrigerant from said drum to said circuit; means for delivering from the condenser to the drum, at a pressure higher than the setting of said vent valve, vaporous refrigerant, and air when air is present in the condenser; and means for creating a vapor-air atmosphere substantially at condenser pressure and in which the air is concentrated by flow from the condenser and condensation of refrigerant vapor therefrom; and temperature responsive means in said atmosphere and connected to control said delivering means.

4. The combination defined in claim 1 in which the delivering means comprises a motor driven compressor controlled by said controller and having its suction connected with the vapor space of the condenser and its discharge connected with the purge drum, and the loaded vent valve is set to maintain the purge drum at a pressure higher than that in the condenser.

5. The combination defined in claim 1 in which the delivering means comprises a motor actuated valve of restricted flow capacity controlled by said controller and interposed between the condenser and the purge drum, and the refrigerative

means operate at a temperature so low that the purge valve is set to open at a pressure lower than condenser pressure.

6. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a loaded vent valve controlling flow from said drum and set to open when pressure in the drum exceeds a definite value; refrigerative means serving to cool gases in said drum to a temperature which for said refrigerant is substantially lower than that corresponding to said pressure; a connection for returning condensed refrigerant from said drum to said circuit; a water separator in said connection; and means for delivering from the condenser to the drum, at a pressure higher than the setting of said vent valve, vaporous refrigerant, and air and water vapor when present in the condenser.

7. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a loaded vent valve controlling flow from said drum and set to open when pressure in the drum exceeds a definite value; refrigerative means serving to cool gases in said drum to a temperature which for said refrigerant is substantially lower than that corresponding to said pressure; a connection for returning condensed refrigerant from said drum to said circuit; a water separator of the gravity type in said connection; an evaporator also in said connection beyond said water separator, and in which refrigerant is evaporated and oil, if present is trapped; and means for delivering from the condenser to the drum, at a pressure higher than the setting of said vent valve, vaporous refrigerant, and air when air is present in the condenser.

8. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a pressure operated vent valve controlling purging flow from said drum and arranged to open when pressure in the drum exceeds a chosen pressure; refrigerating means for cooling gaseous media in said purge drum to temperatures materially below that corresponding to said chosen pressure on the basis of the thermo-dynamic properties of said refrigerant; means for causing vaporous refrigerant, together with water vapor and non-condensable gases when present, to flow from said condenser to said drum; means responsive to the presence of non-condensable gases in said circuit to control the last named means; means for separating condensed water from condensed refrigerant and for withdrawing them separately from said drum; and means for returning such condensed refrigerant to said circuit.

9. The combination defined in claim 8 in which the refrigerative means for cooling the gaseous media in the purge drum comprises an evaporator coil fed at least in part by refrigerant condensed in the purge drum.

10. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; a pressure operated vent valve controlling purging flow from said drum and arranged to open when pressure in the drum exceeds a chosen pressure; refrigerating means for cooling gaseous media in said purge drum to temperatures materially below that corresponding to said chosen pressure on the basis of the thermo-dynamic properties of said refrigerant; means for causing vaporous refrigerant, together with water vapor and non-condensable gases when present, to flow from said condenser to said drum; means responsive to the presence of non-condensable gases in said circuit to control the last named means; means for separating condensed water from condensed refrigerant and withdrawing them separately from said drum, lubricating oil when present from any source flowing from said separating means with the condensed refrigerant, and means for returning such condensed refrigerant to said circuit, said means including an evaporative separator in which the refrigerant is evaporated and the oil so freed from refrigerant is trapped.

11. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; an air-concentrating chamber in free communication with the condenser; means for cooling said chamber to a temperature lower than condensing temperature whereby a tendency toward concentration of non-condensable gases in said chamber is created; a purge device of the refrigerative separator type; and means responsive to the presence of air in the condenser for connecting said air concentrating chamber to said purge device.

12. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a chamber having connections affording free entrance of gases and vapors from the condenser and free drainage of liquid back to the condenser; means for cooling the interior of said chamber to a temperature substantially below condensing temperature; purging means arranged to draw vapors and gases from said condenser and simultaneously to draw them from said chamber at a restricted rate; and a thermostatic controller for said purging means subject to temperature of vaporous and gaseous media in said chamber.

13. The combination of a refrigerative circuit containing a volatile refrigerant and including a condenser; a purge drum; means forming a restricted communication between the condenser and the purge drum; a pressure responsive purge valve controlling flow from said drum and arranged to open at a purge drum pressure lower than condenser pressure; a cooling coil in said drum and operated at a temperature which for the refrigerant in the circuit is decidedly lower than that corresponding to the pressure at which the purge valve opens, said coil having condensing capacity at least sufficient to condense all the refrigerant that can flow to the purge drum through said restricted communication, a valve controlling said restricted communication; and means sensitive to the presence of non-condensable gases in said circuit connected to said valve to actuate the same and arranged to open said valve when non-condensible gases are present in substantial quantity and close it at other times.

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