May 6, 1952 C. THORWID 2,595,995

REFRIGERATING PLANT

Filed Nov. 2, 1949

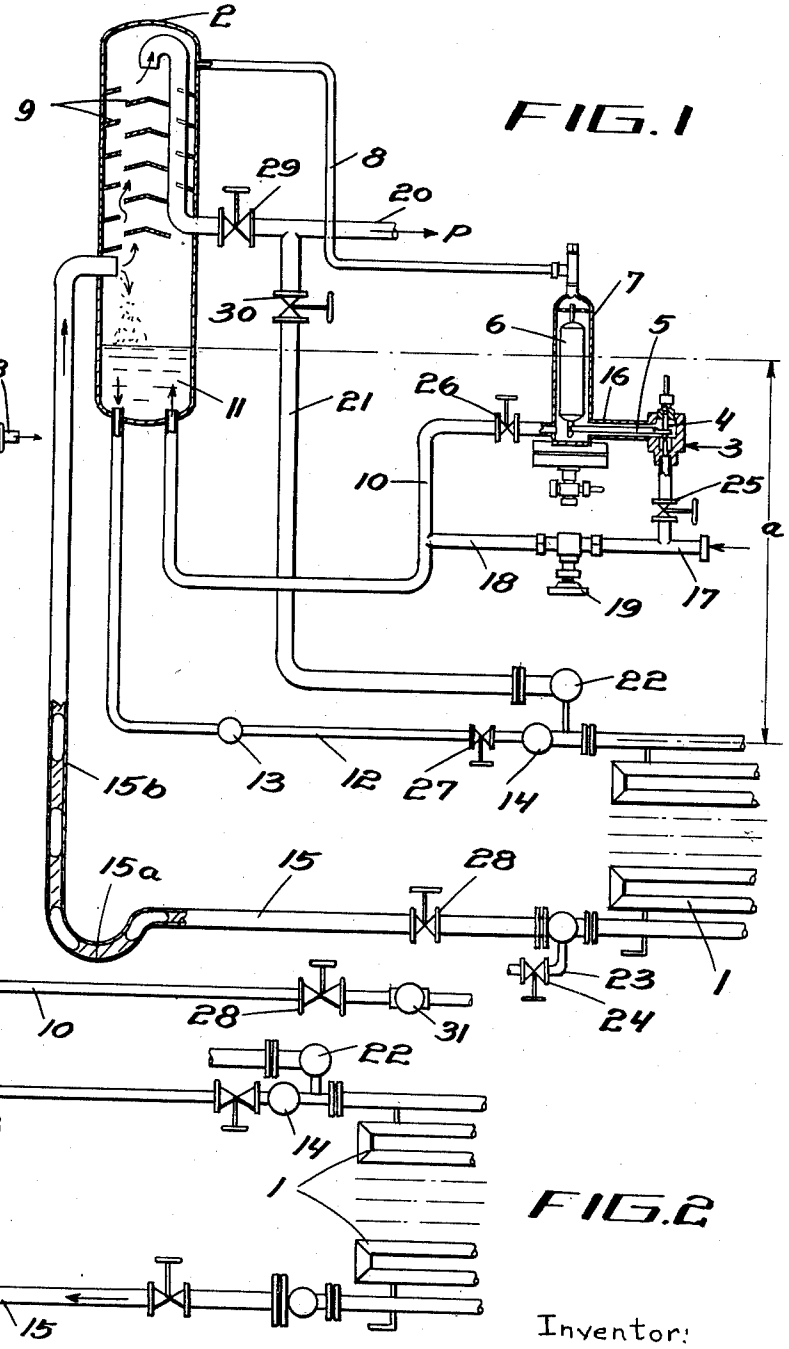


FIG. 1

FIG. 2

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Patented May 6, 1952

2,595,995

UNITED STATES PATENT OFFICE

2,595,995

REFRIGERATING PLANT

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Application November 2, 1949, Serial No. 124,991
In Sweden May 20, 1947

3 Claims. (Cl. 62—126)

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This invention relates to refrigeration plants and more specifically to means for controlling the refrigerant in refrigeration plants of the type comprising a compresser, a condenser and an evaporator for the refrigerant and interconnected through conduits, a reducing valve inserted in the conduit between said compressor and said evaporator, and a receiver suction trap for the refrigerant inserted in the conduit between said evaporator and said compressor. This valve can be an expansion valve controlled by a float provided in a chamber which is in communication with said receiver suction trap. The float is adapted when the level of the liquid refrigerant in the suction trap is raised to reduce the flow area between the valve one and the seat of said expansion valve, and when the level of the liquid refrigerant is lowered to increase said flow area. Both the float chamber and the suction trap are situated at a higher level than the evaporator. The valve, however, could as well be of the type which passes the refrigerant coming from the compressor when in liquid, but not in gaseous state.

The invention has for its object to improve the control of the refrigerant in a refrigeration plant of the type described.

For the object stated, the mainly characterizing feature of the invention resides in that the evaporator is connected at its upper end with the receiver suction trap at the lower end thereof, and that said evaporator is connected at its lower end with said receiver suction trap above the normal level of liquid refrigerant therein. Thereby the advantage is attained that the charge of refrigerant can be reduced to a fraction of the value hitherto necessary. The resistance to flow of the gas in the evaporator (the freezing units) will be highly reduced as compared with hitherto known apparatus, due to the relatively small refrigerant charge. The refrigerant charge is easily received in the condenser of the plant, and the shifting from freezing into thawing operation is easily and rapidly effected. In operation it will be possible to increase or decrease the amount or rate of flow of liquid refrigerant circulated through the evaporation system, and by this expedient a drier or moister consistency of the refrigerant in the evaporator may be obtained. As is well-known, the amount of refrigerant evaporated in unit time is determined by the effective surface of the evaporator, the existing temperature conditions and the suction power of the compressor. Liquid in excess in the evaporator, however, is of advantage, so as to

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assure that the evaporator is wholly utilized and also that the interior surface of the tubes are sufficiently moistened with refrigerant to cause the heat transfer to be satisfactory. The refrigerant in excess will drain through the suction conduit at the lower end of the evaporator. In order to cause the lifting of the surplus of liquid refrigerant up to the suction trap to offer minimum flow resistance to the circulation the suction conduit should be provided with a bend arranged in a manner such that the column of liquid to the suction trap will not be continuous but will be interrupted by non-condensed bubbles of gaseous refrigerant. The overall result will be a maximum refrigerative efficiency of the plant with the use of a minimum amount of refrigerant.

The invention will now be explained more in detail in conjunction with the accompanying drawings illustrating by way of example only two different embodiments of the refrigeration plant according to the inventive concept.

Figure 1 shows one embodiment of the invention in which a float valve is used to feed the refrigerant to the evaporator structure.

Figure 2 shows another embodiment in which a reducing valve is used in the refrigerant feed line.

The compressor and condenser of the plant are not illustrated in the drawings. The evaporator which consists of a number of loops or coils of piping or tubing is indicated at 1, the receiver suction trap at 2 and the expansion valve at 3. According to the embodiment shown in Fig. 1, the valve body 4 of the expansion valve is suspended on one arm of a double-armed lever 5 the other arm of which is pivotally connected to a vertically elongated float 6 which is axially movable in a float chamber 7. The latter is connected at its upper end through a pipe 8 with the upper portion of the receiver suction trap 2 the connection being made above a number of sheet-metal plates or baffles 9 arranged in stagger-fashion in said trap 2. The float chamber 7 communicates at its lower portion through a pipe 10 with the liquid chamber 11 of the suction trap 2. The liquid chamber 11 is connected through a pipe line 12 to the evaporator 1 at the upper portion thereof. In the pipe line 12 there is inserted a non-return valve 13 and a distributing valve 14 by which the refrigerant is equally distributed to the various co-planar coils of piping or tubing of the evaporator 1. The evaporator 1 is connected at its lower portion through a pipe line 15 to the suction trap 2. This pipe line is

formed with what might be termed a "bag," i. e. a bend 15*a*, which serves the purpose of preventing the forming of a continuous liquid column in the vertical portion 15*b* of pipe line 15. As indicated in the drawing, the liquid in pipe line portion 15*b* will be interrupted by gas bubbles. The expansion valve 3 is inserted in a pipe line 16 which is connected to the supply line 17 for refrigerant from the compressor. The arm 5 of the double-armed lever is pivotally mounted in the pipe line 16. The lines 17 and 10 are interconnected by a direct or by-pass conduit 18 in which is inserted a stop valve 19. The receiver suction trap 2 is connected to the compressor through a pipe line 20 which enters the trap above the plates or baffles 9. The line 20 is connected to the evaporator 1 through a pipe line 21 containing a distributing valve 22 of a construction substantially similar to that of the distributing valve 14. The evaporator 1 is connected at its lower portion to the condenser through a pipe line 23 in which is inserted a stop valve 24. The receiver suction trap 2, expansion valve 3 and float chamber 7 are situated at a higher level than the evaporator 1. The level difference is indicated at *a*.

The plant comprises, in addition, a number of stop valves illustrated at 25, 26, 27, 28, 29 and 30.

Before starting the compressor, the valves 25, 26, 27, distributing valve 14, and valves 28 and 29 are opened. Valves 19, 24 and 30 thus remain closed. The refrigerant flows from the condenser through conduit 17, expansion valve 3, conduit 16, float chamber 7, conduit 10, the liquid chamber 11 of receiver suction trap 2, conduit 12, distributing valve 14, evaporator 1, conduit 15 and into the gas chamber of suction trap 2. The refrigerant is vaporized in the evaporator 1, and at first only gas flows into the suction trap 2, passing in zigzag-fashion between the plates or baffles 9 and draining through pipe 20 to the compressor. Since, on starting the plant, the float 6 is in its lower position the expansion valve 3 is then wide open. This will cause this valve to pass refrigerant in excess. After a period of operation, however, the evaporator will be incapable of vaporizing the whole amount of refrigerant passing therethrough, whereby a portion of this refrigerant will enter the receiver suction trap 2 in liquid state. This will cause the level of the liquid refrigerant in the liquid chamber 11 to rise, and as a consequence the float 6 also will be raised causing the flow area of expansion valve 3 to be reduced. Thus the amount of refrigerant flowing into said chamber will be decreased, and the liquid refrigerant level will adjust itself into an average position depending on the degree of vaporization of the refrigerant in the evaporator 1.

When the evaporator is to be defrosted, the suction line and pressure line connected to the compressor are changed so that when the evaporator is to be defrosted the line 20 will conduct warm gas from the compressor to the evaporator. To accomplish this the valves 25, 28 and 29 are closed, and so is the valve 27, if required. The valves 24 and 30 are opened. The line 20 is now connected in such a manner that refrigerant will flow in a direction opposite to that indicated by the arrow P since, when valve 29 is closed and valve 30 is open the warm gas bypasses valve 29 and goes through valve 30, through the evaporator back to the condenser. The refrigerant will thus flow through conduit 21 and distributing valve 22 into evaporator 1 from which it is drained to the condenser through conduit 23.

In the plant illustrated in Fig. 2 the expansion valve has been replaced by a reducing valve 31 which functions as a usual high pressure float valve, i. e. it permits the passing of liquid but not gas through the valve. The conduit 10 from the valve 31 empties in a funnel 32 at the upper end of the conduit 12 to the distributing valve 14. Control of the amount of refrigerant flowing to the evaporator can be effected by means of the distributing valve 14. Thus in this case no float responsive to the liquid level in the suction trap for controlling the operation of the reducing valve will be necessary.

It will be understood that the embodiments described and illustrated are to be considered as examples only, and that the various components of the plant can be constructively varied in many different ways without departing from the inventive concept. Thus, for instance, the float 6 (Fig. 1) might as well be arranged within the receiver suction trap 2 instead of in a separate float chamber 7. Also, the evaporator might be a so-called tubular evaporator for cooling of brine or other liquids in which the refrigerant is cooling the tubes of the evaporator from the outside through direct expansion, the tubes being enclosed in a shell. The liquid is sprayed onto the outer surface of the tubes and the surplus liquid together with the gas formed in the evaporator pass through a bend in the conduit from the lower part of the evaporator to the receiver suction trap above the normal level of the liquid in the same.

What I claim is:

1. A refrigeration plant comprising the combination of an evaporator for the refrigerant, a reducing valve inserted in a conduit for the refrigerant to the evaporator, and a receiver suction trap for the refrigerant inserted in a conduit from the evaporator, said suction trap being disposed at a higher level than said evaporator, said evaporator being connected at its upper end with said receiver suction trap at the lower end thereof, and said evaporator being connected at its lower end with said receiver suction trap above the normal level of liquid refrigerant therein, said conduit connecting the lower portion of said evaporator with said receiver suction trap being provided with a bend said bend being adapted to prevent the formation of a continuous liquid column in a vertically extending portion of said conduit.

2. A refrigeration plant comprising the combination of an evaporator for the refrigerant, a receiver suction trap for the refrigerant inserted in a conduit from the evaporator, and an expansion valve in a conduit for leading liquid refrigerant to said evaporator through said suction trap, and float means for operating said valve, said float means being arranged in such a manner that the flow area between the valve cone and the seat of said expansion valve decreases when the level of the liquid refrigerant in said suction trap raises, and increases when the level of the liquid refrigerant in said suction trap lowers, said suction trap being disposed at a higher level than said evaporator, said evaporator being connected at its upper end with said receiver suction trap at the lower end thereof, and said evaporator being connected at its lower end with said receiver suction trap above the normal level of liquid refrigerant therein, said

conduit connecting the lower portion of said evaporator with said receiver suction trap being provided with a bend, said bend being adapted to prevent the formation of a continuous liquid column in a vertically extending portion of said conduit.

3. A refrigeration plant comprising the combination of an evaporator for the refrigerant, a reducing valve inserted in a conduit for the refrigerant to the evaporator, a receiver suction trap for the refrigerant inserted in a conduit from the evaporator and a valve inserted in a conduit between said suction trap and said evaporator, said valve being capable of leading refrigerant only in the direction of the evaporator, said suction trap being disposed at a higher level than said evaporator, said evaporator being connected at its upper end with said receiver suction trap at the lower end thereof, and said evaporator being connected at its lower end with said receiver suction trap above the normal level of liquid refrigerant therein, said conduit connecting the lower portion of said evaporator with said receiver suction trap being provided with a bend, said bend being adapted to prevent the formation of a continuous liquid column in a vertically extending portion of said conduit.

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