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APPARATUS FOR CONTROLLING REFRIGERANT FLOW

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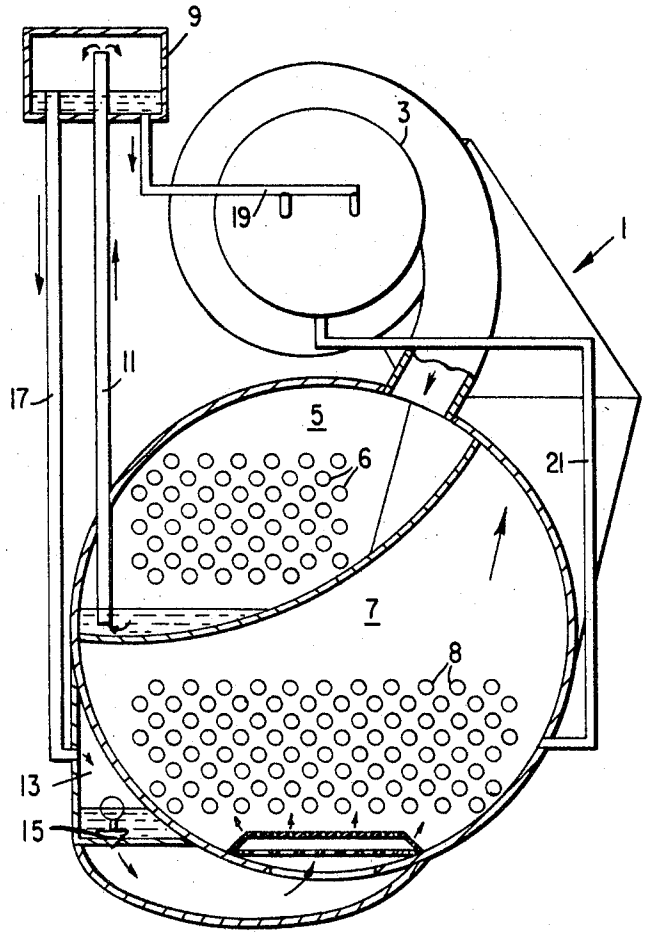

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APPARATUS FOR CONTROLLING REFRIGERANT FLOW

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ABSTRACT OF THE DISCLOSURE

An apparatus to lift liquid refrigerant to a location above the motor-compressor in a refrigeration machine to assure a supply of refrigerant to the motor for cooling thereof in a system wherein the motor-compressor is disposed above the refrigerant condenser.

This invention relates to a refrigeration machine. More particularly this invention relates to refrigerant flow in a refrigeration machine. Still more particularly, this invention relates to a refrigeration machine with provisions for supplying refrigerant to the refrigerant compressor motor to provide cooling thereof.

In a centrifugal refrigeration machine driven by an electric motor, it is desirable to utilize refrigerant to cool the motor to prevent overheating thereof. Numerous methods have been devised to provide a supply of refrigerant to the motor. One of the most economical and simplest methods is to provide a liquid refrigerant supply line between the motor and the refrigerant condenser and a gaseous refrigerant return line from the motor to the evaporator. Under normal operating conditions, the pressure differential existing between the condenser and evaporator is sufficient to provide adequate flow of refrigerant through the motor for cooling. However, at start-up or under abnormal operating conditions wherein there is a low pressure differential between the high and low sides of the machine, an insufficient flow of refrigerant to the motor results causing overheating thereof.

It is therefore the chief object of this invention to provide an improved refrigerant flow control means for a refrigeration machine.

It is another object of this invention to provide a refrigerant flow control means for a refrigeration machine which will maintain a sufficient pressure differential between the high and low pressure sides thereof to insure an adequate refrigerant supply to the motor for cooling thereof.

It is a further object of this invention to provide a method for controlling the flow of refrigerant in a refrigeration machine.

The objects of this invention are attained by providing a motor driven refrigeration machine with a refrigerant collecting chamber disposed above the drive motor with a standpipe communicating between the collecting chamber and a low portion of the high pressure side of the system so that liquid refrigerant will be forced into the collecting chamber under normal operating conditions. A refrigerant line between the collecting chamber and the motor provides refrigerant to the motor for cooling. Means are provided for maintaining a relatively constant refrigerant level in the collection chamber and for metering liquid refrigerant to the low side of the refrigeration machine.

Other objects and features of my invention will be apparent upon a consideration of the ensuing specification and drawing in which the figure is a schematic view having portions thereof in section of a motor driven centrifugal refrigeration machine employing the flow control apparatus of my invention.

Referring more particularly to the drawing, there is shown a refrigeration machine 1 similar to the machine disclosed in U.S. Letters Patent No. 3,270,517 issued Sept. 16, 1966 to W. E. Clark, having a motor-compressor 3, a condenser 5 and an evaporator 7. A refrigerant collection chamber 9 is in communication with condenser 5 by means of standpipe 11. A refrigerant metering chamber 13 having a float valve 15 therein is provided for regulating the flow of refrigerant into evaporator 7. Refrigerant is supplied to metering chamber 13 from collecting chamber 9 through drain line 17. A tube bundle 6 is provided in condenser 5 for passing a heat exchange medium therethrough such as water from a cooling tower (not shown) to cool the compressed refrigerant from motor-compressor 3 causing it to condense and collect in the form of a pool in the bottom of condenser 5. A tube bundle 8 in evaporator 7 is provided for passing the medium to be cooled in heat transfer relation with the refrigerant expanded through valve 15.

A motor cooling refrigerant supply line 19 provides liquid refrigerant from chamber 9 to the motor-compressor for cooling the motor. The refrigerant in the motor, after absorbing the heat from the motor, is drained therefrom through motor cooling refrigerant drain line 21 to evaporator 7.

For a description of refrigerant distribution within the motor, reference may be had to U.S. Letters Patent No. 3,241,331 issued Mar. 22, 1966 to J. W. Endress et al.

The location of the refrigerant lines 17 and 19 in chamber 9 is important for the correct functioning of the disclosed refrigeration apparatus. The end of line 17 is disposed in chamber 9 at a level corresponding to the desired level of refrigerant therein. The end of line 19 is located below the end of line 17. With this arrangement under normal operating conditions, the pressure differential between the high and low pressure sides of the machine will cause liquid refrigerant to rise in standpipe 11 and spill into chamber 9. Stated another way, under normal operating conditions, the condenser is under a relatively high pressure. The pressure in chamber 9 is somewhat lower than condenser pressure due to the fact that the chamber is in communication with the low pressure evaporator by way of line 17 and refrigerant metering valve 15 and through the motor cooling circuit comprised of line 19, the motor 3 and line 21. Since there is a higher pressure on the pool of refrigerant in the condenser than there is at the top of standpipe 11, condenser pressure will force refrigerant liquid up standpipe 11 into chamber 9. Only a small portion of the refrigerant supplied to chamber 9 through standpipe 11 will pass through line 19, causing the refrigerant level to rise to the top of line 17. Since line 17 is large enough to pass as much refrigerant as standpipe 11, excess refrigerant will continuously drain therethrough and the refrigerant level in chamber 9 will remain relatively stable.

As can be seen from the foregoing, in the event of a temporary abnormal operating condition of the refrigeration machine resulting in a pressure differential insufficient to raise refrigerant to the level of the chamber 9, the liquid refrigerant level in condenser 5 will rise and due to the termination of flow of liquid refrigerant to chamber 13, valve 15 will close.

Under these conditions, the liquid refrigerant in the condenser will flood tubes and increase the condensing temperature while the simultaneous removal of refrigerant from the evaporator by the compressor in the absence of a refrigerant supply thereof will lower evaporator pressure, thereby increasing the system pressure differential to the desired minimum level.

The foregoing description of my invention has been based on a low pressure refrigeration machine. If this in-

vention were to be applied to a high pressure refrigeration machine, it would be desirable to add a pressure reducing valve in line 11 so as to minimize the height of the standpipe which would be necessary to balance the machine pressures.

While I have described a preferred embodiment of my invention, it is to be understood that the invention is not limited thereto but may be otherwise embodied within the scope of the following claims.

I claim:

1. A refrigerant flow control apparatus for a motor-compressor refrigeration machine having the motor-compressor located above the condenser comprising:

a refrigerant collecting chamber disposed above the condenser and motor-compressor;

a standpipe communicating between said collecting chamber and a low portion of the high pressure side of the system;

fixed means for maintaining a relatively constant refrigerant level in said collecting chamber; and

a refrigerant line communicating between a low point in said collecting chamber and the refrigerant compressor motor to provide refrigerant thereto for cooling thereof.

2. A refrigerant control apparatus according to claim 1 further including a refrigerant metering chamber disposed between the high and low pressure sides of the refrigerant machine; and

refrigerant metering means for regulating flow of refrigerant from said metering chamber to the low pressure side of the refrigerant machine;

said fixed means for maintaining a relatively constant level of refrigerant in said collecting chamber comprising a refrigerant drain line communicating between said refrigerant metering chamber and a location in said collection chamber corresponding to the desired level of collected refrigerant therein.

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MEYER PERLIN, *Primary Examiner.*