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REFRIGERANT FLOW CONTROL FOR MAINTAINING MINIMUM HEAD

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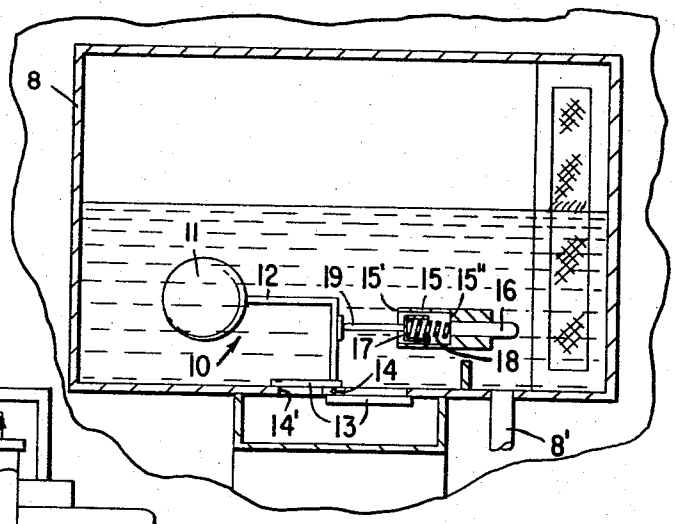
FIG. 2



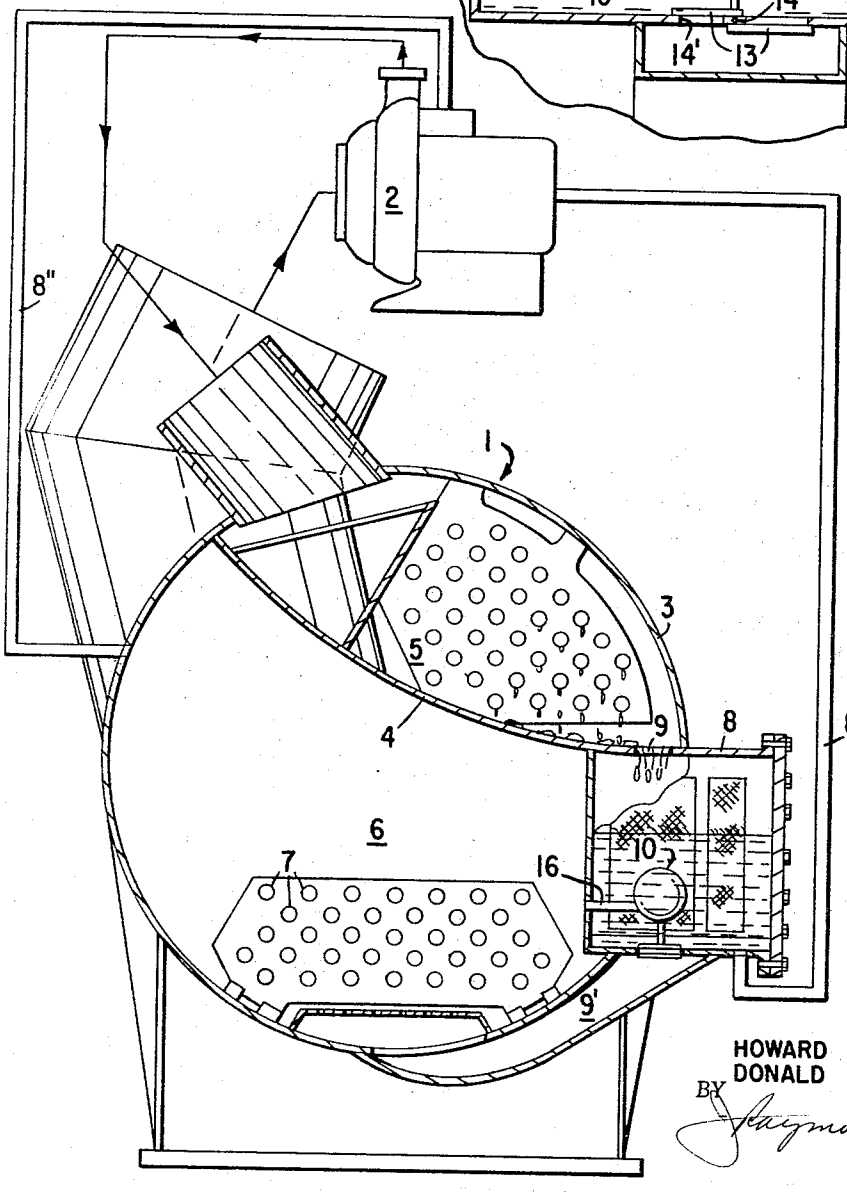


FIG. 1

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REFRIGERANT FLOW CONTROL FOR MAINTAINING MINIMUM HEAD

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This invention relates broadly to a refrigeration machine. More particularly, this invention relates to the control of refrigerant flow in a refrigeration machine. Still more particularly, this invention relates to a liquid refrigerant metering device particularly equipped to provide a rapid refrigerant pressure increase in the high pressure side of a refrigeration machine at start up and to maintain minimum pressure therein under abnormal conditions.

In high tonnage refrigeration machines, a compressor is arranged to extract gaseous refrigerant from an evaporator, compress the refrigerant, and pump it to a condenser where it is cooled and condensed. In communication with the condenser, there is normally provided a receiver for collecting liquid refrigerant formed in the condenser prior to its passage to the evaporator. The receiver usually contains refrigerant both in the liquid and gaseous phases. In some instances, a portion of the liquid refrigerant is utilized to cool the motor driving the refrigerant compressor. To insure sufficient refrigerant flow to the motor being cooled, a minimum refrigerant pressure differential in the machine is required.

To maintain a liquid seal in the receiver, a metering device is employed to regulate refrigerant flow from the condenser or receiver to the evaporator. Under normal operating conditions, the level of the liquid refrigerant collected in the receiver is a function of the pressure difference between the high pressure side of the machine and the low pressure side of the machine and the load on the machine, it being understood the condenser is disposed in the high pressure side and the evaporator in the low pressure side of the machine. Refrigerant flow from the condenser to the evaporator occurs in an amount related to the loading on the machine and automatic controls such as suction guide vanes are provided for the purpose of maintaining flow rates corresponding to machine loading. Float operated valve assemblies are provided to pass a predetermined amount of refrigerant in accordance with the level of liquid refrigerant collected to maintain a liquid seal in the receiver.

The liquid from the receiver is passed through the metering device to the evaporator. The evaporator contains a multiplicity of tubes usually referred to as a tube bundle through which the medium to be cooled is passed in heat transfer relation with the refrigerant in the evaporator.

Under normal operating conditions, the pressure in the refrigeration machine is sufficient to force the desired quantity of liquid refrigerant from the receiver or condenser to the refrigerant compressor motor to provide proper cooling thereof. However, at start up or under abnormal operating conditions, the pressure difference between the receiver or condenser and the motor casing may be insufficient to force the required liquid refrigerant to the compressor motor.

The chief object of this invention is to provide a refrigerant control device which will provide for rapid pressure increase in the high pressure side of the machine when it is started and maintain a minimum pressure difference therein under abnormal operating conditions. It is an additional object of this invention to provide a refrigerant control device which will maintain a liquid seal in the receiver under normal operating conditions. Another

object of this invention is to provide an improved method for controlling refrigerant flow in a refrigeration machine between the high pressure and the low pressure sides thereof.

The objects of this invention are attained by providing a cylinder having one end in communication with the interior of the receiver. A control line is provided between the other end of the cylinder and the evaporator. A piston disposed within the cylinder is operably connected to a refrigerant metering float valve assembly through a push rod. A spring in the cylinder biases the piston and push rod against the refrigerant metering float valve assembly to maintain the valve closed until a sufficient pressure differential is built up between the evaporator and condenser or receiver to overcome the spring force and move the piston with the push rod attached, out of engagement with the float valve.

Other objects and features of this invention will be apparent upon consideration of the ensuing specification and drawing in which:

FIGURE 1 is an elevational view partially in section of a portion of a refrigeration machine incorporating the preferred embodiment of the refrigerant float control mechanism forming the subject of this invention.

FIGURE 2 is a fragmentary view, partly in section, of the receiver portion of the refrigeration machine illustrating the float valve and regulating mechanism.

Referring more particularly to the drawing, there is shown a centrifugal refrigeration machine **1** for cooling a relatively large quantity of water for flow in a closed circuit forming a part of an air conditioning plant. The machine **1**, having motor driven refrigerant compressor **2**, includes shell **3** for housing the heat transfer units associated with the machine. The shell **3** has a partition **4** therein for separating the high pressure condenser section **5** from the low pressure evaporator section **6**. Tube bundle **7** in evaporator section **6** is provided for passing the water to be chilled therethrough. Lines **8'** and **8''** provide a path of flow for a portion of the liquid refrigerant formed in the condenser through the motor compressor to cool the motor.

Refrigerant receiver or float box **8** is provided for receiving gaseous and liquid refrigerant from the condenser through an opening **9** communicating therewith. Float valve assembly **10** in float box **8** is provided for metering refrigerant from the float box to the evaporator section **6** through passageway **9'**. The float valve assembly **10** comprises float ball **11**, float arm **12**, and throttle plates **13**. The float valve assembly is pivoted on pin **14** mounted in the sides of an opening **14'** in the floor of the box. A cylinder **15** is provided in the float box having one end **15'** thereof in communication with the interior of float box **8** and the other end **15''** in communication with evaporator **6** through control line **16**. A piston **17** in cylinder **15** is biased toward the end **15'** of cylinder **15** by spring **18**. Push rod **19** solidly affixed to piston **17** is provided to hold float valve assembly **10** closed to prevent communication between the high pressure side of the machine and the low pressure side of the machine when the piston **17** is displaced toward the end **15'** of cylinder **15**.

Considering the operation of this refrigerant metering device under normal operating conditions, the pressure differential between the condenser and evaporator will be sufficient to overcome the force of spring **18** and displace piston **17** toward the end of cylinder **15** in communication with the evaporator. Push rod **19**, therefore, will not interfere with the normal operation of float valve assembly **10**. As such, float valve assembly **10** will maintain a constant liquid refrigerant level in float box **8**.

At start up or under abnormal operating conditions when the pressure between the condenser and evaporator is at or below the desired minimum difference, spring **18**

will force piston **17** with push rod **19** attached against float valve arm **12** to maintain valve **10** closed until the pressure differential between the evaporator and condenser exceeds the desired minimum.

This will insure a pressure differential under most operating conditions sufficient to provide liquid refrigerant flow to the refrigerant compressor motor so that the motor is properly cooled.

While we have described a preferred embodiment of our 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.

We claim:

1. A refrigerant metering device disposed in the high pressure side of a refrigeration machine for controlling flow of refrigerant to the low pressure side of the machine comprising:

a float valve assembly operable in response to liquid refrigerant level in the high pressure side of the machine to pass refrigerant to the evaporator, and

actuator means operable in response to a predetermined refrigerant pressure difference between the high pressure and low pressure sides of the machine to maintain said float valve closed irrespective of refrigerant level in the high pressure side of the machine.

2. A refrigerant metering device according to claim **1** wherein said actuator means comprises:

a pneumatic cylinder in the high pressure side of the machine having one end in communication with the high pressure side of the machine and the other end in communication with the evaporator of the refrigeration machine,

a piston slidably disposed in said cylinder,

a spring biasing said piston away from the end of the cylinder in communication with the evaporator, a push rod solidly affixed to said piston between the float valve and said piston to hold said float valve closed irrespective of the refrigerant level in the high pressure side of the machine when said piston is displaced in a direction away from the end of the cylinder in communication with the evaporator.

3. The method of controlling refrigerant flow in a refrigeration machine which consists in the steps of

regulating a passage of liquid refrigerant from the high pressure side of the machine to the low pressure side of the machine by mechanism operable in response to the level of liquid refrigerant collected in the high pressure side of the machine, and

overriding the action of said mechanism when the pressure differential between the high pressure and low pressure sides of the machine is below a desired minimum to hold said mechanism closed until the desired minimum pressure differential is attained.

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