Sept. 3, 1968 W. T. OSBORNE 3,399,544

REFRIGERATION SYSTEM WITH HIGH SIDE FLOAT

Filed April 19, 1967

FIG. 1

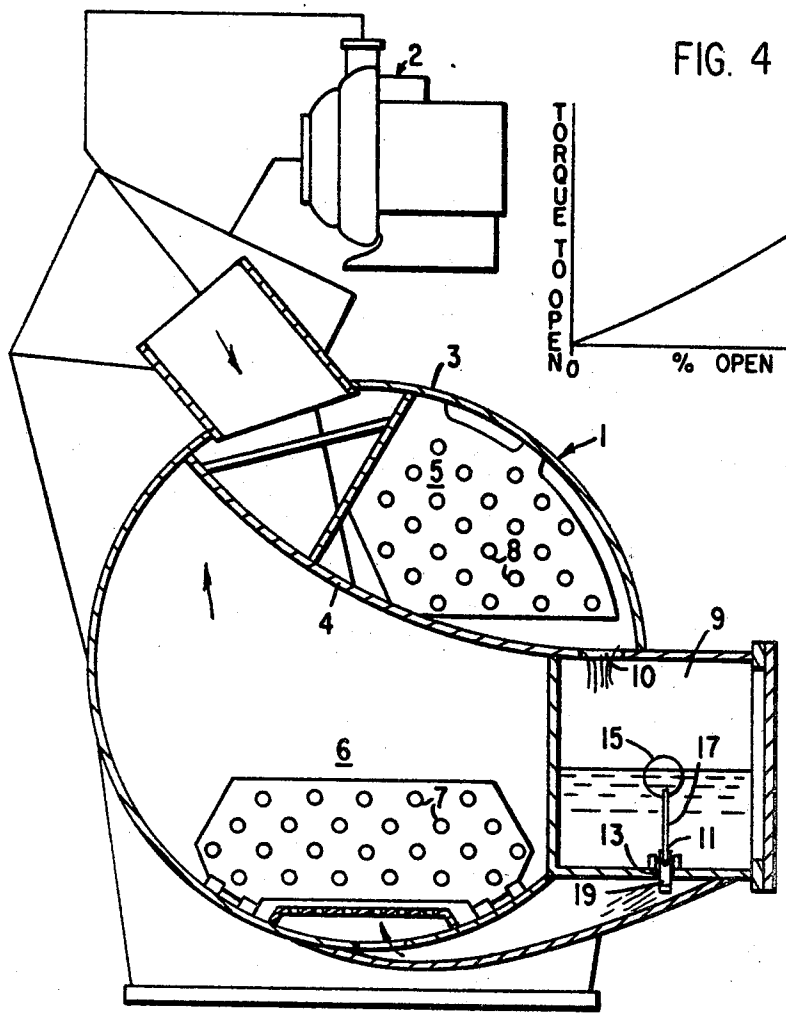

FIG. 4

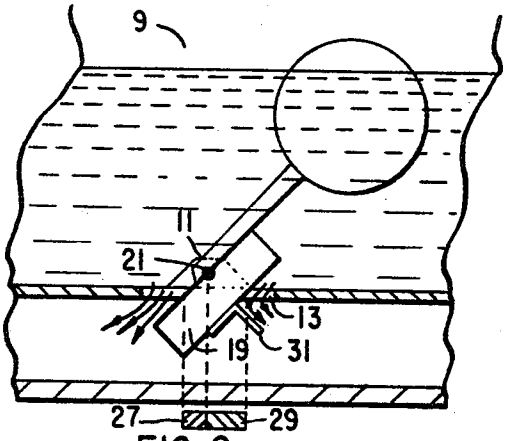

FIG. 2

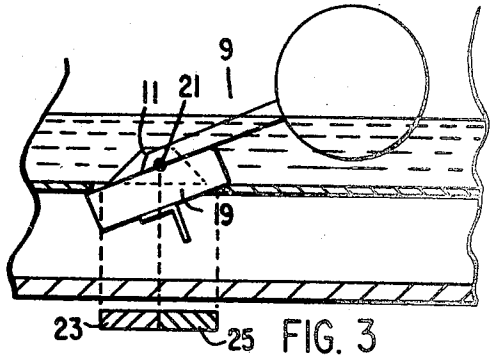

FIG. 3

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REFRIGERATION SYSTEM WITH HIGH SIDE FLOAT

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ABSTRACT OF THE DISCLOSURE

A refrigeration system employing a stabilized refrigerant valve to regulate flow of refrigerant from the high to the low side of the system. The refrigerant valve is provided with a pressure bias and a dynamic bias to prevent unstable operation thereof.

Background of the invention

This invention relates to refrigeration systems and more particularly to a refrigeration system employing a float valve to regulate refrigerant flow therein and provide a liquid seal between the high and low sides of the system. Balanced valves have been used for this purpose to reduce the necessary operating torques on the valve to a minimum.

During actual operation, it has been found that these valves are subject to unpredictable dynamic forces, especially when operating under conditions of high flow rates or large pressure drops. Consequently, the valve becomes unstable which in turn produces loss of chilled water temperature control, surging, and danger of freeze-up. In some instances, the unknown, unexpected forces on the valve are sufficient to swing the valve wide open, lifting the float ball completely out of the refrigerant or to slam the valve shut, thereby submerging the float ball in the refrigerant.

Summary of the invention

In accordance with a preferred embodiment of this invention, a refrigerant metering valve having a pressure bias and a dynamic bias is provided for a refrigeration system having a high pressure side including a compressor and condenser, a low pressure side including an evaporator and means forming an opening between the high and low pressure sides of the system. A valve plate is pivoted above the plane of said opening and operably associated therewith so that the forces acting on the plate are substantially balanced when the plate is in a closed position and resultant closing force is present on the plate when it is pivoted toward open position. A bias plate is attached to the underside of the valve plate to provide a dynamic closing bias on the plate to prevent instability thereof. The valve plate is also provided with a float and float arm for positioning the plate in response to the level of liquid refrigerant on the high side of the machine.

Brief description of the drawing

FIGURE 1 is an elevational view partially in section of a refrigeration machine with portions of the refrigerant piping shown schematically;

FIGURE 2 is an elevational view in section of the refrigerant float valve in open position;

FIGURE 3 is an elevational view in section of the refrigerant float valve in closed position; and

FIGURE 4 is a graph of the torque necessary to open the valve versus the percent of valve open illustrating the increasing closing torque on the valve at high refrigerant flow rates therethrough.

Description of the preferred embodiment

Referring more particularly to the drawing there is shown a centrifugal refrigeration machine **1** for cooling a large quantity of water. Refrigeration machines of this type are employed to cool water flowing within a closed circuit forming a part of an air conditioning installation. The machine **1** having a refrigerant motor compressor **2** includes a shell **3** for housing the heat transfer units (evaporator and condenser) 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**. A tube bundle **7** in evaporator section **6** is provided for passing the water to be chilled therethrough.

A tube bundle **8** in the condenser section **5** is provided for passing cooling water therethrough from a suitable source such as a cooling tower, not shown, to condense the compressed refrigerant in condenser section **5**. A refrigerant receiver or float box **9** is provided for receiving gaseous and liquid refrigerant from the condenser through passageway **10** communicating therewith. Float valve assembly **11** in float box **9** is provided for metering refrigerant from the float box to the evaporator section **6** through opening **13**. The float valve assembly **11** comprises a float ball **15**, a float arm **17** and a valve plate **19**. The float valve assembly is pivoted on pin **21** which is disposed in a plane above the plane of opening **13** for reasons to be hereinafter explained.

Considering the operation of the refrigeration system, the float valve assembly will operate to maintain a liquid seal in float box **9** under all normal operating conditions. Under low load conditions, a small quantity of refrigerant will flow to the float box **9** causing the refrigerant level therein to drop. The float will therefore hold valve plate **19** in a substantially closed position to provide minimal flow of refrigerant to the evaporator. Under these conditions, a relative stable refrigerant flow is encountered. As can be seen from FIGURE 3, when the float valve assembly **11** is in a substantially closed position the pressure differential across opening **13** acts on equal projected plate areas **23** and **25** and thereby creates opposing torques about pivot pin **21** which are substantially equal resulting in a substantially balanced valve under low load conditions.

Under high load conditions, a large quantity of refrigerant will be provided to float box **9** causing the refrigerant level therein to rise and open the float assembly to pass a greater quantity of refrigerant through opening **13**. Due to the large quantity of refrigerant liquid flowing through opening **13** at very high velocity, unpredictable dynamic forces are created which normally cause a float valve assembly to be extremely unstable. Referring to FIGURE 2 which illustrates the float assembly **11** in a substantially open position, it can be seen that the pressure differential across opening **13** acts on unequal protected plate areas **27** and **29** and thereby creates opposing torques about pivot pin **21** which are unequal. This causes a resultant closing torque on said valve plate **19** in opposition to the opening force exerted thereon by float arm **17** and float **15**, thereby stabilizing the valve. The bias plate **31** which is attached to the underside of plate **19** is acted upon by the stream of refrigerant flowing through opening **13** causing a greater closing force to be exerted on the plate **19**. The graph of FIGURE 4 illustrates the increasing torque necessary to open the valve as the percent of valve opening increases in response to the pressure inbalance on the valve plate and the force exerted on the bias plate.

The valve of my invention, which is subjected to a closing bias when it is in the open position has extremely stable control characteristics. Furthermore, by converting the normally random, unpredictable, reversible dynamic forces which exist due to large high velocity flow rates

through the valve into directed, non-reversible, predictable bias forces, a valve is provided which has the additional feature of control reliability.

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

I claim:

1. In a refrigeration system, the combination of a high pressure side including a compressor and a condenser, a low pressure side including an evaporator,

means forming an opening between the high and low pressure sides of the system,

a valve plate associated with said opening, movable between closed position and an open position for regulating refrigerant flow therethrough,

pivot means disposed above the plane of said opening, and mounting said valve plate so that the forces acting on said plate are substantially balanced when said plate is in a closed position and a resultant closing force is present on said plate when it is pivoted toward open position,

a float, operably associated with said plate to position said plate in response to the level of liquid refrigerant on the high side of the machine,

and bias means to provide a dynamic closing bias on said plate to prevent instability thereof.

2. In a refrigeration system, the combination according to claim 1 wherein said bias means comprises a bias plate, affixed to the underside of said valve plate, substantially perpendicular to the plane of said valve plate, the refrigerant flowing through said opening impinging thereon and exerting a closing force on said valve plate.

3. A refrigerant valve for regulating the flow of refrigerant through an opening between the high and low pressure sides of a refrigeration machine comprising:

a valve plate associated with said opening, movable between closed position and an open position for metering refrigerant therethrough,

pivot means disposed above the plane of said opening, operably associated with said valve plate so that the forces acting on said plate are substantially balanced when said plate is in a closed position and a resultant closing force is present on said plate when it is pivoted toward open position,

a float, operably associated with said plate to position said plate in response to the level of liquid refrigerant on the high side of the machine,

and bias means to provide a dynamic closing bias on said plate to prevent instability thereof.

4. A refrigerant valve according to claim 3 wherein said bias means comprises a bias plate, affixed to the underside of said valve plate substantially perpendicular to the plane of said valve plate, the refrigerant flowing through said opening impinging thereon and exerting a closing force on said valve plate.

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