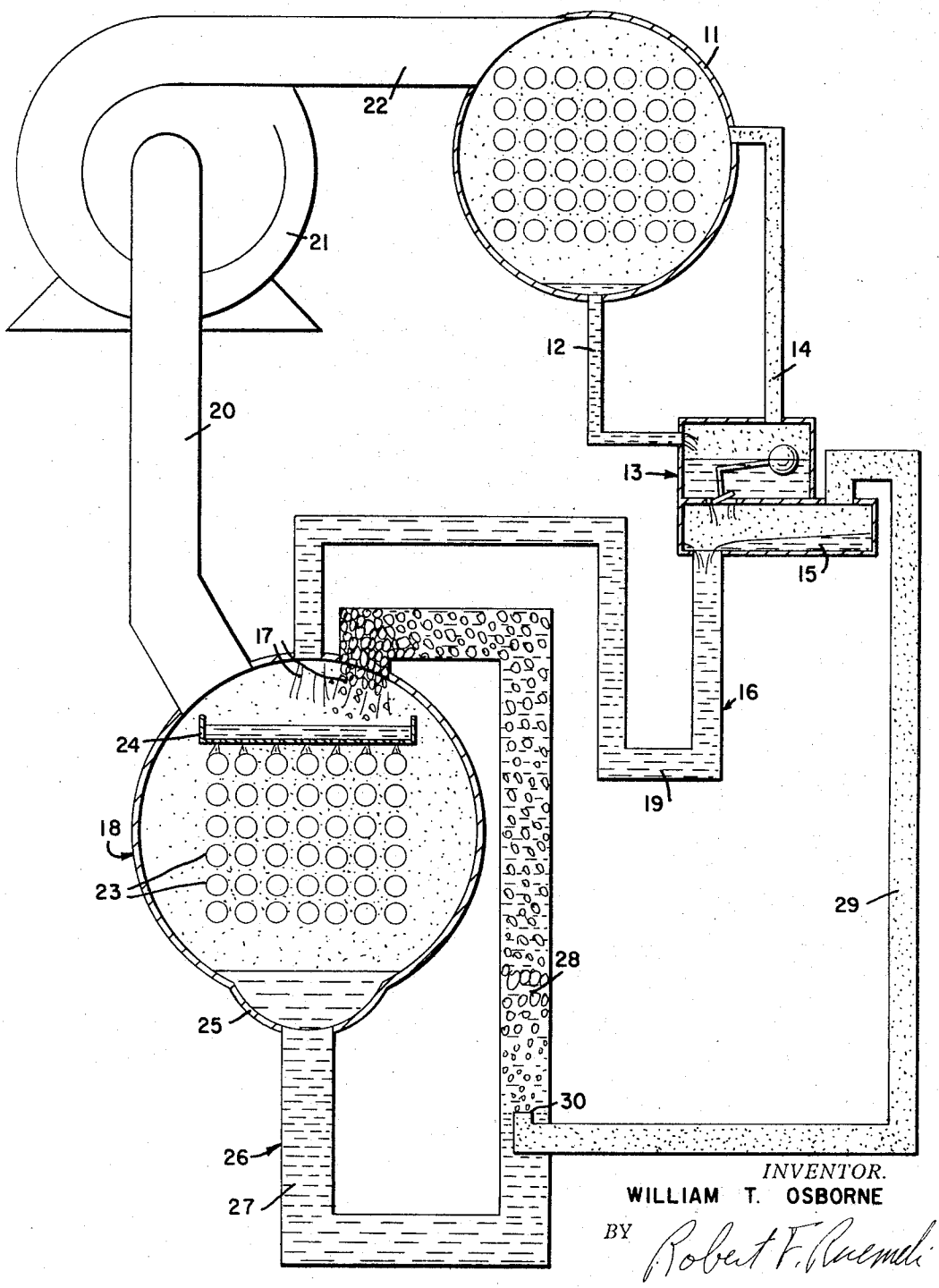
Jan. 24, 1967 W. T. OSBORNE 3,299,653

REFRIGERATION SYSTEM

Filed Oct. 20, 1965



INVENTOR.

WILLIAM T. OSBORNE

BY Robert F. Ruemli

ATTORNEY.

United States Patent Office 3,299,653 Patented Jan. 24, 1967

3,299,653

REFRIGERATION SYSTEM

William T. Osborne, Syracuse, N.Y., assignor to Carrier Corporation, Syracuse, N.Y., a corporation of Delaware

Filed Oct. 20, 1965, Ser. No. 498,815
4 Claims. (Cl. 62—115)

This invention relates to a refrigeration system and to a method of operating a refrigeration system and, more particularly, to recirculating residual liquid refrigerant through an evaporator by utilizing flash gas in the system.

In various types of evaporators such as those having tube bundles over which refrigerant is sprayed or dripped, or through which refrigerant is pumped, for example, some means is usually required for recirculating residual liquid refrigerant through the evaporator to fully wet all heat exchange surfaces, thereby providing acceptable efficiency. Motor driven pumps are commonly used for this purpose but are expensive and often troublesome.

It is a primary object of this invention to provide a new and improved refrigeration system and method of providing refrigeration. A related object is to recirculate residual liquid refrigerant collecting in the system. Another related object is provision for recirculating this liquid refrigerant by utilizing flash gas.

These and other objects and advantages of the invention will be apparent from the following description and drawing which is a schematic flow diagram of a refrigeration system embodying features of the invention.

The invention is equally applicable to various types of refrigeration systems such as an absorption system or a compression system and is illustrated as embodied in a centrifugal compressor refrigeration system.

Referring to the drawing, refrigerant condensate passes from a condenser **11** through a refrigerant condensate line **12** and flow metering means such as a float valve unit **13** vented to the condenser **11** through a vent line **14**. From the float valve the liquid refrigerant passes through a flash gas chamber **15** and a refrigerant supply line **16** to a refrigerant inlet **17** of an evaporator **18**. The supply line **16** has a liquid seal loop **19** for substantially preventing passage of flash gas through the supply line **16** into the evaporator **18** to maintain the chamber **15** above evaporator pressure. The liquid refrigerant vaporizes in the evaporator **18** and is withdrawn through a suction line **20** communicating with a compressor **21** from which compressed refrigerant vapor passes through a high-pressure refrigerant line **22** to the condenser **11**.

The illustrated evaporator **18** has a tube bundle **23** through which chilled water is suitably circulated to a load having a cooling requirement. The refrigerant entering the evaporator **18** through the refrigerant inlet **17** passes into a drip pan **24** having a plurality of perforations in its bottom wall through which the liquid refrigerant drips over the tube bundle **23** and is vaporized as the chilled water in the bundle is cooled. A portion of the liquid refrigerant passing over the tube bundle **23** does not vaporize but collects in a sump **25** of residual liquid refrigerant in the bottom of the evaporator **18** from which the residual refrigerant is pumped back through a recirculating refrigerant line **26** to the refrigerant inlet **17** and the drip pan **24** for recirculation over the tube bundle **23**.

Pumping of the residual liquid refrigerant results from a high density head of this liquid refrigerant lifting a relatively lower density column of froth formed by mixing refrigerant gas with a portion of the residual liquid refrigerant. More particularly, in order to pump the liquid refrigerant from the evaporator sump **25** to the evaporator inlet **17**, the illustrated embodiment of the recirculating refrigerant line **26** is formed with a loop having a depending portion **27** extending downwardly from

the sump **25** and communicating with an ascending portion **28** extending upwardly to the refrigerant inlet **17**. The refrigerant froth is formed in the ascending portion **28** of the line **26** by passing refrigerant flash gas from the chamber **15** through a flash gas line **29** opening into the ascending portion **28** at an elevation sufficiently below the head of residual liquid refrigerant that the substantially lower density froth mixture is lifted to the inlet **17**. The flash gas line **29** preferably extends through the recirculating line **28** in sealed engagement therewith, and has a suitable mixing portion **30** herein opening upwardly in the line **28** to mix the gas with the liquid refrigerant to form the froth.

While a preferred embodiment of the invention has been described and illustrated, it should 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 method of operating a refrigeration system including a first portion adapted to contain liquid refrigerant and a second portion at a higher elevation adapted to receive the refrigerant comprising dispersing gas in a portion of said liquid refrigerant to form a mixture having a substantially lower density than the liquid refrigerant, and applying the head pressure of said liquid refrigerant in said first portion to said gas and liquid mixture to raise said portion of gas and liquid to said second portion.

2. A method of operating a refrigeration system including an evaporator having an inlet for liquid refrigerant in an upper portion, a sump for residual liquid refrigerant in a lower portion, and conduit means having a portion descending from said sump and a portion ascending to said inlet in which the steps consist in providing flash gas at a pressure above the evaporator pressure during operation of the system, passing said flash gas into liquid refrigerant in the ascending portion of said conduit means below the level of said liquid refrigerant in said conduit means to form a relatively low density mixture of refrigerant liquid and gas, and lifting said mixture to said inlet by the head pressure of liquid refrigerant in said descending portion.

3. In a refrigeration system, the combination of a first region adapted to contain liquid refrigerant, a second region at an elevation higher than the first region adapted to receive refrigerant from the first region, a line connecting the two regions having a descending portion and an ascending portion adapted to contain liquid refrigerant, means for discharging gaseous refrigerant in the ascending portion of said line below the level of liquid refrigerant therein to form a froth of substantially lower density than the liquid refrigerant, said gaseous refrigerant being discharged into the line at a position such that the head of liquid refrigerant in said line raises the froth to the second region.

4. A refrigeration system comprising an evaporator and refrigerant inlet means in an upper portion of the evaporator for the passage of liquid refrigerant into the evaporator to vaporize and provide cooling, a sump for residual liquid refrigerant in a lower portion of the evaporator, means adapted to withdraw the refrigerant vapor from said evaporator, means adapted to pass refrigerant to said evaporator including a flash gas chamber adapted to be at a pressure above the evaporator pressure during operation of the system, means adapted to pass liquid refrigerant to said chamber, means adapted to pass liquid refrigerant from said chamber to said inlet means, a line having a first portion descending from said sump and a second portion ascending from the descending portion to said inlet means for the passage of said residual liquid refrigerant to said refrigerant inlet means,

and means adapted to pass said residual liquid refrigerant through said line to said inlet means including means communicating with said chamber and opening into said ascending portion of said line below the level of said residual liquid refrigerant therein adapted to inject flash gas from said chamber into the liquid refrigerant to form a relatively low density mixture of refrigerant liquid and gas, said flash gas being discharged into the line at a position such that the head of residual liquid refrigerant lifts said mixture to said inlet means.

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LLOYD L. KING, *Primary Examiner.*