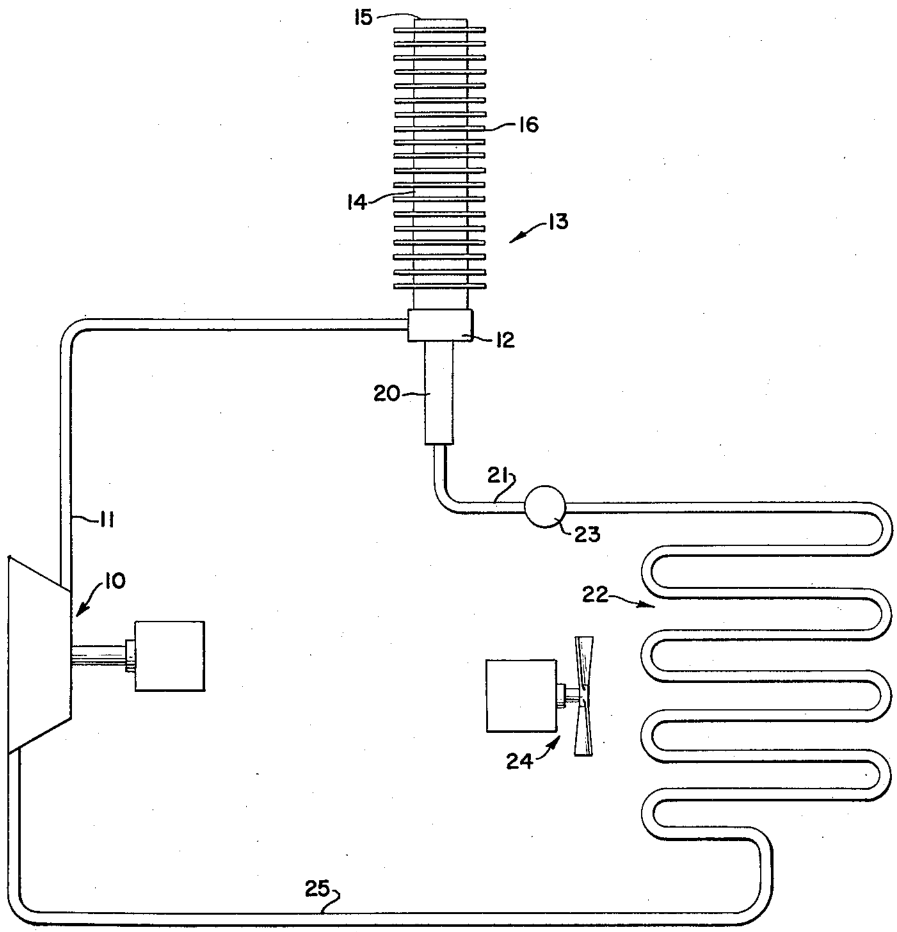
Jan. 12, 1960 J. L. BARTLETT, JR 2,920,457

REFRIGERATION SYSTEM WITH VORTEX MEANS

Filed March 3, 1958



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REFRIGERATION SYSTEM WITH VORTEX MEANS

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Application March 3, 1958, Serial No. 718,841

6 Claims. (Cl. 62—5)

This invention pertains to refrigeration systems and more particularly to a vapor cycle refrigeration system which utilizes a vortex tube as a heat exchange means for dissipating heat to the surrounding atmosphere.

As is well known, a conventional vapor cycle refrigeration system utilizes a compresor to increase the pressure of the gaseous refrigerant withdrawn from the evaporator. The compressed refrigerant is then converted to a liquid in a condenser by transferring heat to the surrounding atmosphere or other coolant, after which the liquid refrigerant is passed through an expansion valve or other throttling or expansion device where it is partly converted to a low temperature gas. The mixture of liquid and gas, at relatively low temperature and pressure, then flows through the evaporator where the refrigerant absorbs heat from the medium being cooled, and the heated refrigerant, now completely gaseous, flows from the evaporator back to the compressor where its pressure is again increased and the cycle repeated.

The size of the condenser required in the above-described vapor cycle refrigeration system is dependent, of course, on many variables, such as the temperature of the atmosphere or other coolant surrounding the condenser, the refrigerant used and the system pressures. The choice of refrigerant as well as the pressures used in the system can be varied to meet different conditions, but the temperature of the surrounding atmosphere or other medium is usually fixed. Thus, in order to further decrease the size of the condenser after the refrigerant and system pressures have been chosen, it would be necessary to increase the temperature difference between the compressed refrigerant and the surrounding atmosphere or to increase the coolant flow. This is often not feasible in the conventional type of vapor cycle system employing a condenser, and thus the size of the condenser can only be reduced to a certain minimum.

This invention would solve the problem of increasing the temperature difference between the compressed refrigerant and the surrounding atmosphere by utilizing a vortex tube in place of the condenser normally employed in such systems. The vortex tube is preferably of the type having a closed end hot tube so that none of the refrigerant is lost to the surrounding atmosphere. Such a vortex tube is more particularly described and claimed in the co-pending application of Frederick H. Green, Serial No. 171,147, filed June 29, 1950, now Patent No. 2,839,898, and entitled "Multiple Vortex Tube Generator Cooling Unit." This type of vortex tube operates without loss of fluid and with the temperature of the fluid flowing in the hot tube above the temperature of the fluid admitted to the tube. This temperature difference between the inlet temperature of the gas and the temperature of the gas in the hot tube results in a greater temperature differential between the temperature of the refrigerant and the surrounding coolant, thus permitting a decrease in the amount of heat exchange surface required.

Accordingly, the principal object of this invention is to provide a novel vapor cycle refrigeration system which utilizes a vortex tube in place of the conventional condenser.

A still further object of this invention is to provide a novel vapor cycle refrigeration system which is very compact and is capable of high efficiency over a wide range of temperature of the coolant employed.

These and further objects and advantages of this invention will be more easily understood by those skilled in the art to which it pertains, from the following detailed description of a preferred embodiment when taken in conjunction with the attached drawing. The drawing shows a schematic arrangement of a vapor cycle refrigeration system embodying the principles of this invention.

Referring to the drawing, there is shown a suitable compressor unit **10**, in this instance illustrated as being a motor-driven centrifugal compressor, which compresses the gaseous refrigerant withdrawn from the evaporator **22**. The discharge of the compressor **10** is connected to the inlet **12** of a vortex tube **13** by means of a conduit **11**. The vortex tube **13** has a hot tube **14** extending from one end of the inlet **12** and a cold tube or outlet **20** extending from the opposite side of the inlet. The inlet **12**, of course, should be designed so that the compressed gaseous refrigerant is caused to flow in a helical path into the interior of the hot tube **14** and to return out the cold tube **20**, as required in operating a vortex tube of the aforementioned type. The operation of such a vortex tube is more fully explained in the above-referenced co-pending application. The extreme end **15** of the hot tube **14** is closed by any desired means, such as an end cap or the like, in order to prevent the escape of refrigerant from the system. The hot tube **15** may also be provided with suitable fins **16** in order to increase the surface available for transferring heat from the refrigerant in the hot tube to the surrounding atmosphere or other coolant. In some cases it may be desirable to provide artificial means, such as a fan or pump, not shown, for increasing the flow of coolant over the surface of the hot tube **14**.

The cold outlet **20** of the vortex tube is connected, by means of a conduit **21**, to the evaporator **22** of the refrigeration system. The lower end of the cold outlet **20** serves as the liquid receiver for the system, although it may be desirable in some systems to provide a separate receiver. An expansion valve **23** or other flow restricting means is mounted in the conduit **21** for controlling the expansion of the liquid refrigerant into a low pressure gas and liquid mixture.

The discharge of the evaporator **22** is connected to the inlet of the compressor **10** by means of the conduit **25** so that the gaseous refrigerant discharge from the evaporator may be recompressed by the compressor **10**. A small motor-driven pump or fan **24** is shown for circulating the medium which is being refrigerated over the coils of the evaporator **22**. The fan, of course, is unnecessary in many refrigeration systems, such as those utilized in household refrigerators.

As explained in the above-reference co-pending application, a vortex tube may be operated with the end of the hot tube completely closed, and the surface of the hot tube will act as a heat exchanger to transfer to the surrounding coolant heat from the gaseous fluid flowing in a helical or vortical path in the hot tube.

The temperature of the refrigerant vapor flowing at the inner periphery of the hot tube will be much higher than its inlet temperature, and thus the transfer of heat from the compressed gaseous refrigerant to the surrounding coolant will be improved due to the greater temperature difference between the gas and the coolant, thus permitting a reduction in the heat transfer area required in order to supply a desired condensing capacity. In addition to decreasing the size of the over-all system, the use of the vortex tube also permits the system to operate efficiently over a wider range of temperatures of the coolant.

While but one embodiment of this invention has been described in detail, many additional modifications and improvements will occur to those skilled in the art within its broad spirit and scope.

I claim:

1. A vapor cycle refrigeration system comprising: means for increasing the pressure of a refrigerant; a vortex tube; the inlet of said vortex tube being connected to the discharge of said pressure increasing means; the cold outlet of said vortex tube being connected to the evaporator of the refrigeration system; and the outlet of said evaporator being connected to the inlet of said pressure increasing means.

2. A vapor cycle refrigeration system comprising: a compressor means; the discharge of said compressor means being connected to the inlet of a vortex tube, said vortex tube having a closed end hot tube, the cold outlet of said vortex tube being connected to an evaporator; and the outlet of said evaporator being connected to the inlet of said compressor.

3. A vapor cycle refrigeration system comprising: a compressor means for increasing the pressure of the refrigerant; the discharge of said compressor being connected to the inlet of a vortex tube, said vortex tube having a closed end hot tube; passage means for connecting the cold outlet of said vortex tube to an evaporator; flow restricting means disposed in said passage means for restricting the flow therein and the outlet of said evaporator being connected to the inlet of said compressor means.

4. A refrigeration system comprising: compressor means for increasing the pressure of a gaseous refrigerant; the discharge of said compressor being connected to the inlet of a vortex tube, said vortex tube having a closed end hot tube; cooling means disposed on said hot tube; the cold outlet of said vortex tube being connected to an evaporator; and said evaporator being connected to the inlet of said compressor.

5. A refrigeration system comprising: compressor means for increasing the pressure of a gaseous refrigerant; the discharge of said compressor being connected to the inlet of a vortex tube, said vortex tube having a closed end hot tube; cooling means disposed on said hot tube; the cold outlet of said vortex tube being connected to an evaporator; and means for controlling the flow from said cold outlet to said evaporator.

6. In a refrigeration system having compressor means for increasing the pressure of a refrigerant, expansion means for said refrigerant, and evaporator means for said refrigerant; condensing means for said refrigerant comprising a vortex tube, the inlet of said vortex tube being connected to the discharge of said compressor means and the outlet of said vortex tube being connected to said expansion means.

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