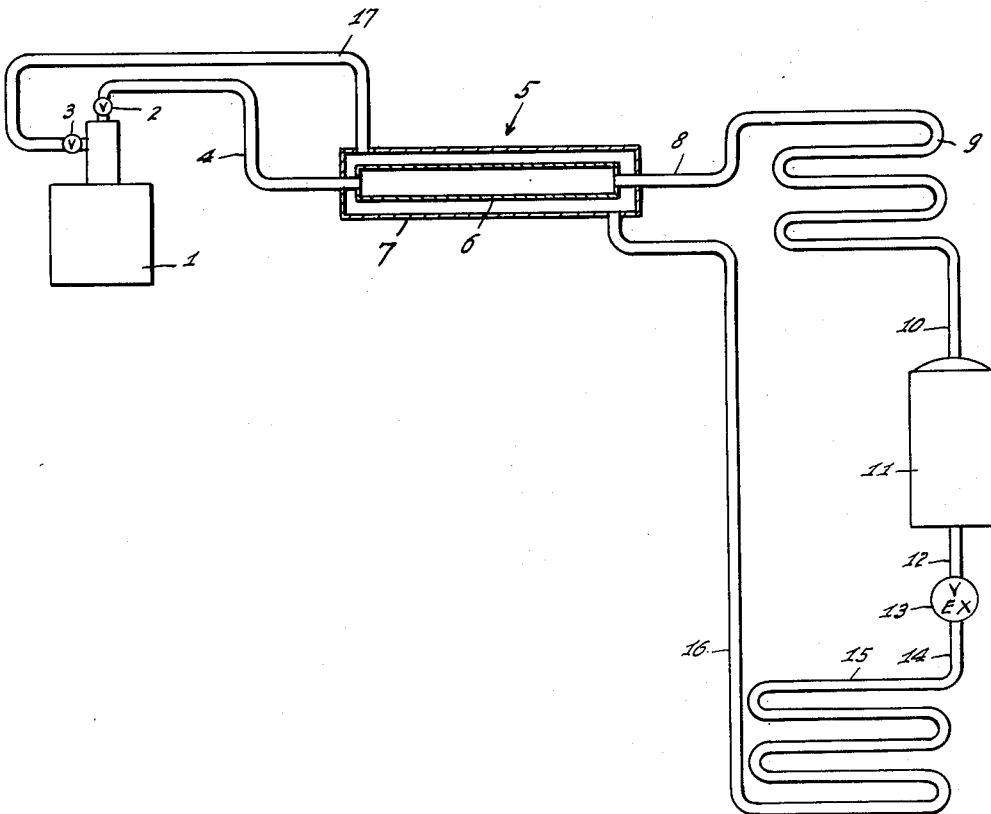


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REFRIGERATING SYSTEM
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REFRIGERATING SYSTEM

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The present invention relates to a refrigerating system, and is primarily concerned with the provision of means whereby the efficiency of a more or less standard compressor-type refrigerating system may be decidedly improved.

I have found that, when means is provided to extract some of the heat from the compressed refrigerating fluid, in its gaseous state, before it reaches the standard condenser, and when that heat is supplied to the returning fluid, as it flows from the evaporator back toward the intake of the compressor, very substantial improvements are attained in the operating characteristics of the system. By this means, the cost of operating the system to maintain a predetermined temperature in the atmosphere surrounding the evaporator is reduced; the minimum temperature of that atmosphere obtainable through operation of the system is lowered; and at the same time the compressor is protected against the accidental drawing of slugs of fluid, in the liquid phase, into the intake side of the compressor.

Further objects of the invention and advantages resident therein will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawing, attention being called to the fact, however, that the drawing is illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

The single figure is a more or less diagrammatic illustration of a refrigerating system incorporating my invention.

In order to illustrate my invention, I have shown, diagrammatically, a compressor 1 which will preferably be provided with a valve 2 controlling flow through the compressor discharge and a valve 3 controlling flow through the compressor intake. These valves 2 and 3 may be manually operable, or they may be controlled in any desired manner.

A pipe 4 leads from the compressor discharge to one side of a heat exchanger, indicated generally by the reference numeral 5. Said heat exchanger may take the illustrated form, in which it comprises a chamber 6 entirely enclosed within, but having no fluid communication with, an outer chamber 7. Obviously, since the chamber 6 is entirely enclosed within the chamber 7, said chamber 6 will be subjected, throughout its outer surface, to the temperature of any fluid which may be present in the chamber 7; and, as

obviously, differences in temperature between media within the respective chambers will tend to be equalized.

A pipe 8 leads from the chamber 6 to a condenser 9, while a pipe 10 leads from said condenser to a standard receiver 11 which may preferably be used in a refrigerating system of the type here under consideration.

A pipe 12 leads from the receiver 11 through a control means which, in the illustrated embodiment of the invention, may be a thermoresponsive expansion valve 13; and a pipe 14 leads from said valve to the evaporator 15. The function of the evaporator 15 is, of course, to maintain a predetermined subatmospheric temperature in the space in which said evaporator may be enclosed.

From the evaporator 15, a pipe 16 leads to the lowermost portion of one end of the chamber 7, while a pipe 17 leads from the uppermost portion of the opposite end of said chamber 7 to the intake of the compressor 1.

In the operation of a system of the character here under consideration, suitable pressure responsive or temperature responsive means will be provided to control the operation of the compressor 1. When such control means is actuated to energize the compressor 1, fluid will be drawn from the evaporator 15 through the pipe 16, chamber 7, and pipe 17, into the compressor. Theoretically, that fluid will be in a gaseous phase when it leaves the evaporator; but in practice it is found that slugs of liquid refrigerant are frequently entrained in the gas stream; and in standard systems, such slugs of liquid refrigerant are sometimes drawn into the compressor with obviously deleterious results.

At the same time, gas, compressed in the compressor 1, will be forced through the pipe 4, under high pressure. The compression of the gas, of course, greatly increases its temperature; so that gas forced into the chamber 6 will be at a relatively high temperature. The gas drawn into the chamber 7, of course, will be of a relatively low temperature, depending upon the rate of evaporation in the evaporator 15. But if any slug of liquid refrigerant is drawn into the chamber 7, the heat emanating from the hot gas within the chamber 6 will tend promptly to evaporate that liquid. Because of the manner in which the pipes 16 and 17 are connected into the chamber 7, obviously liquid cannot be drawn out of that chamber toward the compressor unless the chamber 7 becomes completely filled with liquid; and the existence of the high temperature gas within

the chamber 6, plus the fact that the pressure within the chamber 7 will be subatmospheric because of its connection through the pipe 17, with the intake side of the compressor 1, positively insures that the chamber 7 will never fill up with refrigerant in the liquid phase.

The transfer of heat from the gas within the chamber 6 to the refrigerant within the chamber 7 likewise facilitates the condensation of the compressed gas, since the phase change depends upon reduction in the temperature of the gas after compression. That heat transfer further improves the efficiency of the compressor by raising the pressure of the gas within the chamber 7, and thus supplying gas to the compressor at a pressure higher than would otherwise obtain.

A further advantage which I have discovered in the operation of refrigerating systems constructed in accordance with my invention lies in the fact that the lubricating oil from the compressor does not tend to collect in the circulating system to any such extent as is common in other refrigerating systems known to me. I have not at present evolved any certainly tenable theory as to the reason for this condition, but actual tests have shown that, whereas a teacup full or more of lubricating oil will collect in the circulating system of the character here disclosed, in the absence of a heat exchanger like my unit 5, during an operative period of a few months, less than a teaspoon full of oil will be found in my circulating system after a corresponding operative period.

I do not claim to have been the first to conceive the thought of incorporating a heat exchanger in a refrigerating system whereby the fluid, in its flow from the evaporator toward the intake side of the compressor, is brought into heat exchanging relation with fluid flowing toward the evaporator. But, so far as I am advised, I am the first to have conceived the thought of bringing that returning fluid into heat exchanging relation with hot, compressed refrigerant in the gaseous phase as it emanates from the compressor and as it flows toward the condenser. The improvement in efficiency produced when that concept is put into practice is indicated by tests which I have made. Using a refrigerating system of the type illustrated herein, and maintaining all other conditions constant, I found that the system consumed 12.4 k. w. h. in 8 days of operation when the heat exchanger 5 was connected in the manner illustrated; but that it consumed 16.2 k. w. h. in 8 days of operation when the heat exchanger 5 was shifted from the point illustrated and connected with the chamber 6 between the receiver 11 and the evaporator 15.

Again, with the heat exchanger connected in the manner illustrated, and with thermostatic controls disconnected, I attained a temperature, in the atmosphere surrounding the evaporator 15, of -65° F. With the heat exchanger 5 connected with the chamber 6 between the receiver 11 and the evaporator 15, all other conditions

being the same, the minimum temperature attainable was -48° F.

I claim as my invention:

1. In a refrigerating system including a compressor, a condenser, and an evaporator, conduit means for leading fluid from said compressor to said condenser, conduit means for leading fluid from said condenser to said evaporator, and conduit means for leading fluid from said evaporator to the intake of said compressor, said last-named conduit means being arranged in heat-exchanging relation to said first-named conduit means.

2. In a refrigerating system including a compressor, a condenser, and an evaporator, conduit means cooperating with said devices to provide a circuit for fluid from the discharge of said compressor through said condenser, thence through said evaporator, and thence to the intake of said compressor, and a heat exchanger arranged in said conduit means to bring into heat exchanging relation fluid flowing from said compressor toward said condenser with fluid flowing from said evaporator toward the intake of said compressor.

3. In a refrigerating system including a compressor, a condenser, and an evaporator, conduit means cooperating with said devices to provide a circuit for fluid from the discharge of said compressor through said condenser, thence through said evaporator, and thence to the intake of said compressor, and a heat exchanger comprising a chamber connected in said conduit means between said compressor discharge and said condenser, and a contiguous chamber connected in said conduit means between said evaporator and the intake of said compressor.

4. In a refrigerating system including a compressor, a condenser, and an evaporator, conduit means cooperating with said devices to provide a circuit for fluid from the discharge of said compressor through said condenser, thence through said evaporator, and thence to the intake of said compressor, and a heat exchanger comprising an outer chamber and an inner chamber enclosed in said outer chamber, one of said chambers being connected in said conduit means between said compressor discharge and said condenser, and the other of said chambers being connected in said conduit means between said evaporator and the intake of said compressor.

5. In a refrigerating system including a compressor, a condenser, and an evaporator, a chamber, means providing a closed path for fluid flow from said compressor to said condenser through said chamber but in non-communicating relation to said chamber, conduit means for leading fluid from said condenser to said evaporator, conduit means for leading fluid from said evaporator to the lowermost point of said chamber, and conduit means for leading fluid from the uppermost point of said chamber to the intake of said compressor.

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