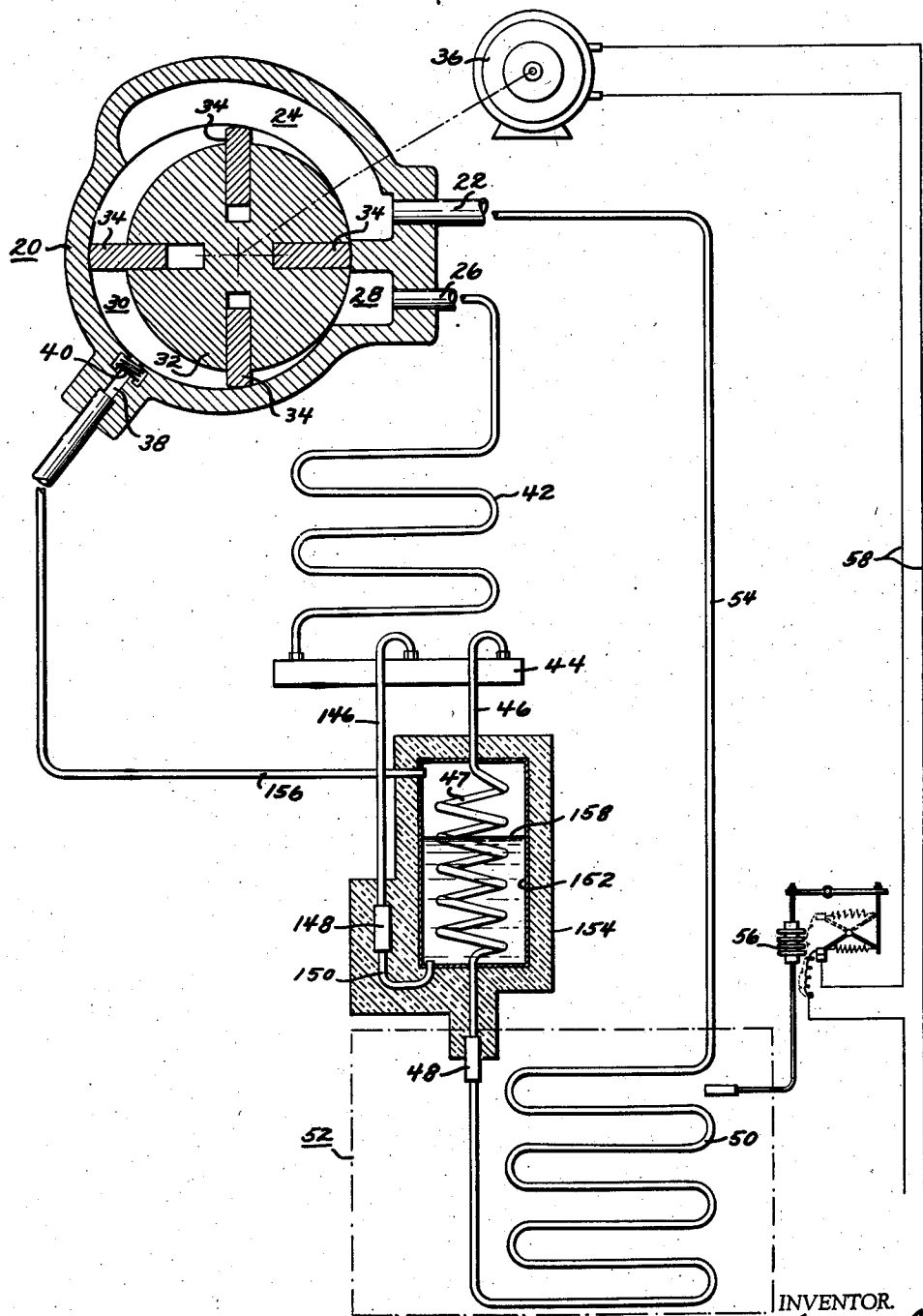


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REFRIGERATING APPARATUS

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REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus and more particularly to means for precooling liquid refrigerant.

Heretofore, some refrigerating systems have not been provided with any means for precooling the liquid refrigerant prior to expansion; other systems have precooled the liquid by suction gases. However, suction gases can only provide a limited amount of cooling effect and, therefore, do not precool the liquid adequately prior to expansion. Some attempts have been made to separate and remove at higher suction pressures the flash gas or vapor from partially expanded liquid refrigerant, but there is extreme difficulty in separating this flash gas and liquid refrigerant in any small space.

It is an object of my invention to provide a better, more compact and more economical method and apparatus for precooling liquid refrigerant prior to complete expansion.

It is another object of my invention to provide a method and apparatus for precooling liquid refrigerant, supplied to an evaporator in the normal manner, by separately evaporating in heat exchange relation with it other liquid refrigerant.

It is known that refrigerating systems operate more efficiently at higher back pressures. It is, therefore, a further object of my invention to provide a method and apparatus for precooling liquid refrigerant prior to expansion by separately evaporating in heat exchange relation with it other liquid refrigerant at higher back pressures.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

The figure is an illustration, partly diagrammatic, of a refrigerating system embodying one form of my invention.

Briefly, I have shown a refrigerating system provided with a multi-vane type of multi-effect compressor connected to a condenser and receiver. Liquid refrigerant from the receiver is supplied in one stream to an expansion device from which it expands into the main evaporator, after which it is returned to the low pressure suction entrance of the compressor. I also provide a second stream of liquid refrigerant from the receiver which is evaporated in a counter-flow arrangement in heat exchange relation with the liquid stream or supply conduit for the main evaporator. This evaporated refrigerant is used for precooling the stream of liquid for the main

evaporator. The refrigerant evaporated for precooling purposes is conducted to the high pressure suction entrance of the compressor so that the precooling is performed economically at higher back pressures.

Referring now to the drawing, there is shown a multi-vane multi-effect compressor 20 having a low pressure inlet 22 connecting to an inlet chamber 24 and an outlet 26 connected to an outlet chamber 28. The compressor is provided with a cylindrical chamber 30 containing a smaller cylindrical rotor 32 which is mounted eccentrically within the chamber. This cylindrical rotor 32 is provided with four vanes 34 which are thrown out against the cylindrical walls of the chamber 30 by centrifugal force when the rotor 32 rotates. The rotor 32 is rotated by an electric motor 36 which is directly connected to the rotor.

The compressor 20 is also provided with a high pressure suction entrance 38 which is located so that it is separated by one of the vanes at all times from the inlet chamber 24. This high pressure suction entrance 38 is provided with a check valve 40 for preventing any gas compressed in that section of the chamber 30 from escaping through the high pressure suction entrance.

The compressor 20 delivers the compressed refrigerant to the condenser 42 where the condensed refrigerant is collected, for the purpose of illustration, in a receiver 44. If desired, the bottom of the condenser may serve as the receiver. From the receiver 44, the liquid refrigerant is conducted through a liquid supply conduit 46 to an expansion device such as a restrictor 48 which controls the flow of liquid refrigerant into the evaporating means 50 where the liquid refrigerant evaporates under reduced pressure to cool the medium within the compartment 52. The liquid refrigerant which evaporates in the evaporating means 50 is returned to the low pressure suction inlet of the compressor 20 through the suction conduit 54. The operation of the motor 36 and the compressor 20 is controlled by a thermostatic switch 56 having its thermostatic bulb located within the medium in the compartment 52 for controlling the supply of electric energy through the conductors 58 to the motor 36 so as to maintain the medium in the compartment 52 at the desired temperature.

It has been common to interchange heat between the liquid supply conduit 46 and the suction conduit 54 in order to precool the liquid in the liquid supply conduit 46 prior to complete expansion. However, the evaporated refrigerant

or suction gas, which leaves the evaporator 50, has comparatively little refrigerating capacity and, therefore, does not provide adequate precooling of the liquid. Also, particularly in larger systems, there is difficulty in providing satisfactory means for interchanging the heat of the liquid refrigerant in the liquid supply conduit with the cooler suction gases in the suction conduit. This is primarily because of the fact that gases have such low specific heat, and large volumes of gas must be passed into intimate contact with the liquid supply conduit to secure reasonable efficiency in heat transfer. The rush of large volumes of gas through restricted spaces in heat exchangers causes considerable noise and also tends to restrict the flow of gases out of the evaporator. Therefore, in many systems, this method of precooling has definite disadvantages.

It is well known that an interchange of heat can readily be made with evaporating refrigerant. It has been proposed to expand the refrigerant in steps and to remove the flash gas between the two steps. It has been found that there is great difficulty in properly separating the flash gas from the liquid refrigerant in a small space under such circumstances.

In order to provide a better method of precooling, I provide a second liquid supply conduit 146 which connects at its upper end to the receiver 44 and at its lower end to its own restrictor 148 which, in turn, is connected by a conduit 150 with an evaporating chamber 152. The evaporating chamber 152, the restrictor 148, the conductor 150 and the upper portion of the restrictor 48 are all enclosed within insulation 154. The evaporating chamber 152 has the high pressure suction conduit 156 connected to it above the level 158 of liquid refrigerant. This high pressure suction conduit connects to the high pressure inlet 38 of the compressor 20 and thus removes the evaporated refrigerant from the evaporating chamber 152 at a higher back pressure than the suction gases in the conduit 54. Thus, the evaporation in the evaporating chamber 152 is performed more economically than evaporation in the evaporator 50.

The evaporating chamber 152 contains a coiled portion 47 of the suction conduit 46 so that the liquid refrigerant in the evaporating chamber 152 is evaporated in direct contact with the outside of this coil. This coil may be provided with fins or other suitable devices for increasing heat transfer. Preferably, the chamber 152 is made long and narrow and, as shown, with the liquid refrigerant fed into the chamber at the point nearest the restrictor 48 so that heat exchange between the two circuits may take place in counter-flow fashion. It will thus be seen that the system is divided into two circuits and that the refrigerant in the high pressure circuit is evaporated in the counter-flow heat transfer arrangement with the liquid refrigerant in the low pressure circuit prior to expansion. Since a multi-effect compressor is used, there is no loss in capacity of the refrigerating system. In fact, there is a gain in capacity. The high pressure inlet port is so arranged that it does not have access to the compression chamber until the compression chamber between each set of valves is at its greatest size and has admitted a full charge of low pressure evaporated refrigerant.

While I have shown a multi-effect two-circuit refrigerating system for providing the precool-

ing of liquid refrigerant prior to complete expansion by separately evaporating liquid refrigerant in heat exchange relation with it, it is obvious that a single simple compressor could be used with the suction conduit 156 connected to the low pressure suction entrance 22 in addition to the suction conduit 54. Also, that this evaporation for precooling could be performed by an entirely separate refrigerating system. Also, if it is desired, instead of a multi-effect compressor, two separate compressors, each delivering to a common condenser, might be used as an alternative arrangement to the multi-effect compressor. In any one of the different ways described above, adequate precooling of the liquid refrigerant can be obtained within a compact space in an economical manner without any gas noises and without restricting the outlet of the main evaporator.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including a multiple effect compressor having a low pressure suction inlet and a high pressure suction inlet for compressing low and high pressure suction gas in a single stage in the same compression chamber, a condensing means for the compressed gas, a first evaporating means having its outlet connected to said low pressure suction inlet and its inlet connected to a refrigerant control device for controlling the flow of refrigerant into said first evaporating means, closed fluid conduit means communicating with the condensing means and with said device for conducting refrigerant from said condensing means to said device, a second evaporating means for evaporating liquid refrigerant in direct contact with the closed fluid conduit means containing the condensed liquid refrigerant flowing from said condensing means to said control device, the outlet of said second evaporating means being connected to said high pressure inlet, the inlet of said second evaporating means being provided with a refrigerant control device connected to said condensing means.
2. Refrigerating apparatus including a multiple effect compressor having a low pressure suction inlet and a high pressure suction inlet for compressing low and high pressure suction gas in a single stage in the same compression chamber, a condensing means for the compressed gas, a first evaporating means having its outlet connected to said low pressure suction inlet and its inlet connected to a refrigerant control device for controlling the flow of refrigerant into said first evaporating means, closed fluid conduit means communicating with the condensing means and with said device for conducting refrigerant from said condensing means to said device, a second evaporating means for evaporating liquid refrigerant in direct contact with the closed fluid conduit means containing the condensed liquid refrigerant flowing from said condensing means to said control device, the outlet of said second evaporating means being connected to said high pressure inlet, the inlet of said second evaporating means being provided with a refrigerant restrictor for controlling the flow of refrigerant.

ALEX A. McCORMACK.