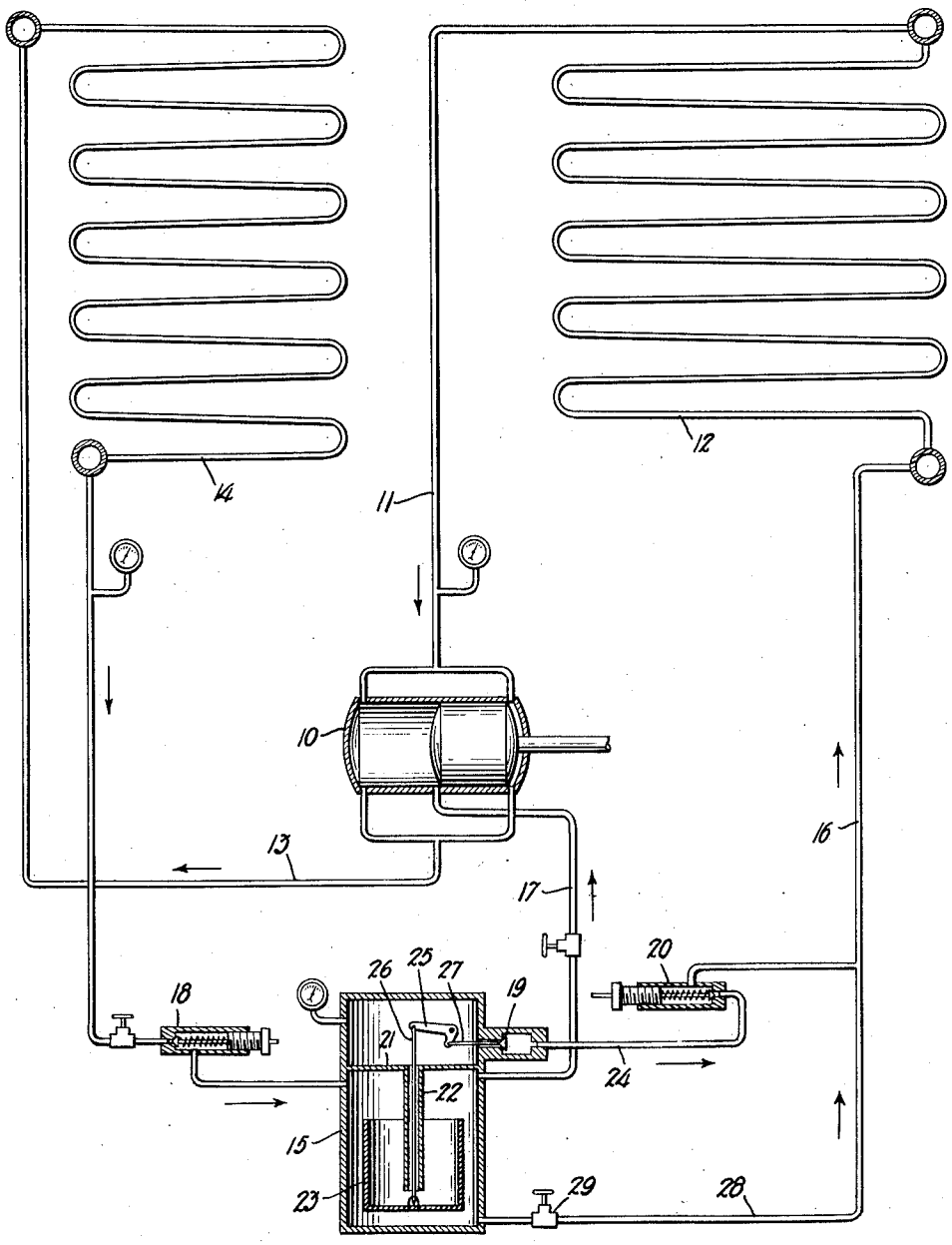
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REFRIGERATING APPARATUS

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REFRIGERATING APPARATUS.

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This invention is an improvement in refrigerating apparatus of the compression type, in which so-called "multiple effect" is employed as disclosed in the Voorhees Patent No. 793,864. By permitting the evaporation of a portion of the liquefied refrigerant in a mutiple effect receiver or precooler, the remainder of the liquid is cooled to a temperature much lower than that of the condenser before going to the evaporator. The same compressor takes, at one end of the cylinder, the gas from the evaporator, while at a point intermediate of the ends of the cylinder it takes the gas at a higher pressure from the receiver.

The invention relates more particularly to the construction of the precooler or multiple effect receiver, and to the control of the pressures in this part of the system.

In order to get the maximum capacity and efficiency, two conditions are necessary. First, nothing but liquid should be fed from the condenser to the receiver, and second, nothing but liquid should be fed from the receiver to the evaporator. The first condition is readily obtained by the use of an ordinary automatic pressure regulator, because if the refrigerant be pure, and sufficient pressure be maintained in respect to the condenser temperature, all of the refrigerant gas will be liquefied in the condenser and may flow by gravity to the receiver. The second condition may be obtained by the use of a float type of regulator which will maintain liquid in the receiver and at the same time permit any surplus liquid to pass to the evaporator.

As the condenser pressure when carbon dioxid (CO_2) is used as the refrigerant may be 1,000 pounds, and the evaporator pressure may be 300 pounds, it will be noted that there will be a very considerable difference between the intermediate pressure in the receiver, and the opposite extreme pressures of the condenser and the evaporator. If the valve controlling the outlet from the receiver to the evaporator be of such size that it will permit the desired rate of flow for a large capacity apparatus, a large float is required to operate the valve against the pressure difference, and this requires a correspondingly large precooler or intermediate receiver.

The main object of my invention is to permit the use of smaller, cheaper and simpler parts, and I accomplish this object by a novel arrangement whereby the difference in pressure against which the float operated valve must work is materially smaller than has been possible in previous apparatus with which I am familiar.

In carrying out my invention I use two intermediate pressure stages instead of only one, and arrange the float operated valve so that it works against only the pressure difference between the two intermediate pressure stages. I place the float operated valve and a separate spring pressed valve in series in the outlet passage from the precooler to the evaporator. Thus, between the two valves there will be a pressure higher than that of the evaporator and lower than that of the receiver, and the work done by the float is only that required to overcome the pressure difference between this intermediate pressure and that of the receiver. Therefore, a smaller, cheaper and simpler float and a smaller precooler may be employed.

In the accompanying drawing I have shown somewhat diagrammatically an apparatus embodying my invention. In this apparatus there is employed the ordinary type of multiple effect compressor 10 which is preferably double acting, and receives the low pressure gas through a conduit 11 from the evaporator 12. The compressed gas passes through a conduit 13 to a condenser 14 where it is liquefied, and flows to a precooler or multiple effect receiver 15. The liquid passes by a conduit 16 to the evaporator while gas produced by the precooler or the receiver 15 goes by a conduit 17 to the compressor cylinder at a point intermediate of the ends of the latter. All of these parts to the extent so far described may be of any ordinary type well known in the art.

In carrying out my invention there is provided an automatic pressure regulating valve 18 between the condenser 14 and the receiver 15 which may be set so as to maintain the desired pressure required in the condenser for liquefaction of the refrigerant under the condenser temperature used. This prevents the delivery of any unliquefied gas from the condenser to the receiver, so long as the refrigerant remain comparatively pure and the condenser temperature is maintained.

In the outlet passage from the receiver to the evaporator there are provided two separate valves arranged in series. The first

valve 19 is float-operated, while the other valve 20 may be of the ordinary automatic pressure regulating type.

The receiver illustrated is provided with a transverse partition 21 from which depends a conduit 22, the lower end of which is in a float 23 of the bucket type. The gas outlet conduit 17 leads from a point directly below the partition 21, while the conduit 24 in which the valves 19 and 20 are located, leads from above the partition. The float 23 is connected to the valve 19 in any suitable manner, as for instance by a bell crank lever 25 and a pair of links 26 and 27.

Assuming that carbon dioxid be the refrigerant employed, the pressure in the condenser and up to the valve 18 may be approximately 1,000 pounds. The pressure in the evaporator beyond the valve 20 may be approximately 300 pounds. By means of the valve 19 which is between the valves 18 and 20, the pressure in the receiver may be approximately 600 pounds and the pressure in the conduit 24 between the valves 19 and 20 may be approximately 500 pounds. When the pressure in the condenser exceeds the limit of the valve 18, the liquefied refrigerant will flow into the receiver until a sufficient amount is accumulated to cause the valve 19 to open. Liquid will then flow up the conduit 22 and through the conduit 24 to the valve 20 which will open if the pressure is above 500 pounds, and the liquid will flow on to the evaporator. When the liquid level in the receiver drops to such a point that the valve 19 closes, gas under a pressure of approximately 500 pounds will be held in the conduit 24 because it cannot escape at that pressure past the valve 20. Thus, when liquid has accumulated to a point when the float again opens the valve 19, it will open it against a pressure difference of only approximately 100 pounds, namely the difference between the 600 pounds pressure of the receiver, and the 500 pounds pressure of the conduit 24. A comparatively small float is ample to operate the valve against this comparatively small pressure difference.

Although from the above description of the operation it might appear that the opening and closing of the several valves is effected intermittently, it will be understood that in practice under normal uniform conditions all of these valves will remain substantially at rest in a partly open position to maintain substantially constant and uniform flow and the desired pressure differences. If desired, the main flow from the receiver to the evaporator may be through a conduit 28 controlled by a manual or automatic valve 29, and the float actuated to open the valve 19 and permit an extra flow only in case liquid accumulates in the receiver above a normal operating level.

I do not wish to be restricted to any particular type of float, and have used the term "float" in a broad sense. The particular float shown is of the bucket type which rises when the liquid level outside of the bucket is high and the level in the bucket is low, due to withdrawal therefrom through the conduit 22. In normal operation the level outside of the bucket will be such that the liquid will overflow into the bucket at substantially the same rate that it flows out of the bucket through the conduit 22. Any type of float which will open the valve 19 on high liquid level in the receiver might be employed.

Although in practice only a single valve 20 is used, it will be apparent that two or more such automatic pressure reducing valves might be employed in series, so that the pressure difference against which the valve 19 operates might be still further reduced.

To facilitate illustration, the valves 18 and 20 have been shown spaced from the receiver, although in practice it will be obvious that the valve 18 might be directly at the inlet of the receiver, and the valve 20 might be in the same valve casing with the valve 19, or might be at the inlet of the evaporator proper.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A refrigerating apparatus of the multiple effect type, including a receiver having a liquid inlet from the condenser, a liquid outlet to the evaporator, and a gas outlet to the compressor, a float operated valve for controlling said liquid outlet, and an automatic regulating valve intermediate of said first mentioned valve and the evaporator.

2. A refrigerating apparatus of the multiple effect type, including a multiple effect compressor, a condenser, an evaporator, a receiver, an automatic pressure regulating valve for controlling the delivery of liquid from the condenser to the receiver, a float valve in said receiver for controlling the delivery of liquid from the receiver, and an automatic pressure regulating valve between said second mentioned valve and said evaporator, whereby a pressure may be automatically maintained between said float valve and said third mentioned valve, higher than that of the evaporator and lower than that of the receiver.

3. A liquid receiver for use in refrigerating apparatus, said receiver having a liquid inlet, a spring pressed valve for controlling the same, a liquid outlet, a float operated valve for controlling said outlet, and a spring pressed valve beyond said float operated valve whereby a comparatively small difference in pressure may be maintained upon opposite sides of said float operated valve.

4. A liquid receiver for use in refrigerating apparatus of the multiple effect type, including a receiver, a conduit for delivering liquid therefrom to an evaporator, and a float oper-

ated valve and a separate spring pressed valve arranged in series for controlling said delivery.

5. A refrigerating apparatus of the multiple effect type, including a receiver having a main liquid outlet conduit, means for controlling the same, and a second liquid outlet conduit having a float operated valve and a spring pressed valve in series for controlling the same.

Signed at Carbondale, in the county of Lackawanna and State of Pennsylvania this 21st day of November, A. D. 1927.

NICOLAI H. HILLER.