June 25, 1946. F. Y. CARTER 2,402,802

REFRIGERATING APPARATUS

Filed Feb. 17, 1944

FIG. 1

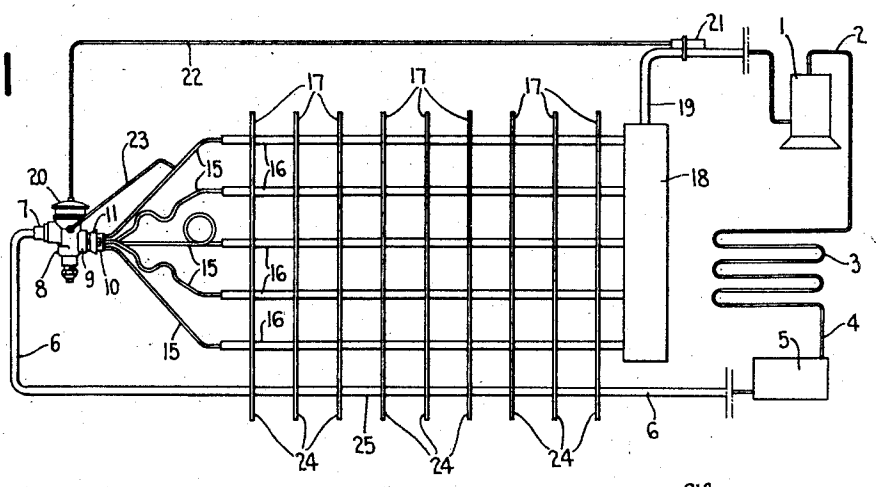


FIG. 3

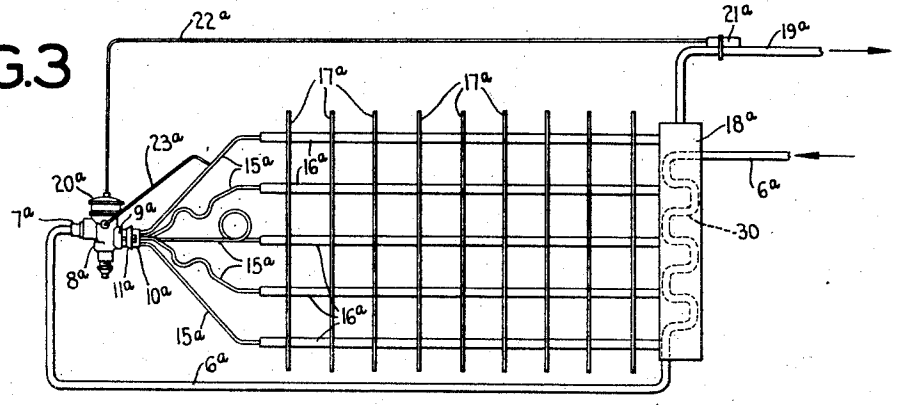
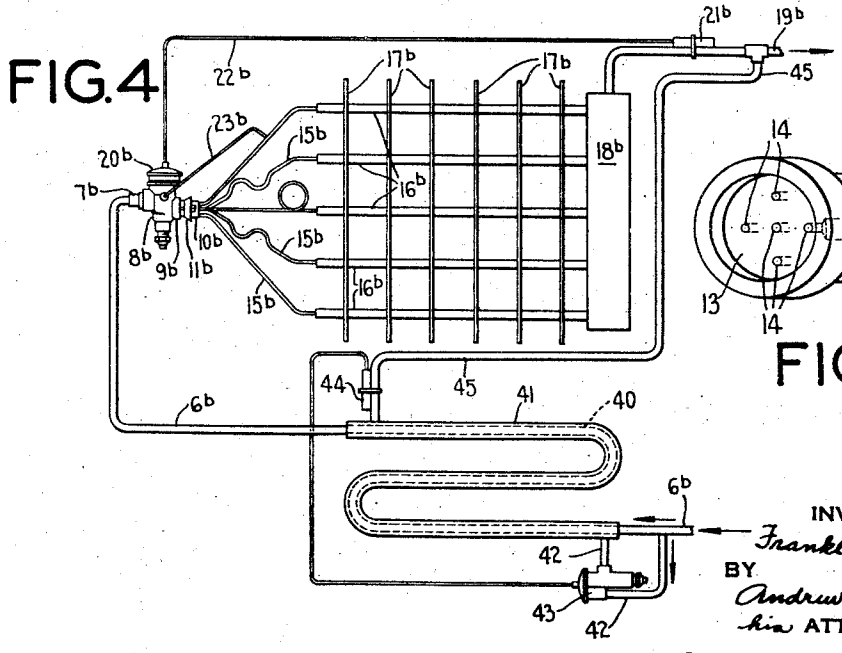


FIG. 4



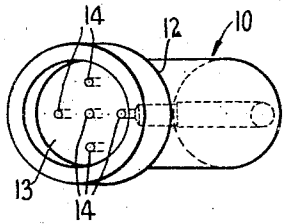


FIG. 2

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2,402,802

REFRIGERATING APPARATUS

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Application February 17, 1944, Serial No. 522,741

1 Claim. (Cl. 62—8)

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This invention relates to new and useful improvements in refrigerating apparatus and more particularly to means for supplying refrigerant medium to a multiple evaporator.

In order that a plurality of evaporating elements or a multi-pass evaporator, supplied with refrigerant medium from a single condenser in a refrigerating system, may be supplied with equal quantities of refrigerant medium, a header or distributor member for dividing the flow of the refrigerant medium must be employed. The volatilization or vaporization of the refrigerant medium on the outlet side of the expansion valve, normally results in the gasifying of the refrigerant medium on the inlet side of the distributing member and, accordingly, various kinds of distributing devices have been employed for equalizing the flow of liquid refrigerant medium through the distributing member. Such devices have either failed to provide equal flow of refrigerant medium liquid per unit of time or have been so inefficient in distributing the liquid that there has been non-uniformity in the work done by the various evaporator elements or passes of a multi-pass evaporator.

Accordingly, it is an object of this invention to provide an apparatus in which each of the evaporator elements of a multiple system are supplied with equal quantities of liquid refrigerant medium per unit of time for equal heat exchange evaporator elements or with quantities proportional to the heat exchange surface of the elements.

Other objects and advantages of the invention will be apparent from the following specification and the novelty of the invention will be particularly pointed out and distinctly claimed.

In the accompanying drawing to be taken as a part of this specification, there are fully and clearly illustrated several preferred embodiments of the invention, in which drawing:

Figure 1 is a diagrammatic view of a refrigerating apparatus or system showing one form or arrangement for accomplishing the invention;

Fig. 2 is a detail view in perspective of a distributing member forming part of the invention;

Fig. 3 is a diagrammatic view of part of a refrigerating apparatus or system showing another form of apparatus for accomplishing the invention, and

Fig. 4 is a diagrammatic view of part of a refrigerating apparatus or system showing another arrangement for accomplishing the invention.

Referring to the drawing, Fig. 1, by characters of reference, the numeral 1 designates a compressor driven by any motive power means, such as an electric motor (not shown) and which may be controlled in any of the usual ways as by a return or suction line pressure switch. The high pressure side of the compressor is connected to

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and discharges into a conduit or pipe 2 which feeds into a condenser 3 which is connected by a pipe or conduit 4 to the usual receiver 5. The refrigerant medium high side liquid line or conduit 6 connects from the receiver 5 below the liquid level therein and leads to the inlet 7 of a thermostatically controlled refrigerant expansion valve 8 which may be of the type and construction disclosed in my copending application Serial No. 510,328 filed November 15, 1943 for Refrigerant distributing means. The outlet 9 of the expansion valve is connected to a distributing member 10, see Fig. 2, which is clamped to the expansion valve body by an annular clamping member 11 which seats against the flange 12 on the member 10. The outlet passage of the expansion valve opens into a pressure chamber 13 in the member 10. The chamber 13 has a plurality of restricted outlet ports or passageways 14, equal in number of the number of passes or evaporator elements to be supplied with refrigerant medium. The passageways 14 are connected by conduits 15 of restricted internal bore and preferably all of the same length and internal bore, one to each of the evaporator elements or passes 16 which are provided with common or interconducting heat exchange fins or plates 17 connecting the tubes or passes of the evaporator. The tubes or elements 16 connect into a suction or return line header 18 from which a refrigerant medium return or suction line 19 connects into the suction or inlet side of the compressor 1. The valve 8 is thermostatically controlled by a thermostatic actuator 20 having the usual pressure responsive movable wall member operable to move the valve member toward open position in accordance with a desired superheat setting of the valve and in response to the temperature of a volatile liquid in the bulb element 21 clamped in heat exchange relation to the return line 19 and connected by the usual capillary tube 22 to the expansible chamber of the actuator 20. The valve 8 is also controlled by the back pressure of the refrigerant medium, as is well understood in the art, by means of an equalizer tube or connection 23 connected at one end into the chamber of a pressure responsive member in the valve tending on pressure increase to move the valve member toward closed position, the tube 23 being connected at its other end into the system low side and, for example, into one of the liquid refrigerant medium feeding tubes 15. The heat exchange fins or plates 17 are preferably provided with extended portions 24 which are apertured to receive a portion 25 of the liquid refrigerant feed line or conduit 6 which is intimately bonded to and for heat exchange relation with the fin portions 24. Accordingly, the liquid refrigerant medium supplied to the valve 8 will be cooled in the conduit portion 25 and the ex-

tent of heat abstraction is predetermined so that the temperature of the refrigerant medium on the outlet side of the valve 8 and in the distributing member chamber 13 will be below the boiling point of the refrigerant medium so that flash gas or vaporization will not occur in the chamber 13.

If there is no cooling of the liquid refrigerant medium fed to the expansion valve, then it will be impossible to prevent flashing or vaporizing of the refrigerant medium in the distributing member chamber 13. For example, if the refrigerant medium supplied to the valve is say at a temperature of 100° F. which, for Freon, would mean a gas pressure of 117 lbs. per square inch, then, because of the necessity to have a pressure drop in order to have refrigerant medium through the valve 8, the pressure of the refrigerant medium in the chamber 13 would have to be lower than 117 lbs. per square inch and, accordingly, the refrigerant medium in the chamber 13 would be at a temperature above its saturation temperature and accordingly gasify or vaporize, with the result of unequal feeding of the liquid portion of the refrigerant medium through the ports 14 to the evaporator passes. Therefore, by this invention the refrigerant medium is cooled in the liquid line portion 25 to a temperature below that which will correspond to the intermediate pressure in the chamber 13 and, accordingly, there will be no flash gas or vaporization of the refrigerant medium which would upset the equal feeding of liquid through the ports 14. For example, and solely by way of illustration, if there is a head pressure of say 117 lbs. per square inch with a compressor creating a suction pressure of 40 lbs. per square inch, and it is desired to have a pressure drop through the distributor member ports or passageways 14 and the tubes 15 at a pressure drop across the valve 8 of say 47 lbs. per square inch in order to have feeding of the necessary quantity of liquid refrigerant medium to provide the desired evaporator capacity, then there will be a pressure in the chamber 13 of 70 lbs. per square inch. Accordingly, since the temperature of the refrigerant medium in the chamber 13 at which boiling will occur will be for Freon at 70 lbs. per square inch, a temperature of 70° F., then the heat abstracted from the liquid refrigerant medium in the line portion 25 must be sufficient to cool the liquid refrigerant medium to a temperature below the saturation temperature in the chamber 13, say for example to a temperature of 65° F. as a margin of safety. The number and extent of the fin portions 25 in heat exchange relation to the port 24 and the number of passes of the portion 25 through the fin portions will of course vary in accordance with the temperature of the high side liquid refrigerant medium in the conduit 6, the temperature of the evaporator, and the saturation temperature in the distributing member chamber 13, but can be readily ascertained when these variables are known.

Referring to Fig. 3, the reference characters applied to Fig. 1, but with the suffix *a*, designate like parts in this Fig. 3. Instead of having the heat exchange fins or plates 17ª extended to provide the portions 24, the high side liquid refrigerant line 6ª is provided with a heat exchange coil or conduit portion 30 which is positioned

within or in intimate heat exchange relation with the suction line header 18ª so that the liquid refrigerant medium in the liquid line 6ª is cooled by the refrigerant medium at the outlet end portion of the evaporator. This system or apparatus functions in the same manner as that of Fig. 1 and the illustrations above set forth are equally applicable here, it being apparent that the extent of the tubing or coil 30 must be sufficient to cool the liquid refrigerant medium below the saturation temperature which obtains in the distributing member chamber 13.

Referring to Fig. 4, the reference characters applied to Fig. 1 but with the suffix *b* designate like parts in this figure and therefore the description of the same will be apparent from the description of Fig. 1. In this Fig. 4, the high side liquid refrigerant line or conduit 6ᵇ has a coil or heat exchange portion 40 which is in intimate heat exchange relation with an evaporator 41 which may be of tubular form to surround the liquid line portion 40 passing longitudinally therethrough. The evaporator 41 may be supplied with refrigerant medium by a pipe or conduit 42 connected into the liquid line or conduit 6ᵇ and having intercalated therein for controlling flow of refrigerant therethrough to the evaporator 41 a thermostatic expansion valve 43 controlled by back pressure and by temperature from a bulb element 44 similarly to the control of the valve 8ᵇ to control the flow of refrigerant medium. A suction or return line pipe or conduit 45 leads from the evaporator 41 and connects into a suction line or conduit 19ᵇ on the outlet side of the bulb element 21ᵇ of the main evaporator controlling expansion valve 8ᵇ. The operation of the apparatus of this Fig. 4 will be apparent from the foregoing description of Fig. 1 but has the advantage that the subcooling of the liquid refrigerant medium to be supplied to the valve 8ᵇ can be regulated or controlled without necessitating change in the construction and extent of heat exchange surface as would be necessary in Figs. 1 and 3.

Having thus described my invention, what is claimed and is desired to be secured by Letters Patent of the United States is:

A refrigerating apparatus comprising a multipass evaporator, a refrigerant medium distributing member having a chamber and a plurality of restricted outlet passageways leading therefrom, a plurality of distributing conduit members for connecting the passageways to the evaporator passes and connected one to each of said passageways and passes, an expansion valve controlling the supply of refrigerant medium to said distributing member chamber, said outlet passageways being so restricted as to create in said chamber a predetermined refrigerant medium pressure, a liquid refrigerant medium conduit spaced from said evaporator passes and leading to the inlet of said expansion valve, and a plurality of heat exchange fins projecting from said liquid conduit and having apertures tightly receiving said evaporator passes so as to cool the refrigerant medium to be supplied to said chamber to a temperature such that the refrigerant medium will not vaporize at the predetermined pressure in said chamber.

FRANKLYN Y. CARTER.