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REFRIGERATING APPARATUS

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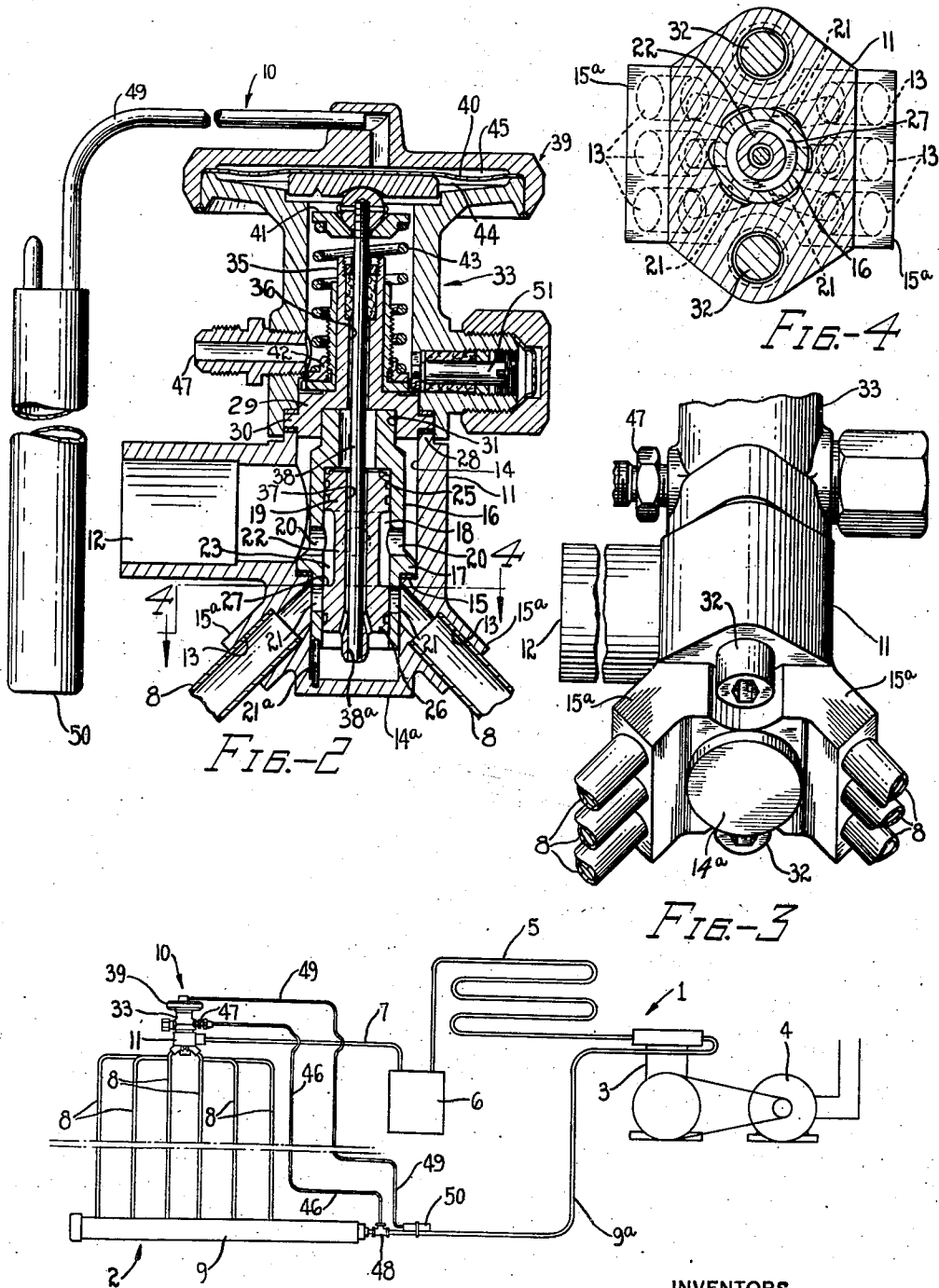


FIG.-1

FIG.-3

FIG.-4

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REFRIGERATING APPARATUS

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7 Claims. (Cl. 62-127)

Our invention relates generally to refrigerating apparatus and more particularly to an apparatus having a plurality of cooling elements or evaporators.

5 An object of our invention is to provide in a refrigerating apparatus having a multiple evaporator, i. e., a plurality of cooling coils, a control for maintaining the coils uniformly or equally refrigerated during the operating cycle of the apparatus.

10 Another object is to provide a control means which is operable to supply equal quantities of refrigerant to each of a plurality of multiply connected, i. e., connected in parallel or multiple, evaporators.

15 Another object is to provide a fluid flow controlling valve of novel construction and having efficient operation.

20 The invention consists in the improved construction and combination of parts, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

25 In the accompanying drawing, to be taken as a part of this specification, we have fully and clearly illustrated our invention, in which drawing—

Figure 1 is a diagrammatic view showing a refrigerating apparatus having certain structure embodying our invention;

30 Fig. 2 is a view shown in vertical central cross-section of a preferred form of valve embodying our invention;

35 Fig. 3 is a perspective view of part of the valve looking at the side and bottom or outlet portion thereof, and

Fig. 4 is a view shown in section on the line 4-4 of Fig. 2.

40 Referring to the drawing by characters of reference there is shown in Fig. 1 a well known type of refrigerating apparatus or system comprising a refrigerant condensing unit 1 and a cooling element or refrigerant evaporator 2. The element 1 comprises a compressor 3 driven by a motor 4, a refrigerant condenser 5 and a receiver 6, all communicatively connected together. The evaporator 2 is fed or supplied with refrigerant medium from the receiver 6 by a conduit member 7 and comprises a plurality of spaced cooling coils or evaporator elements 8 having a common return or outlet header member 9. The header member 9 is connected to the compressor 3 by a refrigerant medium suction or return line 9^a. The cooling coils 8 are preferably substantially of equal length and flow capacity and may

for example be arranged in the path of an air stream supplying a room or other enclosed space to be air conditioned. In order to provide an efficient refrigerating system or apparatus, each of the coils 8 should receive refrigerant medium 5 at the same rate, that is, the medium should be uniformly or evenly distributed, and to this end we provide our novel thermostatic expansion valve designated in general by the numeral 10.

Referring now to the construction of the expansion valve 10, it includes a hollow body member or distributor head 11 having an inlet conduit 12 receiving the conduit member 7, and also having a plurality of outlet conduits 13 for connection to the coils 8. The member 11 is substantially rectangular in horizontal cross-section and has a substantially cylindrical chamber or recess 14 which opens at its upper end through the top wall of member 11 and which has a bottom or end wall 14^a. The inlet conduit 12 opens 20 through a lateral projecting portion on the side wall of the member 11 and through a side wall port into the chamber 14. Below the inlet port of conduit 12, the chamber 14 is of reduced diameter providing an internal, upwardly facing 25 annular shoulder 15. Beneath the shoulder 15, the member 11 has oppositely directed, downward diverging, substantially rectangular projecting portions 15^a through each of which a series of the conduits 13 extends. The conduits 30 13 have their outlet end portions in substantially parallel alinement and open in radially spaced relation from chamber 14 beneath the shoulder 15. Disposed in the chamber 14 is an open ended, elongated sleeve or tubular housing member 16 35 having intermediate its ends an external annular flange 17 which fits in the chamber 14 and provides a downward facing shoulder which seats on the shoulder 15. The tubular member 16 has a longitudinally extending cylindrical bore or 40 valve chamber 18 in which a piston-like, cylindrical valve member 19 is adapted to reciprocate with a snug sliding fit. Through its side wall the tubular member 16 has, above the flange 17, a plurality of inlet apertures or ports 20 45 establishing communication between the inlet 12 and chamber 18. Below the shoulder 15 the member 16 fits the reduced bore of chamber 14 and has through its side wall a plurality of radially spaced apertures or valve ports 21 which register one 50 with each of the conduits 13. The ports 21 are preferably circular and of equal area, and equally spaced above the bottom wall 14^a. The member 16 is held in fixed rotative position with the ports 21 and the outlets 13 in registry, by 55

a dowel or locating pin 21^a seating at its ends in sockets in member 16 and wall 14^a. Intermediate its ends the valve member 19 has a reduced portion 22 providing a circumferential annular chamber or recess 23 for establishing communication between the inlet ports 20 and the outlet ports 21. The reduced portion 22 provides at the lower end of member 19 a cylindrical valve portion or head 26 having an upward facing annular cut-off shoulder 27. Above ports 20, the member 16 has an internal, downwardly facing annular shoulder 25 to limit upward movement of the valve member 19. When the valve member 19 is in a raised position, the valve portion 26 overlies and closes the inlet side of the outlet ports 21. When the valve member 19 is in closed position, the upwardly facing valve shoulder 27 is preferably only slightly above the outlet ports 21 so that communication will be established between the inlet ports 20 and the outlet ports 21 upon slight downward movement of the valve member 19.

Surrounding the opening at the upper end of the body member 11 is an annular flange 28 which receives a removable closure and supporting member 29 having a flange portion 30. The underside of member 29 has a cylindrical recess 31 to receive the upper end portion of the housing member 16, and to hold member 16 down against shoulder 15. Mounted on and secured by bolts 32 to the members 11 and 29 there is a hollow casing 33, the joints preferably being sealed by gaskets. The member 29 has an upstanding guide portion 35 with a central, longitudinal bore 36 therethrough, through which and an aligned valve member bore 37, a valve actuating thrust rod or member 38 extends. The rod member 38 is secured to the valve member 19, as at 38^a, in a portion which bridges the bore 37 so that liquid 40 will not be trapped beneath member 19.

The casing 33 terminates at its upper end in a chamber portion 39 containing a diaphragm member 40 in operative thrust transmitting engagement with the thrust member 38. Interposed between an abutment member 41 on thrust member 38 and an adjustable abutment member 42 carried by the closure member extension 35; there is a helical coil spring 43 under compression and acting to oppose downward movement of member 40 and to move the valve member 19 upward toward closed position. The diaphragm member 40 serves to divide the interior of casing 33 into two pressure chambers 44 and 45. The lower chamber 44 is in communication with the outlet end of the header 9 by means of a conduit or pipe 46 leading from the casing nipple or fitting 47 to a T-fitting 48 in the return line 9^a. This chamber 44 therefore is at the return line refrigerant medium pressure which acts on the underside of diaphragm member 40. The chamber 45 is communicatively connected by a tube 49 to a bulb element 50 containing a temperature responsive volatile liquid so that fluid pressure corresponding to the temperature of element 50 acts on the upper side of diaphragm member 40 in opposition to the pressure in chamber 44 and the force of spring 43. The bulb element 50 is clamped in intimate heat exchange relation to the return line or conduit 9^a adjacent the header outlet. An adjusting means 51 for regulating the force of spring 43 extends through the side wall of casing 33.

When the compressor 3 is operating, gaseous refrigerant medium is withdrawn from the evaporator header 9 creating a suction pressure in

the coils 8 and valve pressure chamber 44. The medium is compressed and delivered to the condenser 4 where it is liquified and whence it goes to the receiver 5. From the receiver 5 the refrigerant medium returns to the evaporator 2 under control of the thermostatic expansion valve 10. The valve 10 regulates or throttles the refrigerant medium flow in response to the differential of pressures acting on opposite sides of the diaphragm member 40, one pressure varying in accordance with the temperature of bulb element 50 and the other pressure varying in accordance with the refrigerant medium in the header 9 or return line 9^a. As the thrust member 38 moves downward, the valve head will admit refrigerant medium to the outlet conduits 13 and since equal port areas are simultaneously uncovered, the refrigerant medium will be distributed equally and at the same rate to each of the coils 8. Since the point of distribution of the refrigerant medium is on the high pressure side of the system, so that the refrigerant medium is substantially in liquid phase, the division by our valve of the refrigerant medium supplied to the valve will be uniform and equal in quantity per unit of time for any given open position of the valve member 19.

What we claim and desire to secure by Letters Patent of the United States is:

1. In a refrigerating apparatus, a plurality of multiply arranged refrigerant medium evaporating elements, a refrigerant medium supply conduit having a plurality of branch conduits communicatively connected one to each of said elements, a valve casing having a plurality of outlets and intercalated between said conduit and its branch conduits, a single valve member in said casing and directly controlling each of said outlets and operable to distribute the refrigerant medium at equal rates to said branch conduits, a return conduit member communicatively connected with the outlets from a plurality of said elements, and means controlling said valve and responsive to temperature at said return conduit member.

2. A valve of the character described, comprising a hollow body member having a substantially cylindrical chamber open at its upper end and having an upward facing annular shoulder in said chamber, said body member having an inlet conduit to said chamber above said shoulder and having a plurality of outlet conduits leading from said chamber below said shoulder, an elongated hollow housing member positioned in said chamber and having intermediate its ends a downward facing surrounding shoulder seating on said annular shoulder, said housing member having an inlet port above said shoulder and communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with said housing member and urging said surrounding shoulder into engagement with said annular shoulder, an elongated valve member longitudinally reciprocal in said housing member and having intermediate its ends a circumferential recess communicating with said inlet port, the lower end portion of said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports, and means to hold said housing member against rotation in said chamber.

3. A valve of the character described comprising

ing a hollow body member having a substantially cylindrical chamber open at its upper end and having an upward facing annular shoulder in said chamber, said body member having an inlet conduit to said chamber above said shoulder and having a plurality of outlet conduits leading from said chamber below said shoulder, an elongated hollow housing member positioned in said chamber and having intermediate its ends a downward facing surrounding shoulder seating on said annular shoulder, said housing member having an inlet port above said shoulder and communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with said housing member and urging said surrounding shoulder into engagement with said annular shoulder, and an elongated valve member longitudinally reciprocal in said housing member and having intermediate its ends a circumferential recess communicating with said inlet port, the lower end portion of said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports.

4. A valve of the character described comprising a hollow body member having a substantially cylindrical chamber open at its upper end and having an upward facing annular shoulder in said chamber, said body member having an inlet conduit to said chamber above said shoulder and having a plurality of outlet conduits leading from said chamber below said shoulder, an elongated hollow housing member positioned in said chamber and having intermediate its ends a downward facing surrounding shoulder seating on said annular shoulder, said housing member having an inlet port above said shoulder and communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with said housing member and urging said surrounding shoulder into engagement with said annular shoulder, an elongated valve member longitudinally reciprocal in said housing member and having intermediate its ends a circumferential recess communicating with said inlet port, the lower end portion of said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports, and means for flow of liquid from and to opposite ends of said valve member so that liquid will not be trapped in said housing member beneath said valve member.

5. A valve of the character described comprising a hollow body member having a substantially cylindrical chamber open at its upper end and having an upward facing annular shoulder in said chamber, said body member having an inlet conduit to said chamber above said shoulder and having a plurality of outlet conduits leading from said chamber below said shoulder, an elongated hollow housing member positioned in said cham-

ber and having intermediate its ends a downward facing surrounding shoulder seating on said annular shoulder, said housing member having an inlet port above said shoulder and communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with said housing member and urging said surrounding shoulder into engagement with said annular shoulder, and a valve member longitudinally reciprocal in said housing member, said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports.

6. A valve of the character described comprising a hollow body member having a substantially cylindrical chamber open at its upper end, said body member having an inlet conduit to said chamber and having a plurality of outlet conduits leading from said chamber, an elongated hollow housing member positioned in said chamber and having an open upper end, said housing member having an inlet port communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with and urging said housing member into engagement with said body member, an elongated valve member longitudinally reciprocal in said housing member and having intermediate its ends a circumferential recess communicating with said inlet port, the lower end portion of said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports, and means cooperable with said valve member and said housing member to seal said open upper end against flow of fluid.

7. A valve of the character described comprising a hollow body member having a substantially cylindrical chamber open at its upper end, said body member having an inlet conduit to said chamber and having a plurality of outlet conduits leading from said chamber, an elongated hollow housing member positioned in said chamber, said housing member having a plurality of inlet ports communicating with said inlet conduit and having a plurality of outlet ports registering with said outlet conduits, a closure member for and on the open upper end of said chamber, said closure member having engagement with and urging said housing member into engagement with said body member, and an elongated valve member longitudinally reciprocal in said housing member and having intermediate its ends a circumferential recess communicating with said inlet port, the lower end portion of said valve member cooperating with said outlet ports and being operable upon reciprocation to cover and uncover said outlet ports, said housing member inlet ports opening into said valve member recess.

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