REFRIGERANT FLOW DISTRIBUTION MEANS
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FIG. 1

FIG. 2

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This invention relates to air conditioning apparatus including a refrigeration system which can be operated under the reverse cycle principle to provide either heating or cooling, more particularly to a refrigerant distributor having special utility in such reverse cycle refrigeration systems for implementing the flow of refrigerant to the heat exchanger coils of the apparatus when the refrigerant flows to the coil, and facilitating bypass of the expansion means of the refrigeration system when the refrigerant flows from the coil.

In that class of air conditioning apparatus employing a refrigeration system capable of operating on the reverse cycle principle to produce either cooling or heating as desired, it is necessary to provide means permitting a bypass of the expansion valving normally arranged adjacent the heat exchange coils. As is apparent to those skilled in the art, since the heat exchange coils of the reverse cycle refrigeration system are alternately employed for either heating or cooling, and since the expansion valving necessary for the evaporation portion of the refrigerant cycle should be in close proximity to the coils functioning as an evaporator, separate expansion valving is provided adjacent each group of heat exchanger coils. In order to permit any given coil of the reverse cycle refrigeration system to function alternatively as an evaporator or condenser, it is necessary to bypass the expansion valving associated with the coil, when the coil functions as a condenser.

Additionally, in relatively large installations a plurality of rows of tubes of substantial length are employed to form the heat exchange coils. It is desirable to insure a uniformity of refrigerant distribution to all of the tubes in the coil without excessive pressure drop and to this end the refrigeration system is provided with a distributor feeding refrigerant from the line of the system to a number of parallel circuit tubes.

It is accordingly a primary object of this invention to provide an improved refrigerant distributor valve serving the twofold purpose of feeding refrigerant simultaneously to a number of circuits in a heat exchange coil when refrigerant is fed to the coil, and acting to permit bypassing of the expansion valving associated with the coil when the refrigerant cycle is reversed and the coil functions as a condenser.

A further object of the invention is to provide a combined expansion valve member bypass and refrigerant distributor for a reverse cycle refrigeration system.

Another object of the invention is to provide means permitting the elimination of the conventionally employed external check valve of a conventional heat pump.

The present invention relates to air conditioning apparatus of the type including a refrigeration system which is selectively operable to cool or heat air. The refrigeration system includes a compressor, a first heat exchange coil, and a first expansion member associated with said coil and a second heat exchange coil, and a second expansion member, said elements being connected in a closed fluid circuit through which refrigerant may flow. The first coil acts as an evaporator when the system is used for cooling. Also incorporated into the refrigeration circuit is a reversing valve permitting the refrigerant to be selectively directed from the compressor either to said first coil or to said second coil, so that the first coil functions as an evaporator during the cooling cycle acts as a condenser coil during the heating cycle. The aforesaid coils are of a multi-tube, multi-circuit type, so that a refrigerant distributor is provided to feed uniform quantities of refrigerant to each circuit of the coil. Since the coils are usually remotely located with respect to each other, separate expansion members have been provided for each coil. As will be understood by those skilled in the art, only one of the expansion members will be active during each cycle of operation of the refrigeration system. Thus when the first coil is employed as an evaporator the first expansion member is active, with the second expansion member being bypassed. To the organization described there is added a novel refrigerant distributor for feeding refrigerant to the tubes of the coil, said distributor having means integral therewith for bypassing the inactive expansion member when refrigerant flows from the coil.

An important feature of the invention resides in the provision of a single valve member manipulatable as a unit in assembly of the refrigeration system which serves the twofold function of aiding in refrigerant distribution when refrigerant flow therethrough is in one direction, and aiding expansion member bypass when flow of the refrigerant is in an opposite direction.

The present invention will be more fully understood when the following specification is read in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a schematic diagram of the air conditioning apparatus which includes a reverse cycle refrigeration system embodying the instant invention; and

FIGURE 2 is an enlarged cross-sectional view through the novel refrigerant distributor employed in the air conditioning apparatus of FIGURE 1.

Referring now more particularly to the drawings like numerals will be employed to designate like parts in the different figures.

As best seen in FIGURE 1, a refrigerant compressor is coupled via line 11 to four way valve 12 which permits flow of refrigerant from line 11 through valve conduit 13 to line 14 which leads to first heat exchange coil 15. Heat exchange coil is of a multi-tube type here shown as having two circuits 15a and 15b, but obviously subject to formation with a greater number of tubes or circuits if desired, or as a single circuit coil.

Header distributor 16 of conventional type couples the tubes of the coil between line 14 and coil 15.

In the described orientation of four way valve 12, as apparent to those skilled in the art, first coil 15 is coupled so that the coil functions as a condenser in the illustrated refrigeration system.

Condensed refrigerant line 17 leads via intermediate line 19 and second coil line 20 to second heat exchange coil 22 which is of a multi-tube type similar to first coil 15, and comprises coil circuits 22a and 22b. A second coil header 23 couples second coil 22 via line 24 to reversing four way valve 12. Refrigerant flowing through
line 24, in the illustrated orientation of valve 12, passes through valve conduit 25 to compressor suction line 26.

A first fan 30 is arranged to direct air flow through first coil 15, and a second fan 31 is arranged to direct air through second coil 22, in conventional fashion.

Associated with first coil 15 is a first expansion member 35, and associated with second coil 22 is a second expansion member 36 illustrated in parallel flow relation with lines 17 and 20, respectively.

A first refrigerant distributor 40 is arranged between first coil 15, expansion member 35, and refrigerant line 17. A second refrigerant distributor 49a is arranged between second coil 22, second expansion member 36, and refrigerant line 20. Refrigerant distributor 49 is substantially identical to refrigerant distributor 49a, except for a possible design variation in shape and capacity depending on the capacity and construction of second heat exchanger 22. Refrigerant distributor 49 will be described in specific detail, it being understood that this description is applicable to refrigerant distributor 49a.

As best seen in FIGURE 2, refrigerant distributor 40 comprises a housing 41 having coil tube connections 42 and 43. Two coil tube connections 42 and 43 are shown to permit coupling to coil tube circuits 15a and 15b. It will, however, be understood by those skilled in the art that the number of coil tube circuit connections provided in the valve housing are determined by the number of circuits comprising the coil to which the housing is connected. A valve seat 44 is formed in the valve housing 41 at an end of housing bore 45 closest to tube connections 42 and 43. At the other end of housing bore 45 a valve stop 46 is formed. A sliding valve member 47 having circumferentially spaced longitudinal grooves 47a and a metering orifice 48 is slidably positioned on a slide way in housing bore 45 so as to permit movement of the valve member 47 between valve seat 44 and stop 46. The end of valve housing 41 remote from coil tube connections 42 and 43 is provided with a refrigerant line connection 50 and a bypass connection 51 is formed in the valve body to extend from bypass port 52 over which the valve member 47 slides.

In use, the aforesaid air conditioning system including a refrigeration system which can be operated under the reverse cycle principle is provided with the novel refrigerant distributor 40 so as to eliminate the need for the conventially employed external check valve.

The operation of the air conditioning system is initiated by energizing fans 30 and 31 along with compressor 16. With four way valve 12 set in the position illustrated in FIGURE 1, first coil 15 functions to provide heating of the air passing into heat exchange relationship with the coil since coil 15 acts as a heat dissipating refrigerant condenser in the illustrated refrigeration system. Refrigerant from compressor 10 flows through conduit 13 of valve 12 to coil 15. From coil 15 the condensed refrigerant flows into refrigerant distributor 40. As viewed in FIGURE 2, it will be noted that the flow of high pressure condensate refrigerant into valve housing 41 causes valve member 47 to move toward valve seat 46 opening bypass port 52 so that the condensed refrigerant will flow through line 17, bypassing expansion valve 35. Since the cross-sectional area of bypass port 52 is materially larger than that of metering orifice 48, only a tiny portion of the condensed refrigerant will flow through the metering orifice 48 which is immaterial in terms of refrigerant system functioning since it occurs at the high pressure side of the expansion member 35.

The condensed refrigerant flowing through line 17 flows through line 19 to a second expansion member 36, second refrigerant distributor 49a and second heat exchanger 22 which now functions as a heat absorbing refrigerant evaporator.

When refrigerant from the expansion member 36 enters refrigerant distributor 49a as will be apparent from a consideration of the structural detail shown in FIG.
able between said coil connecting means and line connecting means to open or close said bypass connecting means in response to whether refrigerant is flowing to said coil connecting means or from said coil connecting means, said valve means opening said bypass connecting means when refrigerant flows from said coil connecting means, and closing said bypass connecting means when refrigerant flows to said coil connecting means.

6. In a refrigerant distributor as in claim 5, said valve means comprising: a valve member having a metering orifice therethrough, metering the refrigerant flowing to said coil connecting means.

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