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REVERSE CYCLE REFRIGERANT FLOW CONTROL MEANS

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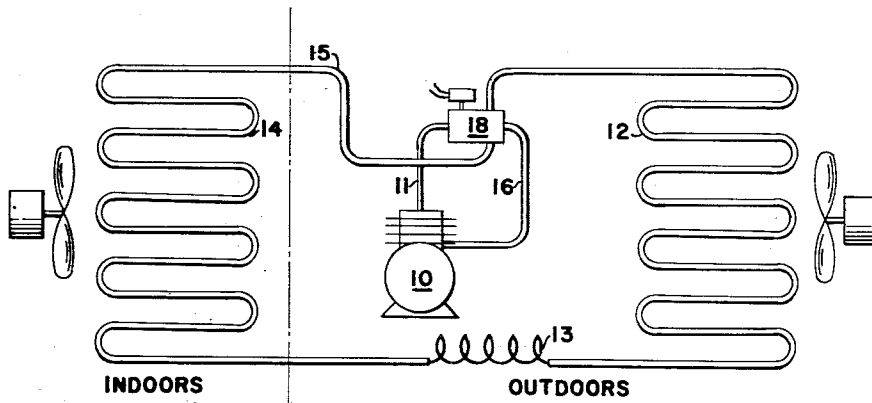


FIG. 1

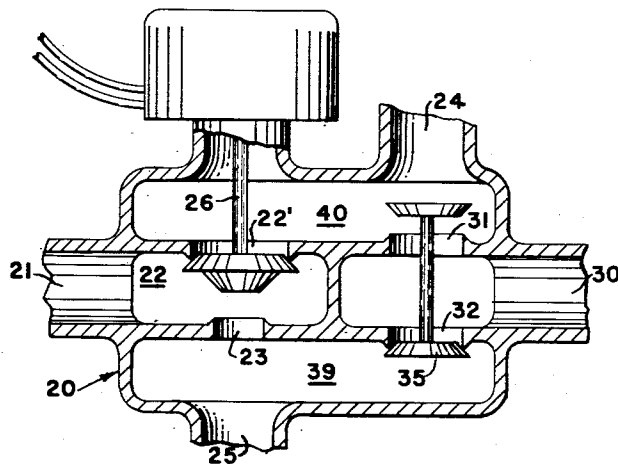


FIG. 2

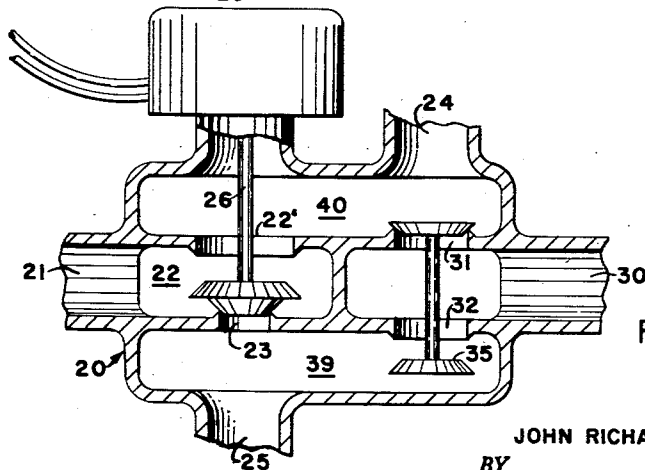


FIG. 3

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1

3,003,334

REVERSE CYCLE REFRIGERANT FLOW
CONTROL MEANS

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This invention relates broadly to refrigeration systems. More particularly, this invention relates to refrigeration systems operable under the reverse cycle principle which may be incorporated into structure to form an air conditioning unit. Still more particularly, this invention pertains to an improved valve for reversing refrigerant flow through a portion of a refrigeration system for the purpose of interchanging the functions of the evaporator and condenser.

In equipment of the kind described, a refrigeration system may be employed within an air conditioning unit so that either a heating or cooling effect may be obtained by proper manipulation of a valve controlling the direction of refrigerant flow through the system. Air conditioning equipment incorporating a refrigeration system operable under the reverse cycle principle is usually referred to as a heat pump.

One of the problems involved in utilizing a reverse cycle refrigeration system in a heat pump involves the fact that on the heating cycle a greater capacity is usually required of the refrigeration system than the capacity necessary to accommodate the normal cooling load on the equipment.

The chief object of this invention is the provision of an improved control valve for reversing refrigerant flow in a reverse cycle refrigeration system that includes means for increasing the capacity of the heat transfer coil functioning as a condenser on the heating cycle.

Another object of the invention is the provision of an improved method of operating a refrigeration system under the reverse cycle principle which involves varying the capacity of the system under various operating conditions.

These and other objects of the invention will be apparent upon consideration of the ensuing specification and drawings in which:

FIGURE 1 is a diagrammatic representation of a refrigeration system operable under the reverse cycle principle which may be incorporated in an air conditioning unit;

FIGURE 2 is a diagrammatic view of a reversing valve for controlling the direction of refrigerant flow in a portion of the system illustrated in FIGURE 1, and

FIGURE 3 is a view similar to FIGURE 2 showing the reversing valve in another operating position.

Referring to the drawings wherein an air conditioning unit including a refrigeration system is diagrammatically illustrated, it will be observed that a motor driven compressor 10 of the reciprocating type feeds compressed gas at a relatively high pressure through discharge line 11, and reversing valve 18, to a coil 12 which functions as a condenser when the unit operates on the cooling cycle. Coil 12 will hereinafter be referred to as the outdoor coil for it is located outside the enclosure being served by the heat pump. Liquid refrigerant formed in the condenser 12, as ambient air flows over its surface through the influence of a fan, passes through a capillary or other convenient expansion member to a coil 14 which may be referred to as the indoor coil functioning as an evaporator under cooling cycle operation. From the coil 14 vaporized refrigerant flows through line 15 to the reversing valve 18 from where it is for-

2

warded through suction line 16 to the compressor to complete the refrigerant flow circuit.

When the air conditioning apparatus of which the refrigeration system illustrated in FIGURE 1 forms a part, is operated so as to provide a heating effect, the reversing valve is indexed in a manner to be more particularly described so that the refrigerant flowing from line 11 passes to the indoor coil 14 from the reversing valve. The gaseous refrigerant entering the coil 14 is liquefied through the action of a fan in such a manner that the heat of condensation is made available to the occupants of the area being served by the indoor coil. The liquid refrigerant thus created flows through the capillary 13 to the outdoor coil 12 where it is vaporized as heat is extracted from the ambient flowing over the surface of the coil 12 under the influence of the fan. Vaporized refrigerant formed in the outdoor coil flows into the reversing valve and is directed to suction line 16 to complete the refrigerant flow cycle under circumstances where the air conditioning apparatus is operated on the heating cycle.

The reversing valve forming a part of this invention is illustrated in FIGURES 2 and 3. A casing or housing 20 for the valve includes an inlet 21 for connection to the hot gas discharge line 11. The passage 21 terminates in a passage 22 located centrally of the reversing valve. Opposed outlet 22' and 23 permit passage of the hot gas refrigerant flowing in line 11 to either valve outlet 24 or valve outlet 25. It will be observed that a valve member 26 operable under the influence of a solenoid coil is arranged to control passage through the outlets 22' and 23 from passage 21. It will be further observed that the outlet 22' is of a greater diameter than the outlet 23.

The improved reversing valve is likewise provided with a passageway 30 for connection with the suction line of the refrigeration system. The passageway 30 is provided with openings 31—32 of substantially the same diameter which serve as inlets to the passage 30. A valve member 35 of the "slave" valve type is provided for controlling flow of gaseous refrigerant through the openings into the passageway 30.

Considering the operation of the refrigeration system equipped with the improved reversing valve illustrated in FIGURE 2, when it is desired that the air conditioning unit incorporating the refrigeration system having the improved valve as a component thereof, is operated to create a cooling effect, the solenoid coil controlling the operation of valve 26 is deenergized causing valve 26 to close opening 23 and permit the flow of hot gaseous refrigerant from the compressor to flow through upper valve chamber 40 to valve outlet 24 which is connected to the outdoor coil 12. Vaporous refrigerant created in the indoor coil 14 in the manner described above flows into the reversing valve through opening 25 connected to line 15. From the opening 25 the gaseous refrigerant flows through the lower chamber 39 of the valve and into the passageway 30 the end of which is connected to suction line 16. The slave valve controlling flow into the passageway 30 assumes the position shown in FIGURE 3 by virtue of the pressures acting on the upper and lower faces of the valve, the uppermost surface of the slave valve being subject to high pressure gas such that the valve is forced to the position shown. In other words, the slave valve may be considered as being self-actuating in response to the pressure developed by the compressor inasmuch as the reversing valve is in communication with both the suction and discharge sides of the compressor 10.

When it is desired to operate the air conditioning equipment of which the refrigeration system forms a part, on the heating cycle, the solenoid coil controlling operation of the valve 26 is energized through an operating

circuit, not shown, causing the armature to move upward so that the valve seats against the upper opening 22' to expose opening 23 and permit flow of hot gaseous refrigerant from the discharge line 11 through the smaller valve opening 23. It will be appreciated that the opening 23 being of a smaller diameter than the opening 22', a greater resistance to the flow of hot gaseous refrigerant through the valve occurs when the valve is operating on a heating cycle. This has the effect of raising the pressure in the discharge line which in turn increases the head against which the compressor is pumping. This, in turn, causes the compressor to demand more power from its prime motor, increasing the temperature of the gas flowing in the discharge line. Thus, it will be appreciated that the reversing valve 20, constructed in the manner illustrated, provides a greater capacity for heating in terms of temperature of the gas than could be realized under the circumstances where openings 23 and 22 are of the same diameter.

The hot gas refrigerant flowing through the opening 23 enters the lower chamber of the reversing valve and flows to the indoor coil 14 where it is liquefied. From the indoor coil 14, liquid refrigerant flows via capillary 13 to the outdoor coil 12. Vaporous refrigerant formed in the outdoor coil enters the reversing valve through opening 24. The upper chamber 40 is now in communication with the passageway 30 in the valve which is connected to the suction line thus a path of flow through the reversing valve for the gaseous refrigerant is provided.

The above disclosure has been given by way of illustration and elucidation and not by way of limitation, and it is desired to protect all embodiments of the herein disclosed inventive concept within the scope of the appended claims.

I claim:

1. In a refrigeration system operable under the reverse cycle principle, including a compressor, a first heat transfer member and a second heat transfer member, means for reversing the flow of refrigerant within a portion of the circuit, said means including a first chamber in communication with said first heat transfer member, a second chamber in communication with said second heat transfer member, means forming a first passageway for the flow of refrigerant from said compressor, means forming a second passageway for the flow of refrigerant to said compressor, said first and second passageways having openings communicating with said first and second chambers, valves controlling passage through said openings, one of the openings in said first passage being smaller than the other of said openings so as to vary the resistance to flow of refrigerant to one of said chambers from said first passageway.

2. A refrigerant flow control member for use in a refrigeration system operable under the reverse cycle prin-

ciple comprising a housing, means forming a first passage, means forming a second passage, said first and second passage forming means serving to divide the interior of said housing into upper and lower chambers, said first and second passage forming means being provided with openings for communication with said upper and lower chambers, valve members associated with each passage for governing flow of refrigerant between the chambers and the passages, the openings in said first passage being unequal so as to vary the resistance to flow from the first passage in accordance with the chamber receiving said flow.

3. In a refrigeration system operable under the reverse cycle principle, a compressor, a first heat transfer coil, a second heat transfer coil and a refrigerant expansion member disposed between said heat transfer coils connected to form a circuit, refrigerant flow reversal means interposed in said circuit, said refrigerant flow reversal means having a first connection with said compressor discharge, a second connection with said compressor suction and a plurality of refrigerant flow passages presenting two refrigerant flow patterns whereby refrigerant discharged by said compressor may be selectively delivered to either heat transfer coil while receiving refrigerant from the other for delivery to the compressor suction, said passages being constructed so as to provide a greater restriction to flow through the flow reversal means from the compressor under one pattern of refrigerant flow than under the other pattern of refrigerant flow, and valves governing refrigerant flow through said passages.

4. In an air conditioning apparatus including a refrigeration system operable under the reverse cycle principle, a compressor, a first heat transfer coil, a second heat transfer coil and a refrigerant expansion member disposed between said heat transfer coils connected to form a circuit, refrigerant flow reversal means interposed in said circuit, said refrigerant flow reversal means having a first connection with said compressor discharge, a second connection with said compressor suction, and a plurality of refrigerant flow passages presenting two refrigerant flow patterns whereby refrigerant discharged by said compressor may be selectively delivered to either heat transfer coil while receiving refrigerant from the other for delivery to the compressor suction, said passages being constructed so as to provide a greater restriction to flow through the flow reversal means from the compressor under one pattern of refrigerant flow than under the other pattern of refrigerant flow, and valves governing refrigerant flow through said passages.

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