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VALVE STRUCTURE

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FIG. 1

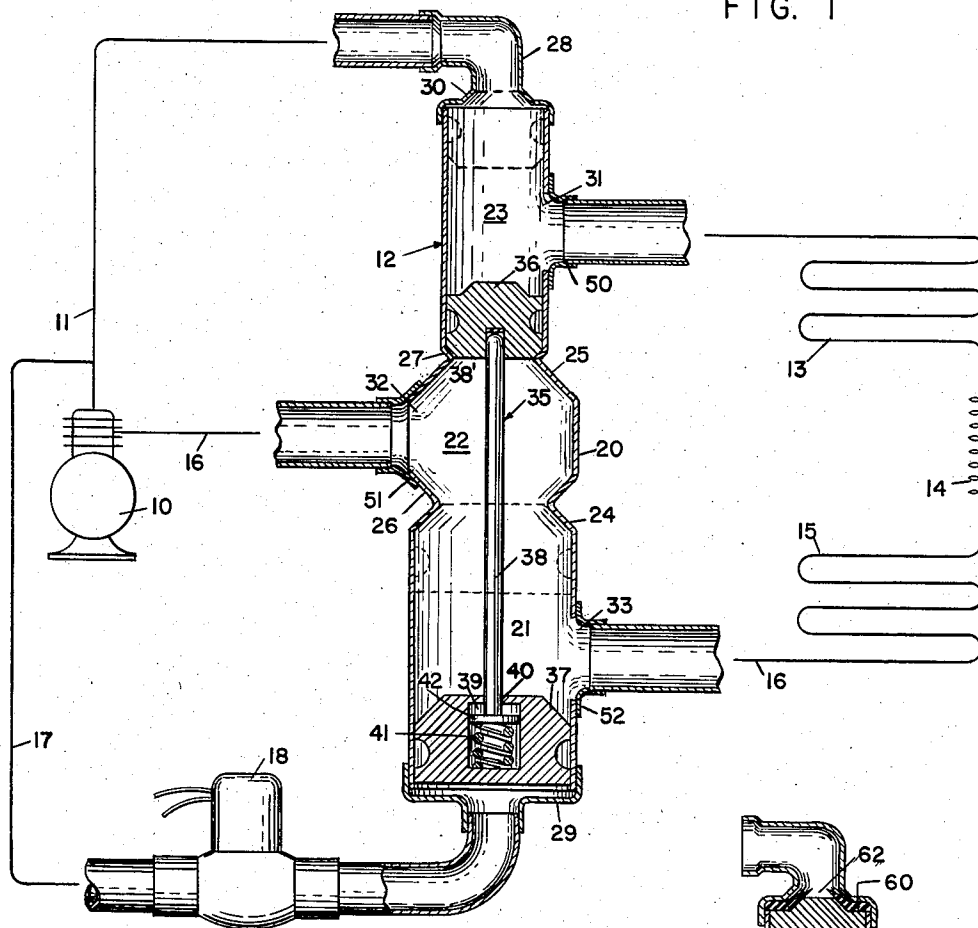


FIG. 2

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2,889,690

VALVE STRUCTURE

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10 Claims. (Cl. 62—160)

This invention relates to a control for a refrigeration system. More specifically this invention relates to an improved transfer valve of the type used in refrigeration systems employed in air conditioning units operable under the reverse cycle or heat pump principle.

The function of a transfer valve in a refrigeration system is to control the path of refrigerant flow through the system in such a manner that in one of its operating positions a cooling effect may be created in the evaporator of the refrigeration system and in its other operating position flow of refrigerant is controlled so that a heating effect is created in the coil previously used for cooling. The transfer valve accomplishes its function by controlling flow of refrigerant from the compressor to the heat exchange coils functioning as the evaporator and condenser respectively.

The chief object of this invention is to provide an improved valve of the kind under consideration wherein operation of the valve is under the influence of the flow of discharge line gas in the refrigeration system. In attaining the chief object of the invention it is contemplated that the normal refrigeration system of the type utilizing a reciprocating compressor, for illustration, be provided with a branch line connected to the normal discharge line of the compressor. The transfer valve forming the subject of this invention is provided with two inlets, the first communicating with the normal discharge line and the second communicating with the branch line to likewise permit the flow of hot gaseous refrigerant to the transfer valve. The branch line is provided with a solenoid valve to control the flow of hot gaseous refrigerant through the branch line. The transfer valve member forming the subject of this invention is provided with an actuating member comprising two spaced pistons interconnected by a rod so that movement of the actuating member causes substantial unity of movement between the two pistons.

Further in attaining the chief object of this invention it is contemplated that the particular pistons referred to above be dimensioned in accordance with the respective functions which they are to perform. This permits certain pressure differentials necessary to actuate the transfer valve in a predetermined manner, to be realized.

Another object of this invention is the provision of an improved transfer valve whereby certain economies of production may be obtained in the fabrication thereof.

A further object of this invention is the provision of a transfer valve having an actuating member of the type referred to above wherein a connection between the rod connecting the two piston members and one of the piston members to permit a limited amount of lost motion to positively seat the pistons is provided.

Other advantages and objects of the invention will be apparent upon a consideration of the ensuing description and drawings, in which:

Figure 1 is a view partly in elevation and partly in section of a transfer valve constructed in accordance with my invention as it pertains to a refrigeration system, dia-

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grammatically set forth, of the type used in air conditioning applications; and

Figure 2 is a partial view, partly in section and partly in elevation showing a modification of the transfer valve.

Referring more particularly to the drawings, 10 represents a compressor of the type usually found in a refrigeration system employed in air conditioning equipment. Gaseous refrigerant under pressure flows from the compressor through discharge line 11 and transfer valve 12 to a heat exchange coil 13. The gaseous refrigerant is changed in the heat exchange coil 13, which normally functions as a condenser, to the liquid phase as a cooling medium flows in heat exchange relation therewith. The liquid refrigerant normally flows through a restriction such as a capillary 14 to a zone of lower pressure such as evaporator 15. The liquid refrigerant is changed to the gaseous phase in the lower temperature or pressure zone as heat is absorbed by the refrigerant when a medium, such as air, flows in heat exchange relation with the evaporator. The gaseous refrigerant then flows under the influence of the compressor from the evaporator 15 through a portion of the transfer valve 12 to the suction line 16. The gas is then compressed in the compressor and the cycle described repeated.

As stated above the function of the transfer valve 12 is to control the flow of refrigerant within a portion of the refrigeration system so that the normal functions of heat exchange coils 13 and 15 may be interchanged when it is desired to utilize the refrigeration system to create different thermal effects. In order to accomplish this function a branch line 17 is connected to the transfer valve from the hot gas line 11. Flow of hot gas from the branch line 17 is controlled through the action of solenoid valve 18.

Referring more particularly to Figure 1 transfer valve member 12 comprises a body or casing 20 which may be formed from a section of tubing having a differential bore. The tubing is provided with three spaced openings in the side wall thereof in a manner to be later described. Portions of the tube forming the casing of the transfer valve are indented by a conventional swaging operation so as to form annular seats defining a lower chamber 21, an intermediate or central chamber 22, and an upper chamber 23. The chambers or compartments 21, 22 and 23 vary in diameter with the upper chamber 23 having a smaller diameter than the lower and intermediate chambers. The swaging operation referred to above causes the tube to have axial conical surfaces 24 and 26 as well as 25 and 27. Connected to the upper or open end of the tubing is an adapter member 28 for receiving at one end a portion of the hot gas discharge line 11. The adapter member is provided with a conical section 30 serving as a valve seat in which manner to be later described. The adapter member is secured to the end of the valve casing 20 by brazing or a similar operation. Located at the lower end of the tubing 20 is a second adapter member 29 constructed to provide a connection between branch line 17 and the interior of chamber 21 of valve body 20.

The upper compartment 23 of the valve 20 is provided with a port 31 in the side wall thereof. An adapter member 50 permits a connection between the valve body 20 and a portion of line 11 leading to the condenser 13. The central or intermediate chamber of the transfer valve body 20 includes a port 32 in the side wall thereof. This permits communication between the central chamber of the valve and suction line 16 and may be referred to as the valve outlet. An adapter member 51 permits a connection to be made between the transfer valve body 20 and a section of the suction line 16. The lower chamber or compartment 21 of the transfer valve body is provided with a port 33. Adapter member 52 is secured to the

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side of the transfer valve body by brazing and permits a connection between the chamber 21 and a section of the suction line 16.

Mounted for reciprocatory movement within the valve body 20 is an actuating member 35 including a first piston 36 and a second piston 37. Connecting the two piston members is a rod 38. The parts are so constructed that piston 36 moves between an upper limit defined by the seat 30 on the adapter member 28 and a lower limit as defined by seat 25 formed at the lower part of chamber 23. The piston 37 likewise moves within the lower chamber 21 between the upper position shown in the dotted line and the lower position shown in full lines. Piston 37 is further provided with an internal cavity 39 and a passage 40 connecting the cavity with the chamber 21 through the upper surface of the piston. Rod member 38 slides within the passage 40 and engages a shoe 42 which in turn is urged, under the influence of compression spring 41 to the upper portion of the cavity 39. The upper end of rod 38 is rigidly secured in socket 38' in the upper piston 36. The function of this particular connection is to insure positive seating under the valve in its upper position in a manner to be later described.

Considering the operation of the improved transfer valve the parts are normally in the positions indicated in Figure 1 with the solenoid valve closed to prevent communication between line 17 and chamber 21. Under these circumstances relatively high pressure gas flowing in the discharge line 11 acts on the upper surface of piston 36 and forces the actuating member 35 to the position shown. Under these circumstances the hot gaseous refrigerant from the compressor flows directly to the heat exchange coil 13 which functions as a condenser, causing the hot gaseous refrigerant to be liquefied. The liquid refrigerant from the condenser passes through the capillary 14 to the evaporator 15 where it is converted to the gaseous state in the manner mentioned above. The gaseous refrigerant flows from the evaporator through chamber 21 of the transfer valve 12, into the central chamber 22, into the suction line 16 and the compressor 10. Thus a cooling effect is created in the evaporator 15. It will be appreciated that the evaporator may form the inside coil on an air conditioning unit of the type generally referred to as a room cooler, wherein air from an enclosure such as a room, flows, under the influence of a fan, over the evaporator coil and is cooled as the exchange of heat referred to above takes place. In the conventional room cooler construction the unit is usually mounted in a window in such a manner that the condenser coil 13 is located outside the confines of the enclosure to be supplied with conditioned air. When it is desired to create within the enclosure a heating effect it is necessary to manipulate the transfer valve so that the functions of coil 13 and coil 15 are interchanged. This is accomplished in my invention by closing a switch, not shown, adapted to energize the solenoid 18 and permit hot gaseous refrigerant to flow from the compressor against the under side of piston 37 located in the chamber 21 of the transfer valve body 20. The cross-sectional area of piston 37 being greater than the cross-sectional area, or the area over which hot gas is normally supplied, of the piston 36, the unbalance of forces created causes upward movement of piston 37 within the lower chamber 21. The movement of piston 37 is transmitted to the rod 38 which in turn, because of its connection with piston 36 is supplied to the upper piston causing the piston 36 to seat against seat 30. Then, due to the action of the spring 41, relative movement between piston 37 and rod 38 occurs, permitting piston 37 to seat against seat 26.

Considering the flow of refrigerant within the system under these circumstances it will be appreciated that hot gaseous refrigerant flows through the branch line 17 into lower chamber 21 from where it flows to the

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heat exchange coil 15. As stated previously this coil may be the inside coil of a room air conditioner. Air flowing under the influence of a fan passes over coil 15 and extracts heat from the refrigerant in the coil 15. This causes the refrigerant to be converted to the liquid phase and flow through the expansion member 14 into the coil 13. In the latter coil the refrigerant absorbs heat from the medium flowing over the coil and is reconverted to the gaseous state. From the coil 13 the gaseous refrigerant flows into the chamber 23, and into the chamber 22 from where it flows through the port 33 into the suction line 16 of the refrigeration system. If desired a by-pass line may be provided around the capillary 14 in order to increase the volume of refrigerant flow during the cooling cycle. Such a by-pass line which normally includes a check valve to accomplish its intended function is conventional.

Referring more particularly to Figure 2 it will be noted that a resilient circular member 60 may be interposed between the uppermost end of tubing 20 and the adapter fitting or member 28. An annular opening 62 may be provided centrally of the resilient member 60 and the area of the member immediately adjacent may be formed upwardly out of the plane of the member 60 in the manner shown. With the construction disclosed in Figure 2 it will be unnecessary to use the type of connection between rod 38 and lower piston 37 shown in Figure 1. Under these circumstances the rod may be rigidly connected to piston member 37.

One of the important advantages accruing through the use of an actuating valve member of the kind illustrated in Figure 1 involves the elimination of the need for strict manufacturing tolerances. For example, it will be apparent that the spacing of the two piston members 36 and 37 is governed by the distance between the seats 30 and 24 respectively. With the construction described minor variances in the length of the rod 38 are permissible due to the action of the spring 41. The use of member 60 also permits some latitude in tolerances. It will be obvious that the rod 38 may be shorter than necessary if the resilient member 60, capable of achieving a cushioning action, is utilized.

It will thus be appreciated that there is provided an improved transfer valve member operable in response to the application of hot gaseous refrigerant to cause a predetermined path of refrigerant flow through a refrigeration system. Other constructions will suggest themselves to those skilled in the art without departure from the spirit of the invention. For illustration the transfer valve body 20 may be formed by joining together two sets of material previously fabricated to form one half the configuration desired.

While I have described a preferred embodiment of the invention, it will be understood that the invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In a valve mechanism, a unitary body member of a material readily susceptible to deformation, said body member forming three interconnected compartments, two of said compartments each including an inlet and a port remotely disposed with respect to the inlet and the other compartment including an opening constituting an outlet, means operable within the body member for selectively connecting the outlet with the port in either of the end compartments while preventing communication between the outlet and the other compartment port and both compartment inlets, said last mentioned means comprising a pair of pistons and a rod connecting the pistons.

2. The invention set forth in claim 1 wherein said body member includes a plurality of annular indentations forming seats for said pistons.

3. The invention set forth in claim 1 wherein the rod

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member is resiliently connected to one of said piston members and rigidly connected to the other.

4. The invention set forth in claim 1 wherein one of said pistons is disposed within one of the end compartments to control communication between the intermediate compartment outlet and the port in said end compartment while the other piston is located within the other end compartment, the pistons being so arranged that when one piston is positioned between the end compartment port and the intermediate compartment outlet the other is positioned to permit communication between the outlet and the compartment port in which the latter piston is located.

5. In a refrigeration system including a compressor, a first heat exchange unit, an expansion member and a second heat exchange unit connected to form a closed circuit for the flow of refrigerant, means for reversing flow of refrigerant through a portion of the system to interchange the functions of the heat exchange units, said means including a body member having three interconnected chambers, the first chamber having an opening communicating with the suction side of the compressor, each of the other chambers having an opening in communication with one of said heat exchange units, said means further including an actuating valve member including two spaced pistons, and a rod member having a fixed connection with one of said pistons and a connection with the other piston permitting predetermined relative axial movement between the piston and the rod.

6. In a valve mechanism for use in refrigeration systems operable as reverse cycle units, a body member shaped to form three co-axial compartments, a valve member movably mounted in said body member, said valve member including interconnected spaced portions movable within the two end compartments, the middle compartment of said body member being provided with an outlet, and the end compartments being each provided with an inlet and opening located remotely therefrom, the valve members being connected by a rod member so as to move in unison and selectively permit communication between one of said end compartments with the middle compartment while preventing communication between the other end compartment and the middle compartment.

7. In a refrigeration system including a compressor, a first heat exchange unit, a first line connecting the compressor and the first heat exchange unit, a second heat exchange unit, a second line connecting the first and second heat exchange units, means interposed in said last line for creating a pressure differential between said first and second heat exchange units, and a third line connecting the second heat exchange unit with the compressor to form a circuit for the flow of refrigerant, valve means for directing flow of refrigerant to either of said heat exchange units while accepting, for flow into said third line, refrigerant from the other of said heat exchange units, and means including a branch line connecting said compressor and said second valve means for selectively causing the refrigerant pressure within the valve means to change the flow of refrigerant through said valve means whereby the refrigerant flow will be through said branch line and through said valve means to the remainder of the system.

8. A pressure-responsive reversing valve for reversing the direction of flow of fluid through a circuit comprising a body member having a smaller and a larger end chamber connected by a central chamber; an inlet port in each of said end chambers adapted to be coupled to a source of fluid under pressure; an outlet port in each of said end chambers adapted to be coupled to each other through

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said circuit; a second port in said central chamber; a larger piston positioned in said larger end chamber; a smaller piston positioned in said smaller end chamber; a connecting member connecting said pistons to each other; a valve member associated with said inlet port in said larger chamber for selectively allowing fluid to flow from said source to said inlet port; said fluid flow through said circuit being in one direction when said valve member does not allow fluid to pass to said larger chamber inlet port thereby causing the pistons to be positioned by said fluid pressure so that fluid is caused to pass from said source through said inlet and outlet ports of said smaller chamber, said circuit, said outlet port of said larger chamber, and then through said second port; said fluid flow being in an opposite direction through said circuit when said valve member allows fluid to pass to said larger chamber inlet port thereby causing said pistons to be so positioned by said fluid pressure so that fluid is caused to pass from said source through said inlet and outlet ports of said larger chamber, said circuit, said outlet port of said smaller chamber, and then through said second port.

9. A pressure responsive valve for reversing the direction of flow of fluid through a circuit comprising a body member having two end chambers connected by a central chamber; an inlet port in each of said end chambers adapted to be coupled to a source of fluid under pressure; an outlet port in each of said end chambers adapted to be coupled to each other through said circuit; a port in said central chamber for exhausting flow of fluid from said circuit; valve means associated with the inlet port of one of said end chambers for selectively permitting fluid to flow from said source into said end chamber; and means positioned in said end chambers responsive to the pressure of said fluid to cause the direction of fluid flow through said circuit to be dependent on whether said valve means are opened or closed.

10. In a refrigeration system including a compressor, a first heat exchange unit, an expansion member, and a second heat exchange unit connected to form a closed circuit for the flow of refrigerant: a valve member for reversing the flow of refrigerant through a portion of the system to interchange the functions of said heat exchange units comprising a body member having two end chambers connected by a central chamber, an inlet port in each of said end chambers adapted to be coupled to the outlet of said compressor, an outlet port in each of said end chambers adapted to be coupled to each other through said heat exchange units and said expansion member, a port in said central chamber for passing refrigerant to the inlet of said compressor, valve means associated with the inlet port of one of said end chambers for selectively permitting refrigerant to flow from said compressor into said end chamber, and means positioned in said end chambers responsive to the pressure of said refrigerant to cause the direction of refrigerant flow through said heat exchange units and expansion member to be dependent on whether said valve means are opened or closed.

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