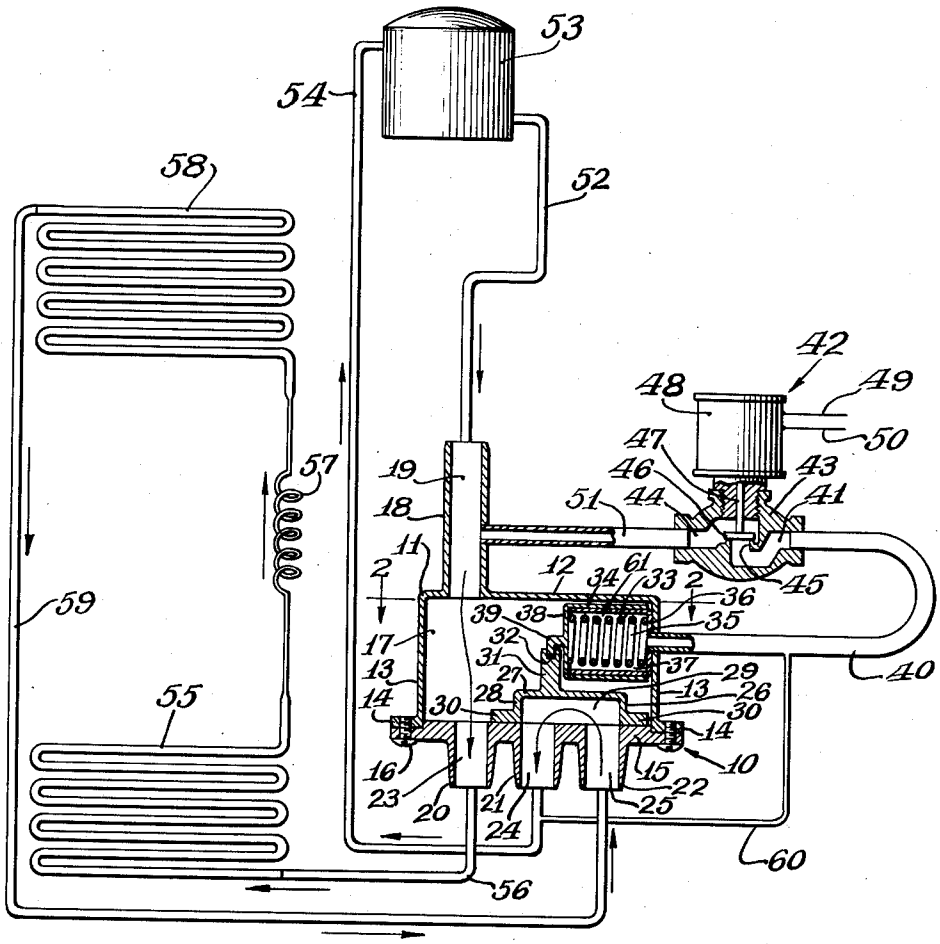
Nov. 15, 1955 A. R. CLARK 2,723,537

REVERSING VALVE FOR REFRIGERATION SYSTEM

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FIG. 1.



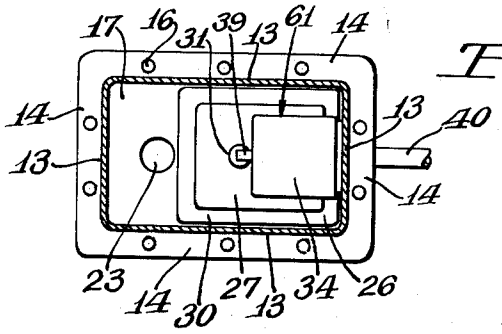


FIG. 2.

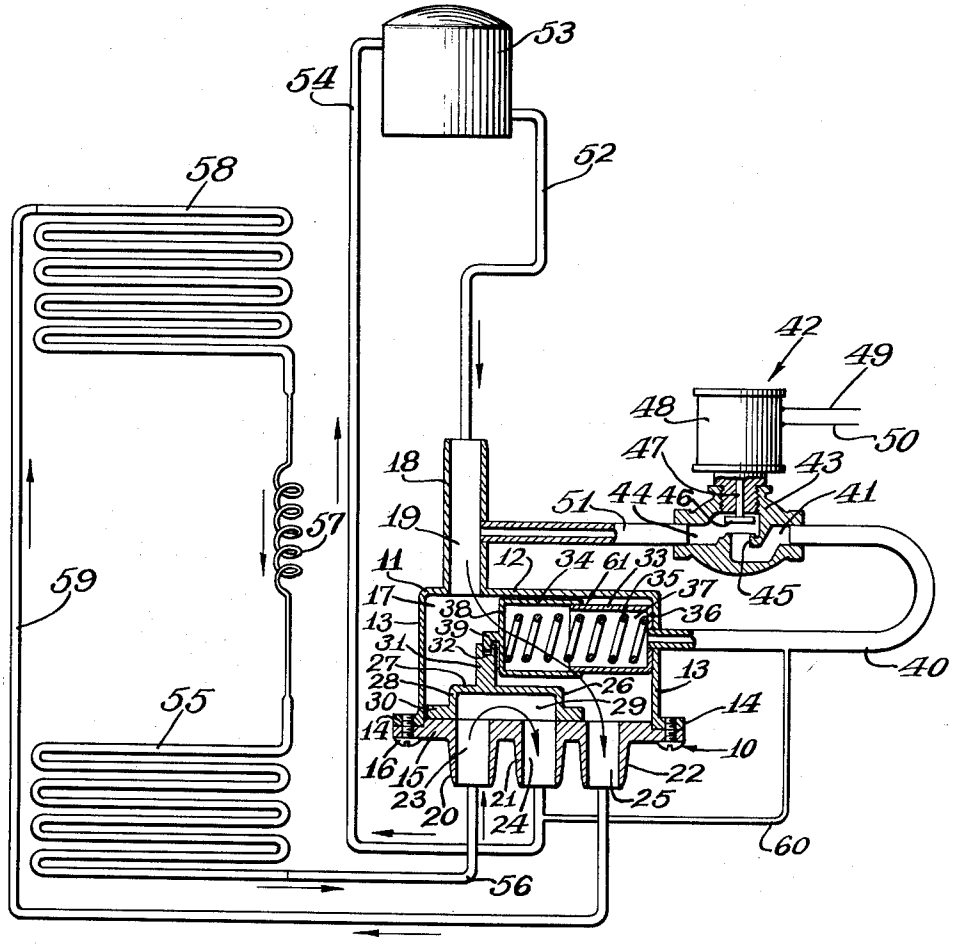
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REVERSING VALVE FOR REFRIGERATION SYSTEM

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FIG. 3.



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2,723,537

REVERSING VALVE FOR REFRIGERATION SYSTEM

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Application December 29, 1951, Serial No. 264,034

10 Claims. (Cl. 62—115)

This invention relates to a reversing valve and more particularly to a reversing valve which operates to reverse the flow of refrigerant through a refrigeration system.

One object of the present invention is to provide a multiple port reversing valve which is connected in a compressor-condenser-evaporator type refrigerating system and which operates to reverse the refrigerant flow through the condenser and the evaporator.

Another object of the invention is to provide a reversing valve which is compactly arranged, economical to manufacture and efficient in operation.

A further object is to provide a reversing valve which will effect rapid defrosting of the evaporator.

A still further object of the invention is to provide a reversing valve having a valve block slidably secured therein whereby the direction of refrigerant flow is reversed by moving said valve block from normal position to reversed position.

A still further object is to provide pressure responsive means for moving said valve block from one position to the other position.

A still further object is to provide a solenoid valve which operates to change the pressure acting on said pressure responsive means whereby the valve block is positioned in response to said solenoid valve.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a cross-sectional view of a reversing valve embodying the present invention with the refrigeration system shown schematically and the reversing valve shown in normal position.

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is similar to Fig. 1 but with the reversing valve shown in reversed position.

Referring now to the drawings, reference numeral 10 designates generally a reversing valve for a refrigeration system. The valve 10 comprises a rectangular shaped outer casing 11 having a top wall 12 and vertical disposed side walls 13. The lower edges of the side walls 13 are provided with outwardly projecting flanges 14 to which is secured a plate 15 by screws 16. The plate 15 is sealed tightly against the flanges 14 in order to enclose a sealed valve chamber 17 within the casing 11. The top wall 12 is provided with an upwardly extending connection 18 having an inlet port 19 therethrough which opens into valve chamber 17. The plate 15 is provided with three downwardly extending connections 20, 21 and 22 having ports 23, 24 and 25 extending therethrough respectively into valve chamber 17.

Positioned within valve chamber 17 is a valve block 26 having a top wall 27 and side walls 28 which enclose a compartment or passageway 29. The side walls 28 of the valve block 26 are provided with outturned edge portions 30 which are slidably secured to the plate 15 in sealed relationship by any suitable means. The top

wall 27 of the valve block 26 is provided with an upwardly extending circular shaped projection 31 which is provided with a slot 32 in the upper end thereof.

Spaced above valve block 26 is a perssure responsive device 61 comprising an inner cylinder 33, an outer cylinder 34 and a coiled spring 35. The inner cylinder 33 has one closed end 36 which is permanently secured to a side wall 13 of the valve casing 11. The outer cylinder 34 fits over the inner cylinder 33 in sliding relationship and the two cylinders cooperate to form a spring chamber 37 therebetween. The outer diameter of the inner cylinder 33 and the inner diameter of the outer cylinder 34 are constructed within close limits whereby the spring chamber 37 is sealed from valve chamber 17. The closed end 38 of the outer cylinder 34 is provided with a centrally located projection 39 having a downturned end portion which extends into the slot 32 provided in valve block 26. A compression type coiled spring 35 is disposed in spring chamber 37 with one end abutting end wall 36 of the inner cylinder 33 and the other end abutting end wall 38 of the outer cylinder 34.

End wall 36 of the inner cylinder 33 is provided with an aperture therethrough into which one end of a curved tube 40 is secured in sealed relationship thereto. The opposite end of the curved tube 40 is connected to the outlet port 41 of a solenoid operated valve 42. The solenoid valve 42 comprises a valve casing 43 having an inlet port 44 and an outlet port 41 with a valve seat 45 therebetween. Positioned over valve seat 45 is a valve plate 46 which is secured to the lower end of a vertically disposed valve stem 47. The opposite end of the valve stem 47 extends upwardly from the valve casing 43 and is connected to a solenoid 48. The solenoid 48 may be one of the many types common in the art which will act to move the valve stem 47 upwardly when energized by a suitable power supply across lines 49 and 50. A tube 51 connects the inlet port 44 of the solenoid valve 42 to the inlet port 19 of the reversing valve 10.

The inlet port 19 of the reversing valve 10 is connected by conduit 52 to the outlet of a motor-compressor unit 53, and the inlet of the motor-compressor unit 53 is connected to the port 24 by conduit 54. A heat exchange unit 55 has one end connected by a conduit 56 to the port 23, and the other end connected to a capillary restrictor tube 57. A second heat exchange unit 58 is connected between the restrictor tube 57 and valve port 25 by a conduit 59. A small diameter tube or capillary tube 60 has one end opening into tube 40 and the other end opening into conduit 54.

Having described the construction and arrangement of parts of the present invention, its operation will now be explained. As is well known in the art, it is necessary to reverse the flow of refrigerant through the heat exchange units of a refrigeration system which is being used in a heat pump in order to change the system from the heating cycle to the cooling cycle, or from the cooling cycle to the heating cycle. Another application of the refrigeration system where reversal of refrigerant flow is required is in a household refrigerator wherein the evaporator is defrosted by passing hot refrigerant gases from the compressor directly into the evaporator. The refrigeration system shown in Fig. 1 and Fig. 3 could be interpreted to be one of these systems.

In Fig. 1 it may be assumed that the refrigeration system is operating on the cooling cycle, and that the arrows designate the path of refrigerant flow. After being compressed by the motor-compressor unit 53 to a high pressure, the refrigerant flows through conduit 52, inlet port 19, valve chamber 17, port 23 and conduit 56 into the heat exchange unit 55. As the refrigerant flows through the unit 55, it will be cooled and condensed by a cooling medium being circulated over the unit, then metered

by the restrictor tube 57 into the heat exchange unit 58 where it will be at a low pressure. Heat will be absorbed by the refrigerant as it passes through the unit 58 from air being circulated over the outer surfaces of the unit 58 whereby the refrigerant will be heated and vaporized. The refrigerant gases will then flow through conduit 59, port 25, valve block passageway 29, port 24, and conduit 54 to the inlet side of the motor-compressor unit 53 from where it will repeat the refrigeration cycle.

During the cooling cycle of the refrigeration system, solenoid valve 42 is not energized so that the valve plate 46 is held in contact with the valve seat 45 whereby tube 40 is sealed from inlet port 19. The capillary tube 60 connects tube 40 to conduit 54, and since the refrigerant flowing through conduit 54 is at a low pressure, tube 40 and the spring chamber 37 of the pressure responsive device 61 will also be subjected to a low pressure. The high pressure refrigerant within valve chamber 17 will be acting against closed end 38 of the outer cylinder 34 and will be great enough to overcome the combined pressure of the spring 35 and the low pressure of the refrigerant within spring chamber 37. This difference in pressures will maintain the outer cylinder 34 in a telescoped position over the inner cylinder 33 as illustrated in Fig. 1, whereby the valve block will be positioned with the valve block passageway 29 connecting the ports 24 and 25.

When the flow of refrigerant through the heat exchange units 55 and 58 is to be reversed, the solenoid 48 is energized through leads 49 and 50. This may be accomplished by a manual switch or automatically controlled means. Upon energization of the solenoid 48, valve plate 46 is moved away from valve seat 45 and tube 40 is connected to the inlet port 19 by tube 51. Capillary tube 60 has such a small diameter that it offers a high resistance to the flow of refrigerant therethrough so that a high pressure will be maintained within tube 40 and within the spring chamber 37 when the valve plate 46 is positioned above valve seat 45. Spring 35 is calibrated so that when the spring chamber 37 is subjected to this high pressure, the spring 35 will force outer cylinder 34 to slide away from the closed end 36 of the inner cylinder 33 to the position shown in Fig. 2. During this movement, valve block 26 will be moved by the outer cylinder 34 to the position illustrated where the port 23 is connected to the port 24 by passageway 29. The high pressure refrigerant from motor-compressor unit 53 will now flow through conduit 52, port 19, valve chamber 17, port 25, conduit 59 into heat exchange unit 58 where it will be cooled and condensed, and then metered by capillary tube 57 into heat exchange element 55 where it will be heated and vaporized at a low pressure. The refrigerant vapors will then be returned to the motor-compressor unit 53 through tube 56, port 23, passageway 29, port 24 and conduit 54.

To change the refrigeration system to the cooling cycle, it is only necessary to break the circuit to solenoid 48, which again moves the valve plate 46 into contact with valve seat 45. The tube 40 will no longer be in communication with inlet port 19, and the high pressure refrigerant within the tube 40 and spring chamber 37 will meter through capillary tube 60 until the pressure therein is equal to the low pressure within conduit 54. The high pressure refrigerant within valve chamber 17 will now force the outer cylinder 34 to the position shown in Fig. 1 whereby valve block 26 is moved to cooling position. By providing the capillary tube 60 with a carefully determined inner diameter, the high pressure refrigerant within the tube 40 and the pressure responsive device 61 will be quickly metered into conduit 54 whereby the valve block 26 will be moved to cooling position shortly after the solenoid valve 42 has closed.

From the foregoing it is readily apparent that a reversing valve is provided which is particularly adaptable for reversing the direction of flow of refrigerant within a refrigeration system. The reversing valve is simple in structure, compactly arranged and efficient in operation. A multiple port reversing valve is combined with a solenoid valve so that the reversing valve is operated by the difference in refrigerant pressures whenever the solenoid valve is opened or closed. The reversing valve can be easily and quickly operated by simply energizing or deenergizing the solenoid valve. The reversing valve is ruggedly constructed and the parts are so arranged and sealed that the problem of refrigerant leakage therefrom is reduced to a minimum.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and it is desired that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What is claimed is:

1. In a refrigeration system having two heat exchange units connected in series to a compressor and being charged with a refrigerant, a reversing valve comprising a casing having a valve chamber, a valve block movably mounted within said valve chamber, a tube connecting said chamber to the outlet of said compressor, refrigerant flow means associated with said heat exchange units, said chamber, and the inlet of said compressor operating responsive to the movement of said valve block to one position for causing said refrigerant to flow in one direction through said heat exchange units and operating responsive to the movement of said valve block to another position for causing said refrigerant to flow in the opposite direction through said heat exchange units, a pressure responsive device mounted within said valve chamber so that said pressure responsive device is externally exposed to the pressure within said valve chamber, said pressure responsive device comprising a portion movable in response to pressure differences internally and externally of said pressure responsive device, said portion joined to said valve block, means operable to connect said compressor outlet internally of said pressure responsive device whereby the pressure acting on said movable portion will be equalized, biasing means operating responsive to said equalized pressures for moving said movable portion to in turn move said valve block to said one position, and means effectively operating when said second means is not operated for connecting the inlet of said compressor internally of said pressure responsive device, whereby the compressor outlet pressure within said valve chamber will overcome said biasing means and move said movable portion of said pressure responsive device which will in turn move said valve block to said another position.

2. In a refrigeration system as claimed in claim 1, said refrigerant flow means comprising a plurality of ports mounted through said valve casing, and a plurality of tubes associated with said valve ports, said two heat exchange units and the inlet of said compressor, said valve ports positioned through said valve casing in a cooperating relationship to said valve block whereby different refrigerant circuits are completed through said valve ports and said chamber dependent upon the position of said valve block.

3. In a refrigeration system as claimed in claim 1, said pressure responsive device formed in the shape of two concentric cylinders, one of said cylinders rigidly attached to an inner wall of said valve chamber, the other of said cylinders being sealed at one end and comprising said portion movable in response to pressure differences internally and externally of said pressure responsive device.

4. In a refrigeration system as claimed in claim 1, said second means comprising a conduit connected to said compressor outlet and through said valve casing to the inside of said pressure responsive device, and an operable valve connected in a portion of said conduit.

5. In a refrigeration system as claimed in claim 4, said

operable valve comprising a solenoid valve, and means for biasing said solenoid valve to close said conduit when said solenoid valve is deenergized.

6. In a refrigeration system as claimed in claim 4, said fourth means comprising a tube having a diameter substantially smaller than the diameter of said conduit, said small diameter tube connected to the inlet of said compressor and to said conduit in a portion thereof between said operable valve and said pressure responsive device.

7. In a refrigeration system as claimed in claim 1, said biasing means comprising a coil spring mounted within said pressure responsive device, said coil spring having a potential force sufficient to move said movable portion when the pressures internally and externally of said pressure responsive device are equal.

8. In a refrigeration system, a reversing valve comprising a valve casing defining a valve chamber, a plurality of ports formed through said valve casing into said valve chamber, valve means movably mounted within said valve chamber for establishing communication between certain ones of said plurality of ports and between certain ones of said plurality of ports and said valve chamber dependent upon the movement thereof, pressure responsive actuating means operating responsive to pressures applied internally and externally thereof for moving said valve means to establish communication between certain ones of said plurality of ports and said valve chamber independent of any pressures on said valve means, said pressure responsive actuating means mounted within said valve chamber so that said pressure responsive actuating means is externally exposed to any pressure established within said valve chamber through at least one of said plurality of ports, said pressure responsive actuating means further mounted in cooperation with a separate one of said plurality of ports so that said pressure responsive actuating means is internally exposed to any pressure established at said separate one of said ports.

9. In a refrigeration system as claimed in claim 8, said pressure responsive actuating means comprising two concentrically cooperating cylinders, one of said cylinders

rigidly mounted to an inner wall of said valve casing and including said separate one of said ports, the other of said cylinders having one end closed and slidable over said one of said cylinders, so that said other of said cylinders is movable in response to pressure differences internally and externally of said two cylinders, and linkage means mounted to the closed end of said other cylinder and to said valve means for a translation of the movement of said other cylinder into a movement of said valve means.

10. In a refrigeration system, a reversing valve comprising a valve casing defining a valve chamber, five ports formed through said valve casing into said valve chamber, valve means mounted within said valve chamber and movable to one position for establishing communication between the first and second of said five ports through said valve chamber and between the third and fourth of said five ports, and to another position for establishing communication between the first and fourth of said five ports through said valve chamber and between the second and third of said five ports, pressure responsive actuating means operating responsive to pressures applied internally and externally thereof for moving said valve means, said pressure responsive actuating means mounted within said valve chamber so that said pressure responsive actuating means is externally exposed to any pressure established within said valve chamber through the first and second of said five ports when said valve means is in said one position and through said first and fourth of said five ports when said valve means is in said another position, said pressure responsive actuating means further mounted in cooperation with the fifth of said five ports so that only said pressure responsive actuating means is internally exposed to any pressure established at said fifth of said five ports.

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