

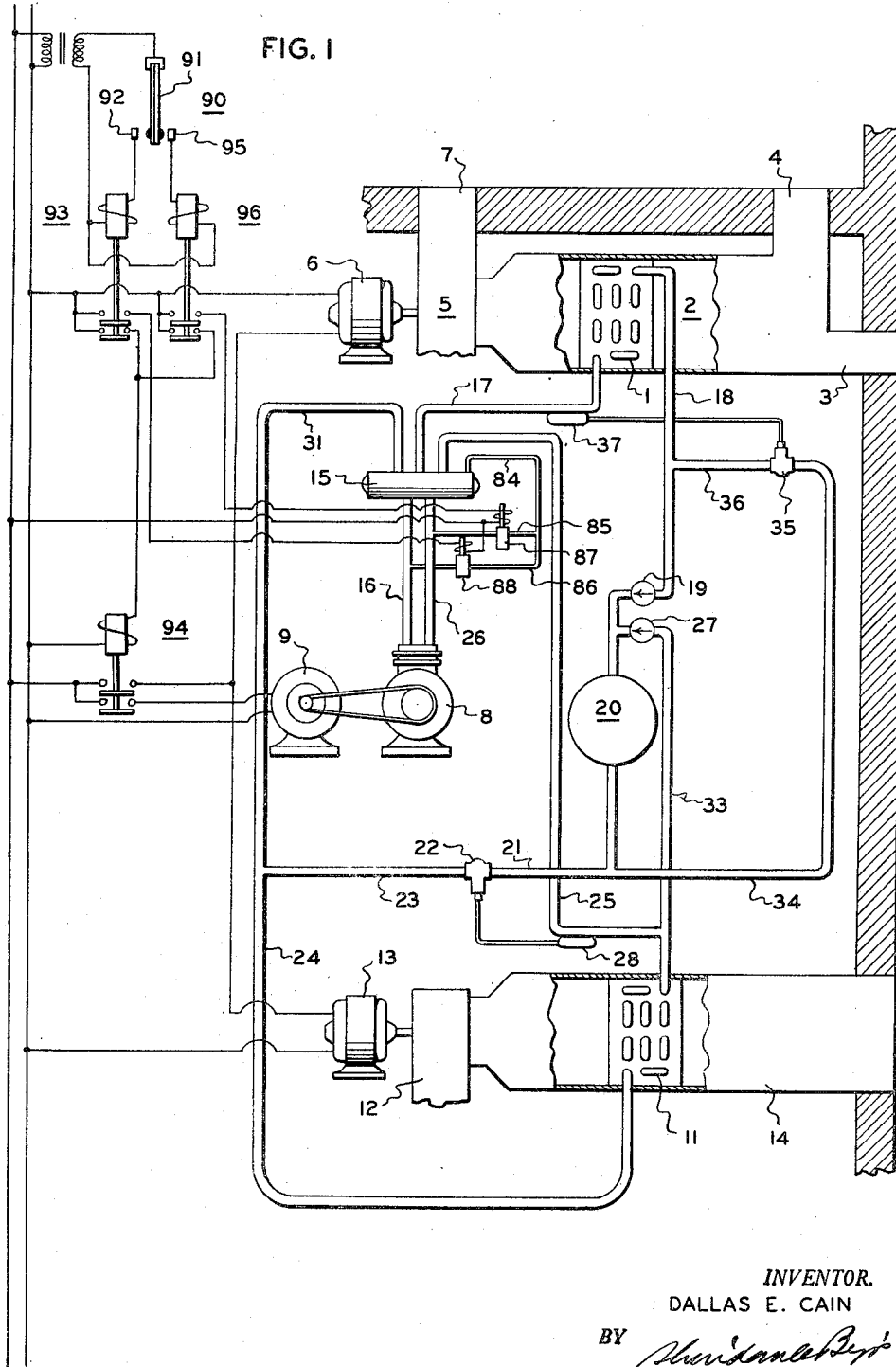
Oct. 30, 1956

D. E. CAIN
COMBINED UNLOADING AND REVERSING VALVE FOR REVERSIBLE
REFRIGERATING SYSTEM

2,768,506

Filed Oct. 6, 1954

2 Sheets-Sheet 1



INVENTOR.

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BY

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HIS ATTORNEY

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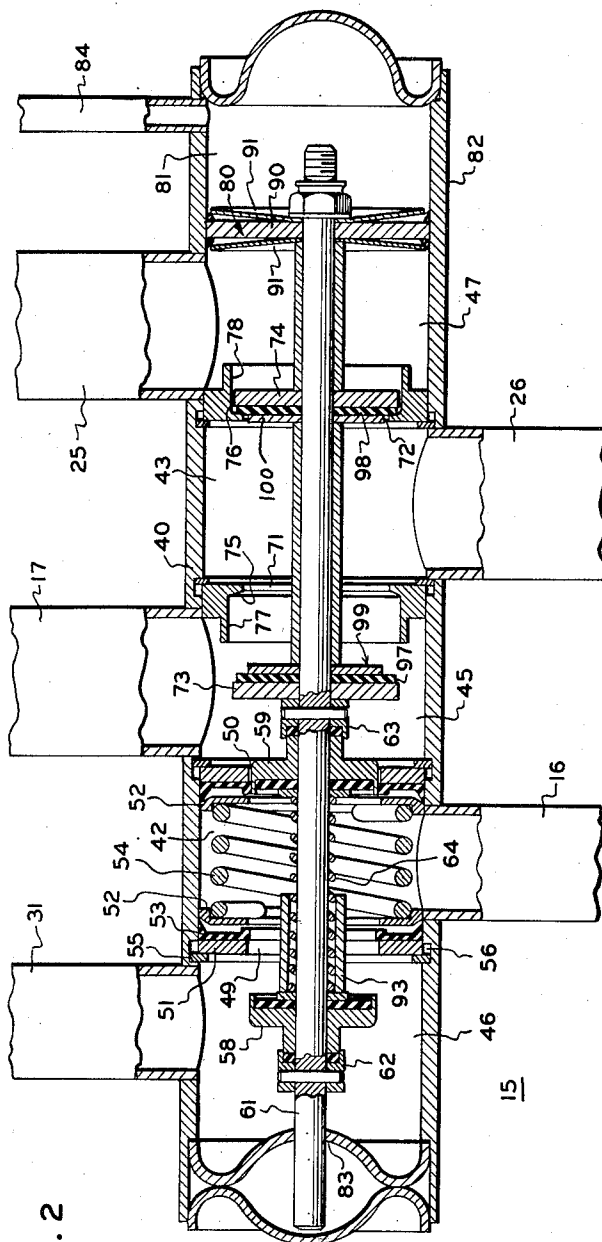


FIG. 2

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2,768,506

COMBINED UNLOADING AND REVERSING VALVE FOR REVERSIBLE REFRIGERATING SYSTEM

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Application October 6, 1954, Serial No. 460,616

8 Claims. (Cl. 62—3)

The present invention relates to reversible refrigerating systems and particularly to a control valve for effecting both the reversal or changeover of such systems and also the unloading thereof during the changeover.

The reversible refrigerating systems known as heat pumps which are employed for heating dwellings or other structures in the winter and for cooling in the summer, include interconnected indoor heat exchange and outdoor heat exchange units or coils through which refrigerant is circulated by a compressor in a direction which is dependent upon the desired cycle of operation of the refrigerating system. For example, during operation of the system on the heating cycle, the indoor coil functions as a condenser and the outdoor coil as an evaporator. To reverse the functions of the two coils for operation of the system on the cooling cycle, it is necessary to reverse the connections of the compressor to the system so that the refrigerant flow will be such that the indoor coil functions as the condenser and the outdoor coil as the evaporator. Various changeover valve arrangements have been employed for connecting the two heat exchange units or coils alternatively to the suction and discharge sides of the compressor. Due to the normally high pressure differences prevailing between the two sides of the refrigerating system, very substantial forces have been required to reverse the changeover valves and various unloading arrangements have therefore been used for overcoming this difficulty. However, these systems, which in general have included at least one and usually two reversing valves plus some unloading arrangement, have not been entirely satisfactory from the standpoint of simplicity and cost or from the standpoint of securing proper and efficient operation of the systems under all conditions. In addition the time required to effect a complete changeover of a system of this type from operation on one cycle to operation on the other has been substantial in that the system must first be unloaded before switchover of the reversing valves for operation of the system on the reverse cycle.

Accordingly it is a primary object of the present invention to provide a combination unloading and reversing valve for a reversible refrigerating system, which valve is of simple and compact construction and effective to unload and reverse a refrigerating system under all pressure or operating conditions.

It is another object of the invention to provide a combination unloading and reversing valve for a reversible refrigerating system which is substantially pressure balanced to permit easy operation thereof for effecting both unloading and reversal of the refrigerating system.

It is a further object of the invention to provide a simple and low cost five-way unloading and reversing valve for a reversible refrigerating system.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the inven-

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tion will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In carrying out the objects of this invention, there is provided a five-way valve structure for a reversible refrigerating system, which structure comprises a high pressure valve chamber having a pair of opposed ports for directing the flow of compressed refrigerant from a compressor to either of two heat exchange units and a low pressure valve chamber connecting the other of the two units to the suction side of the compressor for flow of refrigerant from that unit through either of two inlet ports in the low pressure valve chamber and through an outlet to the suction side of the compressor. A valve member or a disc is provided for each of the ports and these valve members are mounted on a single valve actuating shaft in such a manner that one port in each of the chambers is closed and the other port opened when the valve is in either of its two operating positions. The valve members or discs for the ports in one of the two valve chambers are in the form of sleeve valves slidably arranged on the valve actuating shaft for movement beyond a normal port closing position to a system unloading position against the action of a biasing means which normally holds the sleeve valves in their port closing positions on the shaft.

For a better understanding of the invention, reference may be had to the accompanying drawing in which Fig. 1 is a diagrammatic illustration of an air conditioning or heat pump system provided with a reversible refrigerating machine including the valve embodying the present invention, and

Fig. 2 is an enlarged detailed sectional view of the changeover valve forming the subject matter of the present invention.

Referring now to Fig. 1 of the drawing, the system disclosed comprises an indoor heat exchange unit or coil 1 arranged in a duct 2 to heat or cool air admitted to the duct through a fresh air inlet 3 and through a room return air inlet 4 and circulated over the unit 1 by operation of a blower 5 driven by a motor 6, the air discharged from the blower being returned to the room by a duct 7. The indoor unit or coil 1 is arranged to operate either as the condenser or evaporator of a refrigerating system through which refrigerant is circulated by means of a compressor 8 driven by an electric motor 9. The system also includes a second heat exchange unit or coil 11 over which outdoor air is circulated by a blower 12 driven by an electric motor 13. The blower 12 is arranged to draw outside air through a duct 14 and to discharge the air to a suitable exhaust connection (not shown).

A five-way valve 15, which forms the subject matter of the present invention, controls the flow of refrigerant from the compressor to the coils 1 and 11 and back to the compressor so that the refrigerating machine can be operated with the coil 1 as the condenser for heating the air passing through duct 2 or as an evaporator for cooling that air. When the system is operated with the unit 1 as the condenser and the unit 11 as the evaporator for heating purposes during the winter, hot compressed refrigerant is delivered by the compressor 8 through the high pressure discharge line 16 to the five-way valve 15. From the valve 15, the high pressure refrigerant flows through the middle fluid flow connection or conduit 17 to the indoor coil 1. In the indoor coil 1, the refrigerant is cooled and liquefied by heat exchange with the air flowing through the duct 2 and the heated air is delivered by the blower 5 to the interior of the dwelling or other structure being conditioned. The liquefied refrigerant flows from the indoor coil 1 through the conduit 18 and check valve 19 to a liquid receiver 20. Liquid refrigerant from the receiver passes through the conduit 21, expan-

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sion valve 22, and conduits 23 and 24 to the outdoor coil 11 where it is vaporized by the absorption of heat from the outdoor air circulated through the duct 14 by the blower 12. The vaporized refrigerant from the outdoor coil 11 then flows through the suction conduit 25, the five-way valve 15 and the suction or intake line 26 to the compressor 8. The expansion valve 22 is provided with a feeler bulb 28 in heat exchange with the outlet connection of the unit 11 and operates in the usual manner to maintain a predetermined amount of superheat of the refrigerant discharged from the coil 11 when this coil is acting as an evaporator.

During operation of the system on the cooling cycle with the indoor coil 1 functioning as an evaporator, the high pressure refrigerant from the compressor 8 flows through the discharge line 16, valve 15, conduit 31 and conduit 24 to the outdoor coil 11, flow of refrigerant through the conduit 23 being prevented by the fact that the expansion valve 22 is closed. From the outdoor coil 11, the liquefied or condensed refrigerant passes through conduit 33 and check valve 27 to the liquid receiver 20. From the receiver 20 liquid refrigerant flows through the conduit 34 to the expansion valve 35 which controls the flow of refrigerant to the indoor coil 1 through conduit 36 and 13. In the coil 1, the liquid refrigerant is vaporized or evaporated by heat exchange with the room air flowing through the duct 2 and the vaporized refrigerant is returned to the compressor through conduit 17 which now functions as a suction conduit, valve 15 and suction line 26. The degree of superheat of the refrigerant returning from the indoor coil 1 is controlled by the expansion valve 35 provided with a thermal feeler bulb 37 in contact with the conduit 17 adjacent the outlet from coil 1. During the heating operation, when conduit 17 carries high pressure hot refrigerant from the compressor to the indoor coil 1, the bulb 37 sensing the relatively high temperatures then existing in the conduit 17 completely closes the expansion valve 35 to prevent flow of the hot refrigerant through the conduits 36 and 34.

From the foregoing it will be apparent that the direction of flow of refrigerant through the system is controlled by the single valve 15. The manner in which this valve operates will be more readily apparent by reference to the sectional view thereof in Fig. 2 of the drawing in which the valve is shown in its operating position for directing the flow of refrigerant through the system during the cooling cycle with the outdoor coil 11 functioning as a condenser and the indoor coil 1 an evaporator.

Referring now to Fig. 2 of the drawing, the valve 15 comprises a casing 40 having therein a plurality of valve chambers including a high pressure or compressor discharge valve chamber 42 and a low pressure or compressor suction valve chamber 43. Compressed refrigerant is supplied to the valve chamber 42 through the compressor discharge line 16 while the suction line 26 forms an outlet connection for the valve chamber 43.

The valve also includes a plurality of system valve chambers each having external fluid flow connections with one or the other of the heat exchange units or coils 1 and 11. One of these system chambers indicated by the numeral 45 is positioned between the high pressure valve chamber 42 and the low pressure valve chamber 43 and is connected to the indoor coil 1 by the conduit 17. Additional system chambers 46 and 47 which are respectively located on the sides of the compressor valve chambers 42 and 43 opposite the system chamber 45 are connected to the outdoor coil 11. The system chamber 46 which is adjacent the high pressure valve chamber 42 is connected to the outdoor coil through the conduit 31 while the system chamber 47 which is adjacent the low pressure or suction valve chamber 43 is connected to the outdoor coil through conduit 25.

Communication between the high pressure chamber 42 and the adjacent system chambers is provided in the form

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of opposed coaxial ports 49 and 50, each of which is made up of a plurality of annular or ring-shaped members including a backing ring 51, a retainer ring 52 and a ring-shaped gasket or sealing member 53 sandwiched between the rings 51 and 52 with the central apertures in the three ring-shaped members 51, 52 and 53 being coaxial and co-extensive and together forming the ports 49 and 50. A spring member 54 within the high pressure valve chamber 42 having its opposite ends bearing against the retainer ring 52 serves to compress the gasket 53 between the retainer ring 52 and the backing ring 51, each of the backing rings 51 being held in position by the snap rings 55 engaging the recessed portions 56 in the valve casing 40.

The purpose of this arrangement for compressing the seal or gasket 53 between the two ring members 51 and 52 is to maintain the outer periphery of the seal 53 in contact with the inner periphery of the casing 40. By means of an interference fit, the inner periphery of seal 53 contacts the outer periphery of members or discs 53 and 59 which respectively are designed to slide into and close the ports 49 and 50 by a sleeve valve action. These valves control the flow of gas from the high pressure chamber 42 to either the system chamber 46 or the system chamber 45, only one of the ports 49 or 50 being closed and the other open for operation of the system on either the heating or cooling cycle. The two valve members 58 and 59 are mounted on and actuated by a common shaft 61 extending longitudinally in the casing 40 and along the common axis of the opposed ports 49 and 50. These valve members 58 and 59 are spaced apart on the shaft 61 a distance greater than the distance between the opposed ports 49 and 50. However this spacing and the thickness of seal back-up rings 51 are such that over a portion of the actuation stroke of shaft 61, these valve members 58 and 59 are simultaneously within the inner periphery of their respective ring members 51 and so simultaneously close ports 49 and 50 though these ports are not sealed until near the extreme positions of the shaft 61 where the valve members 58 or 59 engage their respective seals 53. These valve members 58 and 59 are held in this spaced-apart relationship against stops 62 and 63 by means of a spring 64 surrounding the shaft 61 within the high pressure valve chamber 42. It will be noted that these valve members 58 and 59 are respectively positioned for movement into the system chamber when in the port opening position and close their cooperating ports by movement against the direction of flow of the gas through that port. Both of the valve members 58 and 59 are slidably arranged on the shaft 61 and are capable of limited movement against the biasing action of the spring 64 entirely through the port served by the valve member and into the high pressure valve chamber 42, this relative movement being provided to effect unloading of the system during the changeover operation in a manner which will be described more fully hereinafter.

Also concentrically arranged about the shaft 61 or in other words coaxial with the ports 49 and 50 are a second pair of opposed ports 71 and 72 respectively providing communication between the low pressure or suction chamber 43 and the adjacent system chambers 45 and 47. A valve member or disc 97 supported by discs 73 and 99 and fixed to the shaft 61 is adapted to close the port 71 while a second valve member or disc 98 supported by discs 74 and 100 and fixed to the shaft 61 is arranged to close the port 72. These valve members are spaced apart on the shaft 61 a distance greater than the distance between the ports 71 and 72 and about the same distance as valve members 58 and 59 so that only one of the ports is closed at any given time. The valving arrangement for the low pressure or suction chamber 43 is of the face-seating type in that the valve discs 97 and 98 face-seat on valve seats 75 and 76 forming part of or surrounding the ports 71 and 72. Also each of the ports 71 and 72 have extension or sleeve portions 77 and

78 extending away from the valve seats and towards the cooperating valve discs or in other words into the adjacent system chambers. These extending portions are of a diameter only slightly larger than the diameter of the discs or members 73 and 74 and with the cooperating valve member form loosely fitting sleeve valves.

The valve shaft 61 is actuated by a pneumatic arrangement which includes a piston element 80 reciprocally arranged in cylinder 81 formed by the extending end portion 82 of the casing 40 connected to and supporting one end of the shaft 58. The other end of the shaft 58 is slidably supported in a bearing member 83.

The piston 80 comprises a rigid disc element 90 fixed to the shaft 61, and dish-shaped discs 91 on opposite sides of the element 90 formed of spring steel or the like and adapted to engage at their peripheries sealing rings of teflon or the like with a compressive force that has a radially outwardly directed component which forces the teflon seals into tight engagement with the wall of the cylinder 81.

Piston 80 in effect forms an end wall for system chamber 47. The actuation of the valve mechanism including the shaft 61 and the various valve members or discs is effected by creating a pressure differential on the opposite sides of the piston 80 which is accomplished by admitting to the cylinder 81 through the conduit 84 refrigerant gas at either suction pressure or discharge pressure depending on the pressure in chamber 47. As is shown in Fig. 1 of the drawing the other end of the conduit 84 is in the form of branched lines 85 and 86 connected respectively to the suction line 26 and the compressor discharge line 16. Each of the branched lines 85 and 86 is provided with a solenoid operated valve 87 and 88 for controlling the admission of refrigerant gas at either suction pressure or at discharge pressure to the cylinder 81. The valves 67 and 68 are in turn operated by an electrical control system including a room thermostat 90 which also controls the operation of the remaining electrically operated elements of the refrigerating machine.

Upon a call for cooling by the room thermostat 90 the bimetallic element 91 moves to the left to engage the contact 92 which completes a control circuit resulting in the closing of the relay switches 93 and 94 so that the fan motors 6 and 13 and the compressor motor 9 are energized as is also the control circuit for the solenoid valve 88. Opening of valve 88 causes refrigerant gas at discharge pressure to be admitted to cylinder 81 of the valve 15. On the other hand when the bimetallic element 91 moves to the right into contact with the contact 95 the relay switches 96 and 94 are closed to energize the circuits controlling the motors 6, 9 and 13 and also to energize the circuit controlling the solenoid valve 87 with the result that suction gas from the suction line 26 is admitted to the valve control cylinder 81.

The advantages of the present valve structure for the unloading and reversing of a reversible refrigerant system will best be understood from a consideration of the manner in which the valve is connected into the reversible refrigerant system and the manner in which the valve operates during a reversal of the system.

With the valve mechanism including the shaft 61 and the valve members 59 and 98 in the position shown in Fig. 2, that is with the shaft 61 moved to the left so that the valve members 59 and 98 respectively close ports 50 and 76, the compressor 8 is connected to the refrigerating system for operation of the system on the cooling cycle with the discharge gas from the compressor discharge line 16 passing through the chambers 42 and 46 and conduit 31 to the outdoor coil 11. Vaporized refrigerant is returned from the indoor coil 1 through the conduit 17, the system chamber 45 and through the port 71 into the suction valve chamber 43 from which it passes through the suction line 26 to the compressor 8.

Considering the pressure conditions existing within the

valve at this time, it will be noted that high pressure or compressor discharge pressure conditions exist in the valve chambers 42 and 46 as well as the system chamber 47. The existence of high pressure conditions within the chamber 47 results from the fact that the conduit 31 connected to the system chamber 46 and the conduit 25 connected to the system valve chamber 47 are connected to the outdoor coil 11. One of these chambers carries a flow of refrigerant on one cycle of operation and the other on the other cycle of operation but because they are interconnected through the system whatever pressure conditions exist in the operating chamber also exists in the inoperative or dead-end chamber. In other words the pressures within the chambers 46 and 47 are always the same and may be either high when chamber 46 is operating or low when chamber 47 is operating.

While high pressure refrigerant is present in chambers 42, 46 and 47, low or suction pressures exist within the chambers 43 and 45 when the valve is in the operating position shown in Fig. 2. Thus there will be a pressure differential across the valve member or disc 59, which member closes the port between the high pressure chamber 42 and the low pressure system chamber 45. This pressure differential is to the right. On the other hand, there is an oppositely directed pressure differential across the valve member or disc 98 which is closing the port 72 between the high pressure system chamber 47 and the suction valve chamber 43. For the same effective valve areas these two pressure differentials would exactly balance one another so that unlike the usual three-way valve or valves employed for reversing reversible refrigerating systems, the switchover movement of the valve members could be effected with a minimum or theoretically no effort. However, in order to provide a holding force to maintain the valve in either of its operating positions, the suction valve members 97 and 98 are made to have a larger effective valve area than the valve members 58 and 59 so that there is a slight over-all pressure differential which tends to hold the valve mechanism in an operating position.

This holding force is determined entirely by the pressure differentials existing across the various valve discs or members since the pressures on the opposite side of the operating piston 80 are the same or equal when the valve is in either of the two operating positions and the system operating on the heating or cooling cycle. For example, with the valve in the position shown in Fig. 2 both the system chamber 47 and the cylinder 81 are connected to sources of high pressure refrigerant so that the pressures on the two sides of the piston 80 are the same.

Upon a call for heating by the room thermostat 90 the solenoid valve 88 is de-energized and the solenoid valve 87 energized so that the suction line 26 is connected to cylinder 81 and the high pressure gas in the cylinder is vented to suction pressure. There is thereby created a pressure differential across the piston 80 to the right. Since the piston 80 has a larger effective area than the difference in effective areas between the suction valve discs 97 or 98 and the high pressure discharge chamber valve discs 58 or 59, the valve shaft assembly moves to the right. This shifting to the right continues until the right-hand suction valve 74 begins to move out from the recess within the seat extension or sleeve 78. At this point, two conditions come into play and are significant in the operation of the valve. First, the left-hand suction valve 73 has moved into the seat extension 77 with the result that the suction line 26 is substantially closed off from the indoor coil with which it was previously connected through the port 71. On the other hand the leakage around the valve member or disc 74 which has moved slightly out from the seat extension or sleeve 78 causes an equalization of pressure across this valve member, which pressure has previously been responsible for maintaining the entire valve mechanism in its operating position for operation of the system on the cooling cycle.

The admission of high pressure gas from the conduit 25 and valve chamber 47 to the suction line 26 also causes an equalization of pressures across the piston 80 due to flow of the high pressure gas from the conduit 25 through the suction line 26, the open valve 87 and conduit 84 into the cylinder 81. Thus there is a loss of shifting force, and the shifting of the valve slows down or hesitates momentarily. From this point on the piston is no longer effective in the shifting sequence.

At or near this hesitation point, the movable valve member or disc 58 for the discharge chamber port, has moved into a position where its unloading action becomes effective. At this hesitation point, the right-hand discharge valve 59 has moved out from its seal position within the port 50 and the low pressure conditions within the conduit 17 and the indoor coil 1 begins to draw down the discharge line pressure, that is, the pressure within the discharge chamber 42 and the line 16. Also at this point, the left-hand disc or member 58 has entered its cooperating port 49 and isolated chambers 46 and 42 from each other. While the pressure conditions with regards to these chambers have been the same, that is, high pressure conditions, up to this point, there now occurs a pressure difference between these chambers which is due to the unloading of the high pressure from the compressor discharge line 16 into the low pressure portion of the system including the conduit 17. As a result, the higher pressure bearing on the left or rear side of the valve member 58 overcomes the biasing force of spring 64 and the valve member 58 moves entirely through the port 49 and to the right into the high pressure valve chamber 42. A sleeve 93 surrounding a portion of the spring 64 between the valve members 58 and 59 and extending about half way between the two valve members when they are in their normal positions against their respective stops 62 and 63 serves to limit the forward travel of either of these valves during their check valve or unloading action by contact of the sleeve with the opposite valve member. With the valve member 58 in its unloading position, both the compressor connected to the discharge line 16 and the portion of the system which had been operating at a high pressure, that is, the portion of the system including the outdoor coil 11 and the conduit 31 now supply high pressure gas through the port 50 to the low pressure side of the system including the conduit 17 and the indoor coil 1. This continues until the indoor coil pressure and the outdoor coil pressure are equalized. Thereupon the spring 64 returns the left-hand discharge valve 58 to its operating position against the stop 62 and within the port 49.

After the return of the discharge valve 58 against its stop 62, the main flow of discharge gas is to the indoor coil through the partially opened port 50 and the conduit 17 while the flow of suction gas is from the outdoor coil through conduit 25, the partially opened port between 78 and 74, and suction line 26. The subsequent pressure build-up of the indoor coil side of the system, and the pressure draw down of the outdoor coil side results in a pressure difference which acts on the difference in area of the suction disc 73 over the discharge valve 58 so that the valve shaft 61 is urged to complete its stroke in the right-hand direction until the valve disc 97 seats against the valve seat 75.

Upon a subsequent call for a reversal of the system to the cooling operation, the shifting sequence of the valve is somewhat the same except in reverse. A minor difference exists in the conditions that determine the hesitation point. In this case, discharge pressure is connected to the cylinder 81 to initiate the shift and the hesitation point is determined by the point at which the pressures across the piston 80 are equalized by valve member 58 leaving ring 51 of port 49 and thereby admitting discharge pressure to chamber 47, with valve disc 74 having already entered sleeve extension 78 and isolated chamber 47.

By the present arrangement there is provided a change-over valve including a check valve action which permits the refrigerant system to bleed down at a relatively fast rate rather than to be pumped down by action of the compressor. Also, the check valve action prevents the pressure reversal on the stationary discharge seals of the suction valve ports from being great enough to be destructive to these seals and seats. In addition, there has been provided by the present invention, a valve which will properly shift to either of the two operating positions when starting up the reversible refrigerating system from a pressure-equalized condition. This operation will take place regardless of the position of the valve shaft assembly at the time the compressor is started.

To explain this operation, the shift stroke may be considered as comprising three portions or regions. In shifting from cooling to heating with the suction line connected to 81, the first region begins with the cooling position and extends to the point where disc 73 enters 77. Should the valve assembly be located in this region upon starting the compressor with an equalized system, the compressor will begin to charge the outdoor coil and draw down the indoor until sufficient pressure differential exists across piston 80 to overcome the shaft assembly friction and move the shaft assembly into the second region.

This second region extends to the point where disc 74 moves out of sleeve 78, which is the aforementioned "hesitation point." With the valve assembly in this region the compressor suction line is essentially closed off. Therefore upon starting the compressor the pressure in line 76 will be drawn down below the system pressure in chamber 47 until sufficient pressure differential exists across piston 80 to move it to this hesitation point.

The third region begins with this hesitation point and extends to the seated position for heating. Should the valve assembly be located at the hesitation point or in this region upon starting, the compressor main gas flow will be discharged to the indoor coil and suction from the outdoor coil. The compressor will then build up a system pressure differential, until this differential pressure applied to the area differential between discs 73 and 58 supplies the force necessary to move the valve assembly into its seated position for heating.

The same operation takes place in the opposite direction except in this case the discharge line is connected to 81 and the three regions are defined by the action of the discharge valves 58 and 59 and ports 50 and 49. The division between the first and second region is the position where valve 59 begins to enter its ring 51; the second region extends to the hesitation point which is where valve 58 leaves its ring 51; the third region comprises the rest of the stroke to the fully sealed position in cooling.

From the above, it can be realized that should the valve assembly become lodged in the stroke, the construction of the valve allows a pressure differential to build up in a direction to overcome the lodging force. The maximum force available is determined by the closeness of the fit between discs 73 and 77, and sleeve extensions 74 and 78 as well as the fit of the discharge valves 58 and 59 in ports 49 and 50 prior to their engagement to their seals 53.

While there has been shown and described a specific embodiment of the present invention, it is to be understood that the invention is not limited thereto, and it is intended by the appended claims to cover all modifications within the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A combination unloading and reversing valve for a reversible refrigerating system comprising a casing having therein a high pressure valve chamber and including an inlet and opposed outlet ports for controlling the flow of refrigerant in either of two paths to said system, a low pressure valve chamber including a pair of opposed inlet ports for receiving refrigerant from said sys-

tem, and spaced valve members for alternatively closing the ports in each of said chambers, the valve members for the ports of one of said chambers being sleeve valves slidably mounted on said shaft for movement beyond a port closing position to unload said system, and resilient means for holding said valve in its normal port closing position.

2. A combination unloading and reversing valve for a reversible refrigerating system comprising a casing having therein a high pressure valve chamber and including an inlet and opposed outlet ports for controlling the flow of refrigerant in either of two paths to said system, a low pressure valve chamber including a pair of opposed inlet ports for receiving refrigerant from said system, and spaced valve members for alternatively closing the ports in each of said chambers, the valve members for the ports of one of said chambers being sleeve valves slidably mounted on said shaft for movement along said shaft beyond a port closing position to unload said system during reversing operation of said valve.

3. A combination unloading and reversing valve for a reversible refrigerating system comprising a casing having therein a high pressure valve chamber and including an inlet and opposed outlet ports for controlling the flow of refrigerant in either of two paths to said system, a low pressure valve chamber including a pair of opposed inlet ports for receiving refrigerant from said system, and spaced valve members for alternatively closing the ports in each of said chambers, said valve members being mounted on a common shaft, the valve members for the ports of said high pressure chamber being sleeve valves slidably mounted on said shaft for movement beyond a port closing position and into said high pressure chamber to unload said system during reversing operation of said valve and resilient means for holding said valve in its normal port closing position.

4. A control valve for controlling the flow of refrigerant through a reversible refrigerating system including a compressor and two heat exchange units, said valve comprising a casing having a discharge valve chamber and a suction valve chamber and external flow connections for connecting said chambers respectively to the discharge and suction lines of said compressor, each of said chambers having a pair of opposed ports, a valve member for closing each of said ports, valve actuating means interconnecting all of said valve members and arranged in one position to effect closure of one port in each of said chambers and in a second position to effect closure of the other port in each of said chambers, the valve members for closing the ports in one of said chambers being face seating valves and the valve members for the ports in the other of said chambers being sleeve valves of sufficient thickness so that at least a portion thereof is received in the cooperating port upon seating of said face seating valve, said sleeve valves being movable beyond their port closing positions to effect unloading of the refrigerating system during movement of said valve from one operating position to another.

5. A control valve for controlling the flow of refrigerant through a reversible refrigerating system including a compressor and two heat exchange units, said valve comprising a casing having a discharge valve chamber and a suction valve chamber and external flow connections for connecting said chambers respectively to the discharge and suction lines of said compressor, each of said chambers having a pair of opposed ports, a valve member for closing each of said ports, valve actuating means including a valve shaft interconnecting all of said valve members and arranged in one position to effect closure of one port in each of said chambers and in a second position to effect closure of the other port in each of said chambers, the valve members for closing the ports in said suction valve chamber being face seating valves and the valve members for the ports in the discharge valve chamber being sleeve valves of sufficient thickness so that at least a

portion thereof is received in the cooperating port upon seating of said face seating valve, said last mentioned valve members being slidably mounted on said valve shaft for movement beyond a port closing position into said discharge valve chamber to effect unloading of said system during operation of said valve to effect a reversal of the flow of refrigerant through said system.

6. A reversing fluid flow control valve comprising a casing having a plurality of chambers therein including a high pressure chamber and a low pressure chamber, means including valve members mounted on a common valve shaft for controlling the fluid flow through said chambers, each of the valve members controlling the flow of fluid through said high pressure chamber being a sleeve valve slidably supported on said shaft for movement during reversing operation of said valve through its cooperating valve port to a position beyond a normal port closing position and in which fluid pressures within the system served by said valve are equalized, and means for returning each of said slidably supported sleeve valves to a normal port closing position after pressure equalization.

7. A valve for controlling the flow of refrigerant from a compressor to a reversible refrigeration system including two heat exchange units, said valve comprising a casing having therein a plurality of valve chambers including a high pressure chamber, a low pressure chamber, a first system chamber between said high and low pressure chambers and second and third system chambers respectively on opposite sides of said high and low pressure chambers from said first system chamber, said first system chamber having an external flow connection to one of said heat exchange units, said second and third system chambers each having an external flow connection to the other of said units adapted to maintain the same pressure conditions in both of said additional chambers, said high pressure chamber including an inlet connection from the compressor discharge line and opposed ports opening into the adjacent system chambers, said low pressure chamber having an outlet connection to the compressor suction line and opposed ports communicating with the adjacent system chambers, all of said ports being concentric about a common axis, valve discs for closing each of said ports and valve actuating means including a shaft supporting said discs and extending along said axis, a cylinder adjacent said third system chamber and a piston mounted on said shaft and slidably arranged in said cylinder with one face thereof forming an end wall of said third system chamber, and means for admitting to said cylinder refrigerant at pressures existing in the high and low pressure chambers, said low pressure chamber ports each comprising a cylindrical recess portion having a valve disc receiving end facing the adjacent system chamber and a valve seat at the low pressure chamber end of said port, the low pressure valve discs for alternatively closing said low pressure ports each being fixedly mounted on said shaft in an adjacent system chamber and being adapted to be rather snugly received in said recess during movement to a port closing position and to face-seat on the cooperating valve seat, said recesses and said low pressure valve discs being so arranged that upon movement of said valve actuating means to open one and close the other of said low pressure ports, said disc moving to a port closing position enters its cooperating port recess before the other of said valve discs leaves its port recess, said high pressure valve discs being respectively arranged on said shaft in the system chambers adjacent said high pressure chamber for alternatively closing said high pressure ports and being slidably mounted on said shaft for limited movement towards one another, means biasing said high pressure discs to their normal positions on said shaft, said high pressure discs each being of the sleeve valve type capable of moving through its cooperating port and into said high pressure chamber against the action of said biasing means for unloading said refrigerant

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erating system during the operation of said valve to reverse the flow of refrigerant in said system, said high pressure valve discs being of smaller effective area than said low pressure valve discs, whereby the pressure differential in the valve closing direction across the operating low pressure valve disc provides a force that is greater than the force arising from pressure differential in the opposite direction across the operating high pressure valve disc and effectively holds the valve arrangement in the operating position.

8. A valve for controlling the flow of refrigerant from a compressor to a reversible refrigeration system including two heat exchange units, said valve comprising a casing having therein a plurality of valve chambers including a high pressure chamber, a low pressure chamber, a first system chamber between said high and low pressure chambers and second and third system chambers respectively on opposite sides of said high and low pressure chambers from said first system chamber, said first system chamber having an external flow connection to one of said heat exchange units, said second and third system chambers each having an external flow connection to the other of said units adapted to maintain the same pressure conditions in both of said additional chambers, said high pressure chamber including an inlet connection to the compressor discharge line and opposed port opening into the adjacent system chambers, said low pressure chamber having an outlet connection to the compressor suction line and opposed ports communicating with the adjacent system chambers, all of said ports being concentric about a common axis, valve discs for closing each of said ports and valve actuating means including a shaft supporting said discs and extending along said axis, a cylinder adjacent said third system chamber and a piston mounted on said shaft and slidably arranged in said cylinder with one face thereof forming an end wall of said third system chamber, and means for admitting to said cylinder refrigerant at pressures in the high and low pressure chambers for actuating said valve, said low pressure chamber ports each comprising a cylindrical recess portion having a valve disc receiving end facing the adjacent system chamber and a valve seat at the low pressure

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chamber end of said port, the low pressure valve discs for alternatively closing said low pressure ports each being fixedly mounted on said shaft in an adjacent system chamber and being adapted to be rather snugly received in said recess during movement to a port closing position and to face seat on the cooperating valve seat, said recesses and said low pressure valve discs being so arranged that upon movement of said valve actuating means to open one and close the other of said low pressure ports, said disc moving to a port closing position enters its cooperating port recess before the other of said valve discs leaves its port recess, said high pressure valve discs being respectively arranged on said shaft in the system chambers adjacent said high pressure chamber for alternatively closing said high pressure ports and being slidably mounted on said shaft for limited movement towards one another, means biasing said high pressure discs to their normal positions on said shaft, said high pressure discs each being of the sleeve valve type capable of moving through its cooperating port and into said high pressure chamber against the action of said biasing means to provide direct communication between said first and second system chambers on opposite sides of said high pressure chamber for unloading said refrigerating system during the operation of said valve to reverse the flow of refrigerant in said system, said high pressure valve discs being of smaller effective area than said low pressure valve discs, whereby the pressure differential in the valve closing direction across the operating low pressure valve disc is greater than the pressure differential in the opposite direction across the operating high pressure valve disc and effectively hold the valve arrangement in the operating position.

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