Jan. 24, 1961 C. J. WOLFF 2,969,091

VALVE APPARATUS

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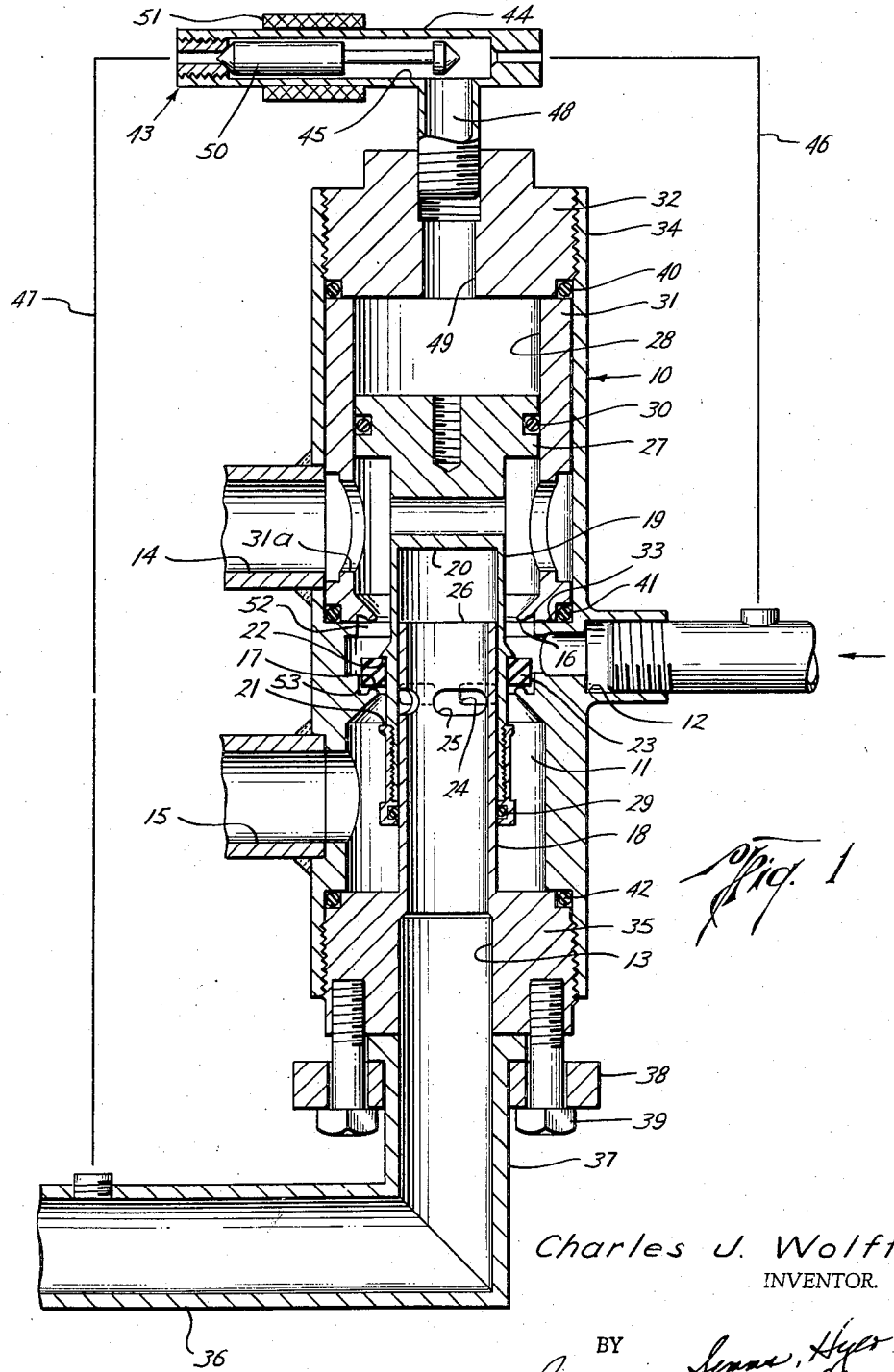


Fig. 1

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VALVE APPARATUS

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Fig. 2

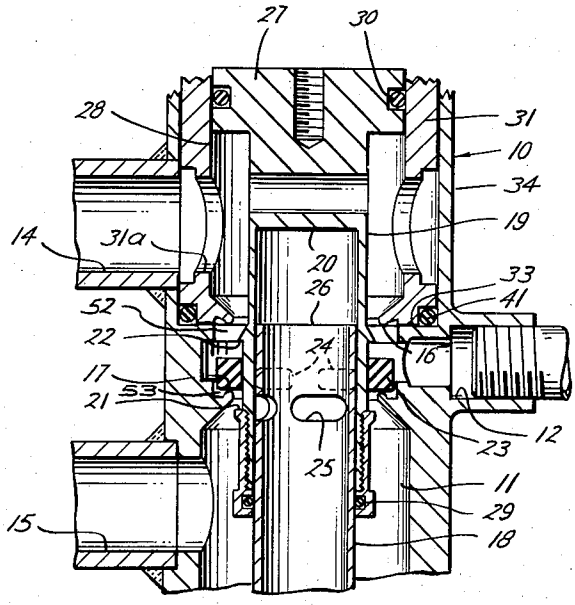


Fig. 3

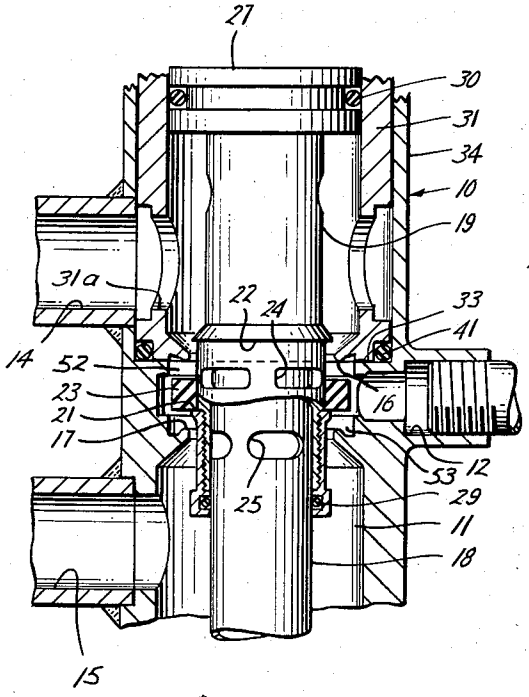
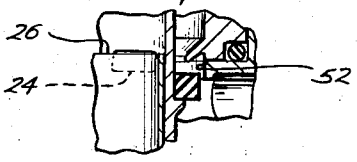


Fig. 3A



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VALVE APPARATUS

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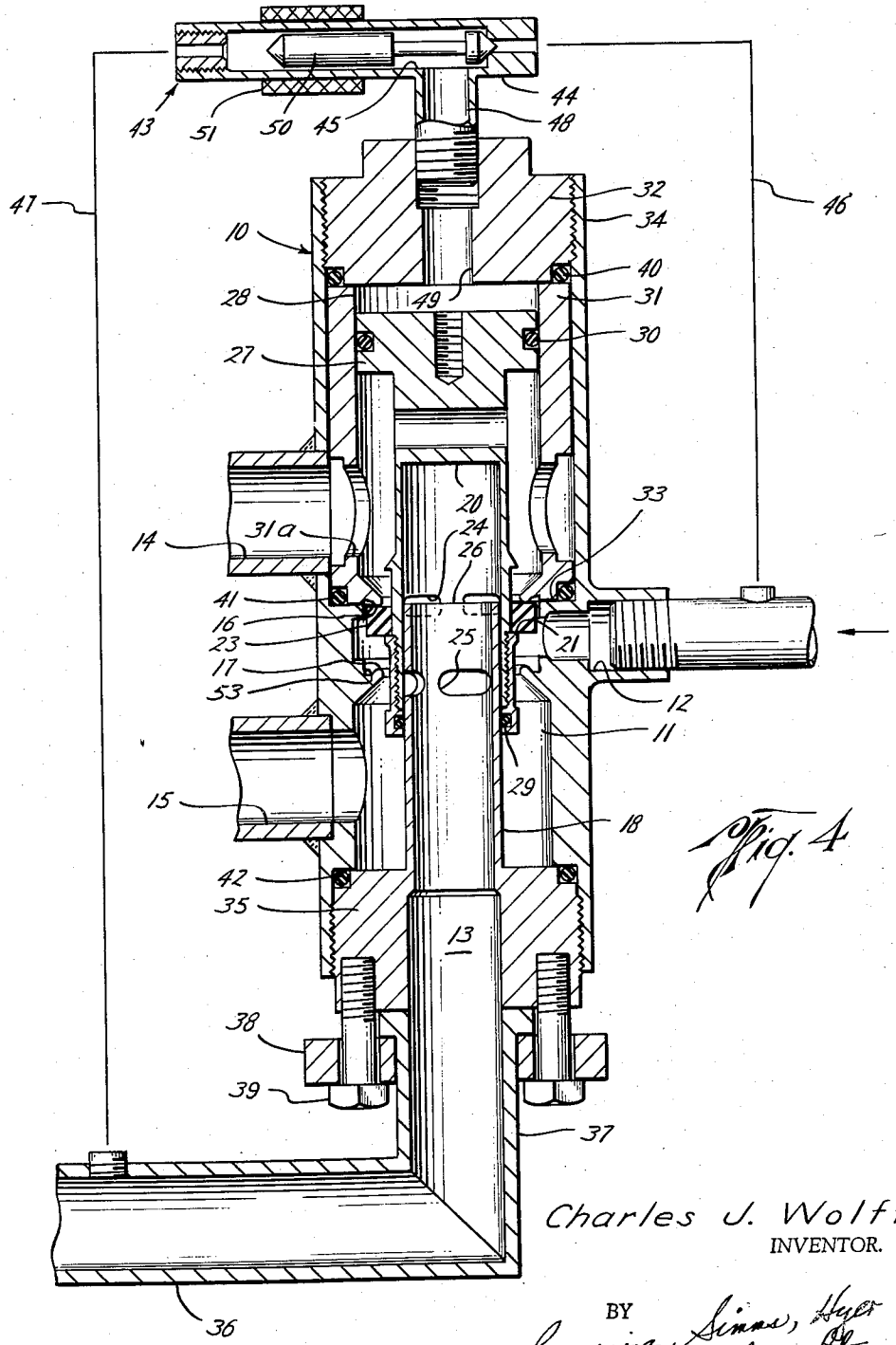


Fig. 4

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2,969,091

VALVE APPARATUS

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Filed Nov. 15, 1957, Ser. No. 696,818

18 Claims. (Cl. 137—625.43)

This invention relates to a four-way valve for use in switching between operating and defrost positions in a refrigeration system. More particularly, it relates to improvements upon the four-way valve of my copending application, Serial No. 443,838, filed July 16, 1954, now Patent No. 2,920,653, entitled "Valve Apparatus" of which the present application is a continuation-in-part.

Although my earlier valve provided many advantages over conventional four-way valves, particularly for the use above-mentioned, it did have certain shortcomings. For one thing, it was found to be somewhat difficult to service in the field. Also, there was a tendency for the valve member of my earlier valve to stop on "dead center." This was believed to be due, at least in part, to excessive venting of high pressure fluid from the discharge port into the suction port of the valve.

An object of the present invention is to provide a four-way valve of the general type shown in my earlier application, but in which the valve member will not stop on "dead center."

Another object is to provide a four-way valve of this type in which there is a minimum of venting from the discharge port into the suction port.

A further object is to provide a four-way valve which is of simpler construction and easier to assemble and service than my earlier valve.

Other objects, advantages and features of this invention will be apparent to one skilled in the art upon a consideration of the written specification, the attached claims and the annexed drawings.

In the drawings, wherein like reference characters are used throughout to designate like parts:

Fig. 1 is a vertical sectional view of an illustrative embodiment of the four-way valve of the present invention in its operating position;

Figs. 2, 3 and 3A are partial sectional views of the valve during movement of the valve member thereof from operating to defrost position; and

Fig. 4 is a view similar to Fig. 1 of the valve in its defrost position.

As in my earlier invention, the four-way valve shown in the above-described drawings includes a body **10** having a flow passage **11** therein, an inlet **12** to and outlet **13** from the flow passage, and first and second connections **14** and **15**, respectively, intersecting the flow passage. Substantially axially aligned and oppositely facing valve seats **16** and **17** are formed on the body within the passage between the inlet and each of the connections **14** and **15**, respectively, and a first sleeve **18** extends from the outlet into the flow passage substantially axially of the body valve seats. A second sleeve **19** closed at one end **20** and slidably received over the first sleeve has oppositely facing valve seats **21** and **22** about its periphery, and an annular sealing element **23** is carried about the second sleeve intermediate the seats thereon for seating, in one axial position (Fig. 1) of such sleeve, between seat **22** thereon and the seat **17** on the valve body to direct flow from the inlet into said first connection and, in another axial position (Fig. 4) of the second sleeve, between the other seat **21** thereon and the seat **16** on the valve body to direct flow from the inlet into said second connection.

This second sleeve has ports **24** therein which are alignable, in its first position, with ports **25** in the first sleeve **18** to direct flow from the second connection **15** into the outlet **13** from the flow passage and, in its second position, with a port **26** formed by the open upper end of the first sleeve to direct flow from the first connection **14** into said outlet. During much of the movement of the sleeve **19** intermediate these positions, the ports **24** therein are disposed opposite an imperforate portion of the sleeve **18** between its ports **25** and **26** (see Figs. 2 and 3, for example), so that it is only toward the end of the movement of the sleeve **19** in either direction that the inlet **12** is vented to the outlet **13**.

More particularly, when this valve is used in a refrigeration system, the inlet **12** will be connected with the discharge from the compressor, the outlet **13** with the suction side of the compressor, the first connection **14** with the condenser, and the second connection **15** with the evaporator of such system. Thus, for the purpose of the description to follow, the first position of Fig. 1 will be termed the operating position in which the discharge from the compressor is conducted to the condenser and the evaporator is connected with the suction side of the compressor. The second position of Fig. 4 will be termed the defrost position wherein the discharge from the compressor is connected with the evaporator and the condenser is connected with the suction side of the compressor. Obviously, however, this valve is useable in other environments in which similar problems might be encountered.

In accordance with one novel aspect of the present invention, the sleeve **19** is moved between said positions by a piston **27** connected to the closed end **20** of the sleeve and sealably slidable within a portion of the flow passage of the body to define a pressure chamber **28** therewith, and means, to be described hereinafter, for alternately connecting the chamber with fluid within one or the other of said inlet **12** and outlet **13**. More particularly, this means is operable to admit high pressure fluid from the inlet into the chamber to move the sleeve to operating position (Fig. 1) and to vent such high pressure fluid to the low pressure fluid in the outlet to move the sleeve to defrost position (Fig. 4).

As will be apparent from the description to follow, this arrangement provides a valve which is not only of simpler construction, but also which is easier to assemble and service than the valve of my earlier invention, wherein the sleeve was moved between alternate positions by means of opposed pistons. Furthermore, this actuating mechanism contributes to a more positive shifting of the sleeve than did the opposed pistons of my earlier valve since, as will be explained more fully hereinafter, during movement of the second sleeve **19** between its alternate positions there is always a pressure differential across the single piston **27** urging the sleeve in the desired direction, regardless of transient pressure conditions within the flow passage. This is to be distinguished from my earlier valve in which one side of the larger piston was exposed to high pressure fluid in the flow passage which was vented from the inlet to the outlet. It will be understood from an examination of my earlier application that such fluid was capable of producing a rather large force opposing movement of the sleeve to defrost position.

In accordance with another novel aspect of the present invention, an O-ring **29** or the like is carried by the sleeve **19** to provide a sliding seal between the second sleeve and the sleeve **18** for preventing high pressure fluid from being vented from the inlet to the outlet when the valve is in its defrost position (Fig. 4) as well as during certain stages of the movement of the sleeve between defrost

and normal operating positions, which will be discussed more fully hereinafter. More particularly, the O-ring 29 is carried by the sleeve beneath the port 24 for sliding engagement with sleeve 18 beneath each of the ports 25 and 26 therein.

Actuating piston 27 will be seen from Figs. 1 and 4 to be provided with a seal ring 30 thereabout slidable within a liner 31 fittable within an open end of the body flow passage 11 and in substantially axially aligned relation with respect to the sleeve 19. The open end of the passage is closed by a cover 32 threadedly or otherwise removably connected to the remainder of the body and bearing against the end of the liner to hold it upon an annular seat 33 in the valve body. As can be seen from the drawings, the valve seat 16 is formed on the inner end of the liner so that, upon removal of the cover 32, the sleeve 19 and sealing element 23 may be removed through the open end of the body flow passage along with the liner. This, of course, greatly simplifies the assembly and repair of the valve member.

The remainder of the valve body 10 includes a casing 34 into which the liner 31 is fittable and across the opposite open ends of which the cover 32 and a cap 35 are threadedly connected. As shown in Fig. 1, the sleeve 18 is formed on the cap 35 and valve seat 17 is formed on the casing 34 so as to further simplify the construction, assembly and maintenance of the valve.

Each of the inlets 12 and connections 14 and 15 are fitted into the valve body casing, the first of these connections communicating with the body flow passage through an aligned port 31*a* in the liner. The outlet 13 is formed through the cap 35 and communicates with an elbow 36 through a fitting 37 releasably connected to the cap by a flange 38 and bolts 39.

The threaded connections of cover 32 and cap 35 with the casing 34 are sealed against the escape of fluid from the valve body by means of annular seal rings 40 and 41, respectively. The liner 31 is sealed at opposite ends with respect to the casing by means of ring 40 and another ring 42.

A means for alternately connecting the pressure chamber 28 with fluid within one or the other of the inlet and outlet comprises a three-way valve 43 having a valve body 44 with a flowway 45 therein connected at its opposite ends to conduits 46 and 47 connecting with the inlet and outlet, respectively, and intermediate such opposite ends with a conduit 48 connecting with an opening 49 through the cover 32. A valve member 50 is longitudinally reciprocable within the flow passage 45 for seating upon the intersection of conduit 47 with the valve body flow passage to admit high pressure fluid from the inlet into the pressure chamber (see Fig. 1) and upon the intersection of conduit 46 with a flow passage 45 to vent such chamber to low pressure fluid in the outlet. As indicated in the drawings, the valve member 50 may be reciprocated by any suitable means, such as the solenoid 51.

Referring now to the operation of the above-described four-way valve, when it is desired to shift the sleeve 19 from the normal operating position of Fig. 1 to the defrost position of Fig. 4, the solenoid 51 is actuated to cause valve member 50 to seat upon the intersection of conduit 46 with the flow passage 45 whereby the high pressure fluid within chamber 28 is vented to the suction side of the compressor. Although the central area of the piston 27 is subjected to the pressure of the suction side of the compressor, the lower annular area thereof is subjected to high pressure fluid from the discharge side of the compressor which is admitted to the flow passage 11 above the sealing element through inlet 12. Due to this large differential of pressure imposed upon the actuating piston, it is caused to move upwardly.

As the piston moves upwardly to raise the sleeve 19 to the position of Fig. 2, ports 24 therein are moved out of alignment with the ports 25 in sleeve 18 so that the suction side of the compressor is isolated from the connection 15 with the evaporator. This is due, of course, not only to the movement of ports 24 over the imperforate portion of the sleeve 18 intermediate ports 25 and 27 therein, but also to the seal means 29 carried by the sleeve 19 as well as the close fit of sealing element 23 about the sleeve intermediate the valve seats 21 and 22 thereon. It will be noted, in this respect, that the sealing element 23 is at least as thick as the depth of the ports 25 so that venting of fluids from the evaporator to the outlet 13 is at a minimum. Consequently, at this stage of the shifting of the sleeve 19 from normal to defrost position, the force urging such sleeve to defrost position is at a maximum.

As the piston 27 and sleeve 19 move from the Fig. 2 to the Fig. 3 position, valve seat 21 engages the lower side of sealing element 23 to lift it from the valve seat 17 into a position substantially intermediate the valve seats 16 and 17. At this stage of the switching operation, high pressure fluid is vented to both connections 14 and 15, thus reducing the pressure of the fluid acting upon the lower side of piston 27. At the same time, and for the reasons previously noted, the suction side of the compressor is still isolated from the system, except for some slight leakage which might take place past sealing element 23, through the ports 24 and between the sleeves 18 and 19 into the port 26. In any case, however, the mean pressure acting on the lower annular area of the piston 27 is greater than suction pressure so that the total force acting upon the sleeve will continue to urge it upwardly to its defrost position.

Intermediate the Fig. 3 position and the defrost position of Fig. 4, the upper side of the sealing element 23 will be brought to a position very close to the valve seat 16 and ports 24 in the sleeve 19 will be aligned with the port 26 in the sleeve 18. Although this will permit venting of the high pressure fluid into the suction side of the compressor, such venting will occur for only a short time. Also, the sealing element 23 will be quickly pulled up into seating engagement with the valve seat 16 due to the sudden rush of fluid between the slight space between the top side of the sealing element and the valve seat 16.

In accordance with a still further novel concept of the present invention, the flow passage 11 is reduced intermediate the body valve seats 16 and 17 to form an annular shoulder 52 adjacent the seat 16 for closely fitting about the outer diameter of the sealing element 23 during the end of its movement into seating engagement with said seat. More particularly, and as illustrated in Fig. 3A, the outer diameter of the sealing ring enters into closely fitting relation within the shoulder 52 as the ports are aligned to permit venting of high pressure fluid into the suction side of the compressor. The sealing element thus limits such venting and also acts as a piston between the sleeve 19 and shoulder 52 so that it is urged upwardly by the high pressure fluid into seating engagement with the seat 16.

Although there will be a pressure differential across the piston 27 in the illustrated embodiment of the invention, even upon venting, the above-described construction may be particularly useful in insuring completion of the seating of the sealing element if it should be found necessary or desirable to dampen the valve movement. Of course, when the sealing element 23 is fully seated between valve seats 16 and 21, high pressure fluid from inlet 12, which is now directed into the connection 15 with the evaporator, is prevented from venting into the suction side of the compressor by means of primary and secondary seals provided by the sealing element 23 and O-ring 29, respectively.

When it is desired to move the sleeve from its defrost to its normal operating position, the solenoid 51 is actuated to cause valve member 50 to seat upon the intersection of conduit 47 with flow passage 45 so that high pres-

sure fluid from the discharge side of the compressor is admitted to the pressure chamber 28. At this time, of course, connection 14 is connected with the suction side of the compressor so that low pressure fluid is acting upon the lower side of the actuating piston 27 in opposition to the above-mentioned high pressure fluid. As a result, the piston and sleeve 19 will begin to move downwardly from the Fig. 4 toward the Fig. 3 position. Of course, when the sleeve 19 reaches the Fig. 3 position during movement toward operating position, the sealing element 23 will remain seated upon valve seat 16 so that the lower side of piston 27 is still subject to low pressure. The suction side of the compressor is, however, isolated from the rest of the system so that there is a maximum amount of force urging the piston 27 downwardly. When the sleeve 19 reaches the Fig. 3 position, the suction side of the compressor is again substantially isolated from the rest of the system.

Intermediate the Fig. 3 and Fig. 2 position, sealing element 23 is unseated by seat 22 so that high pressure fluid admitted through inlet 12 is communicated with both the condenser and evaporator through the connections 14 and 15, respectively, and the suction side of the compressor continues to be isolated from the rest of the system. Thus, although the lower annular area of the piston 27 will be subjected to a higher pressure, the central area thereof is still subjected to the pressure of the suction side of the compressor, and the piston will continue to move downwardly.

Of course, as the sleeve 19 moves from its Fig. 2 into the Fig. 1 position, ports 24 will move into alignment with ports 25 in sleeve 18 to vent high pressure fluid into the suction side of the compressor. However, as pointed out with respect to switching from operating to defrost position, this venting is of short duration and the sealing element 23 is quickly sucked toward the seat 17. Furthermore, although the central area of the piston will be subjected to a pressure higher than suction pressure, it will still be less than the high pressure acting upon the piston 27 in the chamber 28.

However, for the reasons above advanced with respect to movement into defrost position, the flow passage 11 is reduced to provide an annular shoulder 53 adjacent the seat 17 which fits closely about the outer diameter of the sealing element 23 during the end of its movement into seating engagement with said seat. More particularly, this shoulder is so arranged that the outer diameter of the sealing element enters it as the ports 24 and 25 are aligned to vent high pressure fluid into the suction side of the compressor.

The portion of the flow passage 11 between the shoulders 52 and 53 is radially enlarged so as to permit high pressure fluid to pass freely into both connections 14 and 15 in the position of Fig. 3.

As will be apparent from the earlier application, the sealing element 23 is illustrated only diagrammatically, and it is contemplated that such element would be sealable between the valve seats on the sleeve and the valve body in the novel manner set forth in such earlier application. However, it is not believed necessary to repeat a description of these novel features of the seating element.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A four-way valve, comprising a valve body haivng a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, a valve member including relatively slidable hollow parts having ports therein with one such part having a closed end and moveable with said flow passage between a first position directing flow from the inlet into said first connection and from said second connection into said outlet, and a second position directing flow from the inlet into said second connection and from said first connection into said outlet, said valve member being operable intermediate its movement between said positions to permit flow between said inlet and outlet, and means for moving said valve member between said positions, including a piston connected to the closed end of said one valve member part and sealably slidable within the flow passage to define a pressure chamber therewith, and means for alternately connecting said chamber with fluid within one or the other of said inlet and outlet, the area of the piston within the pressure chamber being so proportioned to the area of the piston exposed to the flow passage and the area of the closed end of said one valve member part as to urge said valve member into said first position when said chamber is connected with the inlet and into said second position when said chamber is connected with the outlet.

2. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, valve seats on the body within the passage between the inlet and each of said connections, and a valve member within said flow passage including relatively slidable sleeves having ports therein and an annular sealing member carried by one of said sleeves, said one sleeve being moveable between a first position seating said sealing element upon the seat between the inlet and said second connection to direct flow from said inlet into said first connection and aligning a port therein with a port in the other sleeve for directing flow from the second connection into the outlet, and a second position seating said sealing element upon the seat between the inlet and said first connection to direct flow from said inlet into said second connection and aligning said port therein with another port in the other sleeve for directing flow from the first connection into the outlet, said ports being aligned intermediate seating of said sealing element to permit flow between said inlet and said outlet, and means for moving said sleeve between said positions, including a piston connected to the sleeve and sealably slidable within the flow passage to define a pressure chamber therewith, and means for alternately connecting said chamber with fluid within one or the other of said inlet and outlet.

3. A four-way valve of the character defined in claim 2, including means sealing between said sleeves to prevent flow between said inlet and outlet other than through said ports.

4. A four-way valve of the character defined in claim 2, wherein said piston is slidable within a liner in the flow passage of the valve body having one of said seats formed thereon and substantially axially aligned with said sleeve, and said pressure chamber is defined at one end by a removable cover to permit removal of the sleeve, liner and sealing element from said flow passage.

5. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats, a second sleeve closed at one end and slidably received over said

first sleeve, oppositely facing valve seats about the periphery of the second sleeve, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, said sleeves having ports therein alignable, in said first position of the second sleeve, to communicate said first connection with said outlet, and, in said second position of the second sleeve to communicate said second connection with said outlet, and means for moving said sleeve between said positions, including a piston connected to the closed end of the second sleeve to provide an annular area thereabout and sealably slidable within the flow passage to define a pressure chamber therewith, and means for alternately connecting said chamber with fluid within one or the other of said inlet and outlet.

6. A four-way valve of the character defined in claim 5, including axially spaced apart ports in the first sleeve, a port in the second sleeve intermediate said seats thereon, and means sealing between the sleeves intermediate said ports and the opposite end of said second sleeve.

7. A four-way valve of the character defined in claim 6, wherein said piston is slidable within a liner in the flow passage of the valve body having one of said seats formed thereon and substantially axially aligned with said sleeve, and said pressure chamber is defined at one end by a removable cover to permit removal of the sleeve, liner and sealing element from said flow passage.

8. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats, a second sleeve closed at one end and slidably received over said first sleeve, oppositely facing valve seats about the periphery of the second sleeve, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, said sleeves having ports therein alignable, in said first position of the second sleeve, to communicate said first connection with said outlet, and, in said second position of the second sleeve to communicate said second connection with said outlet, and means for moving said sleeve between said positions, said flow passage intermediate the body valve seats closely fitting about the outer diameter of the annular sealing element during the end of its movement into seating engagement with each of said body valve seats.

9. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats, a second sleeve closed at one end and slidably received over said first sleeve, oppositely facing valve seats about the periphery of the second sleeve, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, said sleeves having ports therein alignable, in said first position of the second sleeve, to communicate said first connection with said outlet, and, in said second position of the second sleeve to communicate said second connection with said outlet, means for moving said second sleeve between said positions, and annular shoulders on the valve body within the flow passage and adjacent each of said body valve seats for closely fitting about the outer diameter of the annular sealing element during the end of its movement into seating engagement with each of said body valve seats.

10. A four-way valve of the character defined in claim 9, wherein the outer diameter of the sealing element enters into closely fitting relation within each of said shoulders as the ports in the sleeves are aligned to communicate the connection to which said shoulder is adjacent with the outlet.

11. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, a valve member including relatively slidable hollow parts having ports therein with one of said parts having a closed end and movable with said flow passage between a first position directing flow from the inlet into said first connection and from said second connection into said outlet, and a second position directing flow from the inlet into said second connection and from said first connection into said outlet, said valve member being operable intermediate its movement between said positions to permit flow between said inlet and outlet, and a piston connected to only the closed end of said one valve member part and sealably slidable within the flow passage to define a pressure chamber therewith, the area of the piston within the pressure chamber being at least substantially equal to the combined area of the piston exposed to the flow passage and the closed end of said one valve member part.

12. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, valve seats on the body within the passage between the inlet and each of said connections, and a valve member within said flow passage including relatively slidable sleeves having ports therein and an annular sealing member carried by one of said sleeves, said one sleeve being movable between a first position seating said sealing element upon the seat between the inlet and said second connection to direct flow from said inlet into said first connection and aligning a port therein with a port in the other sleeve for directing flow from the second connection into the outlet, and a second position seating said sealing element upon the seat between the inlet and said first connection to direct flow from said inlet into said second connection and aligning said port therein with another port in the other sleeve for directing flow from the first connection into the outlet, said ports being aligned intermediate seating of said sealing element to permit flow between said inlet and said outlet, and a piston connected to the closed end of only the movable sleeve and sealably slidable within the flow passage to define a pressure chamber therewith, the area of the piston within the chamber being at least substantially equal to the combined area of the piston exposed to the flow passage and the closed end of the movable sleeve.

13. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats, a second

sleeve closed at one end and slidably received over said first sleeve, oppositely facing valve seats about the periphery of the second sleeve, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, said sleeves having ports therein alignable, in said first position of the second sleeve, to communicate said first connection with said outlet, and, in said second position of the second sleeve to communicate said second connection with said outlet, and a piston connected to the closed end of only the second sleeve and sealably slidable within the flow passage to define a pressure chamber therewith, the area of the piston within the chamber being at least substantially equal to the combined area of the piston exposed to the flow passage and the closed end of the second sleeve.

14. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, valve seats on the body within the passage between the inlet and each of said connections, and a valve member within said flow passage including relatively slidable sleeves having ports therein and an annular sealing member carried by one of said sleeves, said one sleeve being movable between a first position seating said sealing element upon the seat between the inlet and said second connection to direct flow from said inlet into said first connection and aligning a portion therein with a port in the other sleeve for directing flow from the second connection into the outlet, and a second position seating said sealing element upon the seat between the inlet and said first connection to direct flow from said inlet into said second connection and aligning said port therein with another port in the other sleeve for directing flow from the first connection into the outlet, said ports being aligned intermediate seating of said sealing element to permit flow between said inlet and said outlet, and means for moving said sleeve between said positions, including a piston connected to the sleeve and sealably slidable within a liner in the flow passage of the valve body having one of said seats formed thereon and substantially axially aligned with said sleeve, and a cover defining one end of a pressure chamber with the piston and removable to permit removal of the sleeve, liner and sealing element from said flow passage.

15. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, valve seats on the body within the passage between the inlet and each of said connections, and a valve member within said flow passage including relatively slidable sleeves having ports therein and an annular sealing member carried by one of said sleeves, said one sleeve being movable between a first position seating said sealing element upon the seat between the inlet and said second connection to direct flow from said inlet into said first connection and aligning a port therein with a port in the other sleeve for directing flow from the second connection into the outlet, and a second position seating said sealing element upon the seat between the inlet and said first connection to direct flow from said inlet into said second connection and aligning said port therein with another port in the other sleeve for directing flow from the first connection into the outlet, said ports being aligned intermediate seating of said sealing element to permit flow between said inlet and said outlet, means sealing between said sleeves to prevent flow between said inlet and outlet other than through said ports, and means for moving said sleeve between said positions.

16. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats, a second sleeve closed at one end and slidably received over said first sleeve, oppositely facing valve seats about the periphery of the second sleeve, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, said sleeves having ports therein alignable, in said first position of the second sleeve, to communicate said first connection with said outlet, and, in said second position of the second sleeve to communicate said second connection with said outlet, and means for moving said sleeve between said positions, including a piston connected to the closed end of the second sleeve to provide an annular area thereabout and sealably slidable within a liner in the remainder of the valve body having one of said seats formed thereon and substantially axially aligned with said sleeve, and a cover defining one end of a pressure chamber with the piston and removable to permit removal of the sleeve, liner and sealing element from said remainder of the valve body.

17. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, substantially axially aligned and oppositely facing valve seats on the body within the passage between the inlet and each of said connections, a first sleeve extending from the outlet into the passageway substantially coaxially of said body valve seats and having axially spaced apart ports therein, a second sleeve closed at one end and slidably received over said first sleeve, oppositely facing valve seats about the periphery of the second sleeve, said second sleeve having a port therein intermediate the seats thereon, an annular sealing element carried about the second sleeve intermediate said seats for seating, in one axial position of the second sleeve, between a seat on the second sleeve and the seat on the valve body between the inlet and said first connection, and, in another axial position of the second sleeve, between the other seat on the second sleeve and the seat on the valve body between the inlet and said second connection, the port in said second sleeve being alignable with one port in the first sleeve, in said first position of the second sleeve, to communicate said first connection with said outlet, and with the other port in the first sleeve, in said second position of the second sleeve to communicate said second connection with said outlet, means for moving said sleeve between said positions, and means sealing between the sleeves intermediate said ports and the other end of said sleeve.

18. A four-way valve, comprising a valve body having a flow passage therein, an inlet to and outlet from the flow passage, first and second connections intersecting said flow passage, valve seats on the body within the passage between the inlet and each of said connections, and a valve member within said flow passage including relatively slidable sleeves having ports therein and an annular sealing member carried by one of said sleeves, said one sleeve being movable between a first position seating said sealing element upon the seat between the inlet and said second connection to direct flow from said inlet into said first connection and aligning a port therein with a port in the other sleeve for directing flow from the second connection into the outlet, and a second posi-

tion seating said sealing element upon the seat between the inlet and said first connection to direct flow from said inlet into said second connection and aligning said port therein with another port in the other sleeve for directing flow from the first connection into the outlet, said ports being aligned intermediate seating of said sealing element to permit flow between said inlet and said outlet, and means for moving said sleeve between said positions, said flow passage intermediate the body valve seats closely fitting about the outer diameter of the annular sealing member during the end of its movement into seating engagement with each of said body valve seats.

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