MULTIPORT REVERSING VALVES
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Continuation of applications Ser. No. 551,612, Dec. 7,
1955, and Ser. No. 25,310, Apr. 28, 1960. This appli-
cation Sept. 19, 1963, Ser. No. 310,168
3 Claims. (Cl. 137--119)
This invention relates to multiport valves for directing,
diverting or controlling the flow of fluids.
This application is a continuation of my copending
U.S. application Serial No. 551,612 filed December 7,
1955, now abandoned, and application Serial No. 25,310
filed April 28, 1960, now abandoned.
An important application of this valve structure is in
connection with reverse cycle operation of refrigeration
systems to provide both heating and cooling by a heat-
exchanger employed in the system.
The valve structure in accordance with this invention is
especially adaptable to low temperature refrigeration
systems wherein reverse cycle operation of the system is
provided for the purpose of supplying heat to the evap-
orator for defrosting.
It is generally understood by those who are familiar
with the problems of hot gas defrosting for refrigeration
systems that the pressures encountered in the various
stages of operation of both the refrigeration and defrost
cycle are very erratic and unstable. This instability is
carried by the wide variation of temperatures at which
refrigerant gas is condensed during the two different
cycles. This variation of condensing temperatures not
only affects the heat pressure of the compressor, but also
the back pressure on the suction side of the compressor.
Because it is desirable to provide automatic control of
such systems, it is obvious that automatic operation of
the valve used to control the operation of the system from
one cycle to the other is essential.
It is further understood by those who are familiar with
valve structure and operation that direct solenoid opera-
tion of large orifice valves for controlling high pressure
fluids is not practical unless the pressure resistance from
the seated side of the valve can be overcome or at least
substantially equalized by pressure or force from the
opposite direction. Therefore, diversion of pressure from
one direction to another against effective pressure areas
of movable parts of the valve is obviously a practical
method for accomplishing automatic operation of such
valves.
In common practice, three way pilot valves are usually
used in combination with multiport valves to alternately
direct high and low pressure from the system to the motive
power element of the valve.
These pilot valves are usually used in combination with
a cylinder and piston structure built into the valve, the
piston being connected to the movable parts of the valve
and arranged to move the valve parts between one relative
position and another in response to changes in pressure
provided by the pilot valve.
There are several types of valves used in connection
with this type of piston and pilot valve combination in-
cluding the ordinary valve stem disk and seat type and the
sliding or sleeve type, all of which because of their
complicated structure and the necessity of using the sepa-
rate pilot valve are quite cumbersome and expensive to
manufacture.
In the art of multiple port valve design, the principal
difficulty encountered is the seating of two or more valve
disks on their respective seats at the same time. In multi-
port valves that have more than two closable orifices for
alternate opening and closing it is obvious that at least
two of said orifices will necessarily be closed at the same
time and with the same movement of parts within the
valve structure. This simultaneous seating of two or
more valves within the valve structure is obviously diffi-
cult of accomplishment and because of these difficulties
encountered in providing multiport valves with the con-
tventional valve seats and valve stem closures, many types
of slide valves and sleeve valves are used.
These so called slide or sleeve valves overcome the
difficulties encountered in the multiplex seat valves and
are used to simplify and facilitate the movement of the valve
from one operating position to another; however, because
these valves depend upon close tolerance fit between
sliding parts, their efficiency is soon dissipated by wear
between these parts which causes leaks therebetween.
It is obvious that sleeve structure for diverting the flow
of fluid is easier to operate because the pressure resist-
ance encountered in the movement of seated valve plates
is not present in the movement of a sleeve or hollow
cylinder that is exposed to the same pressure on all sides
and ends. It is further obvious that a tight closing seated
valve is more effective in preventing leaks from one side
of the valve to the other.
It is, therefore, an object of this invention to provide
valve structure which incorporates sleeve structure to
effect ease of movement and tight closing seated valve
structure for holding pressure and preventing leaks after
said movement has been accomplished.
It is another object of this invention to provide sleeve
structure for diverting pressure within the valve from
one direction to another to effect movement of seating
components from one seated position to another.
It is another object to provide valve structure for
multiple port valves wherein the various ports are opened
and closed in consecutive order rather than simultaneously
and in which the closing of one port cannot interfere
with the closing of another in the same directional
movement.
Another object is to provide valve structure that is
easily adapted to various types of automatically operated
multiport valves.
It is another object to provide valve structure that is
operable by diverting pressure from one direction to
another within said structure and means within said
structure for providing said diversion of pressure.
Another object is to provide structure for a multiplex
valve wherein various moving parts are movable in
sequence and wherein the movement of each part diverts
pressure from one place to another to impart movement
to another part in the order of said sequence, until all
moving parts of said valve have been moved from one
operating position to another.
It is another object of this invention to provide a
multiplex valve for reversing the flow of refrigerant gas
in a refrigeration system for the purpose of defrosting
the evaporator of said system and which will not be
adversely affected by the wide variations of pressure
encountered in such systems.
Another object is to provide valve structure adaptable
to valves for handling fluids in which two or more clos-
able orifices are employed.
Another object is to provide valve structure for multi-
port valves that is easily adaptable to either manual or
automatic operation.
Another object is to provide valve structure that is
simple in design and versatile in application.
Other and more specific objects and advantages will
become more readily apparent from the following de-
tailed description and accompanying drawings.
In the drawings:

FIG. 1 is a schematic view illustrating a conventional
refrigeration system embodying a multiplex valve posi-
tioned with conduit connections in the system for providing reverse cycle operation for defrosting.

FIG. 2 is a cross-sectional view of a multiport valve taken on its longitudinal axis showing structural detail and connections, the valve being shown in normal operating position;

FIG. 3 is the same cross-sectional view of the valve as that of FIG. 2 except that the movable parts of the valve are shown in alternate operating position;

FIG. 4 is a cross-sectional view similar to that of FIG. 2 of another embodiment of the invention showing a three way valve having only two orifices that are closable by seated closing means;

FIG. 5 is a vertical, central, cross-sectional view illustrating a further embodiment of the invention showing the moving parts in the normal operating condition of the system;

FIG. 6 is a view similar to that of FIG. 5 showing the parts in the reverse cycle operation of the system;

FIG. 7 is a vertical, central, cross-sectional view of a still further embodiment of the invention with the moving parts shown in the positions which they occupy under normal operating conditions of the system;

FIG. 8 is a view similar to that of FIG. 7, the parts being shown in positions which they occupy during reverse cycle operation of the system; and

FIG. 9 is a fragmentary cross-sectional view on an enlarged scale illustrating an intermediate position of the embodiment of FIGS. 7 and 8 during the movement of the parts from normal operating condition of the system to reverse cycle operation of the same.

Referring now to the drawings in greater detail, the invention is illustrated herein in connection with its application to a refrigeration system of usual construction such as that shown in FIG. 1 having a compressor 30, condenser 28, and evaporator 32, the multipoint valve of the invention being shown at 16 connected into the system. The compressor 30 has a suction line 18 and a discharge line 20 connected to the valve 16, and in the normal position of the valve, the suction line is in communication through the valve with a pipe 22 leading from the evaporator 20, while the discharge line is in communication through the valve with a pipe 20 leading to the condenser 12. A pipe 19 leads to the evaporator from an accumulator 28 which is connected by a pipe 26 to the condenser. A pressure reducing valve 29 of any suitable and convention design is interposed in pipe 26.

In the normal operating position of the system fluid is withdrawn by the compressor from the evaporator through pipe 22, valve 16 and suction line 18 and delivered to the condenser through discharge line 20, valve 16 and pipe 24 from whence the fluid flows through pipe 26 to the accumulator 26 and back to the evaporator through pipe 22 and valve 16.

To accomplish reverse cycling of the system, the valve 16 is moved to its alternate position and operates in a manner to be more fully described hereinafter to establish communication between suction line 18 and pipe 24 and between discharge line 20 and pipe 23 to permit the compressor to withdraw fluid from the condenser and deliver it to the evaporator.

FIGS. 2 and 3 illustrate a four way valve in accordance with one embodiment of the invention which comprises the generally tubular hollow body 32, closed at one end by a bonnet 34 and at the opposite end by an end plate 36 and end plate 34 and end plate 36 being removably secured to the ends of the body 32 by any suitable means such as capscrews 35 and 49, respectively. The bonnet 34 is formed centrally thereof with an outwardly extending neck 42 provided with a longitudinal bore 44 whose lower end opens into an enlarged counterbore 46 opening into the inner of the body. The neck 42 has an inlet opening 43 leading into the bore 44 for the connection thereto of the compressor discharge line 20. The bonnet 34 is also provided with a downwardly extending annular flange 50 which fits into the upper end of the body 32 for a purpose hereinafter explained.

The end plate 35 has an upwardly extending annular flange 52 similar to the flange 50 which fits into the lower end of the body 32.

The body 32 is provided with an outlet port 52 to which the suction line 18 of the compressor 10 is connected and is formed with a central port 54 which opens radially inwardly into the chambers 60 and 62 and carries at its upper and lower ends cylindrical extensions 72 and 74, respectively, whose external diameters are somewhat larger than the external diameter of the section 70. The upper extension 72 is slidably fitted into the annular flange 50 of bonnet 34 to guide the valve member and hold the same centralized within the body. The lower end of the extension 72 carries an annular seat element 76 positioned to engage the seat 57 to close the same when the valve assembly 68 reaches its lowestmost position and the upper end of the extension 74 has a similar annular seat element 78 positioned to engage the seat 59 to close the same when the valve member reaches its uppermost position. At its upper end the extension 72 is formed with end notches 89 which form with the annular flange 50 passageways 82 when the valve member is in its lowermost position to provide communication between the interior of the valve assembly 68 and the chamber 60 and which passageways are closed when the valve member is in its upper position. Similarly, the lower extension 74 is provided with end notches 84 at its lower end which form with the annular flange 50 passageways 86 when the valve assembly is in its upper position to provide communication between the interior of the valve member and chamber 62 and which are closed when the valve assembly moves downwardly to its lower position.

The lower extension 74 has an internal web 88 which is provided with a central opening 90 forming a valve seat, and the upper extension 72 also has an internal web 92 provided with a central opening 94. A hollow plunger or valve member 96 is movably positioned within the section 70 of the valve member 68 and is provided with a hollow stem 98 extending upwardly through the opening 94 and is slidably fitted into the counterbore 46 of the bonnet 34. Sealing means, such as an O-ring 100 is provided within the counterbore 46 within an internal groove provided to receive the same with which the stem 95 is engageable when the plunger is in its uppermost position to form a fluid tight seal between the stem and bonnet.

The stem 98 has an externally enlarged portion 102 adjacent the plunger 96 which is engageable with an annular sealing element 104 surrounding the opening 94 to close the opening when the plunger reaches its upper position. The enlargement 102 is also provided with one or more openings 206 which are in communication with the interior of the stem and which lead to the exterior of the same.

The plunger 96 has a hollow, downwardly extending portion 108 which carries a sealing element 110 positioned
for engagement with the web 88 of the extension 74 about the opening 90 to close the opening when the plunger reaches its lower position. This downward extension 108 also has one or more openings 112 which are in communication with the interior of the stem and with the interior of the cylindrical section above the opening 90.

An internal pilot sleeve 114 is slidably fitted into the plunger 96 for axial movement to an upper position, extending into the enlargement 102, to close off communication through the openings 106 between the interior of the stem and the interior of the cylindrical section 70 above the plunger, while establishing communication through openings 112 between the interior of the stem and the interior of the section 70 beneath the plunger, while establishing communication through openings 106 between the interior of the stem and the interior of the section 70 above the plunger.

An operating rod 116 is connected at its lower end to the sleeve 114 and extends upwardly through the stem and bonnet 34 into suitable means, such as the solenoid coil mechanism, indicated at 118 by which the rod may be moved upwardly to move the sleeve 114 to its upper position from which the sleeve may return downwardly to its lower position.

In the operation of the invention, constructed as described above, the valve is in the position illustrated in FIG. 2 with the solenoid mechanism 118 deenergized and the valve assembly 65, plunger 96 and sleeve 114 in their lowermost position.

In this position of the valve, the annular flange 52 is in closing relation to the end notches 84 of the extension 74, closing the passageways 84 and the opening 90 is also closed by the plunger extension 108. The chamber 63 will, however, be in communication with the outlet 54 through opening 59 so that fluid may flow from the evaporator 14 through pipe 22 and suction line 18 to the compressor 10.

The interior of the hollow stem 98 will also be in communication with the interior of the valve assembly 65 through openings 106, and the interior of the valve assembly 65 will be in communication with the upper chamber 60 through opening 94 and passageways 62, which are open, so that fluid may flow from the compressor through discharge line 20, inlet 48 through stem 98, openings 106, opening 94 and chamber 60 to the port 64 and through pipe 24 to the condenser. It will be observed that the relatively high pressure of the fluid discharged from the compressor, while following this course, will be exerted against the upwardly facing pressure areas of all the movable parts of the valve. In this manner, the high pressure fluid is directed to hold the closed valve ports in a tightly sealed condition, the effectiveness of the sealing increasing as the pressure difference between the suction and discharge lines becomes greater.

To accomplish a reverse cycling of the apparatus, the movable parts of the valve are moved from the position of FIG. 2 to that shown in FIG. 3, such movement being initiated by energizing the solenoid mechanism 118 to lift the sleeve 114 to its uppermost position. This upward movement of the sleeve relative to the plunger 96 results in uncovering the lower openings 112 and closing the upper openings 106. The sleeve 114 being open at both ends, does not encounter pressure resistance in movement, and because it need not provide a tight seal for the openings, can have a relatively loose fit in the plunger 96. This requires only a small force for its operation so that the solenoid may be very small.

When the sleeve reaches its upper position, the pressure of fluid discharged from the compressor will be diverted from its course as seen in FIG. 2 to that illustrated in FIG. 3, through the lower openings 112 into the valve assembly 65, moving the plunger 96, whereupon the plunger will be moved upwardly to its upper position. This upward movement of the plunger establishes communication between the interior of the valve assembly 65 and the lower chamber 62 through opening 90 so that pressure builds up beneath the valve assembly 68 to move the same upwardly closing passageways 82 and opening passageways 86. Such upward movement of the valve assembly 68 also tightly closes the opening 59 and opening 94 while opening 57 is opened.

In this position of the valve fluid may then flow from the compressor discharge line 20 through inlet 48, stem 98, opening 90, passageways 86, chamber 62, port 66 and pipe 22 to the evaporator, and fluid will also be withdrawn from the condenser through port 64, stem 98, opening 94 and the sleeve 114 to the valve assembly 65, whereupon it will be directed to another portion of the valve to cause the next movement until all of the movements have been accomplished and the valve is in its alternate operating position.

The movement of the valve parts back to the normal operating position of the valve is accomplished in the same manner as described above except that the pressure is diverted and directed to cause the valve parts to move downwardly. This movement is initiated by deenergization of the solenoid mechanism 118 to cause the sleeve 114 to drop to its lower position over the openings 112 and to uncover the openings 106 to direct pressures into the valve assembly 65 above the plunger 96 thereby forcing the plunger downwardly and permitting pressure to build up in the upper chamber 60 to move the valve assembly 68 downwardly.

In FIG. 4, there is illustrated a somewhat different form of the invention in which the valve is of the three-way type having a hollow bore 122 formed in two parts 134 and 136. The upper part 134 has an upwardly extending neck portion 142 provided with a bore 144 whose lower end opens into a downwardly opening counterbore 146, opening into an upper chamber 150. The upper part 134 also has an outlet 154 leading from the chamber 150 for the connection thereto of a suction line 18 and an inlet 148 leading into the bore 144 for the connection thereto of a discharge 22. An internal annular flange 156 is formed in the lower end portion of the upper part 134, which flange has a central opening 157 therethrough to provide a valve seat.

The lower part 136 has a chamber 162 and is provided with a port 166 leading into the chamber 162 for the connection thereto of a pipe 24. Within the chamber 162 a hollow plunger or valve member 196 is positioned for axial movement therein and has a hollow stem 198 extending upwardly therefrom through the opening 157 in radially inwardly spaced relation to the flange 156 and which is slidably fitted at its upper end into the counterbore 146. Suitable sealing means, such as the O-ring 200 is provided, which is disposed in an internal groove in the counterbore 146 in position to form a fluid tight seal between the stem 198 and the upper part when the plunger is in its uppermost position.

The stem 198 has an externally enlarged portion 202 adjacent the upper side of the plunger and which is provided with one or more openings 206 therein which are in communication with the interior of the stem and with the chamber 162 above the plunger. This enlargement 202 is shaped to seat on a suitable sealing element 204 on the flange 156 surrounding the opening 157 to close the opening when the plunger reaches its upper position.

The plunger 196 also has a downward extension 208 which carries a sealing element 210 in position to close the port 166 when the plunger reaches its lower position in the chamber 162. This downward extension 208 is pro-
vided with openings 212 in communication with the interior of the plunger and the chamber 162 beneath the plunger.

Within the plunger 196 an internal pilot sleeve 214 is movably positioned for downward movement to a lower position to cover the openings 212 while uncovering the openings 206 and to an upper position to uncover openings 212 and cover openings 206. An operating rod 216 is connected at its lower end to the sleeve 214 which rod extends upwardly through the hollow stem 198 and upper part 142 and into the solenoid mechanism 115 by which the rod may be moved upwardly upon energization of the solenoid mechanism to move the sleeve 214 to its upper position.

The upper and lower parts 134 and 136 may be secured together in any suitable manner, as by bolts, not shown.

In the operation of the above-described three-way valve, it will be apparent that the pilot sleeve 214 may be moved from one of its positions to the other to divert pressure from one side of the plunger 196 to the other side thereof to move the plunger from one to the other of its positions whereby the flow of fluid entering the valve through the line 22 may be diverted through the outlet 154 or through the port 166.

With the pilot sleeve in the position shown in FIG. 4, the openings 212 are covered while openings 206 are uncovered, permitting fluid from the inlet 148 to pass downwardly through stem 198 into the chamber 162 above the plunger through openings 206, from whence the fluid may pass out through opening 157 and the outlet 154. This course of the fluid causes pressure to be built up above the plunger 196 to move the plunger downwardly to close the port 166.

Upon energization of the solenoid mechanism 118 the pilot sleeve 214 will be moved upwardly by rod 216 to its upper position uncovering the lower openings 212 and covering the upper openings 206, whereupon fluid may flow downwardly through the stem into the chamber 162 beneath the plunger to raise the plunger and open the port 166. When the plunger reaches its upper position the enlargement 202 closes the opening 157 and the outlet 154 is effectively shut off.

A further embodiment of the invention is illustrated in FIGS. 5 and 6, wherein the internal moving parts of the valve are separately located for independent movement relative to each other. In this embodiment of the invention the valve casing may be made up of two generally tubular hollow bodies or the lower chamber 236 and 233. The body 232 has upper and lower chambers 234 and 236, respectively, therein which are in communication through an intermediate bore 238, while the body 233 is formed with upper and lower chambers 240 and 242 which are in communication through an intermediate chamber 244. The body 232 has an opening 246 leading into the upper chamber 234 into which the pipe 24 leading to the condenser 12 is connected, while an opening 248 is provided leading into the chamber 236 into which the pipe 22 leading to the evaporator 14 is connected. The upper chamber 234 is connected with the upper chamber 240 by a pipe 250 and the lower chamber 236 is similarly connected in communication with the lower chamber 242 by a pipe 252.

The body 232 also has an opening 254 leading into the bore 238 and into which the suction line 16 of the compressor is connected, and the body 233 has an opening 256 leading into the intermediate chamber 244 and into which the discharge line 20 of the compressor 10 is connected.

The body 232 is provided with internal annular valve seats 258 and 260, at the opposite ends of the bore 238, positioned to be engaged by a valve element 262 movably disposed in the body 232 movement therein to open position to close the seat 258 to shut off communication between the bore and the upper chamber 234 while opening the seat 260 to establish communication between the bore and the lower chamber 236, or to another position to close the seat 250 to shut off communication between the bore and the lower chamber while establishing communication between the bore and the upper chamber.

The valve element 262 has a stem 264 extending through the bore 238 and is provided at one end with a sleeve-like head 266 located in chamber 234 and at the other end with a head 268 in chamber 236. Suitable sealing elements 270 may be provided on each of the heads 266 and 268 positioned for engagement with the seats 258 and 260, respectively, to close the seats. The sleeve-like heads are each formed with end notches 272 positioned to provide passageways 274 in communication with the pipes 24 and 250 when the valve 252 moves downwardly, as seen in FIG. 5, and passageways 276 to establish communication between pipes 22 and 252 when the valve element 262 moves upwardly, as seen in FIG. 6.

The body 233 is provided with internal annular valve seats 278 and 280 at the opposite ends of the intermediate chamber 244 and within the body a movable valve member 282 is disposed having an externally enlarged portion 233 intermediate its ends positioned for movement in one direction to close the seat 278 while opening the seat 280 and in the other direction to open the seat 278. This valve member 282 extends through the chamber 244 and has a sleeve-like upper end head 284 in the chamber 240 and a sleeve-like lower end head 286 in the lower chamber 242. Each of the heads 284 and 286 is provided with one or more openings 287 therein which are positioned to establish communication between the compressor discharge line 20 and pipe 250 when the valve member 282 is in position to open the seat 278 and close seat 280, and between the discharge line 20 and pipe 252 when the valve member is in position to close seat 280 and open seat 278.

A central stem 288 is slidably extended longitudinally through the member 282 and carries a piston 290 slidably positioned in the head 286 and a piston 292 slidably positioned in the head 284. The stem 288 extends upwardly through the top of the body for vertical movement relative thereto and the upper end of the stem extends within a solenoid device 218 whereby the stem will be moved upwardly upon energization of the solenoid device.

In the operation of the embodiment of the invention illustrated in FIGS. 5 and 6, assuming that the valve elements 262 and 282 are in the positions shown in FIG. 5 for normal operation of the system, with the suction line 18 of the compressor in communication with the pipe 22 through the lower chamber 236 and bore 238 and the discharge line 20 in communication with pipe 24 through seat 278, upper chamber 240, pipe 250, upper chamber 234 and passageways 274, and it is desired to place the system in condition for reverse cycle operation, then the solenoid device 218 is energized to move the stem 288 upwardly, whereupon the pistons 290 and 292 will be moved upwardly to close the openings 287 in head 284 and uncover the openings 287 of the head 286, thus cutting off the flow of pressure from the discharge line 20 to upper chamber 234. The pressure of the fluid from the discharge line 20 then operates against the head 284 to move the valve member 282 upwardly to close the seat 278 and open the seat 280, whereupon pressure from the discharge line 20 may pass into the lower chamber 236 to act upon the lower head 268 of valve member 262 to move valve member 262 upwardly to the position of FIG. 6 to close seat 260 and open seat 268 to permit reverse cycle flow of fluid through the system.

It is to be noted that the end notches 272 of the sleeve-like heads of the valve member 262 are of such depth that the passageways 274 provided by the upper head 266 will remain partly open upon upward movement of the valve member until the passageways 276 provided by the lower head 268 have been opened substantially, so that upward movement of the valve member will not be re-
slated by downward pressure of fluid on the upper head 266.

The system can be restored to normal operating condition by de-energization of the solenoid device 218 to allow the stem 288 to move downwardly to move pistons 290 and 292 downwardly, whereupon pressure from discharge line 20 will be cut off from the lower chamber 236 and valve member 282 will be actuated to permit the application of pressure to the upper head 266 to move valve member 262 downwardly to the position of FIG. 5 to close seat 258 and open seat 260.

A still further embodiment of the invention is illustrated in FIGURES 7, 8 and 9, wherein the valve mechanism includes valve casings 232 and 233 of similar construction to the bodies 232 and 233 of the embodiment illustrated in FIGURES 5 and 6, the valve element 262 being similar to the element 262 previously described, and the general arrangement of the system being the same. In this embodiment of the invention the valve member 282 is of somewhat differently constructed to the member 282, having a central longitudinal passageway 292 therethrough which opens at its opposite ends into the chambers 249' and 242' at points beyond the sleeve-like heads 284' and 286'. The heads 284' and 286' are also formed with end notches 294 which are positioned to provide passageways 296 through these heads for fluid to flow between the upper chamber 249' and the passageway 292 when the member 282' is in its lower position, shown in FIGURE 7, and passageways 298 through which fluid may flow between the lower chamber 242' and passageway 292 when the member in its upper position, shown in FIGURE 8.

The passageway 292 has an internal enlargement 300 intermediate its ends in which an internal seat 302 is provided on the head 284', surrounding the passageway, there being also an external seat 304 on the head 284' surrounding the upper end of the passageway. It includes a disk-shaped valve element 307 having a stem 309 which extends upwardly through the seats 302 and 304 and bears at its lower end on one end of a coil spring 308 whose other end is seated on the bottom of the internal enlargement 300 and which yieldsingly supports the valve element upwardly relative to the valve member 282'. The valve element 307 is shaped to engage the seat 302 upwardly movement and the upper end of stem 307' is adapted to engage the lower end of a small plunger 299 which forms a valve element adapted to engage the seat 394 upon downward movement of the plunger to close passage way 299. Plunger 299 has at its upper end a head 306' of T-shape which fits into a T-slot 310 in the lower end of a stem 312 which is slidably extended through the upper end of the body 233. The T-head 308 is of somewhat smaller size than the T-slot 310, so that the auxiliary valve element 307 and plunger 309 may move vertically a small distance relative to the stem 312. The stem 312 extends upwardly into a solenoid device 218, in a manner to be moved upwardly upon energization of the solenoid device, and to descent by its own weight when the solenoid is de-energized.

In the normal operation of the system, employing this embodiment of the invention, the parts will be in the positions illustrated in FIGURE 7, the discharge line 20 of the compressor being in communication with the pipe 24 through the seat 278, chamber 240, pipe 250, chamber 234' and passageways 274, and the suction line 18 in communication with the pipe 22 through chamber 236', seat 260' and bore 238'. In this condition of the apparatus the solenoid 218 is de-energized and the plunger 309 of auxiliary valve 306 is in engagement with the seat 304 to close the passageway 292 against the flow of fluid therethrough from the upper chamber 249' to the lower chamber 242'.

When it is desired to place the system in condition for reverse cycle operation the solenoid 218' is energized, to move the stem 312 upwardly, whereupon the auxiliary valve 306 follows the stem upwardly under the influence of the coil spring 308 to an intermediate position, illustrated in FIGURE 9, to open both the seats 302 and 304 to permit the flow of fluid from the upper chamber 249' through the passageway 292 into the lower chamber 242' beneath the lower head 286' to cause the valve member 282' to move upwardly to the position illustrated in FIGURE 8, wherein the seat 278' is closed, and the seat 260' is open. As soon as the auxiliary valve 282' reaches the position illustrated in FIGURE 8 to close the seat 278' and open the seat 260' the auxiliary valve element 307 will be in engagement with the seat 302 under the influence of the spring 308, to close passageway 292.

In this condition the mechanism the passageway 292 of the lower head 266' will be open, so that pressure from the discharge line 20 may also flow through the pipe 252' to chamber 256' to move the valve member 262' to its upper position, whereupon fluid from the discharge line will flow to the pipe 22 and the suction line 18 will be in communication with the pipe 24 through the seat 258'.

The system may be returned to normal operation by de-energization of the solenoid 218', whereupon the auxiliary valve 306 will be moved downwardly to the intermediate position of FIGURE 9 under the influence of the weight of the stem 312 to permit the flow of fluid from the lower chamber 242' through passageway 292 into the upper chamber 249' above the upper head 284', so that the pressure above and beneath the valve member 282' will be balanced, to permit the valve member to move downwardly to the position of FIGURE 7.

It will, of course, be appreciated that the valve bodies or casings 232 and 233 may be made as separate parts, as illustrated in the drawings, or as a single unit having the necessary passageways corresponding to the pipes 250 and 252.

From the foregoing it will be apparent that wide variations in the difference of pressure, between the high and low sides of a refrigeration system or any other pressure fluid system, will not materially affect the operation of the valve of the invention, because the novel structure of the invention provides pressure actuated moving parts in which the pressure acting on the parts on one side will be affected by interchange of pressure within the valve until after the movement has been completed.

While the invention has been disclosed herein in connection with certain specific embodiments of the same, it will be understood that these are intended by way of illustration only, and that numerous changes may be made in the construction and arrangement of the various parts without departing from the spirit of the invention and within the scope of the appended claims.

What is claimed is:
1. A multiport valve comprising, a body having a hollow interior and an inlet port to said hollow interior and at least two additional ports in communication with said hollow interior, valve means longitudinally moveable in said body for controlling fluid flow between said inlet port and said additional ports, said valve means having a first ported valve surface and a second ported valve surface longitudinally spaced from each other, said body having a first poppet valve seat adapted to be contacted by said first valve seat to close fluid flow from said inlet port to a first one of said additional ports, said body also having a second valve seat adapted to be contacted by said second valve surface fluid flow from said inlet port to a second one of said additional ports, flow channel means in said valve means having longitudinally spaced outlet openings, said body having passage means in said hollow interior for directing fluid under pressure from said inlet port through said flow channel means and out of one of said outlet openings, valve means for alternately opening and closing said outlet openings of said flow channel means, said body having additional passage means for directing the fluid under pressure from the
one of said outlet openings which is open to one of said additional ports in said body, and said valve means having a pressure surface adapted to be contacted by the fluid under pressure when one of said outlet openings is open and also another pressure surface adapted to be contacted by the fluid under pressure when the other of said outlet openings is open for alternately moving said valve means longitudinally in said body.

2. A multipoint valve including, a body having a flow passage therethrough, conduit means communicating with the opposite ends of said passage for reversibly directing fluid into said opposite ends, a pair of annular valve seats positioned at longitudinally spaced points in said passage, flow ports communicating with said passage at points between said seats and the points of connection of said conduit means to the passage, and outlet port communicating with the passage between said seats, a valve member reversibly movable longitudinally in said flow passage, said valve member carrying longitudinally spaced closure elements and actuated by the fluid flow from said conduit means to alternately engage said seats in accordance with the direction of said fluid flow, whereby to alternately establish communication between said outlet port and one of the flow ports, while simultaneously closing communication between said one of the flow ports and the conduit means, said valve member having throttling means therewith for gradually releasing fluid pressure at one end of said body between one of said annular valve seats and one of said flow ports, said valve member also having an additional throttling means therewith for gradually developing a pressure in the other end of said body as the pressure is gradually released from said one end of said body, said throttling means including longitudinally extending fingers having notches therebetween through which fluid may flow from the conduit means to said one of said flow ports, the notches being gradually movable into the bore of the body to gradually close such flow to said one of said flow ports and prevent chattering of the valve member during such closure.

3. A multipoint valve including, a body having a flow passage therethrough, conduit means communicating with the opposite ends of said passage for reversibly directing fluid into said opposite ends, a pair of annular valve seats positioned at longitudinally spaced points in said passage, flow ports communicating with said passage at points between said seats and the points of connection of said conduit means to the passage, an outlet port communicating with the passage between said seats, a valve member reversibly movable longitudinally in said flow passage, said valve member carrying longitudinally spaced closure elements and actuated by the fluid flow from said conduit means to alternately engage said seats in accordance with the direction of said fluid flow, whereby to alternately establish communication between said outlet port and one of the flow ports, while simultaneously closing communication between said one of the flow ports and the conduit means, said valve member having throttling means therewith for gradually releasing fluid pressure at one end of said body between one of said annular valve seats and one of said flow ports, said valve member also having an additional throttling means therewith for gradually developing a pressure in the other end of said body as the pressure is gradually released from said one end of said body, said throttling means including longitudinally extending fingers having notches therebetween through which fluid may flow from the conduit means to said one of said flow ports, the notches being gradually movable into the bore of the body to gradually close such flow to said one of said flow ports and prevent chattering of the valve member during such closure.

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