

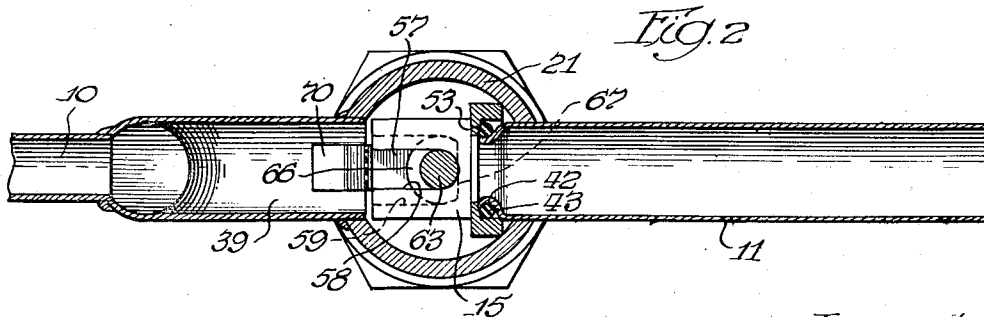
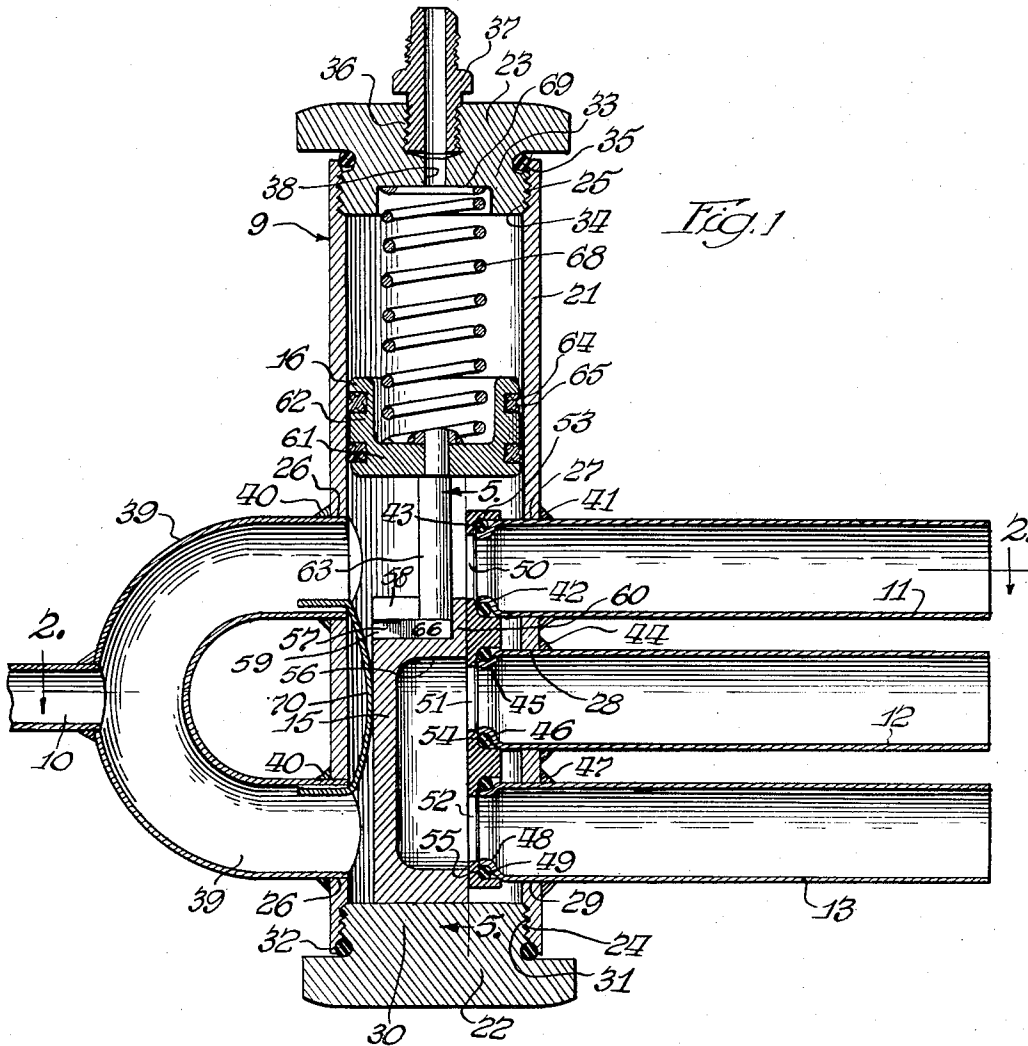
April 1, 1958

E. J. BARUSCH
REVERSE CYCLE VALVE

2,828,767

Filed Feb. 7, 1956

2 Sheets-Sheet 1



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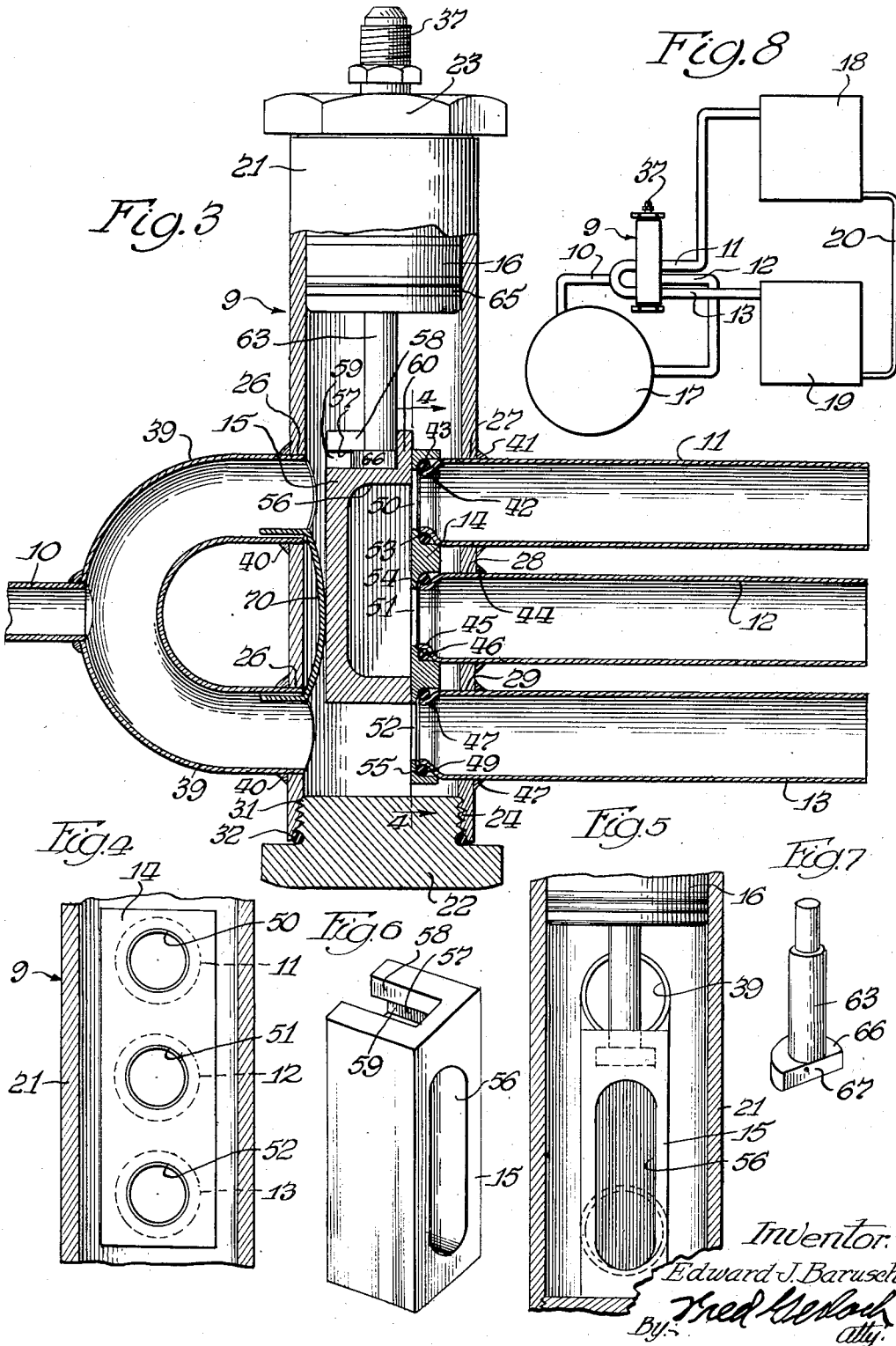
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REVERSE CYCLE VALVE

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4 Claims. (Cl. 137—625.29)

The present invention relates generally to valves. More particularly, the invention relates to that type of valve which is known in the art as a reverse cycle valve; is designed primarily for use in connection with either a heat pump or a mechanical refrigeration system embodying a motor driven refrigerant compressor, a condenser, an evaporator and a conduit between one end of the condenser and one end of the evaporator; comprises a casing with first, second, third and fourth ports therein; also comprises a movably mounted two-position valve member in the casing; has the first port open or exposed at all times to the casing interior and connected by a tube to the pressure side of the compressor; has the second port connected by a tube to the other end of the condenser; has the third port connected by a tube to the suction side of the compressor; has the fourth port connected by a tube to the other end of the evaporator; is adapted when the valve member is in one of its two positions to have the member open or expose the second port and cross connect or establish communication between the fourth and third ports and thereby cause the refrigerant to flow first through the condenser and then through the evaporator; and is further adapted when the valve member is in the other of its two positions to have such member open or expose the fourth port and cross connect or establish communication between the second and third ports and thereby cause the refrigerant to flow first through the evaporator and then through the condenser.

One object of the invention is to provide a reverse cycle valve which is an improvement upon, and has certain inherent advantages over, previously designed valves of the aforementioned type and is characterized by high efficiency and such a novel construction and arrangement of parts that it may be produced at an extremely low cost and also assembled and dismantled with facility.

Another object of the invention is to provide a reverse cycle valve of the type and character under consideration and in which the casing consists of an elongated cylindrical side wall and removable end walls at the ends of the side wall, the first port is formed in one portion of the casing side wall, the second, third and fourth ports are arranged in a rectilinear series and are formed in an elongated plate which is disposed directly inwards and extends lengthwise of another portion of the casing side wall, and the three tubes which are associated respectively with the second, third and fourth ports have the ends thereof that directly communicate with said three ports arranged so that they extend snugly through holes in said another portion of the casing side wall and have the extremities thereof disposed within the casing interior and attached by fluid tight connections to the elongated plate in which said second, third and fourth ports are formed.

Another object of the invention is to provide a reverse cycle valve of the last mentioned character and in which the elongated plate in which the second, third and fourth ports are formed has outwardly facing annular recesses

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around such ports, and the aforementioned tube extremities which are disposed in the casing interior are outwardly tapered and have positioned therearound O-rings which fit within said recesses and form therewith the fluid tight connections for attaching said tube extremities to the plate.

Another object of the invention is to provide a reverse cycle valve of the type and character under consideration and in which the inner side surface of the elongated plate in which the second, third and fourth ports are formed is lapped, and the movably mounted two-position valve member is block-like in configuration, is disposed within, and extends lengthwise of, the casing side wall, has one side surface thereof lapped and in sliding engagement with the lapped inner side surface of the plate, and embodies in its one lapped side surface a comparatively wide longitudinally extending groove for cross connecting the fourth and third ports when the valve member is in one of its two positions and cross connecting the second and third ports when the valve member is in the other of its two positions.

Another object of the invention is to provide a reverse cycle valve of the last mentioned character and in which the valve member is slid longitudinally back and forth between its two positions by way of a piston which is slidably mounted in one end of the cylindrical side wall of the casing and is operatively connected to the block-like valve member by a centrally positioned rod.

Another object of the invention is to provide a reverse cycle valve of the character last mentioned and in which the piston rod is connected to the valve member by a particular head and slot connection which upon removal of the piston from the valve casing permits the valve member to be readily disconnected from the piston rod.

A further object of the invention is to provide a reverse cycle valve of the type and character under consideration and in which the block-like valve member is urged into firm sliding engagement with the elongated plate by way of a leaf spring which is disposed in the interior of the casing side wall and is anchored or secured in place in a novel manner.

A still further object of the invention is to provide a reverse cycle valve which is generally of new and improved construction and effectively and efficiently fulfills its intended purpose.

Other objects of the invention and the various advantages and characteristics of the present reverse cycle valve will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a longitudinal section showing a reverse cycle valve embodying the invention with the valve member thereof in one of its two positions;

Figure 2 is a transverse section on the line 2—2 of Figure 1;

Figure 3 is a longitudinal section like Figure 1 except that it shows the block-like valve member in the other of its two positions;

Figure 4 is a section taken on the line 4—4 of Figure 3 and illustrating in detail the construction, design and arrangement of the elongated plate in which the second, third and fourth ports are formed;

Figure 5 is a section taken on the line 5—5 of Figure 1 and showing the construction and arrangement of the block-like valve member;

Figure 6 is a perspective of the valve member;

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Figure 7 is a perspective of the rod which serves operatively to connect the piston to the valve member; and

Figure 8 is a diagrammatic view showing use of the reverse cycle valve in a conventional mechanical refrigeration system of the type that embodies a compressor, a condenser and an evaporator.

The reverse cycle valve which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is illustrated in Figure 8 of the drawings as forming a part of a conventional mechanical refrigeration system and has as its principal components or parts a casing 9, four refrigerant tubes 10, 11, 12 and 13, a port-forming plate 14, a movably mounted two-position valve member 15, and a piston 16 for effecting shift or sliding movement of the valve member back and forth between its two positions. The refrigeration system embodies a motor driven uni-directional refrigerant compressor 17, a condenser 18, an evaporator 19 and a conduit 20 between one end of the condenser and one end of the evaporator, and is, as hereinafter described more in detail, so controlled by the valve that when the valve member is in one of its two positions the refrigerant flows first through the condenser and then the evaporator and when the valve member is in the other of its two positions the refrigerant flows first through the evaporator and then through the condenser.

The casing 9 of the valve is illustrated in the drawings as being positioned vertically although it is to be understood that the valve casing may be otherwise positioned. It is of composite character and consists of a cylindrical side wall 21 and a pair of end walls 22 and 23. The cylindrical side wall 21 may, if desired, be formed of a section of pipe or a length of standard tubing and except for the hereinafter described screw threads is of uniform internal diameter from end to end. The lower end of the side wall 21 is provided with an internal screw thread 24 and the upper end of the side wall is provided with an internal screw thread 25. The lower end portion of the casing side wall 21 has in one side thereof a pair of vertically spaced circular holes 26 and embodies in the opposite side thereof a vertical series of three equidistantly spaced circular holes 27, 28 and 29. The holes 26 are spaced an appreciable distance apart and together form a first port which is always open or exposed and is connected to the pressure side of the compressor 17 by the tube 10 as described hereafter. The hole 27 is positioned above the holes 28 and 29 and is located diametrically opposite to the upper hole 26. The hole 29 is the lowermost hole of the aforementioned vertical series of three holes and is located diametrically opposite to the lower hole 25. The hole 28 is disposed midway between the holes 27 and 29 as shown in Figures 1 and 3. The end wall 23 of the casing 9 extends across, and serves as a closure for, the lower end of the cylindrical side wall 21 and is provided on the central portion thereof with an integral upwardly extending lug-like part 30 which fits within the lower end of the side wall 21 and is provided with an external screw thread 31. The latter is normally in interfitting relation with the internal screw thread 24 and forms with the latter means for removably securing the end wall 22 in its operative or normal position. The end wall 22 is preferably polygonal in shape or configuration in order that it may be readily gripped by the hand or a wrench in connection with connecting it to or removing it from the lower end of the cylindrical side wall 21. A circular gasket 32 of rubber or any other suitable elastic material extends around the lower end of the lug-like part 30 and, when the end wall 22 is in its operative position, forms a fluid tight seal between the end wall and the lower end of the casing side wall 21. The end wall 23 of the casing 9 extends across, and serves as a closure for, the upper end of the cylindrical side wall 21 and is provided on the central portion there-

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of with an integral depending lug-like part 33 which fits within the upper end of the side wall 21 and is provided with an external screw thread 34. The latter is normally in interfitting relation with the internal screw thread 25 and forms with the latter means for removably securing the end wall 23 in its operative or normal position. The end wall 23 is preferably polygonal in order that it may be readily gripped by the hand or a wrench in connection with connecting it to or removing it from the upper end of the cylindrical side wall 21. A circular gasket 35, like the gasket 32, extends around the upper end of the lug-like part 33 and, when the end wall 23 is in its operative position, forms a fluid tight seal between the end wall and the upper end of the casing side wall 21. The central portion of the end wall 23 is provided with a screw threaded socket 36 in which is mounted the lower end of a vertically extending externally threaded coupling 37. The latter has its interior in communicating relation with the upper end of the interior of the casing side wall 21 by way of a vertically extending duct 38 in the central portion of the depending lug-like part 33 and is adapted to be connected by a conduit (not shown) to a valve-controlled suction source (also not shown).

The tube 10 extends between the compressor 19 and the valve casing and serves to establish communication between the pressure side of the compressor and the interior of said valve casing 9. One end of the tube 10 is suitably connected to the pressure side of the compressor and the other end of the tube is provided with a pair of curved oppositely disposed discharge branches 39. As shown in Figures 1 and 3, the ends of the branches 39 fits snugly within the holes 26 and are fixedly secured to the casing side wall 21 by rings 40 of solder. Such solder rings extend around, and are bonded to, the ends of the branches 39 at the discharge end of the tube 10 and fit against, and are bonded to, the portions of the casing side wall 21 that define the holes 26. When the compressor 17 is in operation, the tube 10 serves to deliver the compressed refrigerant from the compressor into the lower portion of the interior of the valve casing 9. The holes 26 which as previously pointed out together constitute a first port in the valve casing are always open or exposed.

The tube 11 extends between, and is connected to, the valve casing 9 and the condenser 18. One end of the tube 11 is suitably connected to the end of the condenser that is opposite to the end to which the conduit 20 is connected. The other end of the tube extends snugly through the hole 27 in the casing side wall 21 and projects a comparatively small distance into the interior of the valve casing. It is fixedly connected to the casing side wall 21 by way of a ring 41 of solder and has the extremity thereof tapered outwards so as to form an annular seat 42 therearound. The solder ring 41 extends around, and is bonded to, the portion of the tube 11 that is directly outwards of the hole 27, and fits against, and is bonded to, the portion of the casing side wall 21 that defines the hole 27. An O-ring 43 of rubber or other resilient material extends around, and fits snugly within, the annular seat 42.

The tube 12 extends between, and is connected to, the valve casing 9 and the suction side of the compressor 17. One end of the tube 12 is suitably connected to said suction side of the compressor and the other end of the tube extends snugly through the hole 28 in the casing side wall 21 and projects a comparatively small distance into the interior of the valve casing. It is fixedly connected to the casing side wall 21 by way of a ring 44 of solder and has its extremity tapered outwards so as to form an annular seat 45 therearound. The solder ring 44 extends around, and is bonded to, the portion of the tube 12 that is directly outwards of the hole 28, and fits against, and is bonded to, the portion of the casing side wall 21 that defines said hole 28. An O-ring 46, like the O-ring 43,

extends around, and fits snugly within, the annular seat 45.

The tube 13 extends between, and is connected to, the valve casing 9 and the evaporator 19. One end of the tube 13 is suitably connected to the end of the evaporator that is opposite to the end to which the conduit 20 is connected. The other end of the tube 13 extends snugly through the hole 29 in the casing side wall 21 and projects a comparatively small distance into the interior of the valve casing. It is fixedly connected to the casing side wall 21 by way of a ring 47 of solder and has the extremity thereof tapered outwards so as to form an annular seat 48 therearound. The solder ring 47 extends around, and is bonded to, the portion of the tube 13 that is directly outwards of the hole 29, and fits against, and is bonded to, the portion of the casing side wall 21 that defines said hole 29. An O-ring 49, like the O-rings 43 and 46, surrounds, and fits snugly within, the annular seat 48.

The port-forming plate 14 is disposed within, and extends lengthwise of, the lower portion of the interior of the valve casing 9 and is preferably formed of tool steel. It is disposed a small distance inwards of the holes 27, 28 and 29 in the casing side wall 21 and has formed therein a second port 50, a third port 51 and a fourth port 52. These three ports are arranged in a rectilinear vertically extending series and are circular. The second port 50 is in registry and communication with the adjacent end of the tube 11 and is surrounded by an outwardly facing annular recess 53 in which the O-ring 43 fits snugly. The third port 51 is located a small distance beneath the second port 50. It is in registry and communication with the adjacent end of the tube 12 and is surrounded by an outwardly facing annular recess 54 in which the O-ring 46 fits snugly. The fourth port 52 is formed in the lower end of the plate 14 and is positioned or located a small distance beneath the third port 51. It is in registry and communication with the adjacent end of the tube 13 and is surrounded by a rearwardly facing annular recess 55 in which the O-ring 49 fits snugly. The three outwardly facing annular recesses 53, 54 and 55 are formed in the outer side surface of the plate 14, i. e., the side surface that faces towards the holes 27, 28 and 29. The three O-rings 43, 46 and 49 form fluid tight connections or joints between the second, third and fourth ports and the adjacent ends of their respective or associated tubes. The inner side surface of the port-forming plate 14 is flat and lapped. In assembling the valve, the plate 14 is inserted lengthwise into the lower end portion of the interior of the valve casing 9 and is then shifted laterally or outwards in order to bring the three O-rings 43, 46 and 49 into seated relation with their respective outwardly facing annular recesses 53, 54 and 55. When the O-rings are properly seated into such recesses, the port-forming plate 14 is held against lengthwise and lateral displacement relatively to the valve casing and the second, third and fourth ports are in fluid tight relation with the adjacent ends of their respective or associated tubes. If it is desired to remove the port-forming plate 14 for cleaning or inspection purposes, it is only necessary to remove the end wall 22 from the lower end of the casing side wall 21 and then shift the plate laterally away from the adjacent ends of the tubes 11, 12 and 13. Such shift on the part of the plate releases the plate from the adjacent ends of said three tubes and hence permits it to be withdrawn from the valve interior by moving it downwards through the lower end of the casing side wall 21.

The valve member 15 of the reverse cycle valve is block-like so far as configuration or shape is concerned. It is square in cross section and is disposed in, and extends lengthwise, of, the lower portion of the interior of the valve casing 9. The length of the valve member 15 is approximately two-thirds of the length of the port-forming plate 14. One of the side surfaces of the valve

member is flat and lapped and fits slidably against the lapped inner side surface of the plate 14. The valve member 15 is provided in its lapped side surface with a comparatively wide longitudinally extending groove 56 and is slidable vertically back and forth between a down position as shown in Figure 1 and an up position as shown in Figure 3. When the valve member is in its down position, it exposes the second port 50 and by way of the groove 56 cross connects or establishes communication between the fourth port 52 and the second port 51, and when the valve member is in its up position it exposes the fourth port 52 and by way of said groove 56 cross connects or establishes communication between the second port 50 and the third port 51. When the valve is in its aforementioned down position, the refrigerant that is compressed by the compressor 17 flows first through the tube 10, then into the lower portion of the valve casing interior 9 via holes 26 in the casing side wall 21, then through the exposed second port 50, then through the tube 11, then through the condenser 18, then through the conduit 20, then through the evaporator 19, then through the tube 20, then through the fourth port 52, then through the longitudinal groove 56 in the lapped side surface of the valve member, then through the third port 51 and finally back to the compressor by way of the tube 12. When the valve member 15 is in its up position as shown in Figure 3, the refrigerant that is compressed by the compressor flows first through the tube 10, then through the lower portion of the valve casing 9, then through the fourth port 52, then through the tube 13, then through the evaporator 19, then through the conduit 20, then through the condenser 18, then through the tube 11, then through the second port 50, then through the groove 56, then through the third port 51, and finally back to the compressor by way of the tube 12. In connection with such flow of the refrigerant defrosting of the evaporator 19 occurs. The upper end of the valve member 15 is provided with a horizontally elongated inverted T-shaped notch 57 which comprises a vertically extending upper part 58 and a horizontally extending lower part 59 and has the end thereof that is nearer the lapped side surface of the valve member 15 closed by a vertically extending wall 60. The other end of the notch is open and extends through the side wall of the valve member that is in opposed relation with the aforesaid lapped side surface of the valve member.

The piston 16 of the reverse cycle valve is mounted for vertical sliding movement in the upper end portion of the side wall 21 of the valve casing 9 and serves as a medium for sliding the valve member 15 back and forth between its down and up positions. It consists of a circular bottom wall 61 and an upwardly extending cylindrical side wall 62 and is operatively connected to the valve member by a centrally disposed depending rod 63. The cylindrical side wall 62 of the piston fits slidably within the upper end portion of the casing side wall 21 and embodies in its outer periphery annular grooves 64 in which are mounted piston rings 65. The upper end of the rod 62 is suitably connected in a fixed manner to the central portion of the circular bottom wall 61 of the piston. The lower end of the rod 63 extends through the narrow upper part 58 of the inverted T-shaped notch 57 in the upper end of the valve member 15 and is provided with an integral enlarged head 66 which fits within the wide lower part 59 of the notch 57 and coacts therewith to form a connection whereby the valve member is normally in interlocked relation with the lower end of the piston rod but is capable of being disconnected from said lower end of the rod by shifting it laterally relatively thereto. The enlarged head 66 on the lower end of the piston rod 63 is provided at one side thereof with a flat 67 which when the head is in its normal position within the wide lower part 59 of the inverted T-shaped notch 57 abuts against the inner surface of the vertically extending wall 60. When the valve member and the piston

are removed from the valve casing 9, the valve member may be removed from the lower end of the piston rod 63 merely by sliding it laterally in the direction of the wall 60 until the head 66 is fully removed from the wide lower part 59 of the inverted T-shaped notch 57. Connection of the valve member 16 to the lower end of the piston rod 63 is effected by positioning the valve member so that the open end of the inverted T-shaped notch 57 is in alignment with the lower end of the rod and then shifting the valve member laterally in order to effect disposition of the head 66 in the wide lower part 59 of the notch. A spiral compression spring 68 serves when the upper portion of the interior of the valve casing 9 is vented to atmosphere to slide the piston 16 downwards and thus effect movement of the valve member 15 into its aforementioned down position. Such spring is located in the upper portion of the interior of the valve casing and has its upper end disposed in a downwardly facing socket 69 in the lug-like part 33 on the central portion of the upper end wall 23. The lower end of the spring 68 fits within the cylindrical side wall 62 of the piston and abuts against the circular bottom wall 61. The piston 16 is slid upwards by creating a vacuum in the upper portion of the casing interior. It is contemplated that when it is desired to slide the piston upwards the valve in the aforementioned valve-equipped suction source will be opened. Upon opening of such valve air is evacuated from the upper portion of the casing interior via the coupling 37 and results in the piston sliding upwards against the force of the compression spring 68. In connection with upward sliding movement of the piston, the valve member 15 is caused to slide into its up position.

In addition to the parts heretofore described, the reverse cycle valve comprises a leaf spring 70 for urging the block-like valve member 15 into firm sliding engagement with the port-forming plate 14. Such spring is disposed adjacent to the portion of the casing side wall 21 that is between the holes 25. The central portion of the leaf spring is bowed away from said portion of the side wall and bears against, and engages slidably, the side surfaces of the valve member 15 that is opposite to the lapped side surface. The ends of the leaf spring 70 are arranged so that they extend outwards and are in parallel relation. They fit within the ends of the branches 39 at the discharge end of the tube 10 and coact therewith to hold the leaf spring as a whole against longitudinal displacement with respect to the casing side wall 21. Because of the action of the bowed central portion of the leaf spring 70 the valve member 15 is urged against the port-forming plate 14 with spring pressure. The aforementioned leaf spring may be removed from its operative position after removal of the valve member 15 and the piston 16 from the valve casing 9.

The herein described reverse cycle valve is essentially simple in design and due to the particular arrangement and construction of its parts not only effectively and efficiently fulfills its intended purpose but also is capable of being assembled and dismantled with facility.

Whereas the reverse cycle valve has been specifically described as forming a part of a conventional mechanical refrigeration system, it is to be understood that it has numerous other capabilities of use. It is also to be understood that the invention is not to be restricted to the details set forth since such details may be changed or modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A reverse cycle valve comprising a metallic casing provided between its interior and exterior with an inlet opening for fluid under pressure and having in a portion of one wall thereof a rectilinear series of three spaced apart circular holes, an elongated separately formed plate disposed in the casing interior, positioned in

parallel relation with, and a small distance inwards from, said portion of the one wall of the casing, embodying between its inner and outer side surfaces a longitudinally extending series of three spaced apart circular ports in opposed relation with said holes respectively, and having in its outer side surface and around and communicating with the ports outwardly facing annular recesses, three separate spaced apart thin-walled metallic tubes disposed for the most part externally of the casing, extending snugly through said three holes respectively, having the portions thereof that extend through said holes soldered in a fixed and fluid-tight manner to the hole-defining parts of said portion of the one wall of the casing, and having the inner ends thereof positioned in registering and communicating relation with the three ports respectively and shaped or bent to form tapered annular seats therearound, single O-rings mounted in said seats respectively, fitting snugly in said recesses, and forming removable fluid tight connections between the plate and the inner ends of the fixed tubes whereby the plate may be disconnected from the said inner ends of the tubes by shifting it laterally and inwardly relatively thereto, an elongated block-like valve member disposed in the casing interior, positioned directly inwards and lengthwise of the plate, having one side surface thereof in sliding engagement with the inner side surface of said plate, movable lengthwise back and forth between a first position wherein it exposes one of the end ports and covers the intermediate port and the other end port and a second position wherein it exposes said other end port and covers the intermediate port and the one end port, and provided in its said one side surface with a single longitudinal groove for cross connecting the intermediate port and said other end port when the valve member is in its first position and for cross connecting the intermediate port and said one end port when the valve member is in its second position, and means for moving the valve member back and forth between its first and second positions.

2. A reverse cycle valve comprising a casing consisting of an elongated vertically extending cylindrical side wall and removable end walls, provided in a portion of the lower end of the side wall with an inner opening for fluid under pressure, and having in another portion of said lower end of the side wall a rectilinear longitudinally extending series of three equidistantly spaced holes, an elongated vertically extending separately formed plate disposed in the casing interior, positioned in parallel relation with, and a small distance inwards from, said another portion of said lower end of the casing side wall, and embodying between its inner and outer side surfaces a longitudinally extending series of three equidistantly spaced ports in opposed relation with said holes respectively, three separate spaced apart thin-walled tubes disposed for the most part externally of the casing, extending snugly through said three holes respectively, and having the portions thereof that extend through said holes connected in a fixed and fluid-tight manner to the hole-defining parts of said another portion of the lower end of the casing side wall, and having the inner ends thereof in registering and communicating relation with the three ports respectively and connected by removable fluid tight connections of such character that said plate may be disconnected from the inner ends of the tubes by merely shifting it laterally and inwardly relatively thereto, an elongated vertically extending block-like valve member disposed in the casing interior, positioned directly inwards and lengthwise of the plate, having one side surface thereof in sliding engagement with the inner side surface of said plate, movable lengthwise back and forth between a first position wherein it exposes one of the end ports and covers the intermediate port and the other end port and a second position wherein it exposes said other end port and covers the intermediate port and the one end port, provided in its said

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one side surface with a single longitudinal groove for cross connecting the intermediate port and said other end port when the valve member is in its first position and for cross connecting the intermediate port and said one end port when the valve member is in its second position, and having formed in the upper end thereof a horizontally elongated inverted T-shaped notch which consists of a vertically extending upper part and a horizontally extending lower part and has the upper end of its upper part extending through the top surface of the valve member, and means adapted to move the valve member back and forth between its first and second positions and embodying a piston mounted slidably in the upper end of the casing side wall and a vertically extending rod positioned for the most part beneath the piston having its upper end connected fixedly to the piston and its lower end extending through the vertically extending upper part of the notch and provided at its bottom extremity with an enlarged head that fits within, and is the same in height as, the horizontally extending lower part of the notch, said inverted T-shaped notch having one side thereof intersecting and opening through one side of the valve member in order that when the piston, rod and valve member are removed from the casing the valve member may be disconnected from the rod by shifting it laterally relatively thereto.

3. A reverse cycle valve according to claim 2 and in which the other side of the inverted T-shaped notch is closed by an integral part of the valve member and the enlarged head on the bottom extremity of the lower end of the rod embodies a flat which is normally in abutment with said integral part of the valve member and coacts with the latter to prevent the piston and valve member from turning one relatively to the other.

4. A reverse cycle valve comprising a casing consisting of an elongated cylindrical side wall and removable end walls, provided in a longitudinally extending portion of the side wall with two spaced apart inlet openings for fluid under pressure, and having in the portion of the side wall that is directly diametrically opposite to the first mentioned portion of the casing side wall a rectilinear longitudinally extending series of three equidistantly spaced holes, an elongated separately formed plate disposed in the casing interior, positioned in parallel relation with, and a small distance inwards from, the second

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mentioned portion of the casing side wall, and embodying between its inner and outer side surfaces a longitudinally extending series of three equidistantly spaced ports in opposed relation with said holes respectively, three separate spaced apart tubes extending snugly through, and fixedly connected to, said three holes respectively and having the inner ends thereof in registering and communicating relation with the three ports respectively and connected by removable fluid tight connections to the plate, an elongated block-like valve member disposed in the casing interior, positioned directly inwards and lengthwise of the plate, having one side surface thereof in sliding engagement with the inner side surface of said plate, movable lengthwise back and forth between a first position wherein it exposes one of the end ports and covers the intermediate port and the other end port and a second position wherein it exposes said other end port and covers the intermediate port and the one end port, and provided in its said one side surface with a longitudinal groove for cross connecting the intermediate port and said other end port when the valve member is in its first position and for cross connecting the intermediate port and said one end port when the valve member is in its second position, means adapted to move the valve member back and forth between its first and second positions, and a centrally bowed leaf spring operative yieldingly to urge the valve member against said plate, arranged lengthwise of the casing side wall and so that its central portion is in sliding engagement with the valve member side surface that is opposite to said one side surface, and having its ends bent outwards and arranged so that they extend in substantially parallel relation, project into and through the aforesaid spaced apart openings and coact with the latter to hold the spring against longitudinal displacement with respect to the casing side wall.

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