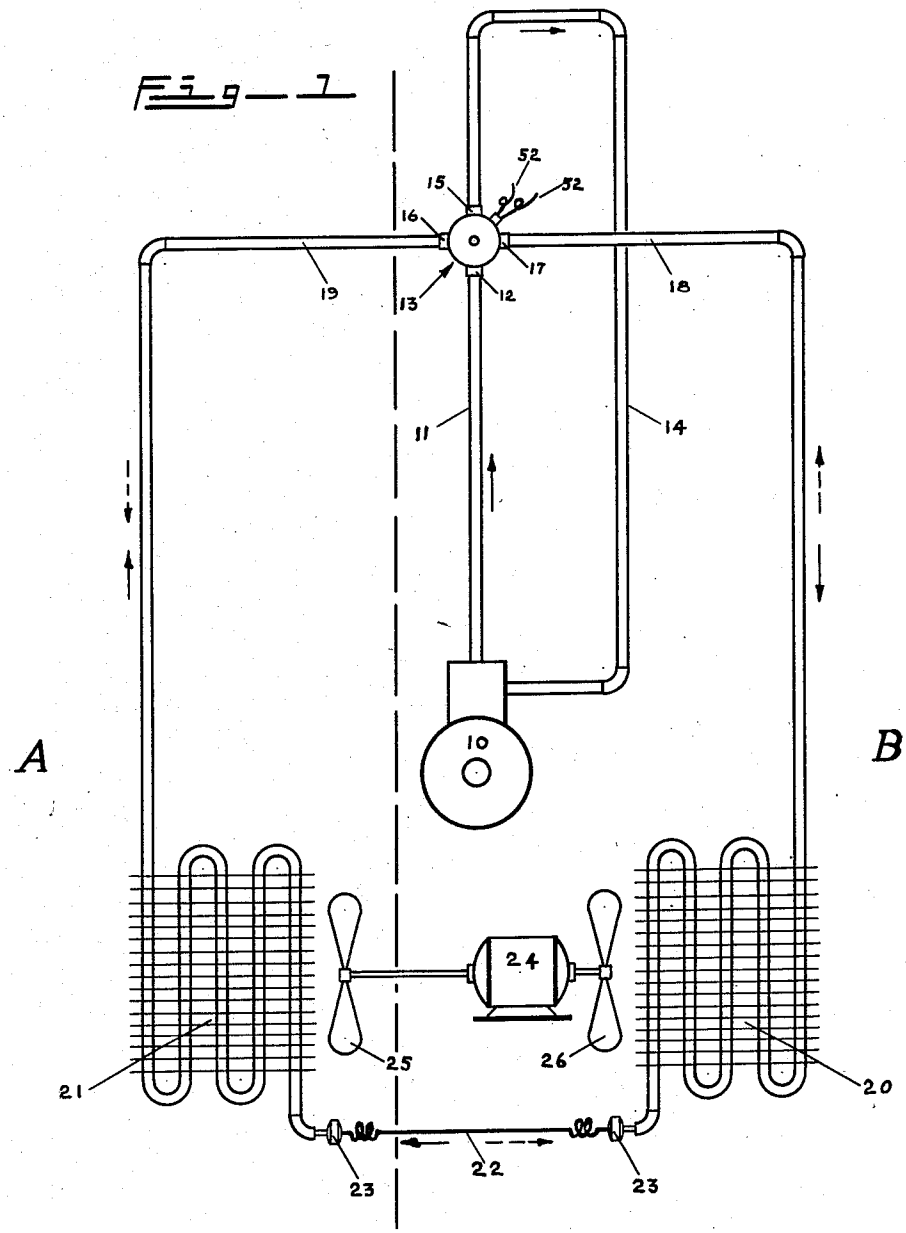
March 23, 1954 V. W. TIPTON 2,672,887

MULTIPLE-PORT VALVE FOR AIR CONDITIONING SYSTEMS

Filed July 21, 1950 2 Sheets-Sheet 1

Fig. 1



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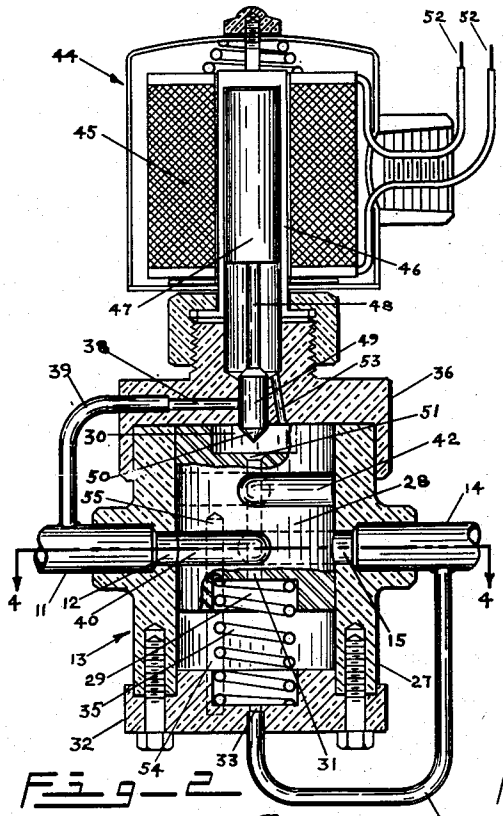


Fig 2

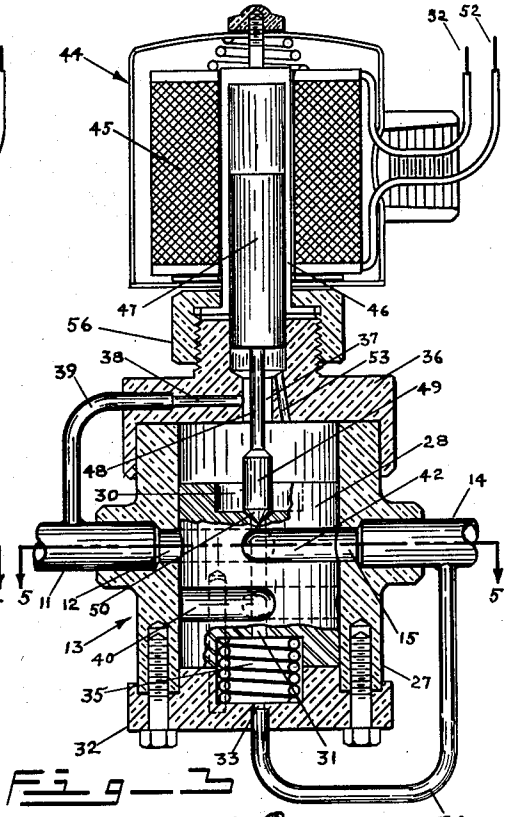


Fig 3

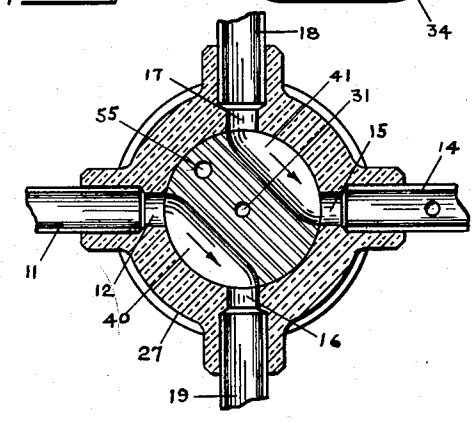


Fig 4

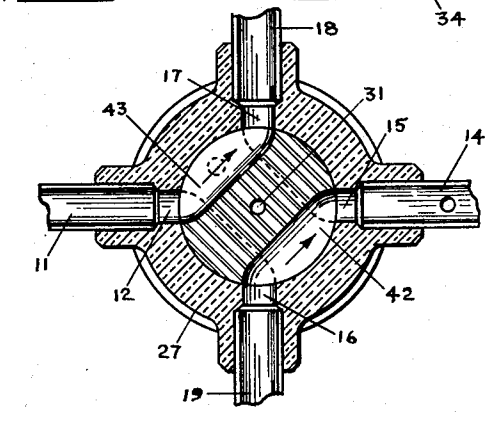


Fig 5

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Patented Mar. 23, 1954 2,672,887

UNITED STATES PATENT OFFICE

2,672,887

MULTIPLE-PORT VALVE FOR AIR CONDITIONING SYSTEMS

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Application July 21, 1950, Serial No. 175,243

5 Claims. (Cl. 137—657)

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This invention relates to a multiple-port valve and is more particularly directed to a solenoid operated valve adapted to be used in an air conditioning unit for reverse cycle operation in order that the conventional air conditioning unit may be also utilized as a space heater.

Therefore, the primary object of the present invention is to provide a multiple-port valve which may be interconnected in an air conditioning system, whereby the system may be operated to selectively cool or heat the volume flow of air being conditioned depending upon the operating position of the multiple-port valve.

A further object of the present invention is to provide a valve device for reverse cycle operation which is simple in construction and operation and inexpensive to manufacture and install in air conditioning units.

A still further object of the present invention is to provide a multiple-port valve for an air conditioning unit which adapts the air conditioning unit for heating as well as cooling air, wherein the multiple-port valve may be electrically operated by a switch for selective operation of the air conditioning unit.

With these and other objects in view, the invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings, forming a part of the present specification with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawings, but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings.

Figure 1 is a diagrammatic view of a simple air conditioning system embodying my invention.

Figure 2 is a longitudinal sectional view of a valve embodying my invention with the valve body shown in one position.

Figure 3 is a longitudinal sectional view similar to Figure 2 but showing the valve body in its other position.

Figure 4 is a sectional view taken thru 4—4 of Figure 2.

Figure 5 is a sectional view taken thru 5—5 of Figure 3.

The apparatus embodying the present invention is shown in connection with air conditioning apparatus for the purpose of illustration. Referring now to the drawings and in particular to Figure 1, there is shown a simple diagrammatic

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sketch of an air conditioning package unit (except for the minor changes made to adapt the device of the present invention to the system) with the area A being the space to be air conditioned and the area B being the space wherein the dissipation of heat, etc. takes place. The air conditioning unit consists of a compressor 10 with its high pressure or discharge hot gas line 11 connected to a port 12 of the multi-port valve 13 and having its return or suction line 14 connected to a port 15 diametrically opposed to the port 12 of the valve 13. Ports 16 and 17 of the valve 13 are each connected to lines 19 and 18 respectively which in turn are connected to a condenser 20 and an evaporator or cooling coil 21. A capillary tube 22 completes the system connecting together the condenser 20 and the cooling coil 21 with a pair of filters 23 interposed at each end of the tube 22 in order to catch any sediment and foreign matter in whichever direction the fluid refrigerant may be flowing. A motor 24 operates fans 25 and 26 which serve the well known function of creating and distributing a volume flow of air over the cooling coil 21 and the condenser 20 respectively.

As shown by Figures 2–4 inclusive, the multiple-port valve 13 consists of a cylindrical casing 27 having four ports 12, 15, 16 and 17 all in the same horizontal plane and symmetrically disposed thereabout at 90 degree intervals. A valve piston 28 which is slidably positioned in the casing 27 has a cavity 29 and 30 at each end thereof and a bore 31 extending longitudinally thru the piston valve 28 connecting the chambers formed by the cavities 29 and 30. The valve casing 27 is provided at its bottom with a cap 32 which is bolted or otherwise secured thereto, having an opening 33 therethru to which a drain line 34 is fitted and communicates with the suction line 14. A spring 35 is positioned between the cap 32 and the piston valve 28 at the cavity 29 to yieldingly hold the piston valve 28 in its upper position as shown in Figure 2. A cap 36 which is soldered or otherwise secured to the top of the valve casing 27 has a port 37 extending thru the cap 36 and a second passage 38 extending radially to connect the first port 37 at about its midsection. A conduit 39 secured to the port 38 is connected to the high pressure line 11 as shown.

A pair of recesses or groove forming passages 40 and 41 are formed along about 100 degrees of the circumference of the valve body 28 in the same horizontal plane, so that the passages 40 and 41 permit communication between the ports 12 and 16 and ports 15 and 17 respectively when

the valve 28 is in the position shown by Figures 2 and 4. There is a second pair of passages 42 and 43 in a plane above the aforementioned passages 40 and 41, but the former pair of passages are at right angles to the latter passages. When the valve is in its lower position, as shown by Figures 3 and 5, the passage 43 connects the ports 12 and 17 while the passage 42 connects the ports 15 and 16. As can readily be seen according to the construction of the valve 43, when the valve piston 28 is in the upper position as shown by Figures 2 and 4, the port 12 is in communication with port 16 and the port 15 connects with the port 17; when the piston valve 28 has been moved to its lower position (see Figures 3 and 5) the port 12 communicates with the port 17 while the port 16 communicates with the port 15. It is to be noted that the piston valve 28 is in its lower position when it abuts against the cap 32, and in its upper position when it abuts against the cap 36, thus ensuring the proper alignment of the pairs of passages 40, 41 and 42, 43 with the ports 12, 15, 16 and 17.

To effect the aforementioned valve movement, a solenoid operated valve mechanism 44 is mounted on the valve casing 27, consisting of a solenoid 45 mounted on a centrally positioned tubing 46 whose flanged open end is secured to the cover or cap 36 by a flange type union 56. A plunger 47 slidably positioned within the tubing 46, is connected to a valve stem 48 upon the free end of which is secured a cylindrical slide valve 49 having its end cone shaped to form a second valve 50. The valve 49 fits snugly in the bore 37 so that when the solenoid 45 is energized the plunger 47 moves to its upper position carrying the valve 49 into the bore 37 and its side wall blocks off the bore 37 from communication with the cavity 30 and the chamber above the piston valve 28 (see Figure 2). The bore 31 in the piston valve 28 has a seat 51 thereon to receive the cone shaped end 50 of the valve 49 when the solenoid 45 is de-energized and the valve 49 moves to its lowered position and the seat 51 receives the end 50 of the valve 49 to cut off communication between the upper and lower cavities 30 and 29. The wires 52, 52 of the solenoid 45 are connected to a switch and power source not shown. A bleed port 53 in the cover 36 extends between the chamber in the tubing 46 and the cavity 30 including the chamber above the piston valve 28 so as to relieve in the tubing 46 any pressures that may accumulate therein. To prevent the piston valve 28 from turning within the casing 27, a pin 54 is mounted on the cover 32 and extending into a bore 55 in the lower portion of the valve 28.

In the operation of the device, when the switch is operated so as to energize the solenoid 45, the plunger 47 moves upwardly carrying the valve 49 upwardly to seat it within the bore 37 cutting off communication between the pressure line 39 and the chamber above the piston 28. The bore 31 now permits the fluid under pressure trapped in the valve chamber above the piston 28 to flow to the lower cavity 29 and the chamber therebelow to equalize the fluid pressures on each side of the piston 28, and permitting the spring pressure 35 to force the piston valve 28 to slide upwardly to its top most position as shown in Figures 2 and 4. While in this position, the high pressure line 11 of the compressor 10 communicates with the line 19 of the evaporator 21 so that the hot discharge gas is permitted to flow into the evaporator or cooling coil 21. Air which

is blown by the fan 25 across the fins of the evaporator coils 21 absorbs the heat which is being given off by the refrigerant in the coils 21, all of which takes place in the area A.

The high pressure fluid in the coils 21 then becomes liquified and passes thru the capillary tubing 22 where the refrigerant is expanded at the condenser coil 20 from where it is returned in a vapor state thru the line 18 back to the valve passage 41 in the valve 28 and into the low pressure or suction line 14 of the compressor 10 thus completing the reverse cycle.

When the solenoid is de-energized (see Figures 3 and 5) the plunger 47 will slide downwardly due its own weight, carrying the valve 49 downwardly to seat on the valve seat 51 of the bore 31, cutting off communication between the upper and lower cavities 29 and 30. The upper cavity 30 of the valve 28 now communicates with the high pressure fluid in the lines 11 and 39, thus causing the piston valve 28 to move downwardly under the fluid pressure exerted by the hot refrigerant gases.

The fluid trapped in the chamber below the valve 28 and in the bore 31 is drained thru the conduit 34 to the suction line 14 of the compressor 10. With the valve 28 in the lower position, as shown by Figures 3 and 5, the high pressure side of the compressor 10 communicates thru the tubing 11 with the port 12 of the valve 28. The passage 43 in the valve body 28 connects the port 12 with the port 17, permitting the flow of the high pressure refrigerant therethru to the line 18 and the condenser 20 where the high pressure vapor dissipates its heat and becomes liquified. The liquid refrigerant then flows thru the capillary tube 22 which acts as an expansion valve causing the liquid refrigerant to expand and cool the evaporator coils 21, which in turn cools the air which is being blown over the coils 21 by the fan 25 to cool the room or area A. The vaporized refrigerant now flows thru the tubing 19 to the port 16, the valve passage 42 and to the suction line 14 of the compressor 10, thus completing the cooling cycle.

It can be seen that by the use of the applicant's device in an air conditioning unit with minor changes and adjustments made thereto, the air conditioning unit may be used as a heater as well as a cooling unit.

While the invention has been described with reference to a certain preferred embodiment thereof, which gives satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is my intention therefore to cover in the appended claims all such changes and modifications.

What I claim is:

1. A multiple-port valve having a valve casing, a plurality of ports contained by said casing, said ports lying in a plane and comprising a plurality of inlets and outlets, a valve body slidably mounted in said valve casing, means mounted in said casing yieldingly forcing said valve body in one direction, a plurality of passages formed in said valve body lying in a plane to form a group and adapted to connect each of said inlets with each of said outlets with said valve body in said position, further means operably connected to said valve body adapted to slide said valve body against said first named means in the opposite direction, and a second group of passages formed

in said valve body in a plane parallel to and spaced from said first group constructed and arranged to connect said inlets together and said outlets together with said valve body in said another position.

2. A valve for reverse cycle operation of an air conditioning system comprising a valve casing, a valve body slidably mounted in said casing, means yieldingly urging said valve body in one position, a plurality of ports contained by said valve casing, said ports lying in the same plane and comprising a pair of inlets and outlets a pair of passages lying in a plane and contained by said valve body adapted to connect each of said inlets with said outlets causing a flow of fluid in one direction when the valve body is in said one position, a second pair of passages contained by said valve body lying in a plane parallel to and spaced from said first pair of passages adapted to connect said inlets together and said outlets together permitting a flow of fluid in a changed direction thru said valve when said valve body is in a second position and fluid pressure means operably connected to said valve adapted to move said valve body to said second position against said means.

3. A device of the class described comprising a valve casing, a plurality of ports contained by said casing, said ports lying in a plane and comprising a plurality of inlets and outlets, a cap secured to each end of said casing, a valve body slidably mounted in said casing between said caps, spring means positioned between said valve body and one of said caps urging said valve body to one position, a plurality of passages contained by said valve body lying in a plane to form a group and adapted to connect each of said inlets with said outlets with the valve body in said one position, fluid pressure means in said second cap communicating with said valve body adapted to force said valve body to a second position, a second group of passages lying in a plane contained by said valve body positioned in spaced relation to said first group of passages and adapted to interconnect said inlets together and said outlets together in said second position, and valve means for controlling said fluid pressure means.

4. A device of the class described comprising a valve casing, a plurality of ports contained by

said casing lying in a plane and comprising a pair of inlets and outlets, a cap secured to each end of said casing, a valve body slidably mounted in said casing between said caps, a cavity contained at each end of said valve body forming a lower and an upper chamber, a spring mounted in said lower chamber between said lower cap and said valve body urging said valve body to its upper position against said upper cap, a bore in said valve body connecting said chambers, a pair of passages lying in a plane contained by said valve body adapted to interconnect said inlets with said outlets with said valve body in said upper position, a port in said upper cap communicating with said upper chamber, a duct connecting one of said inlets and said port, valve means for controlling the flow of fluid through said duct and said port for moving said valve body to said lower position adjacent said lower cap, a second pair of passages contained by said valve body lying in a plane above said first pair of passages, said second pair of passages interconnecting said inlets together and said outlets together with said valve body in said lower position, drain means in said lower cap connecting said lower chamber and one of said outlets, and valve operating means connected to said valve means.

5. The structure as recited by claim 4 and further means mounted within said valve casing adapted to prevent rotation of said valve body.

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