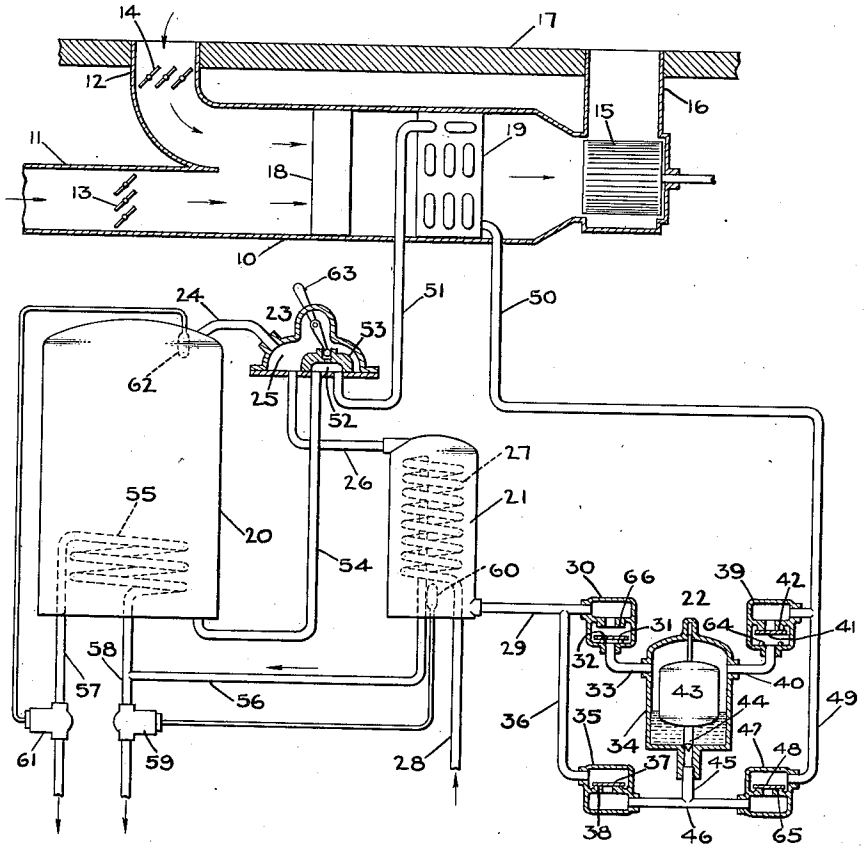
Dec. 29, 1936. E. W. ROESSLER 2,066,161

REVERSIBLE REFRIGERATING SYSTEM

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Fig. 1.




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Fig. 2.

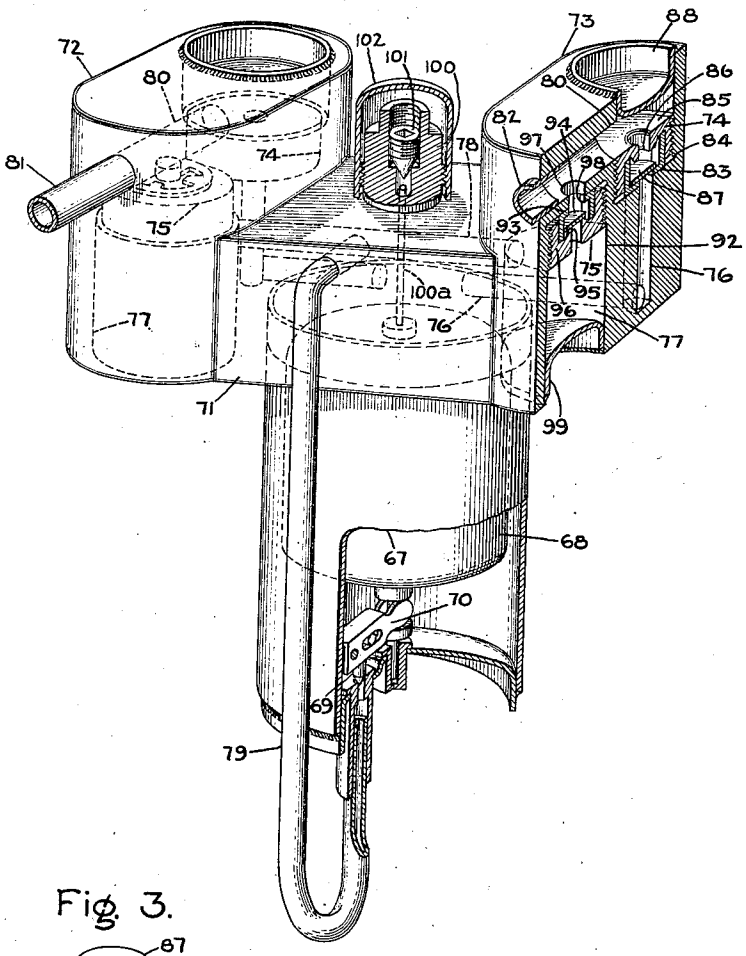
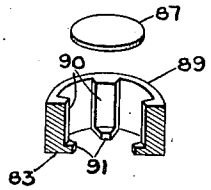



Fig. 3.




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# UNITED STATES PATENT OFFICE

2,066,161

## REVERSIBLE REFRIGERATING SYSTEM

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Application March 6, 1936, Serial No. 67,497

1 Claim. (Cl. 137—78)

My invention relates to refrigerating systems of the type employing two-heat exchange elements and having selectively operable means whereby either of the elements may be utilized as the condenser of the refrigerating machine and the other as an evaporator.

It is an object of my invention to provide in a reversible refrigerating system an improved single flow controlling device for regulating the flow of refrigerant through the system regardless of the direction of flow.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claim annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is a diagrammatic view of an air conditioning system utilizing a reversible refrigerating system embodying my invention; Fig. 2 is a detailed perspective view of an improved arrangement of a float valve embodying my invention; and Fig. 3 is an enlarged detail view of one of the check valve guides shown in Fig. 2.

Referring now to Fig. 1, I have shown an air conditioning system comprising a duct 10 having a fresh air inlet 11 and a return air inlet 12 controlled by adjustable dampers 13 and 14, respectively. Fresh and return air is drawn into the inlets 11 and 12 by operation of a fan 15 arranged at the outlet end of the duct 10 and which discharges the air into the enclosure to be conditioned through an outlet duct 16. The return air duct 12 and the outlet duct 16 pass through a wall 17 of the enclosure to be conditioned. Within the duct 10 is arranged a filter 18, which removes dust and solid particles from the air circulated through the duct, and a heat exchange element 19 for varying the temperature of the air passing through the duct. In order to supply a heat exchanging medium to the element 19, to heat or cool the air passing through the duct 10, I provide a reversible refrigerating machine.

The reversible refrigerating machine comprises a motor and compressor arranged within a sealed casing 20, a heat exchange element 21, a flow controlling device 22, the heat exchange element 19 and a selectively operable reversing valve 23. The valve 23 is shown in its position when the refrigerating machine is operating to cool the air passing through the duct 10, the heat exchange element 19 serving as the evaporator of the refrigerating machine. Refrigerant is compressed in the casing 20 by operation of the compressor therein and flows through a connection 24 to a chamber 25 of the valve 23 and thence through a connection 26 to the heat exchange element 21 serving as a condenser, where the compressed refrigerant is cooled, the heat being absorbed by cooling water circulating through a coil 27 supplied with water through a connection 28. The refrigerant is liquefied and flows through a connection 29 to a check-valve 30 having a valve member 31. The member 31 is shown in its lower position resting on raised stops 32 which permit the liquid refrigerant to flow around the member 31 and through a connection 33 to a receiver or float valve chamber 34. The connection 29 is also in communication with a valve 35 through a connection 36. The pressure on the high side of the system maintains a valve member 37 of the valve 35 against its valve seat 38 and prevents the flow of refrigerant through the valve 35. The chamber 34 is in communication with a check-valve 39 through a connection 40. The pressure of the refrigerant on the high side of the system maintains a valve member 41 of the valve 39 in its closed position against a seat 42 and thereby prevents the passage of refrigerant out of the chamber 34 through the valve 39.

When a predetermined amount of liquid refrigerant has collected in the chamber 34, a float 43 therein rises and lifts a float valve 44, and permits the liquid refrigerant to flow out through a connection 45 to a cross connection 46 providing communication between the check-valve 35 and a check-valve 47. The pressure of the refrigerant in the connection 46 raises a valve member 48 of the valve 47 and permits the refrigerant to flow from the chamber 34 through the valve 47 and a connection 49 to a conduit 50 through which it flows to the heat exchange element 19. The liquid refrigerant in the element 19 is vaporized by the absorption of heat from the air passing through the duct 10 and thereby cools the air. The vaporized refrigerant is withdrawn from the element 19 through a conduit 51 and passes through a passage 52 in a slide 53 of the valve 23 and flows into a connection 54 through which it is returned to the compressor within the casing 20.

The heat of the motor and compressor within the casing 20 may be removed by passing cooling water through a coil 55 arranged within the casing 20 and supplied with water from a conduit 56 connecting the discharge side of the coil 27 with the coil 55. The cooling water flowing through the coil 55 is discharged through a con-

nection 57. The cooling water may also be discharged from the conduit 56 through a connection 58 without passing through the coil 55. The quantity of cooling water flowing through the coil 27 is controlled by operation of a thermostatically controlled valve 59 which is responsive to the temperature of the coil 27, a thermostatic bulb 60 being secured in heat exchange relationship with the discharge side of the coil 27. The amount of cooling water flowing through the coil 55 is controlled by operation of the thermostatically operated valve 61 which is responsive to the temperature of the refrigerant discharged from the casing 20, a thermostatic bulb 62 for operating the valve 61 being secured near the refrigerant discharge connection 24 of the casing 20.

When it is desired to operate the refrigerating machine to heat the air passing through the casing 10, an operating lever 63 of the valve 23 is moved to the right, thereby moving the slide 53 to the left and placing the conduit 51 in communication with the chamber 25 and the connections 26 and 54 in communication with each other through the passage 52. When the valve is in this position the compressed refrigerant discharged from the casing 20 passes through the connections 24 and 51 to the heat exchange element 19 serving as a condenser, where it is cooled and liquefied by the circulation of air through the duct 10, thus heating the air. The liquefied refrigerant discharged from the element 19 flows through the duct 50 to the check-valve 39, the valve member 41 of which is held in its lower position against stops 64 allowing the liquid refrigerant to flow through the valve 39 and connection 40 to the chamber 34. The valve member 48 of the check-valve 47 is maintained against a valve seat 65 by the pressure of the refrigerant in the connection 49. The valve member 31 of the valve 30 is forced against the valve seat 66 by the pressure of the refrigerant on the high side of the machine within the chamber 34. When a predetermined amount of liquid refrigerant has collected in the chamber 34, the float 43 will rise and open the valve 44, thereby admitting liquid refrigerant to the connection 46 and the check-valve 35. The valve member 37 of the valve 35 will then be forced from its seat 38 and the liquid refrigerant will flow through the valve 35, connection 36 and connection 29 to the heat exchange element 21 serving as an evaporator. The liquid refrigerant within the heat exchange element 21 will be vaporized by the absorption of heat from the water flowing through the coil 27. The vaporized refrigerant will be withdrawn from the element 21 through the connection 26, passage 52 and conduit 54, and will be returned to the compressor within the casing 20.

From the foregoing description it is evident that the single flow controlling device 22 operates automatically to control the flow of refrigerant through the system regardless of the direction of flow in the system; that is, regardless of whether the cooling element 19 is utilized as a heater or as a cooler. The only change necessary to reverse the refrigerating system to change it from heating to cooling is the change of the position of the lever 63 operating the control valve 23.

In Fig. 2 I have shown a perspective view, partly in section, of a unitary float valve assembly for a refrigerating machine embodying my invention, the assembly including the check-valve and float-valve indicated at 22 in Fig. 1. Referring now to Fig. 2, I have provided a float chamber 67 having a float 68 arranged therein to operate a valve 69 through a linkage 70, the valve 69 being raised from its seat upon raising of the float. At the top of the float chamber I provide a valve block 71 closing the chamber and within which are arranged the check-valves for automatically obtaining the proper flow of refrigerant through the device. The check-valves are arranged within enlargements 72 and 73 at either end of the block 71. The construction of the two ends of the block is identical and the following description of the arrangement of the valves at one end will suffice for both. Each end of the block is provided with an inlet check-valve 74 and an outlet check-valve 75. The lower side of the inlet check-valve 74 communicates with the interior of the float chamber 67 through a passage 76 formed in the block. The lower side of the outlet check-valve 75 communicates with the float operated valve 69 through a chamber 77 in the end of the block, a cross passage 78 extending between the chambers 77 in the two ends of the block, and a connection 79 outside the block between the passage 78 and the valve 69. The inlet and outlet check-valves in each end of the block communicate with each other at their inlet and outlet sides, respectively, through passages 80 formed in the top of the end pieces 72 and 73 above the valves. The passage 80 in the end 72 of the block communicates with an external connection 81, and the passage 80 in the end 73 of the block communicates with an external connection 82. When the valve assembly is connected in a refrigerating machine such as is shown in Fig. 1, the connections 81 and 82 are arranged in the conduits leading from the heat exchange elements. In other words, if the assembly of Fig. 2 were connected in the reversible refrigerating machine of Fig. 1, the connections 81 and 82 would be arranged in communication with the conduits 50 and 29, respectively. The check-valves 74 and 75 are arranged to operate in the same manner as the check-valves of the device 22 in Fig. 1, and the operation of the refrigerating machine of Fig. 1, when utilizing the device shown in Fig. 2, is the same as has been described above. The inlet and outlet check-valves on the right end 73 of the block 71 correspond respectively to the valves 30 and 35 in Fig. 1, and the inlet and outlet check-valves in the left end 72 correspond respectively to the valves 39 and 47.

The construction of the check-valves 74 and 75 is similar, the valve guides and plates being identical and interchangeable. Referring again to Fig. 2, the check-valve 74 is shown in its open position and comprises a valve guide 83 arranged in an opening 84 in the end 73 of block 71 and held in place by a threaded plug 85 having a valve seat 86 formed therein. A valve disk or plate 87 rests within the guide 83, and in its raised position contacts the seat 86 and closes the valve. The opening 84 is closed by a diaphragm 88 in the top of the block and may be welded or secured to and sealed in the block in any suitable manner. The valve guide 83 as clearly shown in Fig. 3, comprises a hollow cylindrical body 89 having a plurality of longitudinal guides 90 formed on the inner side thereof and having stops or feet 91 at the bottom on which the plate 87 may rest in its lower position. When the disk 87 is in its lower position the refrigerant fluid may pass around the disk between the disk and the cylindrical portion 89 of the guide and under the disk around the feet 91.

The outlet check-valve 75 is arranged in an opening 92 formed in the end of the block 71 below the valve and comprises a valve guide 93 which is of a construction identical to the valve guide 83 but is in an inverted position. A valve disk or plate 94 is arranged within the guide 93 and is normally held by gravity against a valve seat 95 formed in a plug 96. The plug 96 is threaded into the opening 92 and retains the guide 93 in place against the top of the opening and in registry with an outlet port 97. When the outlet valve disk 94 is forced upwardly by the pressure of refrigerant it rests against stops 98 which permit the passage of refrigerant through the valve in the same manner as the stops 91 of the valve 74. The opening 92 is closed by a diaphragm 99 in the bottom of the block secured to and sealed in the opening in the same manner as the diaphragm 88 in the opening 84.

A charging connection 100 for the refrigerating machine is secured to the top of the block 71 having a passage 100*a* communicating with the float valve chamber 67, the passage 100*a* being closed by a threaded sealing plug 101. A protective cap 102 is screwed over the charging connection.

When the unitary valve structure described above is utilized in the reversible refrigerating machine shown in Fig. 1, the connections 81 and 82 are secured in communication with the conduits 50 and 29, respectively. The check-valves 74 and 75 in the end 73 of the block 71 correspond respectively to the valves 30 and 35 of the float controlling device 32 in Fig. 1, and the check-valves 74 and 75 in the end 72 of the block 71 correspond respectively to the check-valves 39 and 47 in Fig. 1. During the operation of the refrigerating machine to cool the air passing through the duct 10, the liquid refrigerant from the heat exchange element 21 flows into the passage 80 in the end 73 of the block 71 and thence through the valve 74 and the passage 76 to the chamber 67. The disk 94 in the block 73 is held against its valve seat 95 by the pressure of the refrigerant. When a predetermined amount of liquid refrigerant has collected in the chamber 67 the float 68 rises and liquid refrigerant passes through the valve 69 and the connection 79 to the passage 78 and thence through the valve 75 in the end 72 of the block 71, it being understood that the disk 94 of check-valve 75 in the end 72 of the block 71 will be forced upwardly to permit the passage of liquid refrigerant to the outlet connection 81. The valve disk 87 of the valve 74 in the end 72 of the block 71 will be forced upwardly against its seat 86 by the pressure of the refrigerant on the high pressure side in communication with the chamber 67 and thereby will prevent the passage of refrigerant directly out of the chamber 67.

When the refrigerating machine is operated to heat the air passing through the duct 10, liquid refrigerant flows from the heat exchange element 19 through the conduit 50 to the connection 81. The liquid refrigerant then flows into the passage 80 in the end 72 of block 71 and through the valve 74 in that end and into the chamber 67, the valve 75 being held closed. The liquid refrigerant from the chamber 67 passes through the valve 69 and thence through the valve 75 in the end 73 of the block and out through the connection 82.

Since the float valve mechanism is symmetrical, the operation in either direction of flow of refrigerant is the same, the corresponding valves in opposite ends of the block being utilized to perform the same functions. Thus refrigerant is admitted through the valve 75 in one end of the block and discharged through the valve 74 in the other end of the block during one direction of operation, and the other inlet and outlet valves are utilized during the opposite direction of operation.

It is, therefore, apparent that I have provided a simple unitary float valve construction for reversible refrigerating machines of the type illustrated in Fig. 1, and which may be utilized in any reversible refrigerating machine in order automatically to control the flow of refrigerant therethrough regardless of the direction of the operation of the machine.

While I have shown and described my invention in connection with a reversible refrigerating machine for an air conditioning system, it will be understood that it is applicable to reversible refrigerating machines of other types. I do not, therefore, desire my invention to be limited to the particular construction shown and described, and I intend in the appended claim to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent is:

A flow controlling device for reversible refrigerating systems including a valve block, means including a chamber arranged below said block for collecting liquid refrigerant, means including two inlet passages arranged in said block and communicating with said chamber for admitting refrigerant to said chamber, a discharge valve for said chamber, means including a float arranged in said chamber for operating said discharge valve, means including two outlet passages in said block and a conduit providing communication between said discharge valve and said outlet passages for removing liquid refrigerant from said chamber, a refrigerant conduit in communication with one of said discharge connections and with one of said inlet connections, a second refrigerant conduit in communication with the other of said discharge connections and with the other of said inlet connections, and means including check-valves arranged in said discharge connections and in said inlet connections for maintaining the same direction of flow of refrigerant through said discharge valve regardless of the direction of flow of refrigerant through said refrigerant conduits.

EDWARD W. ROESSLER.