Aug. 7, 1945. L. A. DICKENS 2,381,651

VALVE MECHANISM

Filed April 15, 1944

Fig. 1.

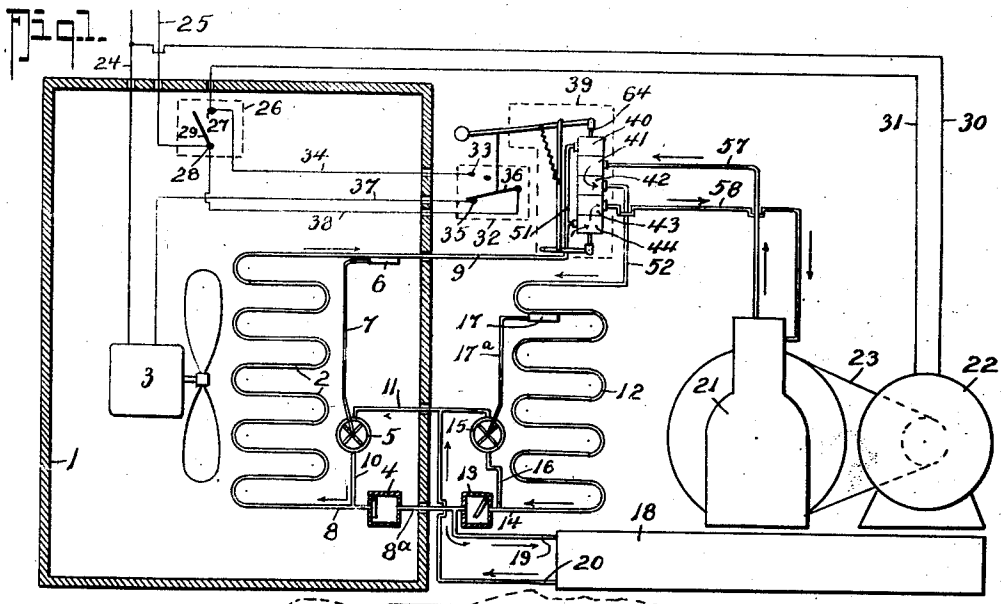



Fig. 3.

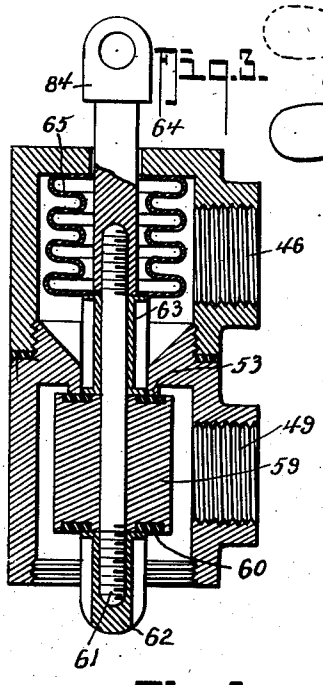



Fig. 2.

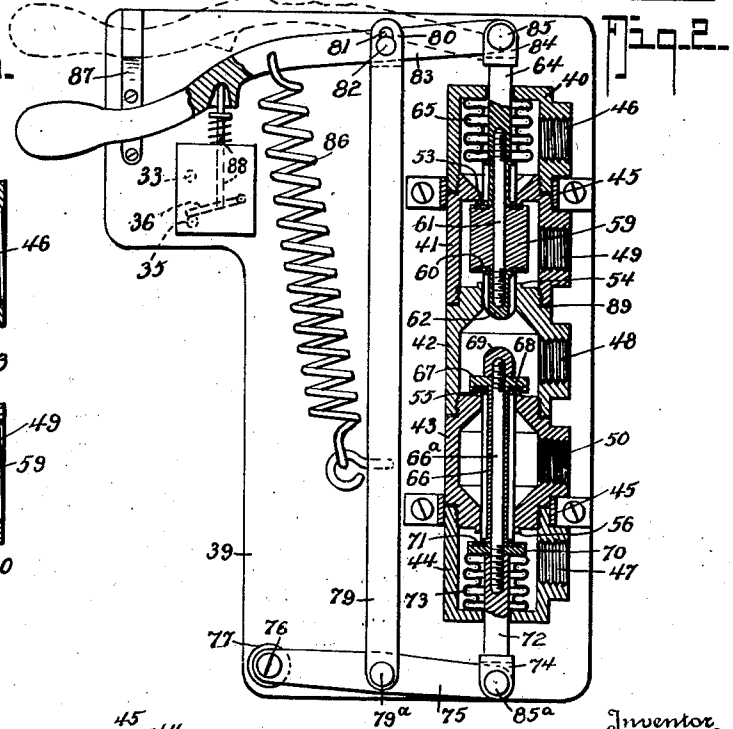
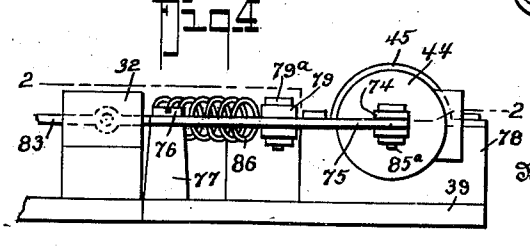



Fig. 4.




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Patented Aug. 7, 1945 2,381,651

# UNITED STATES PATENT OFFICE

2,381,651

## VALVE MECHANISM

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Application April 15, 1944, Serial No 531,179

11 Claims. (Cl. 277—21)

The principal object of the present invention is to provide a valve mechanism of a simple and inexpensive construction in which a positive closing and inter-related movement of all four valves, actuated from a single place, is obtained.

While the valve may be found useful in other enviroments and for other purposes, it has been particularly devised for the purpose of reversing the compression-evaporation cycle of a mechanical refrigeration system; the reversing of the cycle is for the purpose of absorbing heat by the evaporating of refrigerant within the condenser of the system and expelling this heat by the compressing and condensing of the refrigerant within the evaporator of the system to melt the frost loose from the evaporator.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends the invention still further resides in those novel details of construction, combination and arrangement of parts, all of which will be first described in detail and then be specifically pointed out in the appended claims, reference being made to the accompanying drawing in which:

Fig. 1 is a diagrammatic or schematic view of a refrigerating aparatus embodying my invention.

Fig. 2 is a vertical section of the valve mechanism on the line 2—2 of Figure 4.

Fig. 3 is an enlarged detail sectional view of a portion of the structure shown in Figure 2.

Fig. 4 is an end elevation of the same.

In the drawing in which like numerals and letters of reference indicate like parts in all the figures, 1 represents an insulated chamber in which is located on evaporator 2, a fan 3, a check valve 4, an expansion valve 5 with its thermostat 6 connected to it by a duct, 7, and a room thermostat 26. A duct 8 connects one end of the evaporator 2 to the check valve 4 while a duct 9 connects the other end of the evaporator 2 to the manifold 51 of the valve, which valve comprises the subject of the present invention. The expansion valve 5 has its outlet side connected to duct 8 by a duct 10. Its inlet side is connected by a duct 11 to the inlet side of a second expansion valve 15 located outside the chamber 1. The check valve 4 has its outlet side connected, by a duct 8a, to the outlet side of a second check valve 13 also located outside the chamber 1.

A condenser 12 has one end connected by a duct 14 to the inlet side of the check valve 13 and its other end connected by a duct 52 to the outlet 48 of the reversing valve. The expansion valve is controlled by a thermostat 17 via duct 17a and it has its outlet side connected by a duct 16 to duct 14.

A receiver 18 has its intake side connected by a duct 19 with duct 8a, and its outlet side connected by a duct 20 to duct 11.

A compressor 21 is driven by a motor 22 one terminal of which is connected by a wire 30 to line wire 24 (which line wire is also connected to fan motor 3), while the other terminal of the motor 22 is connected by wire 31 with the fixed contact 27 of the room thermostat 26. The motor 22 drives the compressor 21 via pulley and belt drive 23 or in any other suitable way.

The thermostat 26 includes the thermally operated contact 29, mounted at 28, to which the line wire 25 connects, and which in turn is connected by wire 38 to the movable contact 36 of the control switch 32. The fixed contact 27 of room thermostat 26 is connected by a wire 34 to the fixed contact 33 of the switch 32, while the fixed contact 35 of that switch is connected to the fan motor 3 by a wire 37.

*The reversing valve mechanism*

The valve mechanism which constitutes the gist of my present invention comprises a base or support 39 having seats 78 to which the valve housing assembly is strapped as at 45. The valve housing assembly comprises five sections 40, 41, 42, 43, and 44 screw threaded together end to end with suitable washers 89 between the joints. Each section encloses a chamber, the chambers being separated from one another by valve controlled passages having seats 53, 54, 55, and 56.

Within the housing section 41 is a double acting valve 59 having seat engaging elements 60 to engage alternately the respective seats 53 and 54. Within the housing section 40 is a bellows, an end of which is hermetically secured to the housing section and the other end of which is hermetically secured between the valve stem 64 and the ribbed valve guide 63, the stem 64, guide 63 and valve 59 being firmly held assembled by means of a bolt 61 that passes through the valve and guides and is threaded into the stem 64 and into a second ribbed valve guide 62 as clearly shown in Figures 2 and 3.

The outlets 46 and 47 of the end chambers are connected by the manifold 51 hereinbefore referred to. The inlet 49 of housing section 41 is connected by a duct 57 to the outlet side of the compressor 21 while the outlet 50 of the chamber of housing 43 is connected by a duct 58 to the inlet side of the compressor 21.

Within the chamber of housing section 42 is a valve 67 having a valve seat engaging element 68 to engage seat 55. A valve 70 is located in the chamber of housing section 44 and has a seat engaging element 71 to engage the seat 56. The valves 67 and 70 are connected so as to seat alternately by a fluted or ribbed guide 66. A bellows, located in the chamber of the end section 44, is hermetically secured at one end to the housing and at its other end to valve 70, by means of a bolt 66a that is threaded into the nut 69, passes

through valve 67, guide 66, valve 70 and is threaded into valve stem 72. The valve stems 64 and 72 have split heads 84 and 74 respectively.

75 is a lever which is fulcrumed at 76 to a post 77 on support 39 and is pivoted at 85a to head 74. An operating lever 83 is similarly pivoted at 85 to head 84. A connecting rod or link 79 is pivoted at one end, as at 79a to lever 75. At its other end 80 the link 79 is slotted and is connected to lever 83 by a pin 82 passing through slot 81 of link 79. Link 79 is also connected with lever 83 by a stout spring 86. As will be seen by reference to Figure 2, the lever 83 is designed to cooperate with switch 32 whose spring-loaded rod 88 engages (preferably) a socket or recess in lever 83 so that when lever 83 is moved to its defrosting position spring-loaded rod 88 will shift the switch element 36 from point 35 to point 33 to open the fan circuit to stop the fan. Any suitable means may be provided for holding lever 83 in its defrosting position, as for example a spring catch 87, or the automatic controls of my application aforesaid may be used to operate the lever 83.

*Operation*

Figures 1 and 2 show the normal positions of the parts. With the parts in normal position the system acts to cool the evaporator 2 and chamber 1. The arrows in Figure 1 show the direction of flow of the refrigerant.

When the lever 83 is free of restraint, i. e. when no outside force is applied to it or no device is holding it, the lever is drawn by spring 86 toward link 79. This movement will carry pin 82 of lever 83 to the inner end of the slot 81; then the end of the lever 83 which is pivoted to the valve stem 64 is drawn outwardly, taking with it the valve stem 64 and the double acting valve 59. This action closes the passage between the housing sections 40 and 41 and opens the passage between sections 41 and 42 (see Figure 2).

With the valve device in the normal position (Figure 2) hot refrigerant gases, which are being pumped by the compressor pass from the discharge side of the compressor through duct 57 into the chamber of valve housing section 41 and thence via section 42 to condenser 12. From the condenser 12 the fluid passes into the receiver 18 from which it flows, via ducts 20, 11, to expansion valve 5 and from thence through evaporator 2 and back to compressor 21 via the chamber of valve housing sections 44, 43 and the open passage between such sections.

When lever 83 is moved by some outside force in the direction opposing the pull of the spring 86, pin 82 is drawn against the far end of the slot 81 and upon further movement of the operating end of lever 83 in the direction away from the spring, link 79 is drawn with it. Also lever 75 and rod valve stem 72 are moved which lifts valve 67 off seat 55 and tension of spring 86 acting upon link 79 snaps the entire assembly and moves valve 70 to engage seat 56 and close the passage between the chamber of housing sections 44 and 43. This snap action is permitted by the travel of the pin 82 in the slot 81. After the above mentioned snap of the assembly (link 79, lever 75, valve stem 72 and valves 70 and 67) pin 82 is again at the near end of slot 81, but upon further motion of lever 83 away from pull of spring, pin 82 is again drawn against the far end of slot 81 and as valve 70 is now seated against its seat 56, link 79 and assembly can move no farther under the force acting on the operating end of the lever 83 and which is transmitted through pin 82 against the far end of slot 81 and also through increased tension on spring 79.

The pin 82 now becomes the stationary fulcrum of the lever 83. Continued movement of lever 83 toward the position shown in dotted lines in Figure 2, causes valve 59 to leave its seat 53 and spring 86 snaps valve 59 onto its seat 54. After this latter snap action of spring 86 pin 82 is again against the inner end of the slot 81 but as the operating lever is drawn slightly further to engage latch 87 pin 82 is moved approximately midway in slot 81, thereby drawing slightly more tension on spring 86 which firmly holds valve 59 on its seat via lever 83 and stem 64, and holds valve 70 on its seat 56, via link 79, lever 75 and stem 72. This latter position described is the reversed or defrost position of the valve device and in said position the hot gases from the compressor pass into the chamber of section 41 and from thence via chamber of section 40 to the evaporator 2, from thence via valve 4, receiver 18, expansion valve 15, condenser 12 and back to compressor 21 via the chambers of sections 42 and 43.

When the defrosting process shall have been completed and the latch 87 pressed to release lever 83 spring 86 will draw lever 83 over and cause the restoration of the valve device to normal position.

In addition to the other advantages noted before it will be noted that a snap action of each of the two valve assemblies is incidental to this type actuation.

It will be further noted that the operation of this valve device is further aided by the pressure fluctuations in the evaporator of the system and this action is as follows: When the evaporator is in need of defrosting its temperature and corresponding refrigerant pressure is low, consequently the pressure exerted within the chambers of sections 40 and 44 upon the bellows 65 and 73 is low and therefore requires very little if any force to move them inward as is necessary in moving the valves to defrosting position. After the evaporator has been warmed sufficiently to defrost it a higher pressure is created in it and chambers of sections 40 and 44 which has a tendency to force bellows 65 and 73 outward and thereby assist in moving the valve back to normal position.

From the foregoing description taken in connection with the accompanying drawing it is thought the construction, operation and advantages of my invention will be clear to those skilled in the art.

What I claim is:

1. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with

its end chamber; and means cooperating with the aforesaid means for shifting said valve devices to effect communication between said one of said intermediate chambers and the adjacent end chamber and close off communication between that intermediate chamber and the central chamber and to open communication between said central chamber and the other intermediate chamber and close communication between the latter intermediate chamber and the adjacent end chamber; and an outlet for each chamber.

2. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with its end chamber; and means cooperating with the aforesaid means for shifting said valve devices to effect communication between said one of said intermediate chambers and the adjacent end chamber and close off communication between that intermediate chamber and the central chamber and to open communication between said central chamber and the other intermediate chamber and close communication between the latter intermediate chamber and the adjacent end chamber; and an outlet for each chamber; and means cooperative with the aforesaid means for imparting a snap action to said valve devices as they are being shifted from one position to the other.

3. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with its end chamber; and means cooperating with the aforesaid means for shifting said valve devices to effect communication between said one of said intermediate chambers and the adjacent end chamber and close off communication between that intermediate chamber and the central chamber and to open communication between said central chamber and the other intermediate chamber and close communication between the latter intermediate chamber and the adjacent end chamber; and an outlet for each chamber; and means to hold said valves devices in their abnormal or reversed position.

4. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with its end chamber; and means cooperative with the aforesaid means for moving said valve devices from their normal positions to an opposite position, said means including mechanism for first shifting one of said valve devices to reversed position and then shifting the other of said valve devices to its reversed position.

5. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with its end chamber; and means cooperative with the aforesaid means for moving said valve devices from their normal positions to an opposite position, said means including mechanism for first shifting one of said valve devices to reversed position and then shifting the other of said valve devices to its reversed position; and means cooperative with the aforesaid means for imparting snap action to said valve devices in passing from one position to the other.

6. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central

chamber and in communication with its end chamber, said holding means including a valve stem for each valve device, a lever with a fixed fulcrum pivoted to one of said stems, a floating lever pivoted to the other stem, a link pivoted to said fixed-fulcrum lever, a pin and slot connection between said floating lever and said link, and a spring joining said floating lever and said link, said floating lever being shiftable to effect a valve-position-changing action.

7. In a valve mechanism of the character described: a support; a valve housing embodying a central chamber, two end chambers and intermediate chambers located between the central chamber and the end chambers, and passages with valve seats between the respective chambers; two valve devices in said housing, one of said devices controlling communication between one of said intermediate chambers and the central and end chamber adjacent thereto, the other of said devices controlling communication between the other of said intermediate chambers and the central and end chamber adjacent thereto; means normally holding said valve devices in positions normally to maintain one intermediate chamber out of communication with its end chamber and maintain the other of said intermediate chambers out of communication with said central chamber and in communication with its end chamber; and means cooperating with the aforesaid means for shifting said valve devices to effect communication between said one of said intermediate chambers and the adjacent end chamber and close off communication between that intermediate chamber and the central chamber and to open communication between said central chamber and the other intermediate chamber and close communication between the latter intermediate chamber and the adjacent end chamber; and an outlet for each chamber; said one of said valve devices comprising a double-acting valve in an intermediate chamber, a valve stem passing through the adjacent end chamber, a bellows in the end chamber hermetically connected at one of its ends to the valve and at its other end to the housing and embracing said valve stem; the other of said valve devices comprising a valve in said central chamber, a valve in the other end chamber, a valve stem joining the last two mentioned valves and passing through the other end chamber, a bellows in said other end chamber hermetically connected at one of its ends to said last named valve stem and at its other end to the housing and embracing the last named valve stem; and means cooperating with the aforesaid means for shifting said valve devices to reverse their operative positions.

8. In a valve mechanism of the character described: a valve housing composed of a central section, two end sections, and two intermediate sections hermetically secured together, said housing sections providing five serially disposed chambers with passage between the several chambers, which passages have valve seats; two valve devices one of which devices controls the passages between one intermediate chamber and the central chamber and between the said intermediate chamber and the adjacent end chamber while the other controls the passages between the other intermediate chamber and said central chamber and between the said other intermediate chamber and the adjacent end chamber; and means operatively connecting said valve devices together to hold them in a predetermined normal position; and means cooperative with said holding means for moving said valve devices to a reverse position.

9. In a valve mechanism of the character described: a valve housing composed of a central section, two end sections, and two intermediate sections hermetically secured together, said housing sections providing five serially disposed chambers with passage between the several chambers, which passages have valve seats; two valve devices one of which devices controls the passages between one intermediate chamber and the central chamber and between the said intermediate chamber and the adjacent end chamber while the other controls the passages between the other intermediate chamber and said central chamber and between the said other intermediate chamber and the adjacent end chamber; and means operatively connecting said valve devices together to hold them in a predetermined normal position; and means cooperative with said holding means for moving said valve devices to a reverse position; means cooperative with the aforesaid means for imparting a snap action to said valve devices in moving from one position to the other.

10. In a valve mechanism of the character described: a valve housing composed of a chambered central section, two chambered end sections and two chambered intermediate sections detachably secured together in axial alignment and having outlets, the central and intermediate sections having passages with valve seats; a double acting valve in one intermediate chamber to alternately engage the valve seat of that intermediate section and the valve seat of the central section; a valve in the central section for cooperation with the valve seat of the other intermediate section which seat is adjacent the central section; a valve in the end chamber which is adjacent the last named intermediate section for cooperation with another valve seat of said other intermediate section; means for joining said last named two valves to seat alternately and move as one; means continuously tending to hold said valves seated in a predetermined normal position; and means cooperating with the aforesaid means for moving said valves to a predetermined reverse position.

11. In a valve mechanism of the character described: a valve housing composed of a chambered central section, two chambered end sections and two chambered intermediate sections detachably secured together in axial alignment and having outlets, the central and intermediate sections having passages with valve seats; a double acting valve in one intermediate chamber to alternately engage the valve seat of that intermediate section and the valve seat of the central section; a valve in the central section for cooperation with the valve seat of the other intermediate section which seat is adjacent the central section; a valve in the end chamber which is adjacent the last named intermediate section for cooperation with another valve seat of said other intermediate section; means for joining said last named two valves to seat alternately and move as one; means continuously tending to hold said valves seated in a predetermined normal position; and means cooperating with the aforesaid means for moving said valves to a predetermined reverse position; and means for releasably holding said last named means in its valve-reversed position.

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