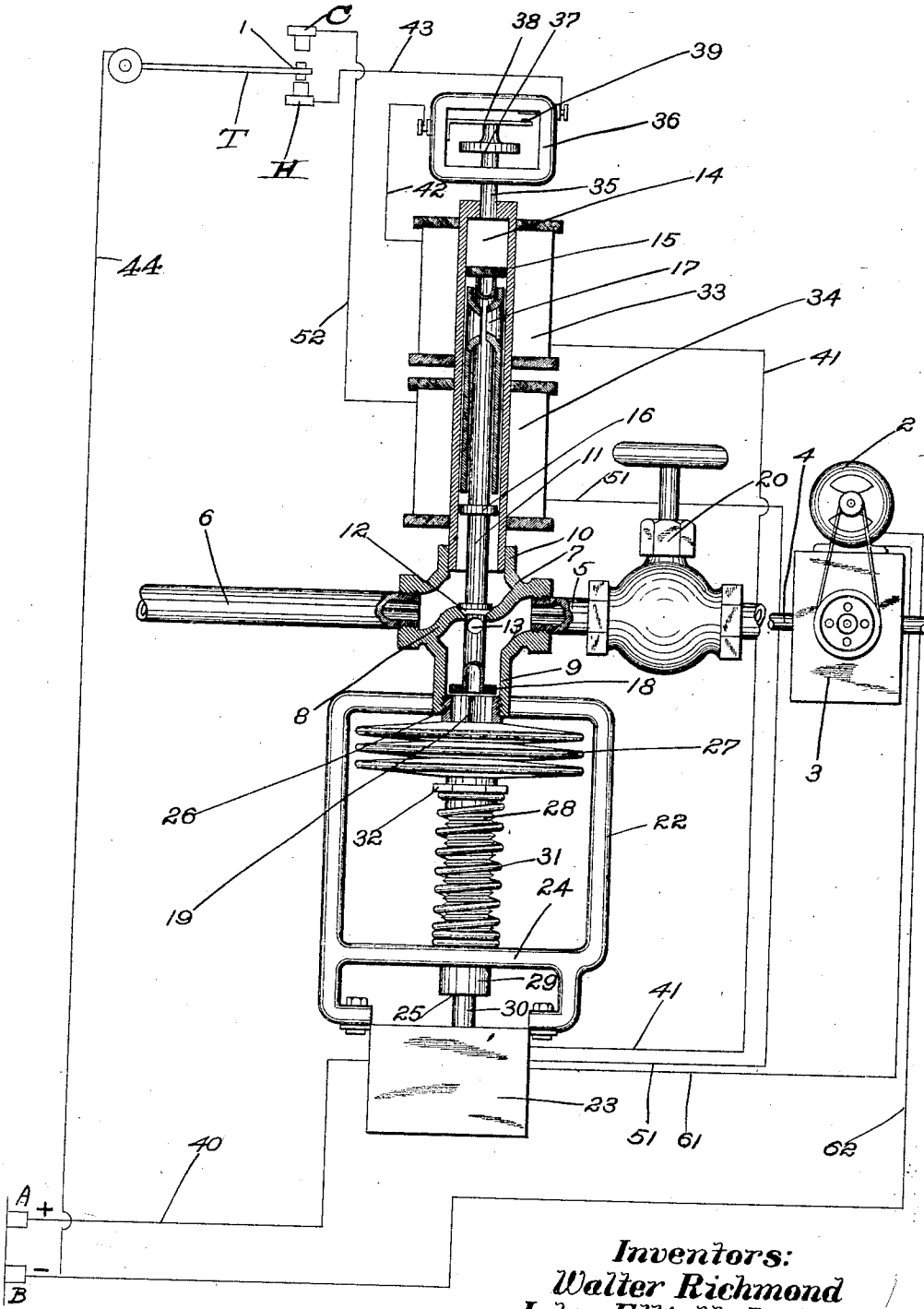


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W. RICHMOND ET AL.
FLUID CONTROL DEVICE.
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UNITED STATES PATENT OFFICE.

WALTER RICHMOND AND JOHN ELLIOTT JENKINS, OF CHICAGO, ILLINOIS.

FLUID-CONTROL DEVICE.

Application filed August 10, 1917. Serial No. 185,452.

To all whom it may concern:

Be it known that we, WALTER RICHMOND and JOHN ELLIOTT JENKINS, each a citizen of the United States, residing at Chicago, Illinois, have invented an Improvement in Fluid-Control Devices, of which the following is a specification.

This invention relates to devices for controlling a multiple fluid system, and particularly for simultaneously controlling the various parts of a complete refrigerating system, although in many of its aspects the invention and several of the subordinate units thereof are capable of broader application.

It is an object of the invention to provide apparatus of the character described simple and economical in construction and extremely efficient and economical in operation.

The drawing is a partly diagrammatic and partly cross-sectional view of a fluid controlling valve and associated apparatus constructed in accordance with our invention.

In the drawings, 1 diagrammatically represents a thermostat located in a refrigerating chamber, which may be that of a household refrigerator, having a hot contact H and a cold contact C between which plays the compound thermostat blade T. 2 diagrammatically represents a motor operating an ammonia gas compression system or its equivalent provided with the usual brine or other pipes for supplying refrigerating fluid to the refrigerating chamber. 3 represents a cooling chamber to cool the compressed ammonia or other gas by means of a flow of cooling fluid, which is preferably water flowing under pressure from the city mains into and from the chamber 3 by the pipes 4. The gas compression system may be of any ordinary and well known type.

We will now describe the controlling valve for the water supply system. The pipe 4 above described is in connection by means of pipes 5 and 6 with the city water mains or other source of pressure water supply. Between the pipes 5 and 6 is inserted a valve comprising a chamber 7 divided by diaphragm 8 separating its inlet from its outlet side. The chamber 7 is provided with cylindrical extensions 9 and 10, aligned with a port through the diaphragm 8. Slidably and rather snugly mounted in the port, is a hollow valve stem 11 equipped with a conical valve 12 co-operating with a valve seat at the port, and further equipped with apertures 13 below and adjacent the valve 12.

The hollow valve stem extends a considerable distance upward within a cylindrical casing 14, sweated or otherwise tightly secured in the extension 10, and is provided with a pair of collars 15 and 16 within said casing, these collars being cut away at different points about their periphery to permit ready flow of fluid past them but having their uncut away portions fitting snugly enough to maintain the valve stem in correct alignment. Between the collars 15 and 16 is loosely mounted an armature 17 (split to prevent eddy currents) shorter than the distance between the collars so as to have a hammer action upon them when moved up or down. Below the diaphragm 8 the hollow valve stem 11 is extended into the extension 9 and at its bottom is provided with an enlargement 18 so calculated as to leave a smaller opening between its peripheral edge and the inner wall of the extension 9 than the effective area of the valve 12. It will be seen that a subordinate chamber 19 is provided in the extension 9 below the enlargement 18 through which water must pass on its way to outlet 5. An adjustable check valve 20 is provided upon the outlet pipe 5 to regulate the flow of water and adjust the hydraulic action in the chamber 19 hereinafter to be described. Depending from and secured to the cylindrical extension 9 is a frame 22, having bolted thereto at its lower end a three-way switch, indicated in general by 23; the construction of which is well known. The frame 22 is provided with a cross bar 24, and screwed into the end of the extension 9, and forming an extension of the chamber 19, is the tube 26 forming a part of the diaphragm 27, from the lower end of which extends the partially screw threaded shaft 28, passing freely through the cross bar and having an end 29 secured at 25 to the operating push rod 30 of the three-way switch. A spring 31 abuts at one end against the cross bar 24 and at the other against an adjustable bolt 32 on the screw threaded shaft 28.

Secured upon the cylindrical casing 14 are a pair of solenoids 33 and 34. Above the cylindrical chamber 14 and in communication therewith by a pipe 35 is a supplementary frame 36 having mounted therein a small diaphragm 37 in open communication with the cylindrical member 14 which controls the circuit breaking device 38 so as to

break the circuit at 39 whenever the water pressure in the chamber 14 disappears.

The electric circuits are as follows: A and B represent the poles of a generator or source of current. The current flows from the generator A through connector 40 to one side of the three-way switch 23, by means of which the current may be directed either through the connector 41 or through both connectors 51 and 61 in parallel. The connector 41 leads to the solenoid 33 and thence by the connector 42 through the circuit breaker 39, thence by connector 43 to the hot thermostat point H, thence to pole B by connector 44. The connector 51 leads to the solenoid 34, and thence by connector 52 to the cold thermostat point C, thence to pole B by connector 44; the connector 61 leads to the motor and back by the return connector 62 to the opposite pole B.

In operation, assuming the motor to be off and the valve 12 in closed position, as shown in the drawings, and therefore the cooling water circulating system out of operation, and the contact through connector 41 being made by the switch 23; the refrigerator, gradually becoming warm, will finally cause the thermostat blade T to contact with the hot thermostat point H. Contact being made through the thermostat, the solenoid 33 will be energized, operating the armature 17 to raise the valve stem 11 and thus open the valve 12. As soon as the valve stem 11 has been raised, the aperture 13 will be brought above the port in the diaphragm 8, and the water under city pressure will flow through the aperture 13 to the interior of the hollow valve stem 11 out at the bottom of the hollow valve stem 11, into the chamber 19, through the constricted annular passage between the walls of this chamber and the peripheral edge of the enlargement 18, out of the outlet port through pipe 5, through the water cooling system of the motor. It will be apparent that pressure will thereby be generated in the subordinate chamber 19 since the outlet from this chamber is constricted relatively to its inlet. This pressure will have a double effect. In the first place, acting upwardly upon the enlargement 18, it will hold the valve stem in elevated position irrespective of the action of the solenoid 33, thus maintaining the valve open even though energizing current through the solenoid 33 be thereafter interrupted. Secondly, the pressure in the chamber 19, acting through the diaphragm 26, will depress the operating rod 30 of the three-way switch 23 against the pressure of the spring 31, breaking the circuit through connector 41 and closing the circuit through connectors 51 and 61. The circuit through connector 61 will operate the compression motor, which will begin the refrigerating operation and the circulation of the brine

through the refrigerator simultaneously with the flow of cooling water through the chamber 3. The closing of the circuit through the connector 51 will prepare the solenoid 34 against the time the thermostat blade T contacts with the cold point C. It will be apparent that in this condition of the parts the mechanism is operating, but the only current consumed will be the current necessary to operate the refrigerating motor 2, no current being required to hold the valve in open position, automatic hydraulic means effecting this result.

The operation of the cooling agency will of course in a short time chill the refrigerator to the desired point, at which time the thermostat blade T will contact with the cold contact C. This will result, by energizing the previously prepared solenoid 34, in moving the valve stem 11 downwardly to close the valve. Once closed, the valve will be held closed by hydraulic pressure acting upon the top of the valve 12. The water pressure in the outlet half of the chamber 7 and in the subordinate chamber 19 will drop with the result that pressure in the diaphragm 26 will be released and the three-way switch operating rod 30 under the influence of the spring 31 will be raised to break the circuits through the connectors 51 and 61, thus shutting off the supply of current to the motor and simultaneously breaking the circuit through the solenoid 34, while closing the circuit at the three-way switch through the connector 41 and bringing the parts back to starting position. In this position of the parts, the motor is not operating, the cooling water flow through the valve is stopped, the valve is maintained closed by hydraulic pressure, and no current is being consumed in any part of the apparatus. The raising of the operating rod 30, however, closes the circuit through connector 41, thus preparing the solenoid 33 to be energized as soon as the thermostat blade T again contacts with the hot point H. It will be noted that the thermostat blade T never breaks a live circuit and therefore sparking at this point is absolutely precluded.

It will be apparent that we have provided a combination of electrical and hydraulic means automatically operating to simultaneously control a refrigerator motor and a cooling water supply therefor without the expenditure of any electrical energy except that necessary to operate the motor and to shift the valve, the valve being maintained in either open or closed position by hydraulic means, and the energizing current which moved the valve in either open or closed position being interrupted immediately or very shortly after the valve has been moved into such position.

The circuit breaker 36-39 is provided as

a safeguard against the cessation of the city water pressure, in the event, for instance, city water pressure is cut off or a leakage occurs in the mains. Assume that this happens while the device is operating. The result will of course be to reduce the pressure in the subordinate chamber 19. The first result of this reduction will be to permit the operating rod 20 to rise, cutting out the motor and cutting out the circuit of the solenoid 34. This, however, will cause the solenoid 33 to be energized, and since either at the time of the reduction of the city water pressure or shortly thereafter, the temperature in the refrigerator will rise, the circuit will be closed also through the hot point of the thermostat H, opening the valve. Since under the assumed abnormal conditions of course no water would flow through the apparatus in response to the opening of the valve, the diaphragm 27 would not thereafter be actuated by water pressure to close the circuit through the solenoid 33. This would result in the continuous operation of the solenoid 33 without any other effect on the apparatus than to maintain the valve 12 in open position, and which might sooner or later burn out the solenoid 33. In order to prevent such a result, the device 36-39 has been added, the operation of which is to break the circuit of the solenoid 33 if the city water pressure is destroyed or substantially reduced. Thus if the city water pressure is destroyed, the entire apparatus becomes dead and non-responsive to the action of the thermostat, the contact of the thermostat blade with the hot point being ineffective to energize the solenoid 33 and therefore ineffective to raise the valve 12 and burn out the solenoid 33; but also of course since the circuits through the connectors 51 and 61 can only be closed through hydrostatic means, neither the motor nor the solenoid 34 can be energized. Upon resumption of the city water pressure by repairing a leak or again turning on the water which has been turned off, the circuit is closed in the device 36-39 and the entire apparatus resumes operation in the manner above explained without having suffered.

We claim—

1. In apparatus of the class described, a refrigerating device, a motor therefor, a fluid system, a primary control device, a valve controlling the flow of fluid through said fluid system, means controlled by the primary control device for opening said valve and simultaneously starting said motor and closing said valve and simultaneously stopping said motor and fluid pressure means independent of said controlled means for maintaining said valve in open or closed position.

2. In apparatus of the class described, a fluid system, a valve therein, and an electrical

control apparatus, means controlled by said electrical control apparatus to open and close said valve, and pressure means controlled by said valve independently of said electrical control apparatus to break the circuit for actuating the valve in one direction and prepare a circuit for actuating the valve in the opposite direction upon each actuation of the valve.

3. In a refrigerating system or the like, a cooling water supply system, a refrigerating device and a motor therefor, a controlling thermostat, and a valve in said cooling water system, solenoids for actuating said valve, hydraulic means for maintaining said valve in open or closed position independent of said solenoids, and hydraulic means controlled by said valve for controlling the motor circuit and the solenoid circuits.

4. In a refrigerating system, a refrigerating device, an electric motor, a cooling water system, a controlling thermostat, and a valve, solenoids for actuating said valve, and hydraulic means controlled by said valve for controlling said solenoid circuits.

5. In a refrigerating system, an electric motor, a circuit therefor, a cooling water system, a controlling thermostat, and a valve, solenoids for actuating said valve, hydraulic means controlled by said valve for controlling said motor circuit, including means for breaking the valve actuating solenoid circuit and preparing a circuit for the opposite solenoid upon each operation.

6. A fluid control device comprising a chamber having an inlet and an outlet passage, a valve on the inlet side of said chamber adapted to be held closed by the water pressure in the inlet side of said chamber, hydraulic means adapted to be operated by the water pressure in the outlet side of said chamber to hold said valve open when opened.

7. A fluid control device comprising an inlet passage, an outlet passage, a valve between said inlet and outlet passages, electric means for opening or closing said valve, and means for maintaining said valve in open or closed position through fluid pressure alone.

8. A fluid control device comprising an inlet passage, an outlet passage, a valve between said inlet and outlet passages, electric magnetic means in a pair of electric circuits acting on said valve for opening or closing the same, hydraulic means for maintaining said valve in either open or closed position, independently of said electro-magnetic means, including means to break the actuating circuit and prepare the other circuit after each operation of the valve.

9. A device for controlling the flow of fluid, comprising a chamber having an inlet and an outlet passage, a valve adapted to divide said chamber between said inlet and

outlet passages, a hollow stem for said valve, an aperture in said stem adjacent the valve and on the outlet side thereof, a constricted opening between the bottom of said valve stem and the interior of said chamber, whereby said valve stem will be hydraulically maintained in open position by the pressure of the water in the chamber prior to its escape through said constricted opening.

10 10. A fluid controlling device comprising a chamber having inlet and outlet passages, a port in said chamber between said inlet and outlet passages, a hollow valve stem slidably and snugly mounted in said port, a valve on said valve stem adapted to close said port, an aperture in said valve stem adapted to connect the inlet side of said passage with the interior of the valve stem when the valve is open, a constricted opening between the discharge point of said hollow valve stem and said outlet passage whereby the back pressure occasioned by said constricted opening serves to maintain said valve in open position.

25 11. A fluid controlling device comprising a chamber having inlet and outlet passages, a port in said chamber between said inlet and outlet passages, a hollow valve stem slidably mounted in said port, a valve on said valve stem adapted to close said port, an opening in said valve stem to permit the passage of water through the same when said valve is in open position, an enlargement upon the lower end of said hollow valve stem constricting the opening between said valve stem and the walls of said chamber whereby the back pressure occasioned by said enlargement acts upon said enlargement to maintain said valve in open position after the same has been opened.

40 12. In a refrigerating apparatus, a fluid supply, a motor operatively associated with said fluid supply, a device for controlling the flow of fluid in said fluid supply system, comprising a chamber having inlet and outlet passages, a valve mounted in said chamber, a subordinate chamber having a constricted outlet, a diaphragm in communication with said subordinate chamber, and circuit controlling means operated by said diaphragm.

50 13. In apparatus of the class described, a motor, a circuit therefor, a fluid supply system, a device for controlling the flow of fluid in said fluid supply system, comprising a chamber having inlet and outlet passages, a valve mounted in said chamber, circuits for operating said valve, a subordinate

chamber having a constricted outlet, a diaphragm in communication with said subordinate chamber, and circuit controlling means operated by said diaphragm, said circuit controlling means being adapted to control the motor circuit and the circuits for operating said valve, means to energize the circuits for operating said valve, and a refrigerating device operated by the motor.

14. In apparatus of the class described, a cooling water supply system, an electrical control device, a valve, electrical devices to open and close the same, hydraulic means for maintaining said valve in open position and simultaneously operating circuit controlling devices.

15. A water supply system for refrigerating devices or the like comprising a valve, solenoids for actuating said valve, hydraulic means controlled by said valve for cutting out the valve opening circuit upon opening the valve and for cutting out the valve closing solenoid circuit upon closing the valve, and hydraulic means for cutting out the valve opening circuit upon failure of pressure upon the inlet side of said valve.

16. In apparatus of the class described and in combination, a refrigerating device and a motor therefor, a fluid system, a primary control device, a valve controlling the flow of fluid through said system, means controlled by said primary control device for opening said valve and starting said motor and closing said valve and stopping said motor, and means enclosed within said fluid system for maintaining said valve in open or closed position.

17. In apparatus of the class described, a casing having an inlet and an outlet, a valve therein adapted to be moved into open or closed position, and means within the casing operative to maintain said valve in open or closed position through fluid pressure without permitting escape of fluid except through said outlet.

18. In apparatus of the class described, a casing, an inlet pipe, an outlet pipe, a valve interposed between the pipes in the casing, and adapted to be shifted to open or closed position, hydraulic means entirely enclosed within the casing for maintaining the valve in open or closed position when communication is made through the inlet pipe with a source of fluid pressure.

In testimony whereof, we have signed our names to this specification.

WALTER RICHMOND.
JOHN ELLIOTT JENKINS.