No. 764,819. PATENTED JULY 12, 1904.

W. P. POWERS.

THERMOSTAT.

APPLICATION FILED MAY 6, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

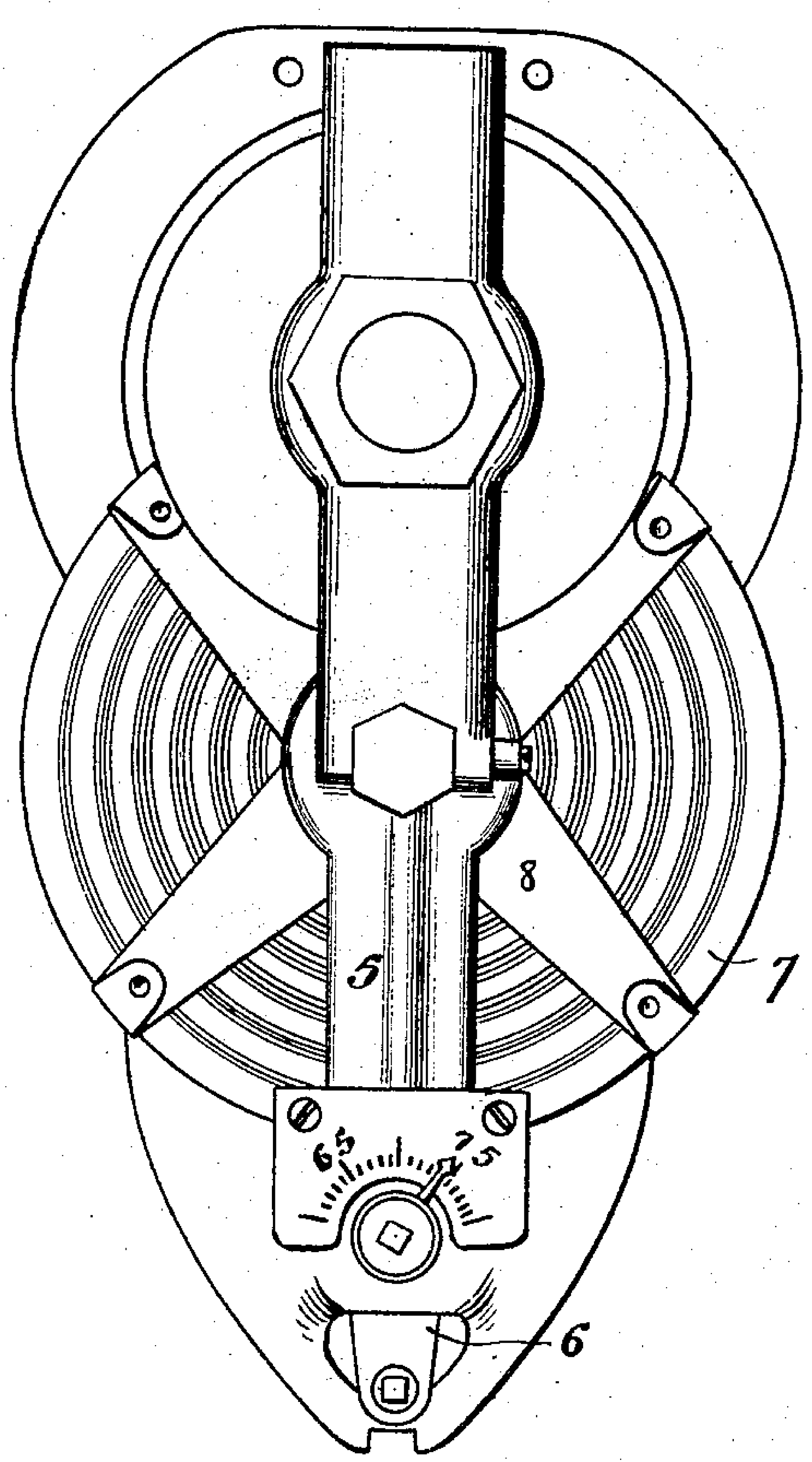


Fig. 2.

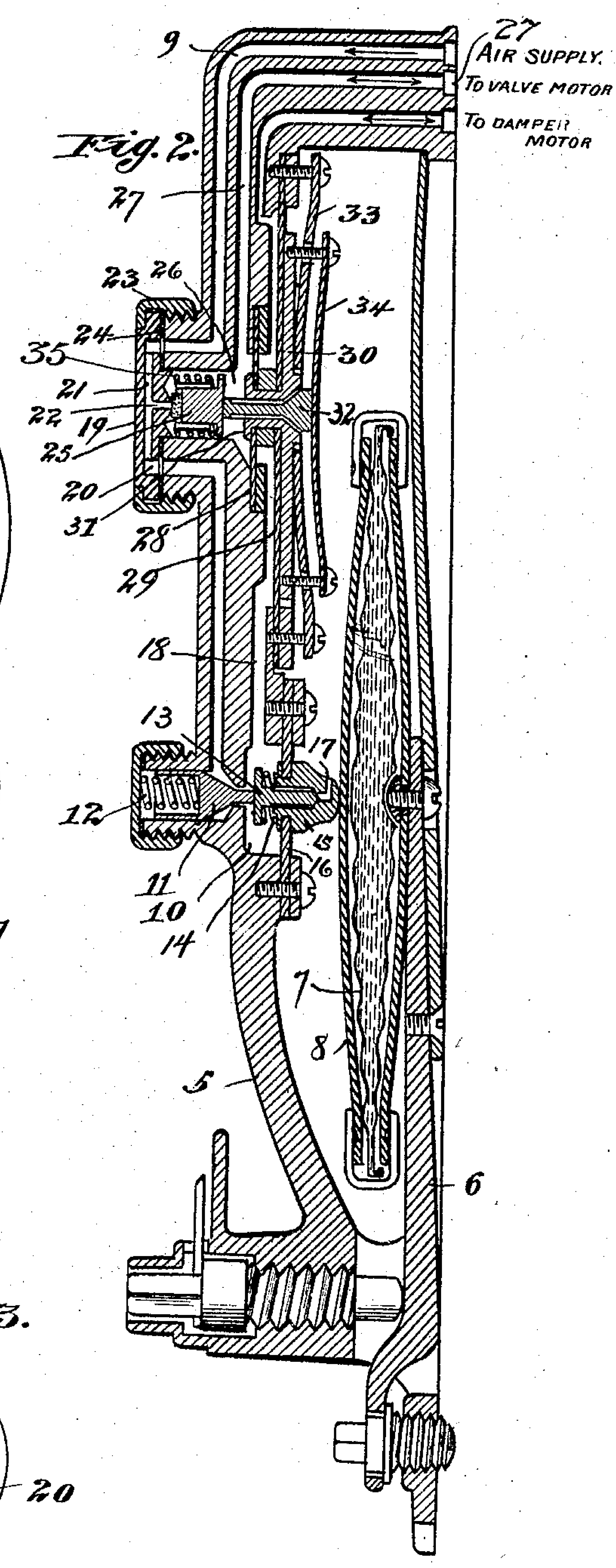
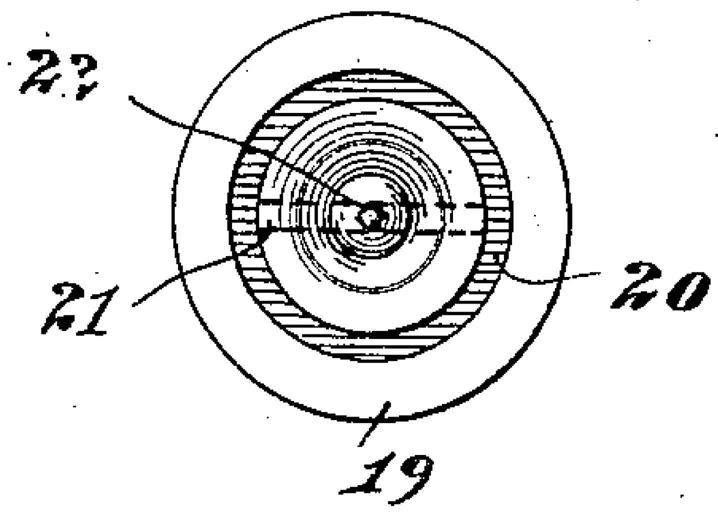


Fig. 3.



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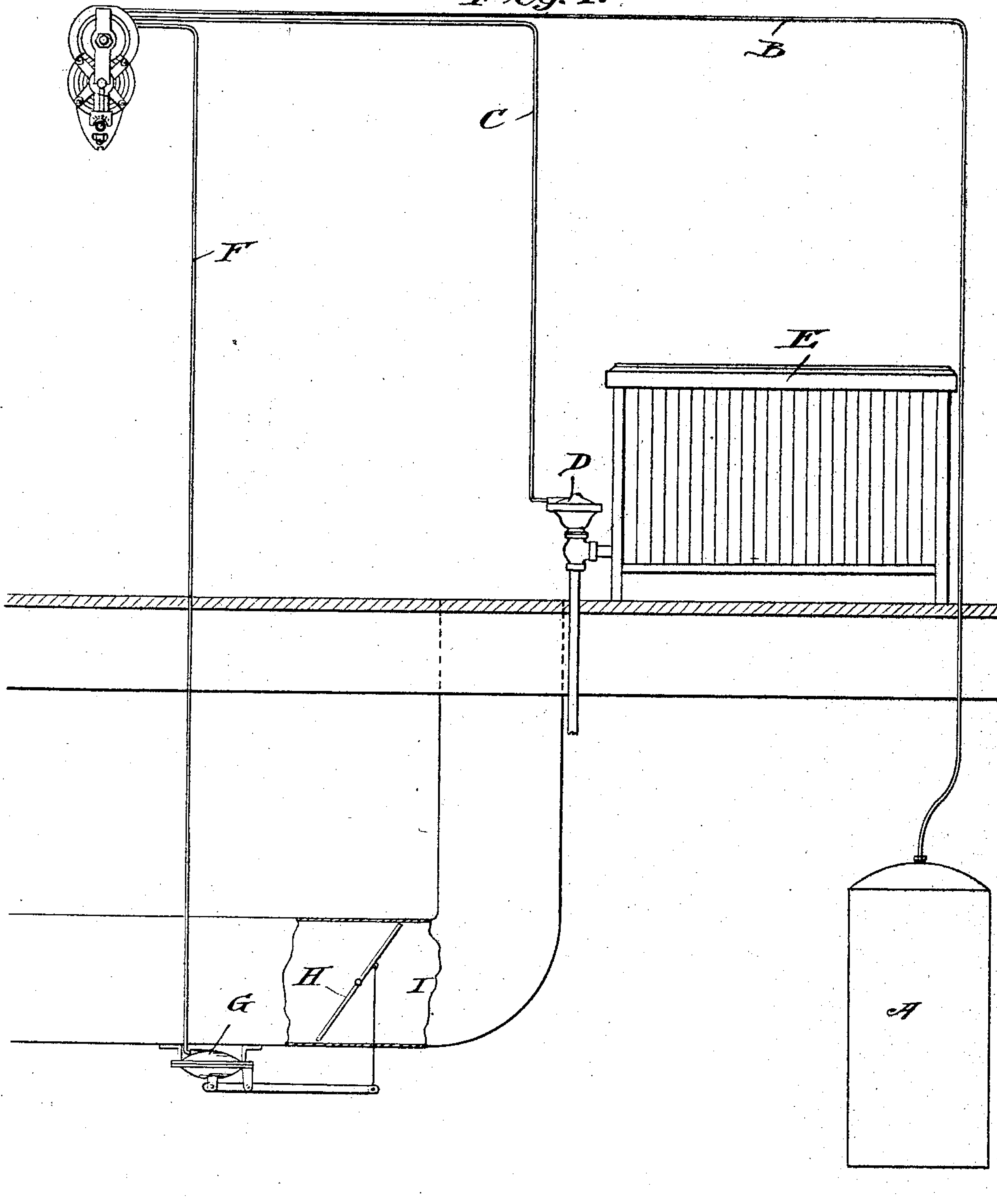
NO MODEL.

2 SHEETS—SHEET 2.

Fig. 4.



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No. 764,819. Patented July 12, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM P. POWERS, OF CHICAGO, ILLINOIS.

THERMOSTAT.

SPECIFICATION forming part of Letters Patent No. 764,819, dated July 12, 1904.

Application filed May 6, 1901. Serial No. 58,980. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM P. POWERS, of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Thermostats, of which the following is a specification.

My invention relates to that class of thermostats which is used for controlling the supply of a motor fluid to diaphragm or other fluid-motors and is particularly or especially adapted for use in temperature-regulating apparatus.

My invention relates, primarily, to a construction wherein a thermomoter or expansible disk is made to control in a graduated manner the air-supply; and it consists in the combination, with such disk, of a primary valve located in the pressure-fluid-supply passage and an escape-valve, both of said valves being thermostatically controlled, so that not only is a graduated supply of air furnished, but waste of air is avoided, and the supply and escape valves are so related as to insure their proper operation and avoid the necessity for fine adjustment and for readjustment.

My invention further relates to the combination, with this primary valve mechanism, of a secondary valve mechanism comprising supply and waste valves controlled by diaphragms which are subjected to the graduated pressure, said diaphragms being of unequal size and the diaphragms being so arranged that when the main supply of air is turned on or off the effect is cumulative on the diaphragms, which results in a full pressure or complete discharge of the motor fluid and a positive movement of a motor for controlling a valve or other positively-acting device.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a front elevation of the thermostat. Fig. 2 is a central longitudinal sectional elevation enlarged. Fig. 3 is a detail view of the cap forming a portion of the air-passages for the secondary valve, and Fig. 4 is a general view showing the subject-matter of the invention in its operative relation to the air-supply and motors.

In the drawings let 5 represent a frame in the form of a casting and upon which is mounted a pivoted lever 6, carrying an expansible disk 7, which is conveniently clamped between the arms 8. The disk contains within its chamber a volatile liquid having a boiling-point somewhat less than the temperature at which the device is to operate.

Within the frame 5 is provided a passage 9, to which a motor-fluid-supply pipe will be connected. This passage leads to a graduated-pressure chamber 10, the entrance to the chamber being controlled by the primary supply-valve 11. Said valve is normally pressed toward its seat by the spring 12. At its lower end it rests upon the head of the primary escape-valve 13, which valve is normally pressed away from its seat by the spring 14. The valve-body 15 is carried by a flexible diaphragm 16, which constitutes a movable wall of the chamber 10. Through this valve-body is provided an escape-aperture 17, which is controlled by the escape-valve 13. A passage 18 communicates with the chamber 10 and affords one path or conduit for the air or other motor fluid which flows through the thermostat and the supply of which is graduated or controlled by the movements of the expansible disk. This passage 18 is designed to communicate with a pipe or other passage leading to a motor which may control one or more dampers with a gradual motion, as hereinafter more particularly described. The volatile liquid within the chamber of the expansible disk being such that it will be converted into a gas at a temperature somewhat lower than that at which the thermostat is set, upon a rise in temperature the expansion of the liquid will cause an expansion or distention of the walls of the disk, and this in turn will impart a movement to the valve-body 15 and will flex the diaphragm. It is assumed that the pressure in chamber 10 will be such as to counterbalance the pressure of the expansible disk when the temperature is at or near the desired point. Upon this assumption the inward movement of the diaphragm 16 will tend to move the valve 13, and through it open the primary valve 11, thus admitting air to pass through the primary supply-valve 11 into chamber 10 and thence to flow through the passage 18 to the damper-motor. The air passing through the chamber 10 of course exerts a pressure tending to return the diaphragm 16 and acts in opposition to the movement of the expansible disk. When the air-pressure in chamber 10 equals the pressure of the thermostatic disk, the primary supply-valve 11 returns to its seat, and the primary escape-valve 13 is also returned to its seat, the spring 12 being stronger than the spring 14. Thus an equilibrium is maintained until there is a further variation in temperature. If now the temperature falls below the predetermined point, the disk will contract and exert less pressure. The pressure remaining constant within the chamber 10 will flex the diaphragm 16 outwardly, moving the valve-body 15 and permitting the escape-valve to open. The pressure will then be relieved by the escape of air through the escape-passage 17 until the pressure within the chamber 10 and the disk-pressure again come into equilibrium.

From the foregoing description it will be seen that the waste-passage 17 is open only for a brief time necessary to restore the equilibrium of pressures between the air-chamber and the disk, the supply and waste valve being closed at all times except when there is a sufficient variation of temperature to cause thermostatic action. It will also be seen that as one of the valves 11 13 is always closed there is not at any time an open passage for the motor fluid to the atmosphere, and the air which is wasted is only that which has already passed the primary supply-valve and is contained within the graduated-pressure chamber and the damper-motor connections.

In order to adapt the thermostatic device above described to the control of the motor fluid for a quick and positively-acting diaphragm or other motor adapted to actuate a steam cut-off and supply valve, I have shown a secondary valve mechanism which will now be described. This secondary valve mechanism is in communication with the supply-passage 9 and the return-passage 18. The supply-passage 9 passes through a cap 19, having an annular groove 20, a straight passage 21, and a port 22. The cap is held by the sleeve-nut 23, and a packing-ring 24, perforated at the passages, is applied between the cap and the frame. 25 represents the secondary supply-valve which controls the port 22, leading into a full-pressure chamber 26, which has an outlet 27 communicating with the motor actuating said steam cut-off and supply valve. A portion of the walls of the passage 18 is composed of two diaphragms 28 29, which are of unequal areas. The diaphragm 28 constitutes a movable wall of the chamber 26, and diaphragm 29 is affixed to a plate 30, the central portion of which is of hub-like or annular form and overlies the diaphragm 28 by means of the flange 31. This hub-like central portion is apertured for the passage of the longitudinally-grooved stem of the secondary escape-valve 32, said valve-stem being extended in contact with the secondary supply-valve 25. The spring 33 is arranged to exert pressure upon the diaphragm-plate 30, and a spring 34 exerts pressure upon the head of the escape-valve 32, normally tending to keep it closed and also tending to hold valve 25 upon its seat, spring 34 being stronger than spring 35, which exerts a contrary pressure on said secondary supply-valve. The spring 33 is connected to an immovable part of the framework, while the spring 34 is connected to the plate 30, which is movable with the diaphragm. From this it results that the spring 33 exerts a pressure upon the diaphragm-plate 30 tending to move the same toward the secondary supply-valve, and thus permitting the spring 34, through the secondary escape-valve, to operate directly upon and hold closed the secondary supply-valve. Normally the secondary escape-valve remains open and the secondary supply-valve 25 closed. The air in the chamber 26 and the passage 27, connecting with the motor chamber or cylinder, will thus be discharged to the outer air. While the spring 33 tends to move the diaphragm in one direction, the air coming from the primary supply-valve through the graduated-pressure chamber 10 and the passage 18 exerts a pressure upon the diaphragm 29 in opposition to the spring. Obviously, also, the air-pressure in passage 18 tends to flex the diaphragm 28; but by reason of the difference in area between the diaphragms 28 and 29 and the fact that they are rigidly connected the resultant motion is in opposition to the spring 33. Assuming that the motor-chamber supplied by the passage 27, said passage to the motor-chamber, and the full-pressure chamber 26 are all depleted the secondary supply-valve 25 will be closed and the secondary escape-valve 32 open, and under these conditions the heat will be admitted to the apartment to be controlled. When the temperature caused by such admission of heat reaches the desired point, thermostatic action will take place, air will be admitted through the primary supply-valve 11, as before described, and through the passage 18 until the differential pressure upon the diaphragm 29 exceeds that of the spring 33. The result will be that the spring 33 will be overcome and the valve 25 allowed to open to admit a supply of motor fluid through the port 22 into the chamber 26, which will then be closed to the atmosphere by the seating of the secondary escape-valve 32. The air-pressure entering the chamber 26 now acts in conjunction with the air-pressure admitted by the primary valve and coming through the passage 18 to move the diaphragms 28 29 in the same direction, and thus coöperating, insure a full and complete movement of the heat-supply valve to be controlled by the motor fluid passing at undiminished pressure through the passage 27. The graduated pressure coming through the passage 18 from chamber 10 need only be sufficient to initiate an outward movement of the diaphragm 29, sufficient, however, to cause a slight opening of the valve 25. The air thus passes slowly at first through the port 22; but as soon as it has filled the chamber 26 and its connections, so as to exert pressure on the diaphragm 28, the combined pressure is sufficient to insure a quick and complete opening of the valve 25 and an admission of the full motor-fluid pressure directly to its motor-chamber. This results in closing tightly the steam-supply valve, and the valve 25 will remain open and the valve 32 closed until there be again a thermostatic action by reason of the cooling off of the apartment under control. This cooling results in a contraction of the disk and a lessening of the pressure in the chamber 10 and passage 18 until the spring 33 preponderates over the combined pressure in the passage 18 and the chamber 26. Thereupon the diaphragm 29 will be moved inwardly and the spring 34 will act through the valve 32 to push valve 25 to its seat. When seated, the supply of air to chamber 26 is cut off, and upon the continued movement of the diaphragm 29 valve 32 will be open and the chamber 26 and its connections will be again depleted. The valve 32 opens slowly at first; but the air escaping from the chamber 26 subtracts from the power opposing the spring 33, and this results in a cumulative action upon the diaphragm 29 and insures the full opening of the valve 32 for the depletion of the motor-chamber.

In Fig. 4 of the drawings I have illustrated in a general view the relation of the thermostat hereinabove described to the air-supply and the motors controlling the valve of the radiator and the damper in the air-duct. Referring thereto, A represents the compressed-air supply; B, the pipe leading therefrom to the passage 9 of the thermostat; C, the pipe leading from the passage 27 of the thermostat to a motor D, controlling the valve of the heater E, and F the pipe leading from the passage 18 of the thermostat to the motor G, controlling the damper H in the warm-air duct I.

I claim—

1. In a thermostat the combination with a frame having inlet and outlet passages for a motive fluid, and also having a motive-fluid chamber in communication with both of said passages, said chamber having an apertured movable wall, of an escape-valve controlling the aperture through said movable wall, a supply-valve controlling the communication between the motive-fluid-supply passage and the motive-fluid chamber and contacting said escape-valve, means for holding one of said valves normally closed, an expansible disk, and means whereby the expanding movement of said disk is imparted through said movable wall and escape-valve to the supply-valve to open the latter, substantially as described.

2. In a thermostat the combination with a frame having inlet and outlet passages for a motive fluid, and also having a motive-fluid chamber in communication with both of said passages, said chamber having a movable wall carrying an apertured valve member, of an escape-valve controlling the aperture of said valve member, a supply-valve controlling the communication between the motive-fluid-supply passage and the motive-fluid chamber and contacting said escape-valve, means for holding one of said valves normally closed, and an expansible disk adapted in its expanding movement to contact said valve member and through the interposed escape-valve effect the opening of the supply-valve, substantially as described.

3. In a thermostat the combination with a frame having inlet and outlet passages for a motive fluid, and also having a motive-fluid chamber in communication with both of said passages, of a flexible diaphragm constituting one wall of said chamber, a valve member carried by said diaphragm and having an escape-aperture therethrough, an escape-valve controlling said aperture, a supply-valve controlling the communication between the motive-fluid-supply passage and the motive-fluid chamber and contacting said escape-valve, a spring normally holding the supply-valve closed and acting through such valve to also hold the escape-valve closed under certain temperature conditions, a lighter spring normally tending to open said escape-valve, and an expansible disk adapted in its expanding movement to actuate said valve member and through the interposed escape-valve effect the opening of the supply-valve, substantially as described.

4. In a thermostat the combination with a frame having a motive-fluid-supply passage, a full-pressure-outlet passage and a graduated-pressure-outlet passage in thermostatically-controlled communication with said supply-passage, said frame further having a graduated-pressure chamber interposed in said graduated-pressure-outlet passage, opposite walls of which are composed of rigidly-connected diaphragms of unequal areas, and a full-pressure chamber having a wall formed by the smaller of said diaphragms and in communication with said supply-passage and said full-pressure-outlet passage, of a supply-valve controlling the communication between said supply-passage and said full-pressure chamber, said valve being automatically controlled by the movement of said diaphragms under the variable pressure of the graduated motive fluid passing therebetween, substantially as described.

5. In a thermostat the combination with a

frame having a motive-fluid-supply passage, a full-pressure-outlet passage and a graduated-pressure-outlet passage in thermostatically-controlled communication with said supply-passage, said frame further having a graduated-pressure chamber interposed in said graduated-pressure-outlet passage, opposite walls of which are composed of rigidly connected diaphragms of unequal areas, and a full-pressure chamber having a wall formed by the smaller of said diaphragms and in communication with said supply-passage, said full-pressure-outlet passage, and the atmosphere, of a supply-valve controlling the communication between said supply-passage and said full-pressure chamber, an escape-valve controlling the communication between said full-pressure chamber and the atmosphere and normally contacting said supply-valve, said valves being automatically controlled by the movement of said diaphragms under the variable pressure of the graduated motive fluid passing therebetween, substantially as described.

6. In a thermostat the combination with a frame having a motive-fluid-supply passage, a full-pressure-outlet passage and a graduated-pressure-outlet passage in thermostatically-controlled communication with said supply-passage, said frame further having a graduated-pressure chamber interposed in said graduated-pressure-outlet passage, opposite walls of which are composed of rigidly-connected diaphragms of unequal areas, and a full-pressure chamber having a wall formed by the smaller of said diaphragms and in communication with said supply-passage, said full-pressure-outlet passage, and the atmosphere, of a supply-valve controlling the communication between said supply-passage and said full-pressure chamber, an escape-valve controlling the communication between said full-pressure chamber and the atmosphere and normally contacting said supply-valve, a spring normally forcing said diaphragms toward said supply-valve, a spring acting upon and tending to seat said escape-valve and through the latter to close said supply-valve, and a spring tending to open said supply-valve when the latter is relieved of the pressure of the escape-valve spring, substantially as described.

7. In a temperature-regulator, the combination of a main conduit leading from a source of fluid under pressure to a fluid-pressure motor, a primary valve governing said conduit, a branch conduit leading from said main conduit to a second pressure-motor, a secondary valve governing said branch conduit, thermostatically-operated means for operating said primary valve, said secondary valve being arranged to be opened by said fluid after it has passed said primary valve.

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