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E. W. COMFORT.

THERMOSTAT.

APPLICATION FILED SEPT. 4, 1900.

NO MODEL.

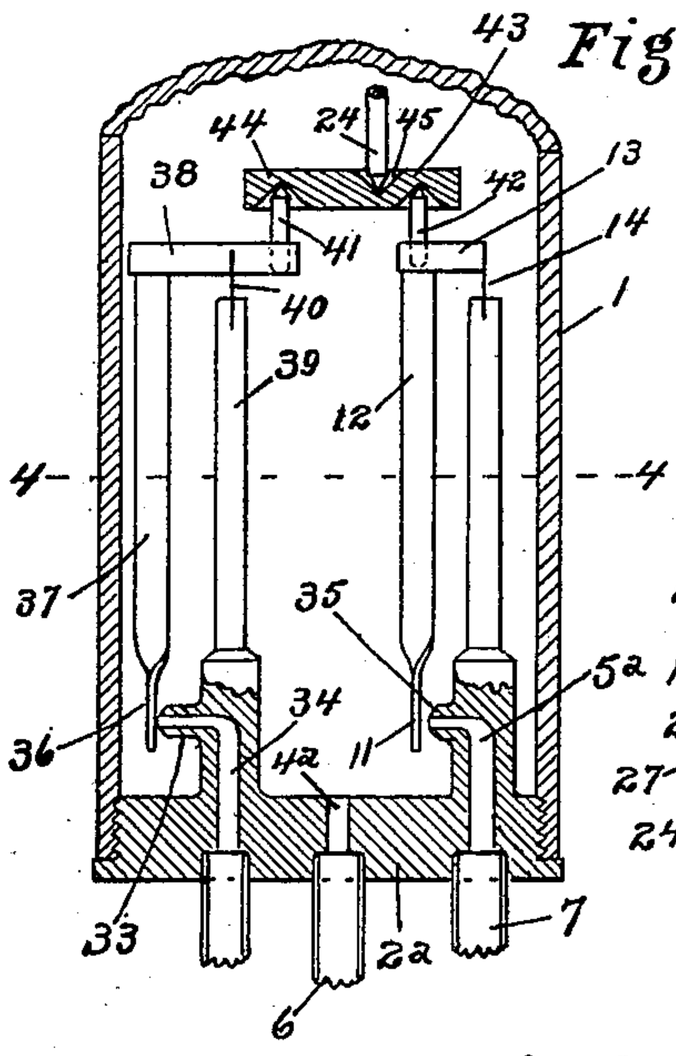


Fig. 2

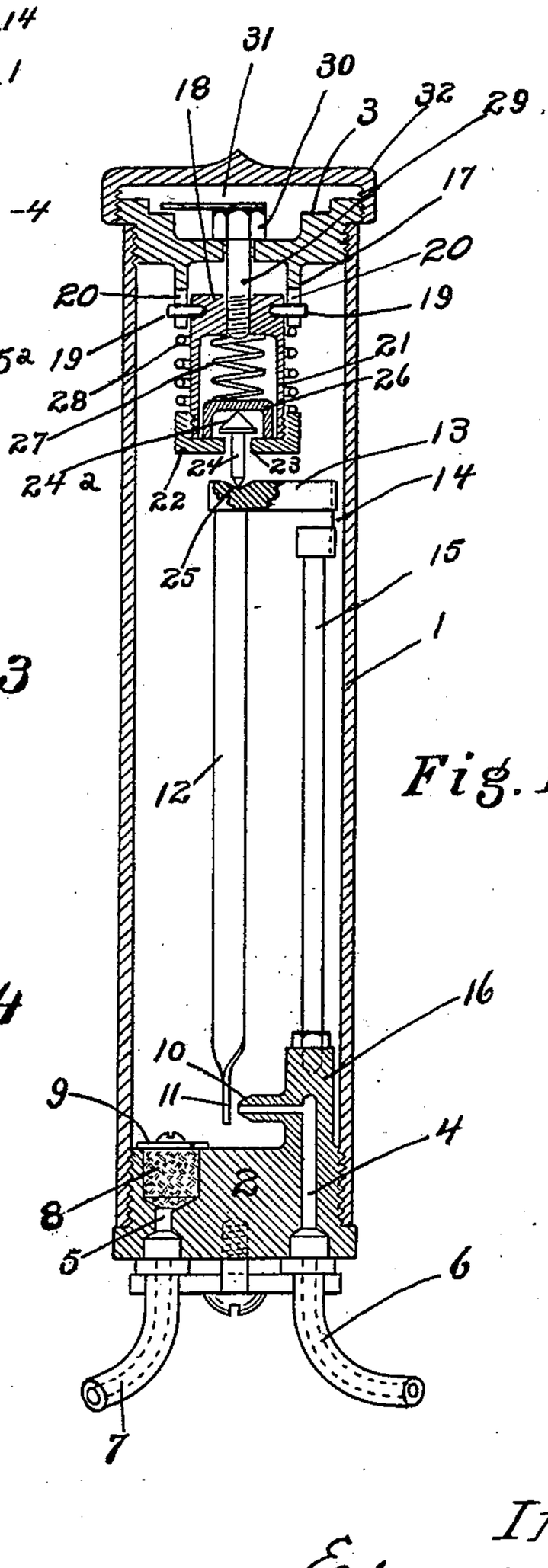


Fig. 1

Fig. 3

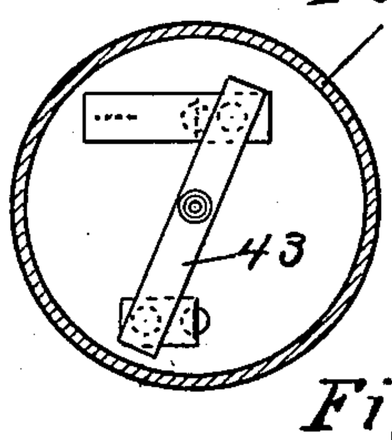
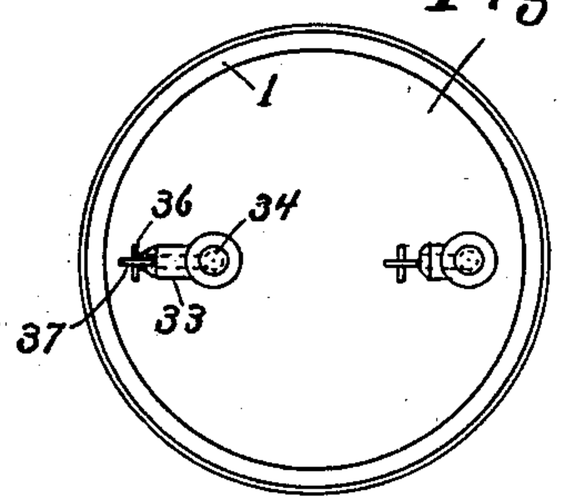


Fig 4



WITNESSES

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No. 730,816. Patented June 9, 1903.

UNITED STATES PATENT OFFICE.

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THERMOSTAT.

SPECIFICATION forming part of Letters Patent No. 730,816, dated June 9, 1903.

Application filed September 4, 1900. Serial No. 28,895. (No model.)

To all whom it may concern:

Be it known that I, EDWARD W. COMFORT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Thermostats, of which the following is a full, clear, and exact specification.

My invention relates more particularly to that class of thermostats designed to be actuated by difference of temperature for controlling the supply to a fluid-pressure motor, usully a compressed-air motor, which operates the heat-controlling device, usually a steam-supply valve; and my invention has for its primary object to provide a thermostat of this general character which shall be compact, simple, and inexpensive and at the same time highly sensitive and efficient, a further object being to house the valve or valves and operating mechanism which controls the fluid-pressure directly within the expansible member which actuates such mechanism.

In accordance with my invention I provide a thermostat having an expansible member, preferably in the form of a tube of rubber or like expansible material, said tube forming part of the exterior inclosing casing of the thermostat, whereby the same may be subjected to changes of atmospheric temperature while inclosiug operative parts of the valve mechanism. A pair of removable plugs or parts are mounted, respectively, at the opposite ends of said expansible member, one of said parts being provided with inlet and outlet ducts for the passage of the fluid, the several parts of the valve-operating mechanism being mounted upon the plugs. I preferably associate the valve-operating mechanism with the plugs, so that said mechanism is separable at some convenient location and so that by the removal of the plugs the valve-operating mechanism will be withdrawn from the expansible tube. By this construction of separable valve-operating mechanism a portion of the mechanism is carried upon each plug and the withdrawal of the plugs serves to separate the separable parts of the mechanism and to withdraw the same from the inclosing tube.

I preferably construct the operating mechanism so that the valve-operating lever is carried upon one of the plugs, while a pressure-pin is carried upon the other plug and is adapted when the parts are assembled to engage and move the operating-lever. The contact between the pressure-pin and the operating-lever constitutes the separable connection which permits the ready removal of the plugs.

In the said drawings, Figure 1 is a vertical longitudinal sectional view of my improved apparatus. Fig. 2 is a similar section of the lower end of the hollow expansible member or tube, showing a slight modification, hereinafter described, in which the exhaust from the valve-motor is controlled by variation in temperature. Fig. 3 is a transverse sectional view of the said tube, showing the preferred manner of arranging the valve mechanism therein; and Fig. 4 is a transverse sectional view taken on the line 4 4, Fig. 2, also showing such preferred arrangement.

Referring more particularly to the construction shown in Fig. 1, 1 represents a hollow expansible member, preferably a cylindrical tube composed of gutta-percha, which is threaded at each end and has secured in the bottom end thereof a plug 2 and in the upper end a plug 3. In the plug 2 are formed two ports 4 5, the former of which communicates with a pipe 6, which leads to the usual or any suitable valve-motor for actuatiug the valve or other device which controls the heat, usually a steam-supply valve, which admits steam to the radiator, and connected with the port 5 is a pipe 7, which leads to a source of some suitable fluid under pressure, such as compressed air, and which port 5 admits the compressed-air or fluid pressure to the interior of the hollow expansible member or tube 1. The plug 2 at a point above the port 5 may, if desired, be provided with a chamber containing suitable filtrant 8, held in place by a pivoted cover 9 for extracting any dirt or particles that might pass with the air into the tube 1, and the upper end of the port 4 terminates in a valve-seat 10, upon which is adapted to rest a valve 11, the seat 10 being preferably composed of a material of a different density or degree of hardness from that of the valve

11 to insure perfect seating of the valve. The valve 11 is formed on an elongated lever 12, which is provided at its upper end with a transverse arm 13, and this arm is supported by a flexible elastic support, preferably composed of a spring-blade 14, which in turn is supported on the upper end of an upright rod 15, whose lower end is secured in a boss 16 on the plug 2, both the lever 12 and the support 15 extending longitudinally of the tube 1. The spring 14 exerts a normal tendency to remove the valve 11 from its seat 10 and permit any pressure fluid contained in the tube 1 to escape through the pipe 6 to the valve-motor, and thereby effect the closing of the heat-regulating valve or device, which, as is well understood, is usually automatically opened by a spring when the fluid-pressure is shut off at the thermostat by the contraction of the tube 1. This closing of the port 4 by the contraction of the tube 1 is effected in my invention by some suitable operative connection or relation between the valve 11 and the tube 1. In the drawings I have shown the plug 3 provided with a socket 17, in which is secured the upper end of a nut 18 by means of lateral pins 19, which project from the sides of said nut and engage in vertical slots 20 in the sides of the socket 17. On the lower side of the nut 18 is formed a cup 21, which is screwed into a cap 22, having a perforation 23, through which passes a pin 24, bearing at its lower pointed end in a seat 25, formed in the upper side of the arm 13, and bearing at its upper end under a follower 26, sliding in the cup 21 and having interposed between it and the nut 18 a coil-spring or other suitable cushion 27. Sleeved on the cup 21 and bearing between the socket 17 and the upper side of the nut 22 is a second spring or cushion 28, which exerts a tendency to force the nut 18, and consequently the pin 24, downwardly to the lower extremities of the slots 20, while the spring 27 holds the pin 24 from slipping upwardly through the perforation 23 excepting when abnormal pressure is exerted thereagainst. The upper end of the pin 24 may be provided with a conical head 24^a for preventing the same from dropping out of the perforation 23. With this construction it will be seen that when the tube 1 contracts as a result of a reduction of temperature the point or pin 24 will bear upon the arm 13 with a pressure equal to the tension of the spring 27, and thus effect the closing of the valve 11, and it is also seen that should such contraction continue after the valve 11 is seated the additional motion will be absorbed by the spring 27 without injury to the valve or its supporting mechanism. In order that the point or pin 24 may be adjusted with relation to the arm 13 after making the operation of the device agree with the thermometer, the nut 18 is provided with an adjusting-screw 29, which is threaded therein and passes loosely through the plug 3, but is provided above the plug 3 with a head 30, which bears on the upper face of the cap and acts as a valve to close the passage in the plug 3, through which the screw 29 passes, the head 30 being held against the face of the plug 3 by the spring 28. If desired, the head 30 may be provided with a pointer or index 31 for indicating the adjustment, graduations being marked on the face of the plug 3 as usual, if desired, and the whole covered over by a cap 32. With a thermostat thus constructed it will be seen that all of the parts are inclosed within the expansible member, and the device is therefore very compact and simple in construction and may be secured wherever desired by any suitable means.

In the form of my invention shown in Figs. 2 to 4, inclusive, I have illustrated a slight modification or addition, whereby the exhaust from the valve-motor is operated by the contraction of the expansible member. In one end of the tube 1 I locate the mechanism which appears in Fig. 1 above the arm 13, and in the other end I employ a plug 2^a, which may be similar in construction to the plug 2, excepting that it is provided with an additional valve-seat 33 and an additional port 34, leading therethrough and constituting an exhaust-port, while the pipe 6, which leads to the valve-motor, instead of being controlled by a valve, as in Fig. 1, is permanently open to the tube 1 through a port 4^a and a port 5^a, formed in the plug 2^a, which is connected to a supply-pipe 7, is provided with a valve-seat 35, against which is adapted to rest the valve 11, supported by the lever 12 and actuated in the manner already described with reference to Fig. 1, it being adapted to close the port 5^a when the tube 1 contracts, and thus shut off the supply of fluid-pressure to the tube, the opening in the valve-seat 35 being so very small that the pressure in the port 5^a is insufficient to unseat the valve 11. The port 5^a is normally open during the expansion of the tube 1, while the port 34 is normally closed during expansion of the tube by means of an additional valve 36, which is supported by a lever 37, similar to the lever 12, already described, and the lever 37 is in turn supported on one end of a horizontal arm 38, which latter is pivotally supported on a support or standard 39, rising from plug 2^a, by an elastic flexible support consisting of a blade-spring 40. The end of the arm 38 opposite that carrying the lever 37 is provided with a bearing pin or point 41, the pivotal support 40 being located between the arm 37 and point 41, so as to constitute a lever of the first order of the arm 38, and the arm 13 carries a pin or bearing-point 42 on the end opposite the spring 14, so as to constitute of the arm 13 a lever of the second order, and resting upon these two pins or points 41 42 is a yoke 43, whose under side is provided with seats 44, into which the points of the pin 41 42 enter, the upper side of yoke 43 being provided with a seat 45 for the pin 24 and the upper

ends of the seats 44 being carried above the lower end of the seat 45, so as to balance the yoke 43 on the pins 41 42 and prevent dislodgment or tipping thereof.

With the construction last described it will be seen that when the tube or expansible member contracts under a reduction of temperature the fluid-supply to the tube 1 will be shut off by the valve 11 and the fluid-pressure trapped in the valve-motor will be permitted to escape through the pipe 6 and port 4^a into the tube 1, whence it discharges through the port 34, the valve 36 being unseated by the downward movement of the yoke 43, thereby permitting the spring or other automatic device of the valve-motor to open the heat-supply valve or device, as usual. When the tube 1 expands under an increase of temperature, a reversal of this operation takes place. In order, however, that the port 5^a may be closed before the port 34 is opened and the fluid-supply of compressed air thus prevented from leaking away through the exhaust, I provide means whereby the pressure of the pin 24 will effect the actuation of the valves 11 36 in succession and not simultaneously. This may be brought about by making the spring 40 stiffer than the spring 14 or by seating the pin 24 nearer the bearing-point 42 than to the bearing-point 41.

In Figs. 3 and 4 a somewhat different arrangement of the parts shown in Fig. 2 is illustrated. In this latter arrangement the yoke 43 is arranged diagonally with reference to the arms 13 38, and these arms instead of being located in line, as indicated in Fig. 2, are arranged side by side and substantially parallel. It is obvious that this arrangement of the parts enables me to place them in a tube of comparatively smaller diameter.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a thermostat the combination of a hollow expansible member having an induction-port for a supply of fluid under pressure, an eduction-port for admitting said fluid under pressure to the valve-motor and an exhaust-port for permitting said fluid under pressure to exhaust from the motor through said expansible member, two valves for respectively controlling the admission into said expansible member through said induction-port and the discharge therefrom through said exhaust-port, levers arranged within said expansible member and secured to and supporting said valves respectively, flexible elastic connections supporting said levers respectively and mechanical means operatively connected with said expansible member for oscillating said levers one in advance of the other, whereby the desired successive action of the valves in opening and closing their respective ports is secured, substantially as set forth.

2. In a thermostat the combination of an expansible tube and a base having an induction-port for a supply of fluid under pressure thereto, an eduction-port for admitting said fluid under pressure to a valve-motor and an exhaust-port for permitting said valve-motor to exhaust through said tube, valves for respectively controlling said eduction and exhaust ports, levers supporting said valves respectively and extending longitudinally of said tube, supports for said levers extending longitudinally of said tube, transverse arms connected with said levers respectively and flexibly connected with said supports respectively, a yoke arranged transversely of said tube and diagonally with relation to said transverse arms and supported at opposite ends upon said arms and an operative connection between said yoke and tube whereby said arms will be oscillated by variation in length of said tube, substantially as set forth.

3. In a thermostat, the combination with an expansible member which also forms part of the exterior inclosing casing of the thermostat, of a pair of independently-removable plugs or parts arranged at opposite ends of said expansible member, one of said plugs carrying a valve-operating lever or levers and the other a pin which separably engages said lever on which it is adapted to exert pressure, said plugs by reason of the separable engagement of the pin with the lever being capable of removal each independent of the other, substantially as described.

4. In a thermostat, the combination with an expansible member which also forms part of the exterior inclosing casing of the thermostat, of a pair of independently-removable plugs or parts carried upon the opposite ends of said expansible member, one of said plugs having suitable valve openings or ducts and carrying a valve-operating lever or levers within the said member, and a part carried upon the other plug adapted to impart the movement of said expansible member to said valve-operating lever or levers, substantially as described.

5. In a thermostat, the combination with an expansible member which also forms part of the exterior inclosing casing of the thermostat, of independently-removable plugs or parts mounted upon the opposite ends of said expansible member and serving to limit the casing to the length of the member, and separable valve-operating mechanism inclosed within said expansible member and interposed between said plugs or parts, the relatively separable portions of said valve-operating mechanism being carried upon the respective plugs or parts, substantially as described.

6. In a thermostat, the combination with an expansible member which also forms the exterior inclosing casing of the thermostat, of a pair of independently-removable plugs or parts mounted upon opposite ends of said expansible member, one of said plugs carrying suitable ducts and a valve-operating lever or levers, the latter being located within the said member, and a pressure-pin carried upon the

other plug or part and adapted to engage and move said valve-operating lever or levers, substantially as described.

7. In a thermostat, the combination with an expansible member which also forms a part of the exterior inclosing casing of the thermostat, of a pair of independently-removable plugs or parts mounted respectively upon opposite ends of said expansible member, one of said plugs or parts carrying suitable valve-ducts, a valve-operating lever or levers carried upon said plug or part and extending longitudinally of said member, a pressure-pin suitably supported upon the other plug or part and separably associated with said valve-operating lever or levers to impart movement thereto, substantially as described.

8. In a thermostat, the combination with a tube of expansible material, of independently-removable metallic plugs fitting respectively in the opposite ends of said tube, one of said plugs having suitable ducts, a valve-operating lever carried upon said plug and extending longitudinally of the tube, and a pressure-pin carried upon the other plug and adapted to engage the said valve-operating lever to actuate the same, substantially as described.

9. In a thermostat, the combination with an expansible tube, of independently-removable screw-threaded plugs adapted to be inserted in the ends of said tube and to close the same, valve-operating mechanism inclosed wholly within said tube and carried by the plugs, said mechanism being separable intermediate the plugs, whereby when either plug is removed from the tube the portion of the mechanism carried thereby is removed with it, substantially as described.

10. In a thermostat, the combination with a hollow expansible member closed at one end and provided at the other with a plug having an induction-port for the admission of fluid under pressure, an eduction-port and an exhaust-port, with a lever provided with a valve adapted to control the induction-port, a second lever provided with a valve adapted to control the exhaust-port, both said levers being within the chamber formed by said hollow member and plug and mounted upon flexible elastic supports, and mechanical means in operative contact with said levers and hollow member for oscillating the former so that one of the valve-controlled ports is closed before the other is opened.

11. In a thermostat, the combination with an expansible tube having a base provided with an induction-port, an eduction-port and an exhaust-port, a lever extending longitudinally of the tube, carrying a valve adapted to control the induction-port and having a transverse arm, a second lever also extending longitudinally of the tube, carrying a valve adapted to control the exhaust-port and having a transverse arm, said levers being mounted within the tube on flexible elastic supports, a yoke arranged transversely of the tube and supported at opposite ends on said arms and means in operative contact with said yoke and tube whereby the levers will be oscillated by variations in length of the tube.

12. In a thermostat, the combination with a hollow expansible member closed at one end and provided at the other with a plug having an induction-port, an eduction-port and an exhaust-port, with a lever provided with a valve adapted to control the induction-port, a second lever provided with a valve for controlling the exhaust-port, both said levers being within the chamber formed by said hollow member and plug and mounted upon flexible elastic supports one of which is made to offer more resistance to a force tending to move the lever mounted thereon than the other, a connection between said levers and means in operative contact with said connection and said tube for transmitting the movement of expansion and contraction of the latter to the connection.

13. In a thermostat, the combination with a hollow tube responsive to temperature changes, of a port near one end of the same and a valve to control the same, a valve-lever to operate said valve located in the tube, a flexible elastic support for said lever, and means connected with the opposite end of the tube to engage and control the operation of said lever when the tube is affected by temperature changes, substantially as described.

14. In a thermostat, the combination with a hollow tube responsive to temperature changes, of a port near one end of the same and a valve to control the same, a valve-lever to operate said valve extending longitudinally within the tube, a flexible elastic support for said lever, and means connected with the opposite end of the tube to engage and control the operation of said lever when the tube is affected by temperature changes, substantially as described.

15. In a thermostat, the combination with a hollow tube responsive to temperature changes, of a plug fitting in one end thereof, a port, a valve therefor, a standard mounted upon said plug and extending into the tube, a valve-lever for operating said valve extending substantially parallel with said standard and within the tube, a flexible elastic connection between said lever and said standard to support the lever and permit its vibration, and a projection from the opposite end of the tube to engage and operate said lever when the tube is affected by temperature changes, substantially as described.

16. In a thermostat, the combination with a tube responsive to temperature changes, of a plug fitting in one end thereof and having a port, a standard on said plug extending into the tube, a lever also in said tube and pivotally mounted upon said standard, said lever having a long arm and a short arm, the long arm being substantially parallel with said standard, a valve carried at the free end of said long arm to open and close said port, and

a part extending from the opposite end of said tube to and engaging the short arm of the lever, substantially as described.

17. In a thermostat, the combination with a tube responsive to temperature changes, of a plug fitting in one end thereof and having a port, a standard on said plug extending into the tube, a lever also in said tube and having a flexible elastic connection with said standard to support the lever and permit it to vibrate, said lever having a long arm and a short arm, the long arm being substantially parallel with said standard, a valve carried at the free end of said long arm to open and close said port, and a part extending from the opposite end of said tube to and engaging the short arm of the lever, substantially as described.

18. In a thermostat, the combination with a hollow tube responsive to temperature changes, of a plug fitting in one end thereof, a port opening at an angle to the axis of the tube, a standard mounted upon said plug and extending into the tube, a lever also in said tube and pivotally mounted upon said standard, said lever having a long arm and a short arm, the long arm being substantially parallel with said standard the free end of which is adapted in the operation of the lever to move transversely of the tube, a valve for said port carried upon the said free end of the long arm, a plug for the opposite end of the tube and a projection extending therefrom and arranged to engage the short arm of the lever, substantially as described.

19. In a thermostat, the combination with a tube responsive to temperature changes, of a plug fitting in one end thereof, and having a port, a standard on said plug extending into the tube, a lever also in said tube and pivotally mounted on said standard, said lever having a long arm and a short arm, the long arm being composed of a spring-tongue and arranged substantially parallel with said standard, a valve carried upon the free end of said long arm to open and close said port, a plug in the opposite end of the tube and a projection extending therefrom and engaging the said short arm of the lever, substantially as described.

20. In a thermostat, the combination with a sensitive tube responsive to temperature changes, of a plug fitting in one end thereof and having a port, a standard in said plug extending into the tube, a lever also in said tube and pivotally mounted upon said standard, said lever having a long and a short arm, the long arm being disposed substantially parallel with said standard, a valve carried upon the free end of said long arm to open and close said port, a plug in the opposite end of the tube, a yieldingly-supported projection extending from said last-mentioned plug and arranged to engage the short arm of the lever, substantially as described.

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