Nov. 2, 1926. 1,605,113

E. A. ILEMAN

REGULATING VALVE

Filed Dec. 19, 1923

Fig:1.

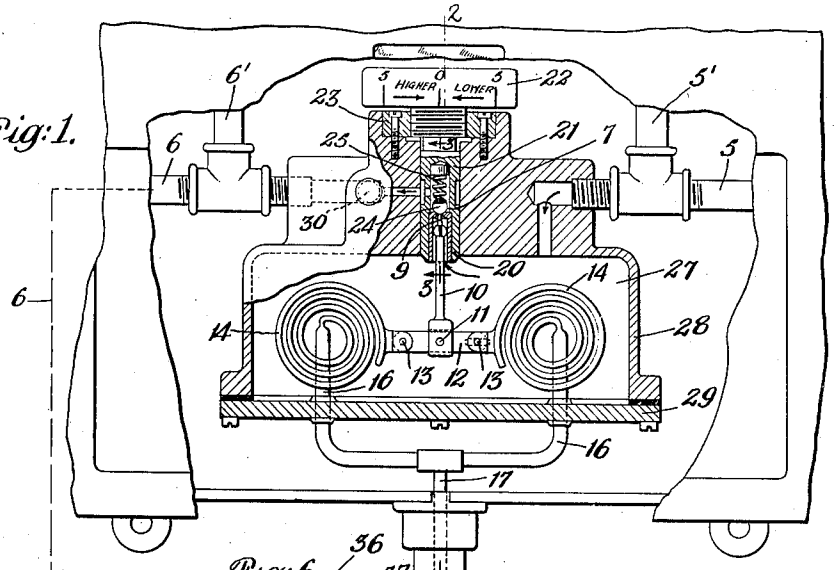


Fig:2.

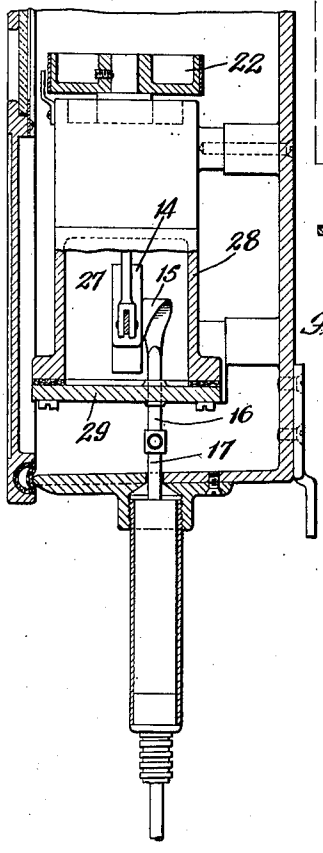
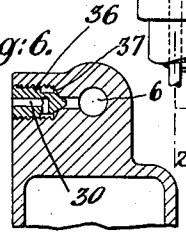


Fig:6.



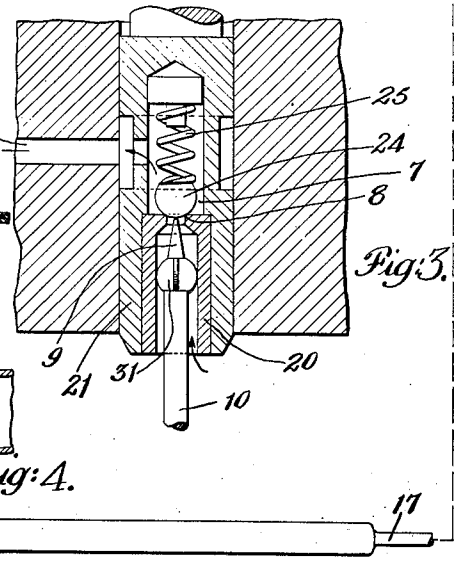


Fig:3.

Fig:3a

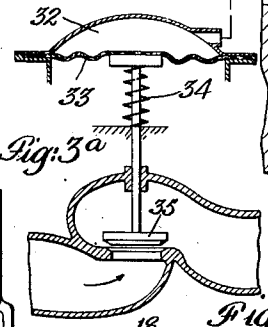
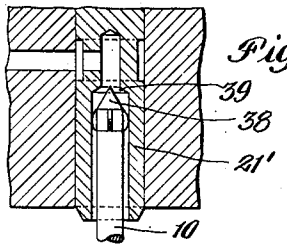


Fig:4.

Fig:5.



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UNITED STATES PATENT OFFICE.

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REGULATING VALVE.

Application filed December 19, 1923. Serial No. 681,545.

This invention relates to temperature controlled apparatus and particularly to such apparatus for controlling a steam supply to regulate the temperature of heating means for industrial purposes or of enclosures such as houses and the like.

The object of the invention is to provide a temperature controlled apparatus which will be simple and durable in construction and reliable in operation.

Further objects of the invention particularly in the combination in the apparatus of mercury actuated control means will appear from the following description taken in connection with the accompanying drawings in which,

Fig. 1 is an elevational view partly in section of apparatus illustrating the invention.

Fig. 2 is a vertical sectional view on line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken on the line 3—3 of Fig. 1.

Fig. 3[a] is a sectional diagrammatic view showing the heat regulating means and with its connection to the control means indicated by broken lines.

Fig. 4 is a sectional view of the control bulb which is connected to the apparatus of Figs. 1, 2 and 3 in any desired manner.

Fig. 5 is a sectional view similar to Fig. 3 and illustrating a modified form of valve means, and

Fig. 6 is a vertical sectional view of a detail of Fig. 1.

In the specific embodiment of the invention shown in the drawings a compressed air supply line 5 is connected to a feed line 6 through a valve 7 which valve is to be controlled by temperature variations at any desired remote point, and the air supply to the pipe 6 in turn will control a valve or other means to regulate the supply of heat.

The valve 7 has a seat 8 with which cooperates the ball 24 which is pressed against said seat by spring 25, spring 25 exerting a downward force in excess of the upward pressure of the compressed air on the under surface of the ball. The valve 7 is opened to a variable extent by lifting the ball 24 from its seat 8 to a variable distance. This is accomplished by movement of the stem 10 having the tapered end 9 engaging under the ball 24 to lift it against the pressure of the spring 25.

Mercury actuated means are provided to move the stem 10. At its lower end the stem 10 is pivoted at 11 to the yoke member 12 each end of which at 13 is pivoted to the outer ends of the spiral tubes 14 connected by the off-sets 15 to the tube 16 which in turn is connected by tube 17 to the control bulb 18 placed at any desired point where the temperature is to be regulated.

The bulb 18, connecting tube 17, U-tube 16 and spiral tubes 15, 14 are filled with mercury. A rise in temperature at the bulb 18 will cause the mercury therein to expand and this expansion will be transmitted through the continuous mercury column to the spiral tubes 14 causing these spirals to tend to straighten or unwind so as to lift upward on the ends of the yoke 12 and thus press upward on the stem 10 with a variable pressure dependent upon the temperature at the bulb 18. The passages through the tubes 17, 16, 15 and 14 are very small in cross section so that the volume of mercury in these tubes is very small and the changes in volume of the mercury column in these tubes, due to temperature variation is so small as to be negligible. By making the passages through these tubes only sufficient to transmit the pressure from bulb 18 to the spirals 14, the full effect of the changes in volume of the mercury in bulb 18 is accurately transmitted to the stem 10 and valve 7 without appreciable variation due to temperature conditions in the pressure transmitting mercury column.

The valve seat 8 is carried by a bushing 20 inserted in a slidable sleeve 21 adjustable by means of the rotatable head 22 screw threaded into the stationary block 23. This permits the position of the valve 24 to be varied with relation to the stem 10 so that the opening action of the stem may be set for any predetermined temperature at the bulb 18. The strength of the spring 25 while sufficient to overcome the compressed air pressure on the lower surface of the ball 24 is not sufficient to overcome the upward pressure exerted by the stem 10 when the spirals 14 are expanded by pressure from the bulb 18. The movement of the stem 10 raises and lowers the ball 24 while the spring 25 maintains a yielding pressure downward on the end of the stem until the ball 24 is set against the end of the bushing 20.

The spiral tubes 14 are contained in a closed chamber 27 in the casing 28, the U-

tube 16 at each of its branches being sealed through the detachable floor portion 29 of said casing. The compressed air supply from pipe 5 maintains a substantially constant pressure of about fifteen pounds, for instance in the enclosure 27. Gauges may be connected to the upright pipes 5′, 6′ to measure the air pressure on each side of the valve 7.

When the valve 7 is opened by the stem 10 air under pressure in chamber 27 will pass through the valve and into the pipe 6 to control the heat supply in any desired manner. For instance, as indicated in Fig. 3ª, the pipe 6 may supply air pressure to the chamber 32 above the diaphragm 33 carrying the valve 35 normally held upward in open position by the spring 34. Air passage 6 is vented to the atmosphere by means of leak 30 (see Figs. 1 and 6). The size of the leak or vent is adjustable by means of adjusting screw 36, co-operating with a seat 37. By means of leak 30 and a varying opening of valve 7 it is possible to maintain a varying pressure in chamber 32. When the valve 7 opens, air pressure through pipe 6 and in chamber 32 depresses the valve 35 toward closed position a variable amount depending upon the extent of the opening of valve 7, and thus throttles the steam supply through valve 35 to lower the temperature at the bulb 18. Conversely a closing movement of the valve 7 will allow leak opening 30 to reduce the pressure in chamber 32 to permit the spring 34 to open the valve 35 and increase the supply of steam so as to raise the temperature at the bulb 18.

Instead of the spring pressed ball valve construction shown in Figs. 1 and 3, the stem 10, as shown in Fig. 5, may be formed with a tapered end 38 cooperating with a seat 39 in the adjustable sleeve 21′ to variably throttle the air pressure according to the movement of the stem 10. Such a valve arrangement will require a corresponding change in the regulating valve means because an upward movement of the stem 10 caused by an increase in temperature at the bulb 18, will decrease, not increase, the supply of air to the steam valve actuating means. With the valve construction of Fig. 5, therefore, the diaphragm 33 and valve 35 of Fig. 3ª will be so arranged that a decrease in pressure on the diaphragm will close the valve 35 instead of opening it as in Fig. 3ª.

By enclosing the spirals 14 and the stem 10 in the pressure supply chamber 27 there are no close or packed fittings between movable parts and the valve control freely floats with the guide ribs 31 of the stem 10 lightly sliding within the bushing 20 so that the stem movement may be made extremely sensitive to relatively small pressure variations, while at the same time the very small volume of mercury required for the spiral tubes 14 reduces the error due to temperature variations to a minimum. The spirals 14 will thus give an accurately controlled upward pressure to precisely and reliably operate the valve 7. The continuous column of mercury in the bulb 18 and the connecting tube 17 and the U-tube 16 and the spirals 14, 15 completely fills the space within these parts without interruption by intermediate air spaces or the like. The apparatus of this invention combines sensitiveness with accuracy and adaptability; the range of the temperature control may be made long or short by changing the size of the bulb 18. A short range may be used with the beginning of that range at any temperature between 0° F. for instance, and nearly 1000° F. This is accomplished by using a size of bulb 18 holding a sufficient quantity of mercury to provide the necessary expansion for the prescribed range and by providing the mercury filled system with a certain initial pressure under which the expansion of the mercury will begin to expand the spring at a low point of the range. Mercury is a liquid throughout a wide range of temperatures and in the system of this invention will remain unaffected for an indefinite period and permanently operative to convert the temperature changes at the bulb 18 into movements of the control valve member 9, 10.

I claim:—

1. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating the same comprising an extensible member of comparatively small capacity adapted to be moved by internal fluid pressure, said extensible member being adapted to have mechanical connection with said valve for effecting actuation thereof, a bulb member of comparatively large capacity subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection between said bulb and said extensible member.

2. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating the same comprising an extensible member of comparatively small capacity adapted to be moved by internal fluid pressure, said extensible member being adapted to have mechanical connection with said valve for effecting actuation thereof, a bulb member of comparatively large capacity subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection between said bulb and said extensible member, said mercury filling said extensible member.

3. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating the same comprising a spiral tube member of com-

paratively small capacity adapted to be moved by internal fluid pressure, said spiral tube member being adapted to have mechanical connection with said valve for effecting actuation thereof, a bulb member of comparatively large capacity subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection between said bulb and said spiral tube member.

4. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating the same comprising a source of fluid under pressure, a control valve therefor, an extensible member adapted to have mechanical connection with said valve to move it by internal fluid pressure, a bulb member subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection throughout said bulb and said extensible member.

5. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating said valve comprising a chamber supplied with fluid under pressure, a control valve for said fluid, an extensible member in said chamber adapted to move said valve by internal fluid pressure, a bulb member subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection throughout said bulb and said extensible member.

6. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating the same comprising an extensible member adapted to be moved by internal fluid pressure, said extensible member being adapted to have mechanical connection with said valve for effecting actuation thereof, a bulb member subjected to temperature variations, a connecting tube between said members, and mercury forming a continuous liquid column connection throughout said bulb and said extensible member, said mercury filling said extensible member and being under a predetermined pressure with which said mercury will begin to actuate said extensible member at a predetermined bulb temperature.

7. In a temperature controlled system the combination with a valve adapted to regulate a supply, of means for actuating said valve comprising a pair of spiral tube members of comparatively small capacity adapted to be moved by internal fluid pressure and a yoke member connecting said tube members, a bulb member of comparatively large capacity subjected to temperature variations, a connecting tube between said members and mercury forming a continuous liquid column connection throughout said bulb and tube and spiral tube members.

8. A controlling mechanism for temperature, pressure or the like, comprising a plurality of expansible spiral sensitive elements, a movable member, and means connecting said expansible sensitive elements to each other and to said movable member so as to give to said member a rectilinear movement due to the movement of each of said spiral elements.

9. A mechanism for controlling temperature, pressure or the like, comprising a movable controlling member, a plurality of expansible sensitive elements normally operative to expand simultaneously, and means for effecting movement of said member by said elements even when said elements have substantially the same degree of expansion and for distributing the actuating forces therefrom substantially equal over all of said elements.

10. A mechanism for controlling temperature, pressure or the like, comprising a movable controlling member, a pair of spiral expansible sensitive elements having free ends, and means for actuating said movable member having operative connection with the free ends of each of said spirals.

11. A mechanism for controlling temperature, pressure or the like comprising a linearly movable valve, and means for actuating the same including a pair of expansible sensitive elements adapted to have relative movement therebetween and normally operative for simultaneous, substantially uniform expansion, and means connecting said elements and having provision for engaging said valve to move the same.

12. A mechanism for controlling temperature, pressure or the like, comprising a linearly movable valve, and means for actuating the same comprising a plurality of spiral expansible sensitive elements, and substantially linearly movable means for engaging said valve having operative connection with said spiral elements whereby any expansion thereof will maintain linear movement of said valve engaging member.

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