

R. THELEN.
THERMOSTAT.

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1,413,073.

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Fig. 1.

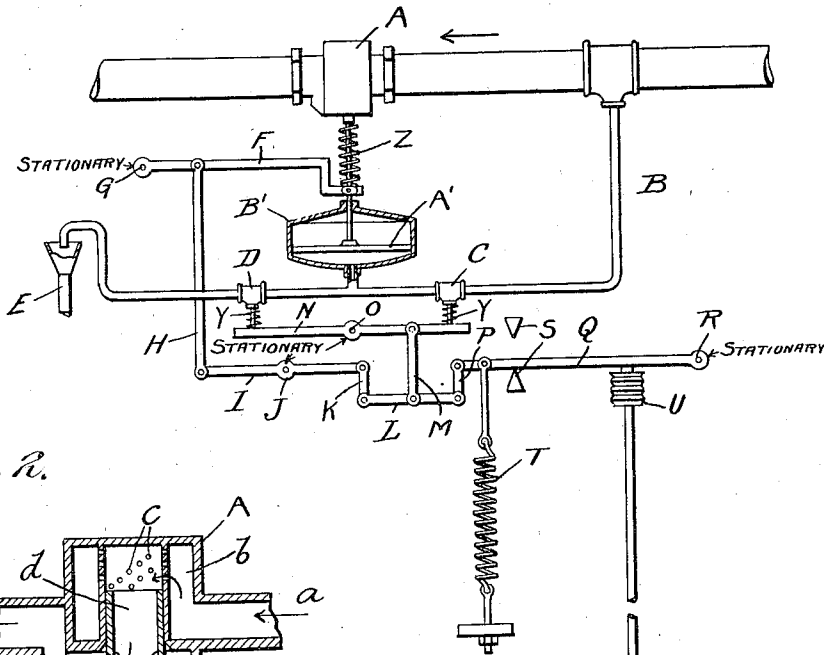


Fig. 2.

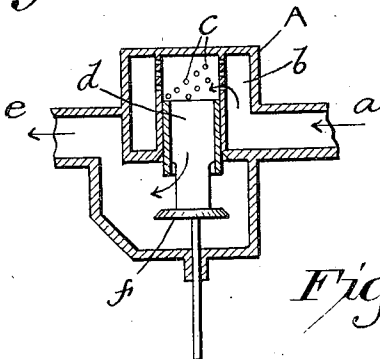
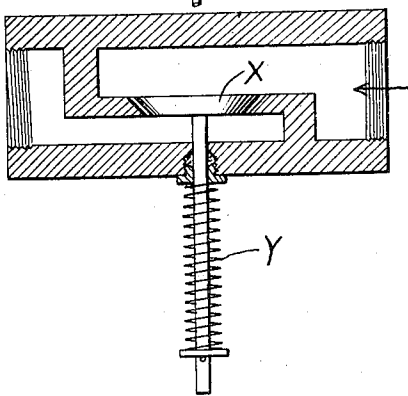


Fig. 3.



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UNITED STATES PATENT OFFICE.

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THERMOSTAT.

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(FILED UNDER THE ACT OF MARCH 3, 1893, 22 STAT. L., 625.)

To all whom it may concern:

Be it known that I, ROLF THELEN, a citizen of the United States of America, and an employee of the Department of Agriculture, residing in Madison, Wisconsin, whose post-office address is Department of Agriculture, Madison, Wisconsin, have invented a new and useful Thermostat.

This application is made under the act of March 3, 1883, chapter 143 (22 Stat., 625), and the invention herein described and claimed may be used by the Government of the United States, its officers and employees, and by any person in the United States without payment to me of any royalty thereon. I hereby dedicate the same to the free use of the Government and the people of the United States.

This thermostat is adapted for use on dry kilns and other spaces heated by steam or vapor, and is an improvement over types now in use for this purpose in that it combines largely within itself the major advantages of both the ordinary self-contained type and the ordinary air controlled or auxiliary operated type. It also embodies as a special feature a novel form of motor valve, especially adapted for this class of service. This motor valve partakes largely of the nature of the ordinary pressure reducing valve.

The various features of this invention will be made clear from the following description and the accompanying drawing in which Figure 1 represents an elevation of the entire compensated throttling thermostat hereinafter called "auxiliary operated thermostatic valve"; Figure 2 represents a vertical sectional view of a portion of the motor valve A of Figure 1; and Figure 3 represents a sectional elevation of the auxiliary valves C and D.

The arrow in Figure 1 indicates the direction of flow of the steam or vapor in the steam main to the heating system. A represents the motor valve with a pressure motor B' of ordinary type. A spring Z surrounding the valve stem of said motor valve A and pressing against the valve body and the lever F at its upper and lower ends respectively, serves to open said motor valve A when the pressure in the pressure motor is relieved. The medium for operating the pressure motor is condensed steam taken

through the pipe B and the auxiliary valve C from the high pressure side of the steam main and acting on the piston or diaphragm A'. The pressure motor is relieved through the auxiliary valve D into the waste pipe E. The motor valve A closes in the upward direction, whereas the auxiliary valves C and D open in the upward direction. In practice a suitable reservoir and a suitable filtering medium would be introduced in the pipe B between the steam main and auxiliary valve C. The thermostatic operating element may be of any well-known type such as metal bars, gas filled bulbs, liquid filled bulbs, or vapor filled bulbs. I have chosen for this particular adaptation a vapor-filled bulb type in which W represents the temperature-sensitive liquid in its bulb. Inside of this bulb is a bellows V connected by means of a suitable tube with the operating bellows U. These two bellows and the connecting tube are intended to be filled with some high-boiling liquid such as oil, the boiling point of which is considerably higher than that of the liquid W. The change in vapor pressure in the bulb produces corresponding changes of pressure in the two bellows and their connecting tube. This change in pressure operates the lever Q, pivoted at the point R, and working between the two stops S. This particular type of thermostatic operating element has been chosen because it is considered to be much less affected by changes in the temperature of the connecting bulb and the operating bellows U than the ordinary vapor filled type. In operation the bulb is placed in the space whose temperature is to be controlled.

The system of links and levers between the operating bellows U and the valve stem of the motor valve A operates to produce a definite and positive setting or opening of the motor valve A for any given setting or opening of the operating bellows U. This is accomplished by the opening and closing of the auxiliary valves C and D which control the movement of the stem of the motor valve A through the admission to or waste from the pressure motor B' of condensed steam as described. Any movement of the operating bellows U produces a corresponding movement of the lever N and a corresponding opening or closing of the auxiliary valves C and D which in turn produces a

movement of the valve stem and the valve proper of the motor valve A through the action of the condensed steam upon the pressure motor B'. This movement of the valve stem produces a corresponding movement of the lever N since the valve stem is pivoted to the lever F, and through it and links and levers H, I, K, L, and M is connected to the lever N. This movement, however, is always opposite in direction to that produced through the movement of the operating bellows U and restores the lever N to the neutral position, in which the auxiliary valves C and D are closed, after the valve stem of the motor valve A has moved the predetermined distance. In this respect the result produced is the same as that produced in the ordinary self-contained thermostat. This result, however, is produced by means of positive auxiliary pressure and has, therefore, all the advantages of positiveness, sensitiveness, larger temperature range, and freedom from sticking, which advantages are usually associated with auxiliary operated thermostatic valves.

For instance, let us assume that the temperature in the kiln is below that corresponding to the tension in the adjustable regulating spring T and that consequently the lever Q rests against the lower stop S. In this position the lever N, which is pivoted at the point O, and is connected to the lever Q through lever L and links M and P will be up on the left side, thus opening the auxiliary valve D and allowing the auxiliary valve C to seat itself. Under these circumstances the steam pressure in the steam main together with the spring Z around the stem of the motor valve A, will open said motor valve and will allow the steam to pass into the heating system. As the kiln gradually warms up, the vapor pressure of the liquid W gradually increases, transmitting the increased pressure through the bellows V to the operating bellows U. This increased pressure finally overcomes the tension of the adjustable regulating spring T, and the lever Q rises. This then raises the right end of the lever L through the connecting link P. The left end of the lever L remains stationary since it is rigidly connected through the series of links and levers K, I, H, and F to the stem of the motor valve A, which is in the open position. The movement of the lever L then lifts up the right side of the lever N through the link M, thus opening the auxiliary valve C and allowing condensed steam in the pipe B to operate the pressure motor B', raising the valve stem and the valve proper in the motor valve A, thus throttling down the steam supply. As the valve proper of the motor valve A rises, it carries with it the lever F, pivoted at the point G, and through the link H depresses the right end of the

lever I, which is pivoted at the point J. The precise location of said point J on the lever I is determined in each individual design by the relative size of other parts and the relative amount of motion desired. This lever in turn, through the link K, lowers the left end of the lever L, thus moving the link M downward and depressing the right end of the lever N allowing the auxiliary valve C to seat itself. The entire system is then in equilibrium, with the motor valve A set in a definite position corresponding to the original movement of the bellows U. Likewise for any other movement of the operating bellows U and the lever Q within the operating range, there will be a corresponding definite movement of the motor valve A.

A portion of one type of motor valve is shown in detail in Figure 2. Steam enters at the point *a*, passes around the annular space *b*, through a portion or all of the series of holes *c* in the cylindrical inner wall of this annular space, through the hollow cylindrical throttling barrel *d* of the valve proper, and then out at *e*. The beveled positive seating disc *f* of the valve proper is adapted to seat tightly upon the body of the valve and thus shut off the steam supply completely when the valve proper is in the closed position. The series of holes *c* is intended to be arranged to give a uniform increase and decrease in the flow of steam with uniform movement of the valve proper. The throttling barrel *d* of the valve proper is intended to fit snugly enough within the cylinder in which it slides to prevent more than a comparatively small amount of steam to leak through between said throttling barrel and said cylinder from that portion of the series of holes *c* covered by said throttling barrel.

Besides the advantages over types in common use this auxiliary operated thermostatic valve possesses certain distinct and unique advantages. In the case of leakage in either the auxiliary valve C or the auxiliary valve D the general action of the thermostat is not affected since through the system of levers the balance between the operating bellows U and the valve stem of the motor valve A will be altered just enough to produce exactly the same amount of leakage in the other auxiliary valve D or C restoring the system to equilibrium.

The range of steam pressures throughout which this auxiliary operated thermostatic valve will operate is unusually great since any variation in the pressure within the valve body is accompanied by a corresponding change in the pressure available to the pressure motor. Thus, the pressure motor can be comparatively small and still be capable of operating under a wide range of pressures. Likewise the temperature range can be as great as that ordinarily secured

in air-operated thermostats since the duty demanded of the thermostatic operating element is of the same type.

I claim:

- 5 A temperature regulating device having a conduit for the heating medium, a valve therein, a diaphragm operatively connected to said valve, a pipe leading from the inlet side of said conduit and communicating with
10 one side of said diaphragm and having an extension thereon, a valve in said pipe and a valve in said extension, a thermostat and a

fluid motor therefor, a series of levers connecting said motor to said auxiliary valves and to the stem of the first mentioned valve and a spring acting on said system whereby a given movement of the thermostat produces a predetermined movement of the main valve and restores the system to equilibrium in the new position.

ROLF THELEN.

Witnesses:

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