(No Model.)

W. P. POWERS.

THERMOSTAT.

No. 416,947. Patented Dec. 10, 1889.

Fig. 2.

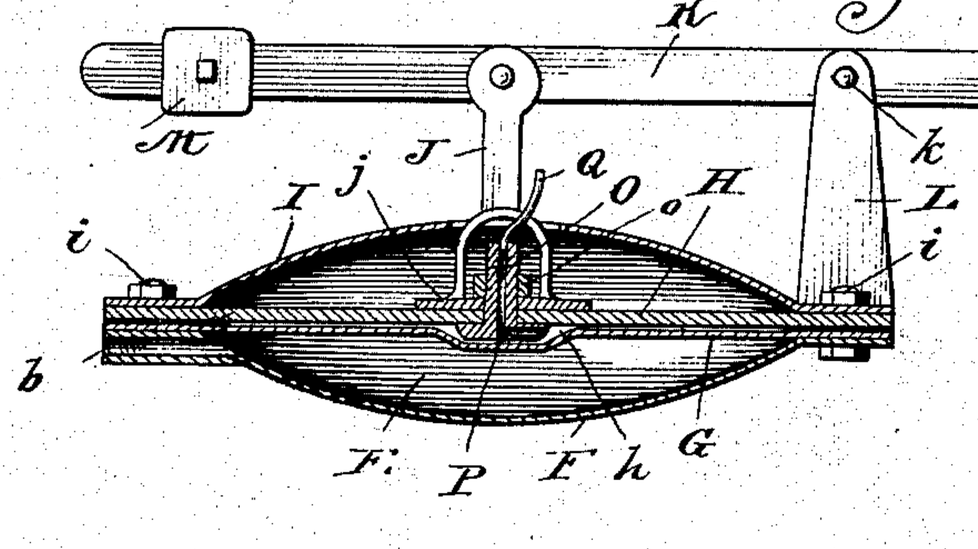


Fig. 5.

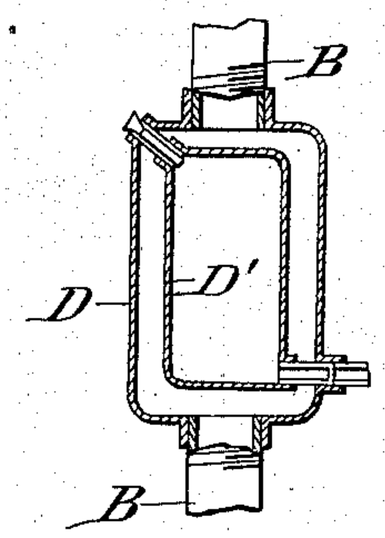


Fig. 3.

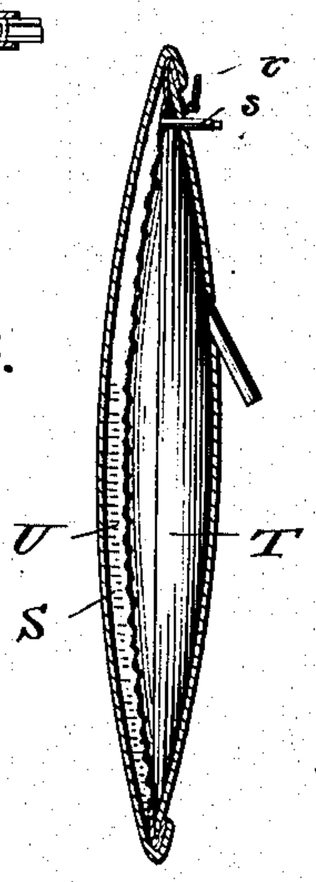


Fig. 4.

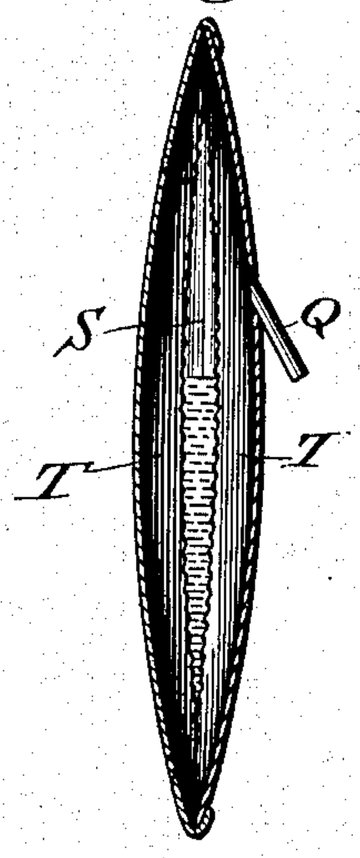
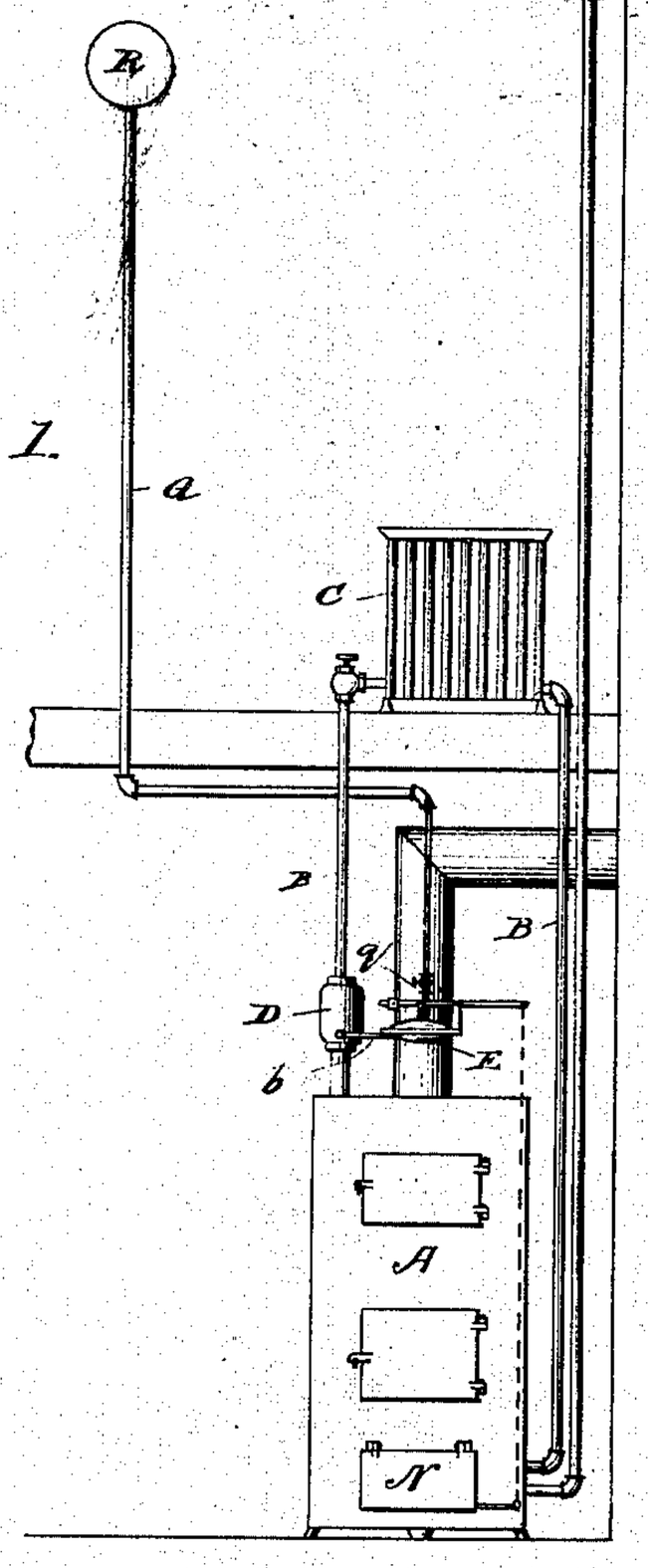


Fig. 1.



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UNITED STATES PATENT OFFICE.

WILLIAM P. POWERS, OF LA CROSSE, WISCONSIN.

THERMOSTAT.

SPECIFICATION forming part of Letters Patent No. 416,947, dated December 10, 1889.

Application filed January 26, 1889. Serial No. 297,626. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM P. POWERS, a citizen of the United States, residing at La Crosse, in the county of La Crosse and State of Wisconsin, have invented certain new and useful Improvements in Thermostats, of which the following is a specification.

My invention has for its object to provide means whereby the temperature of various rooms in a building is automatically controlled.

In carrying out my invention I make use of the expansive force of a fluid vaporizable at a degree of heat approximating that which it is desired to maintain in the building, said fluid being confined in a vessel having one or more flexible metallic walls and located in one of the rooms to be heated, the movement of said wall being utilized to operate, by means of interposed air or other fluid, a damper or transom-actuating device. This device I may combine with means for closing the damper of a furnace by the generation of steam in an ordinary low-pressure steam-heating boiler or in a supplemental boiler located within and heated by the water of a hot-water-heating system and operating by reason of the difference in pressure on the water of the main boiler and the water contained in the supplemental boiler; but this latter improvement is the subject-matter of a prior application, Serial No. 265,228, filed by me in the United States Patent Office February 25, 1888, and so I do not claim herein said last-described improvement.

In the accompanying drawings, Figure 1 is a side elevation of my improved heating appliances, comprising a furnace and hot-water-heating boiler, located, say, in the basement of the building, showing a heating-coil on an upper floor and my thermostat applied thereto. This device may also be applied to the control of a low-pressure steam-heating apparatus. Fig. 2 is an elevation, partly in vertical section, of the damper-operating device. Fig. 3 is a central vertical section of the thermostat which is shown in Fig. 1 located in the same apartment with the heating-coils. Fig. 4 is a similar view showing a modified construction of the thermostat; and Fig. 5 is a sectional detailed view of the enlargement in pipe B, and showing the supplemental boiler or steam-generator hereinafter described.

Referring to the drawings, A indicates the hot-water boiler; B, a pipe leading therefrom to the radiator C; D, an enlargement in pipe B, inclosing a vessel or steam-generating boiler D′, (see Fig. 5,) containing a body of water to be heated by the water of the circulation, and communicating by a pipe *b* with a chamber E, formed by inclosing-wall F and diaphragm G, as shown in Fig. 2.

H is a second diaphragm placed above diaphragm G and secured by means of a curved wall I and bolts *i*, which are passed through the margins of both of the inclosing-walls and of the diaphragms, as shown in Fig. 2. A piston-rod J is seated on the diaphragm H, and its upper end is secured to a lever K, pivoted at *k* to an arm L, projected upwardly from the walls of the chambers described. One end of this pivoted lever will be provided with a weight M, and the other will be connected by chains with the damper N. By reference to Fig. 2 it will be seen that the diaphragms G and H are separate, except around the margin between the confining-plates, with a space or chamber *h* between them, for a purpose presently described. The piston-rod J, as shown in Fig. 2, has its lower end bifurcated and a disk *j* attached to the bottom of these bifurcations, the disk being secured to the diaphragm H by means of a bolt O, having a nut *o*. This bolt has an aperture P through it, which communicates at one end with the space *h* between the diaphragms and at the other with a pipe Q, having therein a valve *q*. Pipe Q is carried upwardly into a room whose temperature it is desired to regulate, and there communicates with a thermostat, (indicated in Fig. 1 by the letter R and shown in sectional elevation in Fig. 3.) This thermostat consists of a vessel divided into two compartments or chambers by a flexible metallic diaphragm U. One of said chambers (marked S) is intended to contain a fluid vaporizable at about the temperature which it is desired to maintain in the room to be heated. Said chamber is smaller than the fellow chamber T, the diaphragm U being curved, as shown, and under tension caused

by the spring or the metal or by suitable coiled or flat springs, whereby it will have a tendency to enlarge the chamber containing the volatile fluid, and thereby produce a partial vacuum in said chamber, which being sealed, the pressure on the fluid therein is relieved and the boiling-point of the fluid is lowered, in accordance with the well-known law that the boiling-point of a liquid is determined by the pressure upon its surface, and thereby I am enabled to secure action of the diaphragm at a temperature lower than the normal boiling-point of the volatile liquid. The liquid is introduced into chamber S through a pipe *s*, which is then sealed, and a ring *r* serves to suspend the vessel on the wall of a room when it is desired to employ a flexible pipe or tube to connect the thermostat with the damper-operating device. The air or other fluid included in chamber T and pipe Q forms a fluid-piston, whereby the movement of the flexible wall of chamber S is communicated to the diaphragm H, and thence by the means described to the damper or transom.

The operation of the device is as follows: When the temperature in the room in which the vessel R is placed reaches a point high enough to vaporize the liquid contained in the chamber S, the expansion or vaporization of said liquid will operate to force the diaphragm U inwardly or toward the opposite wall of the chamber, and thereby compress the air in the chamber T. This air seeking escape will be forced through the connecting-tube Q and into the space *h* between the two diaphragms G and H of the regulating device, and in so doing will distend the upper diaphragm sufficiently to rock the lever and permit the damper to close, thus shutting off the draft and lowering the temperature of the room. As the temperature is lowered in the room the vapor formed in the chamber S condenses, the diaphragm U relaxes, the air flows back into the chamber T, and the lever, acting under the influence of the weight and the pressure of the air upon diaphragm H, approximates toward its normal position, thus opening the damper again and permitting the combustion in the furnace to proceed. The damper is also regulated at the boiling-point of the water inclosed in the supplemental boiler at B. When steam is generated in said boiler, it passes through pipe *b* to the chamber E, and, expanding therein, flexes both diaphragms and operates the damper-rods. When used in connection with a low-pressure steam-heating boiler, the pipe *b* is connected directly with the boiler, preferably below the water-line, the steam-pressure in the boiler operating in the same manner to raise both diaphragms and close the damper, the chamber D and the supplemental boiler D′ being omitted. It is obvious that this device may be applied to open or close a transom or operate other ventilators, the only change necessary to adapt it to operate a transom being to connect the lever K with the operating-rod of the transom.

I prefer to make vessel R much larger than the one to which the actuating-lever is connected, and I obtain an important result thereby. As is well known, the movement of a metallic diaphragm is comparatively limited, and none other than a metallic diaphragm can be used in contact with volatile liquids, as such liquids are active solvents of rubber and similar substances, and hence in the thermostat I employ a metallic diaphragm.

In the lever-actuating device I use a rubber diaphragm, as it is in contact with air and water only, and this diaphragm, being smaller and more flexible than the other, a slight movement of the diaphragm of the thermostat causes a considerable movement of the diaphragm of the damper-actuating device. Thus, where one diaphragm has four times the area of the other, a movement of one-half inch in the first will be magnified into a movement of two inches in the second, through the interposed column of air or other fluid.

It is obvious that modifications may be made of the forms of construction here described—as, for example, in the construction of the thermostat—and I have shown in Fig. 4 such a modification. In this figure the chamber S is formed by two corrugated diaphragms, both of which are flexible, their margins being secured together and inclosed within chamber T. Both of said diaphragms are distended by the vaporization of the fluid in chamber S, and operate to force the air out of chamber T. It is also obvious that the thermostat may be used with a damper or transom regulating device having only one diaphragm—as H, for example—and the provisions for actuating the damper may be omitted. They are conveniently combined, however, and it may be found convenient to use both devices in combination.

The device above described is adapted to control the temperature within a very narrow range, and I regard as the chief improvement the provisions for utilizing an air or other fluid piston interposed between the thermostat and the damper-actuating mechanism, as this improvement renders it easy to control the damper of a furnace located at a distance from the thermostat without the intervention of rod or other connecting devices, the use of which is attended with many objections. By means of this combination of the two diaphragms with the fluid-piston interposed I am able to make a rigid connection of the operating devices with the smaller and more elastic of the two, whereas, if such connection were made direct to the metallic diaphragm at any particular point, (as the center,) the diaphragm would soon be destroyed by its action under pressure, the pressure being exerted upon all its surfaces, while the resistance is only at one point where the piston is connected; but by my method the

pressure is equal upon each side of the metallic diaphragm and distributed over every point of the same, thus making it practicable to use a very light and sensitive diaphragm and still have it durable and lasting. By means of this combination I am also able to increase the movement of the piston as compared with that of the metallic diaphragm by making the piston-diaphragm relatively smaller than the other.

I claim—

1. In a heat-controlling device, the combination, with a thermostat having a vaporizing-chamber to contain a volatile liquid, said chamber having one or more flexible walls adapted to be flexed by the volatilization of the liquid, a second chamber and a pipe leading therefrom, whereby to confine a body of air or other fluid in contact with said flexible wall, and a pressure-chamber with which said pipe communicates, and having a diaphragm or other piston, and suitable operating devices actuated by said diaphragm, whereby the movement of the wall of the vaporizing-chamber is transmitted through the interposed air or other fluid column to the diaphragm of the pressure-chamber, substantially as described.

2. In a heat-regulating apparatus, a double diaphragm composed of two elastic sheets, one of which forms one wall of a pressure-chamber to operate by pressure of steam, the other designed to operate by a fluid pressure transmitted through a pipe and caused by the volatilization of a liquid vaporizing at about the temperature sought to be maintained, the diaphragms being so arranged that the effect desired is produced by the action of either cause independently of the other, substantially as described.

3. In a heat-regulating device, a vaporizing-chamber to contain a volatile liquid, a movable side or wall normally under tension, such tension tending to enlarge the vaporizing-chamber and thereby produce a lowering of the pressure upon the contents thereof and consequently a lower point of vaporization for the purpose of securing action at a lesser degree of heat, as and for the purpose specified.

4. In a heat-controlling device, the combination, with a thermostat, of a damper or ventilator actuating device comprising two diaphragms secured within a pressure-chamber and having a space between their opposing surfaces, a tube communicating with said space and with the thermostat, and a steam-generating boiler communicating with the chamber below the diaphragms, substantially as described.

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