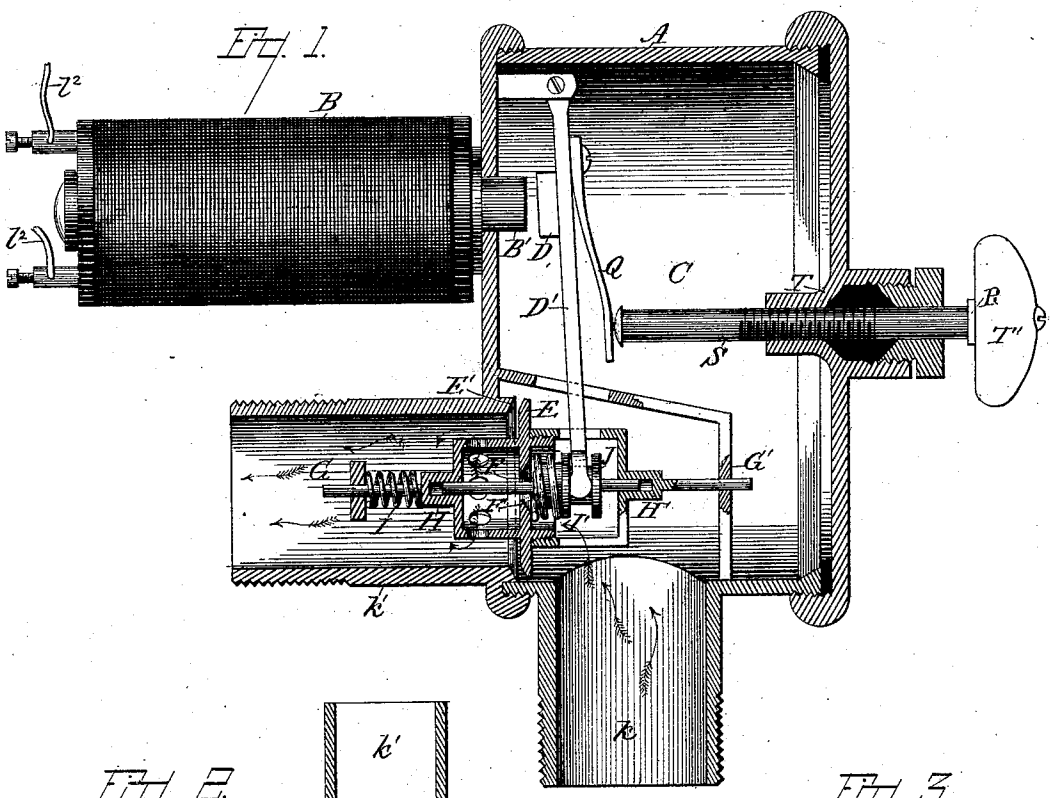
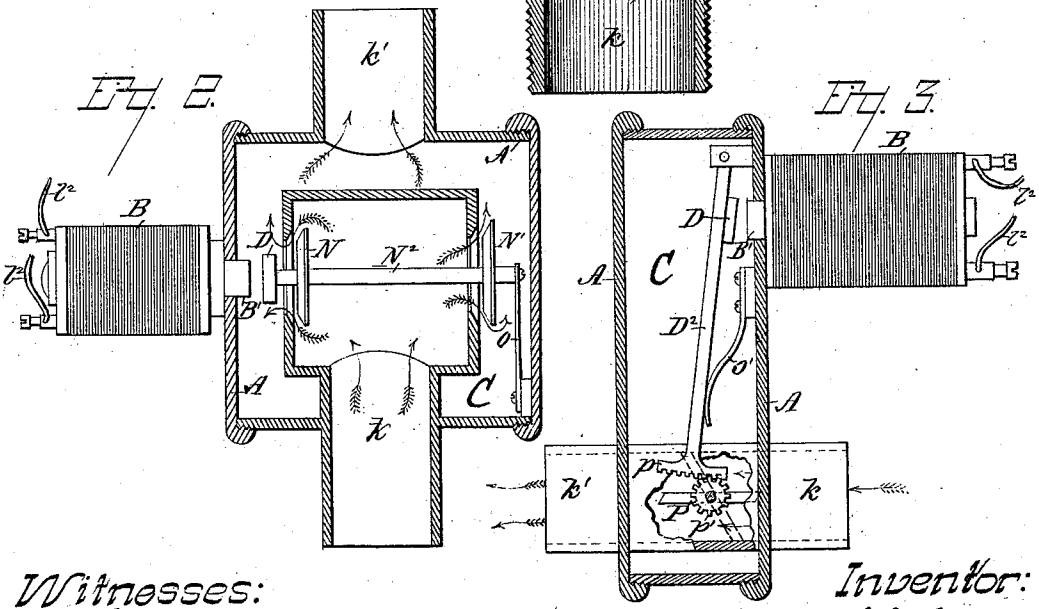
(No Model.) 2 Sheets—Sheet 1.

W. S. JOHNSON.

HEAT REGULATOR.

No. 297,937. Patented Apr. 29, 1884.





Witnesses:
E. G. Jones
R. Platz

Inventor:
Warren S. Johnson
By
Stout & Underwood
Attorneys.

(No Model.) 2 Sheets—Sheet 2.

W. S. JOHNSON.

HEAT REGULATOR.

No. 297,937. Patented Apr. 29, 1884.

Fig. 4

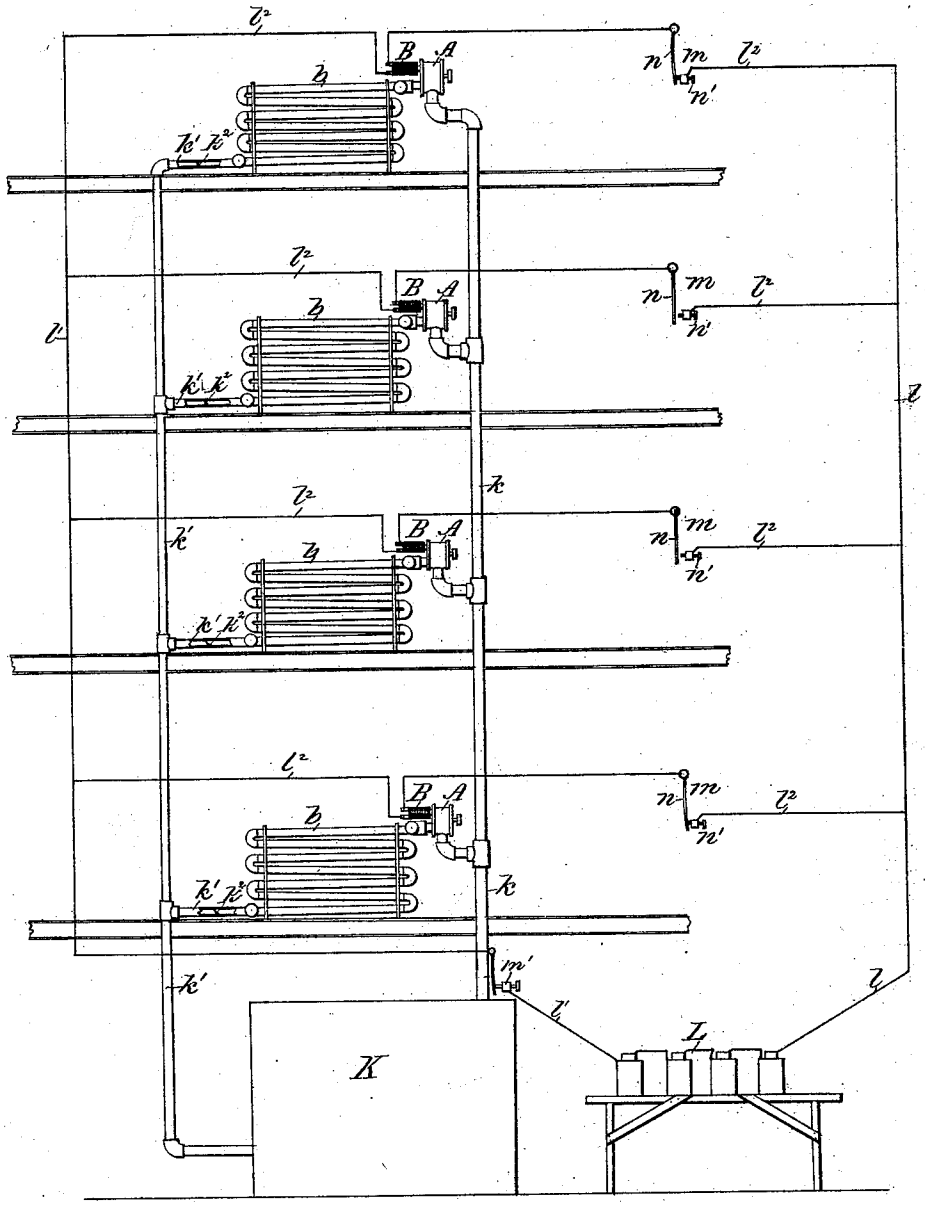
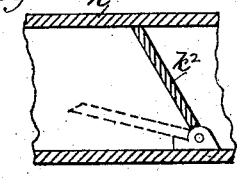


Fig. 5.



Witnesses:
E. L. Spencer
R. Platz

Inventor:
Warren S. Johnson
By
Stout & Underwood,
Attorneys.

UNITED STATES PATENT OFFICE.

WARREN S. JOHNSON, OF WHITEWATER, ASSIGNOR OF ONE-HALF TO WILLIAM PLANKINTON, OF MILWAUKEE, WISCONSIN.

HEAT-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 297,937, dated April 29, 1884.

Application filed January 18, 1884. (No model.)

To all whom it may concern:

Be it known that I, WARREN S. JOHNSON, of Whitewater, in the county of Walworth, and in the State of Wisconsin, have invented certain new and useful Improvements in Heat-Regulators; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to temperature-regulators, and will be fully described hereinafter.

The object of my invention is to provide means to control the temperature of apartments which are heated by steam, either by direct or indirect radiation, the device consisting, essentially, of the following parts, viz: a thermostat in each of the apartments heated, an electric valve to control the advent of steam into the radiators heating the apartments, and a suitable electric generator with wires leading to the thermostats and the corresponding electric valves.

In the drawings, Figure 1 is a vertical section through the center of my electric valve. Figs. 2 and 3 show modifications of the same, and Fig. 4 shows the temperature-regulator complete. Fig. 5 is a detail.

A is the valve-casing, made of any suitable non-magnetic material, such as brass.

B is an electro-magnet, whose coils are external to the steam-chamber C, but whose poles B′ project through the casing A, so as to bring the field of magnetic force within said chamber.

D is the armature of the magnet B, which is attached within the chamber C on the rear face of the lever D′, suitably hinged in the casing A to operate the valve. This consists of a main valve, E, seated at E′, and of a relief-valve, F, seated at F′ in the main valve E. The stem of the main valve E is held by the supports G and G′, through which it moves freely. The stem of the relief-valve F is supported by the main valve at H and H′. The main valve E is normally held open by the spring I, and the relief-valve F by the spring I′. The valve, as a whole, is closed by means of the lever D′, the free end of which is bifurcated to work in the spool J, which is rigidly attached to the stem of the relief-valve F. The spring I′ is much stronger than the spring I, so that when the electro-magnet is excited and draws the armature D toward it the valve E will first be seated. The armature D being now very close to the poles B′, the magnetic force will be sufficient to seat the valve F against the resilient action of the spring I′.

K is the steam-generator, *k* the inducting-pipe, and *k′* the educting-pipe, of the radiators *b b b*, located in different apartments. Each radiator is provided with one of the electric valves in the casing A, as described above, and arranged so as to shut the inducting-pipe *k* of the radiator with which it is connected when a current of electricity excites the electro-magnet B and its armature D.

L is the electric generator, and *l* and *l′* are the two main wires of the circuit, which are connected by the cross-wires l^2 l^2 l^2 l^2. Each of these cross circuit-wires includes a thermostat, *m*, and its corresponding electro-magnet B and valve in casing A—that is, with reference to the electric generator L. The several thermostats *m m* and their respective electric valves are connected in multiple arc. The thermostats may be of any of the well-known forms. In the form shown in the drawings they are composed of a compound metallic strip, *n*, which, under sufficient rise of temperature, will bend toward and touch the screw *n′*. As the metallic strip *n* and the screw *n′* are insulated from each other at other points, and as the conducting-wire l^2 is connected with *n* and *n′*, it follows that when the strip *n* touches the point of the screw *n′* a current will pass through the conductor l^2, thus exciting the magnet B and closing the valve E F. The steam now being cut off, no further rise of temperature can occur. If the temperature now falls, the metallic strip *n* and the screw *n′* will part, thus breaking the circuit and allowing the valve E F to again admit steam. In the system of heating shown there is a separate educting or return pipe, *k′*, in which case each radiator is provided with a trap or check valve, k^2, to prevent the backflow of water from the boiler to the radiator when the electric valve is closed.

Instead of the double electric valve described above, any other form of valve might be used, such as those shown in Figs. 2 and 3. Fig. 2 illustrates a double-seated balance-valve, the heads of which, N N′, are supported on the

stem N^2, and are held open by the spring *o* at one end, while they are closed by means of the electro-magnet B acting through the armature D at the other end. This valve is perfectly balanced; but it is difficult to so adjust its heads N N′ as to have them both rest firmly in their seats. The balanced butterfly-valve represented in Fig. 3, and shown both in full and dotted lines at P, is operated by the electro-magnet B, through the armature D and lever D^2, provided on its lower end with a cogged segment, *p*, that meshes with the pinion *p′*, fastened to the bearing-pin of said valve P inside the steam-chamber. The spring *o′* keeps it normally open; but I preferably use the form of valve shown in Fig. 1, the arrangement of which well answers the purpose, as will be understood from the manner of its operation in the following instance. Let it be supposed that the steam is passing through the valve in the direction of the arrows, and that the temperature of the apartment has attained a desired maximum; the thermostat *m* will close the circuit, and through the electro-magnet B will push the valves E and F to their respective seats. The steam that is in the radiator will now condense, leaving a vacuum therein. The pressure upon the valves E and F will be equal to the pressure of the atmosphere plus the steam-pressure, the two combined tending to hold the valves firmly in their seats. Should the circuit now be opened, if the valve E were solid, the spring I would not have sufficient power to force the valve from its seat to again admit steam to the radiator; but as the opening of the valve F is much smaller and the strength of its spring I′ much greater the valve F will open against the pressure. The steam now rushing through the relief-valve F will establish an equilibrium, allowing the main valve E to open and admit a new supply of steam in the radiator. If the area of the main valve E is one square inch and that of the relief-valve F one-sixteenth of a square inch, the vacuum produced in the radiator by the closing of the valve, added to a steam-pressure of five pounds, will bring the total pressure to twenty pounds against the main valve E, while that against the relief-valve F will be one-sixteenth of that, or one pound and a quarter. To overcome this latter pressure and leave the valve F free to open, the resilient energy of the spring I′ will need to be slightly in excess of one pound and a quarter. As the electro-magnet B in closing the valve F must have a force slightly in excess of that of the spring I′, it must in this case have a force exceeding one pound and a quarter, which is a very small amount, if the close proximity of the armature D to the poles B′ is considered. The further advantage of this valve lies in the fact that it is firmly seated, and that its two heads E and F work on independent stems and are not liable to leak.

It is obvious that the situation of the smaller valve, F, within the larger one, E, is a mere matter of convenience, as they could be seated in the same order and relation to each other on absolutely independent supports of their own. The essential features are, first, that one of the valves shall be much smaller than the other; second, that the larger shall be the most easily seated; and, third, that the resilient action of the spring which closes the smaller valve shall be greater than the combined pressure of steam and atmosphere upon it. In order to close the electric valve E and F when the radiator to which it is attached is not in use, as in the case where it is desired to shut off one or more rooms from the steam system, I provide the rod S, which passes through the stuffing-box T and terminates in the hand-wheel T′. The inner end of the rod S is in contact with the spring Q, which is attached to the lever D′. This spring Q has a greater resilient energy than that of the springs I and I′ combined. Therefore, when the rod S is turned so that it presses sufficiently hard upon the spring Q, the valves E and F will be fully closed, and held so until the rod is again turned out. The object of the spring Q is to prevent injury to the apparatus, as the rod S turns up against the shoulder R before the said spring presses directly against the lever D′.

To prevent an unnecessary waste of the battery when the thermostats *m* are closed by the action of a temperature that is not occasioned by the radiators *b b b*, as in the summer time, when the heating apparatus is not used, a thermostat, *m′*, is placed in the main circuit near the steam-generator, and preferably on the main pipe. This thermostat *m′* is set so as to close only at such a temperature as will be produced when the heating apparatus is in operation—say a temperature of 150° Fahrenheit—and will obviously keep the main circuit normally open.

A very important feature of my electric valve consists in the fact that it is closed wholly by the action of magnetic force, without the intervention of springs, weights, or other mechanical means. Heretofore, so far as known to me, in electric steam-valves, when the magnet was excited, the magnetic force served only to release a detent and enable the valve to be closed by the positive action of weights or springs, &c., held in check by such detent.

I have described the coils of the electro-magnet B as external to the steam-chamber, by which I mean that the said coils are wholly protected from the contact with the steam; but of course the said coils might be so introduced within the main casing of the said chamber (if protected by an independent casing) as to be technically within the chamber and yet external, so far as the steam-passage is concerned.

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

1. In a temperature-regulator, the combination, with an electric generator, of an electric

valve and of two thermostats in circuit therewith, one of said thermostats being situated close to the steam-generator, and serving to close the circuit when said generator is in use, and the other thermostat being located in the apartment which the steam-generator is intended to heat, and serving to close the circuit and actuate the electric valve, whereby the steam is shut off when the desired temperature has been attained, substantially as set forth.

2. In a temperature-regulator, the combination of an electric generator, two main conductors leading therefrom, and two or more wires in multiple-arc circuit with reference to said electric generator, each of the wires of the multiple-arc circuit containing a thermostat and an electric valve, whereby the steam is shut off from a radiator whenever the temperature in one or more apartments in which the thermostats are located has attained the desired limit, substantially as set forth.

3. In a temperature-regulator, the combination of an electric generator, two main conductors leading therefrom, two or more conducting-wires in multiple-arc circuit with said electric generator, each of said wires including a thermostat and an electric valve, and a thermostat located in the main circuit and adapted to be closed automatically by the heat of the steam-generator when it is in use, substantially as set forth.

4. The combination of an electro-magnet whose coils are external to the steam-chamber, but whose field of magnetic force lies within said chamber, the valve-chamber which is in proximity to the field of magnetic force having walls and parts of non-magnetic substance, and of a suitable valve mechanism situated within said chamber, whereby when the electro-magnet is excited by a current of electricity it will actuate the electric valve, substantially as set forth.

5. The combination, with a valve-casing containing an electric valve situated in and adapted to close a steam-passage, the said valve having an armature-lever provided with a spring, of a rod passing through a stuffing-box in said casing, and provided with a hand-wheel, whereby the end of the said rod may be forced against the spring or the lever of the armature and serve to close the valve when the radiator to which it is attached is not desired for use, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand, at Milwaukee, in the county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

WARREN S. JOHNSON.

Witnesses:
S. S. STOUT,
H. G. UNDERWOOD.