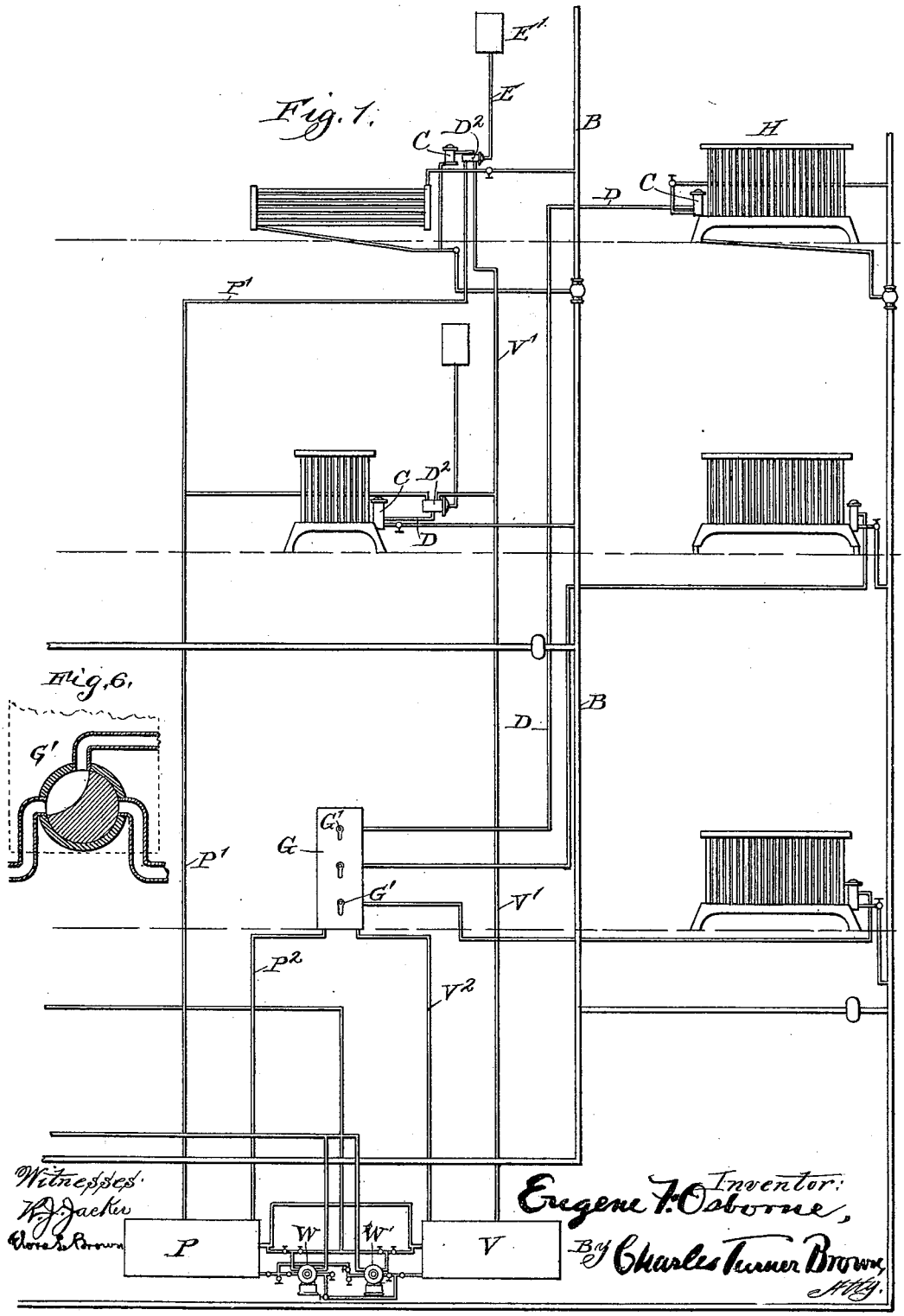
No. 645,929. Patented Mar. 20, 1900.

E. F. OSBORNE.

STEAM HEATING APPARATUS AND DEVICE FOR CONTROLLING ACTION THEREOF.

(No Model.) (Application filed Mar. 3, 1898.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses:
R. J. Jackie
Victor E. Brown

Inventor:
Eugene F. Osborne,
By Charles Turner Brown,
Atty.

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2 Sheets—Sheet 2

Fig. 2.

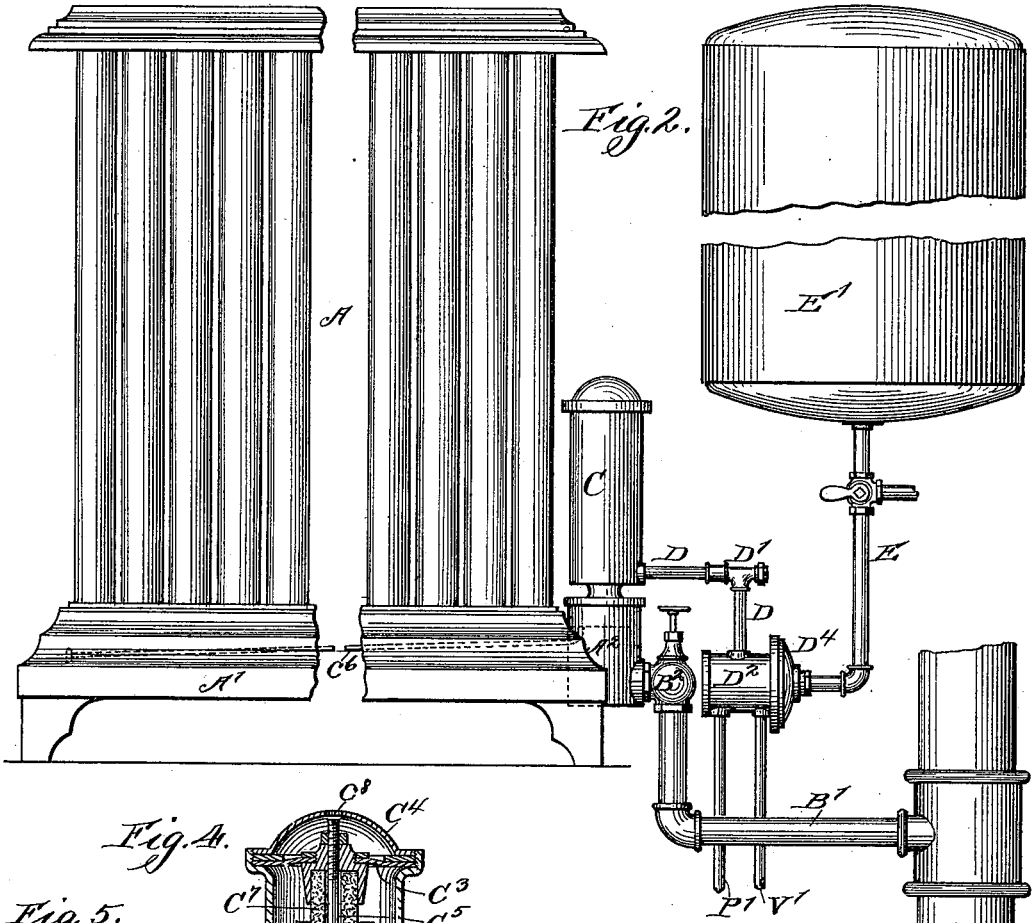


Fig. 4.

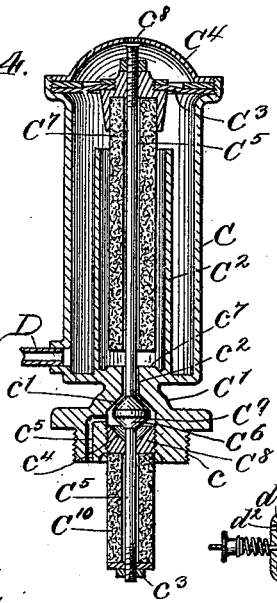


Fig. 5.

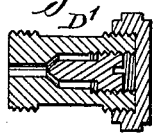
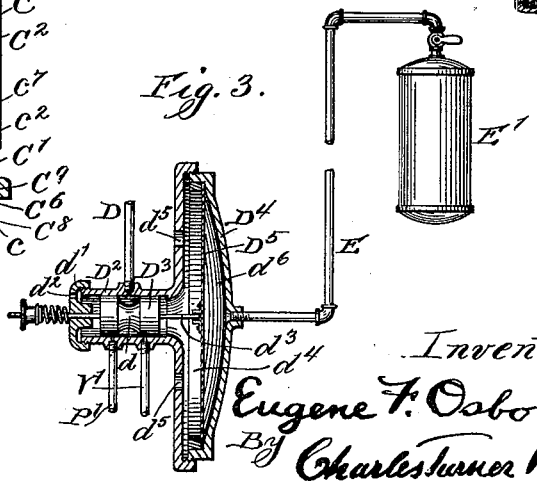


Fig. 3.



Witnesses:
W. J. Jacker.
Thos. L. Brown.

Inventor:
Eugene F. Osborne,
By Charles Turner Brown,
Atty.

UNITED STATES PATENT OFFICE.

EUGENE F. OSBORNE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE OSBORNE STEAM ENGINEERING COMPANY, OF SAME PLACE.

STEAM HEATING APPARATUS AND DEVICE FOR CONTROLLING ACTION THEREOF.

SPECIFICATION forming part of Letters Patent No. 645,929, dated March 20, 1900.

Application filed March 3, 1898. Serial No. 672,448. (No model.)

To all whom it may concern:

Be it known that I, EUGENE F. OSBORNE, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam Heating Apparatus and Devices for Controlling the Action Thereof; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, forming a part of this specification, and wherein a letter of reference applied to designate a given part is used to indicate such part throughout the several figures of the drawings wherever the same appears.

This invention relates to a steam heating apparatus and devices operating in connection therewith by means of which a novel method of regulating the transmission of heat through the walls of a chamber which is in communication with a supply of the heating or cooling agent is reduced to practice; and it consists, essentially, in the construction of devices and connecting the same to the steam heating-chamber or steam-receptacle of a heating system, (steam being preferably used and herein referred to as being the heating agent,) so that by the operation of such devices the space within the chamber or receptacle which may be occupied by such heating (or cooling) agent is varied, and I prefer to construct such devices so that the same are automatically actuated by the change in the temperature of the inclosure which is heated by the steam heating-chamber or steam-radiator.

In the accompanying drawings, Figure 1 is an illustration of the apparatus I prefer to employ to reduce to practice the method embodied in any apparatus including this invention, said figure showing two tanks at the bottom of the drawings connected with each other by means of pumps, by which air is forced from one tank to the other, so as to establish in one a pressure higher than that of the steam and in the other a pressure lower than that of the steam. This figure of the drawings also shows in full lines two pipes leading one from each of the two tanks to the neighborhood of a radiator to be regulated, where they connect with means by which the automatic regulation of the heating capacity of the radiator is effected. The figure also shows a switch by which a pipe leading from either the high or the low pressure tank may be connected with the radiator by an operator at a distant point, and other matters which will be hereinafter referred to. Fig. 2 is an enlarged view in elevation of a steam radiator or coil and attachments thereof located in the same room with the radiator, whereby the apparatus embodying this invention may be automatically operated. Figs. 3, 4, and 5 are vertical sectional details of various parts shown in elevation in Fig. 2. Fig. 6 is a vertical sectional view of a three-way cock and the pipes connected thereto, which may form elements in a steam-heating system embodying this invention.

It is well known that air occupying any part of a steam-radiator limits the space within the radiator which may be occupied by steam and proportionately limits the radiating capacity of the heater. Proceeding upon this fact, the invention proposes the introduction of air to restrict the radiating capacity of the radiator or coil and the withdrawal or discharge of such air to increase its capacity. While this method in its simple form may be performed by any suitable means operated by hand or otherwise, it is proposed in the extension and perfection of the invention to provide for the introduction and discharge of air by automatic means governed or controlled by the temperature of the room in which the radiator or coil is situated, so that after the apparatus has been properly set the steam capacity or space of the radiator or coil will be varied automatically in accordance with the demand of the apartment, so as to secure a uniform prescribed temperature of said apartment.

Describing the apparatus shown in the accompanying drawings and embodying the invention in its more complete (the automatic) form, P and V represent two tanks, which are shown in the basement or lower floor of a building.

W is an air-pump, and W' a vacuum-pump working through pipes connecting the tanks P and V. The tank P contains air under pressure above that of the steam and is here-

in called the "pressure-tank," and V contains air at a pressure less than that of the steam. As the steam-pressure will in practice commonly be at or below atmospheric pressure in the apparatus here shown, it is assumed that the tank V is below atmospheric pressure and the tank P above atmospheric pressure. The air will hence be to some degree exhausted from V, and the latter is therefore, for convenience, herein termed the "vacuum-tank."

A is a steam radiator or coil located in any apartment of a hotel or other building requiring to be heated.

A′ is a hollow base of the radiator, which, as shown in Fig. 2, is provided with a lateral extension A^2.

B is a steam-supply pipe, of which B′ is a branch leading through the valve B^2 into the extension A^2 of the base A′. The valve B^2 may be omitted.

C is a cylindric chamber the bottom of which is provided with a screw-thread *c*, which screws into the top of the chamber A^2. The bottom plate or part C′ of the cylinder C is recessed on the under side and provided with a valve-seat *c′* and with a through-passage c^2. Within the chamber C is a vertical annular flange C^2, concentric with the walls of the chamber C and preferably rising to near the top of the latter, as shown in Fig. 4. Above the flange C^2 is secured a diaphragm C^3 beneath the removable cap C^4, and to this diaphragm is attached a valve-rod C^5, provided with an enlargement or valve C^6, which approaches and recedes from the valve-seat *c′* by upward and downward movements of the diaphragm C^3. There is also secured to the diaphragm C^3 a depending tubular rod C^7, loosely surrounding the rod C^5 and of more widely expansible and contractible material than the rod C^5 under changes of temperature. This rod C^7 protrudes into the inner chamber inclosed by the flange C^2 and is adapted to fit the bottom of said inner chamber around the through-passage c^2, so as to close off the latter.

C^8 is a metal plug provided with a valve-seat c^4 and screwed into the recess in the base C′ below the valve C^6. It stands at a distance from the valve-seat *c′* greater than the vertical depth of the valve C^6, giving a valve-chamber C^9 within which the valve C^6 has vertical play.

C^{10} is a rod of metal or other material similar to that of C^7, surrounding the lower part of the valve-rod C^5, below the seat C^8, and having longitudinal passage, through which rod C^5 freely extends. Beneath the rod C^{10} the valve-rod C^5 is provided with a nut or other adjustable fastening c^3. The upper end of the valve-rod C^5 is screw-threaded through the center piece of the diaphragm, so as to be adjustable vertically.

The chamber C being screwed into the top of the lateral chamber A^2 of the radiator-base, the recess or chamber C^9, in which is located the valve C^6, has communication with the interior of the radiator-base A′ through a passage c^5, to which is attached the pipe c^6, Fig. 2, leading to the opposite end of the radiator-base. Into the side of the chamber C leads a pipe D, having, desirably, an adjusting-valve D′, (shown in detail in Fig. 5,) which pipe D connects with the chamber D^2, into which lead the pipes P′ V′, connected, respectively, with the pressure and vacuum tanks P V. Within the chamber D^2 is shown a cylindric slide-valve D^3, having a central annular groove *d*, as better seen in the sectional Fig 3. This valve is to be automatically operated, directly or indirectly, by the action of any suitable thermostat. The pipes P′ V′ enter the chamber or cylinder D^2 at a distance from each other sufficiently greater than the width of the annular groove *d* to insure the cutting off by the movement of the valve D^3 of either one of said pipes P′ V′ when the other is in communication with said groove. The pipe D enters the cylinder at a point midway of the pipes P′ V′ and is intended to be always in communication with the groove *d* of said valve D^3.

For operation of the valve D^3 by the form of thermostat shown in Figs. 2 and 3 the chamber D^2 has a cap *d′* at one end provided with an air-passage d^2 and at the other end communicates with the chamber D^4, containing diaphragm D^5, attached at its center by a rod d^3 with a sliding valve D^3. The inner chamber d^4 of the inclosure D^4, containing the diaphragm D^5, is open to the atmosphere through passages d^5 d^5, and the outer chamber d^6 of the diaphragm-holder D^4 communicates with a pipe E, with an inclosed chamber E′, containing air or other fluid which is expansible and contractible under changes of temperature. The chamber E′ is desirably made of light or thin metal, so that the outer temperature of the room containing it may promptly affect the fluid contained therein. Any expansion or contraction of the fluid in the chamber E′ serves to correspondingly move the diaphragm D^5 and to slide the valve D^3. In other words, expansion of the fluid within the chamber E′ will press inwardly upon the diaphragm D^5 and correspondingly slide the valve D^3 so as to bring the central groove *d* thereof into communication with the pipe P′, and thus allow air from said pipe and the pressure-tank P to pass through the valve into the pipe D and thence into the chamber C. The opposite movement of the diaphragm resulting from a contraction of the fluid contents of the chamber E′ slides the valve D^3 in the opposite direction and through the same duct places the chamber C into communication with the pipe V′ and the tank V. Suppose the valve B^2 be opened and the room cold. The valve D^3 is consequently drawn back by contraction of the contents of E′, so as to give communication between the chamber C and the vacuum-tank V. The diaphragm C^3 being exposed on

its upper side to a pressure which is greater than that of the tank V, (such greater pressure being in this case that of the atmosphere entering through an opening c^8 in the cap C^4,) the valve-rod C^5 and the expansible tubular rod C^7 are depressed by the diaphragm, bringing the valve C^6 against the lower seat c^4. The rod C^5 is so adjusted in the diaphragm that when at the temperature assumed the valve C rests upon its lower seat the lower end of the rod C^7 will approximate but not touch its seat c^7. There is therefore escape for the air in the radiator through the pipe c^6, passage c^5, valve-chamber C^9, opening c^2 and beneath and around C^7, outward into the pipe D, and thence through valve D^2 and pipe V' into tank V. The steam is therefore free to enter the radiator. In doing so it occupies first that portion of the radiator adjacent to its admission-pipe and advances farther as the air is expelled thereby. In the entrance of the steam it has heated and expanded the lower tubular rod C^{10}, but without so far affecting the operation, because it was previously dropped away from its abutment C^8. If the steam shall continue to enter until it has filled the radiator and begins to pass out behind the air through the various passages above indicated, it comes in contact with the highly-expansible rod C^7 and quickly expanding the latter causes it to seat at the bottom and to thus close the outlet c^2, so that no steam shall enter the tank V. The parts of the apparatus brought to these positions will remain stationary so long as the valve D^3 gives the communication last above stated and that will be until the room is heated to the desired temperature. When this temperature of the room is reached, the thermomstat will have brought the valve D^3 to its middle position, (in accordance with previous adjustment,) shutting off both pipes P' and V'. A further increase of the temperature in the room moves the valve D^3 still farther, until the pipe P' is brought into communication with the pipe D and the chamber C. The pressure from said tank then lifts the diaphragm C^3 and raises all the parts connected therewith until the expanded rod C^{10} strikes the plug C^8, allowing the valve C^6 to proximate, but not to quite bear upon its seat c', in accordance with previous adjustment of the nut c^3. There is now afforded an inlet for air from the pressure-tank P through the pipe D and downwardly around the rod C^7 into the base of the radiator through the pipe c^6. The air thus admitted being of higher pressure than the steam displaces the latter, forcing it into the supply-pipes B' and B. If the cool air shall entirely fill the radiator and shall reach the lower rod C^{10}, it will quickly cool and contract the latter, and thus allow the valve C^6 to promptly seat upwardly by upward pressure of the air against the diaphragm, and to thereby cut off further admission of air, which might otherwise continue to enter and occupy the steam-pipes. The parts in the valve apparatus C C^6, &c., will remain in the position described as long as the valve D^3 gives communication with the pressure-tank. The cooling of the room first shifts the valve D^3 to its central position, cutting off the pipes P' and V', and further cooling the room will shift the valve D^3 into the position at which we started in describing the operation, after which the same cycle of events may succeed. From the foregoing description it is manifest that the radiator need never be entirely filled with or emptied of air, but that more or less air will be caused to occupy the radiator, according to the position of the valve D^3, which depends for its position upon the thermostat or temperature of the room.

Other forms of thermostat or means of moving the valve D^3 through the action of the changes in temperature of the room may be employed. Other forms of valves answering to the chamber C and its contents and connections and generally other mechanisms may be employed in place of those herein shown for performing the novel method herein described.

In Fig. 1 is shown a switch G, consisting of a three-way cock G', by which a single pipe D, extending from the chamber C to the switch, may be connected directly with either tank P or V and steam let on or off a radiator H or a system of radiators from a central point—as, for example, the office of a hotel in which the apparatus is located.

In the employment of a suitable switch cock or cocks located at a distance from the radiator to be controlled and in connection with the pipes P' and V' by connecting both pipes P' V' with the vacuum-tank the above-assigned object of the thermostat is defeated and the radiator would always be kept full of steam. On the other hand, by a reversal of this connection, or, in other words, by connecting both pipes P' and V' with the pressure-tank, the assigned action of the thermostat would be similarly defeated and steam would be permanently excluded from the radiator.

The method embodied in the apparatus above set forth is manifestly applicable to refrigeration as well as heating through the medium of the walls of a chamber into which is supplied a liquid or gas of lower temperature than the air or other substance surrounding the chamber.

It is evident that in this invention the pressure-tank P, containing air at a pressure greater than the pressure of the steam used in the heating system, when put into communication with a radiator of the system, is a source of air-supply thereto and that the reduced-pressure or vacuum tank V, containing air at a pressure less than the pressure of the steam in the radiator, when put into communication with a radiator, is an exhaust device thereto.

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

1. In a steam heating apparatus, the combination of a radiator provided with an air-inlet, communicating with an air-supply having a pressure greater than the pressure of the steam used in the apparatus, a steam-supply pipe discharging into the radiator, a reduced-pressure pipe communicating with the radiator above the discharge end of the steam-supply pipe and at the end of the radiator opposite to such discharge end, automatic means for opening the air-inlet to the air-supply and closing the reduced-pressure pipe to the radiator, and when oppositely operated, for closing the air-inlet and opening the radiator to the reduced-pressure pipe, and an expansible member actuated, by heat, to close the opening from the radiator to the reduced-pressure pipe; substantially as described.

2. In a steam heating apparatus, provided with an air-supply having a pressure greater than the pressure of the steam in the system and an air-supply having a pressure less than the pressure of such steam, the combination of a radiator provided with passage-ways communicating with both such air-supplies, a steam-supply pipe communicating with the radiator, temperature-controlled means for closing the passage-ways between the radiator and both air-supplies and for opening the passage-way from one or the other of such air-supplies to the radiator, and additional temperature-controlled mechanism for closing the passage-way from the radiator to the air-supply having a pressure greater than the pressure of the steam, when the radiator is filled with air, and for closing the passage-way from the radiator to the air-supply having a pressure less than the pressure of such steam when the radiator is filled with steam.

3. In a steam heating apparatus, the combination of a radiator provided with an air-inlet communicating with an air-supply having a pressure greater than the pressure of the steam used in the apparatus, a steam-supply pipe discharging into the radiator, a reduced-pressure pipe communicating with the radiator above the discharge end of the steam-supply pipe and at the end of the radiator opposite to the discharge end of the steam-supply pipe, automatic means for opening the air-inlet to the air-supply and closing the reduced-pressure pipe to the radiator, and, when oppositely operated, for closing the air-inlet and opening the radiator to the reduced-pressure pipe, and a thermostat device comprising a chamber provided with a passage-way to the shifting valve of the air-inlet and reduced-pressure pipes and also provided with a passage-way to the radiator, a diaphragm in such chamber, a valve moved by the movement of the diaphragm to open and close such passage-way to the radiator, and expansible members, one thereof, in the chamber having the diaphragm therein, expanding to close, independently of the diaphragm, such passage-way to the radiator, and the other, in the steam-supply passage-way, expanding to open, independently of the diaphragm, such passage-way to the radiator; substantially as described.

4. In a steam heating apparatus, a radiator, a reduced-pressure pipe and an air-supply pipe, a shifting valve arranged to alternately open and close such pipes, a steam-supply pipe, and a thermostat device comprising a chamber provided with a passage-way to the shifting valve of the air-inlet and reduced-pressure pipes and also provided with a passage-way to the radiator, a diaphragm in such chamber, a valve moved by the movement of the diaphragm to open and close such passage-way to the radiator, and expansible members, one thereof, in the chamber having the diaphragm therein, expanding to close, independently of the diaphragm, such passage way to the radiator, and the other, in the steam-supply passage-way, expanding to open, independently of the diaphragm, such passage-way to the radiator; substantially as described.

5. A temperature-regulating device for heating systems, comprising a controlling device for connecting the radiator with either a source of air-supply or an exhaust device, said controlling device responsive to varying temperature in the apartment controlling the heating; and automatic means, independent of the temperature-controlled device, for controlling the exhaust or the admission of the air to the radiator, so as to limit the supply of air and steam thereto to the capacity of such radiator.

6. In a temperature-regulating device for heating systems, provided with a temperature-controlled air supply and exhaust apparatus, automatic means, independent of the temperature-controlled apparatus, for controlling the exhaust or admission of the air to the radiator as to limit the supply of air and steam thereto to the capacity of such radiator.

In testimony whereof I hereunto set my name in the presence of two witnesses.

EUGENE F. OSBORNE.

In presence of—

CHARLES TURNER BROWN,
EARLE CLARKE.