No. 645,581. Patented Mar. 20, 1900.

C. E. VAN AUKEN.

TEMPERATURE REGULATING APPARATUS FOR STEAM HEATING SYSTEMS.

(Application filed July 5, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1

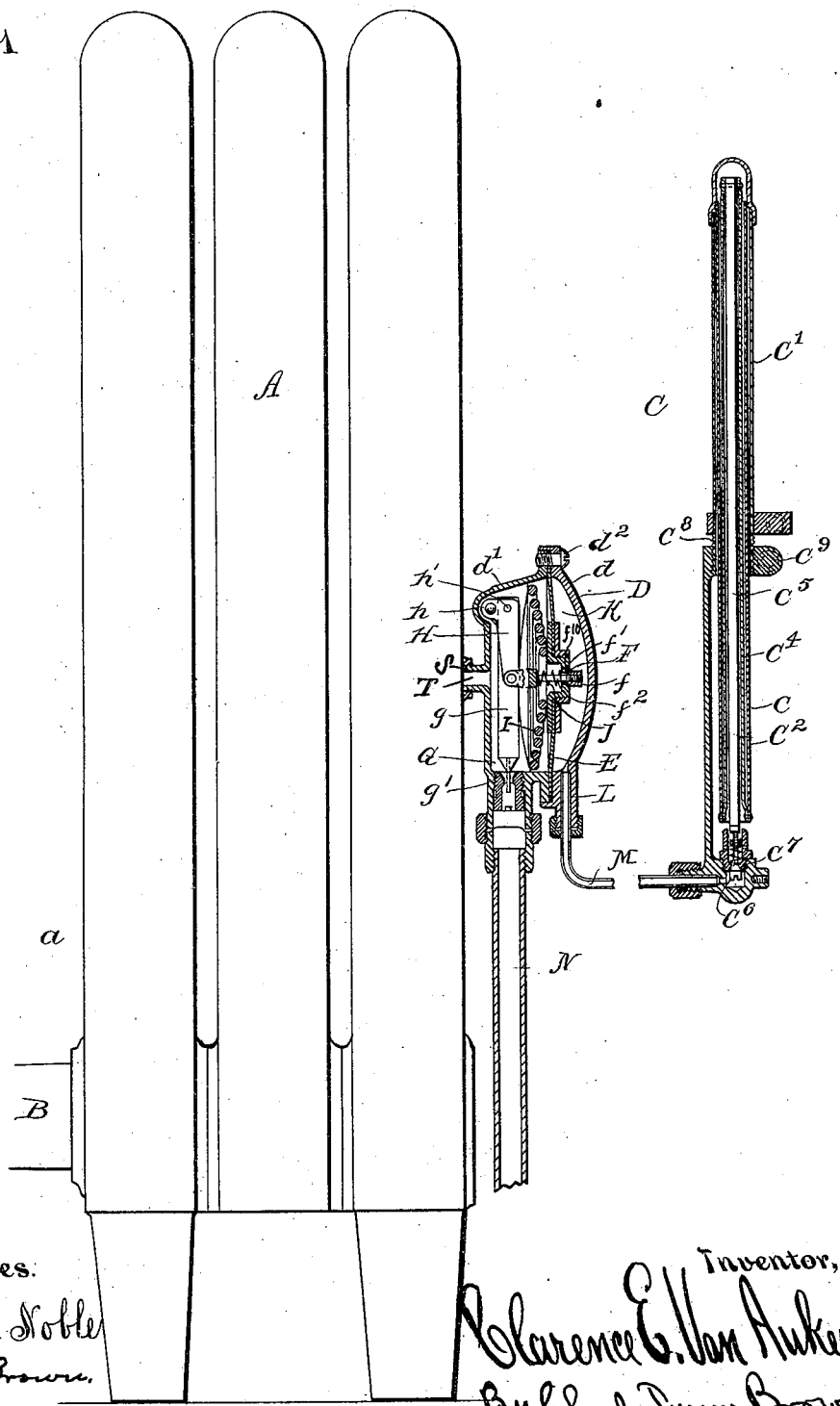

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Fig. 2

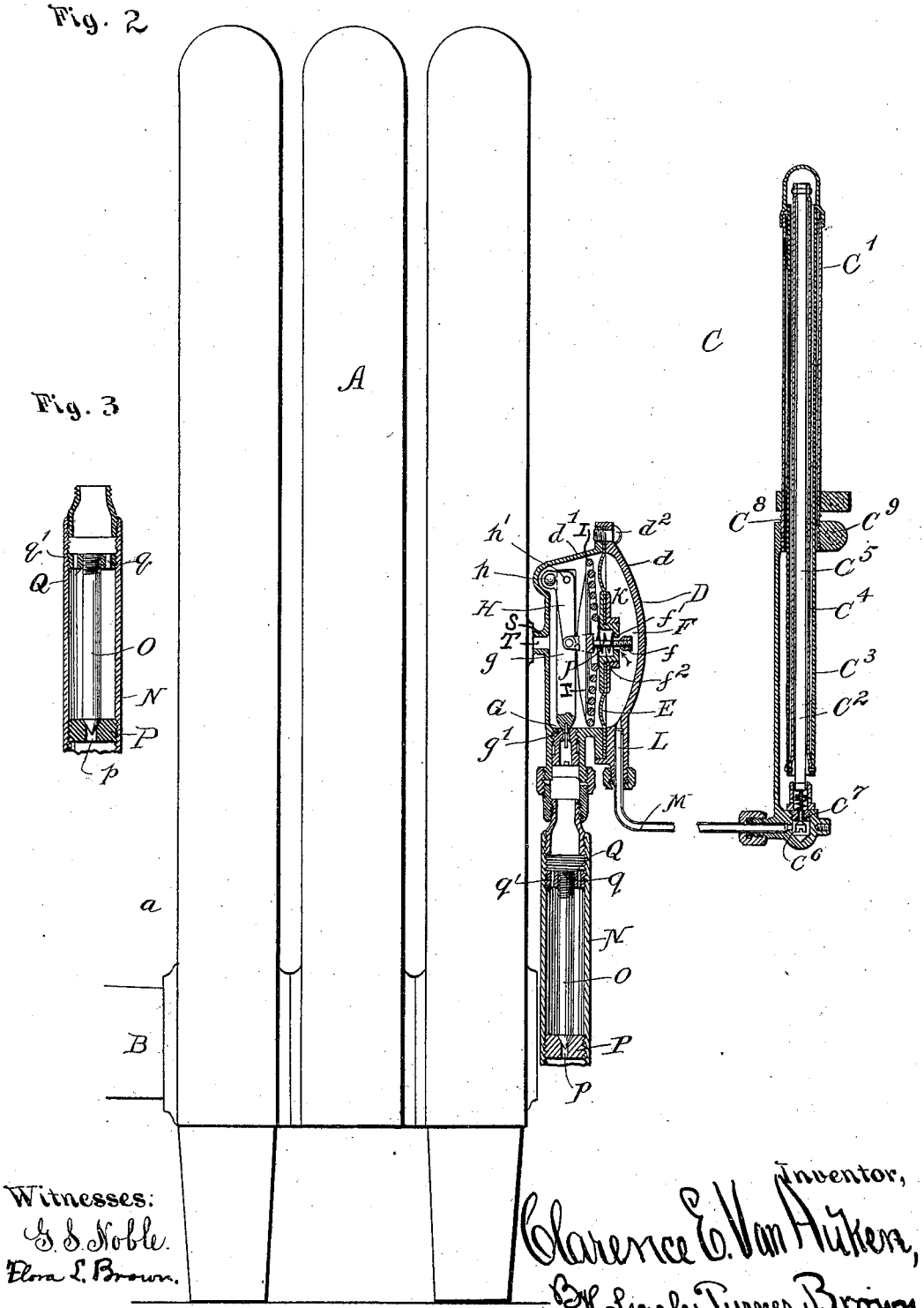

Fig. 3

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Fig. 4

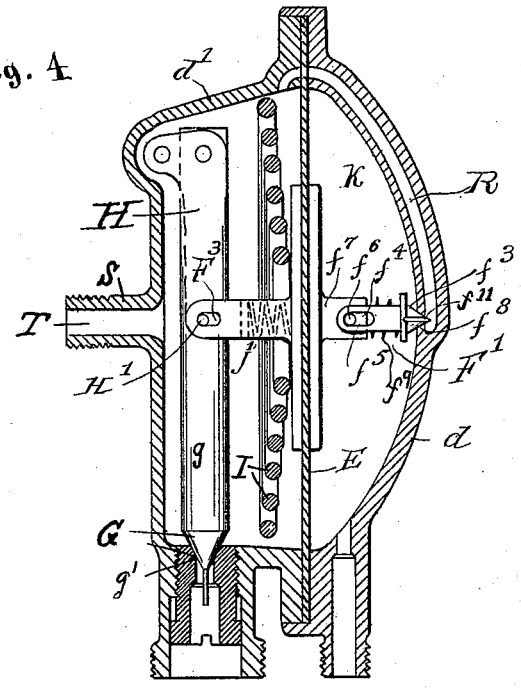

Fig. 5

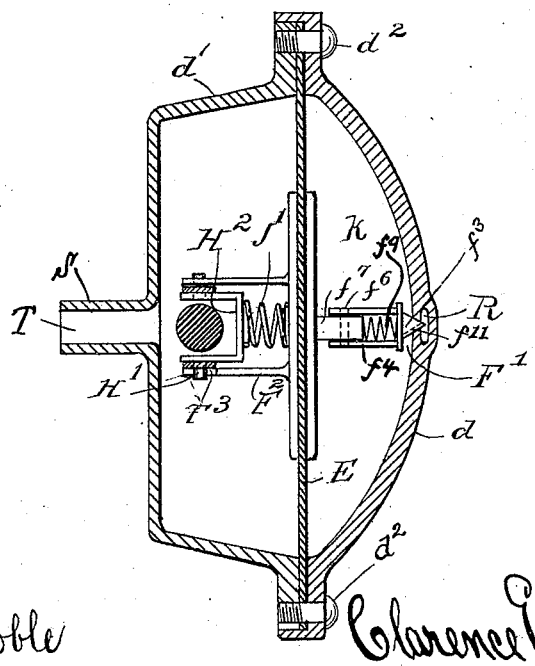

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Fig. 6

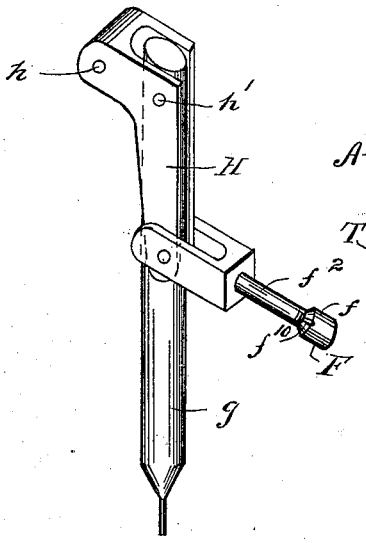
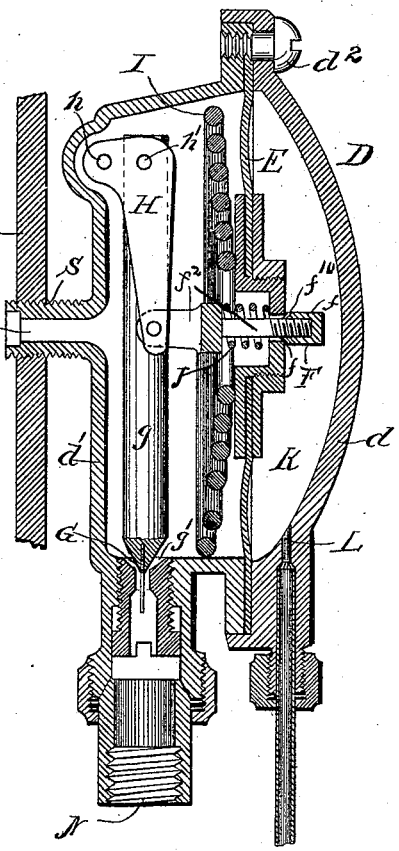


Fig. 7



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UNITED STATES PATENT OFFICE.

CLARENCE E. VAN AUKEN, OF CHICAGO, ILLINOIS.

TEMPERATURE-REGULATING APPARATUS FOR STEAM-HEATING SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 645,581, dated March 20, 1900.

Application filed July 5, 1899. Serial No. 722,843. (No model.)

To all whom it may concern:

Be it known that I, CLARENCE E. VAN AUKEN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Temperature-Regulating Apparatus for Steam-Heating Systems, of which the following, when taken in connection with the drawings accompanying and forming a part hereof, is a full and complete description, sufficient to enable those skilled in the art to which it pertains to understand, make, and use the same.

The object of this invention is to obtain a temperature-regulating apparatus for use on steam-heating systems wherein the radiators or steam-heating coils are connected to a steam-supply and at times, depending upon the temperature of the room containing the same, are connected to a reduced-pressure pipe and an air-supply having a pressure greater than the pressure of the steam used in the system and at times are disconnected from such reduced-pressure pipe and also from such overpressure air-supply, such temperature-regulating apparatus determining by its automatic operation whether the radiator shall be in communication with the reduced-pressure pipe or with the air-supply, and thereby the radiator supplied with steam or air at a pressure greater than the pressure of the steam to variably determine the actively-operating heating-surface of the radiator.

I have illustrated the invention applied to a steam-heating system wherein the steam used is at a pressure less than atmospheric (say three inches) and the air-supply is at atmospheric pressure; but the operation is the same as if the steam-supply were above atmospheric pressure and an air-supply of correspondingly-greater pressure were used, the reduced-pressure pipe being in every instance connected to an apparatus producing a pressure less than the pressure of the steam used.

In the drawings referred to and forming a part of this specification, Figure 1 is an elevation of a radiator having attached thereto a temperature-regulating apparatus embodying this invention, such apparatus having a thermostat device attached thereto, the valve actuated and controlled by the expansible member of the thermostat device being closed, the air-valve of the apparatus closed, and the reduced-pressure-pipe valve open, the several parts being in the position thereof obtaining when the room or chamber in which the radiator and apparatus are placed is cold; and Fig. 2 an elevation of such radiator and temperature-regulating apparatus in position with the thermostat thereof open—that is, the valve controlled by the expansible member of the thermostat device off its seat—the air-valve of the apparatus open, and the reduced-pressure-pipe valve closed, the several parts being in the position thereof obtaining when the actively-operating radiating-surface of the radiator is being reduced by the operation of the temperature-regulating apparatus. There is also shown in Fig. 2 a vertical sectional view of the thermostatic valve illustrated in Fig. 3 in its operative relation to the other parts of the apparatus. Fig. 3 is a vertical sectional view of an expansible member forming a valve. Fig. 4 is a vertical sectional view, on an enlarged scale, of a modification of the apparatus shown in Figs. 1 and 2, and Fig. 5 is a horizontal sectional view of such modification. Fig. 6 is a perspective view of the valve-plug shown in Figs. 1, 2, 4, and 5, showing the parts adjacent thereto and to which it is attached. Fig. 7 is a vertical sectional view, on an enlarged scale, of the valve mechanism of Figs. 1 and 2, showing particularly a groove in the valve-plug, which is mounted on the movable diaphragm, dividing the casing into two chambers, such groove forming a leakage for fluid from one of the chambers K of the casing to the other chamber thereof.

A reference-letter applied to indicate a given part is used to designate such part throughout the several figures of the drawings wherever the same appears.

A is a radiator. *a* is the steam-supply end thereof.

B is the steam-supply inlet to the radiator.

C is a thermostatic device hereinafter fully described.

D is a combined air and reduced-pressure-pipe valve apparatus comprising a diaphragm E, air-valve F, reduced-pressure-pipe valve G, yoke H, and springs I and J. Valve-plug

g of valve G may be an expansible member where expansible member O, Figs. 2 and 3, is desired to be dispensed with.

The shell or casing of the combined air and reduced-pressure-pipe valve D is composed of the parts d d', joined together by bolts d^2 d^2, with the diaphragm E dividing the shell or casing into two chambers, one of such chambers (lettered K) having inlet L, from which chamber air is discharged through the air-valve F to the chamber on the opposite side of the diaphragm E and from thence to the radiator A. Air-inlet L is connected to (in communication with) the thermostat device C, as by conduit or pipe M. Air-valve F is composed of the valve-plug f, valve-seat f', stem f^2, and spring J. The valve-seat f' is mounted on diaphragm E, preferably consisting of a metal plate (in the construction illustrated in Figs. 1 and 2) having a hole therethrough, so that the valve-plug f is on one side of the diaphragm and the valve-stem f^2 is on the other side of the diaphragm. Stem f^2 is connected to the yoke H. Spring J is mounted on the stem f^2, tending to hold the valve-plug f to its seat f'—that is, with the valve F closed. f^{10} is a leakage passage-way on valve-plug f.

Yoke H is fulcrumed, as at h, to the shell or casing of the apparatus, and one end of the valve-plug g is attached to and carried by such yoke, as at h'. Spring I is arranged to yieldingly hold the diaphragm E extended into the chamber K, thereby opening the reduced-pressure-pipe valve G.

g' is the valve-seat of valve-plug g, the two constituting reduced-pressure-pipe valve G. The seat g' is adjustable with reference to the valve-plug g, and when the apparatus is in operative adjustment such seat is in such relation to the valve-plug that when the valve-plug is retracted by the movement of the diaphragm E, as hereinafter described, the valve is open, while at such time or when in such retracted position (if the valve-plug forms also the expansible member) it is extended when heated, as by steam, to come into contact with seat g', thereby closing valve G.

N is the reduced-pressure pipe.

O is an expansible member.

P is the seat of expansible member O, having aperture p therethrough, which is closed by the extension of expansible member O by heat and opened by its retraction when cooled, (not surrounded by steam.)

Q is the base of expansible member O, having passage-ways q q therethrough. Base Q is adjustable, as by screw-threads q', relative to seat P.

When the valve-plug g is also an expansible member—that is, when constructed of rubber or like material expanding when heated by steam more than does the shell of the apparatus—the expansible member O, valve-seat P, and base Q are dispensed with. When the expansible member O, valve-seat P, and base Q are used, they may be located in reduced-pressure pipe N at any desired point relative to apparatus D as, say, at the place where the same is shown in Fig. 2.

The quantity of air supplied chamber K through the inlet L thereof is controlled by the thermostat device C. The expansion of the expansible member of such thermostat device C tends to open the device to the admission of air therethrough to passage-way L, and the contraction of such expansible member (by cold) tends to close the device to the admission of air therethrough to such passage-way L. The thermostat device C is therefore adjusted, so that when the temperature surrounding it is a given number of degrees above the determined temperature of the room whereof the warming is controlled by the thermostat device and radiator connected thereto the expansible member is expanded to admit air freely therethrough and into the passage-way L and chamber K, and when the temperature surrounding the thermostat device is a given number of degrees lower than the temperature determined on the expansible member of such thermostat device is retracted to admit no air therethrough and to the chamber K.

Assuming the radiator of the apparatus to be in operation with steam therein and the room (and the air surrounding the thermostat device) to be above the temperature determined upon, thermostat device C will be closed by the expansion of its expansible member, so that less air is admitted therethrough and through passage-way L into chamber K, that passes by leakage through the valve F into the radiator, and equalization of the pressure on both sides of the diaphragm E will soon occur, at which time the diaphragm will be extended into chamber K by spring I.

When the reduced-pressure-pipe valve G is closed by heat (the valve-plug g being an expansible member) and the diaphragm E is extended into the chamber K by the spring I, the reduced-pressure-pipe valve G is closed and the air-valve F is closed, or nearly so. The spring I will maintain the diaphragm E extended in chamber K so long as the pressure in chamber K is substantially the same as the pressure obtaining in the radiator, and the pressure in the chamber K will remain substantially the same as in the radiator so long as more air is not supplied to such chamber through inlet L than can pass, as by leakage, through valve F—that is, when the valve F is wholly closed (with diaphragm E extended into chamber K) and air is supplied to such chamber through inlet L in quantity greater than can pass by leakage through valve F, as through passage-way f^{10}, such air will in time raise the pressure in such chamber, so that the diaphragm E will be thereby forced back against the resiliency of spring I, opening the valve F, (by moving the seat f^2 away from the valve f,) yoke H and valve-plug f being maintained in an advanced position by the expan-

sion of valve-plug g, as hereinbefore described. Such oversupply of air relative to the leakage capacity of valve F is obtained by the expansion of the expansible member of thermostat-valve C when the room in which the radiator and thermostat device are placed becomes warmer than the determined temperature at which the apparatus is set. As the valve F is opened by such oversupply of air air from chamber K will be discharged into the radiator A and will continue to be so discharged (thereby forcing the steam in the radiator back into the supply-pipe thereof or at least replacing steam reduced to water of condensation by such air) so long as the supply of air from air-inlet L is as great as the discharge of air through valve F. The air discharged through valve F will of course cool the valve-plug g, (it being an expansible member,) which will thereupon retract, and as such retraction of such expansible member occurs the spring J (retracted by the retraction of the diaphragm E, against which one end of such spring abuts) will expand and the valve-plug g will continue seated on seat g', preventing the discharge of air or steam to the reduced-pressure pipe N through valve G. The air thus admitted to the radiator acts as a fluid-piston, forcing the steam therein contained back into the steam-supply pipes of the system or at least replacing the steam converted into water of condensation by radiation from the radiator. The radiator and room in which it is placed are thus cooled, the expansible member of the thermostat device C is retracted, and the admission of air through such thermostat device and inlet L is restricted. When the room has become cooled below the determined temperature, the admission of air through the thermostat device C and inlet L into the chamber K will be less than will pass through the valve F, as by leakage.

When the supply of air through the air-valve F is greater than the discharge of air into the chamber K from air-inlet L, the diaphragm E will gradually be extended into chamber K, as first above described, by the pressure in such chamber becoming the same as the pressure in the radiator, when spring I forces the diaphragm E into its extended position. Such forcing of the diaphragm E into an extended position first closes valve F and thereafter, if such expansion continues, raises the plug g off its seat g' by means of the saddle H and again establishes communication between the radiator A and the reduced-pressure pipe. The air in the radiator will commence to flow into the reduced-pressure pipe and the radiator again become filled, or partially so, with additional steam. The operation of the apparatus, as described, may continue indefinitely, the variation in temperature in the room warmed by the radiator and around the thermostat device C not being necessarily more than 1° or 2° to obtain the operation described.

In the modification illustrated in Figs. 4 and 5 the valve F, discharging through the diaphragm E, is taken out and replaced by the valve F′, discharging around such diaphragm, the construction remaining the same otherwise. The substitution of valve F′ for valve F necessitates the closing of the aperture in diaphragm E. In this modification valve F′ comprises valve-plug f^3, having stem f^4, provided with slots f^5 f^5, into which slots the projections f^6 f^6 on base f^7 extend, valve-seat f^8, discharging into by-pass R, and spring f^9. By-pass R extends from one side of diaphragm E to the other side thereof—that is, from chamber K to the other side of the diaphragm. f^{11}, Figs. 4 and 5, is a leakage passage-way on valve-plug f^3. Diaphragm E in this modification is connected to the yoke H by arms F^2 F^2, provided, respectively, with slots F^3 F^3, into which slots projections H′ H′ on yoke H respectively extend, and spring J′, abutting at one end against the diaphragm E and at the other end against bar H^2 on yoke H.

When constructed as last above described, the air-valve F and the reduced-pressure valve G will in the movement of diaphragm E from an extended to a retracted position or from a retracted to an extended position both be closed, as illustrated in Figs. 4 and 5. Both of such valves being, as illustrated, closed, further expansion of the diaphragm will open reduced-pressure-pipe valve G, with the valve F′ remaining closed, (projections f^6 f^6 moving in slots f^5 f^5 and spring f^9 being compressed,) and further retraction of such diaphragm E opens valve F, valve G remaining closed, the arms F^2 F^2 moving toward the yoke H, with projections H′ H′ moving in slots F^3 F^3, respectively, and compressing springs I and J′.

It occurs from the above-described operation of the apparatus that air-valve F (or valve F′) and valve G cannot be both open at the same time where the valve-plug g is an expansible member, but on the contrary must be alternately opened. The same thing occurs relative to the alternate opening and closing of the valve F (and valve F′) and the valve formed by the expansible member O and its seat P, where the valve-plug g is not an expansible member and such expansible member O, with seat P, are used.

The construction of the thermostat device C, controlling the admission of air through inlet L into the chamber K, forms no essential part of this invention, but may well consist of the shell C′, expansible member C^2, (shown as a compound member comprising expansible tube C^3, non-expansible tube C^4, and expansible rod C^5,) valve-plug C^6, valve-seat C^7, and adjusting screw-threads C^8 on the lower end of the base thereof fitting corresponding screw-threads in bracket C^9.

The part d' of the shell or case of the temperature-regulating apparatus is attached to the radiator by the screw-threaded projection

S in the ordinary way of attaching air-valves to radiators. Projection S has passage-way T therethrough.

When valve-plug *g* of the the reduced-pressure pipe G is not an expansible member and the diaphragm E is extended into the chamber K by the spring I, air-valve F is closed, or nearly so, the reduced-pressure-pipe valve G is not closed, and steam passing through the reduced-pressure-pipe valve G may and ordinarily will extend to the expansible member O, which will be thereby expanded, closing it upon its seat P, the radiator being closed thereby to steam passing therefrom into the reduced-pressure pipe. When in the last above described case air is discharged into chamber K through inlet L thereof faster than air passes from such chamber (as by leakage) through air-valve F into the radiator, the pressure in the chamber K will gradually become greater than the pressure in the radiator and will overcome the resiliency of the spring I, thereby forcing the diaphragm E back, and valve F (yieldingly held closed to such diaphragm by spring J) will be carried back by such diaphragm until the valve-plug *g* becomes seated on valve-seat *g'*, thereby closing valve G and preventing steam or air from passing therethrough into the reduced-pressure pipe N, and thereafter further backward movement of the diaphragm E will open the air-valve F by such diaphragm and valve-seat *f'* moving (against spring J on stem f^2) away from valve-plug *f*, such valve-plug being held stationary by yoke H and valve-plug *g*. Air may at such time pass from chamber K, as hereinbefore described.

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

1. In a temperature-regulating valve apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm, such casing divided by the diaphragm into two chambers, one of such chambers communicating with the radiator and being provided with means for communicating with a source of pressure less than the pressure of the steam used in the system and the other of such chambers being provided with means for communicating with a source of pressure greater than the pressure of such steam, a thermostatic valve controlling such means, such chambers provided with a communicating passage-way and a valve-seat, and a leaky valve coöperating therewith controlled by the diaphragm, and suitable connection between the first and last named valves; substantially as described.

2. In a temperature-regulating apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm in the casing dividing such casing into two chambers one of the chambers communicating with the radiator and being provided with an outlet having a valve-seat thereto, a valve coöperating with such valve-seat, mechanism by means of which such valve is extended to close on the seat and retracted to move from the seat, and the other of such chambers being provided with an inlet, means for holding the diaphragm yieldingly extended into the last-named chamber, a valve-seat and a leaky valve coöperating therewith controlled by the diaphragm, and a connection between the stem of such leaky valve and the mechanism on which the first-named valve is mounted; substantially as described.

3. In a temperature-regulating apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm in the casing dividing such casing into two chambers, one of such chambers communicating with the radiator and being provided with an outlet having a valve-seat thereto, a valve coöperating with such valve-seat, mechanism on which such valve is mounted and a connection between such mechanism and the diaphragm, such other chamber provided with a thermostatically-controlled opening for communicating with a source of air-supply of greater pressure than the pressure of the steam in the radiator, and such chambers provided with a communicating passage-way and a valve-seat, and a leaky valve coöperating with the valve-seat; substantially as described.

4. In a temperature-regulating apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm in the casing dividing such casing into two chambers, such chambers provided with an automatically-controlled communication therebetween, one of such chambers communicating with the radiator and being provided with an outlet having a valve-seat thereto, an expansible member expanding by heat to close the outlet, a valve coöperating with the valve-seat of the outlet, mechanism on which such valve is mounted and a connection between such mechanism and the diaphragm; substantially as described.

5. In a temperature-regulating apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm in the casing dividing it into two chambers, one of such chambers communicating with the radiator and being provided with an outlet having a valve-seat thereto, an expansible member expanding by heat to close the outlet, a valve coöperating with the valve-seat of such outlet, and the other of such chambers provided with an inlet, thermostatic means for controlling the quantity of air delivered into the chamber through such inlet, a communicating passage-way between the chambers and such communicating passage-way being provided

with a valve-seat, a valve coöperating with such valve-seat, and a connection between the valves; substantially as described.

6. In a temperature-regulating apparatus for a steam-heating system, the combination of a casing provided with means for attaching it to a radiator, a diaphragm in the casing dividing it into two chambers, such chambers provided with a communicating passage-way having a valve-seat thereto in one of such chambers, a valve coöperating with the valve-seat, means for yieldingly holding the diaphragm extended into one of the chambers with the valve closed on its seat, and thermostatic-controlled means for delivering air into the chamber to force the diaphragm into a retracted position opening the valve from its seat; substantially as described.

CLARENCE E. VAN AUKEN.

In presence of—
CHARLES TURNER BROWN,
FLORA L. BROWN.