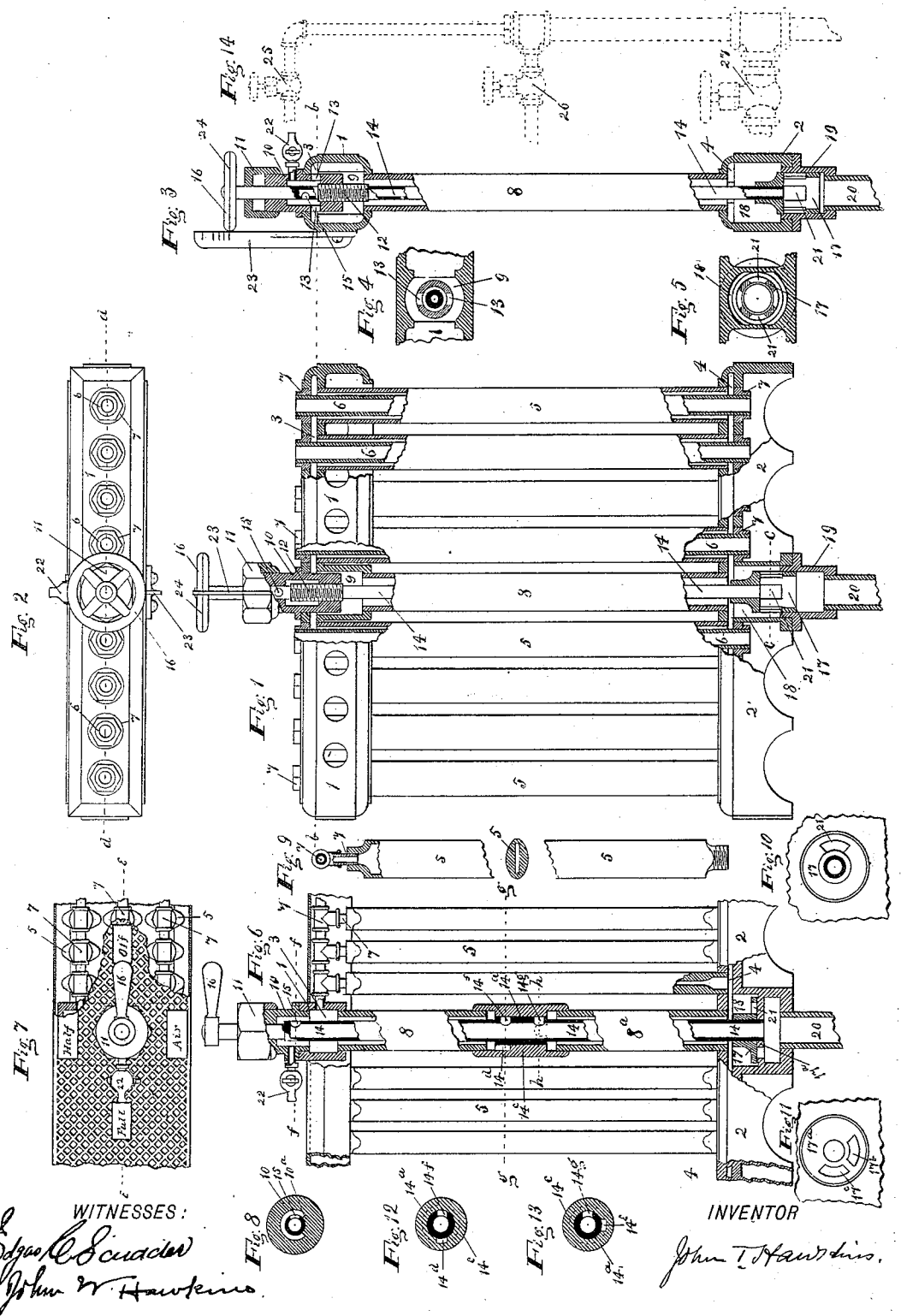
(No Model.)

J. T. HAWKINS.

GRADUATING STEAM RADIATOR.

No. 481,789. Patented Aug. 30, 1892.



UNITED STATES PATENT OFFICE.

JOHN T. HAWKINS, OF TAUNTON, MASSACHUSETTS.

GRADUATING STEAM-RADIATOR.

SPECIFICATION forming part of Letters Patent No. 481,789, dated August 30, 1892.

Application filed February 13, 1892. Serial No. 421,359. (No model.)

To all whom it may concern:

Be it known that I, JOHN T. HAWKINS, residing in Taunton, in the county of Bristol and State of Massachusetts, have invented a new and useful Graduating Steam-Radiator, which invention is fully set forth and illustrated in the following specification and accompanying drawings.

The object of this invention is to effect sundry improvements in steam-heating radiators by means of which the heating and radiating effect may be graduated to correspond to the requirements of varying weather temperatures; to avoid the necessity for air-discharge valves, except when starting up the entire system, of which the radiator forms a part, from a cold state, as when starting fire in the steam-generator which supplies it; to avoid all valves, joints, and openings of any kind into the radiator below the highest possible level of condensed water therein, thus rendering water leakage impossible at any point or under any of the contingencies liable to steam-radiators and to prevent freezing when out of use and in that condition exposed to low temperatures.

The primary feature in this invention consists in graduating the heat-radiating effect and effecting the expulsion of air when put out of use by providing for the radiator becoming partially or wholly filled with the water of condensation, partially filling and maintaining a certain level of said condense-water to graduate the heat-radiating effect, and wholly filling to reduce its heating effect to a minimum. By thus allowing the radiator to completely fill with water when put out of use, the air is excluded, so that when the radiator is again wholly or partially put into use it is done by regulating the escape of the condense-water, as hereinafter shown. In this way an air-valve is never required except when starting up the entire system from a cold state under which circumstances the boiler and all connecting-pipes are generally filled with air, which must be discharged through one or more of the radiators connected thereto; and provision is made in the radiator described herein for the discharge of the air under the latter conditions.

The necessity for air-valves comes principally from the fact that in the ordinary radiator with bottom connections only to both steam and water passage to and from it when shut off from use a vacuum quickly forms therein from the condensation of the contained steam, and the atmospheric pressure from without fills the radiator with air by leakage through stuffing-boxes, &c., or by means of the automatic air-valves themselves when such are used becoming cold and admitting the air as freely as they afterward permit of its escape. As in this invention communication with the boiler is not shut off when the radiator is put out of use, there would be no tendency for the external air to enter at any point even if not filled with water, so that even the very small space in the stuffing-box bonnet above the highest point of escape for the water, as hereinafter shown and described, cannot fill with air, and in that modification of it in which outside connection is made with the boiler the connecting-pipes cannot fill with air for the same reason unless the whole system becomes cold, as above mentioned.

It is well known that automatic air-valves on steam-radiators—designed, as they are, to close a small valve automatically by means of the difference of expansion of two metals (generally brass and iron) used in their construction—will allow water to escape through them whenever the water-level in the radiator may accidentally or otherwise be allowed to reach them, and in this way they are a source of much annoyance and trouble from leakage, while air valves or cocks not automatic are equally obnoxious from the invariable attendance upon them required whenever the radiator is started from a cold state.

In the construction of radiators under this invention they are so made as to hold as small a quantity of condense-water as possible in order that a change in heat-radiating effect may be quickly made by the condensation when the opening for water-discharge is diminished or shut off, which would occur too slowly if constructed to hold a large volume of water. In this system steam is always admitted to the upper surface of the water, whether in partial use or entirely out of heating operation, and as the water will not conduct the heat of the steam downward, and only a thin film on the upper surface remains

heated, what is held in the lower part of the radiator quickly becomes cooled and ceases to radiate heat, except in a very slight degree. In this way the condense-water may be carried at any desired height in the radiator, leaving only as much of the upper parts as remain subject to the heating effect of the steam to act as effective radiating-surface.

In the drawings, Figure 1 is a front elevation of one modification of this invention, shown in vertical section on a central line *d d*, Fig. 2, at sundry points broken away to exhibit the internal structure. Fig. 2 is a top plan view of the same. Fig. 3 is a side elevation of the same, partly in vertical section through the center of Figs. 1 and 2. Fig. 4 is a horizontal section on the line *b b*, Figs. 1 and 3. Fig. 5 is a horizontal section on the line *c c*, Fig. 1. Fig. 6 is a partial front elevation of another modification, also partly in vertical section on a central line *e e*, Fig. 7, at sundry places broken away for that purpose. Fig. 7 is a top plan view of Fig. 6, with the upper perforated cover broken away to show the parts beneath it. In this figure the parts beneath the perforated cover where it is not broken away are not shown through the small openings therein, to avoid confusion of lines. Fig. 8 is a horizontal section of the line *f f*, Fig. 6. Fig. 9 is a side elevation in three parts of one of the elliptical radiating-tubes of Figs. 6 and 7, the upper part being partly in central vertical section, the middle part in horizontal section, and the lower part in elevation. Fig. 10 is a top view of the lower water-discharge valve of Fig. 6, with the tube to which it is attached in horizontal section, and Fig. 11 a similar view of its seat. Fig. 12 is a horizontal section through the upper water-discharge valve on the line *g g*, Fig. 6, viewed from above, and Fig. 13 is a similar section on the line *h h*, Fig. 6, viewed from beneath.

Referring, first, to Figs. 1 to 5, inclusive, 1 is an upper steam-chamber and 2 the base, so constructed as to reduce the steam or water spaces 3 and 4 to a small volume, so as to contain but a small quantity of water when filled. 5 5 are a series of vertical tubes, of which there may be any number of rows desired, with a correspondingly broad upper chamber 1 and base 2, depending upon the amount of radiating-surface required. The tubes 5 5 are expanded into the lower wall of the upper steam-chamber 1 and the upper wall of the base 2, after the manner of steam-boiler tubes in their tube-sheets. 6 6 are a series of smaller tubes within the tubes 5 5, leaving a narrow steam or water space between their exterior and the interior of tubes 5 5. Tubes 6 6 are secured at their ends in the upper wall of steam-chamber 1 and the lower wall of the base 2 by means of bushes or thimbles 7 7, which are screwed into the steam-chamber 1 and base 2 and upon the ends of tubes 6 6. 8 is a central tube screwed at its upper end into a pocket 9, depending from and forming a part of the lower wall of the steam-chamber 1 and at its lower end into the upper wall of the base 2. 10 is a bonnet screwed or otherwise secured to the upper wall of the steam-chamber 1, upon which is screwed the usual cap-stuffing box 11. The lower part of bonnet 10 projects down into the pocket 9 and is threaded to serve as a nut for the reception of the screw 12. The bonnet 10 has openings 13 in its sides to permit the passage of steam and water to and from the chamber 3. 14 is a tube of brass or other metal having a higher coefficient of expansion than that of the iron of the radiator and its tubes, the upper part above the openings 15 being solid and having a screw-thread 12 formed upon an enlargement of it. 15 is an opening in the side of the tube 14, communicating its interior with the interior of the bonnet 10. The upper solid part of tube 14 passes through the stuffing-box 11 and has secured to its upper end a hand-wheel 16. The tube 14 passes down within the central tube 8, leaving a narrow space between its exterior and the interior of tube 8, and has secured to or formed upon its lower end a cylindrical valve 17. Depending from and forming a part of the lower wall of the base 2 is a pocket 18, into which is screwed or otherwise secured a bonnet 19, which serves as a casing for the valve 17. Into the lower end of the bonnet 19 is screwed a pipe 20, leading to the steam-space of the boiler after the manner well known in steam-heating apparatus as "one-pipe work." The valve 17 has openings 21 in its sides. In Fig. 1 the valve 17 is shown at its upper limit of motion and wide open, and in Fig. 3 at its lower limit and closed. When the valve 17 is at its upper limit, as in Fig. 1, the opening 15 in the upper end of the tube 14 passes up within the close neck of the bonnet 10, and thus practically shuts off the passage of the steam at this point to the chamber 3. It is not intended that the opening 15 shall, with the metal of the bonnet 10, form an absolutely-tight valve, but only to so obstruct the passage of steam at this point that it may enter more freely at the bottom than at the top, causing a considerably less pressure above than below any air that may be in the regulator, the steam being entirely free to pass in at the bottom through the openings 21 of the valve 17. With the valve 17 closed, as in Fig. 3, the steam is shut off from the interior at the lower point and can enter only through the opening 15 in the tube 14. At any intermediate point the steam may enter at either or both places. 22 is an ordinary petcock communicating with the interior of the bonnet 10. In this construction it will be seen that the spaces between the inner tubes 6 6 and the outer tubes 5 5, between the inner tube 14 and the outer tube 8, the spaces 3 and 4 and the pockets 9 and 18 form a continuous steam and water space of comparatively small volume, while the interior of the tubes 6 6 and

the exterior of tubes 5 5 constitute a proportionally large extend of radiating-surface, the interior of tubes 6 6 being particularly effective as forming vertical flues through which the air will rapidly ascend. The depending side walls of the base 2 are arched out, as shown, to admit the cold air freely to the interior of the tubes 6 6, and the similar depending walls of the chamber 1 have holes in their sides for the escape of the air heated by the exterior of the tubes 5 5. 23 is a gage secured to the front of the chamber 1, having index-marks inscribed on it, as seen in Fig. 3, and the hand-wheel 16 has a line 24 inscribed upon it to meet the index-lines as a pointer.

The operation of the modification so far described is as follows: Upon starting steam-pressure in the system of which the radiator forms a part, the whole being cold and filled with air, the hand-wheel 16 is run up until the line 24 on the hand-wheel 16 coincides with the highest mark on the gage 23, under which circumstances the opening 15 will be closed and steam admitted freely through the openings 21 of the valve 17, while any steam that may condense during the warming up of the apparatus may escape at the same place into the pipe 20. With the hand-wheel 16 in that position the petcock 22 is opened, and the steam entering from below will force any contained air in the radiator and connecting-pipes out through the cock 22. As soon as steam appears at the cock 22 it is closed and the hand-wheel 16 run down to the second line on gage 23, at which point the valve 17 will be wide open, so that steam may thereafter freely pass through the opening 15 in the tube 14. The apparatus will now be set for full heating effect, the condense-water continuing to pass out through the openings 21 in valve 17, and be returned to the boiler, as in ordinary one-pipe work, by the pipe 20. To graduate the apparatus, so as to reduce its heating effect, the hand-wheel 16 is run down until the openings 21 in valve 17 are not sufficiently wide to permit the escape of all the condense-water, and the base-chamber 4 and the vertical tube-spaces will begin to fill with water. As soon as the condense-water rises in the vertical tube-spaces and cools by radiation the brass tube 14 will by contraction enlarge the effective openings in valve 17 slightly beyond what was due to the original position given the hand-wheel 16, until the rise of the water will be arrested at some point to correspond to the given position of the hand-wheel 16 and similarly for any position given the hand-wheel 16, which does not permit of the escape of all condensed water for a full effect. To change the level at which the water will be maintained to some definite divisions of the whole heating effect, the gage 23 is marked for as many of these positions as may be desired, the lower mark indicating when the valve 17 is closed and the radiator put out of use. In the drawings the divisions on the gage 23 divide the heating effect into three parts, so that it may be set for one-third, two-thirds, or full effect. The varying column of water in the vertical tube-spaces also assist the expansion and contraction of the brass tube 14 in maintaining the water at some level corresponding to the amount of opening given the valve 17, the water discharging through a given opening faster as the head of water increases. To shut off the heating effect altogether, the hand-wheel 16 is run down to its lower limit, when the openings 21 in the valve 17 being closed the condensed water will accumulate until it reaches the level of the opening 15 in the tube 14, after which the area of water-surface exposed to the steam entering at the opening 15 will be only the small ring in the interior of the bonnet 10, as seen in Fig. 4, and as in this case the filling of the apparatus with water excludes the air no air-discharge valve is required to be used when the apparatus is again put into use either for partial or full heating effect. But one row of vertical tubes is here shown to avoid repetition; but any number may be used, and whatever the number of rows, but one central tube 8 and its regulating apparatus is required.

Referring now to Figs. 6 to 13, inclusive, the same numbers of reference are employed, so near as may be. In these figures, which show another modification of this invention, 1 is the upper steam-chamber; 2, the base; 3 and 4, the steam and water-spaces therein. 18 is a pocket formed in the base 2. 5 5 are vertical tubes of an elliptical cross-section and containing a thin wide space within, as shown in Fig. 9. The tubes 5 5 are screwed into the upper wall of the base 2 at their lower ends, and to their upper ends is connected a system of piping 7, which connects every tube with the upper steam and water chamber 3. These tubes 5 5, the chambers 3 and 4, and the pocket 18 in the base 2 form a continuous chamber of small volume. Fig. 7 is shown of a width corresponding to three rows of vertical tubes 5 5. 8 and 8^a are two sections of a central tube. The upper end of section 8 is screwed into the chamber 3 and the lower end of section 8^a into the upper wall of the base 2. The lower end of section 8 and the upper end of section 8^a are screwed into a valve-casing 14^c. 10 is a bonnet screwed into or otherwise secured to chamber 1, and 11 is the usual form of stuffing-box. 14 is a tube passing within the tube 8 8^a, made solid at its upper end above an opening 15 in its side and having an enlargement near the middle of its height, which is a running fit in the casing 14^c. The solid portion of tube 14 passes up through the stuffing-box 11, and to its upper end is secured a handle 16, by means of which the tube 14 is rotated. The opening 15 in the tube 14 communicates with the steam-chamber 3, as shown, except when in one position, as hereinafter described. The valve-casing 14^c has recesses 14^d and 14^e formed in it, one at the top and the other at the bottom of

its contact with tube 14, and at a right angle to one another, as shown in Figs. 6, 12, and 13. The tube 14 where it forms a valve with the casing 14^c has two openings 14^f and 14^g in one side, which correspond in vertical position with the recesses 14^d 14^e in the casing 14^c and has secured to its lower end a disk-valve 17, which has a segmental opening 21 on one side. The valve 17 rests upon a seat 17^a, formed in the pocket 18, and has in it two segmental openings 17^b and 17^c, corresponding in form to opening 21 in valve 17. 20 is a pipe screwed into the bottom of the pocket 18 and leading to the steam-space of the boiler. 22 is a petcock communicating with the interior of bonnet 10. The bonnet 10 has a solid segment 10^a, Fig. 8, embracing the tube 14 at one side, so that in one position of the tube 14 the opening 15 will be practically closed. Upon the perforated cover are placed the words "Air," "Full," "Half," and "Off," and by placing the handle 16 over these words the radiator will be set as indicated by them.

The operation is as follows: When heating up the system, of which the radiator forms a part, from a cold state, the handle 16 is placed in the position marked "Air," Fig. 7, and the petcock 22 opened. In this position the opening 21 in valve 17 will be over opening 17^b in its seat 17^a and the opening 15 in tube 14 will be closed by the segment 10^a in the bonnet 10, in which case steam will be practically excluded above and freely admitted through the valve 17, while water of condensation will escape at the same place and the air will be expelled through the cock 22. With the air expelled and cock 22 shut and the handle 16 placed over the word "Full," Fig. 7, the opening 21 in valve 17 comes over opening 17^c in its seat and free discharge of condense-water at the bottom is had, while steam is admitted through both openings 15 and 21. In this modification but one reduction from the full heating effect is provided for; but by a plurality of valves above the main valve 17 it may be arranged to provide for any desired number of gradations. With the handle 16 placed in the position marked "Half" in Fig. 7, steam will be admitted freely at the top through opening 15; but all communication through valve 17 will be cut off, and the base 2 and the vertical tubes 5 5 will fill up with water until the level in said tubes reaches about the line *g g*, Fig. 6. In this position the opening 14^g in tube 14 will coincide with the recess 14^e in the casing 14^c and permit the condense-water at this level to flow into and down this tube 14 to the boiler, thus maintaining this level. With the handle 16 placed in the position marked off in Fig. 7, steam is admitted at opening 15; but all openings for the escape of the condense-water will be closed and the radiator will fill until the water level reaches the line *f f*, Fig. 6, leaving only the small area of the inside of bonnet 10 exposed to the heating effect of the steam, and what small amount of condensation will occur under these conditions will pass through opening 15 and down tube 14 to the boiler, and the whole radiator will rapidly cool off to or near to the temperature of the room. The recess 14^d in the casing 14^c and the opening 14^f in the tube 14 coincide when the handle 16 is at "Full," allowing any water which may accumulate in tube 8 above the casing 14^c while the radiator is filled with water to escape to the boiler when it is put into full effect.

The last-described modification, Figs. 6 to 13, inclusive, is for ordinary purposes the most desirable, as generally a division of the heating effect into two parts will be sufficient to grade the radiator for changes in temperature, while the operations to be performed to make the changes and adjustments are exceedingly simple, and are more quickly made than in any other form of radiator.

In the modification, Figs. 1 to 5, inclusive, to replace the gage 23 the ordinary glass water-gage—such as used on steam-boilers to exhibit to view the water-level—may be attached to one of the vertical tubes, if desired.

In either of the modifications described with the condensed water wholly filling the apparatus, the water in the central tube 8 will be somewhat heated by the steam in the tube 14, and as there will be some slight circulation set up thereby in the water, the whole will be secure from freezing by the entire water being slightly heated in this way. This heating will, however, be too small to effect any perceptible warming of the apartment.

The arrangement of double tubes shown in Figs. 1 to 5 may be used in the modification shown in Figs. 6 to 13, or vice versa, and the method of construction of the tubing and the radiator generally may be varied in many ways, so long as a general communication is had one tube with the other at both top and bottom. It is not necessary that the valves 17 or 14^c be tight, such as is required of a plug-cock or globe-valve communicating the interior with the outer air, as a slight leakage at either of them will effect nothing more than a slightly-increased discharge of condense-water beyond that provided for, and thus modifying slightly the water-level carried, and as the pressure is at all times equal on both sides of these valves there is nothing to force the water by them but the small water-column itself.

Fig. 14 shows in dotted outline how for factory or other common purposes where leakage through stuffing-boxes is of no great moment the principle of this invention may be carried out by making outside connections with the upper and lower steam-chambers and at one or more intervening points, instead of the internal arrangement of valves shown and described in the other figures. Such outside connections are also available as applied to **S**-coils with horizontal repeated return members, or with circular or other coils so commonly in use in factories, &c. In this

case the small upper valve 25 serves to shut off the steam at the top, while the air is expelled through a petcock, as 22, located on the upper member, and is to be left open on all other occasions. With the radiator on in full effect the middle valve 26 is closed and the lower one 27 is open, when steam will be admitted both at top and bottom and the water will all escape at valve 27. For half effect valve 27 is closed and 26 opened and the water-level will be maintained at valve 26, through which the condense-water will be discharged. When shut off entirely, all valves but 25 are closed and the apparatus fills until the water arrives at the level of valve 25.

I do not confine myself to the exact construction shown for procuring a small volume of steam and water space, as this may be accomplished in many other ways without departing from this invention; nor do I confine myself to the particular form of valve shown, as other well-known forms may be used to perform the same functions under this invention; also, I do not confine myself to the general forms and plans of radiator shown, as there are many other well-known designs to which this invention may be applied, it being necessary to it only that a continuous steam and water space, communicating top and bottom, be had, which construction is common to a large variety of radiators; but

What I claim as of my invention is—

1. In a steam-radiator, an arrangement of steam-inlets and water-outlet, consisting of an adjustable tube, as 14, closed at the top and inclosed within one of the radiating-tubes, as 8, having an opening, as 15, in its side near the top, and a valve, as 17, secured to its lower open end, both the said tube 14 and the valve 17 communicating with a common steam-inlet and water-outlet, as 20, a stuffing-box bonnet, as 10, through which the closed top of said tube 14 passes, containing a solid portion fitting against said tube 14, so as to close the said opening 15 when the said tube 14 is adjusted to bring said opening 15 within it, said bonnet 10 having a petcock, as 22, establishing communication with the open air, whereby steam is admitted to said radiator above any water which may be retained in it, the heating effect be varied by the adjustment of the opening for water-discharge, effecting a variation of the height at which the water of condensation is maintained, and air be expelled from said radiator through said petcock 22, when desired, substantially as and for the purpose set forth.

2. In a steam-radiator, an arrangement of steam-inlets and water-outlets, consisting of an adjustable tube, as 14, closed at the top and inclosed within one of the radiating-tubes, as 8, having an opening, as 15, in its side near the top, and a valve, as 17, secured to its lower open end, both said tube 14 and valve 17 communicating with a common steam-inlet and water-outlet, as 20, a stuffing-box bonnet, as 10, through which the closed top of said tube 14 passes, containing a solid portion fitting against said tube 14, so as to close the opening 15 when the said tube 14 is adjusted to bring the said opening 15 within it, said bonnet 10 having a petcock, as 22, establishing communication with the open air, one or more valves secured to or formed upon the said tube 14 above the valve 17, so constructed as to establish communication between the interior of said tube 14 and the interior of the radiating-tube 8 by the adjustment of the said tube 14 into the required position, whereby steam is admitted to said radiator above any water which may be retained in it by the adjustment of said tube 14, effecting a variation of the height at which the water of condensation may be maintained and air be expelled from said radiator through said petcock, when desired, substantially as and for the purposes set forth.

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Witnesses:
FRED. H. BENT,
F. E. FISKE.