No. 813,606. PATENTED FEB. 27, 1906.

T. WHEATLEY.

AIR VALVE.

APPLICATION FILED AUG. 13, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

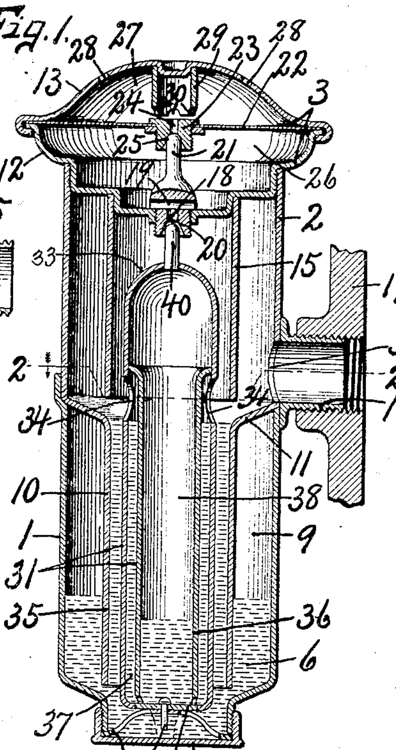

Fig. 2.

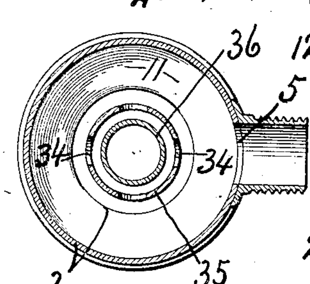

Fig. 3.

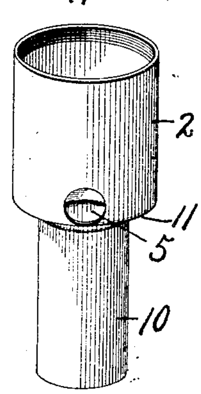

Fig. 5.

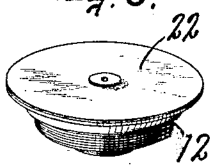

Fig. 4.

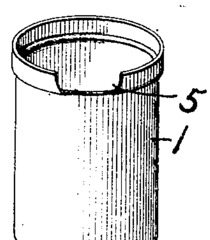

Fig. 6.

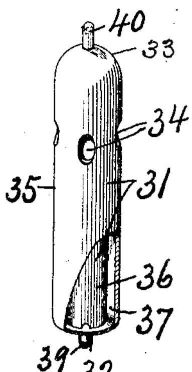

Fig. 9.

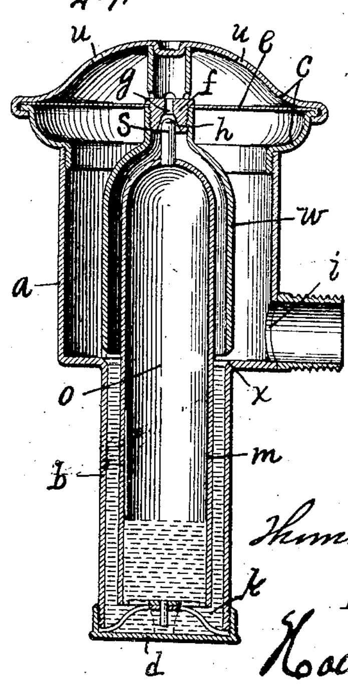

Fig. 7.

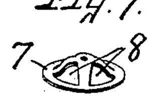

Fig. 8.

WITNESSES,

B. E. Robinson

H. E. Arthur.

Thomas Wheatley INVENTOR.

BY,

Howard P. Davidson

ATTORNEY.

No. 813,606. PATENTED FEB. 27, 1906.

T. WHEATLEY.

AIR VALVE.

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2 SHEETS—SHEET 2.

Fig. 10.

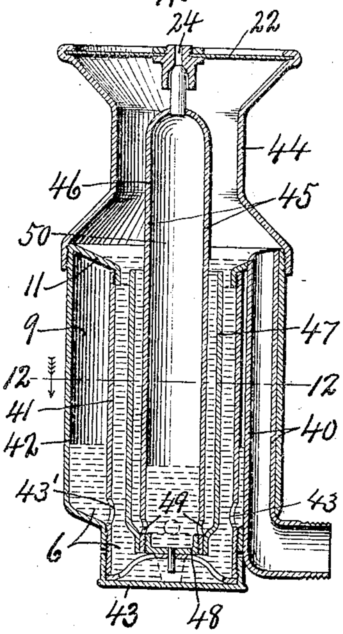


Fig. 11.

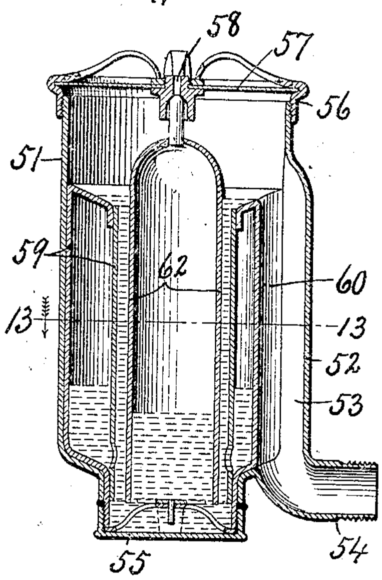


Fig. 12.

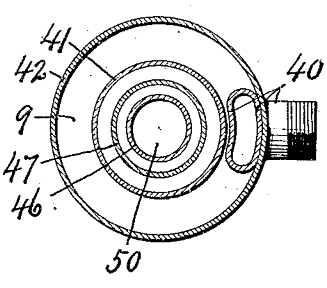


Fig. 13.

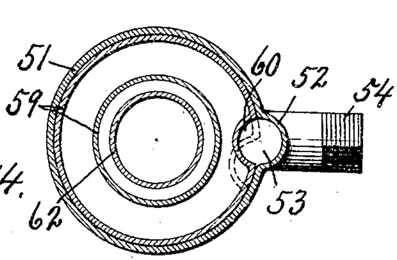
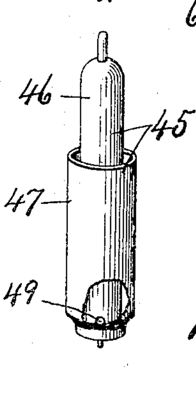


Fig. 14.



WITNESSES,

B. C. Robinson.

C. Hisington,

INVENTOR,

Thomas Wheatley.

BY,

Howard P. Denison

ATTORNEY.

UNITED STATES PATENT OFFICE.

THOMAS WHEATLEY, OF SYRACUSE, NEW YORK.

AIR-VALVE.

No. 813,606. Specification of Letters Patent. Patented Feb. 27, 1906.

Application filed August 13, 1904. Serial No. 220,689.

To all whom it may concern:

Be it known that I, THOMAS WHEATLEY, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Air-Valves, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to improvements in air-valves for steam-radiators from which it is desired to permit the free expulsion of air by the inflowing heating agent and at the same time to prevent the escape of steam or the reëntrance of air by the partial vacuum which is created, due to the condensation of steam in the radiator. In this class of devices the primary object sought is to maintain a free exit for the cold air to atmosphere during the inflow of the steam into the radiator and to close the air-passage as quickly as possible after the air has been expelled, so as to prevent the escape of steam through the air-passage and to subsequently close the air-passage against the reëntrance of air when the steam-pressure ceases. I am aware that certain patents have issued showing different means for carrying out these objects either individually or jointly; but I am not aware that these several objects have been heretofore carried out in a simple, compact, and practical device in which the elements are inclosed in a shell and protected against malicious tampering or interference.

In my present device I not only contemplate carrying out the broad objects above stated, but I have also sought to produce a simple, compact, and self-contained device which may be readily attached to the radiator and in which the communication of the radiator with the atmosphere is controlled by a valved passage in a flexible diaphragm above the inlet to the shell, while the exit of steam is cut off by means of a float containing a well for receiving the water of condensation by which air is trapped in the float, so that when heated the expansive force of the heated air reduces the volume of liquid in the well of the float and causes said float to rise and to operate a suitable valve to cut off communication between the radiator and atmosphere.

Another object is to provide a well in the base of the shell to receive the water of condensation and to also provide said shell with an air-chamber communicating with its well, whereby the water of condensation accumulating in the well in the shell operates to trap the air in said air-chamber, whereby the expansive force of the heated air in the shell causes the liquid in the well of the shell to rise around the float, and thereby elevate the same for the purpose above described, thus bringing into action two separate forces to operate the float to close communication between the radiator and atmosphere as soon as the steam enters the shell.

Other objects and uses will appear in the following description.

In the drawings, Figure 1 is a transverse vertical sectional view of a radiator air-valve embodying the various features of my invention. Fig. 2 is a transverse sectional view taken on line 2 2, Fig. 1. Figs. 3, 4, and 5 are perspective views showing, respectively, the upper and lower sections of the main body of the shell and the cap upon which the diaphragm is mounted. Fig. 6 is a perspective view of the float, a portion thereof being broken away to show the inner tube. Fig. 7 is a perspective view of a lead gasket forming a guide for the lower end of the float. Fig. 8 is a perspective view of the cap forming the bottom of the shell. Figs. 9, 10, and 11 are vertical sectional views similar to Fig. 1, showing further modifications of my invention. Figs. 12 and 13 are sectional views taken, respectively, on line 12 12, Fig. 10, and 13 13, Fig. 11. Fig. 14 is a perspective view of the detached float seen in Fig. 10. Figs. 3 to 8 and Fig. 14 are on a reduced scale.

Referring now to the construction seen in Figs. 1 to 8, inclusive, and particularly in Fig. 1, I have shown an outer shell consisting of a lower or base section 1, an upper section 2, a removable top section 3, and a removable cap-section 4, forming the bottom of the base-section 1. The sections 1 and 2 are tubular in form, the upper portion being fitted in and secured to the upper end of the lower section by brazing, soldering, or otherwise, to form a substantially continuous shell, having an inlet-opening 5 in one side substantially midway between the bottom cap 4 and upper section 3, whereby a well 6 is formed in the base of the lower section 1. The lower end of this section 1 is preferably reduced in diameter and is threaded to receive the threaded cap 4, which forms the bottom of the well. A suitable washer or packing 7, of lead or equivalent material, is impinged between the cap 4 and adjacent end of the lower shell-section 1 to form a water-tight joint, and its central portion is arched upwardly and provided with a central aperture in which the lower end of the float, presently described, is guided, said packing being provided with openings 8 to permit the water of condensation to pass freely through the washer and upon the bottom 4. The lower end of the upper section 2 is reduced in diameter and extends downwardly a considerable distance beneath the upper end of the section 1 to a point in proximity to the bottom 4, so that it is of less diameter than the inner diameter of the shell-section 1, and its lower end is open and dips into the water of condensation in the well 6, thus forming an air-chamber 9 between the shell-section 1 and lower end 10 of the shell-section 2, in which air-chamber the air is trapped by the water of condensation in the well 6. It now appears that the upper end of the air-chamber 9 is closed by a wall 11, while the lower end communicates with the interior of the tubular extension 10, so that the water accumulating in the well 6 is free to pass upwardly into the interior of the said extension 10, which communicates with the inlet-opening 5. The cap 3 in this instance comprises a lower section 12 and an upper section 13, the lower section being threaded and screwed into the upper end of the shell-section 2, while its upper end flares outwardly and receives the bell-shaped upper section 13, having its marginal edge clamped over and upon the marginal edge of the section 12, whereby the two sections 12 and 13 are permanently secured together. The inner or lower end of the top section 3 is reduced in diameter, so that it is considerably smaller than the surrounding shell-section 2, and secured to this reduced portion of the top section is a tubular extension 15, which projects downwardly some distance below the lower end of the section 12 to a plane in substantial alinement with the lower edge of the inlet-opening 5, but still a slight distance above the upper wall 11 of the air-chamber 9, so as to leave a clear passage between the lower end of the tube 15 and wall 11. The inlet 5 is provided with a suitable nipple 16, which is adapted to be secured to a radiator, as 17, and it now appears that the lower end of the tube 15 extends across the inner end of the inlet-opening 5, so that the inflowing steam impinges against said tube and the water of condensation which may accumulate above the inlet is deflected inwardly into the tubular extension 10 by the inclined wall 11, so that all of the water of condensation is precipitated immediately into the bottom of the section 1, where it traps the air in the chamber 9 and serves as a means for operating the float in the manner hereinafter described. The reduced lower end or bottom of the upper section 3 is provided with a nipple having vertical lateral passages 18 and 19, said nipple having in its lower end a valve-seat 20, forming the lower end of the passage 18, while the upper end of said nipple is provided with a valve 21, and therefore this valve 21 and seat 20 are fixed from movement. A flexible diaphragm 22 is suspended at its marginal edges between the upper and lower top sections 12 and 13, so that its central portion is free to vibrate vertically by the differences in pressure above and beneath the same, said central portion being provided with a nipple 23, having a vertical passage 24 and a valve-seat 25 at the lower end of and communicating with said passage 24. This diaphragm divides the interior of the top shell-section 3 into lower and upper chambers 26 and 27, the lower chamber 26 communicating with the interior of the tube 15 through the passages 18 and 19 and also communicating with the upper chamber 27 through the passage 24 in the diaphragm 22. This diaphragm is normally disposed in a substantially horizontal position when the pressure is substantially equal at both sides, so that the valve-seat 25 normally rests upon the upper end of the valve 21, and therefore communication between the chambers 26 and 27 is normally cut off when the pressure above the diaphragm is equal to or greater than the pressure below the diaphragm. The upper shell-section 13 is provided with one or more openings 28, which connect the chamber 27 with the atmosphere. In order to prevent undue upward movement of the diaphragm 22 when the pressure below the diaphragm is greater than atmospheric pressure in the chamber 27, I provide the upper section 13 with a central depending nipple 29, the lower end of which terminates a slight distance above the upper end of the nipple 23 and is perforated at 30, so that when the diaphragm is elevated by the excessive pressure of air in the chamber 26 it will be limited in its upward movement and still the air will be free to pass from the inlet 5 downwardly through the lower end of the tube 15 and then upwardly through the passages 18 and 19, thence into the chamber 26 and outwardly through the passages 24 and apertures 30 and through the apertures 28 to atmosphere. On the other hand, when the steam is shut off from the radiator and condensation takes place therein a partial vacuum is formed in the radiator, as well as in the shell 2, which reduces the pressure at the under side of the diaphragm 22, so that it is forced downwardly by the atmospheric pressure in the chamber 27, thereby causing the seat 25 to engage the upper end of the valve 21, thus closing communication between the radiator and atmosphere and preventing the reëntrance of air to the shell and to said radiator.

I have thus far described the means for permitting the free exit of air from the radiator and for preventing the reëntrance of air, and I will now proceed to describe the means for closing communication between the radiator and atmosphere when the steam is present in the valve-shell. This means preferably consists of a float 31, having a closed bottom 32 and a closed top 33, while its intermediate portion is provided with one or more openings 34, which are located in this instance in substantially the same plane as the lower edge of the inlet-opening 5 and communicate with said inlet-opening, thus forming a well 37 in the base of the float the height of which is determined by the openings 34. This float preferably consists of an outer tube 35 and an inner tube 36, which latter is of smaller diameter than the interior diameter of the outer tube 35 and has its upper end secured to the outer tube above the openings 34, as best seen in Fig. 1, while the lower end of the inner tube is open and communicates with the base of the well, as 37, in the base of the float. By this construction an inner air-chamber 38 is formed in the upper end of the float and within the tube 36, which communicates with the well 37, and inasmuch as the openings 34 in the float extend slightly below the lower edge of the inlet 5 and communicate with said inlet it is evident that the water of condensation rising within the tubular extension 10 of the shell overflows through said openings 34 and passes down into the bottom of the well 37 in the float, thereby trapping the air in the chamber 38. The bottom of the float is closed and is provided with a depending stem 39, which is guided in the central opening in the washer 7, while the upper end of the float is also closed and is provided with a valve 40, which is adapted to seat itself in the seat 20 when the float is elevated.

In the operation of the device seen in Fig. 1, assuming that the wells in the shell and float are empty and that the radiator is cold, in which case the valve 40 is unseated from the seat 20 and the diaphragm valve-seat 25 is seated upon the valve 21, so that communication between the radiator and atmosphere is closed, now upon the inlet of steam into the radiator the air is expelled through the inlet 5 beneath the bottom and into the tube 15 through the passages 18 and 19 into the chamber 26, the pressure of such air operating to elevate the diaphragm and to lift the valve-seat 25 from the valve 21, whereupon the air is free to escape through the passages 24 and 30 and 28 to atmosphere. This expulsion of the air continues until the steam enters the inlet 5, which steam first enters the interior of the shell 2, which is more or less cold, and thus condenses the steam which trickles down along the inner side of the section 2 upon the inclined wall 11, from which it is precipitated into the well 6 in the bottom of the shell-section 1, thereby sealing the lower end of the section 10 and trapping the air in the chamber 9. As the water of condensation continues to accumulate it rises in the extension 10 and overflows through the opening 34 into the well 37 into the bottom of the float 31, thereby sealing the lower end of the tubular section 36 and trapping the air in the upper end of the float. By this time the trapped air in the chambers 38 and 9, heated by the contents of the shell, begins to expand and to therefore expel a portion of the water in the well 37, while at the same time the water in the well 6 is also partially expelled from the chamber 9 and exerts a lifting power upon the lower end of the float 31, so that the float is not only elevated by the partial expulsion of the liquid from the lower end of the chamber 38 and the upward expansive force of the air in said chamber 38, but is additionally elevated by the influx of the water in the extension 10 around the float, due to the partial expulsion of the water from the chamber 9 by the expansion of the air within. This action of the float is therefore made more positive and more instantaneous than would be possible with a float open at its lower end and dipping into a well, and therefore the valve 40 is quickly seated in the passage 18 to close communication between the radiator and atmosphere upon the entrance of steam into the shell. Now when the pressure beneath the diaphragm 22 is reduced by the partial vacuum created in the radiator and shell, due to the condensation of the steam in the radiator, said diaphragm is forced downwardly by the atmospheric pressure until the seat 25 engages the upper end of the valve 21, thus closing communication between the radiator and atmosphere and preventing reëntrance of air to the radiator, the partial vacuum serving to facilitate the reflow of steam when the steam-valve is again opened.

In Fig. 9 I have shown a radiator-valve consisting of a shell *a*, having a reduced lower end *b* and a removable upper section *c*, the reduced lower end *b* having a removable cap or bottom *d*, while the upper section is provided with a diaphragm *e*, similar to the diaphragm 22. This diaphragm also has a central nipple *f* with a passage *g* therethrough and a valve-seat *h* at its lower end. The shell *a* is provided with an inlet *i* some distance above its bottom *b* for forming a well *k* in the bottom of the shell and is also formed with an annular seat *x* just below the inlet *i*. A float *m* is centrally arranged within the shell *a* and has its lower end open and dipping into the water of condensation in the well *k*; while the upper end is closed for forming an air-chamber *o*, in which the air is trapped by the water of condensation in the well *k*. A valve *s* is mounted upon the upper end of the float, but is shown as unseated from the seat *h* to permit the air to pass from the inlet *i* upwardly through the passage *g* and outwardly through apertures u in the top section c above the diaphragm e. A tubular cap w has its upper end secured to the nipple f, while its lower end encircles the upper end of the float and extends downwardly to a point in proximity to the seat x at the lower edge of the inlet i. This tubular cap w is open at the bottom and is somewhat larger than the inclosed portion of the float, so that the air is free to pass from the inlet beneath the bottom of the cap and upwardly through the same through the passage g and outwardly through the openings u. It is apparent from the foregoing description that the cap w is carried by the diaphragm e, and when a partial vacuum is created in the radiator by the condensation of steam therein this diaphragm is forced downwardly by atmospheric pressure until the seat h is engaged with the upper end of the valve s, and at the same time the lower edge of the cap w is seated against the seat x at the upper end of the tubular extension b of the shell a. In this device the float is actuated by the expansion of heated air in the chamber o in said float to close the valve s against the seat h when the steam enters the shell a, and inasmuch as the partial vacuum begins in the radiator and shell while this valve is thus seated it is evident that the excessive atmospheric pressure above the diaphragm will hold the seat against the valve, and thereby force the diaphragm and cap 11 and also the float m downwardly.

In Fig. 10 I have shown a modified construction of air-valve having a well 6 and a chamber 9, similar to the well 6 and air-chamber 9 seen in Fig. 1; but instead of admitting the steam through the side of the outer shell above the air-chamber I insert a steam-inlet tube 40 through the bottom of the well 6 and upwardly through the upper wall 11 of the air-chamber 9, so as to discharge into the upper end of the shell above the wall 11. In this construction the lower portion of the shell forming the well 6 and air-chamber 9 is composed of inner and outer sections 41 and 42, which are united at the top by the wall 11, and the inner section 41 extends downwardly through the lower end of the section 42 and is provided with a closure or cap 43, which forms the bottom of the well, said inner section 4 having communication with the air-chamber 9 through suitable passages 43′. The upper portion 44 of the outer shell is screwed to the upper end of the section 41 and carries a diaphragm 22, having a central air-vent 24. The float 45 is movable within the tubular section 41 and consists of inner and outer sections 46 and 47, which have their lower ends secured together and closed by the cap 48. The outer section 47 is open at the top to form a well in the bottom of the float, which communicates with the interior of the section 46 through apertures 49. The upper end of the section 46 is closed to form an air-chamber 50, in which the air is trapped by the accumulation of water in the bottom of the section 47; otherwise the operation is very similar to the device seen in Fig. 1.

In Fig. 11 I have shown an outer shell 51 as provided with a lateral projection 52 in one side for forming a vertical steam and air passage 53, the lower end of which terminates in a nipple 54, which is adapted to be secured to a radiator. The bottom of this shell is closed by a cap 55 and the top is closed by another cap 56, carrying a diaphragm 57, having a central air-vent 58. The inner shell 59 is fitted within the shell 51 and is provided with an inward depression in one side for forming a vertical steam and air channel 60. This shell 59 is rotatable in the shell 51, so as to vary the cross-sectional area of the steam and air inlet passages formed by the channels 53 and 60, and in order to permit this by hand when desired the lower end of the shell 59 extends downwardly through the bottom of the shell 51 and the cap 55 is screwed upon the lower end of this extension, but is made so as to abut against the lower end of the section 51, so that by loosening the cap slightly the inner shell may be rotated for the purpose above mentioned, after which the cap is retightened to hold the shell 59 in place. In this construction I have shown an ordinary float 62, which is open at the bottom and communicates with the well in the base of the shell, so that the water of condensation accumulating in the well serves to trap the air in the upper end of the float, which is closed. The operation of this device is also very similar to that shown and described in Fig. 1.

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

1. An air-valve for radiators comprising a shell having an inlet above the bottom forming a well, and an air-vent above the inlet, said well being divided into two chambers communicating with each other near the bottom of the well, one of the chambers being open at the top forming a float-chamber, and the other closed at the top forming an air-chamber, a float situated in the float-chamber, said float comprising a well open near its top, and an air-chamber closed at its top and communicating with the float-well near the bottom thereof, the inlet and air-vent being in free communication with the float-chamber.

2. In an air-valve for radiators, a shell comprising a well and an air-chamber communicating with each other near the bottom of the well, the air-chamber being closed at the top, said shell having an inlet and an air-vent, both in free communication with the upper end of the well above the closed top of

the air-chamber, a float in the well, and a valve actuated by the float to close the air-vent.

3. In an air-valve for radiators, a shell having an inlet above its bottom communicating with the atmosphere, a float comprising a well closed at the bottom and opening near its top and an air-chamber closed at the top and communicating at its bottom with the float-well, and a valve actuated by the float to cut off communication between the inlet and atmosphere, said float-well having free communication with the inlet and with the atmosphere.

4. An air-valve for radiators comprising a shell having an inlet and an air-vent, a float in the shell having a closed bottom and an opening above the bottom whereby a well is formed to receive water of condensation, said float also having an air-chamber closed at the top and opening near its bottom into said well whereby air is trapped in said chamber by the accumulation of water in the float-well, and a valve for the air-vent actuated by the float.

5. In an air-valve for radiators, in combination, a shell having an inlet and an air-vent, a float comprising outer and inner hollow parts, one part being closed at the bottom and having an opening above the bottom whereby a well is formed, and the other part having its lower end open and dipping in the well and its upper end closed forming an air-chamber in which the air is trapped by the water in the float-well, and a valve actuated by the float to close the air-vent.

6. In an air-valve for radiators, a float comprising a well closed at its lower end and an air-chamber opening at or near its lower end into the well and closed at the top, said float having an opening in one side above the bottom to determine the depth of the well.

7. In an air-valve for radiators, a shell having an inlet above its bottom communicating with atmosphere, and forming a well, in combination with a float closed at the bottom and having an inlet above the bottom forming a well below the inlet, said float having an air-chamber opening at the bottom into the well and closed at the top, and a valve actuated by the rise of the float to cut off communication between the inlet and atmosphere.

8. In an air-valve for radiators, a shell having an inlet and a vent above the inlet, in combination with a baffle-tube surrounding the vent and extending partially across the inlet and having its lower end open to receive the escaping air, a valve for the air-vent, and a float in the open end of the baffle-tube and operable by varying temperatures and adapted to open and close said valve.

9. In an air-valve for radiators, a shell having an inlet above its bottom forming a well, and an air-vent above the inlet, said well communicating with the inlet, a baffle-tube surrounding the vent and extending partially across the inlet but having its lower end communicating with said inlet, a float in the well and baffle-tube, and a valve actuated by the float to close the vent.

10. In an air-valve for radiators, a shell having an inlet above its bottom forming a well and an air-vent above the inlet, a fixed valve between the inlet and vent, a flexible diaphragm between the fixed valve and atmosphere and provided with an air-passage having its lower end seated on the valve, said diaphragm being operable by varying pressures to seat the passage upon and to unseat it from the valve.

11. In an air-valve for radiators, a shell having an inlet above its bottom forming a well and a diaphragm above the inlet, said diaphragm having an air-passage communicating with the inlet and with the atmosphere, the interior of the shell being divided into two chambers communicating with each other near the bottom of the well, one of said chambers being open at the top forming a float-chamber and the other closed at the top forming an air-chamber, a float situated in the float-chamber and a valve actuated by the float for controlling communication between the inlet and atmosphere through the passage in the diaphragm.

12. In an air-valve for radiators, a shell comprising a well and an air-chamber, the well being open at the top and the air-chamber closed at the top and communicating near its bottom with the well, said shell having an inlet above the well and an air-vent above the inlet, a diaphragm between the inlet and atmosphere and provided with an air-passage, a fixed valve between the inlet and diaphragm and coacting with said passage to close communication between the inlet and atmosphere, a float in the well, and a valve actuated by the float to control communication between the inlet and passage in the diaphragm.

13. An air-valve for radiators comprising a shell having an inlet in one side, forming a well below and communicating with the inlet, said shell having an air-chamber closed at the top and its lower end opening into the well, a flexible diaphragm in the top of the shell having a passage therethrough communicating with the inlet and atmosphere, a valve for said passage, a float in the well, and itself having a well in its base communicating with the first-named well and with the inlet, said float having an air-chamber closed at its top and its lower end opening into the well in the float, and means brought into operation by the float to close communication between the inlet and passage in the diaphragm.

14. In combination with a radiator, a shell having an inlet therein, of a cap for the shell having an air-passage in its bottom, a dia-

phragm within the cap and also having an air-passage therethrough, a heat-actuated valve for the passage in the bottom of the cap, and a fixed valve for the passage in the diaphragm, said diaphragm being actuated by varying pressures to seat and unseat the fixed valve, and a float in the shell for operating the first-named valve.

15. In an air-valve for radiators, a shell having an inlet, a cap removably secured to the shell and provided with a valved passage, and a diaphragm in the cap having a valved passage the valve of the latter passage being fixed in the cap.

16. In an air-valve for radiators, a float having an inlet above its bottom forming a well in the base of the float in combination with an inclosing shell having an inlet above the float-inlet.

17. A float having an inlet above its bottom forming a well in the base of the float, said float including an air-chamber closed at the top and communicating with the well near its bottom whereby the air is trapped in said chamber by the water in the well.

18. A float comprising outer and inner tubes, the outer tube having an inlet above its bottom to form a well and the inner tube engaged with the outer tube above the inlet and having its lower end dipping in the well, the chamber above the well being closed at the top.

19. In an air-valve for radiators, a shell having a removable bottom and an inlet above the bottom, a packing between the bottom and adjacent end of the shell and having a raised center, and a float in the shell guided on said center of the packing.

20. In an air-valve for radiators, a float comprising a well and an air-chamber communicating with each other near the bottom of the well, the air-chamber being closed at the top and the well having an inlet above its bottom.

21. In an air-valve for radiators, a shell having a removable cap, said cap having an air-passage through its bottom and a diaphragm above the bottom forming a chamber between said diaphragm and the bottom of the cap, said diaphragm having an air-passage therethrough, and a valve for the passage of the diaphragm.

In witness whereof I have hereunto set my hand this 28th day of July, 1904.

THOMAS WHEATLEY.

Witnesses:

H. E. CHASE,

MILDRED M. NOTT.