No. 701,524. Patented June 3, 1902.

F. TUDOR.

STEAM TRAP.

(Application filed July 3, 1901.)

(No Model.) 2 Sheets—Sheet 1.

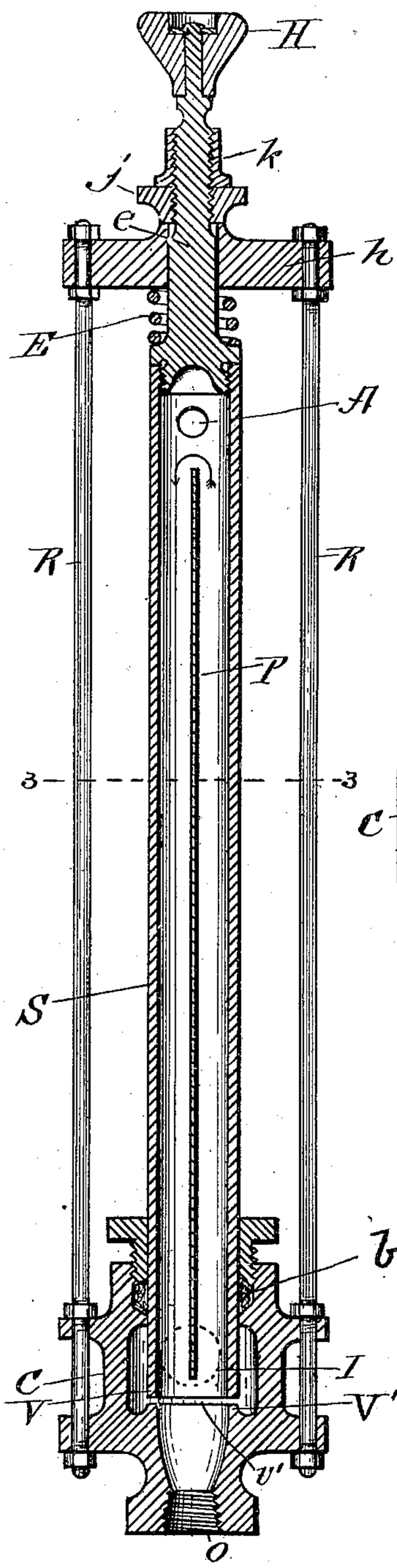

Fig. 1.

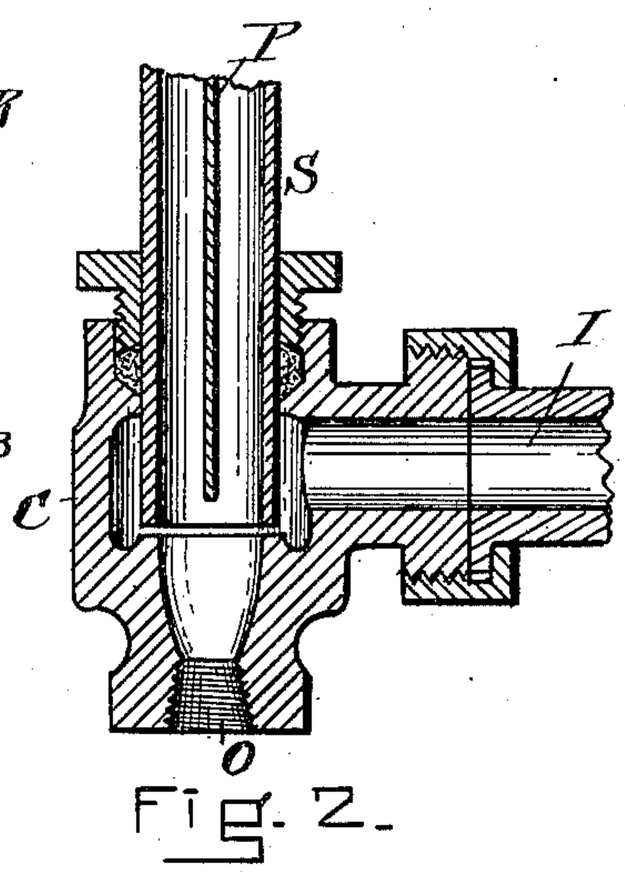

Fig. 2.

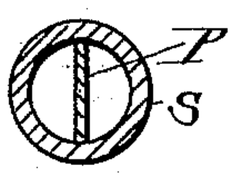

Fig. 3.

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(No Model.) 2 Sheets—Sheet 2.

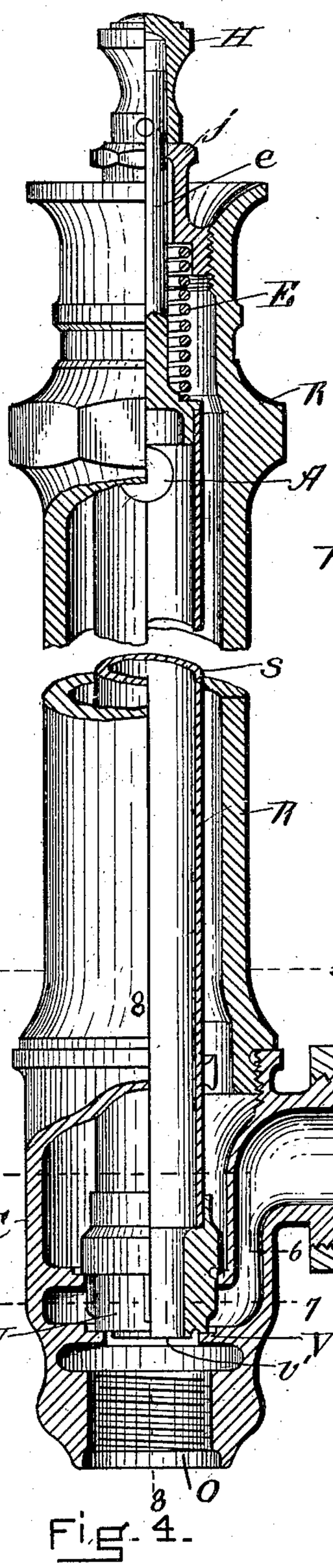

Fig. 4.

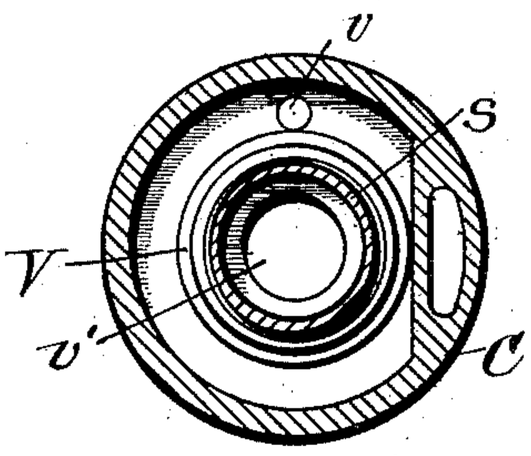

Fig. 6.

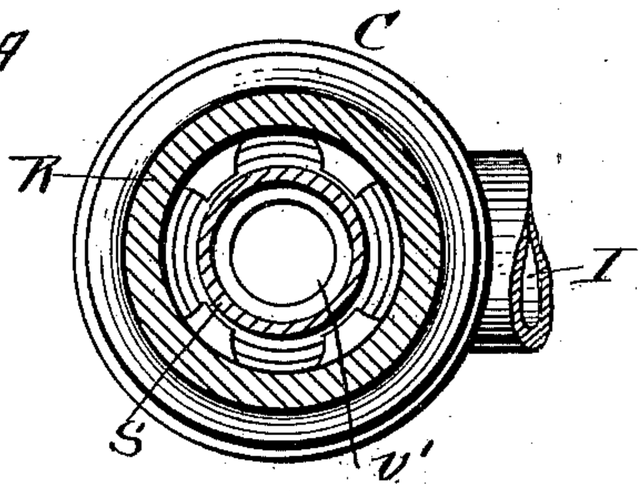

Fig. 5.

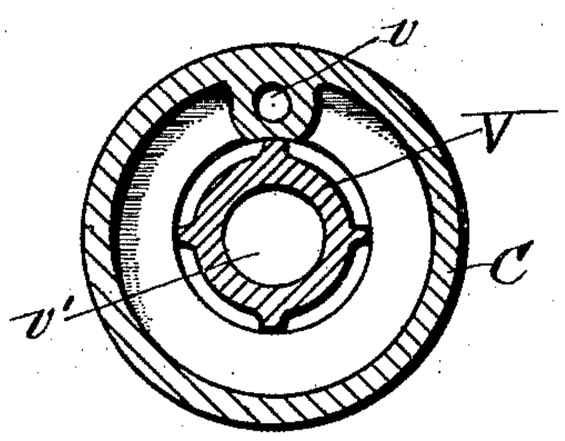

Fig. 7.

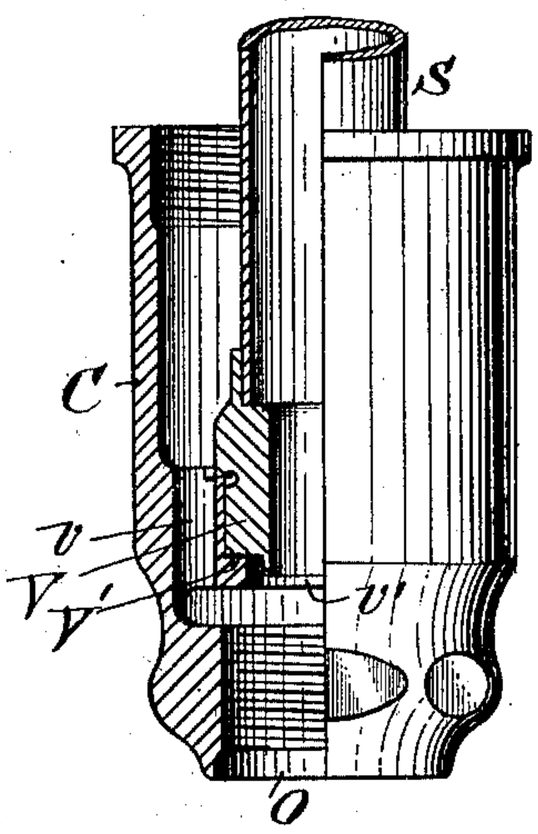

Fig. 8.

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UNITED STATES PATENT OFFICE.

FREDERIC TUDOR, OF BROOKLINE, MASSACHUSETTS.

STEAM-TRAP.

SPECIFICATION forming part of Letters Patent No. 701,524, dated June 3, 1902.

Application filed July 3, 1901. Serial No. 66,961. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC TUDOR, a citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented new and useful Improvements in Steam-Traps, of which the following is a specification.

The object of my invention is the production of an automatic steam-trap which shall maintain an opening sufficiently free to drain water and air from the steam apparatus with which the trap is used and which will not close until steam appears at the trap-opening.

Heretofore, so far as I am aware, steam-traps of the class to which this invention belongs—namely, expansion-traps wherein an outlet is controlled by the direct or differential expansion of parts subjected to the heat of fluids flowing through the trap—have been open to the grave defect of closing as the boiling-point of water is approached, so that in order to discharge water at or near the boiling-point the trap must be so adjusted that steam also may escape. Failing such adjustment the steam-traps heretofore known to me often close by expansion in response to the heat of the water and retain a large quantity of water in the trap and communicating apparatus. With steam-traps of the type to which I refer such behavior has been unavoidable, because water and steam occupying the same receptacle and in contact with each other have always the same temperature, and, as such an expansion steam-trap is made sensitive to fluctuation of temperature, if it is adjusted to allow water to escape at a given temperature it will also allow steam to escape at the same temperature. Thus in this important respect expansion steam-traps have failed to accomplish the object for which they are applied—namely, to draw water from steam-containing apparatus and to close or prevent the escape and waste of steam. In consequence of this fact the practical usefulness of heretofore-existing steam-traps is limited only to a partial effectiveness, so far as I am aware—that is to say, such traps cannot discharge all the water in a receptacle filled with steam or water formed from condensation or accumulation by entrainment, but can discharge only such portion of the water as may have accumulated at the lower part of the apparatus or in the pipes leading from it and which, being removed from contact with the steam and exposed to cooling influences, has so far subsided in temperature as to cause the sensitive parts of the steam-trap to contract and open the escape-valve. Inasmuch as the true function of the steam-trap is thoroughly to drain out the water as fast as it accumulates in the apparatus that it serves it is apparent that the variety of steam-traps as heretofore constructed is not adequate to accomplish this purpose.

In my improved steam-trap I provide means whereby the water accumulated in the steam or water passages is kept out of heat-conductive proximity to the sensitive portions of the trap or is so far kept out of such proximity that not enough heat is transmitted from the water to the sensitive parts of the trap to cause these parts to operate and close or choke the escape-valve. Heretofore in all practical constructions the transmission of some heat to the sensitive parts of the trap from water flowing through its passages has been inevitable; but in my improvement it is possible so to conduct water through and from the trap as to render its heat practically inoperative upon the sensitive expansible portions of the trap. On the other hand, my invention provides means whereby steam entering the trap through its inlet-pipe is induced to circulate in heat-conductive proximity to the sensitive expansible valve-controlling portions of the trap, so that the presence of steam in the trap will cause it to close instantly or at least as soon as the heat of the steam can be communicated to the expansible member. I accomplish this by providing a channel for water which conveys hot water out of the trap without passing it into conductive contact with the expansible valve-controlling portions of the trap and by providing separate side channels adapted to the induction and circulation of gaseous contents of the trap into heat-conductive contact with the expansible members of the trap.

By employing a steam-trap constructed according to my invention the outlet-valve of a low-pressure steam-heater can be arranged so as to drain away the water condensed in the heater at a substantially constant rate, corresponding to the rate of condensation in the heater. If the conditions under which the

heater operates are changed—as, for instance, by changes in the outside temperature—so that the condensation in the heater is less rapid than before, the steam-trap guards against waste of steam by closing automatically as soon as the condense-water is drained away and steam appears at the outlet.

In the drawings hereto annexed there are shown two embodiments of my invention, one operating by direct expansion of a single member, the other operating by differential expansion of two members. Both of these forms of apparatus are characterized by the same principle of operation.

Figure 1 shows one form of my steam-trap in vertical section. Fig. 2 shows in vertical section the lower part of the steam-trap of Fig. 1 viewed from the right hand. Fig. 3 is a cross-section of Fig. 1 at the line 3 3. Fig. 4 shows another form of my steam-trap, partly in vertical section, partly broken away. Fig. 5 is a cross-section of Fig. 4 at the line 5 5. Fig. 6 is a cross-section of Fig. 4 at the line 6 6. Fig. 7 is a cross-section of Fig. 4 at the line 7 7. Fig. 8 shows the lower portion of the steam-trap of Fig. 4, partly in vertical section, viewed from the left hand.

The inlet-pipe I is connected with the apparatus with which the steam-trap is in service, and the outlet-pipe O delivers the contents of the trap to such receptacle as may be provided. The inlet-pipe I and outlet O constitute a discharge-passage for fluids from the apparatus with which the trap is used and are shown as formed in the casting C, wherein also the valve-seat V′ is formed and adapted to coöperation with the valve V.

In Fig. 1 a tubular steam-chamber S passes through the top of the casting C and makes a steam-tight joint therewith by means of the packing *b*. At its outer end the steam-chamber S, which is tubular in form, is attached to a stem *e*, which passes through the cross-head *h*, sliding freely therein. The cross-head *h* is rigidly connected with the casting C by means of side rods R. The inner end of the steam-chamber S is ground to the valve-surface at V and coöperates with the valve-seat V′, which is formed on the casting C. The outlet O is placed below the opening of the valve V, so that liquids which pass through the discharge-passage and valve-opening immediately flow downward and away from the steam-trap and steam-chamber S.

The walls of the steam-chamber S are composed of material sensitive to heat and readily expanding under the influence of heat—brass tubing, for instance. The chamber S is further provided with means whereby the circulation of steam and air through the chamber is induced. By providing a central partition P the circulation of steam issuing from the inlet-pipe I is more readily initiated than will be the case where no special means for inducing circulation are presented.

Where there would be no objection to the escape of air from the trap into the place or room where the trap is used, an opening A may be provided and may be employed either with or without a circulation-partition P. Between the outer end of the steam-chamber S and cross-head *h* I provide a spring E, which serves as an elastic cushion, which when the valve S is seated by the expansion of the steam-chamber S absorbs any surplus expansion of the steam-chamber and prevents straining of the apparatus.

To provide for blowing out the trap without disturbing the adjustment, the rod *e* is threaded to receive a nut *j*, resting on the cross-head and held firmly against the latter by the spring E. The instrument is adjusted by means of this nut *j*, and the latter is prevented from turning on the thread after adjustment by the lock-nut *k*. By pulling up the handle H, attached to the rod *e*, the valve may be lifted a quarter of an inch or more from its seat and be thoroughly cleared of all kinds of sediment, dirt, and scale, and when released will return to its normal position.

In Fig. 4 I show a different specific arrangement of parts of a steam-trap adapted to perform the functions peculiar to my invention. Here the rods of Fig. 1 are replaced by a tube R, surrounding an inner tube S, which has a coefficient of expansion different from that of the supporting-tube R. The outer tube R may be of cast-iron, the inner tube S of zinc. The valve V is attached to the zinc tube S and is urged to its seat by the spring D under compression between tubes R and S through the rod *e*, handle H, and adjusting-nut *j*. The valve V is double-seated and when slightly open offers a passage downward for water and a passage upward for air and steam. At the side of the valve is a small passage *v*, connecting the upper outlet and chamber with the main outlet and passing through or by the inlet-chamber. This is to drain away any water escaping into the upper chamber of the trap. It will be seen that air first and subsequently steam which escapes into the upper chamber find their easiest way out through openings A at the top of the inner tube S, water going directly out by the side passage *v*; but the expansion produced by the heat of the steam acting differentially upon the tubes R and S will have closed the valve before steam can escape from the main outlet at O. If the expansive movement is more than sufficient to close the valve or if sediment should be lodged between either face of the valve and its seat, the surplus movement will be taken up by the spring E and injury to the instrument will be prevented. In the case of Fig. 4 the adjusting-nut *j* is screwed to the outer tube R instead of to the rod *e*, and there is no lock-nut. Any thick paint made with a non-drying oil applied to the joint between R and *j* will bind the parts together. The adjustment and the mode of blowing out sediment are, however, substantially the same in Fig. 3 as in Fig. 1.

The operation of the apparatus shown in

these drawings is as follows: If the water is accumulated in the apparatus to which the trap is attached, it enters the discharge-passage in the casting C, issuing from the apparatus to which the trap is attached by the inlet-opening I, the trap is adjusted so that when no steam is actually present in the steam-chamber S the valve V is open. When, therefore, hot water issues from the inlet I, it flows through the valve-opening at v' and directly out of the apparatus through the outlet O, passing by the entrance of the expansible steam-chamber S, so that substantially no heat is communicated to the sensitive expansible parts from the hot water. The location of the outlet O below the valve V insures this result. When the water has been drained from the apparatus, steam proceeding therefrom flows or circulates freely upward as well as outward, and its circulation through the tubular chamber S is encouraged by the presence of the partition P or by the air-aperture A, Fig. 1, if the latter is provided, or by both, and straightway heat is communicated to the expansible parts of the apparatus, which operate immediately to close the valve V, and so long as steam remains in the trap the valve V will by closure prevent its escape. It will be observed that steam being prevented from escaping by the outlet O and from it into any pipe thereto connected can only act upon the trap by escaping past the open valve. Hence when the valve becomes closed it cannot remain closed, because its members gradually parting with their heat begin to contract and again cause the valve to open. The slightest opening gives passage to water, which escapes more and more freely until it is all drained away and steam again enters the upper chamber. The effect of these actions is to keep the steam side of the trap quite free from water, the expansive members taking a permanent temperature and position, which is that allowing only enough steam to pass to maintain its temperature at the critical point, only the lower half or thereabout of the instrument being as hot as steam. The trap is also an efficient automatic air-valve, suitable for use in steam-heating systems as such, or combining the functions of both steam-trap and automatic air-valve.

In all expansion-traps where the opening for the escape of water is necessarily limited there is a tendency to accumulate sediment, which finally completely chokes the outlet and renders the trap inoperative. Fine-wire nettings or screens designed to intercept this sediment become themselves choked and are of little or no advantage. The most effective remedy for this defect in such trap is to provide means for loosening and blowing out the sediment; but to do this it has been heretofore necessary to disturb the adjustment of the trap, which ought to be permanent. Consequently whenever the trap is blown out adjustment has to be made over again, as at first, and demands the attention and care of a person skilled in this kind of work. To obviate this disadvantage, I have contrived means for opening the valve manually without disturbing the adjustment, giving free passage to comparatively large objects as well as sediment should such happen to have been carried into the trap. The trap can thus be cleared in an instant by any person without disarranging the adjustment.

What I claim, and desire to secure by Letters Patent, is—

1. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, substantially as described.

2. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, an elastic cushion, whereon the valve-controller is abutted, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, substantially as described.

3. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and means whereby the valve-controller may be manually operated to lift the valve from its seat substantially as described.

4. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber and means whereby the valve-controller may be manually operated to lift the valve from its seat against the stress of the elastic cushion, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, substantially as described.

5. In a steam-trap or analogous apparatus the combination of a discharge-passage, a

steam-tube of heat-expansible material, a valve connected therewith controlling the discharge-passage and the entrance to the steam-tube, the steam-tube adapted to receive steam issuing from the discharge-passage, connections between the expansible steam-tube and the valve whereby expansion of the tube is accompanied by closure of the valve, the discharge-passage being so located that liquids passing therethrough flow away from effective heat-conductive proximity to the steam-tube.

6. In a steam-trap or analogous apparatus the combination of a discharge-passage, a steam-tube of heat-expansible material, a valve connected therewith controlling the discharge-passage and the entrance to the steam-tube, the steam-tube provided with devices whereby circulation of steam issuing from the inlet-pipe is induced through the steam-tube, connections between the expansible steam-tube and the valve whereby expansion of the tube is accompanied by closure of the valve, the discharge-passage being so located that liquids passing therethrough flow away from effective heat-conductive proximity to the steam-tube.

7. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller, substantially as described.

8. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, an elastic cushion, whereon the valve-controller is abutted, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller, substantially as described.

9. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and means whereby the valve-controller may be manually operated to lift the valve from its seat and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller, substantially as described.

10. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber and means whereby the valve-controller may be manually operated to lift the valve from its seat against the stress of the elastic cushion, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller, substantially as described.

11. In a steam-trap or analogous apparatus the combination of a discharge-passage, a steam-tube of heat-expansible material connected therewith, controlling the discharge-passage and the entrance to the steam-tube, the steam-tube adapted to receive steam issuing from the discharge-passage, connections between the expansible steam-pipe and the valve whereby expansion of the tube is accompanied by closure of the valve, the discharge-passage being so located that liquids passing therethrough flow away from effective heat-conductive proximity to the steam-tube, and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller.

12. In a steam-trap or analogous apparatus, the combination of a fluid-discharge pipe, a valve in the same, the said valve controlled by a heat-expansible valve-controller, and so located that liquids passing through the discharge-pipe past the valve flow away from the valve-controller, a steam-opening leading to the controller from the outlet side of the valve, so that steam, to approach the controller must first pass the valve, substantially as described.

13. In a steam-trap or analogous apparatus, the combination of a fluid-discharge pipe, a valve in the same, a tubular valve-controller secured to the valve, an aperture from the outlet side of the valve leading to the interior of the tubular controller, a casing surrounding the controller, an aperture in the controller communicating with the interior of the said casing, and drain-apertures from the casing to the discharge-pipe, substantially as described.

14. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber branching from and commu-

nicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, substantially as described.

15. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber branching from and communicating therewith, a valve, controlling the discharge-passage and the entrance of the steam-chamber, a heat-expansible valve-controller in heat conductive proximity to the steam-chamber, an elastic cushion, whereon the valve-controller is abutted, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, substantially as described.

16. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber branching from and communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber, a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquid flows through the discharge-passage without entering the steam-chamber, and means whereby the valve-controller may be manually operated to lift the valve from its seat substantially as described.

17. In a steam-trap or analogous apparatus the combination of a discharge-passage, a steam-tube of heat-expansible material branching therefrom, a valve connected therewith controlling the discharge-passage and the entrance to the steam-tube, the steam-tube adapted to receive steam issuing from the discharge-passage, connections between the expansible steam-tube and the valve whereby expansion of the tube is accompanied by closure of the valve, the discharge-passage being so located that liquids passing therethrough flow away from effective heat-conductive proximity to the steam-tube.

18. In a steam-trap or analogous apparatus the combination of a discharge-passage, a steam-tube of heat-expansible material branching therefrom, a valve connected therewith controlling the discharge-passage and the entrance to the steam-tube, the steam-tube provided with devices whereby circulation of steam issuing from the inlet-pipe is induced through the steam-tube, connections between the expansible steam-tube and the valve whereby expansion of the tube is accompanied by closure of the valve, the discharge-passage being so located that liquids passing therethrough flow away from effective heat-conductive proximity to the steam-tube.

19. In a steam-trap or analogous apparatus, the combination of a discharge-passage, a steam-chamber branching therefrom and communicating therewith, a valve, controlling the discharge-passage and the entrance to the steam-chamber a heat-expansible valve-controller in heat-conductive proximity to the steam-chamber, the discharge-passage and steam-chamber being so disposed with relation to each other that liquids flow through the discharge-passage without entering the steam-chamber, and connections with the valve whereby the valve may be opened at will independently of the normal operation of the valve-controller, substantially as described.

Signed by me at Boston, Massachusetts, this 24th day of June, 1901.

FREDERIC TUDOR.

Witnesses:
REUBEN L. ROBERTS,
ODIN B. ROBERTS.