(No Model.) 2 Sheets—Sheet 1.

C. TAYLOR.

STEAM TRAP.

No. 481,601. Patented Aug. 30, 1892.

Fig. 1.

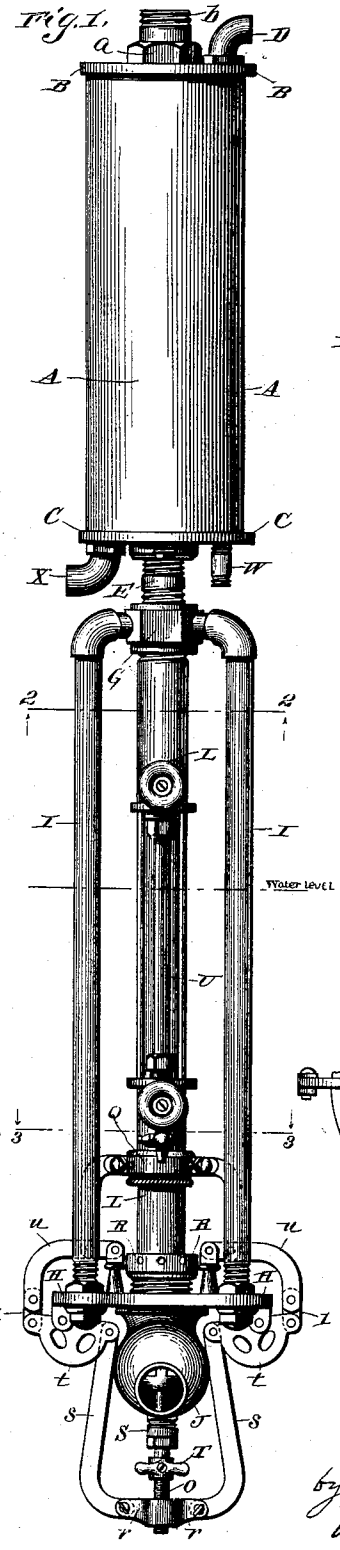


Fig. 8.

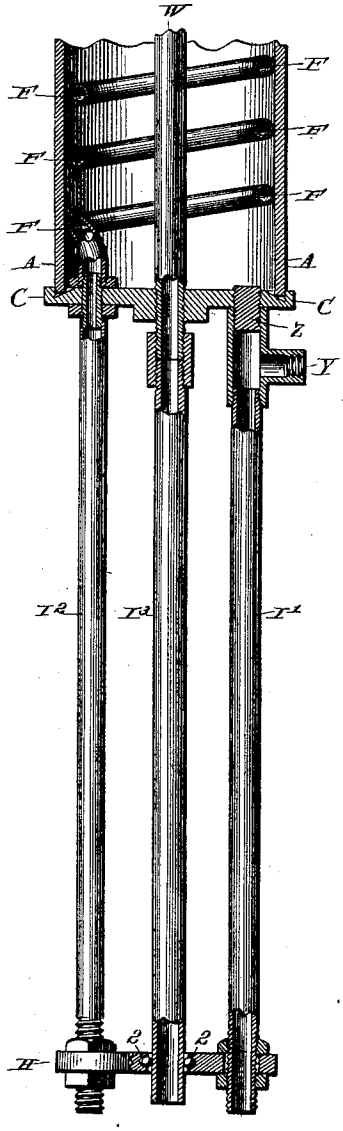


Fig. 2.

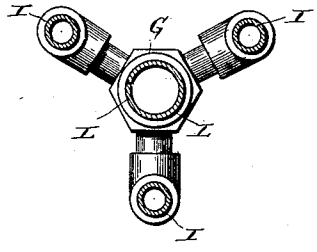
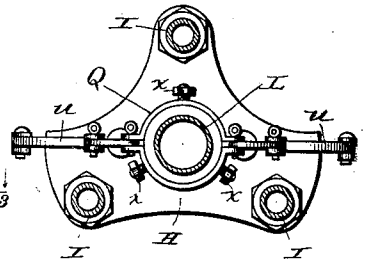


Fig. 3.



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(No Model.) 2 Sheets—Sheet 2.

C. TAYLOR.

STEAM TRAP.

No. 481,601. Patented Aug. 30, 1892.

Fig. 4.

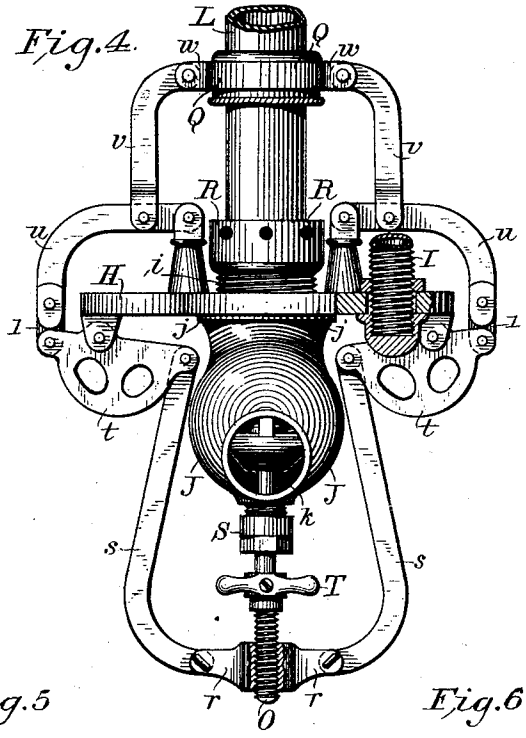


Fig. 5

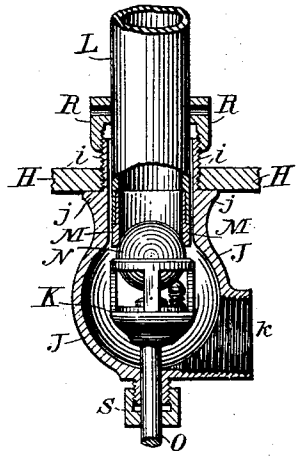


Fig. 6.

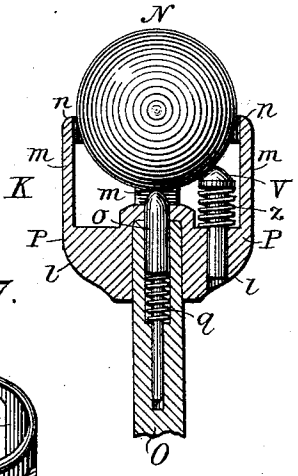
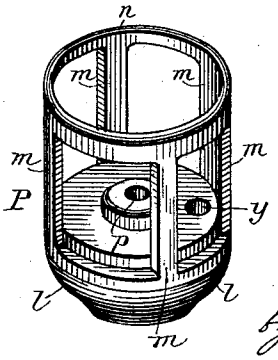


Fig. 7.



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UNITED STATES PATENT OFFICE.

CYRUS TAYLOR, OF BUFFALO, NEW YORK, ASSIGNOR, TO THE EXCELSIOR SPECIALTY COMPANY, OF NEW YORK.

STEAM-TRAP.

SPECIFICATION forming part of Letters Patent No. 481,601, dated August 30, 1892.

Application filed July 20, 1891. Serial No. 400,123. (No model.)

To all whom it may concern:

Be it known that I, CYRUS TAYLOR, of Buffalo, Erie county, New York, have invented certain new and useful Improvements in Steam-Traps, of which the following is a specification.

This invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a front view of the improved steam-trap. Fig. 2 is a horizontal section in a plane indicated by the line 2 2 in Fig. 1. Fig. 3 is a horizontal section in a plane indicated by the line 6 6 in Fig. 1. Fig. 4 is a detail view, on an enlarged scale, of the valve-operating mechanism. Fig. 5 is a vertical section of the valve mechanism. Figs. 6 and 7 are details of the valve mechanism. Fig. 8 illustrates a modification of the trap.

The improved trap consists, essentially, in an automatic thermal-valve mechanism which automatically controls a valve to regulate the discharge of water of condensation, the movement of the valve being determined by the temperature of the water of condensation and of the steam from which the water of condensation is formed. This improved expansion-trap mechanism is preferably used in connection with a condenser which is connected with a steam-boiler or a steam-user (such as a steam-heating apparatus) for the purpose of withdrawing wet steam or vapor from such boiler or steam-user.

Automatic expansion-traps in connection with a condenser are at present well-known in the art, and since the present invention relates to the trap mechanism only I have not shown the condenser in detail.

In the drawings, A is the condenser, consisting of a closed cylindrical vessel having two heads B and C. The upper head B has a central boss *a*, constituting a steam-inlet opening, into which is fitted the open end of a steam-conveying pipe *b*, through which steam is introduced to the condenser. The lower head C of the condenser has a central water-discharge into which is fitted a downwardly-extending discharge outlet-pipe E for the water of condensation. The condenser is preferably one which is artificially cooled by means of cold water passed through a coil F within the same. (See Fig. 8). The external couplings D and X (shown in Fig. 1) are the terminals of the coil F.

No claim is herein made for any of the features of the condenser, since they are claimed in a separate application, Serial No. 420,732, filed by me February 8, 1892. The condenser condenses the steam, and consequently acts as a vacuum-chamber, thereby drawing the wet steam from the apparatus with which the trap is connected and maintaining the steam in said apparatus in a dry condition. The water of condensation collecting in the condenser or vacuum-chamber passes out through the discharge-pipe E.

The trap mechanism is supported by a horizontal spider or frame G parallel with the bottom head C of the condenser, which is secured to said head C by being screwed to the discharge outlet-pipe E.

The valve mechanism is supported by a horizontal frame or plate H, parallel with the spider G, which is secured to said spider and at an invariable distance therefrom by three parallel ties or binders I I, preferably of iron. To the plate or frame H is secured the hollow valve-casing J. This valve-casing has at its upper end an exteriorly-threaded tubular guide-sleeve *i*, which screws into a central aperture of the plate H, and a flange *j* on the casing seats against the under side of plate H, thereby maintaining the valve-casing in fixed relation to said plate. The valve-casing J supports the valve-carrier, which as a whole is lettered K in the drawings. This valve-carrier is vertically movable and vertically adjustable, as will hereinafter appear. The hollow tubular sleeve *i* serves as the inlet to the valve-casing, and the valve-casing is provided with an outlet *k*. The sleeve *i* constitutes a closely-fitting guide for the lower end of a water-discharging thermo-expansible tube L. The upper end of this tube L is rigidly connected to the spider G, into the center of which it is screwed immediately in line with the water-discharge pipe E, of which said tube L constitutes a continuation. The lower end of this thermo-expansible tube L simply extends into the sleeve *i*, which holds its lower end from lateral movement and permits said lower end to move vertically as said

tube expands and contracts. The lower end of the tube L within the valve-casing is formed with a valve-seat M. The valve-seat M is preferably separate from the tube L, and is a sleeve of Tobin bronze slipped within and secured to the lower end of tube L. This valve-seat is a vertically-movable one by reason of its connection with the lower movable end of the thermo-expansible tube L.

Carried by the valve-carrier K and co-operating with the valve-seat M is a ball-valve N of Tobin bronze.

The valve-carrier is composed of two parts, a vertical stem O, which extends downwardly and outwardly through the bottom of the valve-casing J, and a skeleton cage P, which supports the valve N. This cage P, which is shown in detail in Figs. 6 and 7, has a bottom plate *l*, which has a central vertical socket fitting over the upper end of the valve-stem O, and which has four vertical bars *m*, carrying at their upper ends a horizontal ring *n*. The ball-valve rests within the bars *m* and the ring *n*, which constitute a holder and guide for the ball-valve. The inner diameter of the ring *n* is substantially the same as the diameter of the ball-valve, so that the ball-valve is thereby maintained in line with the valve-seat M, since the axial line of the tube L and seat M is coincident with the axial line of the valve-stem O and cage P. The ball-valve N is elastically supported in the cage P by a spring-plunger *o*, which is located and guided in a central vertical bore in the valve-stem O, extends through a central aperture *p* in the bottom *l* of the cage P, and is pressed upwardly by a coiled spring *q*.

The valve-seat M on the one part and the ball-valve with its carrier on the other part are movable to and from each other in a vertical line, and these movements are automatically controlled by the temperature of the water of condensation or of the steam within the thermo-expansible tube L. The movements of the valve-seat and valve-carrier are such that as the temperature of the fluid within the tube L decreases the valve-seat and valve-carrier move simultaneously away from each other, thus separating the seat M from the valve N and permitting the discharge of the water of condensation within the tube L, while when the temperature of the fluid within the tube L increases the valve-seat and valve-carrier move simultaneously toward each other, thus bringing the valve-seat into intimate contact with the valve N, and thereby preventing the escape of steam. These relative movements of the valve-seat and valve-carrier are effected as follows: The thermo-expansible tube L is composed of a metal or alloy having a high coefficient of expansion. Brass is the metal preferably employed for the tube L. Being attached only at one end, the tube L is free to receive the expansive effects of the heat of the hot water or steam within it, and consequently the valve-seat M, carried by its lower end, is free to be moved up or down, as the case may be. Since the heat of the steam or hot water within the tube L is not communicated to the ties or binders I I, (they being separated widely from the tube L, so that the external air circulates freely between them and the tube L,) the full effect of the varying length of the tube L is communicated to the position of the valve-seat M relatively to the valve-casing J. Consequently when the tube L contracts by reason of water of condensation collecting therein and becoming cool the valve-seat M will be lifted in the valve-chamber within the valve-casing J, and when the water of condensation escapes from the tube L and is replaced by steam the tube L expands, thereby lowering the valve-seat M. The valve-carrier K is raised and lowered by intermediate connections between it and the thermo-expansible discharge-tube L. The vertical valve-stem O of the valve-carrier, which extends downwardly through the bottom of the valve-casing J, is connected at its lower end to the center of a cross bar or yoke *r*. The two ends of this yoke *r* are connected by links *s s* to the inner ends, respectively, of the long arms of two multiplying and reversing levers *t t*, which are each pivoted eccentrically to a stationary part, such as to a depending bracket on the plate H. The ends of the outer short arms of the levers *t t* are pivoted, respectively, by short links *l l* to the outer ends of multiplying-levers *u u*, which levers are pivoted, respectively, at their inner ends to upwardly-projecting brackets on plate H. Nearer their inner pivotal connections with said brackets than to their outer pivotal connections with the levers *t t* said levers *u u* are respectively pivoted to the lower ends of links *v v*, which at their upper ends are pivoted, respectively, to the outer ends of ears *w w*, carried by a collar Q, which is fixed to the tube L near its lower end by set-screws *x* or otherwise. The collar Q moves with the tube L, and by reason of the multiplying and reversing levers *t t u u* and their eccentric pivoting the motion of the tube L is multiplied and reversely communicated to the valve-carrier K, which consequently moves up when valve-seat M moves down, and vice versa. The connections between the thermo-expansible tube L and the valve-carrier K thus constitute reversing and multiplying connections. The thermo-expansible tube L enters the valve casing J through a suitable guiding and stuffing box R, and the stem O of the valve-carrier K passes out from the valve-casing J through a suitable stuffing-box S. The water of condensation discharged from the valve escapes through the outlet-nozzel *k* of the casing J. The valve-carrier K is not only movable responsively to the expansion and contraction of the tube L, but it is also vertically adjustable within the valve-casing. This adjustment is effected by means of the valve-

stem O, which screws into the cross-bar *r*, and is turned up or down, as desired, by the hand-wheel T, which is fast to the valve-stem.

The operation of the valve mechanism is as follows: When the apparatus is set up for use, the several parts will be cold, and consequently the valve-carrier K and the valve-seat M will be widely separated, and there will be a free passage past the ball-valve N. When steam then enters the trap, it will pass out through the tube L and past the valve N. The temperature of the steam, however, causes the tube L to expand, and thereby causes the valve-carrier K and the valve-seat M to approach each other and so close upon the valve N, thus preventing any further escape of the steam. As the steam condenses within the trap the water of condensation collects in the tube L and cools therein, the rapidity of the cooling depending largely upon the temperature of the surrounding atmosphere. A water-gage U on the tube L indicates the height of the collecting water. The collected water as it cools causes the tube L to contract, thereby opening the valve and allowing the water to escape. Steam then enters the tube L, expands the same, and again closes the valve. Since the valve opens on a fall of temperature, there is never any danger of the trap being frozen, since all water would be discharged long before the freezing-point could be reached. The vertical adjustment of the valve-carrier K enables the operation of the valve mechanism to be very accurately regulated. When properly regulated, there will always be a constant and uniform discharge of water and the water will be maintained at a uniform level (at about the level indicated in the drawings) in the tube L. The vertical adjustment of the valve-carrier admits of the regulation of the valve mechanism so as to operate properly under varying conditions of temperature of the external atmosphere, and also permits the condensed water within the tube L to be drawn off at pleasure. The vertical adjustment of the valve-carrier also permits adjustment to compensate for the wear of the valve-seat and of the ball-valve N.

In order to prevent irregular wear of the ball-valve N, special means are provided. This valve and the valve-seat, as already stated, are of Tobin bronze, which does not rust and is nearly as hard as hardened steel, so that said valve and valve-seat resist wear and rust to a maximum degree. Nevertheless, in the absence of special provisions to prevent the ball-valve would wear irregularly, since only a portion of its surface is presented to the valve-seat. To prevent such irregular wear, a ball-valve rotator is provided on the valve-carrier for partly rotating the ball-valve each time that the valve-seat and valve-carrier are separated. A desirable form of valve-rotator is provided, as shown in the drawings, (see Figs. 5, 6, and 7,) by making the bottom plate *l* of the cage P with a vertical bore *y* at one side of its center, in which reciprocates a vertically-movable plunger V, which is pressed upwardly by a coiled spring *z*. When both the valve-seat and valve-carrier press against the ball-valve, both the spring *q* of central plunger *o* and the spring *z* of eccentric rotator-plunger V are compressed. When, however, the valve-seat and valve-carrier separate, the springs *q* and *z* expand, lifting the ball-valve N and giving it a partial turn, so that different portions of the ball-valve are presented to the valve-seat when it next closes upon the ball-valve. The spring-plungers *o* and V constitute a yielding or elastic support for the valve, which yield when the valve comes in contact with the seat M. The valve is thereby moved down within the cage P until the spring-plungers *o* and V are depressed to their maximum extent. When in this position, the greatest diameter of the ball-valve N is located within the ring *n*, closely fitting the same. When, however, the valve-carrier and valve-seat M separate, the valve is lifted and at the same time moved laterally and partly rotated. The yielding support of the valve, in addition to its function of assisting to rotate the valve, also insures the valve accommodating itself to fit the seat. The pressure of the steam within the trap is sufficient to carry the discharge-water of condensation to a considerable height by attaching a suitable conducting-pipe to the outlet-nozzle *k*. The trap can, however, be used in connection with an injector to carry the water of condensation to a steam-generator or to a great height.

To adapt the trap to be used with an injector, cold water must be supplied to cool the water of condensation, and steam must be brought to operate the injector. The cold water which is supplied to the injector may be the water which has passed through the coil F in the condenser. In such a case a pipe would run from the coupling X below the condenser (see Fig. 1) to the injector. Steam for the injector can be taken from the upper part of the condenser, where the steam within the condenser is hottest and driest. For this purpose a steam-pipe W is shown in Figs. 1 and 8, extending vertically within the condenser, and which should open into the condenser near the top of the condenser. This pipe extends through the bottom C of the condenser, where may be coupled to it a pipe leading to the injector. A pipe would also be coupled to the outlet-nozzle *k* of the valve-casing to convey the water of condensation to the injector.

Where an injector is employed in connection with the trap, as here described, it may be used for pumping water, the source of water-supply being connected with the upper coupling D of the water-coil F. The injector would thus not only serve to pump water, but also secure the circulation of water and a constant flow of cold water in the water-coil.

The condensing steam-trap shown in Figs.

1 to 7, which has thus been described, provides a condenser which condenses the steam rapidly, thus creating a partial vacuum within the condenser and thereby drawing off the wet steam from the apparatus with which the condensing steam-trap is employed and maintaining the steam in such apparatus dry and hot. The double compound leverage employed between the thermo-expansible tube and the valve-carrier makes the valve mechanism very sensitive and insures a wide and sufficient opening of the valve. The valve and valve-seat move to and from each other in right lines, so that the valve and its seat co-operate properly.

In Fig. 8 a modification is shown, wherein the spider G is omitted, and the ties or binders I I are connected at their upper ends to the bottom head C of the condenser. In this modification, also, the ties or binders are shown as hollow pipes, serving as conduits for water and steam. In this figure the thermo-expansible tube L and the steam-delivery pipe D are omitted, as is also the valve mechanism, the figure being designed only to represent the modification in the ties or binders. The tube L would in this modification be screwed to the pipe E or directly to the bottom C.

In order to distinguish the several ties or binders from each other, they are lettered I′, I^2, and I^3, respectively. The pipe I′ is connected at its upper end with a T Y, which is connected with the head C by a plug Z, and which affords the means of communication with a cold-water-supply pipe. Each pipe I′ and I^2 extends through plate H and is provided below plate H with means for connecting with an injector, as shown. The pipe I^3 is employed as the instrumentality for furnishing steam to the injector by being connected with the pipe W within the condenser. The pipe I^2 is connected with the water-coil F, and serves as the means for conveying cold water to the injector. When the pipe I^3 is used as a steam-conveying pipe, it is not attached to the plate H but passes loosely through an aperture therein and is guided in said aperture by antifriction balls or rollers 2 2. It assists, however, in maintaining the plate H in proper horizontal position. The cold-water pipes I′ I^2 will also be found to be of considerable utility, even in cases where an injector is not employed with the trap. In many instances where traps of this character are employed the water of condensation is used on account of its purity, and it is desirable that cold water should be conveniently accessible at the place of use of the hot water from the condenser. The pipes I′ I^2 are then conveniently used as conduits for cold water. In case there is no use for the pipes the T Y, can be plugged and the open ends of the pipes I′ I^2 I^3 can be closed by caps.

I am aware that many of the generic features involved in the construction and operation of the trap, as described, are not new with me. For example, a condenser or vacuum-chamber in connection with a steam-trap is not new with me, and automatically-acting thermo-expansive traps are also old. It is old to have a valve-seat carried by an expansible tube or pipe and a valve which moves simultaneously with the valve-seat and in an opposite direction by reason of connections between the valve and the valve-seat. It is also old to connect a valve-chamber with a condenser by ties and to have the free end of a thermo-expansive tube movable in said valve-chamber.

The novel features of the present invention, generally speaking, consist in the oppositely-movable valve and valve-carrier with the ball-valve between them, the construction of the valve-seat and valve of Tobin bronze, the particular construction of the multiplying and reversing connections for operating the valve-carrier, the adjustable valve-carrier, the ball-valve rotator, and the utilization of the ties as cold-water and steam-conveying pipes.

I claim as my invention—

1. The thermo-expansible tube of a steam-trap having a valve-seat, in combination with a valve-carrier connected with said tube so as to move simultaneously with and oppositely to said valve-seat, and a ball-valve loosely held and carried by said carrier and co-operating with said valve-seat, substantially as set forth.

2. The thermo-expansible tube of a steam-trap having a valve-seat, the fixed plate H, and the valve-casing J, supported by said plate, into which valve-casing the free end of said thermo-expansible tube extends, in combination with a valve-carrier below said plate H, and extending within said casing J, and multiplying and reversing connections between said tube and said valve-carrier, said multiplying and reversing connections consisting of the links *v v*, connected with the thermo-expansible tube, the multiplying levers *u u*, pivoted at their inner ends to said plate H above the same and eccentrically connected with said links *v v*, the multiplying and reversing levers *t t*, eccentrically pivoted to said plate H below the same, said levers *u u* and *t t* being connected together at their outer ends beyond said plate H, and links *s s*, connecting the inner ends of said levers *t t* with the valve-carrier, substantially as set forth.

3. The thermo-expansible tube L of a steam-trap, having a valve-seat, the fixed plate H, and the valve-casing J, supported by said plate, into which valve-casing the lower free end of said thermo-expansible tube extends, the valve-carrier K below said plate H, and extending within said casing J, and the cross-bar or yoke *r*, by which the said valve-carrier is carried, in combination with collar Q, fixed to said tube L, the links *v v*, pivoted at their upper ends to said collar Q, the levers *u u*, pivoted at their inner ends to and above said plate H and eccentrically connected with the

lower ends of said links *v v*, the reversing-levers *t t*, eccentrically pivoted to and below said plate H, links *l l* beyond said plate H, connecting the outer ends of said levers *u u* to the outer ends of said levers *t t*, and links *s s*, connecting the inner ends of said levers *t t* with said cross-bar *r*, substantially as set forth.

4. The valve-seat, the ball-valve, and its carrier, said ball-valve and carrier moving to and from said valve-seat, in combination with a ball-valve rotator carried by said valve-carrier, substantially as set forth.

5. The ball-valve and its carrier, in combination with a ball-valve rotator consisting of a spring-actuated plunger which comes in contact with said ball-valve at one side of its vertical axis, substantially as set forth.

6. The ball-valve and its carrier, in combination with the centrally-located spring-actuated plunger *o* and the eccentrically-located spring-actuated plunger V, substantially as set forth.

7. In a steam-trap having a thermo-expansible tube which is fixed at one end to a suitable support and the other end of which moves (responsively to changes in temperature) in a valve-casing, ties connecting said support and said casing, said ties being tubular and adapted to serve as conduits for cold water and steam, substantially as set forth.

8. In a steam-trap having a condenser and a thermo-expansible tube which is fixed at one end to a suitable support and the other end of which moves (responsively to changes in temperature) in a valve-casing, ties connecting said support and valve-casing, said ties being tubular, a portion of said ties serving as conduits for water, and one at least of said ties communicating with the interior of said condenser and serving as a conduit for steam, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CYRUS TAYLOR.

Witnesses:
WALTER R. POOLEY,
GANSON DEPEW.