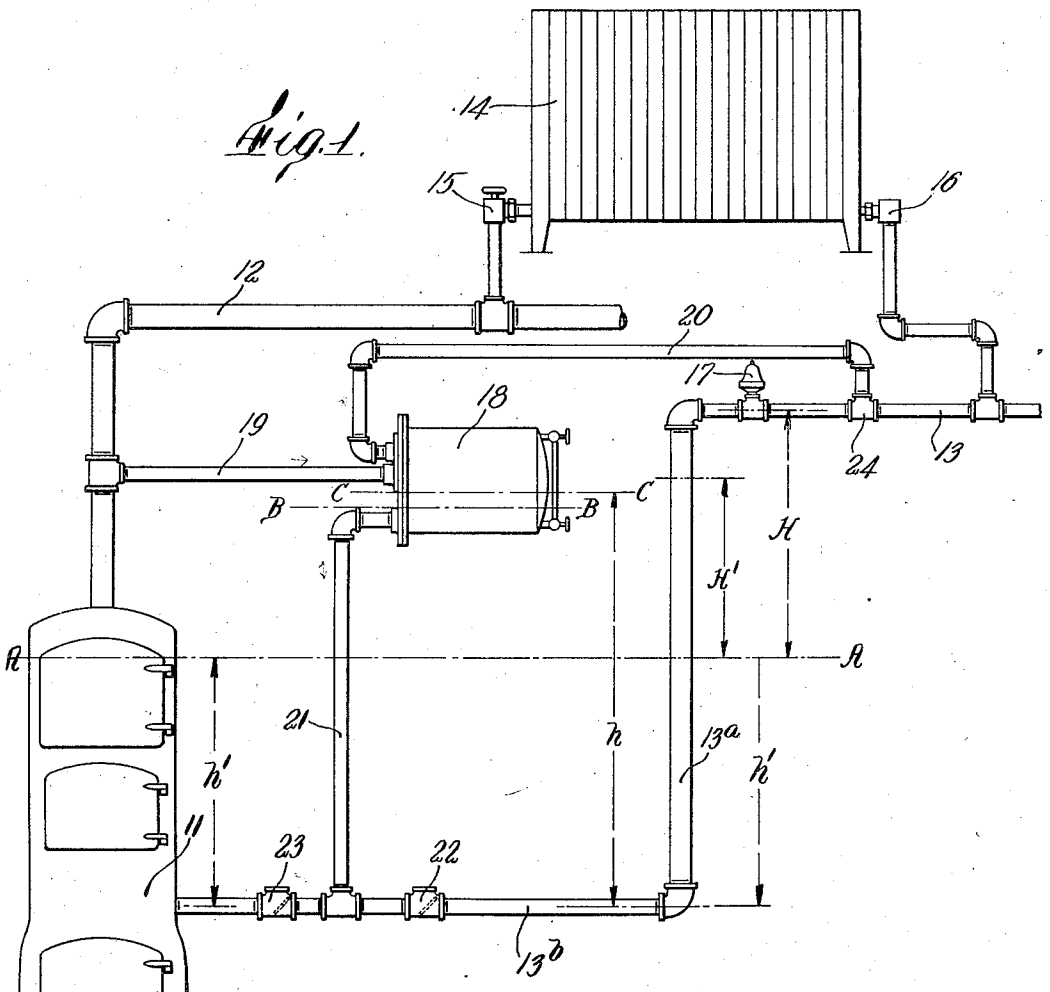
June 2, 1936. W. K. SIMPSON 2,043,073

BOILER RETURN TRAP

Filed July 23, 1932 3 Sheets-Sheet 1

Fig. 1.



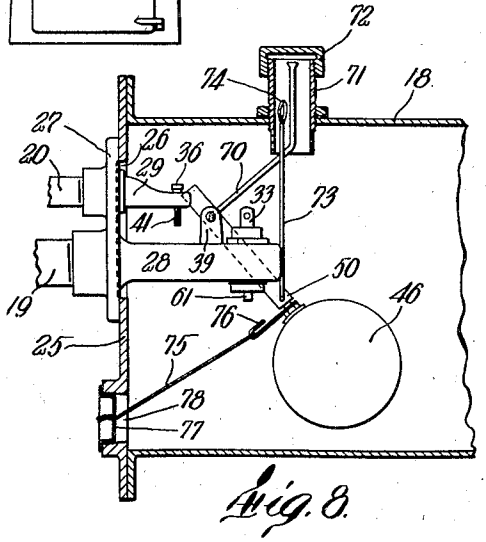


Fig. 8.

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Fig. 2.

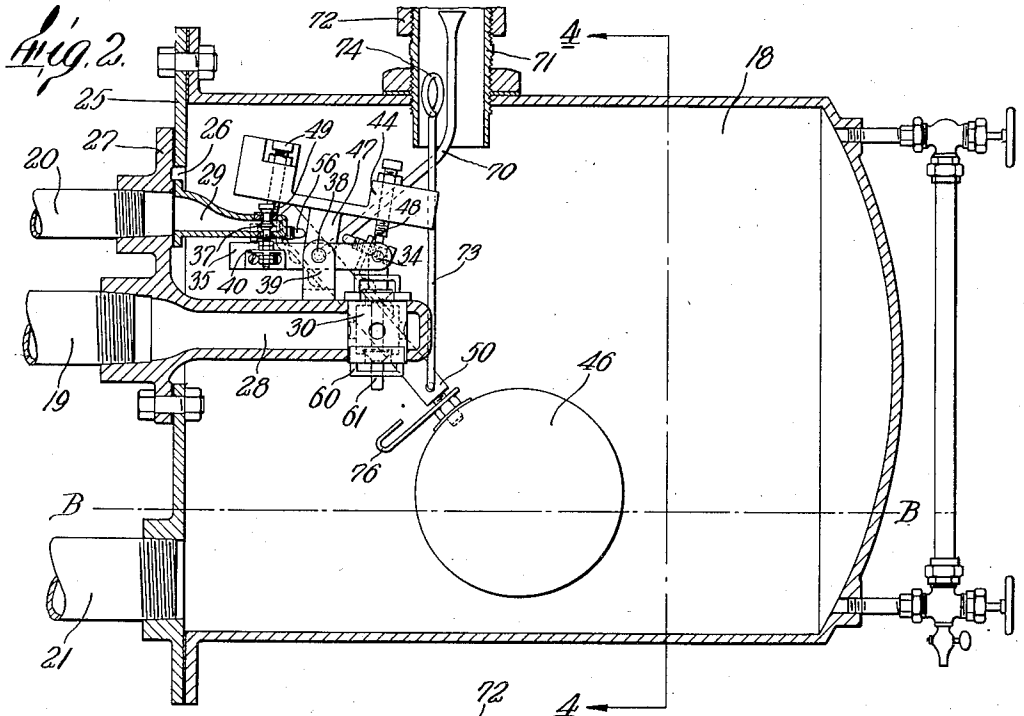

Fig. 3.

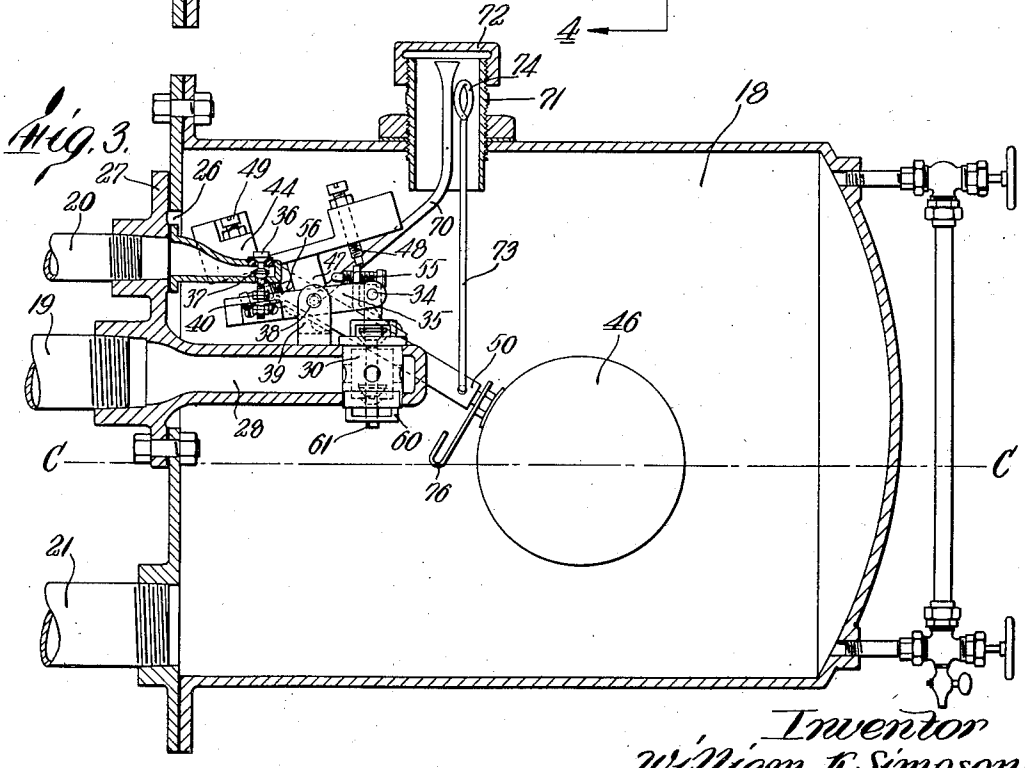

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Fig. 4

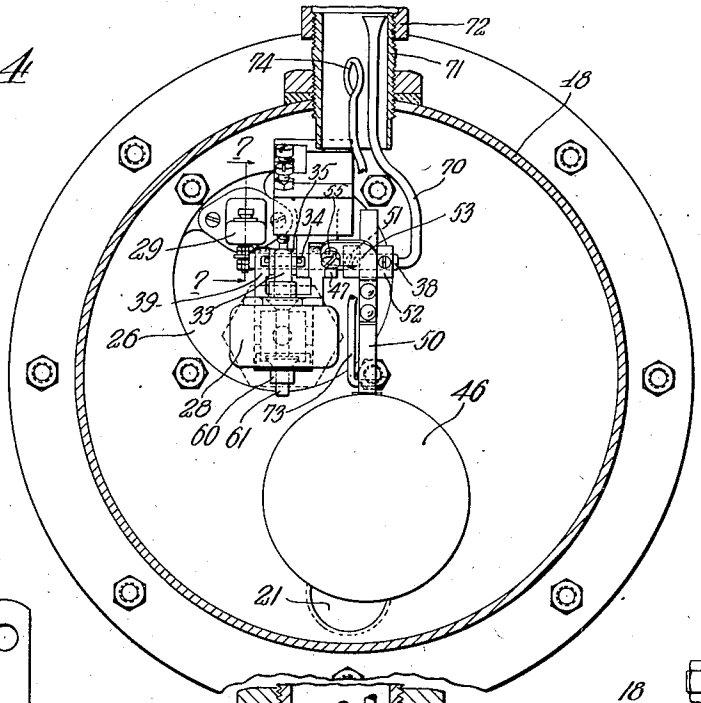


Fig. 6.

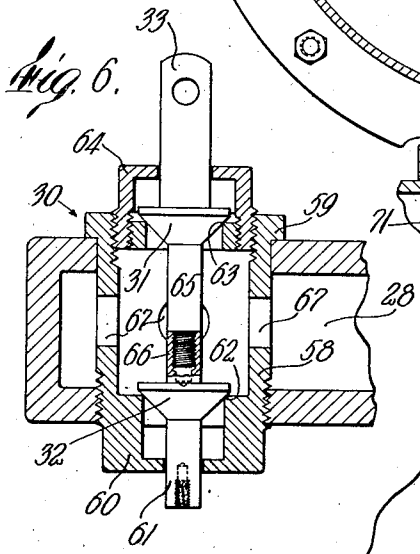


Fig. 5.

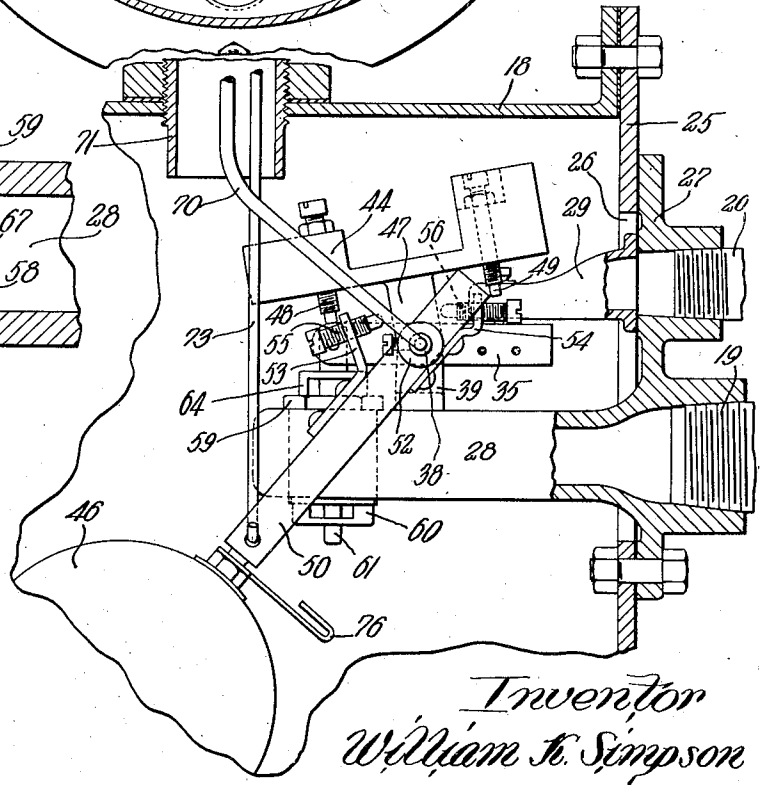
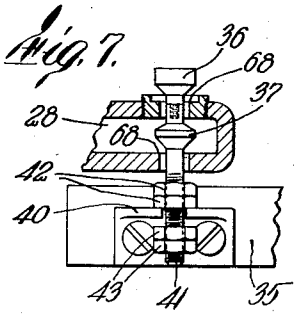


Fig. 7.



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Patented June 2, 1936 2,043,073

UNITED STATES PATENT OFFICE

2,043,073

BOILER RETURN TRAP

William K. Simpson, Waterbury, Conn., assignor to Hoffman Specialty Company, Waterbury, Conn., a corporation of Illinois

Application July 23, 1932, Serial No. 624,172

9 Claims. (Cl. 137—103)

This invention relates to traps for effecting return of water of condensation to a boiler under the combined effects of gravity and the boiler pressure. It is intended, and the embodiment herein illustrated is designed, particularly for use with steam heating systems where the boiler pressure is of moderate amount, i. e., is not more than a few pounds. However, the scope of protection which I claim is not limited to a specific range of boiler pressures, for the essential principles are applicable to any steam generating system in which the condensate of steam after use is returned to the boiler. It is to be understood therefore that the following description of a specific embodiment is illustrative of the invention and not narrowly limiting as to its scope.

In the drawings furnished herewith,—

Fig. 1 is a diagrammatic view illustrating the installation of my steam trap in a typical low pressure steam heating installation;

Fig. 2 is a longitudinal section of the trap showing the working parts in the position taken when the steam admission valve is closed;

Fig. 3 is a similar view of the trap showing the parts in a different position; that wherein the steam admission valve is open and the exhaust valve closed;

Fig. 4 is a cross section of the trap taken on line 4—4 of Fig. 2 and looking in the direction of the arrows;

Fig. 5 is an elevation of the valve operating mechanism as seen from the opposite side to the viewpoint of Fig. 2, the body of the trap and external steam connections being shown in section;

Fig. 6 is a detail sectional view of the balanced valve controlling the steam inlet of the trap;

Fig. 7 is a fragmentary sectional view showing the steam exhaust valve and the operating arm which opens and closes it;

Fig. 8 is a sectional view omitting parts of the valve operating means in order to show more clearly the provisions for lubricating such means and freeing them after prolonged periods of inaction.

Like reference characters designate the same parts wherever they occur in all the figures.

In Fig. 1 a typical steam boiler adapted for house heating purposes is shown at 11. 12 is the steam main, 13 the return line, and 14 one of the radiators which is coupled with the steam main through a valve 15 and with the return line through a trap 16 which permits outflow of air and water but closes thermostatically to confine the steam. 17 is a thermostatic vent valve of well known character connected in the return line to relieve air and having a float and thermostatic means to prevent escape of water and steam.

The line A—A represents illustratively the normal level of water in the boiler when there is no steam pressure. The major part of the return line, to which all the radiators of the system are connected, is above this level. The descending pipe 13a and a lower pipe section 13b continue the return line to connection with the boiler at a point below the water level.

In the ordinary gravity return heating system water rises in the return line to a head sufficient to balance the boiler steam pressure, and as condensation accumulates above this head, it is forced into the boiler. It is necessary in practice that all but a minimum of the return line be higher than this head in order to prevent accumulation of so much water in the return line as would deplete the boiler and uncover part of its heating surfaces, and conversely to prevent flooding of the steam space in the boiler when the pressure subsides. Such a system should always be so operated that the steam pressure will not exceed a water head equal to H, the distance from the water line A—A to the bottom of the return line 13, in order to avoid backing up of much water into the return line. But the usual limitations of space available for installation of steam heating systems make the height H so small that only very low steam pressures can be carried without flooding the return line; so low that difficulty is encountered in delivering steam to remote radiators, unless extra large steam mains are provided. Large pipes, however, are objectionable because expensive, and unsightly in comparison with smaller pipes which would be adequate with greater steam pressures. Also it is not possible always to regulate the fire so that the back pressure head will never exceed a height H of moderate amount. With a coal fired boiler even automatic damper regulators are ineffective if the ash pit door is accidentally left open. With oil fired boilers it is often desirable to develop pressures of from three to five pounds in order to reduce the frequency of firing periods, and such pressures would require the value of H to be from seven to twelve feet. Ordinary dwelling house construction does not provide room for such a height.

In order to overcome these difficulties and insure return of condensed steam to the boiler,

without possibility of flooding the return line and without the use of pumps, I have devised a steam trap which is shown at 18 in Fig. 1. This trap is connected with the steam main by a pipe 19, with the dry return line by a pipe 20, and with the terminal section 13b of the return line by a pipe 21. Check valves 22 and 23 are also interposed in the return line section 13b, one on each side of the connection with pipe 21, both of which open toward the boiler and prevent flow in the direction away from the boiler. The trap is mounted at any desired height between the level A—A and the level of the dry return line 13; that is, that part of the trap in which water rises and falls is so located; the top and bottom boundaries of its shell may be at any height.

Pipe 20 provides for exhaust of steam from the trap to the return line and it is therefore made of great enough length, and connected to the return line at a point 24, far enough away from the vent valve 17, to insure condensation within it of practically all the steam exhausted from the trap and to prevent such exhaust steam from reaching the thermostat of vent valve 17 and closing this valve.

Referring now to Figs. 2 and 4, for a showing of the details of the trap, numeral 18 there is applied to the trap body or shell. One end of the shell is closed by a removable cover or head 25 in which there is an opening receiving one end of the pipe 21. This opening is near the bottom of the trap. A second opening 26, at a higher level, is covered by a plate or secondary cover 27 to which the steam inlet and exhaust pipes 19 and 20 are connected, and which carries the valves and supports the interior working parts.

The plate 27 has an elongated hollow extension 28 projecting inward in registry with pipe 19, and a similar extension 29 in registry with pipe 20. One of these extensions is shown as integral with the plate and the other as detachably secured to it; but both may be integral or both detachable.

Extension 28 is closed except for alined top and bottom holes near its inner end in which is set, a steam inlet valve 30. This is a balanced valve containing two valve disks 31 and 32, the stem 33 of which extends upward and is connected by a pivot at 34 with one arm of a lever 35. The other extension 29 is closed except for ports in its top and bottom walls which are controlled by balanced valve disks or bodies 36 and 37.

Lever 35 is a bar forked at one end to embrace valve stem 33, and is pivoted on a rod 38 which is held stationary in two separated uprights of a bracket 39 which is mounted and secured on the top side of the hollow extension 28. The arm of this lever at the opposite side of pivot 38 from the valve stem 33 carries a laterally projecting forked bracket 40 which embraces the stem 41 of balanced valve 36, 37, between adjustable stop and lock nuts 42, 43, threaded on said stem. These nuts are suitably adjusted, with whatever lost motion may be needed, to enable either balanced valve to be opened when the other is closed, and vice versa, with movements of the lever 35 caused by an overbalanced weight 44 controlled by a float 46.

Weight 44 has a forked lug 47 projecting from its under side, the branches of which embrace the right hand (Fig. 4) upright of bracket 39 and are perforated to receive and fit freely on the pivot rod 38. The weight is relatively long, wide and massive, and a part of it overlies the lever 35. By virtue of these characteristics, and the length of lug 47 which raises its center of gravity well above the pivot shaft 38, it is unstable and readily overbalanced so as to fall toward one side or the other of the pivot shaft. It carries adjustable impact screws 48 and 49 arranged to bear respectively on the opposite arms of the lever 35, with such lost motion as is needed to shift its center of gravity from one side to the other of the pivot before it moves the lever.

Float 46 is connected by a screw and lock nut with one end of a bar or arm 50 which has a perforation receiving and turning about the pivot shaft 38. It is retained in position by flanking collars 51 and 52 which are secured by set screws to the shaft. Two arms, 53 and 54, are secured to the bar 50 and carry adjustable screws 55 and 56 at opposite sides of the lug 47 of the weight, whereby they are adapted to tilt the weight from one overbalanced position to the other as the float rises and descends, with provision for any necessary amount of lost motion of the float.

Having described the main characteristics of the trap, I will now explain its mode of operation, before describing certain other details which are also important and for which I claim protection.

With the movable parts in the position shown in Figs. 2, 4, and 5, the steam inlet valve 31, 32 is closed and the exhaust valve 36, 37 is open. Atmospheric pressure thus exists in the trap casing because in these circumstances the vent valve 17 is open to the atmosphere. Water is prevented by the check valve 23 from backing out of the boiler into the return line or into the trap no matter what the boiler pressure may be. As water of condensation accumulates in the upright leg 13a, it passes the check valve 22 when its head is sufficient to overcome the resistance of the valve, and thereafter it rises in the pipe 21 also. Eventually the water enters the trap casing and rises therein. When it passes approximately the level B—B shown in Figs. 1 and 2, it commences to raise the float. In rising, the float tilts the weight 44 to its dead point. Although the pressure of the weight is then relieved from the inlet valve, the latter does not open because the steam pressure on the disks 31 and 32 is equal, or may be made slightly greater on the disk 32, if desired, in order to insure retention of the valve in closed position.

As soon as the weight passes the dead point, as it does when the water has risen to approximately the level C—C, it drops suddenly to the position shown in Fig. 3, impelling by its screw 49 the lever 35 to close the exhaust valve and open the inlet valve. Steam at boiler pressure then fills the trap. This pressure plus head h is greater than the combined boiler pressure plus head h' plus the resistance of check valve 23, wherefore the check valve will open and allow water to flow to the boiler. Also the head h plus boiler pressure plus the weight of check valve 22 is greater than the combined heads h' and H', (H' being the height to which water may rise in the return line in filling the trap up to level C—C), wherefore check valve 22 remains closed and water is not forced back into the return line. As the water in the trap subsides, the float descends and tilts the weight in the opposite direction until, when the level has been lowered to approximately the line B—B, the weight falls again to the position shown in Fig. 2, suddenly closing the steam admission valve and opening the exhaust valve, whereby the steam in the trap is released. These actions are repeated alternately as long as the system continues in operation at a pressure greater than that at which water can return to boiler by gravity.

Provision is made for adjustment of the balanced valves to insure simultaneous and equally close seating of both members or disks of each. The steam inlet valve is shown in detail in Fig. 6. It comprises a hollow body or casing **58** passing through a hole in the top side of the inlet extension **28**, the rim of which is overlapped by a flange **59** on the body, and screwed into a tapped hole in the bottom side of the extension. Its lower end is made as a yoke **60** having a guideway through which the tail stem **61** of the valve disk **32** passes, and having ports in opposite sides opening to the passageway which is surrounded by a valve seat **62**. The seat **63** for the valve disk **31** is made in or on a ring which is screwed into a yoke **64**. This yoke has a central guide passage for the stem **33** and lateral ports, and it is screwed into the open end of the casing **59**. Thus equal seating of both valve disks at once is made possible. The disks **31** and **32** are constructed separately from one another with stem sections **65** and **66** which are screwed together; a construction which permits assemblage in the arrangement shown. Ports **67** in the sides of valve casing **58** permit flow of boiler steam past both seats **62** and **63** and out through the ports in yokes **60** and **64** when the valve is open.

The exhaust valve, shown in detail in Fig. 7, is so made that the valve disk **37** cooperates directly with a seat **68** surrounding a port through the bottom wall of the extension **29**, and the disk **36** cooperates with the seat **69** in a ring which is screwed into the top wall of this extension and is thereby made adjustable. The two disks are detachably screwed together, as shown by dotted lines. This valve may equally well be of the same character and design as the admission valve; and conversely the admission valve may have the same construction and design as the exhaust valve.

A practically valuable feature of the invention resides in the assemblage of the valve operating weight, lever, and float, previously described. Pivot shaft **38** is held immovably in the uprights of bracket **39**, by any suitable means known in the mechanic arts. The forked lug **47** which holds the weight **44** on the pivot shaft, by embracing one of the uprights of bracket **39**, dispenses with all special means for retaining this, the heaviest piece of the apparatus, in its proper place. Lever **35** in turn is confined in its place between said lug and the other upright of the bracket. The shaft of course is put and secured in place after the holes for receiving it in the bracket uprights, the lug **47** and the lever **35**, have been alined.

When used in connection with domestic heating systems, the trap is allowed to lie idle for a long time during the summer season when the heater is out of use. When the water used in the system contains sediment, scale, oil, mineral salts, etc. there is a tendency for the moving parts to stick or corrode, and consequently to fail to operate properly when again put in action. The use of noncorrodible alloys, while helpful so far as avoidance of corrosion alone is concerned, is ineffective to prevent sticking by deposit of dirt, mineral salts, etc. on the moving parts.

To avoid and overcome difficulties from this cause, I have devised as part of this invention, means for lubricating the sliding parts, and means for applying force, greater than the forces acting in ordinary operation, for moving them. Lubrication is effected by making the pivot shaft hollow, with one end plugged, connecting an oil tube **70** to the open end of the shaft, and providing holes in the side of the shaft from its inner passageway to the surfaces on which the pivoted parts have their bearings. The oil tube extends to a fitting **71** passing through a wall of the trap casing at any convenient location, which is normally closed by a cap **72**, a plug or any other suitably tight closure. Oil may be poured into the tube for lubricating the parts, or a solvent for mineral salts may be similarly delivered, or a hose may be connected to the tube for flushing out the bearing surfaces by water under pressure.

To overcome initial sticking, a light but stiff wire rod **73** is connected to the float lever, and extends into the fitting **71**, whereby its upper end is guided as the float rises and falls, and is accessible for manipulation. The upper end of this rod has an eye **74** or a hook, or other suitable coupling element for connection with a hook in the hand of the operator, whereby to move the float lever up and down. By thus moving it, and thereby the weight and the rock lever **35** for the valves, initial sticking is overcome and oil admitted through the tube **70** is worked between the rubbing surfaces. I have shown for simplicity and convenience, the tube and rod extending into the same fitting or nipple. This is not essential, however, for the tube may be led to some other accessible point if desired.

The member **75** in Fig. 8 represents a tie member applied to prevent the moving parts from knocking about during shipment of the trap. This tie member is a loop of wire of which the bend is passed over a hook **76** permanently connected to the float lever, and the ends are passed through two separated holes in a temporary plug cover **77**, of inexpensive sheet metal, set in the opening **78** which is provided for reception of the water connection pipe **21**. The extremities of the wire loop outside of the plug are twisted together to make the tie member taut. Then the float lever, by means of its impulse screw **56** presses on the weight **47**; which in turn by means of impulse screw **48** presses on the valve controlling lever **35** and holds both valves firmly in position; thus preventing seating surfaces of the valves, and the abutment faces of other parts, from being injured with rough handling of the trap. When the trap is installed, the tie wire and plug are removed, leaving the float lever free.

What I claim and desire to secure by Letters Patent is:

1. A boiler return trap comprising a shell, inlet and outlet extensions projecting into said shell, a balanced inlet valve in one of said extensions, a balanced outlet valve in the other of said extensions, a tiltable weight, a tiltable lever operable by the weight and having arms at opposite sides of its fulcrum each connected independently to one of the valves, so that when tilted in one direction said lever opens the outlet valve and closes the inlet valve and, when the weight is tilted in the opposite direction, it closes the outlet valve and opens the inlet valve, provisions for admission of water into the trap casing, a float adapted to rise and descend with the water in the trap, and means comprising a pivoted float lever to which the float is secured and adjustable set screws carried by said lever in position to act oppositely on the weight, whereby the float tilts the weight in respectively opposite directions as it rises and descends.

2. A boiler return trap comprising a shell having a water connection in its lower part, a float arranged to be raised and lowered with rise and

descent of water in the shell, a weight pivoted with its center of gravity above the pivot axis, a lever pivoted on the same axis with said weight, to which the float is secured, having adjustable impulse devices on opposite sides of a part of the weight so arranged that the float in rising and descending tilts the weight in respectively opposite directions past its dead point, said weight having laterally separated masses on respectively opposite sides of the vertical through its axis, steam inlet and outlet valves, and means by which the weight in falling to one side of its dead point opens the balanced inlet valve while closing the balanced exhaust valve, and in falling to the opposite side of its dead point closes the inlet valve while opening the exhaust valve.

3. A boiler return trap comprising a shell having a water connection and inlet and outlet connections for steam, a balanced valve in each of said steam connections arranged to close and open the communication thereof with the trap interior, a lever having two arms each coupled separately with one of said valves in such fashion as to close either valve while opening the other, said arms and valves being on respectively opposite sides of the lever fulcrum, a weight pivoted unstably with capacity to fall to either side of its dead point and having means for swinging said lever in one direction or the other according to the side toward which the weight falls, and a float having lost motion means for raising the weight and moving it past its dead point from one side or the other as the float moves up or down respectively with rise or descent of the water level in the trap.

4. In a boiler return trap separate connections for inflow and outflow of steam respectively, a balanced controlling valve in each of said connections, a pivoted weight having laterally separated weight masses above, and at opposite sides of the vertical through its pivotal axis, whereby it is adapted to fall toward either side of the axis according as it is tilted in one direction or the other by the after mentioned float; transmission means having provision for lost motion between said weight and valves whereby the weight in falling toward one side is enabled to open the inlet valve while closing the outlet valve, and in falling toward the other side to close the inlet valve while opening the outlet valve, and a float having means for tilting the weight from either lowered position past the dead point in rising or descending respectively.

5. In a boiler return trap, a shell having an inwardly protruding steam connection fitting provided with ports in its top and bottom sides constituting its only communication with the interior of the trap, a balanced valve for opening and closing said ports, a bracket having separated uprights mounted on top of said fitting, a stationary pivot shaft mounted in said upright, a lever pivotally mounted on said shaft and coupled to said valve, a weight having a forked lug embracing one of said uprights pivoted on said shaft with its center of gravity above the shaft and so disposed as to be shiftable to either side of the dead point, impact means carried by the weight arranged to bear on the lever alternately at opposite sides of the pivot shaft as the weight falls to one side or the other of its dead point, a second steam connection protruding into the trap, a balanced valve controlling communication with said second connection and being coupled with said lever to be opened when the first valve is closed, and vice versa, and a float having means for tilting the weight past its dead point from one side or the other according as the float is raised or lowered.

6. A return trap comprising a shell adapted to be connected with the water return line to a steam boiler for inflow and outflow of water through such connection, a hollow extension protruding into said shell adapted to be connected externally with a steam connection and being otherwise closed except for ports in its upper and lower sides within the shell, a valve having substantially balanced valve elements arranged in relation to the respective ports for opening and closing the same and having an upwardly extending valve stem, a second inward extension closed except for ports in its top and bottom sides and having an external outlet, a balanced valve in said second extension having a downwardly protruding stem, a bracket mounted on the upper side of the first extension, a pivot rod secured in said extension, a lever pivoted between its ends on said rod having one arm in connection with the stem of the first balanced valve and its other arm connected with the stem of the second named balanced valve, one of said connections having provision for lost motion, and the arrangement being such that when the lever is tilted in one direction the first valve is opened and the second valve closed, and when tilted in the opposite direction the second valve is opened and the first valve is closed, a weight having separated masses and a downwardly projecting lug intermediate said masses pivoted on the pivot rod and having adjustable screws at opposite sides of the pivot in position to bear on the opposite arms of said lever when the weight is tilted so as to bring its center of gravity respectively to opposite sides of the vertical through the pivot axis, and a float having a connecting arm pivoted on the same pivot rod, said float being arranged to be raised and lowered with rise and descent of the water in the trap shell, and adjustable screws carried by the float lever at opposite sides of the lug of said weight adapted to engage said lug, with lost motion, and tilt the weight in opposite directions when the float rises and descends respectively.

7. A return trap comprising a shell adapted to be connected with the water return line to a steam boiler for inflow and outflow of water through such connection, two hollow extensions protruding into said shell adapted to be connected externally with separate steam connections and both being otherwise closed except for ports in their upper and lower sides within the shell, balanced valves cooperating with the ports in said extensions respectively, said valves being spaced apart laterally from one another, a pivoted lever having arms extending to opposite directions from its fulcrum, one of said arms being connected with one of the before named valves, and the other arm connected with the other valve, a weight pivoted on the same axis with said lever having laterally separated weight masses at respectively opposite sides of the vertical through said axis and so disposed that the center of gravity of the weight as a whole is above the axis, adjustable impact elements mounted in said weight masses and respectively disposed so as to bear on the different arms of the lever when the weight is tilted to shift its center of gravity from one side to the other of the vertical through said axis, a float pivoted on the same axis with said weight and lever, and adjustable means connected with the float for applying tilting force in one direc-

tion or the other to the weight as the float rises and descends respectively.

8. In a steam trap of the character set forth, a valve and means for operating the valve consisting of a bracket having laterally separated uprights, a shaft mounted in said uprights crossing the space between them and extending at one end beyond one of the uprights, a weight having a forked lug embracing one of said uprights and pivoted on said shaft, the body of the weight being above said lug and having laterally separated weight masses on its ends, a valve controlling lever mounted on said axis between one arm of the forked lug and the bracket upright other than the one which is embraced by the lug, a float arm pivoted on the outwardly extending portion of said pivot, collars secured to the pivot at opposite sides of the float arm for holding the latter in position, adjustable screws carried by said float arm located on opposite sides of said forked lug whereby to apply a tilting impulse to the weight in one direction or the other as the float arm rises or descends respectively, and adjustable screws mounted in the separated weight masses of said weight in position to engage the different arms of the lever and tilt the latter as the weight is tilted to one side or the other.

9. In a boiler return trap, a valve, a float lever, intermediate motion transmission connections between the float and valve, a stationary hollow pivot shaft on which said float lever and connections are mounted for angular sliding movement, said shaft having lateral holes from its interior passageway to the areas on which said sliding parts have their bearings, and a normally stationary conduit leading from a point accessible from the exterior of the trap into connection with the inside of said shaft for conveyance to the bearing surfaces of lubricant, or of a solvent of mineral salts, or a flushing liquid under pressure.

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