No. 824,143. PATENTED JUNE 26, 1906.

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LIQUID LEVEL APPARATUS.

APPLICATION FILED OCT. 11, 1905.

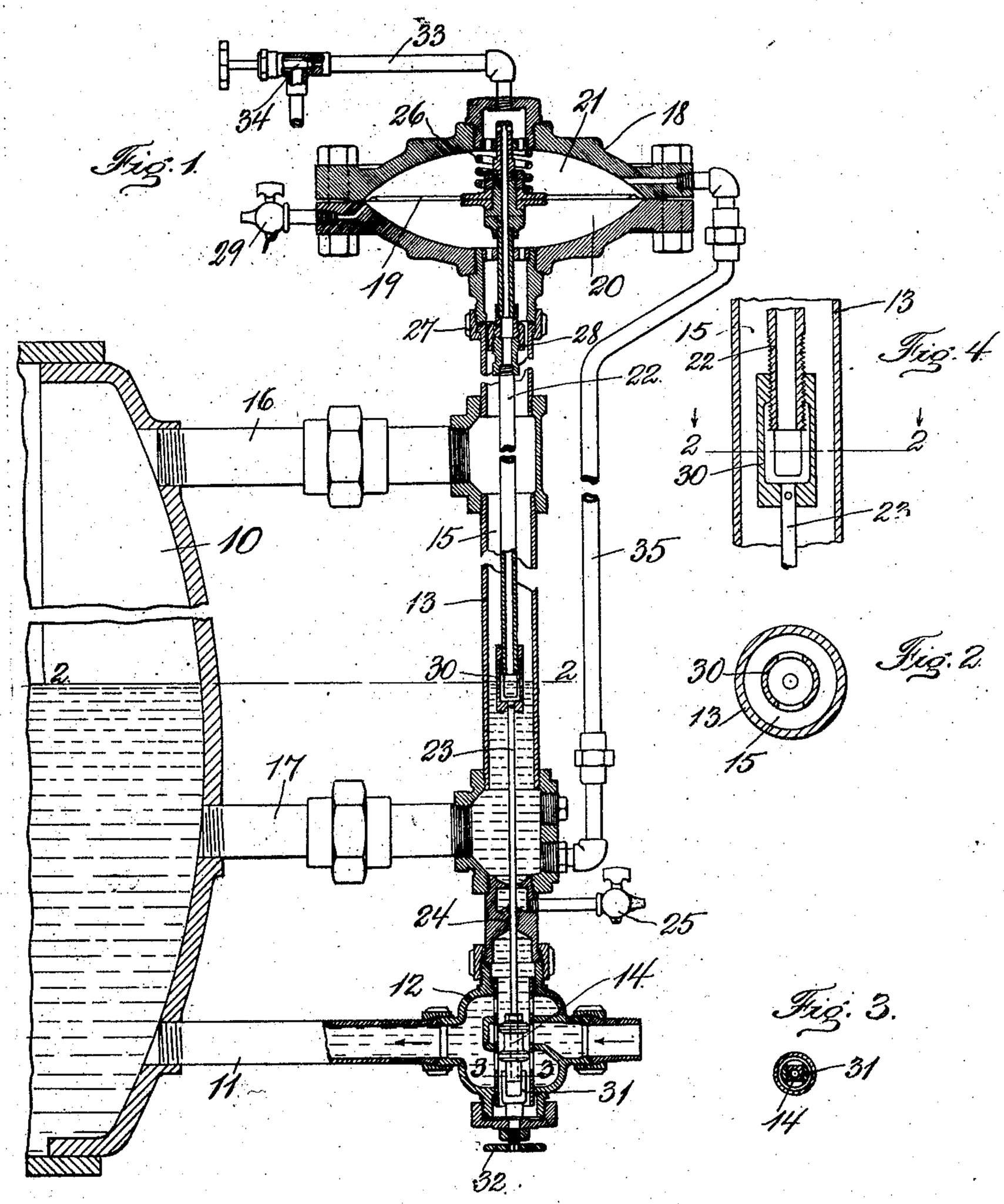

Fig. 1.

Fig. 4.

Fig. 2.

Fig. 3.

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LIQUID-LEVEL APPARATUS.

No. 824,143. Specification of Letters Patent. Patented June 26, 1906.

Application filed October 11, 1905. Serial No. 282,286.

To all whom it may concern:

Be it known that we, SIDNEY A. REEVE, residing at Worcester, county of Worcester, and EDWARD P. NOYES, residing at Winchester, county of Middlesex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Liquid-Level Apparatus, of which the following specification and accompanying drawings illustrate one form of the invention which we now regard as the best out of the various forms in which the invention may be embodied.

This invention relates to liquid-level-controlled devices applicable to a vessel containing a liquid and an elastic fluid under pressure—for example, a steam-boiler—and adapted to perform a useful function with respect to said vessel, such as controlling the inflow or exit of liquid or gaseous contents, giving an alarm, &c.

The invention involves the differential action of constant and variable pressures derived from the vessel on a movable member, such as a diaphragm, under control of the liquid-level in the vessel, and among the objects sought are a sensitive and powerful action, durability, low cost, and adjustability.

Of the accompanying drawings, Figure 1 represents a sectional view of a liquid-level apparatus embodying our invention and applied to a vessel assumed to be a steam-boiler. Fig. 2 represents a section on the line 2 2 of Fig. 4. Fig. 3 represents a section on the line 3 3 of Fig. 1. Fig. 4 represents an enlarged vertical section of the lower end of the dip-tube and adjacent parts.

The same reference characters represent the same parts in all the views.

Referring to the drawings, in which for the sake of illustration the invention is shown as applied to regulate the feed-water supply of a boiler, 10 designates the boiler with normal water-line at about the line 2 2 and supplied with water through a feed-pipe 11, adapted to be connected with a feed-pump. In this is placed a valve-casing 12, forming the lower part of the controller-casing 13 and containing a balanced valve 14, whose vertical movement opens and closes the feed-pipe, and thus controls the delivery of feed-water to the boiler. The feed might be controlled in other well-known ways, and for the purpose of interchangeability we have made the valve-casing 12 asymmetrical with respect to its median horizontal axis, so that on disconnecting it and turning it end for end about said axis without changing the position of the valve the ports of said valve-casing instead of being closed by an upward movement of the valve, as in the drawings, will be opened by such movement, thus adapting the valve to act as a by-pass (with suitably revised connections) instead of a direct feed-throttle.

The controller-casing 13 contains a main chamber 15, which is connected by branch pipes 16 17 with the steam and water spaces, respectively, of the boiler 10, so that the same water-level is maintained in said casing as in the boiler, the chamber 12 being, like an ordinary water-column, practically a part of the boiler. At the upper end of the casing 13 is located a diaphragm-casing 18, containing a flexible diaphragm 19 with a chamber 20 below it forming a continuation of the upper part of chamber 15, and thus constantly filled with steam at normal boiler-pressure, and with a chamber 21 above it subject to variations in steam-pressure Diaphragm 19 is attached to valve 14 by a connection, whose upper part is a tube 22, called the "dip-tube," having an inlet at the intended water-line and an outlet to th upper diaphragm-chamber 21, and whose lower part is a rod 23, constituting the stem of the valve 14. Said stem passes through a partition 24, dividing the chamber 15 from the valve-casing 12, in which partition the valve-stem has a snug machine fit and is hydraulically packed by the boiler-water without requiring other packing. The upper face of this partition is upwardly coned to keep sediment from the valve-guide, and a blow-off cock 25 is provided for disposing of sediment. The lower face of the partition is also upwardly coned to guide the valve-stem into its aperture in assembling it with the dip-tube 22. A spring 26, pressing downwardly on the diaphragm, normally tends to open the valve 14 and establish the boiler-feed. Casing 13 and dip-tube 22 are coupled at 27 and 28 at about the same level for convenient assembling and taking apart. 29 is a valved vent or blow-off from the lower diaphragm-chamber.

The dip-tube is adjustably connected with

rod 23 by means of a short sleeve 30, screwing on the tube, and for the purpose of rotating the rod and sleeve the lower boss of valve 14 is embraced by a parallel-faced claw 31, imposing rotation on the valve, its stem 23, and the sleeve 30, but permitting their vertical movement, said claw being journaled in the lower wall of the valve-casing 12 and having an outside hand-wheel 32 for rotating it. A convenient adjustment from below is thus provided for varying the height of the valve 14 with respect to the diaphragm 19, and thus adjusting said valve with relation to its ports independently of the movement imposed by the diaphragm.

From the upper diaphragm-chamber 21 a vent-pipe 33 leads to any locality of lower pressure than the boiler and contains an adjustable vent-valve 34, through which a slight leakage is maintained, the opening of this valve being smaller than the inlet-opening of dip-tube 22, so that pressure in the upper diaphragm-chamber 21 will not become appreciably reduced when the dip-tube is uncovered. An outside stationary drainage-pipe 35 connects the upper diaphragm-chamber with the water-space of the casing-chamber 15 to permit the return to the boiler of water which is blown up through the dip-tube when the latter becomes uncovered.

In the operation of the regulator as shown, supposing the water-level to be below the inlet of dip-tube 22, the full boiler steam-pressure will exist in both lower and upper diaphragm-chambers 20 21, fluid-pressures on the diaphragm 19 will be balanced, and accordingly spring 26 will depress the diaphragm and open the valve 14, thus permitting feed-water to enter the boiler. The pump is supposed to deliver more water than the boiler evaporates, so that the water-level will rise and finally cover the inlet of dip-tube 22. The upper diaphragm-chamber 21 being then sealed from the steam-space of the boiler, the slight leakage established past vent-valve 34 (aided by condensation of steam) will rapidly reduce the fluid-pressure acting on the upper side of the diaphragm, water rises in the dip-tube as a measure of the differential thus created, and the preponderating pressure on the lower side of the diaphragm raises the latter and tends to close the feed-valve 14 and stop the feed; but this elevation of the diaphragm also tends to raise the dip-tube out of water, limit the amount of variation of the pressure in the upper diaphragm-chamber, and restore equality of pressure above and below the diaphragm at a slightly-higher water-level. If the level still continues to rise, the above action is repeated until evaporation and feed are balanced. If the level starts to fall, the foregoing action takes place on a descending scale, the feed-valve 14 being gradually opened wider or more frequently to permit a more copious feed or greater frequency of feed. Thus it will be seen that the diaphragm has a plurality of positions of equilibrium or balanced pressure corresponding to slightly-different liquid-levels. The covering of the dip-tube destroys the pressure equilibrium, and the raising of the inlet of said tube out of water neutralizes the force which destroyed said equilibrium. This is an important feature, for although our invention is operative and useful without it the use of the movable inlet gives a controlling motion of more delicate character and makes possible the partial opening and shutting of the controlling-valve to suit the need of the movement.

While a minute leakage is the preferred means of reducing the pressure in the upper diaphragm-chamber after the water has covered the inlet to said chamber, and we consider that this expedient has many advantages, we do not wholly confine ourselves thereto.

A useful feature in the construction and arrangement of our controller consists in the location of the diaphragm and the pump-valve at remote points, so that the former may be above the water-level and the latter below, making it unnecessary to carry the water-pipe and valve above the water-line, and also the provision of a simple hydraulic packing in the partition separating the boiler-section of the controller-casing from the pump-valve chamber, which enables the valve-stem to work with great freedom, but which would be difficult to maintain if the valve were at the same end of the casing as the unsubmerged diaphragm.

Our invention is capable of a variety of adaptations and modifications of structure to meet particular needs. It may be used as a gas or liquid trap, may control the height of a water seal, and may be combined with various additional mechanism designed to add to or modify its functions.

This application is in part a substitute for and continuation of our application, Serial No. 204,592, filed April 23, 1904.

What we claim as new, and desire to secure by Letters Patent, is—

1. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a movable member operated by differences in pressure of said elastic fluid for performing a useful function with respect to said vessel, a chamber on one side of said member constantly open to the upper space of said vessel, and a chamber on the opposite side of said member having an elastic-fluid inlet from said vessel sub[illegible] the liquid-level therein.

2. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a movable diaphragm above the liquid-line for performing a useful function with respect to said vessel, a cham-

ber on one side of said diaphragm having a free connection with the upper space of said vessel, and a chamber on the opposite side of said diaphragm connected with said vessel at the intended liquid-line, whereby the elastic fluid alternately enters and is shut off from the latter chamber by the liquid in said vessel.

3. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a member operated by differences of pressure of said elastic fluid thereon for performing a useful function with respect to said vessel, a chamber on one side of said member having an elastic-fluid inlet from said vessel subject to the liquid-level therein, and a leakage-outlet from said chamber for reducing the pressure in the latter and causing movement of said member when said inlet is covered by the liquid.

4. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a member operated by differences of pressure of said elastic fluid thereon for performing a useful function with respect to said vessel, a chamber on one side of said member having an elastic-fluid inlet from said vessel subject to the liquid-level therein, and a leakage-outlet from said chamber smaller in size than said inlet for reducing the pressure in the latter and causing movement of said member when said inlet is covered by the liquid.

5. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a differential member located above the liquid-line for performing a useful function with respect to said vessel, chambers on opposite sides of said member one of which is connected with the upper space of said vessel, the other having an inlet from said vessel at the intended liquid-line, and a leakage-outlet from the latter chamber.

6. In a liquid-level controller, the combination of a differentially-controlled movable member, a chamber on one side thereof having a leakage-exit and an inlet subject to the liquid-level in the controlled vessel, a chamber on the opposite side of said member subject to the pressure in said vessel, and means to adjust the size of said exit.

7. In liquid-level apparatus, the combination of a vessel for containing a liquid whose level varies and an elastic pressure-fluid, a device for performing a useful function with respect to said vessel and having a plurality of positions of equilibrium, means subject to the liquid-level for subjecting said device to a force which destroys its equilibrium, and means operated by the movement of said device to a new position of equilibrium for neutralizing the influence of said force.

8. In liquid-level apparatus, the combination of a pressure vessel having liquid and elastic-fluid contents, a device controlled by the liquid-level and operated by differences of elastic-fluid pressure produced by variation in said level, for performing a useful function in connection with said vessel, and means controlled by said device for establishing equilibrium of the fluid-pressures acting thereon, at a plurality of different liquid-levels.

9. In a liquid-level controller, the combination of a pressure vessel, a chamber having an inlet from said vessel subject to the liquid-level therein, and means controlled by the pressure in said chamber for limiting the amount of variation of said pressure.

10. In a liquid-level controller, the combination of a pressure vessel, a chamber having a pressure connection with said vessel and provided with movable pressure-varying means, and means controlled by the pressure in said chamber for limiting the movement of said means.

11. In a liquid-level controller, the combination of a pressure vessel, a chamber having an inlet from said vessel at the intended normal liquid-line, and means operated by the difference in elastic-fluid pressure between said chamber and the vessel for varying the height of said inlet.

12. In a liquid-level controller, the combination of a pressure vessel, chambers above the normal liquid-level in said vessel, one of which has a pressure connection with the vessel above said level, a movable partition separating said chambers, and a dip-tube carried by said partition connecting the interior of said vessel with the other of said chambers.

13. In a liquid-level controller, the combination of two chambers, an interposed movable member subject differentially to the pressures in said chambers, a feed-valve connected with said member, and externally-exposed means for adjusting said valve with respect to said member.

14. In a liquid-level controller, the combination of a casing having two diaphragm-chambers, a movable diaphragm separating said chambers, a feed-valve attached to the diaphragm and having a threaded adjustment for varying its distance from the diaphragm, and a rotary valve-adjuster mounted on the casing and connected for joint rotation and for relative longitudinal sliding movement with said valve, whereby the latter may be longitudinally adjusted with respect to the diaphragm.

15. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a differentially-operated member above the liquid-line, and a chamber on the upper side thereof having an inlet from said vessel subject to the liquid-level and a separate drainage-outlet leading to the liquid-space of said vessel.

16. The combination with a vessel adapted to contain a body of liquid and an elastic fluid under pressure, of a differentially-oper-

ated member above the liquid-line, a chamber on one side thereof having an inlet from said vessel subject to the liquid-level therein and carried by said member, and a stationary drainage-conduit leading from said chamber to the liquid-space of said vessel.

17. In a liquid-level controller, the combination of a casing having in one portion a differential member adapted to be located above the liquid-line of a vessel and in a distant portion a liquid-controlling valve adapted to be located below said line, an operating connection between said member and valve, chambers on opposite sides of said member for receiving an elastic-fluid pressure from said vessel, and a conduit connection extending from one of said chambers to the intended liquid-line in the direction of said valve and adapted to have its inlet alternately covered and uncovered by the liquid.

18. In a liquid-level controller the combination of a casing having at different heights a differential member and a valve-chamber, a liquid-controlling valve in the valve-chamber, conduit connections extending from said casing at different heights for connection with the steam and water spaces of a boiler or similar vessel, elastic-fluid-pressure chambers on opposite sides of said member, one of which has an inlet at the intended water-line between said member and valve and the other a boiler-inlet above said line, a partition separating the intermediate portion of the casing from said valve-chamber, and an operating connection between said member and valve traversing said partition and fitted for hydraulic packing therein by the boiler-water.

In witness whereof we have hereunto set our hands, before two subscribing witnesses, the 9th day of September, 1905.

SIDNEY A. REEVE.
EDWARD P. NOYES.

Witnesses:
C. F. BROWN,
A. W. HARRISON.