Sept. 27, 1938. T. J. SULLIVAN 2,131,335

APPARATUS FOR FEEDING WATER TO STEAM BOILERS

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Fig. 1.

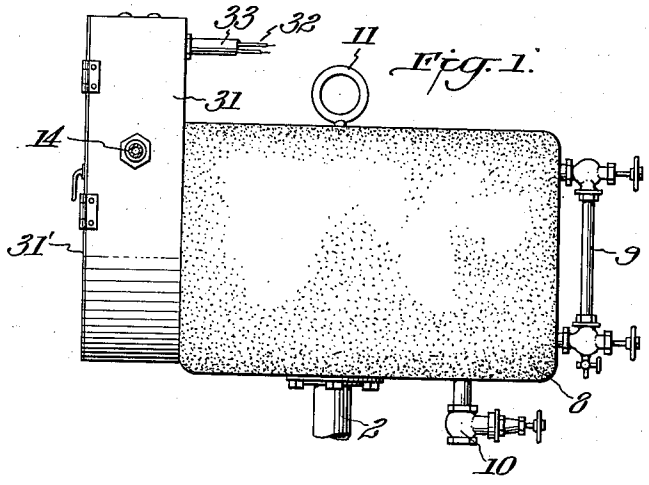



Fig. 4.

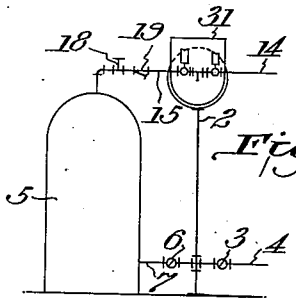



Fig. 2.

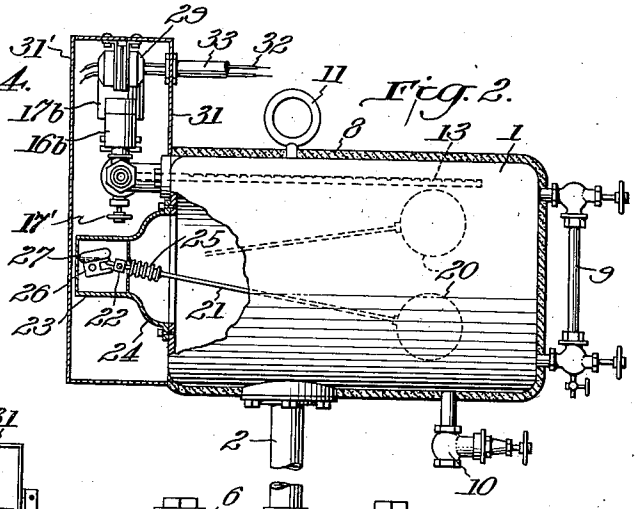
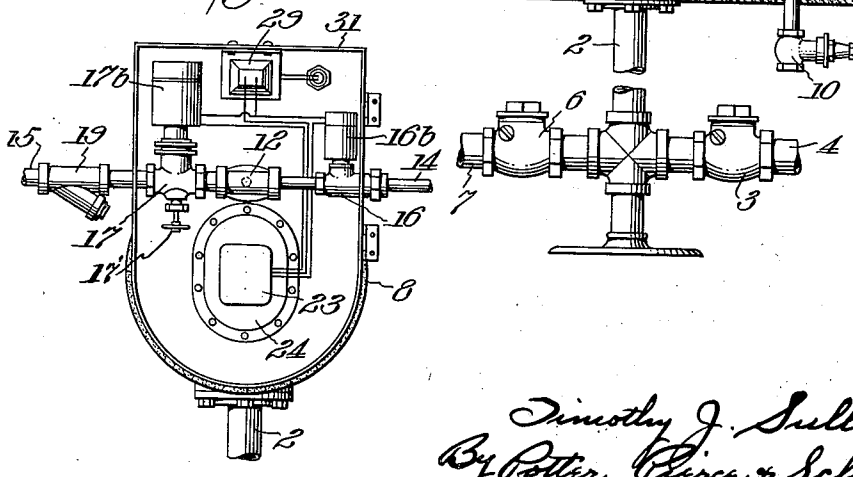



Fig. 3.




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Fig. 6.

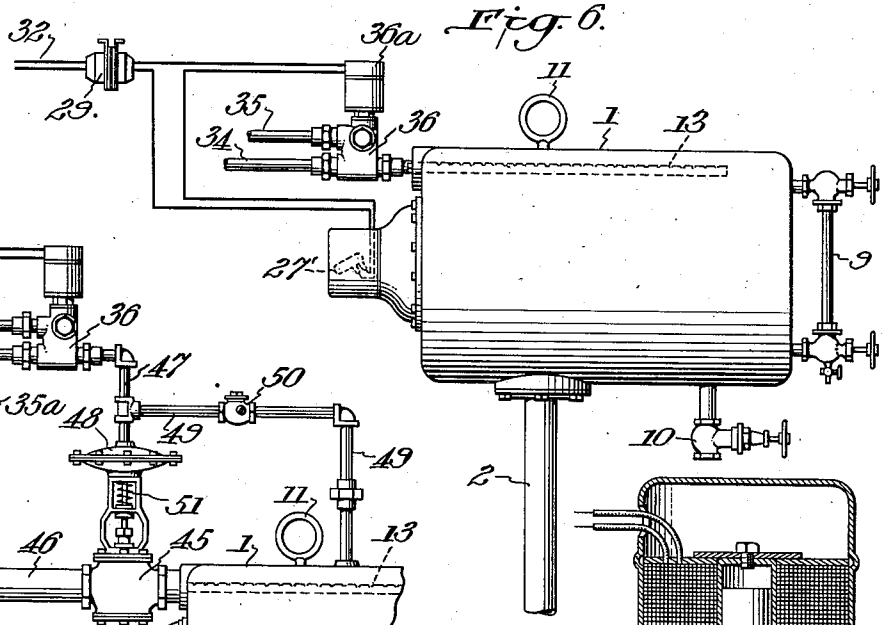



Fig. 8.

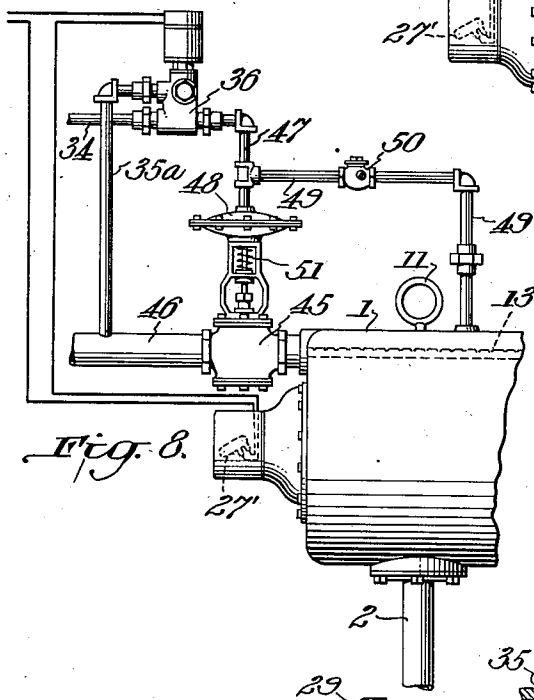



Fig. 7.

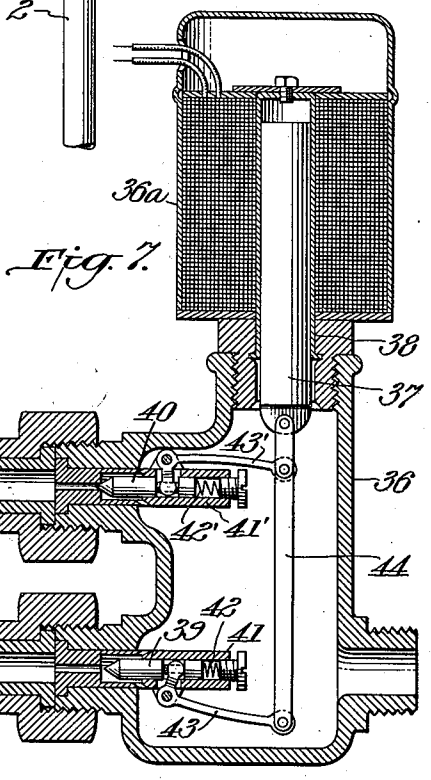
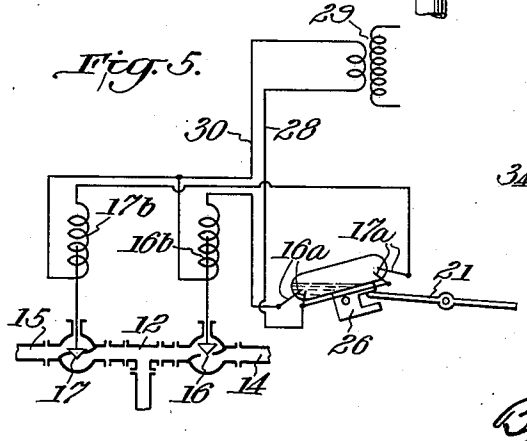



Fig. 5.




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Patented Sept. 27, 1938

2,131,335

# UNITED STATES PATENT OFFICE

2,131,335

## APPARATUS FOR FEEDING WATER TO STEAM BOILERS

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Application June 5, 1936, Serial No. 83,779

6 Claims. (Cl. 137—101)

This invention relates to improvements in apparatus for feeding water to steam boilers.

The invention relates particularly to that type of apparatus wherein the water to be fed to the boiler enters a sump or float chamber under a low or atmospheric pressure, and flows by gravity into the boiler when the chamber is placed under boiler pressure. The water may be the condensate from the devices supplied with steam from the boiler or may be fresh water supplied to maintain the proper level in the boiler.

It is an object of the invention to provide an improved form of control means for governing the admission of steam pressure to the chamber and the venting of pressure therefrom.

Another object of the invention is to provide an apparatus including a float chamber and valves outside the chamber for determining the pressure therein, the float extending to the exterior of the chamber through a flexible, hermetically sealed joint.

A further object is to provide a boiler feed chamber or return trap having electrically actuated valves which may be, and preferably are, of the type in which the moving parts are located entirely within the valve casings, thus eliminating the usual packings.

Other objects and advantages of the invention will become apparent as the description proceeds and upon reference to the accompanying drawings, wherein—

Fig. 1 is a side elevation of the principal parts of a preferred embodiment of the invention,

Fig. 2 is a similar view with some of the parts broken away and others in section,

Fig. 3 is an end view of the float chamber as seen with the door of the valve housing removed,

Fig. 4 is a diagrammatic view showing the application of the invention to a boiler,

Fig. 5 is a fragmentary circuit diagram of the electrical switch and the valve operating circuits,

Fig. 6 is a side elevation illustrating a modified form of the invention,

Fig. 7 is a sectional view of the control valve shown in Fig. 5, and

Fig. 8 is a side elevation of another modified form of the invention.

In the drawings, the reference numeral 1 identifies a sump or float chamber which is positioned above the boiler level and receives condensate return or feed water through a pipe 2, check valve 3 and pipe 4, when the chamber is under low pressure, and discharges water to the boiler 5 through the pipe 2, check valve 6 and feed pipe 7 when the chamber is under boiler pressure.

The chamber 1 may be provided with an insulating jacket 8, a sight gauge 9, a manual drain valve 10 and, preferably, with a ring bolt 11 to facilitate handling of the chamber during assembly or removal.

A T-fitting 12 opens into the upper part of the float chamber through a perforated pipe 13, and a vent pipe 14 and steam pipe 15 from the boiler are connected to the fitting 12 through electrically operated valves 16, 17, respectively. A manual shut-off valve 18 and steam strainer 19 are preferably included in the steam line 15. The circuits for actuating the valves are controlled by a float 20 and lever 21 which has a pivotal support 22 in a switch housing 23 that is mounted on the end cap 24 of the chamber 1, the switch housing being hermetically sealed from the chamber without using the customary packed joints by extending the lever 21 through the flexible metal bellows 25.

The outer end of the float lever 21 extends into a notch in the pivotally mounted plate 26 which carries a single mercury switch 27 having pairs of contacts 16*a*, 17*a* at its opposite ends or, alternatively, two oppositely arranged mercury switches each having a single pair of contacts. One contact of each pair is connected by a lead 28 to one side of the secondary winding of a step-down transformer 29, and the other contacts are connected to the respective solenoids 16*b*, 17*b* of the valves 16, 17. The secondary circuit is completed by a lead 30 from the other solenoid terminals to the secondary winding. The transformer is mounted on a sheet metal casing 31 that provides a housing for the valves, and the line connections 32 to the primary of the transformer are brought in through the usual conduit 33 that is secured to the casing. The closure 31′ for the casing is preferably a hinged door which permits ready access to the valves and transformer in case of inspection or repair.

The method of operation will be apparent from Fig. 2 and the wiring diagram, Fig. 5. The parts are illustrated in the positions which they occupy when the float has dropped to its low level operating point, i. e., the float lever 21 has rocked the switch plate 26 counterclockwise to connect contacts 16*a* through the ball of mercury. The solenoid 16*b* of the vent valve 16 is energized, the valve is lifted and the chamber is open to the vent pipe 14. Condensate return or feed water flows into the chamber until the float 20 is raised to that level which results in a clockwise tilting of the mercury switch by the float

lever 21. The mass of mercury rolls to the opposite end of the tube, thus opening the contacts 16a to permit valve 16 to close prior to the closing of the contacts 17a to energize solenoid 17b of the steam line valve 17. The water trapped in the chamber 1 can then flow to the boiler 5 by gravity, through pipe 2, check valve 6 and feed pipe 7. The float drops towards its lower level as the water is fed to the boiler, and the switch plate rocks again to open the circuit of the steam valve solenoid before the circuit of the vent valve solenoid is closed.

This successive operation of the switches is particularly advantageous since it eliminates the springs and/or snap-action levers and toggles which were used with mechanical control systems to effect an approximately simultaneous opening of one valve and closing of the other. The electrical control system has the further advantage that commercial types of "packless" valves may be used, thus avoiding the difficulties and annoyance of leaking valves. The electrical control has the further advantage that the valves 16, 17 close automatically in the case of electrical failure. The system can then be operated manually through bypass lines, for example by connecting a steam line to the drain valve 10 of the float chamber or, as shown in Fig. 3, through a by-pass valve 17 which is controlled by the wheel 17'.

The successive actuation of the valves may also be effected with a single solenoid by the arrangements shown in Figs. 6 to 8. The float chamber of these modified constructions, and the water inlet and outlet connections may be of the described construction, and like parts are therefore identified by the corresponding reference numerals of Figs. 1 to 5.

As shown in Fig. 6, the perforated steam inlet pipe 13, and the vent and steam lines 34, 35 are connected to the casing 36 of a double valve which functions as a three-way valve. The solenoid 36a of the valve has an armature or plunger 37 that slides in a tube 38 that has a closed upper end for sealing the interior of the valve casing from atmosphere. The vent valve 39 and steam valve 40 are of similar construction, being pressed towards closed position in the valve seat bushings 41, 41' by springs 42, 42'. The operating levers 43, 43' are pivoted upon the valve seat bushings and have curved ends extending into slots in the vent valve 39 and steam valve 40, respectively. The other ends of the levers are connected to the plunger 37 through a link 44, and the parts are so designed that both valves are seated by their springs when the plunger 37 and link 44 are in mid-positions.

The switch 27' is a mercury switch of the single pole, single throw type which closes the circuit from the transformer 29 to the solenoid 36a when the float is in raised position. The solenoid is thus energized and the plunger 37 is lifted from the position shown in Fig. 7, and the spring 42 forces the vent valve 39 to closed position before the cam end of lever 43' opens the steam valve 40 against the spring 42' that normally holds the valve closed. The float drops to open the switch 27' as the water drains from the float chamber to the boiler, and the plunger 37 drops when the electric circuit is opened. The lever 43' tilts to permit the closing of the steam valve 40 before lever 43 has moved into position to open the vent valve. The double valve thus operates as a three-way valve to isolate the float chamber momentarily from both the vent line and the boiler at each change of pressure conditions within the float chamber.

The modified arrangement shown in Fig. 8 includes a large diaphragm operated steam valve 45 in the steam pressure line 46 to the perforated inlet pipe 13 of the float chamber 1, the diaphragm valve being controlled by the float through electrically actuated valves which may be, and preferably are, three-way valves such as shown in Fig. 6. A small steam pipe 53a is connected between the steam line 46 and the steam inlet valve of the valve casing 36, and the vent pipe 34 is connected to the other valve union. Pipe 47 connects the interior of the valve casing 36 to the diaphragm chamber 48 of the stem valve 45, and the branch connection 49 from the pipe 47 to the top of the float chamber 1 includes a check valve 50 which prevents steam from entering the chamber through the branch connection. The steam valve is normally held in closed position by a coiled spring 51, and is moved to open position by steam pressure in the diagram chamber.

The electrical circuits to the three-way valve are the same as in the Fig. 6 construction, and the float chamber is vented to pipe 34 so long as the solenoid 36 of the valve is not energized. When current is supplied to the solenoid, the plunger is lifted and valve 39 closes just prior to the opening of valve 40, see Fig. 5. Steam enters the valve casing 36 through the pipe 35a when valve 40 is opened, and passes to the diaphragm chamber 48 to force the main steam valve 45 to open position, thus placing the float chamber under boiler pressure. When the float chamber is emptied, the solenoid circuit is broken and the plunger drops to close valve 40 and open valve 39. The diaphragm chamber 48 is vented through the pipe 47, valve 39 and vent pipe 34, and the check valve 50 will then open to vent the float chamber 1 to pipe 34.

While I have illustrated typical embodiments of the invention, it is to be understood that there is considerable latitude in the design and arrangement of the various parts, and that there are numerous arrangements which fall within the spirit of my invention as set forth in the following claims.

I claim:

1. In an apparatus for feeding water to a steam boiler, a chamber, a conduit for supplying water to said chamber, a conduit for feeding water from said chamber to said boiler, check valves for preventing reverse flow in said conduits, a steam supply conduit leading from said boiler to said chamber, a steam supply valve in said conduit, a vent valve in said connection, independent electrical operating means for said steam supply and vent valves, control circuits for said operating means including a float actuated switch operative to open the circuit controlling one of said valves and thereafter to close the circuit to the other of said valves dependent upon the level of liquid in said chamber.

2. In apparatus for feeding water to a boiler, the combination with a float chamber having a water outlet connection to the boiler and a water inlet connection, check valves to prevent reverse flow in said connections, a steam pressure pipe from the boiler to the chamber, a vent pipe for said chamber, and an independent control valve in each of said pipes, said control valves being biased towards closed position, of control means for operating said control valves in succession to close one valve and open the other, and a float in

said chamber for actuating said control means; said control means including independent electrically actuated means for operating each of said control valves, circuits for energizing said electrically actuated means, and switches in said circuits and actuated by the float.

3. A boiler feed system of the type including a float chamber located above boiler level, connections for supplying water to said chamber and for delivering water from said chamber to a boiler when the chamber is under atmospheric and boiler pressure respectively, and means including a steam and a vent valve exterior to said chamber for controlling the pressure within said chamber; said means comprising solenoid means for actuating said valves, one wall of said chamber having an opening therein, a cap member secured over and closing said opening, a switch housing carried by said cap member, switch means mounted in said switch housing for controlling circuit connections to said solenoid means, and a float lever extending through the wall of said chamber and said cap member into said switch housing for actuating said switch means.

4. Apparatus as set forth in claim 3, wherein said solenoid means includes a solenoid for each valve, and said switch means comprises a mercury switch having a pair of contacts at opposite ends for alternatively completing the circuit connections to the respective solenoids.

5. In an apparatus for feeding water to a steam boiler, a chamber, means for supplying water thereto, a steam connection from said boiler to said chamber, a steam control valve in said connection, a diaphragm operator for said steam valve, a three way valve having one port connected to said diaphragm operator and to said chamber, one port connected to said boiler and one port connected to a vent, electromagnetic operating means for said three way valve adapted when energized to close said vent port and open said steam port to admit pressure to said diaphragm and when deenergized to open said vent port to relieve the pressure on said diaphragm, and a control circuit for said electromagnet including a switch and a float in said chamber for actuating said switch to complete the circuit to said electromagnet upon filling of said chamber and to break said circuit upon emptying of said chamber.

6. In a device for feeding water to a steam boiler, a float chamber above boiler level, connections for supplying water to said chamber and for delivering water from said chamber to a boiler when the chamber is under atmospheric and boiler pressure respectively, a steam pipe and a vent pipe connected to the upper portion of said chamber, a solenoid operated valve in each of said pipes, said float chamber having an opening in one end thereof, an end cap member carried by said chamber and closing said opening, a switch housing carried by said end cap, a float lever within said chamber having an end portion projecting into said switch housing through said cap, a flexible bellows sealing the passage of said lever through said cap, a pivotal mounting for the projecting end of said lever in said switch housing, a mercury tilt switch mounted in said switch housing having a notched plate element loosely embracing the projecting end of said float lever, and said switch having a pair of contacts at each end thereof for alternatively completing circuit connections to the respective solenoids of said steam and vent valves.

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