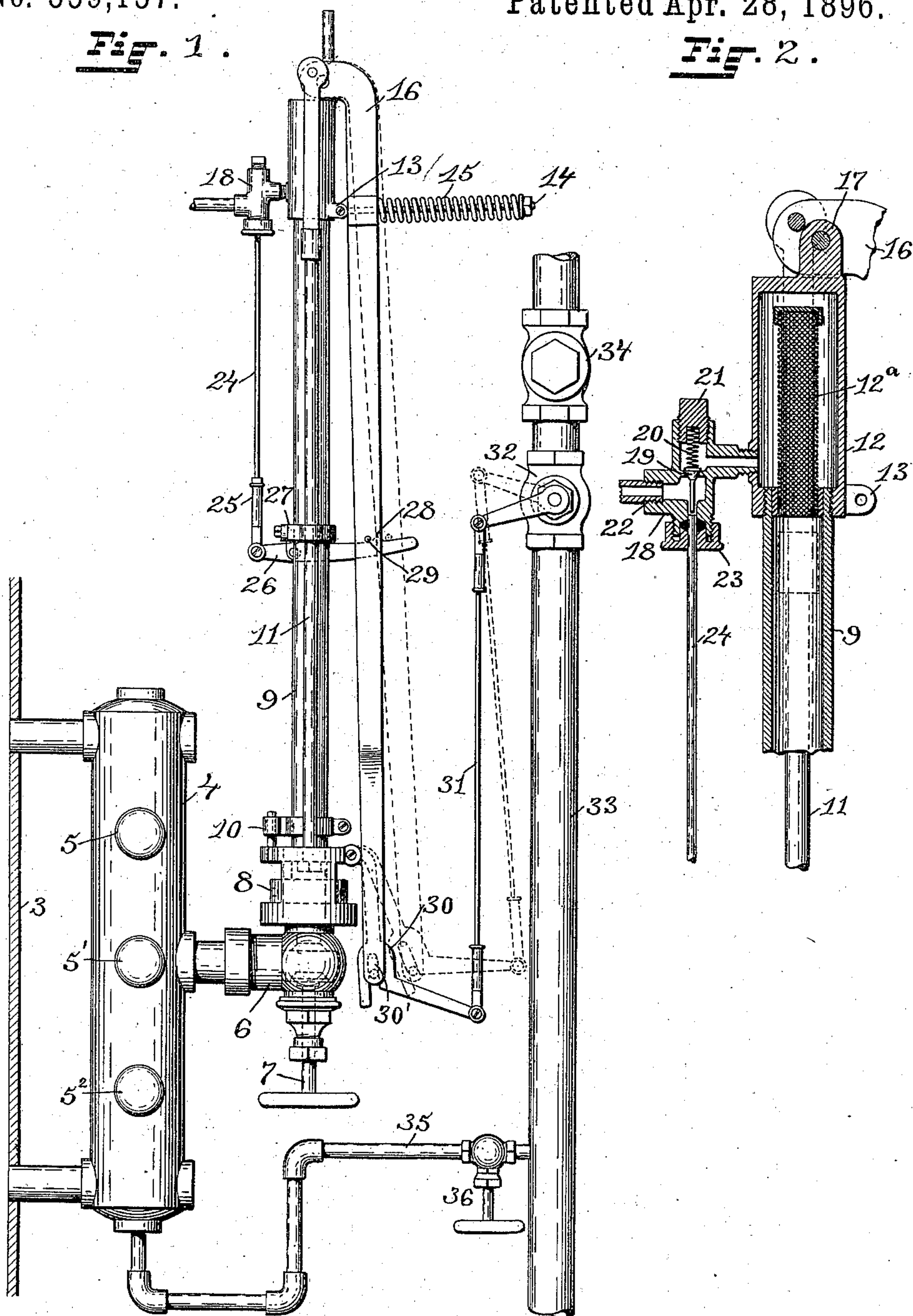


(No Model.)

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AUTOMATIC FEED WATER REGULATOR FOR STEAM BOILERS.  
No. 559,157. Patented Apr. 28, 1896.

Fig. 1.

Fig. 2.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

DARWIN ALMY AND FRANK DELANO ALMY, OF PROVIDENCE, RHODE ISLAND.

## AUTOMATIC FEED-WATER REGULATOR FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 559,157, dated April 28, 1896.

Application filed November 11, 1895. Serial No. 568,574. (No model.)

*To all whom it may concern:*

Be it known that we, DARWIN ALMY and FRANK DELANO ALMY, of the city of Providence, county of Providence, and State of Rhode Island, have invented a certain new and useful Improvement in Automatic Feed-Water Regulators for Steam-Boilers; and we hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to improvements in the class of automatic feed-water regulators for steam-boilers in which the expansion of a tube operates the feed-water valve and regulates the water supply of the steam-generator.

The invention consists in the peculiar and novel construction of the regulator, as will be more fully set forth hereinafter.

Automatic feed-water regulators for steam-boilers, particularly when the same are used on water-tube steam-generators in which a comparatively small quantity of water is subjected in a series of tubes to the heat of the fire, must act promptly to regulate the water supply, and, above all things, such a regulator must be reliable. As heretofore constructed such regulators could not be relied upon for their permanent prompt action. The tube, which receives alternately the steam and the water in cooling, was liable to produce a partial vacuum in the upper end of the tube and thereby allow the water to enter the tube, while when the change from steam to water followed quickly the steam still in the tube prevented the entrance of the water. To overcome these defects and to secure the prompt action of the regulator is the object of this invention, and to this end we provide the upper end of the expansible tube with a check-valve and operate the same, as is more fully set forth hereinafter.

Figure 1 is a side view of our improved feed-water regulator, showing the same connected with the water-column of the boiler and the valve of the feed-water pipe. Fig. 2 is a sectional view of the upper end of the expansion-tube, showing the check-valve connected therewith.

Similar numerals of reference indicate corresponding parts in both figures.

In the drawings, 3 indicates the plate which forms part of the steam-boiler near the water-line; 4, the usual vertical water-column, connected at its upper end with the steam-space and at its lower end with the water of the boiler. This column 4 is provided with the usual gage-cocks on one side and usually with a glass gage on the other side. (Not seen in the drawings.)

The gage-cock 5 is above the normal water-line, the gage-cock 5' on the normal water-line, and the gage-cock 5<sup>2</sup> below the normal water-line.

The valve-fitting 6 is connected with the column 4 on the normal water-line. It is provided with the valve 7 and is connected with the base 8, in which the expansible tube 9 is secured at its lower open end. The tube 9 is held against rotation by the clamp-ring 10, one end of which is secured to a stud projecting from the base 8.

Two rods 11, one on each side of the expansible tube 9, are secured at their lower ends to the base 8. The base 8 is vertically adjustable by means substantially like the means shown and described in Patent No. 538,402, of April 30, 1895, granted to us for improvement in feed-water regulators.

To the upper end of the expansible tube 9 the cylindrical piece 12 is secured. This piece 12 is provided with the lug 13, to which the rod 14 is pivotally connected. The spring 15 surrounds the rod 14 and bears against a nut at the end of the rod and the lever 16. The lug 17 extends upward from the cylindrical end piece 12 and forms the pivotal support for the lever 16. The piece 12 is also provided with a tapped hole into which the lateral branch of the valve-casing 18 is secured. Within this casing a valve-seat is formed on which is supported the check-valve 19, provided with a long downward-extending stem. The spring 20 bears on the check-valve 19 to hold it to its seat, and the tension of the spring is adjusted by the screw-plug 21. Below the check-valve 19 is the lateral outlet 22, which may be connected with a pipe, as indicated in Fig. 2. The lower end of the valve-casing 18 is provided with the stuffing-box 23, through which the upper part of the rod 24 passes. The lower end of the rod 24



is adjustably secured in the internally-screw-threaded sleeve 25. The lower end of the sleeve is pivoted on the end of the lever 26, which lever is pivotally secured to the clamp-piece 27, supported on the tube 9 and rods 11. The longer end of the lever 26 is provided with the raised cam 28 and the lever 16 at this point with a pin 29, which, when it passes over the cam 28, depresses the longer end of the lever 26 and causes the upper end of the rod 24 to raise the check-valve 19.

To the upper end of the expansible tube 9 the cylindrical screen-tube 12<sup>a</sup> of a finely-woven wire-cloth is secured, so as to prevent any impurities from passing into the valve-case 19.

The upper ends of the rods 11 are pivotally connected with the lever 16, so that when the tube 9 is expanding in length by the heat of the steam in the tube the fulcrum of the lever 16 in the lug 17 is raised, while the short end of the lever 16 is held by the rods 11 against rising, and the lower end of the lever 16 is moved outward, as is shown in broken lines in Fig. 1. The lower end of the lever 16 is provided with a pin which extends into and rides in the fork 30' of the lever 30, one end of which is pivotally secured to the base 8, the other end of the lever 30 being connected by means of the adjustable rod 31 to the lever of the valve 32, controlling the feed-water supply through the pipe 33 to the boiler.

34 is a check-valve.

In the device shown in Patent No. 538,402, above referred to, a constant but limited supply of feed-water is delivered directly to the lower part of the feed-regulator. In the present device we connect the feed-water pipe 33, by the small pipe 35, with the bottom of the vertical column 4 and control the constant supply by means of the valve 36.

The operation of the two methods is practically the same. The constant supply of the cold or at least cooler water insures the prompt contraction of the expansible tube and thereby the quick regulation of the water supply.

In the improved construction shown in the drawings the water in the column 4 is maintained at a low temperature by the constant supply through the pipe 35, and although the column is connected with the water and the steam-spaces of the boiler there is no circulation of water through the column.

We will now more fully describe the operation of our improved automatic feed-water regulator under normal conditions. The pipe 33 is connected at the end at which the check-valve 34 is located with the steam-boiler, the opposite end being connected with the pump or other means for supplying the feed-water under sufficient pressure to pass through the check-valve into the boiler. The water in the boiler is at or slightly above the gage-cock 5'. The constant feed-water supply through the pipe 35 is in practice no more than would be evaporated in the boiler when doing the least

amount of work. When now the water is evaporated faster than it is supplied, the water-line in the boiler sinks, and with it the surface of the water in the column 4. As soon as the surface of the water sinks below the opening of the connection between the column 4 and the valve-casing 6, the steam enters the regulator, the tube 9 commences to expand and move the lever 16 outward, the pin 29 in passing over the cam 28 depresses the long end of the lever 26 and raises the rod 24 sufficiently to lift the check-valve 19 off its seat, the air or gases in the tube 9 are quickly discharged, the pressure in the tube 9 is diminished, and the hot steam fills the tube, causing the same to expand lengthwise and move the lever 16 outward. The lower end of the lever 16 operates the lever 30 and through the same opens the valve 32. The water is now supplied to the boiler direct and in larger quantities. When now more water is supplied than is evaporated by the boiler, the water-level rises above the opening connecting the column 4 with the regulator, the water enters the expansible tube, cools the same, condenses the steam in the tube partially, the lever 16 moves inward by the partial contraction of the tube 9, the pin 29 passes over the cam 28 and depresses the lever 26, thereby operating the check-valve 19, as before described, the confined steam in the tube escapes, the pressure in the tube is diminished, and the cool water rushes into the expansible tube 9. The tube is cooled, contracts, and the lever 16 with its connections completes the closing of the valve 32. The reliable closing of the check-valve 19 requires that the same can be frequently inspected. This is done by closing the valve 7 and unscrewing the screw-block 21.

The feed-water regulator instead of controlling the water-valve 32 can be used to control the steam-valve connected with the feed-water pump.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In an automatic feed-water regulator adapted to control the main feed-water supply, the column 4 connected with the steam and water spaces of the boiler and with the regulator, the pipe 35 and valve 36 connected with the feed-water-supply pipe and the column, whereby a constant limited quantity of feed-water is supplied to the boiler without affecting the steam in the expansible tube when the regulator is in action, as described.

2. The combination with an automatic feed-water regulator provided with an expansible tube connected at its lower end only with the steam and water of the boiler, of a valve-case, connected with the upper end of the expansible tube, provided with a valve, mechanism operated by the expansible tube to control the water supply, and mechanism, substantially as described, for operating the valve, whereby the internal pressure in the expan-



sible tube is momentarily reduced and the inflow of the steam and water facilitated, as described.

3. In an automatic feed-water regulator, 5 the combination with the expansible tube 9, the rods 11, the check-valve 19, and the lever 16, of the clamp-piece 27, the lever 26, the cam 28, the pin 29, and the rod 24 operated from the short end of the lever, whereby at 10 the initial inward or outward movement of the lever 16 the check-valve 19 is momentarily raised, as and for the purpose herein described.

4. In an automatic feed-water regulator, 15 the combination with the expansible tube 9 and the cylindrical end piece 12, of the screen-tube 12<sup>a</sup>, the valve-case 18 connected with the end piece 12, the valve 19, the spring 20, the plug 21, the stuffing-box 23, the lateral 20 outlet 22, and the mechanism for automatically opening the valve and thereby relieving the pressure in the expansible tube, as described.

5. In an automatic feed-water regulator,

adapted to control the main feed-water supply to a steam-boiler, the combination with 25 the valve-casing 6 and valve 7, the base 8, the expansible tube 9 and rods 11 secured thereto at one end, of the lever 16 pivoted to the end piece 12 and to the rods 11, the lever 30 30 provided with the fork 30', and connections with the main supply-valve 32 adapted to control the main feed-water supply, the lever 26 connected at one end with the rod 24 and provided near the other end with the cam 28 35 operated by the pin 29, and the check-valve 19 whereby the pressure within the expansible tube is momentarily released, the inflow of the steam and the water accelerated and the automatic operation of the feed-water 40 regulator facilitated, as described.

In witness whereof we have hereunto set our hands.

DARWIN ALMY.

FRANK DELANO ALMY.

Witnesses:

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HENRY J. MILLER.