D. R. KNAPP & H. E. CADE.

BOILER FEED WATER REGULATOR.

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999,317. Patented Aug. 1, 1911.

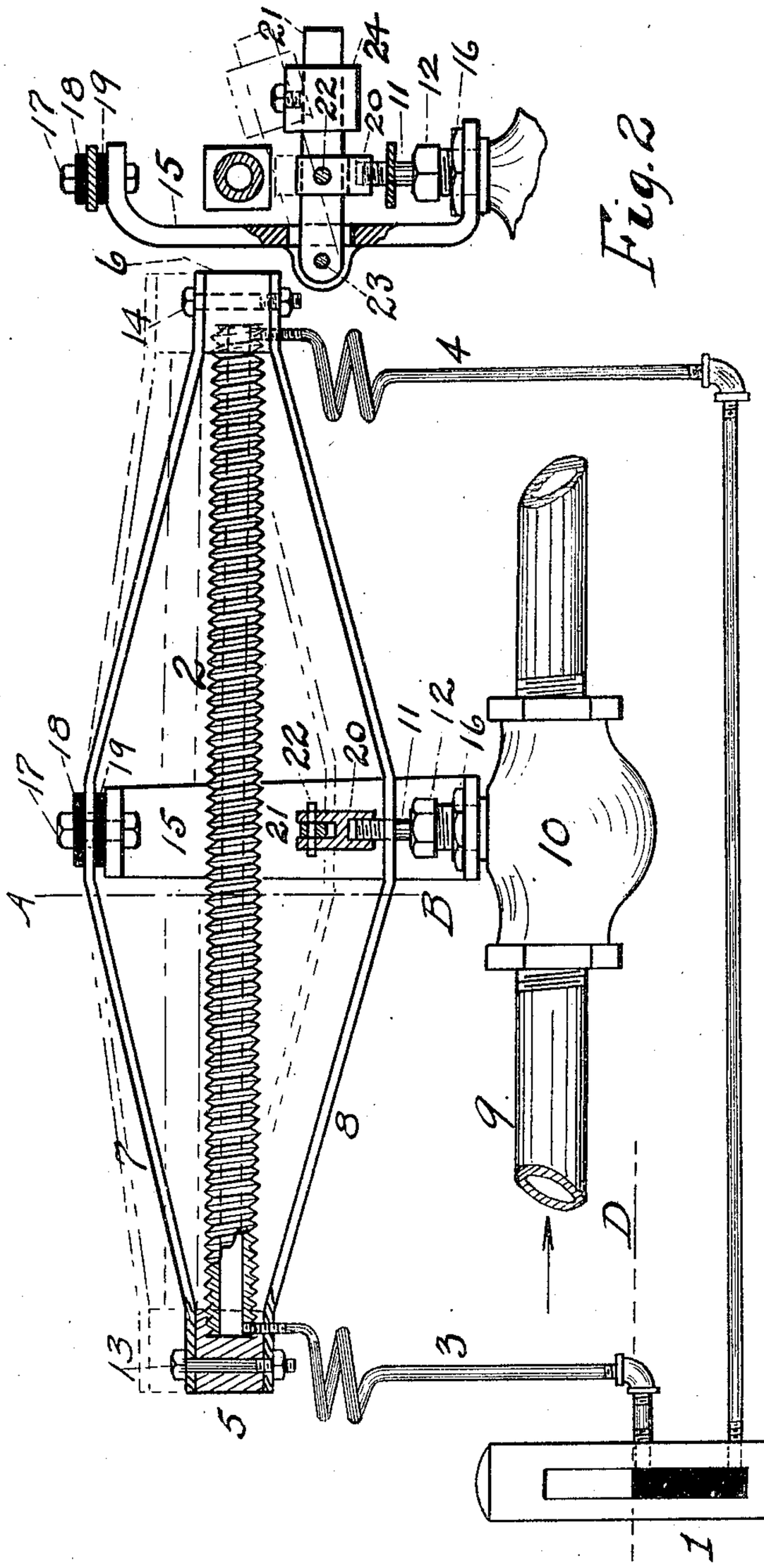

Fig. 1

Witnesses

Jas. S. Hamilton

Howard S. Grose

Inventors

David R. Knapp.

Howard E. Cade.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

DAVID R. KNAPP, OF PHILADELPHIA, AND HOWARD E. CADE, OF PENCOYD, PENNSYLVANIA.

BOILER-FEED-WATER REGULATOR.

999,317. Specification of Letters Patent. **Patented Aug. 1, 1911.**

Application filed December 6, 1910. Serial No. 595,968.

To all whom it may concern:

Be it known that we, DAVID R. KNAPP and HOWARD E. CADE, citizens of the United States, and residents, respectively, of Philadelphia, in the county of Philadelphia, and of Pencoyd, in the county of Montgomery, both in the State of Pennsylvania, have invented certain new and useful Improvements in Boiler-Feed-Water Regulators, of which the following is a specification.

Our invention relates to that class of devices wherein feed water is fed automatically into a steam boiler, during evaporation in such a manner that the water level is kept practically constant.

The improvements as set forth in this application are particularly directed to Letters Patent of the United States No. 971,357 of September 27, 1910, issued to us as joint inventors, wherein the herein invention discloses a structure whereby the valve may be moved a greater distance with the same amount of expansion of the tube than can be attained in aforesaid mentioned invention. This structure is more particularly applicable to low pressure steam installations, where the expansion tube is subjected to low temperature conditions incidental to the use of such pressures.

Our objects are as follows; first, to provide a simple and efficient means that may be attached thereto or integral therewith of a water controlling means in a boiler feed line to automatically control the water supply to said boiler; second to provide a feed water regulator that is positive in its action and of a simple and cheap structure; third, to provide a means whereby the small movement of an expansion and contractive means attached to or integral with a means in a feed line for controlling the supply of water therein and adapted to be actuated by the level of the water in the boiler may be effectively multiplied so as to effectively operate the said means in the feed line; fourth, to provide a construction, wherein the use of an expansive tube is employed that may be inserted directly in the feed line and supported thereby, the same as a pipe fitting, and said construction so arranged, as to multiply the small movement of the expansive tube so that it may effectively operate the water controlling means in the feed line; fifth, to construct the expansive means in such a manner that it may radiate its heat quickly after the steam supply has been shut off; sixth, to construct the supply piping in such a manner that any circulating water will be cooled before entering the tube and seventh, to provide a construction wherein the expansive tube is subject to no bending strain during expansion and contraction.

With these objects in view our invention consists in certain novel features of construction and arrangement of parts as will hereafter be more fully described and pointed out in the claims, reference being had to the accompanying drawings forming part of this specification and in which,

Figure 1, is an elevation, partly in section showing a convenient embodiment of our said invention and Fig. 2, a side elevation, also partly in section on A—B of Fig. 1 and showing more particularly the lever arrangement which is not shown in Fig. 1.

Referring to the figures, in which similar numerals of reference refer to similar parts throughout the several views, the numeral 1, designates a water column found on steam boilers to visually indicate the level of the water in the boiler and such level is indicated by the line C—D.

2, designates an expansion and contraction means preferably a tube made from some metal having a high coefficient of expansion and said tube is located above the water level of the boiler. The said tube is threaded from end to end, thereby giving it more radiating surface to radiate its heat after the steam supply has been cut off. 3, designates a pipe line of small diameter, connecting one end of the said expansion tube to the water column at a point where the water level is desired to be maintained. 4, designates a pipe of similar construction to that of pipe 3 and connects the other end of said expansion tube to some point below the desired water level of the boiler, preferably to the lower portion of the water column. The said pipes 3 and 4 are composed of a number of turns forming a helix and enable said pipes to have sufficient flexibility upon any movement of the expansion tube, also the helix formation of pipe 3 has a tendency to cool any circulating water that may flow after the steam has been cut off from the expansion tube. The said pipe 3, communicates steam to the said expansion tube 2 when the water level in the water column falls below the point where the pipe

3 connects thereto and the pipe 4 drains any water back to the boiler due to condensation of steam which takes place when said tube is deprived of steam due to the water rising in the water column and closing or sealing pipe 3 to any steam supply. It is obvious that the tube 2 will be subjected to a wide range of temperature which will cause it to expand and contract as the steam thereto is admitted and cut off.

5 and 6 designates headers to which the ends of the expansive tube are rigidly secured by threaded engagement.

7, designates a strap, preferably of some metal having a low coefficient of expansion such as steel and preferably of a rectangular section. Said strap is of a bent formation and forming an angle with equal legs. One end of said strap is rigidly secured to the header 5 by the bolt 13 and the other end is secured to the header 6 by the bolt 14. It is obvious that such a formation forms an isosceles triangle with the tube 2 as a base and the strap 7 the legs thereof.

8 designates a strap of similar construction and material to that of 7 and is connected to the headers 5 and 6 in a like manner but to the opposite side. The expansion tube 2 then forms a common base for two similar triangles and formed by the similar straps 7 and 8, and these elements therefore constitute what might be termed a bodily-movable thermostatic-frame wherein the straight single expansive tube has a bodily lateral movement with the said upper and lower bowed expansion straps 7 and 8.

9 designates a feed water supply line to the boiler and delivers water above the boiler pressure. Inserted in the said feed water supply line is a water controlling means 10, preferably a balanced valve, provided with its usual stem 11 and stuffing gland 12. We do not wish to limit ourselves to any particular type of water controlling means as it is obvious that a stop valve could be used in lieu of a balanced valve, or an injector could be used as said controlling means or any other of the many forms of controlling means; further if a feed water pump is used with a single boiler, the said water controlling means could be a valve in the steam line to the pump and starting and stopping the pump for controlling the water supply to the boiler, however the balanced valve 10 designates a convenient means to illustrate the operation of our improved device and it will be understood that said controlling means forms no element of our invention.

15, designates a suitable support for the mechanism and which consists of a vertical portion and ends turned at right angles thereto. The lower end is provided with an aperture through which passes the neck of the valve and is held rigidly by the nut 16. The strap 7 is rigidly secured to the upper portion of the support by the nut 17, at a point designated as the apex of the triangle. 18 and 19 designates material of a heat insulating property placed on either side of said strap 7 so that any heat may be prevented from being conveyed from the support 15 to the strap 7 due to possible high feed water temperature in the feed line.

20 designates a bifurcated member, adjustably secured to the end of the valve stem 11. 21 designates a lever arm pivotally connected to said bifurcated member by the pin 22 and fulcrumed to the support 15 by the pin 23. 24 designates a weight, adjustable on said lever arm 21 and is of sufficient weight to seat the valve against the pressure of the stuffing box 12.

The said strap 8 is provided with an aperture at the apex of its triangular formation through which the valve stem 11 is adapted to freely pass, the bifurcated member 20 being secured to the valve stem a sufficient distance to allow the said strap 8 to rise and lower a predetermined distance before engaging with the bifurcated member 20 or the stuffing box 12.

Having thus described the various parts throughout the several views, all of which will be readily understood by those skilled in the art to which this invention relates, its mode of operation will be substantially as follows: When the water in the boiler is at its normal level, the water in the water column seals the steam supply to the pipe 3 and the parts are as shown in the figures with the valve closed. When the water in the boiler falls below the normal level as indicated by the line C—D, the water seal to the pipe 3 is broken and steam from the upper part of the water column is admitted to said pipe 3 which communicates it to the expansion tube 2. The said tube now being subjected to the high temperature of the steam increases in length and the following movements take place; the strap 7 as aforesaid forms the two legs of an isosceles triangle with the expansion tube as a base. It is obvious that if the two legs remain of constant length and the base increases the altitude will decrease. The strap 7 being in a fixed rigid position at the apex of the triangular formation causes the tube to move in a position toward the said apex resulting in the strap 8 engaging with the member 20 and lifting the valve from its seat which allows water to enter the boiler under the pressure of the boiler pump. The strap 8 being of similar formation to that of 7 also decreases its altitude which further lifts the valve seat and therefore the total lift of the valve is greater than that which would be caused if a single strap was employed as disclosed in our invention aforesaid. Water is now admitted to the boiler in such a quan-

tity as to bring the level up to normal when the water in the water column will act as a seal to the steam to the pipe 3. The absence of steam from the expansion tube 2 will cause it to cool and contract which will reverse the aforesaid movements and close the valve to the water supply under the following conditions: The steam in the tube being now deprived of its heat supply condenses and the water of condensation will return to the boiler through the pipe 4. The condensation causes a partial vacuum in the expansion tube which will cause the water to rise into the tube and cause a circulation of the same due to the siphoning effect caused by the difference in head between the steam supply pipe 3 and the drain 4 and also augmented by the tendency of the hot water to rise. The tube will therefore not cool as it would in its inoperative state but will cool sufficiently to allow the strap 8 to disengage with the member 20 which will allow the weight 24 acting through its leverage to continue the closing movement of the valve until it has properly seated.

Experience has shown that the tube will vary in length due to difference in atmospheric temperatures which may occur very suddenly and it is therefore obvious that if the strap 8 was rigidly connected to the valve stem that the stem would be raised and lowered by other temperatures than that caused by the boiler which would render the device inoperative and dangerous especially admitting water when not desired. The strap 8 has sufficient play between the member 20 and the stuffing box 12 to allow it to rise and lower a predetermined safe distance without affecting the position of the valve whatsoever.

The foregoing movements and the structure as described shows an operative structure that is effective and positive in its operation and the absence of any complicated parts makes it simple in operation and cheapens the construction, thus accomplishing the heretofore first and second mentioned objects of our said invention.

The difference in length of the tube due to the expansion and contraction is exceedingly small and the effective movement of the valve stem is required to be comparatively large. It is obvious that a very small movement in a direction to lengthen the tube 2 will cause a comparatively large decrease in the altitude which together with a similar movement of the other side gives a maximum movement that such a design can accomplish. With both straps of a similar construction the bending strain will be neutralized and which will not be true if only one strap is employed, thus accomplishing the heretofore third and seventh objects of our said invention.

Our device being installed directly in the feed line same as an ordinary pipe fitting does not require any attachment means to the boiler or its supports which are very often undesirable due to low ceilings and sometimes to the type of boiler construction itself, inasmuch as some types of boilers do not offer any desirable means of securing such devices. Our device being directly supported by the feed line and inserted therein offers a very ready and desirable means for installation. This together with the construction described wherein a small movement of the expansion tube is effectively multiplied to operate a valve in the feed line accomplishes the heretofore fourth mentioned object of our said invention.

As aforesaid there is a circulation of water in the tube after the water has sealed the steam to the pipe 3. This circulation of water being from the boiler will be of high temperature and by inserting a cooling coil in the pipe 3 such circulating water will be cooled to some extent before it enters the tube and which will give the tube a greater degree of action. The tube in order to act quickly will necessarily be required to radiate its heat quickly after the steam supply has been cut off. This is accomplished by threading the tube which gives it a greater radiating surface and which allows it to cool quickly and operate the valve instantly, thus accomplishing the fifth and sixth objects of our invention.

We do not wish to limit ourselves to the exact construction as shown in the drawing as it is obvious that slight departures may be made therefrom without departing from the spirit and intent of our said invention. For instance the tube may be placed at the water level.

We are aware that expansion tubes have been employed for feed water regulators but know of none where a small movement of the tube is so effectively multiplied in such a simple manner and where provisions are made to keep the device operative and not affected by local room temperature variations and where provisions are made to keep the circulating water cool and the tube designed to radiate its heat quickly.

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

1. In a boiler feed-water regulator, the combination with the valve to be operated and closing means therefor, of a bodily movable thermostatic frame comprising a straight single expansive tube in communication with the boiler through a water column, opposite bowed expansion straps arranged respectively at opposite sides of the tube and having rigid connection at their ends with the ends of the tube, one of said straps having an operative connection at its center with the valve, and a fixed support having rigid connection with the other strap

at its center and constituting the sole point of support for the thermostatic frame.

2. In a boiler feed-water regulator, the combination with the valve to be operated and closing means therefor, of a bodily movable thermostatic frame comprising a straight single expansive tube in communication with the boiler, opposite bowed expansion straps arranged respectively at opposite sides of the tube, and having rigid connection at their ends with the ends of the tube, said terminal connections with the tube constituting the sole support for the same to permit the tube as an entirety to move laterally with both straps, an operative connection between the center part of one strap and the valve, and a fixed support having rigid connection with the opposite strap at its center and constituting the sole point of support for the thermostatic frame.

3. In a boiler feed-water regulator, the combination with the valve to be operated having a stem with an abutment thereon and closing means therefor, of a bodily movable thermostatic frame comprising a straight single expansive tube in communication with the boiler, opposite bowed expansion straps arranged respectively at opposite sides of the tube and having rigid connections at their ends with the ends of the tube, one of said straps having a loose engagement at its center with the said valve stem and arranged to move against the abutment on the latter, and a fixed support having rigid connection with the opposite strap at the center of the latter and constituting the sole point of support for the thermostatic frame.

In testimony whereof we have signed our respective names to this specification in the presence of two subscribing witnesses.

DAVID R. KNAPP.
HOWARD E. CADE.

Witnesses:
JAS. S. HAMILTON,
TOWARD S. GROSE.