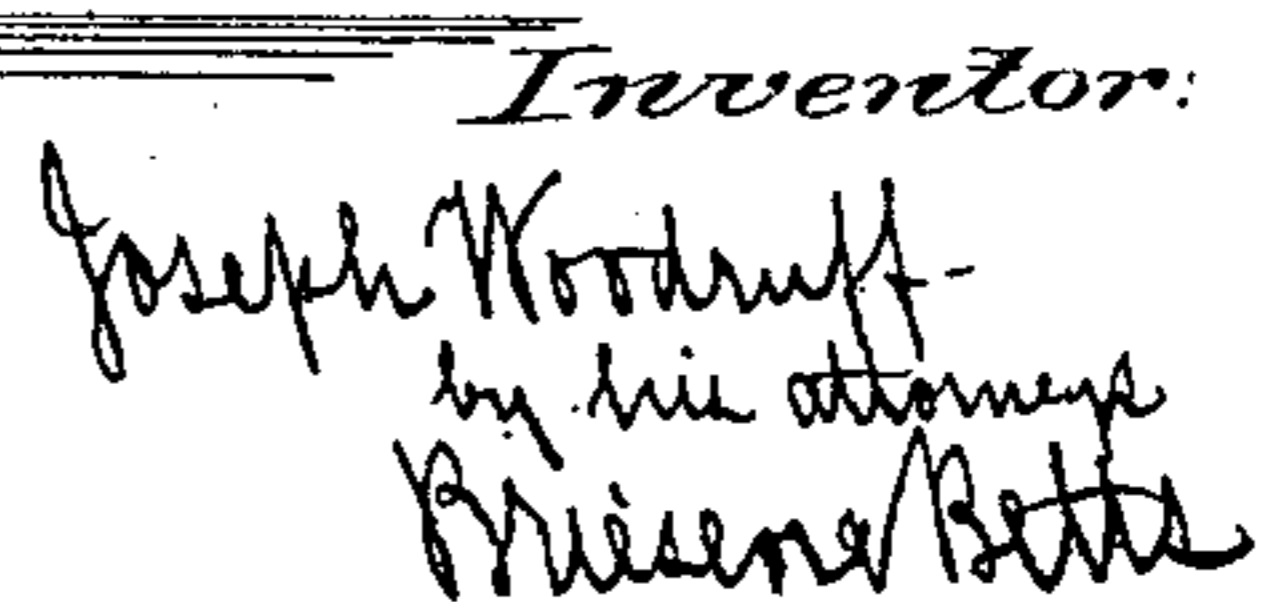


Patented Mar. 13, 1883.



UNITED STATES PATENT OFFICE.

JOSEPH WOODRUFF, OF RAHWAY, NEW JERSEY.

BALANCED FEED-WATER REGULATOR.

SPECIFICATION forming part of Letters Patent No. 273,929, dated March 13, 1883.

Application filed April 28, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH WOODRUFF, of Rahway, county of Union, State of New Jersey, have invented an Improved Balance Feed-Water Regulator for Steam-Boilers, of which the following is a specification.

Figure 1 is a sectional side view of my improved balance water-regulator. Fig. 2 is a longitudinal section of a flexible pipe-joint, which may be used in connection with my improvement.

The object of this invention is to keep the water in steam-boilers automatically at a desired height.

Many explosions of boilers are undoubtedly caused by the water in the boiler not being maintained at a proper and uniform height, and any device which will automatically keep the water in boilers at a desired height will diminish the risk of explosions, and will permit of boilers being less carefully watched than is now necessary.

My invention depends on the principle that water will seek its own level; and it consists in so arranging an auxiliary cylinder outside the boiler and connected therewith by pipes that the center of the cylinder, when the water is in the boiler, is on a horizontal line with the height at which it is desired to carry the water in the boiler. The boiler being connected with the cylinder by a pipe near the bottom part, the water in the cylinder will tend to remain at the same height as the water in the boiler, and by hanging said cylinder on a balanced beam properly adjusted, and making connection between said beam and a valve in the pipe through which the boiler is fed, and by means of the mechanical adjustments to be hereinafter described, it results that as the water rises or falls in the boiler it also rises or falls in the cylinder, thus making the cylinder lighter or heavier and drawing the balance-beam upward or downward. This opens or closes a cock in the feed-water pipe, so that as the water in the boiler becomes lower it is lower in the cylinder also, which, being thus lighter, allows the balance-beam to move and the cock is opened and more water will flow in through the feed-pipe; but as the water in the boiler becomes higher than the desired level the water in the cylinder also becomes higher, and the cylinder becoming heavier the balance-beam moves in

the other direction to close the cock in the feed-pipe, letting in a less supply of water, and thus the boiler regulates its own supply of water, and the water therein is maintained at the uniform height desired.

In the accompanying drawings, the letter A represents a steam-boiler, having running through it the ordinary pipes, *a a*, through which pass the products of combustion from the furnace.

The letter B represents the water-line in the boiler at the desired height. The boiler is fed through the pipe C from any convenient reservoir. This pipe enters the boiler either near its bottom or at any other place. This pipe C has in it a check-valve, *b*, allowing the water to be fed into the boiler, but preventing it from flowing out. The pipe C also contains a cock, *d*, arranged to open and shut the passage through the pipe as the handle of the cock is moved.

D represents the furnace situated below the boiler, with a fire burning therein. The products of combustion from this furnace are carried under the boiler and through the tubes *a a* in it, heating the water as they pass through, and pass from said tubes *a a* into the smoke-stack E, from which they emerge to the outer air. The furnace D is provided with a swinging door, F, of the ordinary style, having a back plate, *e*, to ward off the heat, and a foot, *f*, projecting so it can be struck by a lever from below to open the door F.

G represents the grate of the furnace, and H a lower door, through which the ashes are removed. The boiler has projecting from it, below the water-line B, a pipe, I, having in it a hand-valve, *g*, and one or more flexible joints or sections, *h*, and this pipe I connects with a cylinder, J, through an opening in it, near the bottom of said cylinder. From an opening in the top of said cylinder J extends the pipe X, provided with one or more flexible sections or joints, *h h*, and with an ordinary hand-valve, *z*. This pipe X connects the top of the cylinder J with the top of the boiler A, and carries steam from the boiler into the top portion of the cylinder when the valve is opened, thus equalizing the pressure. The cylinder J is suspended by a yoke, K, and bands *i i*, that are connected to this yoke and pass around the cylinder, or in any other suitable way,

from the end *j* of the balance-beam *L*. The connection between the yoke and the beam *L* is by a rod or strap, *k*, one end of which passes through an opening in the yoke *K*, while the other end forms a loop which is slipped over and held by a projecting stud on the beam *L*. The balance-beam *L* is supported by knife-edge pivots *m* in hangers *n*, that are carried by a post, *M*. Any movement except in a vertical direction of the beam is prevented by the slotted guide *o*, which extends downward from an arm of the pillar *M*. A set-screw, *a'*, passing downward through the arm *b'* of the pillar, may be adjusted to regulate the extent of the vertical movement of the beam *L*. To the other end of the beam *L* from that on which is suspended the cylinder *J*, is attached the weight *P*, adjusted to balance said cylinder at the desired height. To the beam *L* is also attached, by a pivotal connection, *p*, the rod *Q*, which is also attached, by a pivotal connection, *q*, to the handle of the cock *d* of the boiler feed-pipe *C*. This rod *Q* may also be continued beyond the point *q*, and by means of pivotal connections *r* joined to a bell-crank, *R*, which is hung at *s*, just below the door *F* of the furnace *D*, and regulated to strike the foot *f* and open the door when the rod *Q* is pushed very far downward.

Fig. 2 shows a form of flexible joint for the connections *h*, which is novel with me, and which I preferably use. The letters *S S* indicate the sections of the pipe *C* or *X* between which the joint is applied. These are screw-threaded near the ends to receive nuts *t* and *u*, that clamp diaphragms *w*, forming the ends of the outer cylinder, *U*. The inner nuts, *u*, are each part of a perforated cap, through which the fluid can at all times pass from one section of the pipe *S* to the next section thereof. The two caps receive the headed ends of a rod, link, or bolt, *T*, and are thereby flexibly united. The nuts *u* and screw or pin *T* are incased in a cylinder, *U*, which carries at each end a diaphragm, *w*, and collars *V V*, that are provided with grooved flanges. The collars *V V* are united by bolts *y*. The screw *T*, which holds together the nuts *u u*, owing to its adjustment, can play backward and forward, and to some extent laterally or vertically, in them, and the diaphragms *w*, held firmly at their outer and inner edges, also allow a certain amount of play, so that a joint is formed between the pipes *S S*, which allows them a certain amount of movement in relation to each other, but which also allows of a free passage for liquids between the sections of the pipes *S S* through the flexible joint.

The operation of my water-regulator is as follows: The valve *g* in the pipe *I* is first opened, and water is fed into the boiler *A* through the pipe *C*, the cylinder *J* being so adjusted that the cock *d* is sufficiently open to allow the ordinary amount of water required to be fed to the boiler. As the boiler *A* fills with water

the water flows through the pipe *I* into the cylinder *J*, and the balance-beam *L* is then adjusted by means of the weight *P* to make the cylinder *J* hang at such a height that a line drawn longitudinally through the center of the cylinder *J* is in the same or nearly the same horizontal plane with the water-line *B* in the boiler *A*. The pipes *X* and *I* are constructed so as to permit this adjustment. Then, as the water is diminished in the boiler by being turned into steam, if there is a greater loss of water than is supplied through the feed-pipe *C*, the level of the water in the boiler *A* falls, and the level of the water in the cylinder *J* falls also. This outflow of the water makes the cylinder *J* lighter than when it was originally adjusted, and allows the weight *P* to draw down that arm of the beam *L* on which it is fastened. The beam *L* thus forces down the rod *Q*, which acts to turn the handle of the cock *d*, which is arranged to be opened as its handle is pushed downward, and thus more water is allowed to flow into the boiler *A*, gradually raising the level of the water therein, and also raising the level of the water in the cylinder *J*, which becomes heavier by the inflow of the water and resumes its former position. If the water in the boiler rises above the desired level, *B*, the cylinder *J* becomes heavier and is drawn downward, thus acting through the beam *L* to lift the rod *Q* and close the cock *d*, and allow less or no water to enter the boiler.

The rod *Q* may also be connected with the bell-crank lever *R*, and when the rod *Q* is forced far downward this lever is moved to strike against the foot *f* of the furnace-door *F* and throw it open, causing the fire to slacken, and thus stopping the too rapid conversion of the water into steam.

The flexible joints *h h* allow a slight movement of the pipes *X* and *I*, so as to permit the cylinder *J* to rise and fall accordingly as it contains a greater or less weight of water.

I desire it to be understood that any connection of rod *Q* with the feed-pump or other device for accelerating or reducing the flow of the feed-water into the boiler is equivalent to the cock *d*.

I claim—

1. In an automatic water-regulator for boilers, the combination of the boiler *A*, pipe *I*, vessel *J*, steam-pipe *X*, balance-beam *L*, with its adjustable weight *P*, support *M*, rod *Q*, feed-pipe *C*, and cock *d*, all substantially as and for the purposes described.

2. In an automatic water-regulator for boilers, the combination of the boiler *A*, pipe *I*, vessel *J*, pipe *X*, beam *L*, standard *M*, rod *Q*, cock *d*, and pipe *C*, all arranged as and for the purposes described.

3. The method of keeping the water in steam-boilers automatically at a desired level, which consists in so connecting the boiler with an external balanced vessel that water and steam will flow from the boiler into the said vessel,

and so balancing the said vessel that when it is about half filled with water the level of the water in it will be in the same horizontal plane with the water - line in the boiler, and also in
5 so connecting the beam on which said cylinder is hung with a cock in the feed - water pipe of the boiler that when the balanced vessel rises or falls said cock will be opened or closed and the supply of water to the boiler increased or
10 diminished accordingly, all substantially as shown and described.

4. In an automatic water-regulator for boilers, the combination of the boiler A, pipes I and X, cylinder J, beam L, rod Q, cock *d*, pipe
15 C, bell-crank lever R, and furnace-door F, all arranged as and for the purposes described.

5. The pipes S S, combined with the perfo-

rated caps *u*, bolt or link T, nuts *t*, diaphragms *w*, and cylinder U, substantially as described.

6. The combination of the pipes S S with the
20 nuts *t*, diaphragms *w*, nuts and caps *u*, link or bolt T, cylinder U, collars V, and bolts *y*, substantially as shown and described.

7. The combination of the steam-boiler with two flexible pipes, I X, suspended vessel J, and
25 balanced beam, from which said vessel is suspended, and with connection, substantially as described, from said beam to a gate regulating the supply of water to the boiler, substantially as described.

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Witnesses:

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