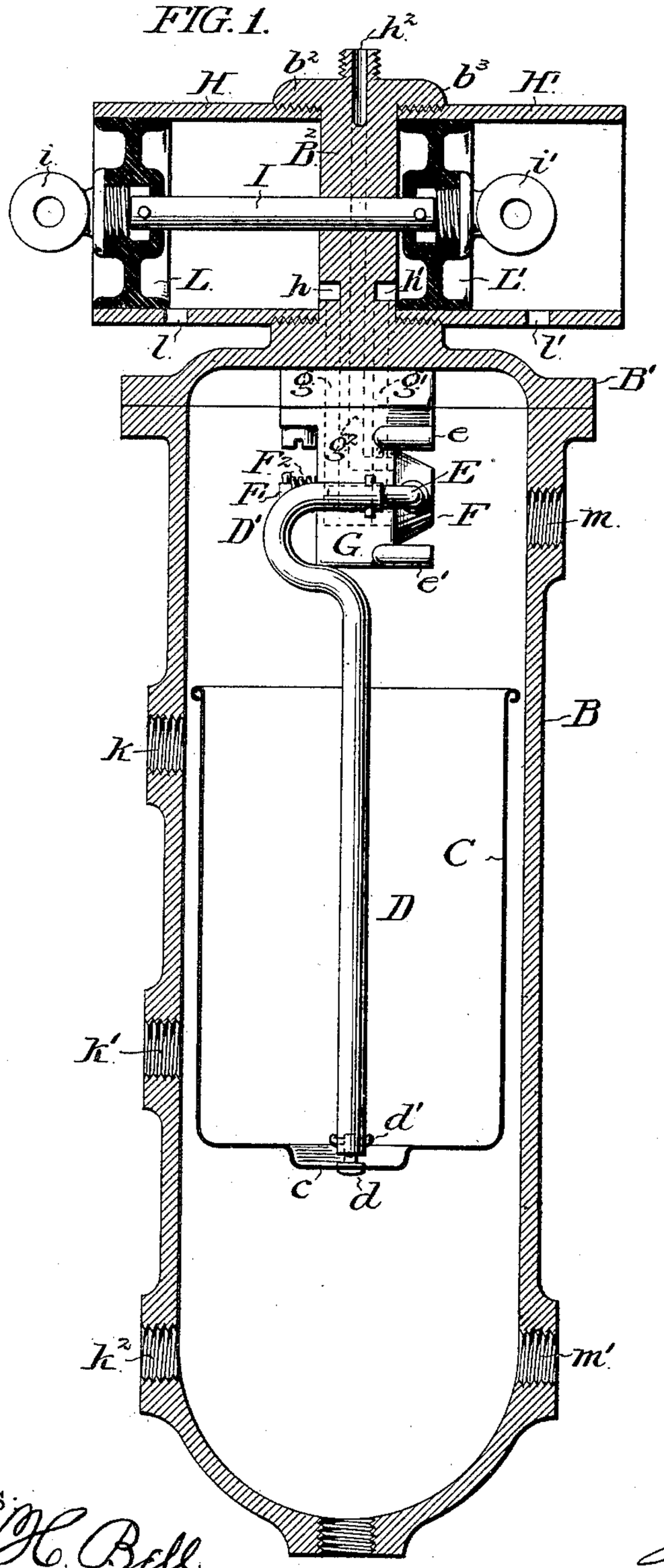
(No Model.) 3 Sheets—Sheet 1

J. S. FORBES.

FEED CONTROLLING APPARATUS.

No. 467,717. Patented Jan. 26, 1892.

FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

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FIG. 2.

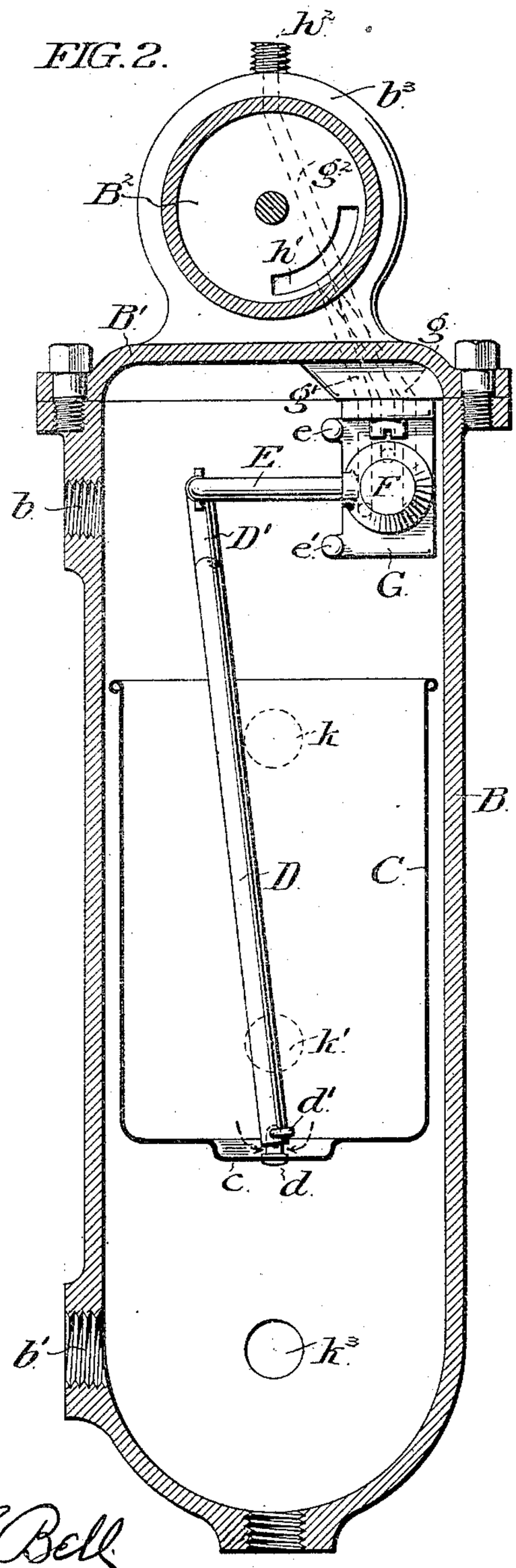

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FIG. 3.

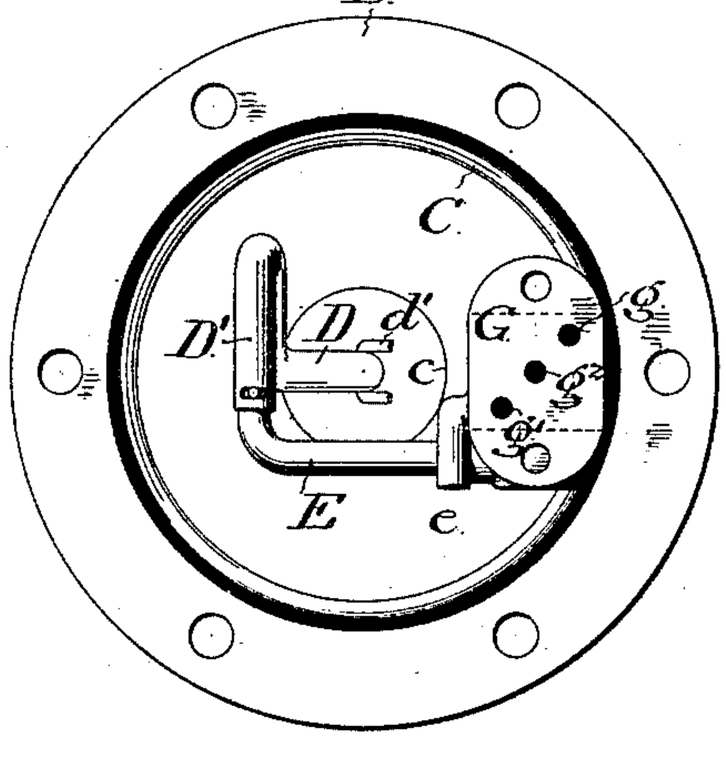


FIG. 4.

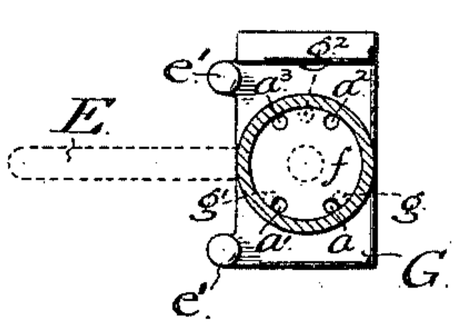


FIG. 5.

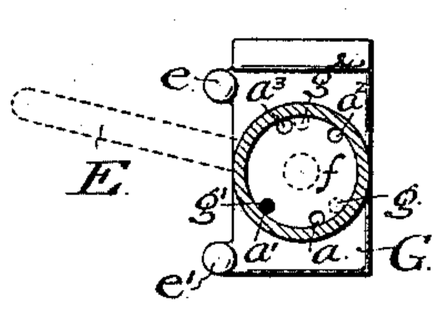


FIG. 6.

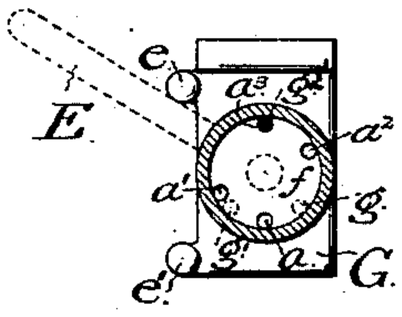
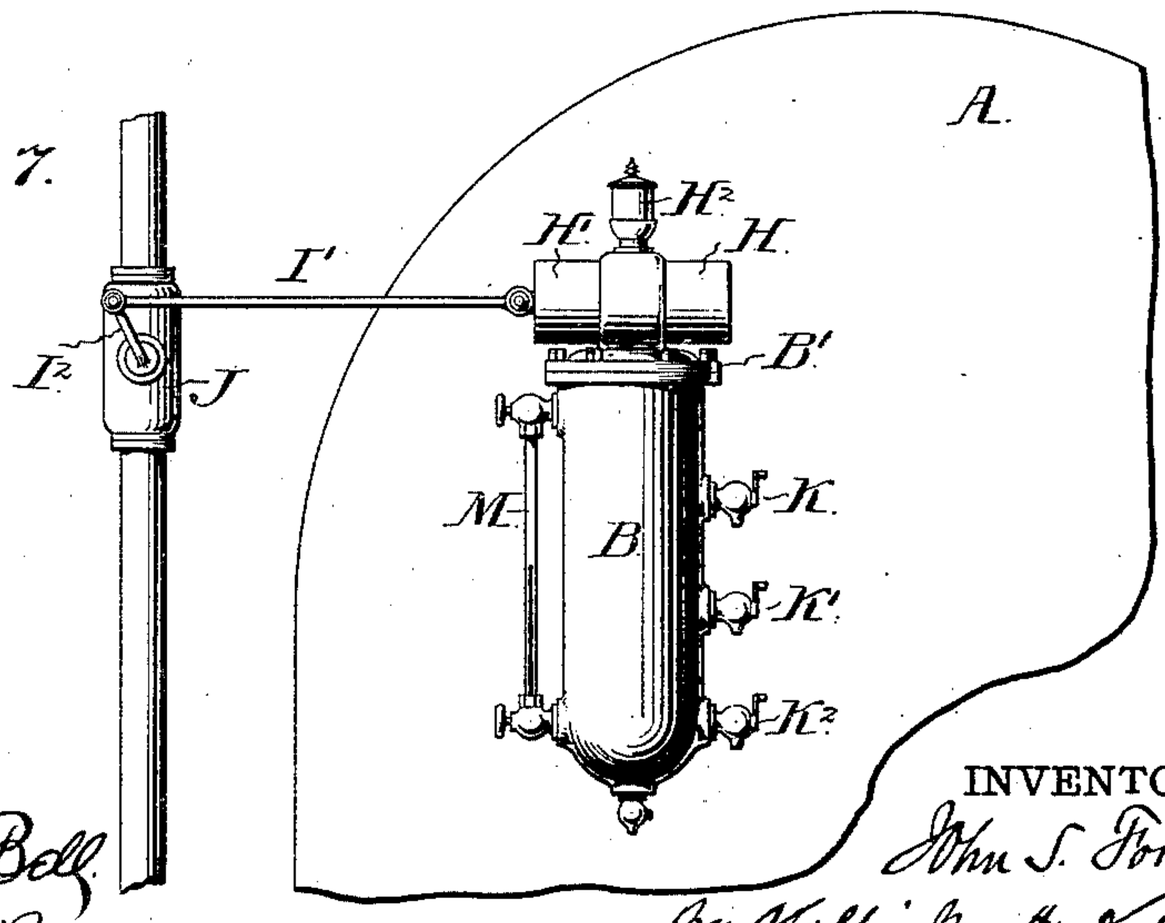


FIG. 7.



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FEED-CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 467,717, dated January 26, 1892.

Application filed January 31, 1891. Serial No. 379,863. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. FORBES, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Automatic Boiler-Feed-Controlling Apparatus and Alarms therefor.

The following is a specification of said improvements, reference being had to the accompanying drawings, wherein—

Figure 1 represents a centrally-vertical section through the device, showing certain of the interior working parts in elevation. Fig. 2 is a similar sectional view on a plane at right angles to the plane of Fig. 1. Fig. 3 is a top or plan view of the interior, the cap or cover being removed. Figs. 4, 5, and 6 are detail views in vertical section of the valve of the apparatus, showing the same in three different positions; and Fig. 7 is an exterior view on a small scale, illustrating the apparatus as applied to a boiler and connected with the starting-lever of an injector.

In said drawings, B represents the cylindrical casing of the apparatus, which is closed at top by a cap or cover B′ and communicates with the boiler A through the openings *b b′* for steam and water, respectively. A cup-shaped float C, open at its top and having a depression *c* in its bottom, moves freely up and down within the casing, being suspended therein by means of the tubular valve-operating stem D. The open lower end of said stem extends down into said depression *c*, and is pivotally connected by a pin *d′* to a stud *d*, mounted centrally in the bottom of the float. The upper part of said stem D is bent, as indicated at D′, into an approximately U-shaped form, and the upper horizontal leg of the U is freely connected at its end to the end of the tubular arm E, whose other end is rigidly attached to and communicates with the interior of a rotatable valve F. This valve F is a hollow truncated cone, whose base *f* fits closely against the vertical side of a pendent block G, in which are situated the passages or ducts controlled by the valve, as will be hereinafter described.

The base of the valve F is provided with a central exterior shaft or axis F′, which projects horizontally through a bearing in the block G, and carries at its protruding free end a coiled spring F^2, which presses against the other side of the block, and by its tension retains the valve in place against its side in the absence of steam-pressure within the casing. Stops *e e′*, projecting from the top and bottom of the block G, limit the upward and downward movement of the arm E, and consequently the range of rotation of the valve F. In the bottom or base *f* of the valve are four holes *a*, *a′*, a^2, and a^3, respectively arranged diametrically in pairs and in substantially the relation shown in Figs. 4, 5, and 6.

The block G is provided with three ducts or nozzles *g*, *g′*, and g^2, leading inward horizontally from that side which is the seat of the valve F for different distances, and then rising vertically through the block G, (see Fig. 3 and the dotted lines of Figs. 1 and 2,) their upper ends registering with corresponding ducts or passages formed in the cap B′ of the casing.

The relation of the holes *a*, *a′*, a^2, and a^3 in the valve to the proximate ends of the ducts *g*, *g′*, and g^2 is such that when the valve F is turned into the extreme upward position of the arm E (see Fig. 6) the hole a^3 registers with the duct g^2. In the extreme downward position of the arm E (not shown) the hole a^2 registers with the same duct g^2, and in either case the other two ducts *g* and *g′* are closed by the bottom *f* of the valve. In the mean position (see Fig. 4) all the ducts are closed by the bottom of the valve. In an upper intermediate position (shown in Fig. 5) the hole *a′* registers with the duct *g′*, the other ducts being closed, and in the corresponding lower intermediate position (not shown) the hole *a* registers with the duct *g*, the others being closed.

Mounted centrally upon the top of the cap B′ is a vertical disk-shaped partition B^2, having upon each of its faces an internally-threaded annular flange, as shown at b^2 b^3, respectively. Open-ended cylinders H H′, respectively, are mounted horizontally in the flanges upon each side of the partition B^2, and said cylinders contain loose-fitting pistons L L′, connected together by a rod I, which passes freely through the center of the partition B^2. In the bottom of each cylinder is an outlet-hole, as indicated at *l l′*, the location of each hole being such as to be inside of and just

clear a piston when it is in its extreme outward position in its cylinder. The upward continuation of the duct g through the cap B^2 connects at h with the interior of the cylinder H, and a similar continuation of the duct g' communicates at h' with the interior of the cylinder H′. The central duct g^2 is continued upward through the body of the partition B^2 and terminates in a screw-nozzle h^2, which is connected with the steam-whistle H^2. (See Fig. 7.)

The pistons L L′ are respectively provided with eyes i i', to one of which a rod I′ is attached, leading to the starting-lever I^2 of an injector (indicated at J) or the throttle-valve of a pump or controlling member of any suitable feed-water device for the boiler. The casing B may be provided with gage-cocks K K′ K^2 and with a glass gage M, if desired.

The operation of the device is as follows: In Figs. 1 and 2 of the drawings the water-level of the boiler is supposed to be normal and the corresponding position of the float C is such that the arm E is in its mean position, so that the valve F closes all three of the ducts. If now the water-level in the boiler falls, the float C descends and turns the arm E downward, so as in the first instance to bring the hole a into registry with the duct g. Upon this the steam which is in the interior of the casing flows up through the hollow stem D and arm E into the interior of the valve F and thence into the duct g. Thence it passes by the opening h into the cylinder H and at once forces the piston L outward. The consequent movement of the rod I′ shifts the lever I^2 of the injector J into the position proper for commencing the feed. If, notwithstanding the action of the feed, the water-level continues to fall in the boiler, the farther descent of the float C to the extreme downward position of the arm E brings the hole a^2 into registry with the duct g^2, and the steam now flowing upward through the stem D passes through the duct g^2 to the whistle H^2, thus sounding the alarm. If, however, the feed is sufficient, the float rises until it slightly passes its mean position and turns the arm E into the position indicated in Fig. 5. This brings the opening a' into registry with the duct g' and the steam passes up through the stem D and valve F into the cylinder H′. The pressure then throws the piston L′ outward and the movement of the rod I′ stops the action of the injector or other feed device. This position of the parts is indicated in Fig. 7. If, however, through improper action or failure to stop the feed the water continues to rise in the boiler, the corresponding rise of the float C will turn the lever-arm E into its extreme upward position, as indicated in Fig. 6, and bring the opening a^3 into registry with the duct g^2, thus opening communication with the whistle and sounding an alarm for high water. It will be observed that after the arm E is turned either upward or downward to an extent sufficient to open communication with either cylinder the shifting action of the piston thereof takes place immediately and the piston remains in its shifted position, notwithstanding the subsequent cutting off of communication by the further turning of the valve in the same direction. When either piston reaches its extreme position, the hole l or l' of its cylinder is uncovered and free communication with the atmosphere is thus provided, so that the piston no longer remains under pressure and the condensed steam can escape. When, therefore, the reverse movement takes place, the return of the piston is unimpeded. The cup C, not being under pressure, has no tendency to leak; but should it do so, or should water overflow its top, it immediately descends. As soon as in descending it has turned the arm E into a position which opens communication with a duct the steam-pressure within the apparatus will force the water which is within the cup C up through the tubular stem D and out through the duct, thus clearing the interior of the cup. The object of the depression c is to preserve the equilibrium of the cup by concentrating any accumulation of water which may occur therein, and thus preventing it from flowing to one side or the other. Furthermore, the amount of water which is allowed to remain in the cup is minimized.

In my Letters Patent, No. 418,607, dated December 31, 1889, I have specified a device for automatically opening the valves of a feeder and indicator by the action of a float. It will be observed, however, that not only is the float itself different from that of my present invention, but that the control which it possesses over the feeding devices and the alarm is of a different nature. Thus in said former patent, whenever the admission of steam to the operative parts took place, the alarm was necessarily sounded—a feature which in practice may cause the alarm to be sounded unnecessarily, and hence tend to detract from the effect thereof upon the operator to whom it is addressed.

It will be noted that in the present invention the alarm is not sounded until after the state of affairs which led to the actuation of the feeding mechanism has progressed in the direction of danger. For instance, in case of low water the injector or pump will first be brought into operation, and if the consequent feed is sufficient to restore the water-level, or even to prevent further fall, the alarm will not be sounded; but if the feed is not sufficient and the descent of the water-level continues the alarm will be given. In the converse case, where the water-level is rising, no alarm will be sounded, except where the movement which should have stopped the feed has failed to do so, and consequently the water rises beyond the proper point.

I am aware that the use of an open cup-shaped float and means whereby communication may be effected from the interior of such float to a point of discharge is not, broadly

speaking, new, and I therefore disclaim the same. As heretofore used, however, such devices have been so arranged as to require the sliding of the communicating-tube longitudinally in a packed channel or passage, thus greatly increasing the friction and diminishing the sensitiveness of the apparatus. My system of communication between the interior of the float and the valve, which permits the discharge being based upon the free suspension and comparatively easy movement of the parts, relieves the device of this objection and renders it instantly responsive to a change of the conditions.

To avoid unnecessary prolixity in the claims, I also wish it to be understood that I therein use the word "casing" to mean any suitable inclosing chamber communicating both with the steam and water spaces of the boiler and adapted to contain the float. I also use the term "actuating-piston" to indicate that element of the apparatus which, when moved by the action of steam from the casing, is adapted to actuate the controlling member of an injector, pump, or other feeding device.

Having thus described my invention, I claim—

1. The combination of a casing, a pair of cylinders in communication with the steam-space thereof, a pair of actuating-pistons within said cylinders, respectively, a steam-actuated alarm in independent communication with the steam-space of said casing, a valve controlling in substantially the order set forth the respective communications between said casing, said cylinders, and said alarm, and a float freely suspended within said casing and operatively connected with said valve, substantially as set forth.

2. The combination of a casing, a pair of cylinders in communication with the steam-space thereof, a pair of actuating-pistons within said cylinders, respectively, a steam-actuated alarm in independent communication with the steam-space of said casing, a valve-seat located within the casing and having a series of openings corresponding, respectively, with said communications, a rotatable valve mounted on said seat and adapted to control said communications in substantially the order set forth, an arm rigidly attached to said valve, a stem freely connected with said arm, and a hollow open-top float freely suspended from the lower end of said stem, substantially as set forth.

3. The combination of a boiler, a casing exterior thereto, but communicating with the water and steam spaces thereof, a steam-actuated alarm, a pendent block located within the casing and containing a passage which leads from the vertical side of said block to said alarm, a hollow rotatable valve seated upon the vertical side of said block, a central axis for said valve projecting through said block, a spring mounted on said axis and normally retaining said valve in position in the absence of steam-pressure, a hollow lever-arm rigidly connected with said valve and communicating with the interior thereof, a hollow stem freely jointed upon a horizontal axis to the end of said lever-arm, and a hollow open-top float freely suspended from the lower end of said stem at a point within the interior of said float and within the bottom thereof, substantially as set forth.

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