No. 683,914. | Patented Oct. 8, 1901.

J. DESMOND.

INJECTOR.

(Application filed Dec. 5, 1900.)

(Model.) | 4 Sheets—Sheet 1.

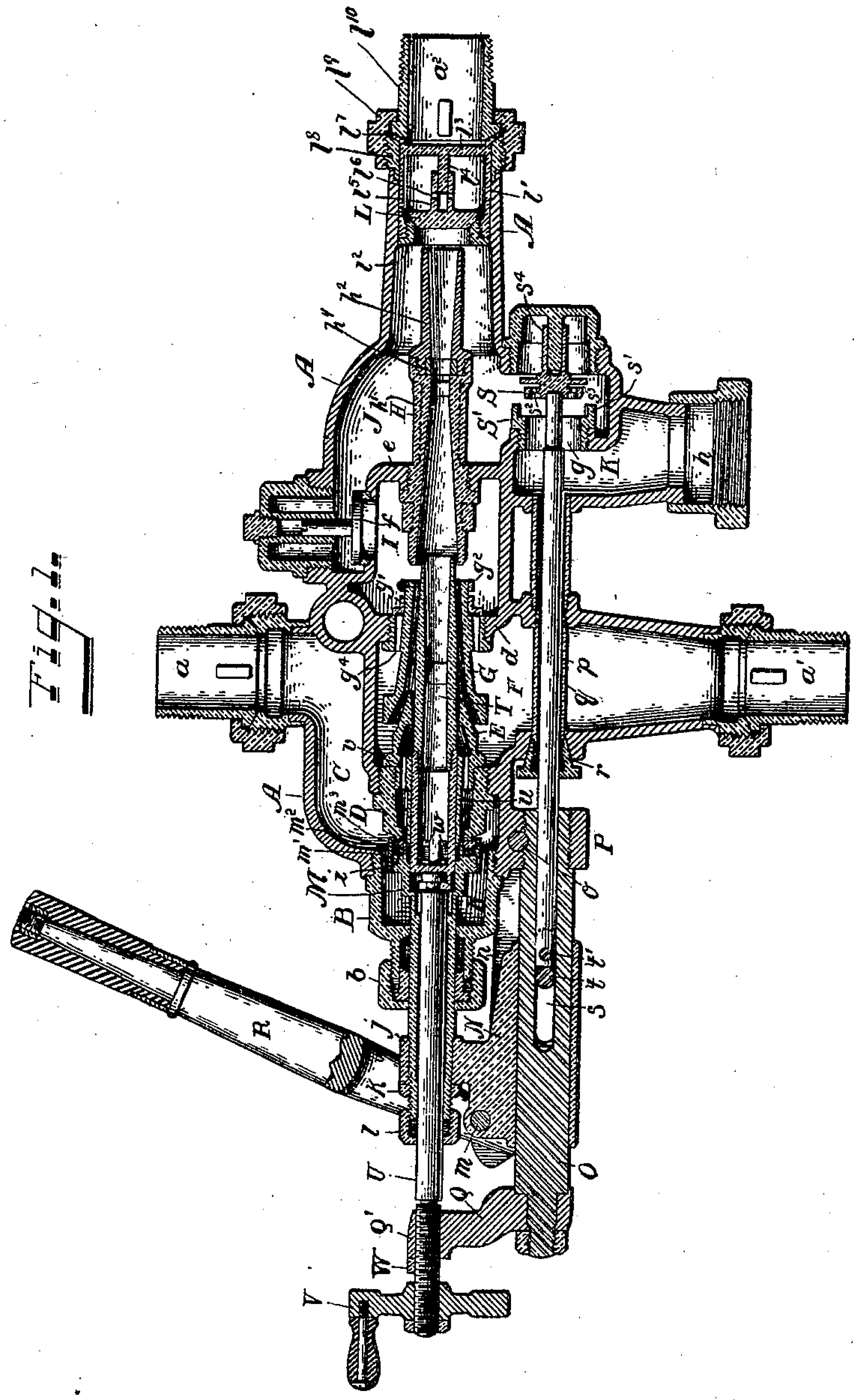

Fig. 1.

Witnesses.

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No. 683,914. J. DESMOND. Patented Oct. 8, 1901.

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(Model.) 4 Sheets—Sheet. 2.

Fig. 2.

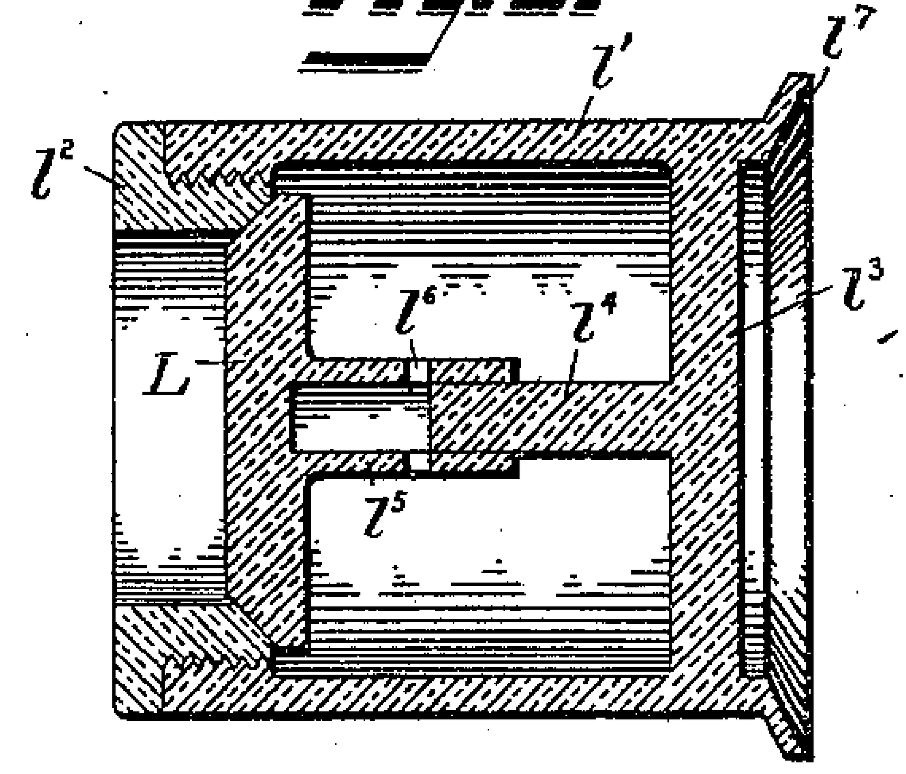


Fig. 3.

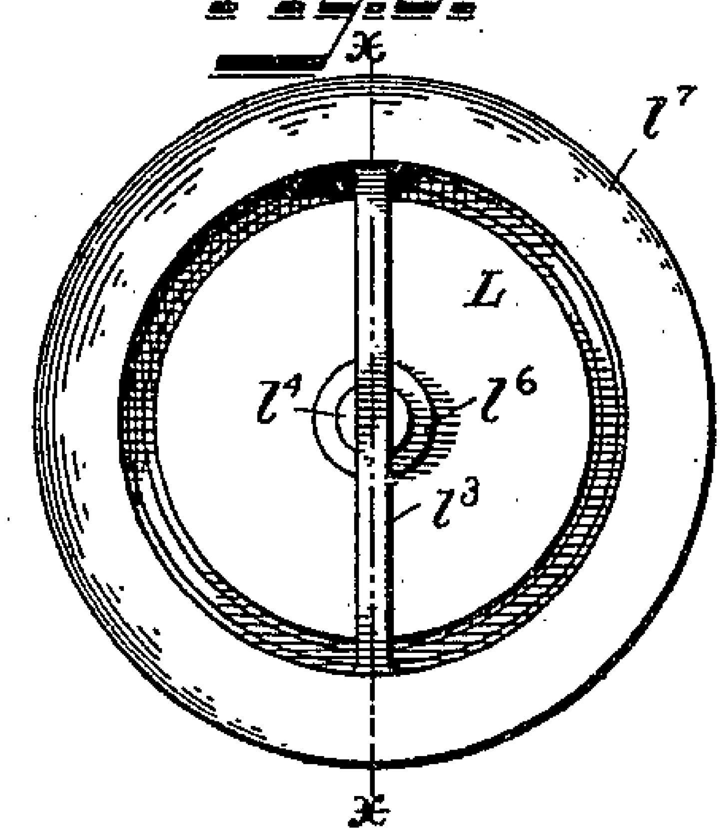


Fig. 4.

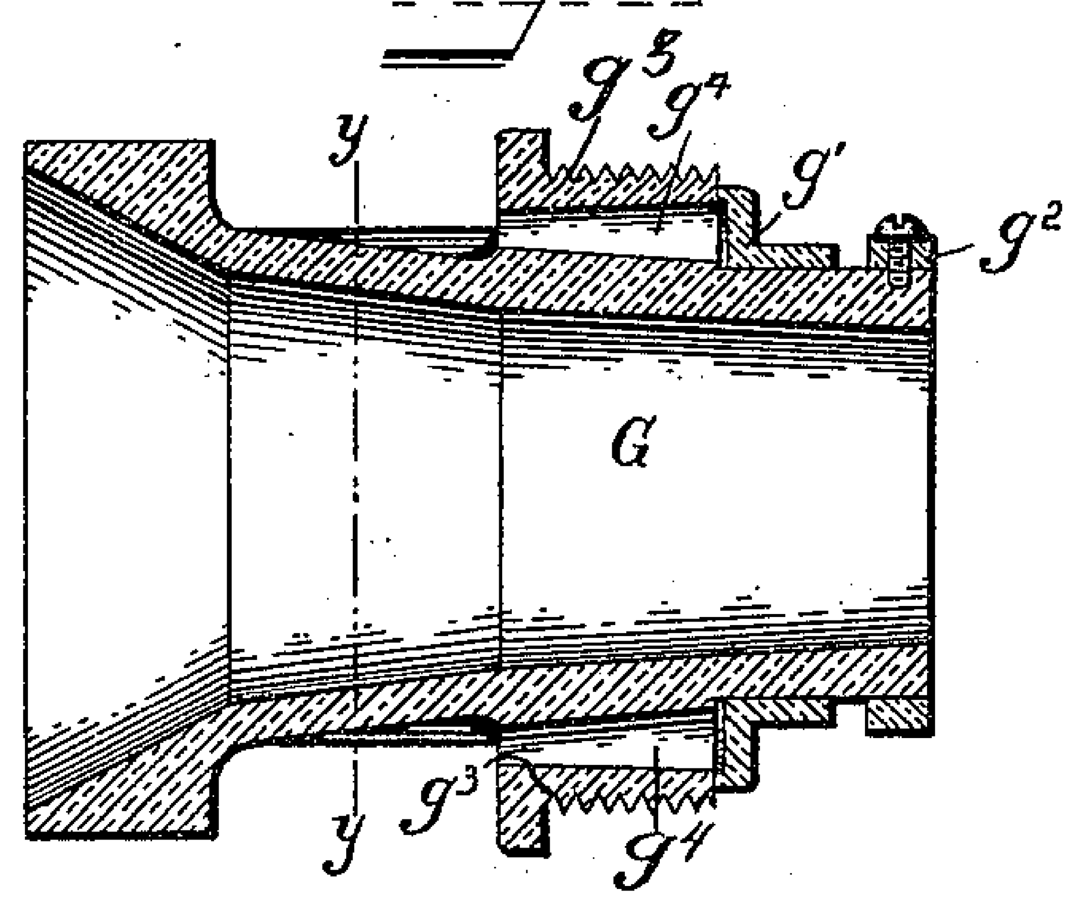


Fig. 5.

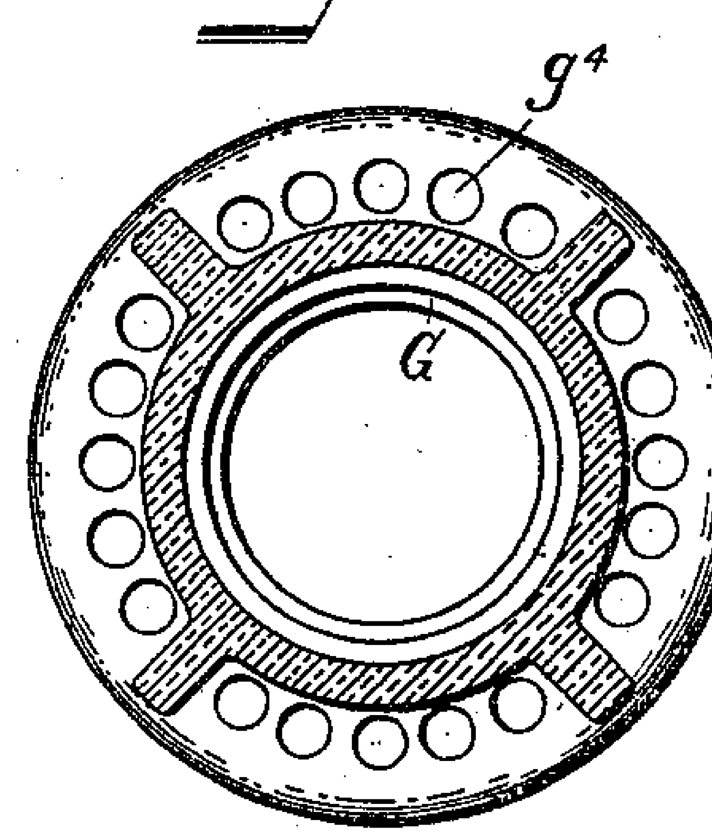


Fig. 6

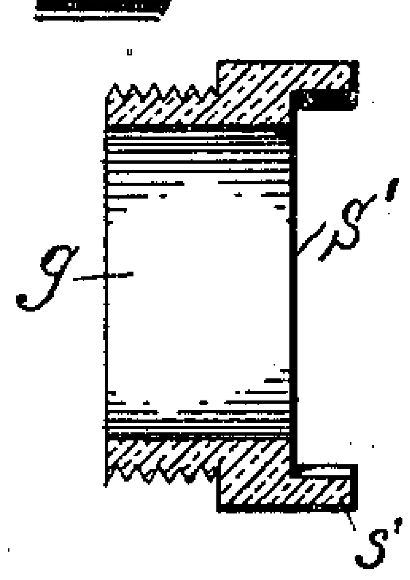


Fig. 7.

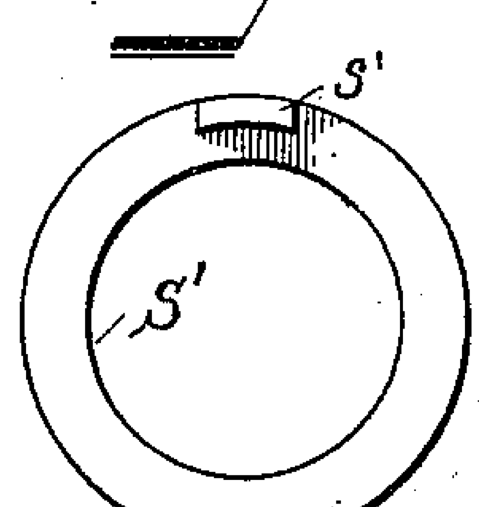


Fig. 8.

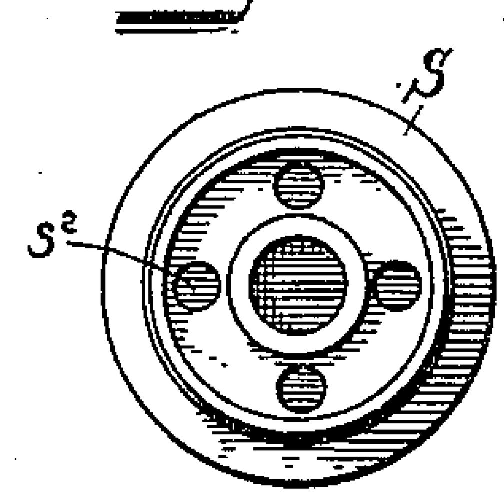


Fig. 9.

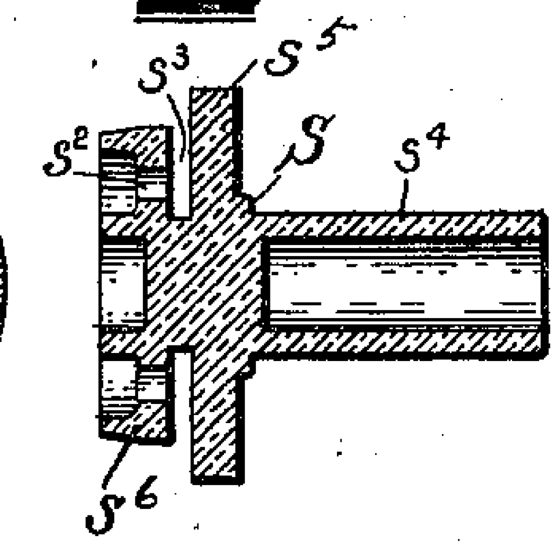
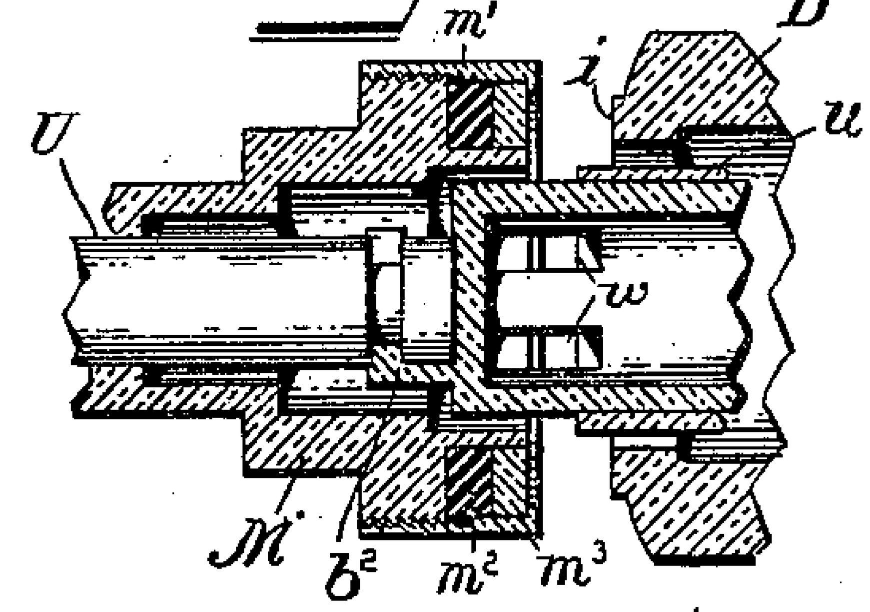


Fig. 10.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

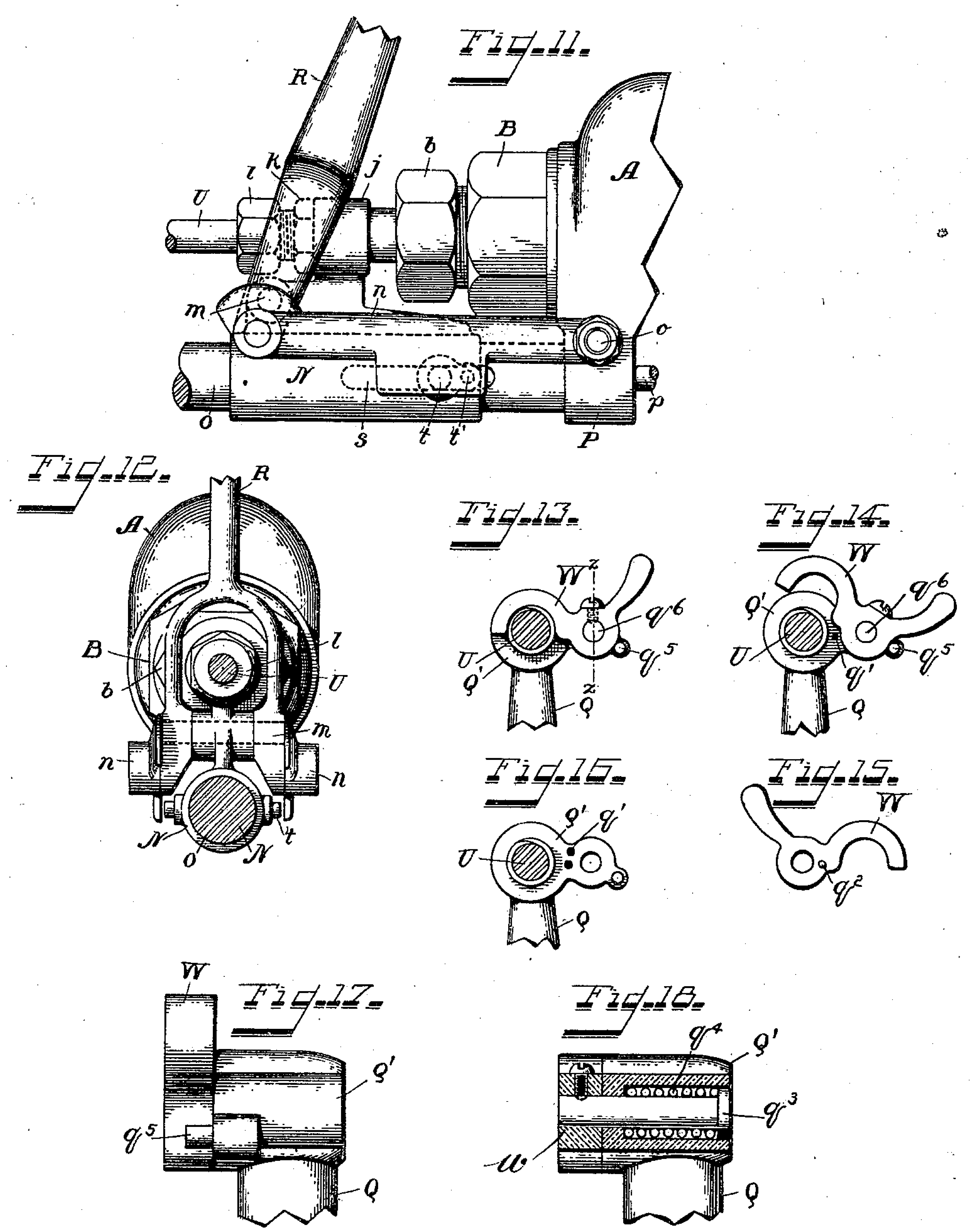
No. 683,914. Patented Oct. 8, 1901.

J. DESMOND.

INJECTOR.

(Application filed Dec. 5, 1900.)

(Model.) 4 Sheets—Sheet 3.



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No. 683,914.

Patented Oct. 8, 1901.

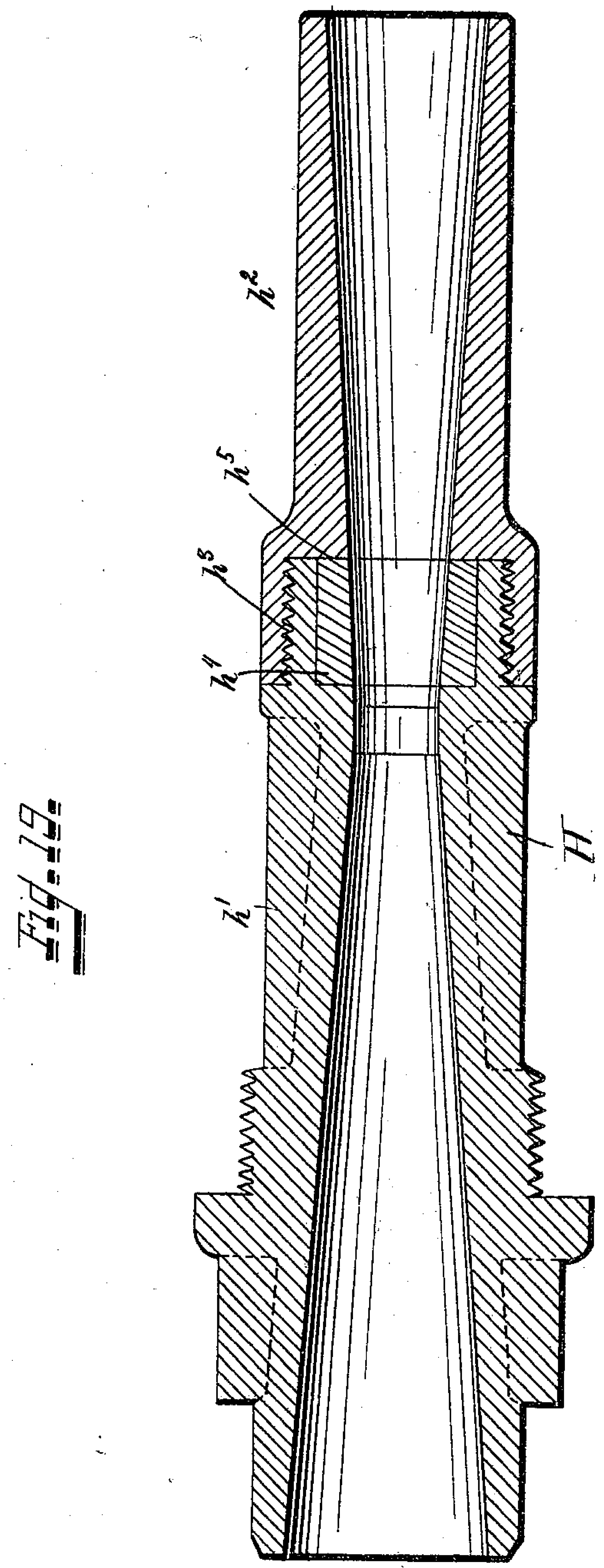
J. DESMOND.

INJECTOR.

(Application filed Dec. 5, 1900.)

(Model.)

4 Sheets—Sheet 4.



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UNITED STATES PATENT OFFICE.

JOHN DESMOND, OF CINCINNATI, OHIO, ASSIGNOR TO THE LUNKENHEIMER COMPANY, OF SAME PLACE.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 683,914, dated October 8, 1901.

Application filed December 5, 1900. Serial No. 38,836. (Model.)

To all whom it may concern:

Be it known that I, JOHN DESMOND, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Injectors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to injectors in which successive impulses of a plurality of steam-jets force the water into the boiler and in which the final overflow is positively closed, suitable means being used for the opening and closing of the overflow simultaneously with the closing and opening of the valve which admits the operating-steam into the injector.

My present injector in its general construction and mode of operation is very similar to that of my prior patent, No. 636,499, of November 7, 1899, of which it may be said to be an improvement; and, like that injector, one object of my present invention is to construct the injector in such a manner that its feeding capacity can be readily adjusted to the required duties of either stationary or locomotive engines.

Another object is to so construct the feeding mechanism that the feeding of the injector will not raise the temperature of the fed-in water to such a degree as to deposit scale within the tubes of the injector, by which its use would be impaired, and the final object is to produce an injector of a simplified and cheapened mode of construction and at the same time increase its reliability and efficiency of action.

All of these objects are obtained by the mechanism illustrated in the accompanying drawings and hereinafter to be more fully described, and the novelty of my invention will be specifically pointed out in the claims.

In the accompanying drawings, Figure 1, Sheet 1, is a longitudinal axial section, in side elevation, of an injector embodying my invention. Fig. 2, Sheet 2, is an enlarged central section, in side elevation, of the delivery-valve and its supporting-cage on the dotted line $x\,x$ of Fig. 3. Fig. 3, Sheet 2, is an end elevation of Fig. 2 looking to the left. Fig. 4, Sheet 2, is an enlarged central section, in side elevation, of the lifting-tube and associated parts. Fig. 5, Sheet 2, is a sectional end elevation of the same on the dotted line $y\,y$ of Fig. 4 looking to the right. Fig. 6, Sheet 2, is an enlarged central section, in side elevation, of the overflow-valve seat. Fig. 7, Sheet 2, is an end elevation of Fig. 6 looking to the left. Fig. 8, Sheet 2, is an end elevation of the overflow-valve, looking to the right of Fig. 9. Fig. 9, Sheet 2, is a central sectional side elevation of the overflow-valve. Fig. 10, Sheet 2, is an enlarged central sectional side elevation, partly broken, of the main steam-inlet valve and associated parts. Fig. 11, Sheet 3, is an enlarged broken side elevation of the forward part of the injector, showing the lever-operating mechanism for the steam-inlet and overflow valves. Fig. 12, Sheet 3, is an end elevation of Fig. 11 looking to the right. Fig. 13, Sheet 3, is a broken sectional detail elevation of the removable stop mechanism closed. Fig. 14, Sheet 3, is a corresponding view with the stop open. Fig. 15, Sheet 3, is a reversed view of the stop. Fig. 16, Sheet 3, is a view corresponding to Figs. 13 and 14 with the stop removed. Fig. 17, Sheet 3, is an enlarged detail side elevation of the stop-bearing. Fig. 18, Sheet 3, is a corresponding view, partly in section. Fig. 19, Sheet 4, is an enlarged axial section of the delivering-tube.

The same letters of reference are used to indicate identical parts in all the figures.

A is the shell or casing of the injector, which at a, a', and a^2 is provided with the usual threaded necks for the steam, inlet-water, and boiler delivery connections. At the end the shell A opposite the delivery end a^2 is an interiorly-threaded opening concentric with the opening a^2, into which is screwed a cap or bonnet B, provided with a stuffing-box b. The steam-inlet a opens into a chamber C, formed by the outer shell A and an inner diaphragm c, and the latter has a threaded aperture, into which is screwed a cap or bonnet B, projecting toward the bonnet B, and into the opposite end of which is screwed a nozzle E, projecting into the water-chamber F, that communicates with the water-inlet a', and by the passage of the steam through which the initial lifting of the water is effected in starting the injector. There is a second diaphragm *d* within the shell A, into a central bore of which is screwed the lifting-tube G, into the end of which the nozzle E of the tube projects. There is a third diaphragm *e* within the shell A, into which is screwed the combining and delivery tube H. The tubes H G and the nozzle E are in axial alinement, and in this instance in alinement with the axes of the outlet a^2 and stuffing-box *b*. Between the diaphragms *d* and *e* is the overflow-chamber I, and in the diaphragm *e* is seated a check-valve *f*, opening into the delivery-chamber J, from whence the overflow passes through a valve-controlled opening *g* and passage K to an outlet *h*, leading to the atmosphere.

L is the check-valve interposed between the discharge ends of the delivery-tube H and the outlet a^2, to be closed at proper times by the back pressure of the boiler. This valve, with its attachments and mode of connection to the injector-casing, constitutes one of the features of my present invention and will be more fully described hereinafter.

The cap or bonnet B has its apertured end within the steam-chamber C formed into a valve-seat *i*, (see Fig. 10,) against which closes a tubular valve M, whose tubular stem extends rearwardly through the stuffing-box *b*, thence through a head or collar *j* on a sleeve N, having its bearing and sliding upon a tubular support O, supported by a bracket P, depending from the casing A and carrying at its outer end an upturned bracket Q.

The stem of the valve M is threaded at its outer end and is locked to the lug *j* by a shoulder on one side thereof and by a nut *k* on the opposite side, and it has upon its extreme rear end a stuffing-box *l*. A hand-lever R has a fork straddling the sleeve N, which is pivoted thereto on both sides, as at *m*. (See Figs. 1 and 11.) The lower ends of the fork of the lever on each side of the sleeve N are provided with forwardly-extending pivoted links *n*, whose forward ends are pivoted, as at *o*, to the bracket P in such manner that the vibration of the lever R will cause the longitudinal movement of the valve M to open and close the same, as will be readily understood. In addition to this function of opening and closing the valve M the lever R also closes and opens the valve S, which controls the opening *g* in the overflow-chamber K by means of a stem *p* passing through a tubular bearing *q* in the chamber F, thence through a taper nut *r* at the forward end of the tubular bearing, which takes the place of a stuffing-box, and thence forward into a bore in the tubular support O. The tubular support O has slots *s* through it on opposite sides, through which and having their bearings in the sliding sleeve N two pins *t t'* are passed, the former bearing against the forward end of the stem *p* and serving as a push-pin to open the valve S, and the latter passing through said stem and serving as a pull-pin to withdraw the stem when it is desired to have the valve S closed by the pressure back of its disk, as will be explained more fully hereinafter The slots *s* are sufficiently elongated to permit the fullest movement of the lever R in both directions.

Extending axially through the nozzle E and the tube G is the forcing-tube T, the discharge end of which, slightly tapered exteriorly, partially enters the inlet end of the tube H. Said tube is again beveled and enlarged exteriorly just in rear of the discharge-nozzle of the tube and has its bearing in a tubular extension *u* of said nozzle. Between the said tubular extension and the threaded end of the nozzle E are a series of perforations *v*, Figs. 1 and 10, surrounding the tube *u*. The rear end of the forcing-tube T is closed, but is provided with a series of longitudinal slots *w*, Figs. 1 and 10, opening into the rear end of the tube. Upon the rear end of the tube T, within a recess in the valve M, is an extension b^2, having a slot cut down into it, into which is slipped the T-headed end of a rod or stem U, which passes rearwardly through a bore in the stem of the valve F and has its rear end threaded and engaging with a threaded aperture in the bracket Q, and a hand-wheel or crank-handle V, fast on the rear end of the stem, serves to turn the same to cause the longitudinal movement of the tube T.

In addition to the check-valve *f* I provide a ring check-valve *g'*, Fig. 4, which fits snugly upon and is free to slide on the discharge end of the tube G. The rear side of this ring-valve is flanged outwardly to form a seat against the forward end of the threaded bearing g^3, by which the tube G is screwed and securely held in the diaphragm *d*. Through this threaded portion g^3 and extending from one side of the diaphragm *d* to its opposite side are a series of perforations or ports g^4, Figs. 4 and 5, adapted to be opened and closed by the forward and backward sliding of the ring-valve *g'*, as hereinafter explained. The ring-valve *g'* has sufficient play upon the tube G and is held from disconnection therefrom by a ring g^2 or other suitable stop secured upon the forward end of the tube G, as seen in Fig. 4.

The construction of the check-valve L and its connection to the injector-casing is as follows, reference being had to Figs. 1, 2, and 3: The discharge end l^8 of the injector-casing, of brass and in this instance brazed to the casing, which is of iron, is exteriorly threaded to receive a union-nut l^9, which holds on the union-coupling l^{10}, and between them is clamped the flanged end l^7 of a tubular cage *l'*, which fits within the discharge end of the injector-casing, as seen in Fig. 1. The rear end of the cage *l'* is interiorly threaded to receive a threaded ring-seat l^2, which is screwed therein and against which the check-valve L seats. The valve L has on its forward side a tubular stem l^5, engaging a guide-pin l^4, over which it loosely fits, and which guide-pin is carried by a spider-arm l^3, forming part of or carried by the cage l'. Vent perforations l^6 through the stem l^5 permit the free play of the valve and stem on the guide-pin l^4. By this construction the cage l' can at any time be easily removed from the injector-casing to substitute a new valve or valve-seat or to cleanse or regrind the same, as occasion may require.

By reference to Figs. 1, 6, 7, 8, and 9 the construction and mode of operation of the overflow-valve will be readily understood from the following description: The valve-disk s^5 is carried upon a tubular stem s^4, guided upon a pin s^7, projecting from a cap-nut screwed into an aperture in the injector-casing in rear of the valve. In front of the valve-disk s^5 is a smaller flanged disk s^6, through which are a series of openings s^2, opening into a slot or cavity s^3 between the valve-disk s^5 and the flanged disk s^6. When the valve S is closed, the outer edge of the disk s^5 is seated against a ring-seat S', screwed into an aperture in the diaphragm which separates the chamber A from the chamber K, and this ring-seat is provided with lugs s', Figs. 6 and 7, by means of which it is screwed into place by a spanner or other suitable tool through the aperture containing the cap-nut, before mentioned, which guides the stem of the valve F. The forward end of the stem p fits loosely into an aperture in the disk s^6, and the purpose of the cavity or slot s^3 and apertures s^2 is to cause a circulation of the water across the seating-surface of the disk s^5 when the valve is partially opened, which effectually cleanses out any sediment or scale which might otherwise adhere to the disk s^5, and thereby prevent its proper closing. Upon opening the valve M to admit steam to the injector by drawing back the hand-lever R the sleeve N and stem p are at the same time drawn back away from the valve S, which as the pressure in the chamber J increases behind it forces the valve to its closed position. The reverse movement of the lever R in closing the valve M through the medium of the stem p presses forward and opens the valve S, as will be readily understood.

Referring now to Fig. 10, the construction of the valve M will be readily understood from the following description: The valve M is tubular, with bores of three different diameters—the rearmost to receive the coupling extension b^2 of the tube T, the middle one to receive the rear end of the tube itself, and the forward one to receive the end of the tubular extension u, which projects to some distance in rear of the seat i upon the cap or bonnet D. The exterior of the valve is threaded and rabbeted or cut away on its forward face to receive first an elastic ring m^2, of rubber, composition containing rubber, or other suitable elastic material, over which is fitted a metal ring m^3, which forms the valve proper and engages with the seat i when the valve is closed. An interiorly-threaded flanged ring or collar m', screwed upon the threaded end of the valve, serves to hold the rings m^2 m^3 in place, as will be readily understood. By this construction I insure a perfect and tight fit at all times between the ring m^3 and seat i to insure the proper self-adjusting and tight-closing of the valve with its seat.

The operation of the injector is as follows: Assuming the parts to be in the position shown in Fig. 1, the lever R is drawn rearward, and thereby first uncovers or opens the valve M, admitting steam into the cap or bonnet D, which passes through the orifices v and escapes from the nozzle E, around the tube T, into the lifting-tube G, thereby creating a vacuum in the chamber F, which will cause the water from the source of supply to enter said chamber through opening a'. The water so raised will pass through the tube G and be driven into the chamber I and partly through the tube H into the chamber J until the pressure in the chamber I is sufficient to raise the valve f, whereupon the water in the chamber I, joining that in the chamber J, will pass through the opening g and escape through chamber K into the atmosphere. The further movement of the lever R in opening the valve M will gradually permit the valve S to be forced toward a closing position until such time as the ends of the ports w in the forcing-tube T are uncovered, whereupon steam will enter through said ports into the tube T and will impart a second impulse to the water passing through the tube H sufficient to form an equilibrium between chambers I and J, which will cause valve f to drop to its seat, thereby closing communication between the two chambers. Valve S being still open all the water is passed through tube H to the atmosphere through opening g. As the back movement of lever R still gives more steam through ports w, the velocity of the water through jet H is increased sufficiently to resist boiler-pressure. At about that time or a little later valve S begins to close, gradually bringing pressure in chamber J up to boiler-pressure, and at that point valve L immediately opens, allowing free access to the boiler for all the water, and just at this moment the valve S will be closed, the overflow will be stopped, and the increasing velocity of the water through the tube H by the further uncovering of the ports w will be sufficient to overcome the boiler-pressure and open the valve L to permit the water to pass from the injector into the boiler. As soon as the pressure in chamber J rises above that in the chamber I the check-valve f is closed and all of the water that passes through the tube G has to pass through the tube H. Should a vacuum be formed in the chamber I, the ring-valve g' will at once be open to admit water from the chamber F into the chamber I, and thereby restore equilibrium. As soon as the injector is thus started the tube T by means of the crank-handle V can be moved forward longitudinally to regulate the amount of steam passing from nozzle E around the tube T, and by cutting off this supply of steam or throttling the nozzle E the steam is made to pass almost entirely through the tube T, and the entering water through the tube G will not be heated to an extent sufficient to deposit scale in the tubes of the injector, as fully described in my prior patent, before referred to.

Another feature of my invention, illustrated in Figs. 1, 13, 14, 15, 16, 17, and 18, consists in applying a pivoted removable stop W between the bearing Q′ of the bracket Q and the hub of the crank-handle V. This stop is so disposed that when in place it will not interfere with the advancement of the tube T to its farthest limit under the requirements of the working of the injector; but when it is lifted out of the way the tube T can be advanced farther into the mouth of the tube H, so as to almost, if not quite, throttle the same. This adjustment is found desirable whenever the injector is stopped from its work of feeding water to the boiler, for then upon opening the valve M steam would pass through the orifices b and out from the nozzle E, and thence down through chamber F and pipe a, whence it would pass back to the supply tank or reservoir to heat its contents. Whenever it is desired to start the injector again, the tube T will be withdrawn and the stop W be turned down to its normal condition. The stop W is pivoted, as at q^6, to a bored lug on the bearing Q′, the bore of which lug contains a pin q^3, to which the stop is secured and around which pin in the bore is a coiled spring q^4, tending to hold the stop close against the bearing and to hold a pin q^2, Fig. 15, on the inner side of the stop in one or the other of two depressions q', Fig. 16, in the bearing. This pin and these depressions serve to hold the stop either in its closed position, as shown in Fig. 13, or in its open position, as seen in Fig. 14.

Referring now to Figs. 1 and 19, I would thus describe the novel features of the combining and delivery tube H. This tube, as is common in most injectors, is contracted at or near its middle, its bore being tapering and enlarging from the middle each way. It has been found in practice that just beyond the contracted part of the bore the tube became disintegrated either from wear or excessive heat, my theory being that the water in its rapid passage through the tube and being compressed at the contracted throat and then relieved just as it passed that point develops an amount of heat sufficient to corrode or disintegrate the metal of the tube at that point, thereby requiring in time the replacement of an entire new tube. I overcome this difficulty by making the tube in two parts h' h^2, Fig. 19, the former being the receiving end and the latter the discharge or delivery end, the two parts being screwed together, as seen at h^3, and a counterbore being formed in the delivery end of the portion h' to receive a ring h^4, of steel or other suitable metal of a high resistance to the disintegrating action before referred to. The interior bore of this ring conforms to the bore of the tube, and, as shown, it is located just at or slightly beyond the contracted part of the tube, and it is held in place by a shoulder h^5 on the inner end of the portion h^2 of the tube. I have found from experience that a ring of this character so introduced into the tube at this point will last very much longer than if the tube were a homogeneous one, and it has the further advantage that in case of disintegration of the ring h^4 the tube can be readily uncoupled and a new ring substituted for the worn one at small expense and with little loss of time.

Having thus fully described my invention, I claim—

1. In an injector, of the character described, the combination of the inlet water-chamber, the adjacent overflow-chamber, a passage between said chambers around the lifting-tube, and a valve within the overflow-chamber carried on said lifting-tube for opening and closing the passage around the lifting-tube and between the two chambers, substantially as described.

2. In an injector of the character described, the combination of the inlet water-chamber, the adjacent overflow-chamber, a lifting-tube opening from the water-chamber into the overflow-chamber, a series of circularly-arranged ports around said lifting-tube and between said chambers, and a ring-valve within the overflow-chamber carried on said lifting-tube for opening and closing said ports around the lifting-tube, substantially as described.

3. In an injector of the character described, the combination of the inlet water-chamber, a lifting-tube therein, a steam-chamber with a nozzle therefrom for the lifting-tube, a valve-seat within the steam-chamber controlling the opening into said nozzle, and a valve for said valve-seat provided with a self-adjusting yielding surface to tightly fit the valve-seat, substantially as described.

4. In an injector of the character described, the combination of the inlet water-chamber, a lifting-tube therein, a steam-chamber with a nozzle therefrom for the lifting-tube, a valve-seat within the steam-chamber controlling the opening in said nozzle, and a valve for said valve-seat provided on its closing-face with a recessed yielding ring covered by a metal ring which contacts with the valve-seat to form a self-adjusting tight-closing surface, substantially as described.

5. In an injector of the character described, the combination of the delivery-chamber, outlet-chamber communicating therewith by means of an opening provided with a valve-seat, a valve for said valve-seat within the delivery-chamber composed of a guided disk forming the valve proper, a second disk carried by the first disk adapted to enter the

opening between the two chambers with a cavity between said disks, a series of perforations through the second disk opening into said cavity, and an operating-stem for said valve to open the same when moved in one direction and to permit the self-closing of the valve when moved in the opposite direction, and whereby said cavity and perforations form an automatic cleansing means for the valve-disk and its seat, substantially as described.

6. In an injector, the combining and delivery tube having a contracted bore at or near its middle provided with a non-disintegrating bearing-surface at or near its contracted portion on the delivery side thereof.

7. In an injector of the character described, the combining and delivery tube having a contracted bore at or near its middle and made in two parts united at the contracted portions, and a renewable non-disintegrating ring inserted in the bore at or near its contracted portion on the delivery side thereof, substantially as described.

8. In an injector, the combination with the discharge end thereof of a cage l' telescopically fitted therein and provided with a flanged end l^7, a check-valve L fitted and guided in said cage, a removable valve-seat l^2 screwed into the end of the cage, and a coupling-union for clamping the flange of the cage to hold the latter in place, substantially as described.

9. In an injector of the character described, the combination of the valve M and its operating-stem, the sleeve N fast to said stem and guided on a projection from the injector-casing, the forked hand-lever R connected by means of pivoted links n to the injector-casing and pivoted to the sleeve N, the overflow-valve S, the stem p therefor, and the push-and-pull pins t t' connecting the sleeve N and the stem p, substantially as described.

10. In an injector of the character described, the combination of a forcing-tube having a defined limited play for the ordinary operations of the injector, an operating-stem therefor, and a removable stop for said stem constantly in an engaging position for the same under the ordinary operations of the injector, said stop being adapted to be thrown out of engagement with the stem when desired to permit the movement of the forcing-tube to an abnormal position, substantially as described.

11. In an injector, the combination with the operating-stem U, bearing-bracket Q therefor, operating-handle R, and pivoted stop W pivoted to the bearing-bracket Q, substantially as and for the purpose specified.

12. In an injector, the combination of the operating-stem U, bearing-bracket Q therefor, operating-handle V, pivoted stop W pivoted to the bearing-bracket Q and yieldingly held thereto by a spring-pressed pin, a pin q^2 on the stop W and depressions q' in the face of the bearing for holding the stop locked in its open or closed position, substantially as described.

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