

No. 609,801.

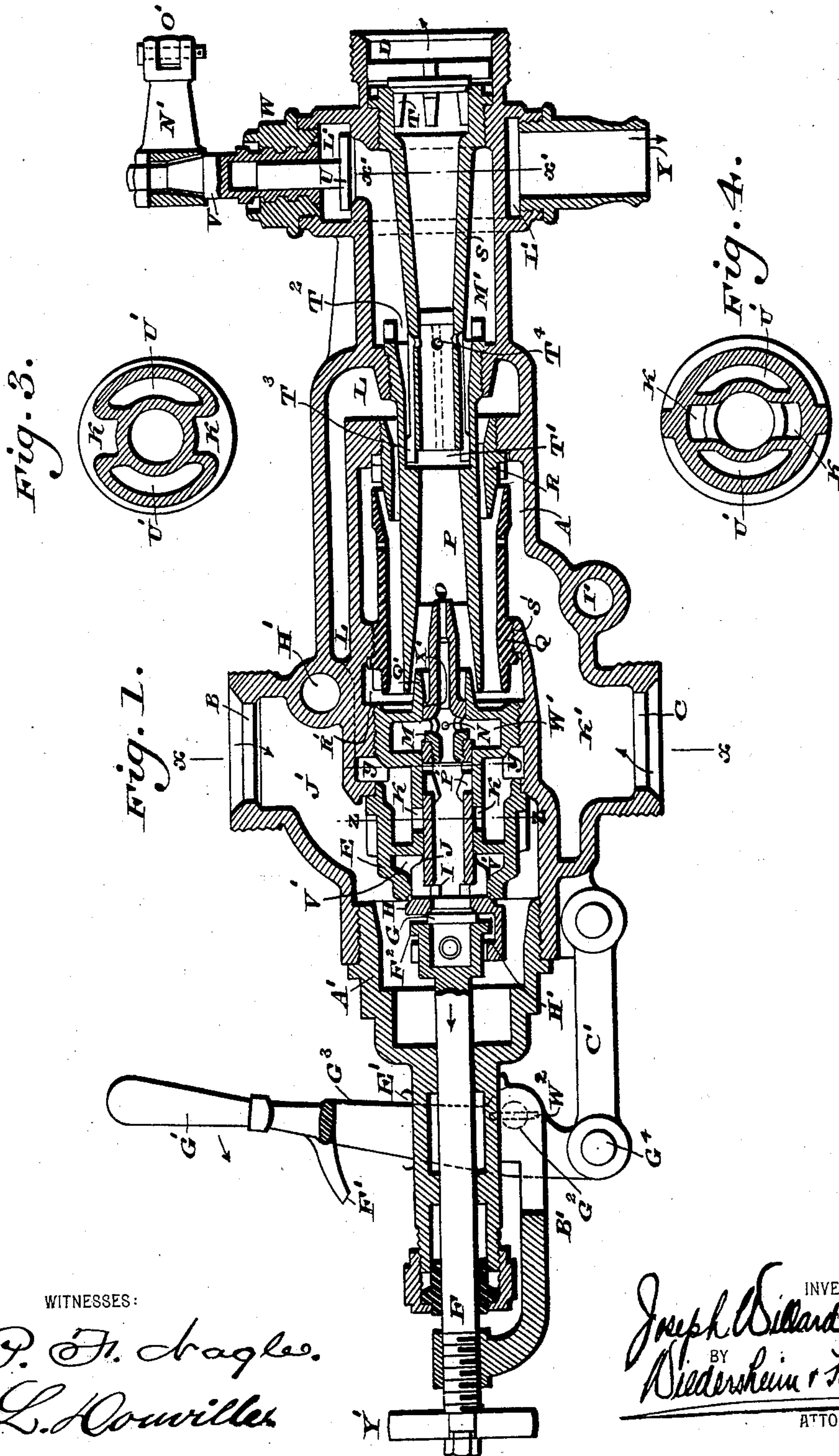
Patented Aug. 30, 1898.

J. W. GAMBLE.  
INJECTOR.

(Application filed Dec. 2, 1897.)

(Model.)

2 Sheets—Sheet 1.



WITNESSES:

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No. 609,301.

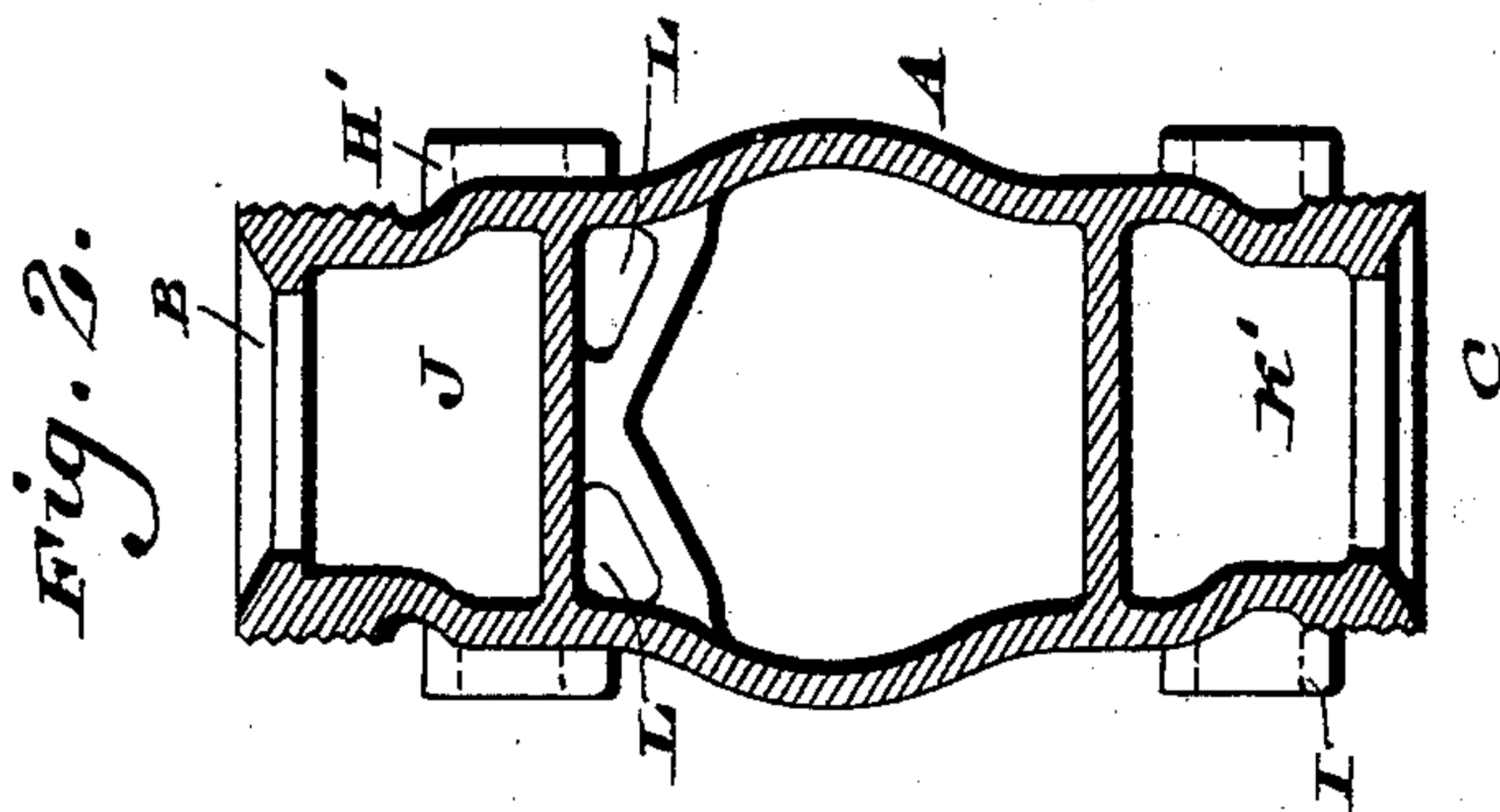
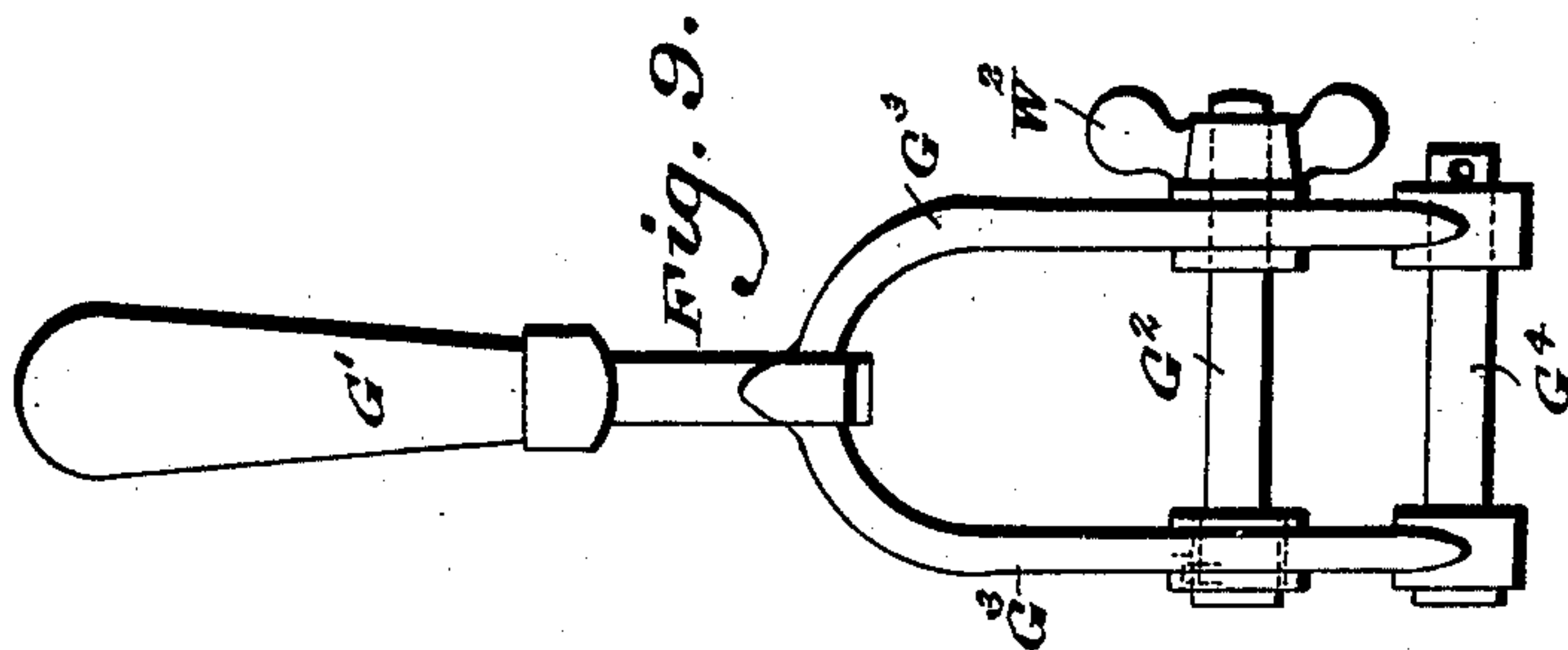
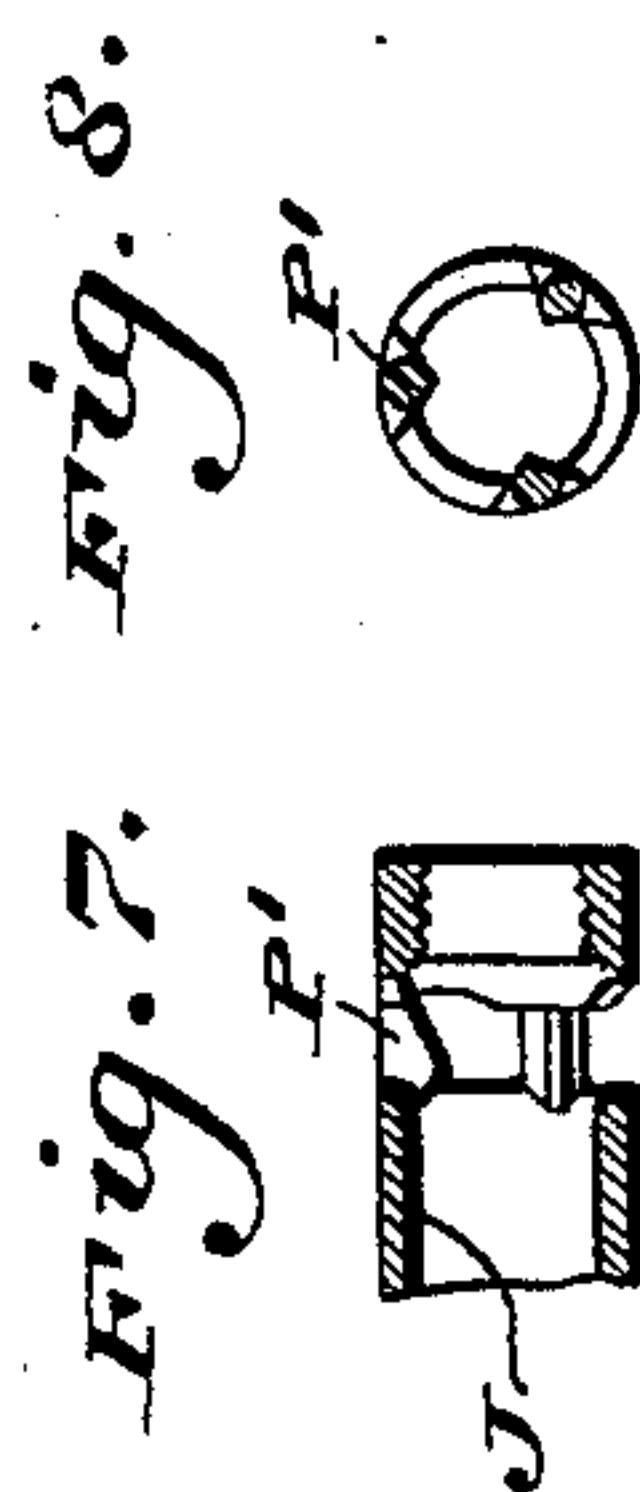
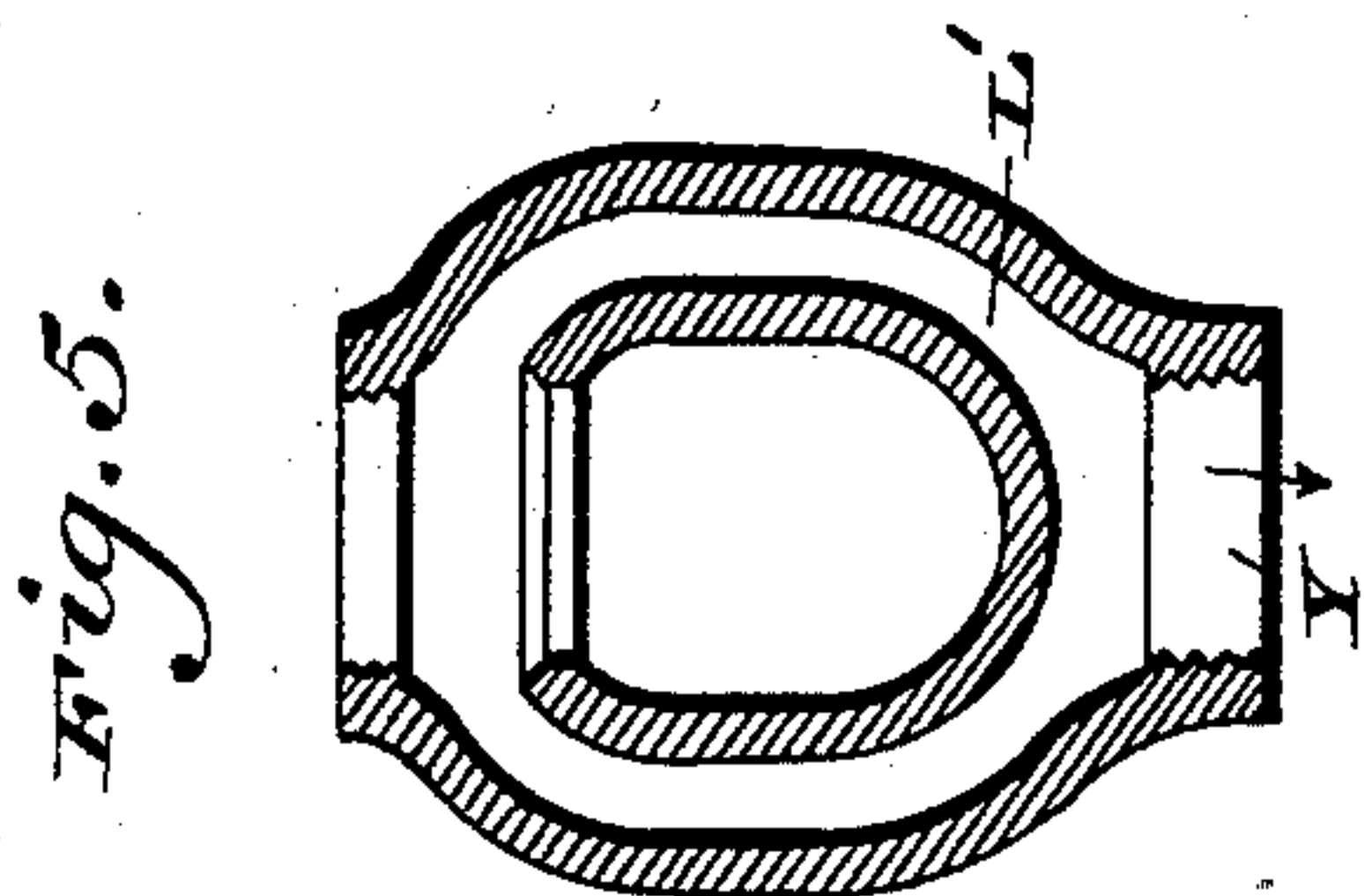
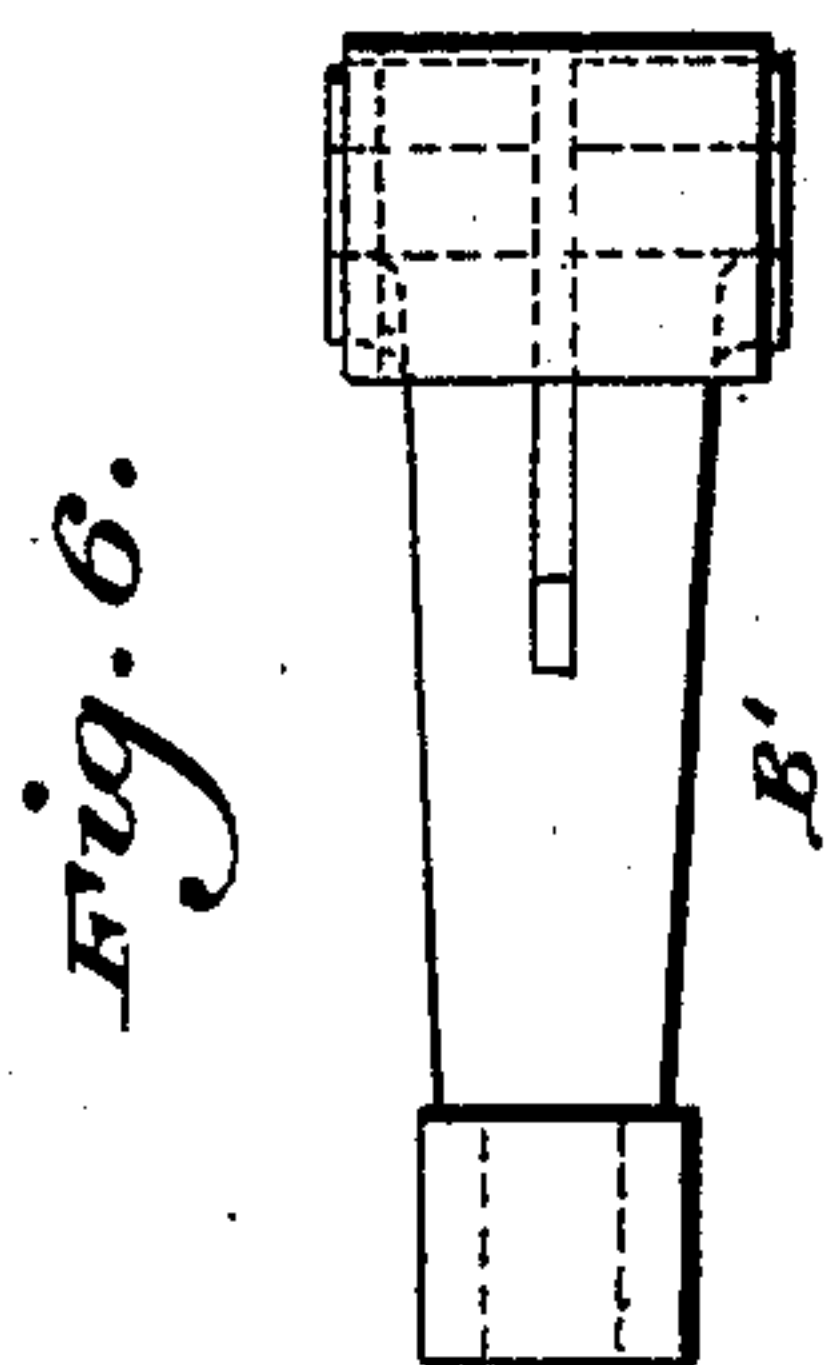
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WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## INJECTOR.

SPECIFICATION forming part of Letters Patent No. 609,801, dated August 30, 1898.

Application filed December 2, 1897. Serial No. 660,476. (Model.)

*To all whom it may concern:*

Be it known that I, JOSEPH WILLARD GAMBLE, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Injectors, which improvement is fully set forth in the following specification and accompanying drawings.

My invention consists of an improved construction of injector whereby the injector known as a "double" injector is rendered more compact in form and is especially adapted to the requirements of modern locomotive railroad practice, means being also provided for giving increased capacity and efficiency to the injector.

It further consists of improved construction of steam-distributing valve and arrangement of the enveloping primary supply-tube, said primary set of tubes being constructed so as to envelop the secondary or forcing set of tubes and being preferably so arranged that the delivery end of the primary set of tubes substantially coincides in position with the entrance end of the secondary set of tubes, thereby combining all the advantages of the double-tube injector with the compact form of the single-tube injector.

It further consists of novel details of construction, all as will be hereinafter fully set forth, and particularly pointed out in the claims.

Figure 1 represents a longitudinal sectional view of an injector embodying my invention. Fig. 2 represents a transverse section on line  $xx$ , Fig. 1. Fig. 3 represents a transverse section on line  $yy$ , Fig. 1. Fig. 4 represents a transverse section on line  $zz$ , Fig. 1. Fig. 5 represents a section on line  $x'x'$ , Fig. 1. Fig. 6 represents a detached plan view of an arm seen at the left of Fig. 1, to be hereinafter referred to. Figs. 7 and 8 represent, respectively, longitudinal and transverse sections of a portion of the hollow steam-distributing valve, shown in detached position. Fig. 9 represents a front elevation of the operating lever or handle seen in Fig. 1 in detached position.

Similar letters of reference indicate corresponding parts in the figures.

Referring to the drawings, A designates

the body or casing of the injector, having the steam-inlet B, the water-supply inlet C, and the outlet D, leading to the boiler.

The steam entering at B passes into the chamber J', said chamber having fitted therein the steam-distributing valve and valve-seat, the construction and operation of which will be hereinafter referred to.

The nozzles Q and R will be designated as the "primary" or "supply" set of nozzles, R being the primary steam-nozzle and Q the primary combining nozzle or tube, the nozzles Q', P, and S being designated as the "secondary" or "forcing" set of nozzles, said nozzle Q' being the secondary steam-nozzle, P the secondary combining nozzle or tube, and S the secondary delivery nozzle or tube, it being noticed that the steam-nozzle Q' of the secondary set is integral with the steam-distributing chamber E.

O designates the steam suction-nozzle, its function being to lift water from the supply to the injector when starting.

K' designates the suction or supply chamber, into which water is first conducted, the nozzle or tube Q being suitably secured at S' to the partition which separates the chamber K' from the chamber R', into which latter water from the nozzle Q is discharged, said water passing thence through the secondary combining-tube P.

M' designates the overflow-chamber, into which the water from the tube P is initially discharged before sufficient velocity has been imparted to said water to enable it to pass into the boiler, said overflow-chamber M' when the check-valve U is raised being in communication with the passage L', which extends around the injector-body and communicates with the atmosphere through the opening Y, as is evident.

Referring now to the construction of the steam-distributing valve and seat, it will be evident that the main steam-valve H is adapted to be seated on the contiguous portion of the shell E, said valve H carrying the hollow cylinder J, which is preferably integral therewith, said cylinder having secured thereto the steam suction-nozzle O, a portion of said nozzle O being enlarged so as to form a piston X', which controls the admission of steam to the



secondary steam-nozzle Q'. The hollow cylinder J has ports or openings at I and P', and the suction steam-nozzle has the openings or ports N therein.

5 The main steam-valve H has a supplementary opening which is adapted to be closed by the valve G, which latter is loose on the stem or spindle F and is connected by suitable mechanism to the lever or handle G'.

10 The spindle F is enlarged at F<sup>2</sup>, forming a flange or shoulder, which engages at the proper period with the portion H' of the main steam-valve H, thus enabling the motion of both valves to be controlled by the handle G'.

15 The shell E is constructed as follows: The chamber V' communicates by the side passage U', as will be understood from Figs. 3 and 4, with the chamber W', the ports K communicating with the passages L, as will be seen from the dotted lines in Fig. 1, it being understood that said Figs. 3 and 4 are sections through the shell E on the lines *y y* and *z z*, respectively. The ports K in the shell E are placed in such relation to the ports P' in the hollow cylinder of the main valve H as will effect the proper admission and regulation of steam-supply to primary steam-nozzle R.

20 The spindle F is preferably threaded at its outer end, as indicated in Fig. 1, for the purpose of changing the position of the main valve H, thereby altering the relative positions of the ports P' and K, and by admitting a greater or less quantity of steam to the primary steam-nozzle R a corresponding increase or decrease of the capacity of the injector will be effected.

30 The motion or throw of the handle G' is limited by means of the projection F', contacting with the spindle F or other suitable portion of the injector.

40 The arm B', which serves to connect the handle G' with the spindle F is split, whereby said arm is enabled to be clamped fast at any part of its stroke, the necessity for such provision being occasioned when it is desired to heat the feed-water supplying the injector.

45 The handle G' is mounted on the arm B' by means of the member G<sup>3</sup>, through which passes the stem G<sup>2</sup>, which is provided with the tightening device or thumb-nut W<sup>2</sup>. The lower extremity of the member G<sup>3</sup> has the stem G<sup>4</sup>, common thereto and to the link C', the other end of said link being pivotally attached to the body of the injector.

50 In the preferred embodiment of my invention I extend an end of the secondary delivery-tubes into the secondary combining-tube P, the latter being recessed for the reception of said delivery-tube, whose extremity terminates a short distance from the shoulder in said tube P, forming the split T', passage T<sup>2</sup> leading into the chamber M'.

55 T<sup>3</sup> designates ribs which serve to retain the tubes in proper position relative to each other, the tube S being provided with the ports T<sup>4</sup>.

H' and I' designate eyes or openings in

bosses or lugs on the injector for enabling the latter to be secured in position.

70 The operation is as follows: If we assume the parts to be in the positions seen in Fig. 1 and steam-pressure to be maintained in chamber J', the initial movement of the handle G' to the left unseats the steam-valve G, steam being then admitted to the cylinder J, which supplies the suction-nozzle O, while at the same time steam will enter through the openings I of said cylinder J and pass into the chamber V', and thence by the side passages U', as will be understood from Figs. 3 and 4, into the chamber W', steam being also supplied to the suction-nozzle O through the ports N.

80 It will be apparent from the foregoing that the steam is now blowing through the suction steam-nozzle O, while the secondary nozzle P serves the purpose of a draft-tube, the steam from the suction steam-nozzle O passing through the tube P, thence through the split T', passage T<sup>2</sup>, and ports T<sup>4</sup> into the chamber M' and lifting the check-valve U, after which it passes to the atmosphere through the side passages L and outlet Y, the steam thus blowing through the tubes producing a vacuum in the chamber K', whereby the water is brought to the injector. The handle G' is then moved to its extreme left-hand position and the injector is now in full operation, the effect of the further movement of said handle being as follows:

100 Suction having been created in the manner described the ports P' gradually coincide with the ports K, whereupon steam passes through the passages L, as will be understood from Figs. 1 and 2, to the primary steam-nozzle R, thence passing through into the primary combining-tube Q and being condensed by coming in contact with the water already in motion, due to the action of the suction steam-nozzle O, this action of the primary set of tubes greatly increasing the velocity of the water passing through the injector and out the overflow. In the next place the piston or plug X, having been moved to the left, as described, opens the chamber W and admits steam to the secondary steam-nozzle Q', the velocity of the water being now sufficiently increased to cause it to cross the split T', unseat its check-valve T, and enter the boiler.

110 If it is now desired to increase or decrease the capacity of the injector, the movement of the hand-wheel Y', mounted on the stem F, in the proper direction will effect this result.

115 When it is desired to employ the injector as a feed-water heater, the overflow check-valve U (seen at the right of Fig. 1) is locked upon its seat, this being effected by screwing down the spindle V, preferably by means of a thread, enabling it to close in about one-third of a revolution, said check-valve being manipulated from the front of the injector by means of a rod O', which may connect the arm N' with the handle G', said connection being made in any suitable manner.



After closing the valve U the handle G' is brought to a substantially vertical position and clamped at the desired point by means of the device W<sup>2</sup>, at which point the quantity of steam employed can be regulated by the proper manipulation of the hand-wheel Y', as already explained.

It will of course be understood that my improved injector is not to be limited in its scope to the exact style of injectors shown, the principle of the enveloping tube, steam-actuating valves, &c., being applicable as well to what is known as the "locked overflow-injector," with the solid instead of the split secondary combining-tube.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an injector, the combination of a primary or supply set of tubes and a secondary or forcing set of tubes, said primary set of tubes enveloping said secondary set and being so arranged that the delivery end of the primary set substantially coincides with the entrance end of the secondary set of tubes.

2. In an injector, a primary or supply set of tubes, a secondary or forcing set of tubes, the latter set being enveloped by said primary set with the delivery end of the primary set substantially coincident with the entrance end of the secondary set of tubes and a steam-distributing valve for admitting steam to the steam-nozzles in their proper sequence and means for operating said valve.

3. In a double-tube injector, the combination of a front secondary or forcing tube and a rear secondary or forcing tube, said front tube being recessed to envelop said rear tube, and being itself enveloped by the primary set of tubes.

4. In a double-tube injector, the combination of the enveloping tubes, the secondary tubes enveloped thereby a distributing steam-valve, a lever or handle therefor, means for limiting the stroke of the valve, a spindle and means for changing the extent of the stroke of the valve according to requirements.

5. In a double-tube injector, the combination of the enveloping tubes, a steam-distributing valve constructed substantially as shown, an operating lever or handle and means on the fulcrum of said lever for clamping said lever at any point of its stroke.

6. In a double-tube injector, a forcing or secondary set of tubes having a front tube and

a rear tube adapted to be enveloped by said front tube, whereby an air-space is provided between the jet of water moving through the forcing set and the jet of steam moving in the contrary direction in the steam-nozzle of the primary set, means being also provided for permitting a free vent for the steam blowing through the suction steam-nozzle.

7. In an injector, a steam-inlet, a shell E, chambers V' and W', in said shell, passages U' forming a communication between said chambers, a steam-valve controlling the inlet of steam to said chambers, ports K controlled by said valve, and leading to the passages L, a primary steam-nozzle R in communication with said passages L, a primary combining-nozzle Q, a secondary combining-nozzle P enveloped by said nozzle Q, a secondary steam-nozzle Q', within said nozzle P, a steam suction-nozzle O, and means for controlling the flow of steam to the chambers V', passages L and nozzle O.

8. In an injector, the shell E, the chambers V', W', inclosed thereby, the passages U' connecting said chambers, the ports K leading to the passages L, and a set of primary and secondary tubes, in combination with a valve H, a cylinder J attached thereto, and provided with ports I and P', a nozzle O, attached to said cylinder and having a piston X' and ports N therethrough, an opening in said valve H, a valve G for initially controlling said opening, and means for operating said valves.

9. In a double-tube injector, the combination of a primary set of tubes and a secondary set of tubes enveloped thereby, of a steam suction-nozzle, a valve, a hollow cylinder movable with the valve and connected with the nozzle, means for operating the valve, and means for adjusting said nozzle, valve and cylinder to regulate the capacity of the injector.

10. In a double-tube injector, the combination of a primary set of tubes and a secondary set of tubes enveloped thereby, of a steam suction-nozzle constituting a piston, a steam-distributing valve connected with the nozzle, and means for operating said valve and nozzle simultaneously.

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Witnesses:

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