

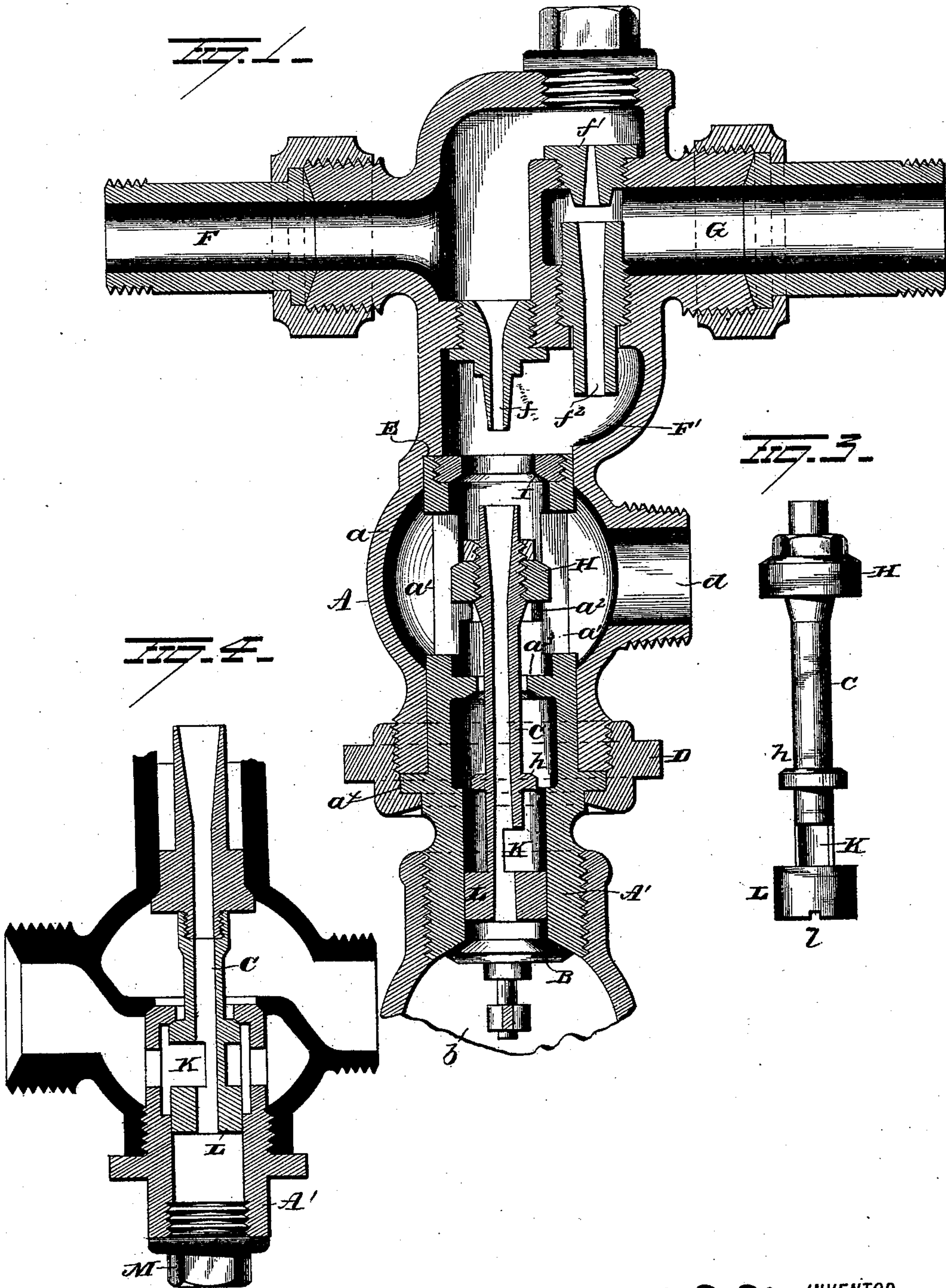
(Model.)

2 Sheets—Sheet 1.

A. S. EBERMAN.
INJECTOR.

No. 361,148.

Patented Apr. 12, 1887.



WITNESSES
B. J. Nottingham
N. Jones.

INVENTOR
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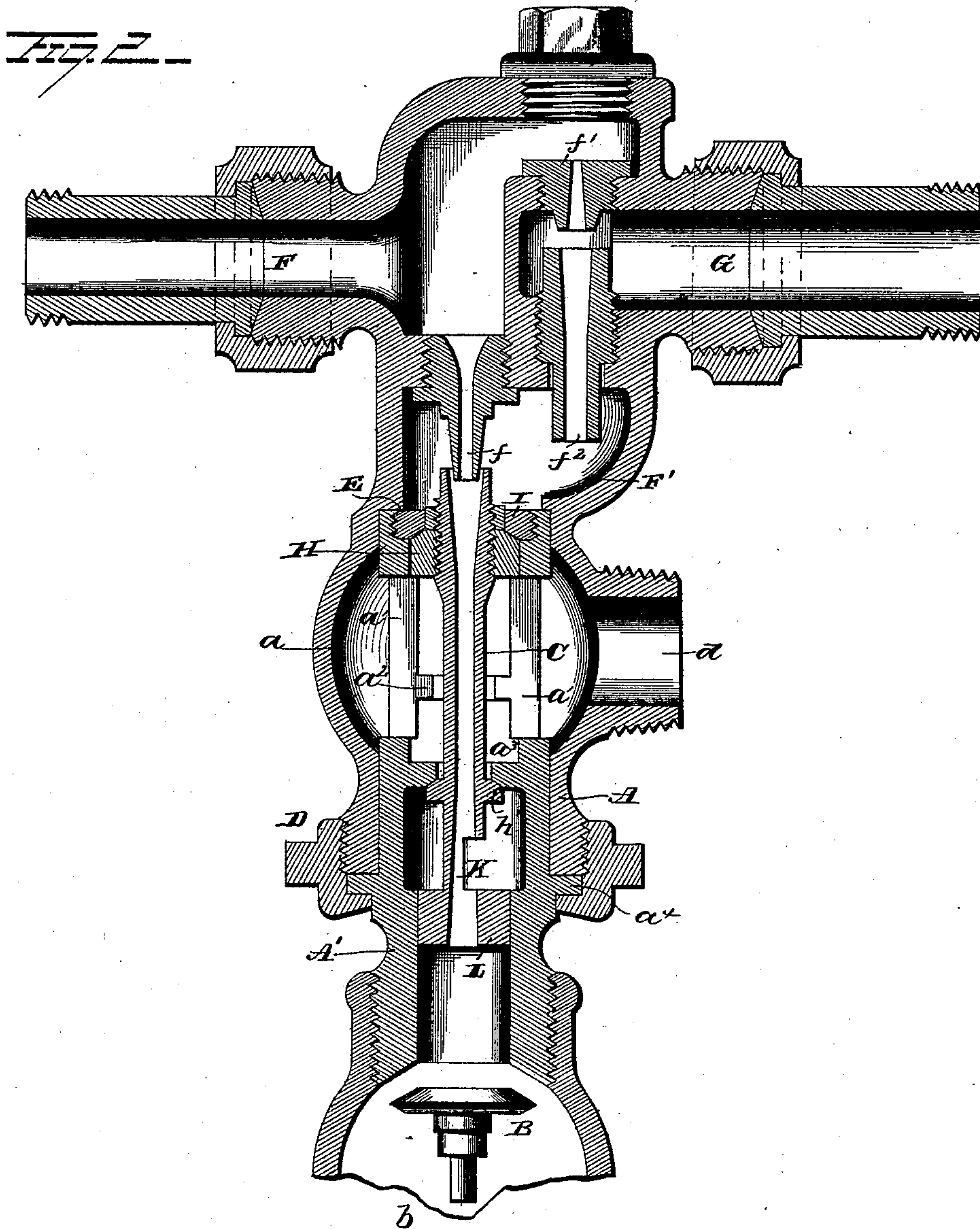
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UNITED STATES PATENT OFFICE.

ALBERT S. EBERMAN, OF BALTIMORE, MARYLAND.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 361,148, dated April 12, 1887.

Application filed May 14, 1886. Serial No. 202,182. (Model.)

To all whom it may concern:

Be it known that I, ALBERT S. EBERMAN, of Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Injectors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in injectors.

In Letters Patent No. 288,039, granted to me on the 6th of November, 1883, an injector was shown and described in which a movable combining-tube and discharge-nozzle having a passage around it was adapted to close the initial overflow by its sliding motion. In that construction the discharge-nozzle was assisted to its seat by spring-power to render its action more prompt and sure in practice, although it possessed the elements of and was capable of operating as an automatic cut-off.

In Letters Patent No. 334,852, granted to me on the 26th of January, 1886, the action of the movable discharge-nozzle was rendered automatic by providing it with a second valve adapted to close and open the secondary overflow simultaneously with the closing and opening of the initial overflow, the injector being adapted to different ranges of steam-pressure and water lifts by means of a hand-operated valve.

The principle upon which the above-referred-to injectors act is that the escape of the air, steam, and water from the pipe or chamber between the boiler end of the injector discharge-nozzle and the check-valve located between the discharge-nozzle and the boiler around the discharge-nozzle into the overflow-pipe will establish a free flow of steam and water through the discharge-nozzle until the pressure of said steam and water becomes sufficient to lift the movable discharge-nozzle and close the overflows, at which moment the pressure of the steam-jet let into the combining-tube or discharge-nozzle will force the check-valve open and establish the jet flowing into the boiler.

Hitherto by regulating the steam-pressure and water lift in accordance with a predetermined standard an injector has been made to

automatically establish a jet by simply turning on steam; but while this may have some practical merit in connection with a boiler where the steam-pressure and water lift sustain a permanent (or nearly so) relation to each other, it is impractical in connection with locomotive-boilers or boilers which are adapted to be transferred from place to place and subject to use in connection with water-lifts of varied depths.

The object of my present invention is to provide an injector which will automatically start and work, when steam is admitted thereto, below or above the ordinary range, under the varied changes which may take place in steam-pressure or water lifts, which will automatically re-establish a jet when the same becomes broken, and which will not be liable to become clogged or get out of working order.

A further object is to provide an injector which will automatically establish a jet under varied pressures of steam and water lifts, and in which the overflows shall be positively and tightly closed when the jet is established, thereby completely obviating the waste and annoyance caused by the permanently-open overflow.

With these ends in view my invention consists in certain features of construction and combinations of parts, as will be hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view of the injector in longitudinal section with parts in the positions which they occupy when the steam is turned on to start it. Fig. 2 is a similar view with parts in position which they occupy when the injector is in operation, and Fig. 3 is a detached view of the discharge-nozzle or combining-tube. Fig. 4 is a modification.

The injector-casing is preferably, although not necessarily, constructed in two sections—the female or outer section, A, and the male or inner section, A'. The male or inner section, A', is adapted to be connected at one end with the boiler, and the ordinary check-valve B is conveniently located in the coupling which connects it with the pipe *b*, leading to the boiler. The said inner section, A', also forms a housing for the sliding combining and discharge tube C, and is provided near its upper end, or

end opposite that attached to the boiler, with a series of elongated slots or openings, a' , extending through the casing. It is further provided with interior annular ribs or projections, a^2 and a^3 —the former adapted to form a stop to limit the sliding movement of the tube C in its movement toward the boiler end of the casing, and the latter to form a seat for the valve h , which closes the secondary overflow, as will hereinafter appear.

The female or outer section of the casing A is adapted to slide over the end of the section A' and down thereon to a flange, a^4 , near the lower end of the latter, to which it is snugly secured by a draw-coupling, D, as shown, or in any other well-known and approved manner. The portion of the casing A which surrounds the slotted portion of the casing A' is enlarged, as shown at a , forming a receiving-chamber for the overflow which escapes through the slots or openings a' , and from the said enlarged overflow-chamber an overflow pipe or conduit, d , leads to the open air. An interior shoulder, E, rests on the upper or outer end of the casing A' when the former is in its position thereon, and thus binds the two sections rigidly together.

The steam-inlet pipe F connects with the upper portion of the casing A, and a nozzle, f , is adapted to conduct the steam from the supply-pipe into the end of the sliding combining and discharge tube C. The water-supply pipe G communicates with the interior of the casing A at the mouth of the combining and discharge tube C and around the steam-nozzle f .

If the injector is employed in connection with an auxiliary lift-injector—a construction considered preferable because of its more general application—the casing A is formed to receive the said auxiliary lift-injector. This consists, essentially, of a nozzle, f' , adapted to eject live steam from the supply-pipe F across a portion of the water-supply pipe G into a receiving and discharge nozzle, f^2 , opening into the water-supply chamber or pipe F', located immediately about the mouth of the combining-tube C and steam-nozzle f .

If the water were supplied to the injector under pressure from a head, or otherwise, the lift-injector could be dispensed with; but to adapt the injector to general use, and because of the slight additional cost involved, it is found preferable to construct the lift in connection therewith.

The tube C combines in itself the injector combining-tube and discharge-nozzle. It might be constructed in two parts, one part being essentially the discharge-tube and the other part the combining-tube; but the construction shown is considered preferable. The said tube is provided with a piston-valve, H, removably secured thereon near its upper or outer end, conveniently, by being screwed onto the threaded end of the tube, as shown. The valve H may seat on the shoulder E of the casing A, which projects over the end of the casing A'; or the seat may be dispensed with,

the fit between the valve and casing forming the closure; but I prefer to employ a removable seat, I, adapted to be screwed into the end of the casing A', since this admits of a ready and inexpensive renewal of the seat when it becomes worn or out of order, and serves to make the casing A', with its combining and discharge tube, more complete in itself. The seat E or I of the valve H is located at such a distance from the overflow-openings a' that the valve will be required to travel some little distance—say three-eighths of an inch, or thereabout—before an opening is made to the initial overflow. (The terms "initial" and "secondary" overflows will be employed in this application in the same manner as in Patent No. 334,852, above referred to, to designate, respectively, the overflow which takes place around the mouth or entrance end of the combining and discharge tube and around the discharge end of the same.) The object of this movement of the valve before opening will appear a little later on.

A second valve, h , is located on the tube C a short distance back from its boiler end, and is adapted to seat on the interior projection, a^3 , at the same moment that the valve H seats on the seat E or I, and when seated closes the secondary overflow around the tube into the overflow-chamber. Below or toward the boiler end of the tube C from the valve h the tube is cut away, leaving a free opening, K, into the interior of the casing A', which interior at this point is preferably somewhat enlarged, as shown, to admit a free passage of steam and water around the periphery of the valve h when the latter is open. The opening K admits of the flow of steam or steam and water from within the tube C to the secondary overflow, and may be called the "relief-opening," since the free flow of steam or steam and water through said opening and out at the secondary overflow serves to relieve the back-pressure of the steam in starting the injector, and serves to establish the jet. On the end of the tube C, below or toward the boiler from the opening K, is secured a movable bearing, preferably a piston, L, which is adapted to fit and have a free sliding movement within the casing A'. The discharge of the combining and discharge tube is conveniently through the central opening in the piston L, which forms a continuation of the bore of the tube. The object of the piston L is to assist the closing of the overflows, and this, taken in connection with the free opening around the valve h , forms the gist of my present improvement.

It was found that the slight choking of the interior of the casing at the seat of the valve for closing the secondary overflow in order to make the combining and discharge tube close readily under a low pressure of steam would cause the combining and discharge tube to close the valves too quickly under a high pressure, or before the water-jet became fully established; hence, to make the injector operative under all conditions, the passage-way around

the valve for closing the secondary overflow is made free, to allow sufficient steam to escape, no matter what the pressure, to establish the water-jet, and the piston L is employed to assist the valves to close when the steam and water shall have exerted a sufficient pressure beneath the piston.

As a matter of construction I find it advantageous to provide the end of the piston L with a channel, l , for the purpose of holding the tube from turning while the piston-valve H is being screwed on, and for the further purpose of inserting the end of a rotary driver for grinding the valves on their seats.

The movement of the combining and discharge tube is determined at one end of the stroke by the seating of the valves H and h , and at the opposite end by the engagement of the valve H with the interior projection, a^2 .

The operation is as follows: The combining and discharge tube C at the start will either be at the boiler end of its stroke with the overflows open or the first impulse of the live steam admitted through the pipe F will throw it into such position. If the injector is attached in the position shown in the drawings, the force of gravity will also tend to keep the overflows open when the injector is not in operation and to open them as soon as the injector ceases to operate. The force of the steam through the nozzle f' , across the water-supply pipe into the water-discharge nozzle f^2 , and out through the initial overflow will immediately tend to lift the water, and the force of the steam at the same time through the steam-nozzle f , combining and discharge tube C, and out through the secondary overflow will draw the water with it through the combining and discharge tube, and as soon as sufficient pressure has accumulated beneath the piston L to assist the steam and water pressure beneath the valve h to slide the tube it will close both initial and secondary overflows. The pressure will then overcome the pressure of the steam within the boiler, and the jet will be established. To prevent the combining and discharge tube from becoming hung in such a position as to leave the valve at the secondary overflow only partially open—a condition which might possibly happen under certain circumstances where the pressure on the opposite ends of the tube was equalized by the relative openings of the overflows—the piston-valve H is provided, and required to slide far enough to make a full opening of the valve h before the valve H opens to the overflow. Thus the steam-pressure will be held on the valve H after it is relieved from the valve h , and a full opening of the latter insured at the start, or at any time during its operation, when for any cause the steam-pressure changes or the water-jet is broken.

The failure of the water from any cause will work an opening of the overflows as follows: The valve H is of greater diameter than the valve h ; hence, when the back-pressure of the steam within the boiler closes the check-valve

B, as it does as soon as the water-jet fails, the steam-pressure on the valve H, of greater diameter, will overbalance the pressure on the valve h , of lesser diameter, and will promptly force open the overflows. The jet will then re-establish itself in the same manner as at first. When the injector occupies the preferred position, with the combining-tube nearly or quite in a vertical position, its weight will also assist in opening the overflows.

The construction of the casing in two parts, as shown, is found to be a convenient and in every way satisfactory form; but it is not a necessary feature in order to provide for the automatic operation of the injector under varying pressures; nor is it essential that the discharge of the injector should be through the assisting piston L.

In Fig. 4 a form of construction is shown in which the discharge from the combining-tube is conducted to the boiler from the side of the chamber surrounding the opening K, and the piston L is adapted to work in the modified casing A', the end of which is closed, as shown at M. This is only one of many changes which might be resorted to in the form and arrangement of the several parts described without departing from the spirit and scope of my invention; hence I do not wish to limit myself strictly to the construction herein set forth; but,

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

1. In an injector, the combination, with a combining and discharge tube and a valve adapted to close the secondary overflow, of a bearing adapted to receive pressure of steam and water from the combining and discharge tube, said bearing being attached to the said valve and located on the side of the relief-opening in the tube opposite that on which the said valve is located, substantially as set forth.

2. In an injector, the combination, with a combining and discharge tube provided with a secondary overflow-valve adapted to open and close a passage-way leading from its discharge end to an overflow, of a bearing adapted to receive pressure in the direction of the longitudinal axis of the tube, said bearing being attached to the tube and located on the opposite side of the secondary overflow-opening in the tube from the secondary overflow-valve, substantially as set forth.

3. In an injector, a combining and discharge tube carrying a valve adapted to open and close an overflow and provided with the auxiliary piston bearing adapted to receive steam and water pressure and assist the seating of the valve, substantially as set forth.

4. In an injector, a combining and discharge tube adapted to open and close an initial and secondary overflow and provided with a piston or its equivalent in addition to the overflow-valves, said piston or its equivalent being

adapted to receive steam and water pressure and assist the seating of the valves, substantially as set forth.

5 5. In an injector, the combination, with a combining and discharge tube adapted to slide longitudinally within a casing, a valve secured to the tube and adapted to close a secondary overflow, the combining and discharge tube being provided with an opening communicating with an enlarged secondary overflow-passage, of a piston attached to the tube and adapted to fit and slide within the casing on the opposite side of the opening in the tube from the valve, the piston having an opening 10 through it in the direction of the longitudinal axis of the tube, substantially as set forth.

20 6. In an injector, the combination, with a combining and discharge tube provided with a secondary overflow-opening at its discharge end and a valve adapted to close the secondary overflow, of a tube-operating piston located on the opposite side of the said secondary overflow-opening from the said valve, substantially as set forth.

25 7. In an injector, a valve adapted to automatically open the secondary overflow in advance of the opening of the initial overflow, substantially as set forth.

30 8. In an injector, a combining and discharge tube adapted to automatically open a secondary overflow in advance of the opening of the initial overflow, substantially as set forth.

9. In an injector, the combination, with a casing having a movable combining and discharge tube located therein and overflow-ports 35 extending through it, of valves secured to the tube adapted to open and close the initial and secondary overflows, the secondary overflow-valve being adapted to make a full opening before the initial valve opens, substantially as 40 set forth.

10. The combination, with the casing and the movable combining-tube located therein and provided with a valve, of the removable valve-seat secured in the end of the casing, 45 substantially as set forth.

11. In an injector, the combination, with a male casing-section adapted to form a housing for a combining-tube and discharge-nozzle and having a series of radial slots opening into 50 the overflow-chamber, of a female casing-section provided with a water-lift and enlarged overflow-chamber adapted to fit over and engage the upper or outer end of the male section, the two sections being constructed and 55 arranged substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALBERT S. EBERMAN.

Witnesses:

E. C. SEWARD,

E. G. EBERMAN.