(Model.)

2 Sheets—Sheet 1.

# A. S. EBERMAN.

## INJECTOR.

No. 334,852. Patented Jan. 26, 1886.

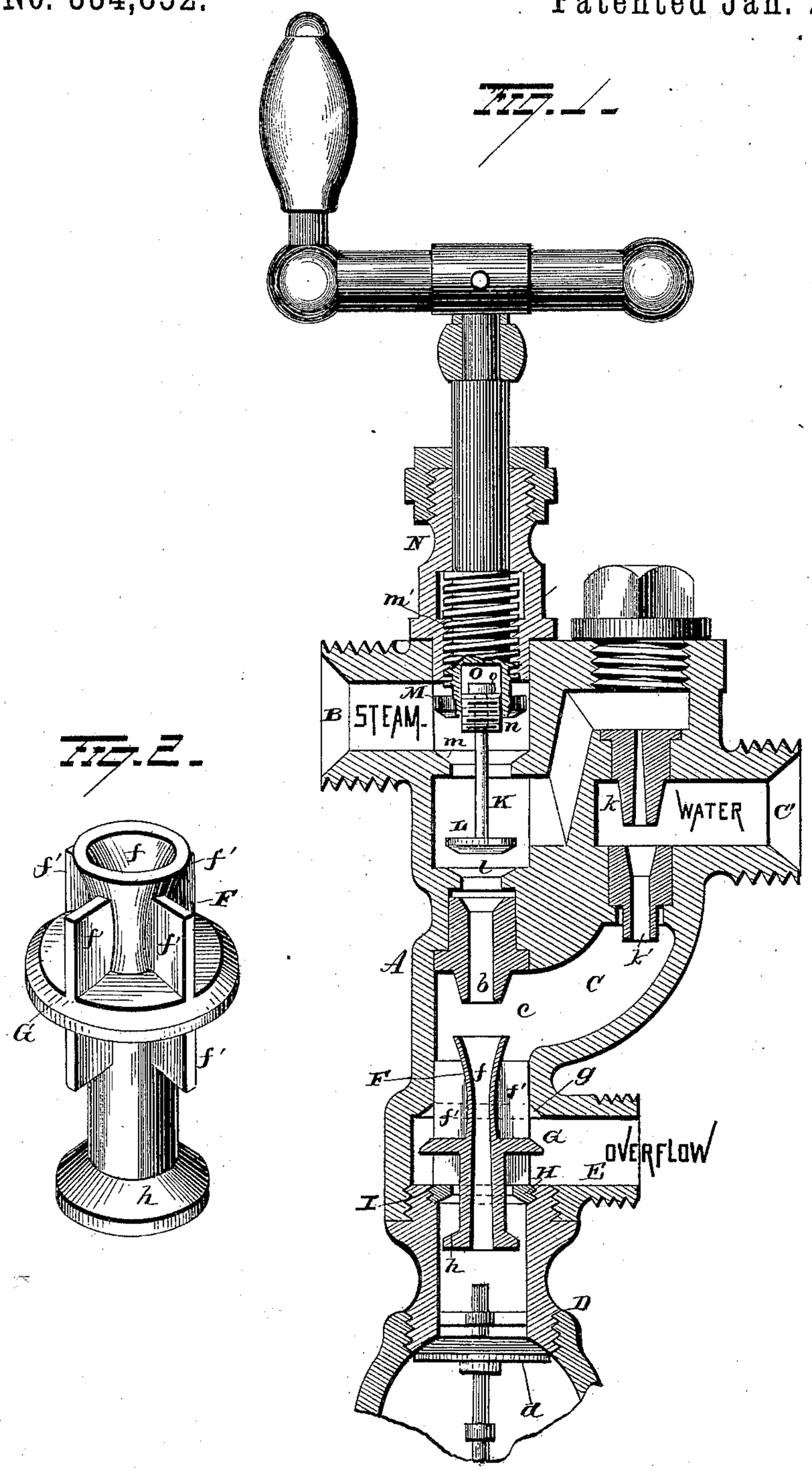


FIG. 1.

FIG. 2.



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(Model.) 2 Sheets—Sheet 2.

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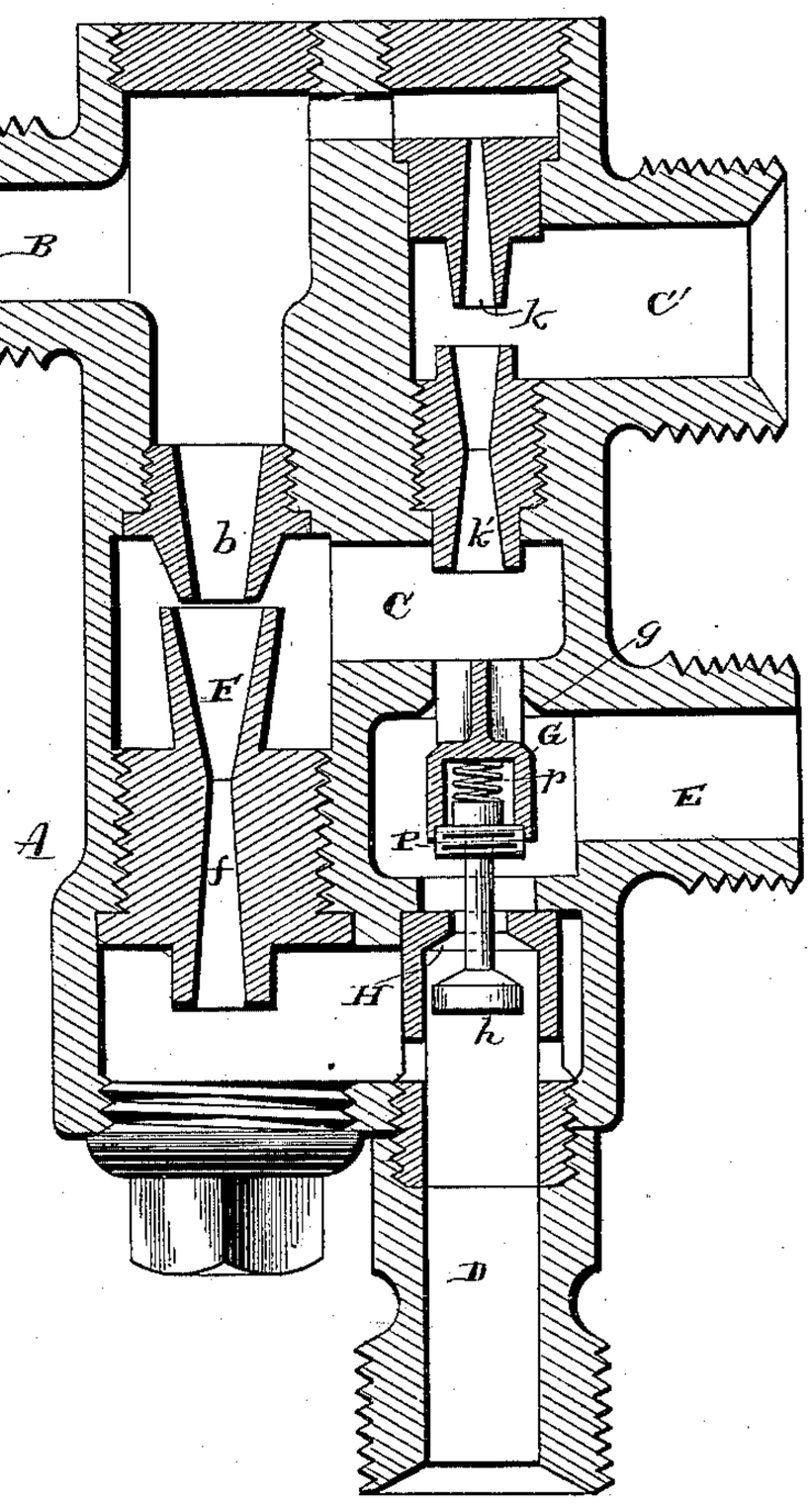
## INJECTOR.

No. 334,852. Patented Jan. 26, 1886.

FIG. 3.

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# UNITED STATES PATENT OFFICE.

ALBERT S. EBERMAN, OF CLEVELAND, OHIO.

## INJECTOR.

SPECIFICATION forming part of Letters Patent No. 334,852, dated January 26, 1886.

Application filed March 6, 1885. Serial No. 157,918. (Model.)

*To all whom it may concern:*

Be it known that I, ALBERT S. EBERMAN, of Cleveland, in the county of Cuyahoga and State of Ohio, 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 November 6, 1883, mechanism was shown and described by means of which the flow of steam and water around the injector-nozzle and the overflow were stopped by the manipulation of a single handle and at such intervals that the overflow would continue open just long enough after the flow of water and steam about the injector-nozzle was closed to establish the jet of water flowing into the boiler.

The object of my present invention is to provide a novel construction of the injector-nozzle and mechanism connected therewith by means of which the overflow, which takes place about the injector-nozzle or its equivalent, which may be termed the "initial" overflow, and the overflow which takes place by the backing of the water from the pipe, connecting immediately with the boiler, or its equivalent, which may be termed the "secondary" overflow, will be automatically closed at the proper time by the pressure of the steam-forced water which is about to be injected into the boiler, a further object being to provide an injector which shall consist of few parts, be well adapted to the requirements of all classes of boilers, and which will occupy a comparatively small space, and be durable and inexpensive; and 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, and Fig. 2 is a detached view of the injector-tube. Fig. 3 is a longitudinal section of a modification.

A represents the casing of the injector. The steam-supply pipe B terminates within the casing in a nozzle, *b*, which projects a short distance across the opening *c* of the water-feed pipe C. The end of the casing A opposite the steam-nozzle *b* is connected with the boiler by a suitable pipe, D, supplied with the ordinary check-valve, *d*. The overflow-pipe E enters the casing a short distance from the feed-water pipe C, as shown.

F is the injector or combining tube. It is provided with a central perforation, *f*, which gradually enlarges toward each end, and with wings *f'*, the edges of which bear against the inner surface of the casing A and form guides for centering the tube F. The tube F is further provided with a disk, G, located conveniently at about the central portion thereof, which is adapted to rest on a seat, *g*, formed in the casing, and when seated cuts off communication between the feed-water and overflow around the tube. The tube F projects a short distance beyond the wings toward the steam-nozzle, and also projects beyond the wings into the pipe leading to the boiler, the end toward the boiler being enlarged and shouldered to form a valve, *h*, which is adapted to rest on a seat, H, formed at the end of the casing, and when seated shuts off communication between the pipe leading to the boiler and the overflow. The tube F, with its wings and valve disk, is allowed a limited longitudinally-sliding motion within the casing, the motion being limited in the direction toward the steam-nozzle by the seating of the valves G and *h*, and in the opposite direction by the abutment of the wings *f'* against the shoulder I at the end of the casing. It is not necessary, however, to limit the motion of the valve in this manner, as stops of various constructions might be introduced to accomplish the purpose; neither is it essential that the wings *f'* should be exactly of the length shown. In fact, a cylinder provided with perforations corresponding to the spaces between the wings might be substituted. The tube F, with its attachments, is preferably cast in one piece, which renders it necessary to introduce a two-part valve-seat, H, of less diameter than the end of the tube; but the enlarged end of the tube *h* may be formed in a separate piece and secured firmly to the tube.

The operation of the injector is as follows: The steam being turned on, the water is drawn

into the casing from the feed pipe C, and forced around and through the tube F out through the overflow E. The valves G and *h* are either open when the steam enters or will be opened by the first impulse of the steam. The opening about the valve *h* into the overflow is not large enough to allow the water and condensed steam which accumulates in the pipe D to escape as fast as it accumulates, and the pressure of the water thus accumulating will at the proper stage of the operation be sufficient to slide the tube F toward the steam-nozzle, thereby closing the valves *h* and G, and stopping the back or secondary overflow, and also the initial overflow, and at the same moment open the check-valve *d*, and force a jet of water into the boiler. This condition will remain unchanged as long as the water is supplied and steam turned on. If, however, the supply of water should momentarily fail, as in swashing from side to side in a locomotive-tender or on board a steamer, or should fail altogether for any cause, the check-valve *d* will close, the pressure on the receiving end of the tube and valve G will overbalance the pressure on the discharge end, and the tube will slide away from the steam-nozzle and open the valves G and H. To insure the opening of the valves under the above circumstances, the valve G or its equivalent is made of greater diameter than the valve *h*. The parts are now ready to repeat the operation of starting as soon as the water is again supplied, and they will operate again with great promptness.

The automatic stopping and starting of the injector becomes of the highest importance in the instances above named, and the accomplishment of this result without increasing the number of parts both increases the practicability and lessens the expense.

The injector as thus described is complete in itself, a valve of some ordinary construction being used to admit the flow of steam. It is, however, found expedient in some instances to supply the water to the injector proper by means of an auxiliary injector which acts as a water-lift. For this purpose the casing A is extended beyond the steam-nozzle *b*, leaving a chamber, K, between the base of the nozzle *b* and the entrance of the steam-pipe B. The chamber K communicates with the water-supply pipe C′ through a jet-nozzle, *k*, which projects partially across the mouth of the pipe C′. The pipe C′ connects with the water-feed pipe C through a second jet-nozzle, *k′*, located in line with and in front of the nozzle *k*, a short clear space being left between the two.

Between the chamber K and the nozzle *b* is a valve-seat, *l*, on which fits a valve, L, and between the said chamber and the steam-supply pipe B is a valve-seat, *m*, on which fits a valve, M. The stem of the valve M extends through an internally-threaded sleeve N, which forms the head of the casing A, and is itself provided with a male thread, *m′*, which registers with the female thread in the sleeve N. The face of the valve M and its stem are bored to admit a plug, *n*, which enters the bore a short distance only, leaving a chamber, O, between its end and the bottom of the bore. The stem of the valve L extends with a free sliding fit through a central perforation in the plug *n*, and is provided with a head, *o*, which locks it in position. The play of the head *o* in the chamber O is such that the valve M may be slightly raised without lifting the valve L from its seat.

The injector is started as follows: Turn the stem of the valve M, thereby lifting the valve a short distance from its seat, but not far enough to disturb the valve L. The steam will now enter the chamber K and pass from thence through the jet-nozzles *k k′* into the water-feed pipe C, drawing the water through the supply-pipe C′ and delivering it about the injector-tube F. As soon as the water appears in sufficient volume at the overflow-outlet, the stem of the valve M is further turned, and the valve L thereby lifted from its seat, and the valve M thrown wide open. The steam now enters the nozzle *b* and passes from thence into the injector or combining tube, and automatically closes the overflow and establishes the jet, as hereinbefore explained.

The injector may also be used without the loose valve L, the steam in that case passing partly through the nozzle *b;* but the valve L is preferable in general practice, as it accelerates the action by affording a stronger lift at the outset.

The modification shown in Fig. 3 consists in locating the injector-tube F stationary within its casing, and locating the double valve G and *h* in a suitable casing at one side of the tube F. The initial overflow in this case communicates with the feed-pipe C, to one side of the tube F and the back or secondary overflow, as before, from the pipe immediately connected with the boiler. The operation is in all respects similar to that hereinbefore described.

I find it preferable to construct the double valve G *h* in two parts, as shown, the stem of the valve *h* having a play within a socket in the stem of the valve G, being cushioned therein by a coiled spring, *p*, and locked therein by a plug or cap, P. This arrangement admits of the valve G being seated slightly in advance of the valve *h*, and allows for any slight errors in the relative distance between the valves and their seats.

It is evident that other modifications might be resorted to in the construction and arrangement of the several parts 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 the main casing and main water-passage, of an injector discharge-nozzle and a valve for automatically closing the initial and secondary overflows independently of the check-valve, substantially as set forth.

2. In an injector, the combination, with the main casing, the main water-passage, and injector-tube adapted to operate as a combining and delivery tube, of a valve for automatically closing the initial and secondary overflows, substantially as set forth.

3. In an injector, the combination, with the main casing and main water-passage, of an injector combining-tube adapted to slide within the casing, and thereby automatically close the initial and secondary overflows, substantially as set forth.

4. In an injector, the combination, with the main casing and water-supply pipe, of an injector combining-tube adapted to admit water to the overflow both from the supply-pipe and from the pipe leading directly to the boiler, and further adapted to automatically close the said overflow-passages, substantially as set forth.

5. In an injector, the combination, with the main casing and main water-passage, of a movable injector-tube adapted to act automatically as a valve for shutting off the initial and secondary overflows, substantially as set forth.

6. In an injector, the combination, with the main casing and main water-passage, of a movable injector-tube provided with enlarged portions, which serve as valves to close the initial and secondary overflows, said tube being automatically operated by the pressure of steam-forced water, substantially as set forth.

7. The combination, with the main casing, main water-passage, an injector-tube, and a valve for automatically closing the overflows, of a loose valve for throwing the whole force of the steam onto the water lift in starting the injector, substantially as set forth.

8. In an injector provided with a water-lift and means for automatically closing the initial and secondary overflows, a loose valve operated by the valve which admits steam, and adapted to remain on its seat while the steam-inlet valve is slightly raised, for the purpose substantially as set forth.

9. The combination, with the main casing and main water-passage, of a water-lift, an injector-tube, and a valve for automatically closing the initial and secondary overflows independently of the check-valve, 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,
S. G. NOTTINGHAM.