No. 697,770. Patented Apr. 15, 1902.

C. B. ALLEN.

AUTOMATIC INJECTOR.

(Application filed Feb. 1, 1902.)

(Model.)

Fig. 1.

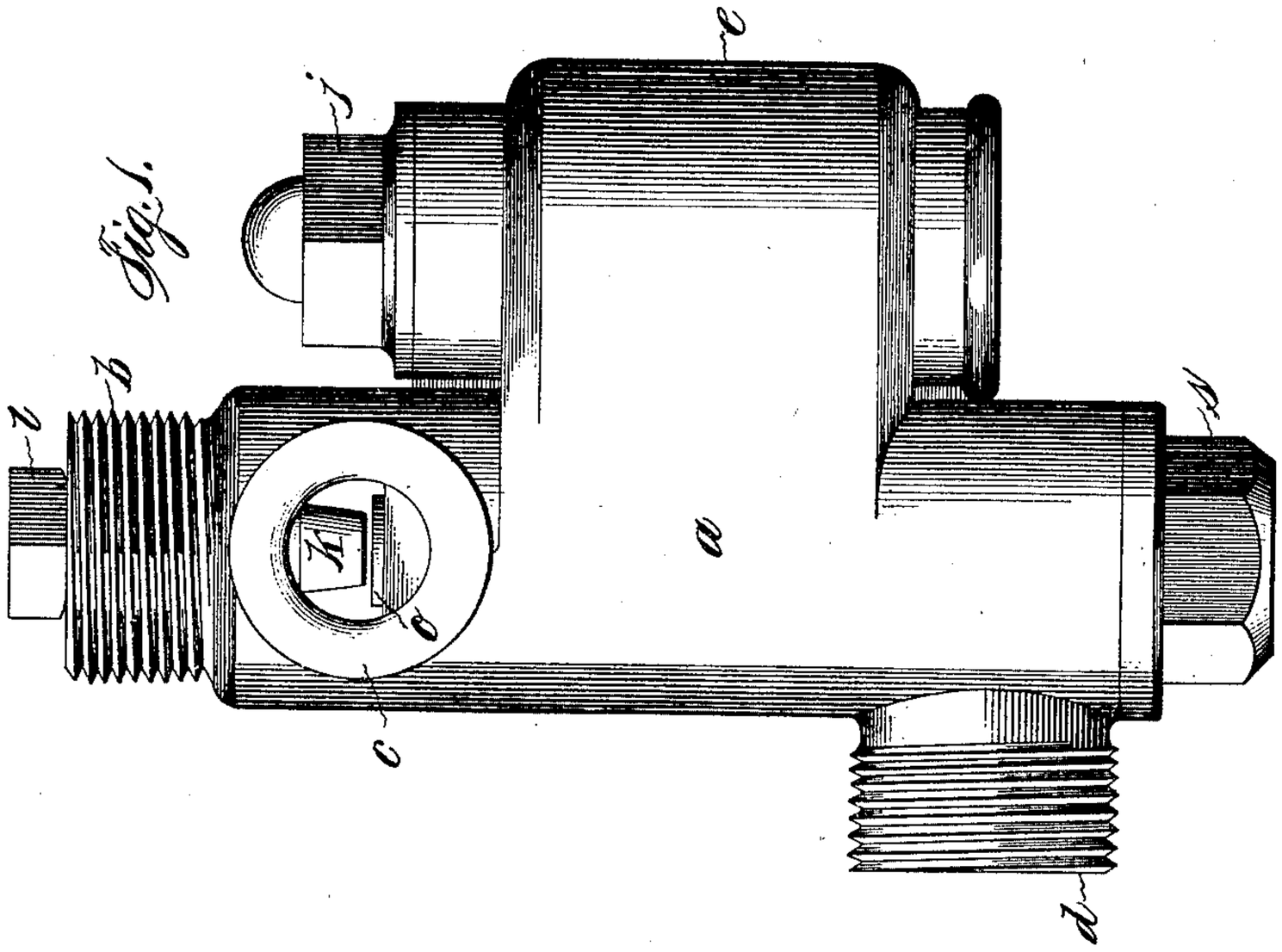
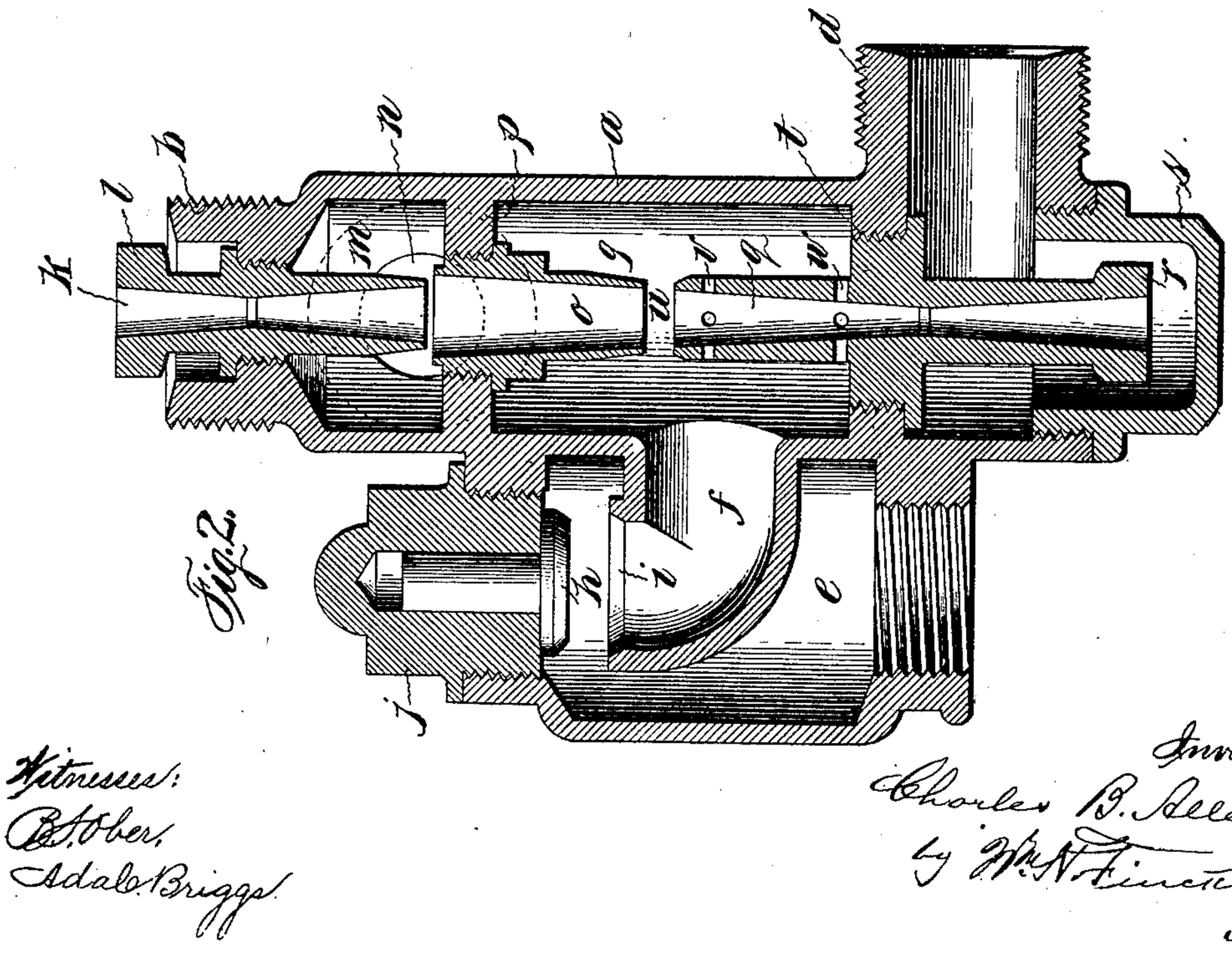


Fig. 2.



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UNITED STATES PATENT OFFICE.

CHARLES B. ALLEN, OF WADSWORTH, OHIO.

AUTOMATIC INJECTOR.

SPECIFICATION forming part of Letters Patent No. 697,770, dated April 15, 1902.

Application filed February 1, 1902. Serial No. 92,211. (Model.)

To all whom it may concern:

Be it known that I, CHARLES B. ALLEN, a citizen of the United States, residing at Wadsworth, in the county of Medina and State of Ohio, have invented a certain new and useful Improvement in Automatic Injectors, of which the following is a full, clear, and exact description.

My invention pertains to an automatic injector which when supplied with steam and connected with the water-supply will automatically start itself and deliver water against a pressure equal to or greater than that of the steam, and if for any reason the jet should be broken it will automatically reëstablish itself and deliver water against pressure as before as soon as the cause of interruption is removed.

In all injectors constructed to operate in any wise similar to the foregoing it has been found necessary to use a rear overflow in the combining-tube at a distance from the steam-inlet and with its diameter large enough to afford free exhaust into the overflow-chamber for the steam issuing from the steam-inlet, and if this overflow be contracted it is impossible to obtain the vacuum necessary for successful operation. The jet of mingled steam and water as it passes the relatively large rear overflow is especially sensitive, owing to the comparatively low velocity with which it is traveling and the imperfect manner in which the steam and water are mixed at this point, and hence in order that prior automatic injectors might be made to operate successfully over an acceptable range of steam-pressures it has been found necessary to separate the rear overflow from the forward and intermediate overflows by means of a check-valve automatically closing upon the establishment of the jet. This check-valve has been used in the form of a plate or bushing sliding on the tube, so as to cover and uncover the rear overflow, also as a common check-valve controlling communication between separate chambers in which the forward and rear overflows are situated, also as a swing-valve on the combining-tube itself, and also as a sliding tube movable to open and close the rear overflow.

It is the object of my invention to dispense with the check-valve and otherwise to simplify the construction and at the same time produce an injector easily repaired and cleaned and capable of delivering water to the boiler at a higher temperature than has heretofore been obtained by automatic injectors, thus increasing the range of the injector and its capacity for supplying hot feed-water and for grading.

In carrying out my invention I use a barrel in which are alined a steam-inlet tube communicating with the water-supply and opening into a lifting-tube, which latter opens into a chamber communicating with the overflow and is alined with a forcing-tube, which communicates with the boiler connection and is provided with an intermediate overflow and a forward overflow formed in it by means of a series of laterally-opening holes having a definite areal relation to the smallest cross-sectional area of the combining-tube, all as I will proceed now more particularly to set forth and finally claim.

In the accompanying drawings, illustrating my invention, in the two figures of which like parts are similarly designated, Figure 1 is an elevation. Fig. 2 is a central longitudinal vertical section.

The barrel *a* is provided with a steam-inlet nipple *b*, a water-inlet nipple *c*, a boiler-connection nipple *d*, a main overflow-chamber *e*, having an elbow-tube *f*, communicating with the chamber *g*, and a check-valve *h*, cooperating with a seat *i* in the tube *f*. The valve *h* plays in a screw-cap *j*, by removal of which access is had to the overflow-chamber *e*. The steam-inlet tube *k* has a screw-threaded connection with the nipple *b* and has an angular head *l* for the reception of a wrench to insert and remove it. The steam-tube opens into the chamber *m*, which communicates through opening *n* with the water-supply connected to the nipple *c*, and it also opens into the lifting-tube *o*, screw-threaded in a diaphragm *p* for separating the water-chamber and the overflow-chamber *g*.

q is the forcing-tube, consisting of the delivery-tube and that portion of the combining-tube forward of the rear overflow, which forward end extends past the end of the barrel *a* and is formed with an angular head *r* to receive a wrench, and this end of the barrel is closed by a removable screw-cap *s*, by means of which access may be had to the in-

terior of the barrel. This tube q is screw-threaded into a diaphragm t, which separates the boiler connection from the chamber g. A space u is left between the adjacent ends of the tubes o and q and constitutes the rear overflow. The tube q is provided with a series of lateral holes v near its rear end, which constitute the intermediate overflow, and it is also provided near its connection with the diaphragm t with a series of holes w, which constitute the forward overflow, and the combined area of each of these series of holes is not greater than one and six-tenths of the smallest cross-sectional area of the said tube.

It will be observed that in the operation of the device all of the overflows u, v, and w must be submerged before water can issue from the overflow f. Until all of the overflows are submerged there is a vacuum in chamber g, which holds the valve h to its seat i, and thus prevents access to the atmosphere, and this is an important point in my invention.

The operation is as follows: Steam being admitted to the steam nozzle or tube k is discharged through said tube into the lifting or draft tube o, and thence into the overflow-chamber g through the overflows u, v, and w, and thence raising the valve h, as shown in Fig. 2, it passes into the atmosphere. This current of steam entrains the air in the chamber m, forming a vacuum that lifts the water into the machine, and then the jet being established forces the water past the overflows u, v, and w into the boiler.

I have found that if in this type of injector the combining-tube be intersected by overflows or spills a vacuum will be produced at these openings and that the farther they are from the smallest diameter of the combining-tube the greater the vacuum. Hence in the herein-illustrated construction the greatest vacuum is produced at the overflow u. I have also found that an injector of this type when working under conditions too severe for its successful operation will begin to spill or overflow at that opening nearest to the smallest diameter of the combining-tube and that in injectors of this type as heretofore constructed the spilling or overflowing begins when the water passing the smallest diameter of the combining-tube reaches a temperature of about 212° Fahrenheit. In my construction the spilling will take place first at the overflow w and will continue until the overflow-chamber g is filled to the level of the overflow v, where the water will be drawn into the combining-tube and again incorporated in the jet. If the quantity of water overflowing at w becomes too great to be drawn in at overflow v, then its level in the chamber g will rise to the overflow u, where the remainder will be drawn in and incorporated in the jet. Since the area of overflow u is many times that of overflow w, this action will continue to take place until, owing to severe conditions of operation, the vacuum at u is destroyed, and I have found that the vacuum at this point is maintained long after that at the overflows v and w is destroyed. The severe conditions of operation herein referred to include high steam-pressures, a long lift owing to the great distance between the injector and the level of the water-supply, feed-water of high temperature, and a great reduction of the quantity of water the injector is throwing below its maximum capacity. All of these conditions tend to decrease the quantity of water mingled with the steam issuing from the steam-tube, thus increasing the temperature of the mixture passing the overflows u v w, and hence increasing the tendency to spill at these points. As already pointed out, this spilling in the case of my injector will take place first at w, then at v, and lastly at u. I have found also that the vacuum at u is maintained under a temperature of delivery-water far above that which destroys the vacuum at w, and hence an injector constructed in accordance with my invention will be able to operate with hotter feed-water under higher pressures of steam and under a greater reduction of feed-water than one constructed on the principle heretofore adopted. Moreover, I have found that in an injector having a forcing-tube consisting of combining and delivery tubes continuous and without overflows water of a higher temperature can be forced through said tube against a pressure equal to or greater than that of the steam actuating the jet than through a forcing-tube containing overflows and also that the farther these overflows are located from the smallest diameter of the combining-tube the more nearly the action of this tube approaches that of the tube without overflows. By my construction I have been enabled to place the forward overflow w back of the smallest diameter of the combining-tube a distance equal to at least twice the smallest diameter of said tube and at the same time have retained perfect action of said injector both as to automatic qualities and efficiency in lifting, and this arrangement enhances the ability to use feed-water of high temperature and steam of high pressure.

I wish it to be understood that the mere details of construction may be varied without departing from the spirit of my invention; but it may be stated here that so far as I am aware I am the first to produce an automatic injector having its forward overflow placed back of the smallest diameter of the combining-tube a distance substantially equal to at least twice such diameter.

What I claim is—

1. An injector, having an overflow-chamber with two or more overflows therein, and an opening to the atmosphere from said chamber arranged at a point above the level of the rear overflow.

2. In an injector, a single overflow-chamber

containing two or more overflows, and a combining-tube, the forward overflow being at a point in the rear of the smallest diameter of said tube a distance equal to at least twice said diameter.

3. In an automatic injector of the class described, the combining-tube, the forcing-tube, a series of overflows *u*, *v* and *w* in a single chamber, and an atmospheric overflow above the series of overflows and provided with a check-valve, combined and arranged so that the series of overflows must be submerged before water can issue from the atmospheric overflow and at all other times the check-valve under vacuum action in the chamber closes the atmospheric overflow.

4. In an automatic injector of the class described, the tube *k* having an accessible angular head, and the tube *q* also having an accessible angular head, an intermediate overflow-chamber having two or more overflows and an opening to the atmosphere arranged above the level of the rearmost overflow.

5. An automatic injector of the class described, having a combining-tube interposed between the overflow-chamber and the boiler connection, and provided with a series of lateral holes near its adit of a combined area not greater than one and six-tenths of the smallest cross-sectional area of said tube, and serving as an intermediate overflow, and a series of holes of similar capacity arranged forward of the intermediate overflow-holes and near the smallest diameter of the tube, substantially as described.

In testimony whereof I have hereunto set my hand this 27th day of January, A. D. 1902.

CHARLES B. ALLEN.

Witnesses:
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CHAS. A. CALHOUN.