L. B. FULTON.

Combined Injector and Ejector.

No. 220,471. **Patented Oct. 14, 1879.**

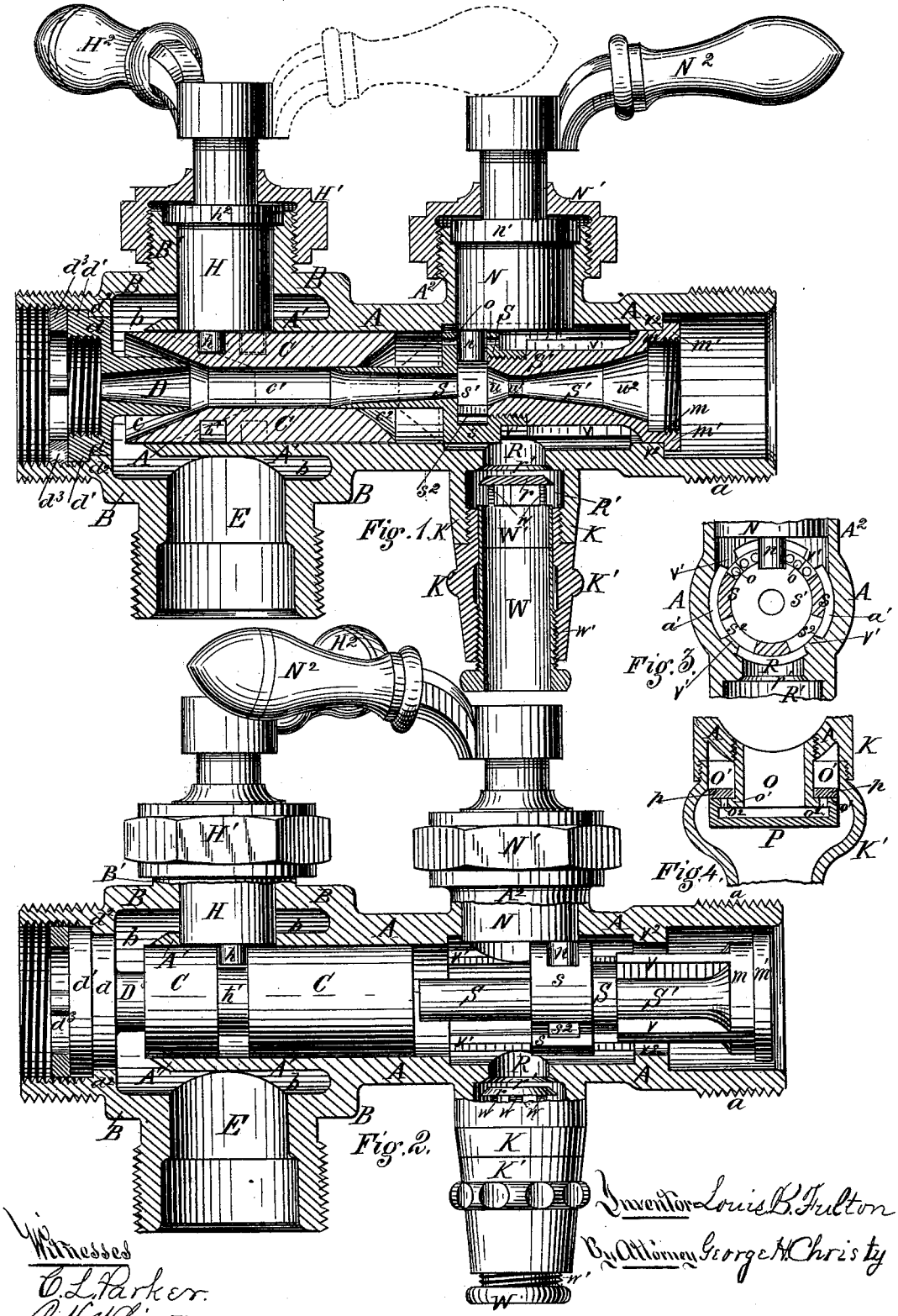

Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

Witnesses
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IMPROVEMENT IN COMBINED INJECTOR AND EJECTOR.

Specification forming part of Letters Patent No. **220,471**, dated October 14, 1879; application filed March 31, 1879.

To all whom it may concern:

Be it known that I, LOUIS B. FULTON, of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Combined Injector and Ejector; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a longitudinal vertical sectional view of my combined injector and ejector, the several parts being arranged for use as an injector. Fig. 2 is a similar view, except that the interior devices are shown in elevation and adjusted for use as an ejector or siphon-pump. Fig. 3 is a transverse sectional view through the overflow-chamber and overflow-port, looking toward the inflow end; and Fig. 4 is a vertical sectional view through the overflow port and valve, illustrative of a modified form of construction.

My invention relates to a combined injector and ejector or pump, and consists in such an arrangement of the several parts that by the adjustment of the same at the pleasure of the operator the device may be adapted for use as an injector for feeding water to a steam-boiler, or as an ejector or siphon-pump for raising and discharging larger bodies or columns of water.

In the drawings, A A^1 represents the main outer casing, one end, A^1, of which is inclosed within a casing head or shell, B, giving an annular chamber, *b*, between A^1 and B. The projecting end of this shell B is threaded both inside and outside, the outer threads being used for coupling the device to a steam-pipe, and the inner threads being used to secure the steam-jet nozzle. This nozzle has an inwardly-projecting nozzle-tube, D, connected to an annular base, *d*, which has an enlarged collar, d^1, fitted against a corresponding shoulder, d^2, on the interior of the shell, and an annular nut, d^3, screwing into the inner threads of the shell, binds the nozzle in place. I prefer to give the interior of this nozzle a tapering or flaring form, the discharge end being larger than the receiving end, and it is extended forward into or within the end of the casing A^1 and combining-tube C. This combining-tube is arranged to fit nicely within the bore or chamber of the casing A A^1, so as practically to afford a water-tight packing, but yet so as to be moved endwise back and forth within the casing. The end opening *c* of this tube C, adjacent to the nozzle D, is conical or lipped in form, as shown, and the interior passage or bore c^1 is approximately the size of the discharge end of the nozzle, so that as the combining-tube is moved toward the nozzle the water-inflow passage around the nozzle will be wholly or partially closed, and by moving in the opposite direction such passage will be enlarged, thus opening or closing in whole or in part this feed or inflow water passage from the annular chamber *b*, this chamber being supplied by inflow-port E, and in so doing the steam-jet will not be increased or diminished thereby, but will remain practically constant.

The tube C is moved back and forth toward and from the nozzle D by pin *h*, working in a circumferential groove, h^1, cut in the outer surface of the tube. This pin is secured to the end of a stem, H, near its periphery, or at such distance from the center as to give to the tube the desired amount of throw or endwise movement as the stem is turned. This stem passes through casing A^1 and outer shell, B, and is guided and held by a projecting rim, B′, and screw-cap H^1, bearing against a collar, h^2, on the stem.

To the upper protruding end of the stem any suitable lever or handle, H^2, may be attached for convenience in operating the tube C. The length of this tube should, by preference, be sufficient to secure the requisite lift when the apparatus is used as an ejector or pump—say from two to three inches in a device of the scale shown. Its discharge-end opening c^2 may also be made conical or lipped, as shown, in order to facilitate discharge from such end; but when the device is used as an injector I make use of a separate endwise-movable discharging tube, S S′.

The reduced end of the part S, adjacent to the tube C, is arranged to enter the bore of such tube like a telescope-joint, as in Fig. 1, but to withdraw out of the same, as in Fig. 2, when desired. When arranged and adjusted as in Fig. 1 this telescoping part of the dis-

charging-tube forms in effect a continuation of the combining-tube, giving a gradually reduced or tapering passage from the mouth of nozzle D toward the discharge.

At the discharge end of the part S is an enlarged head, *s*, in the upper surface of which is a transverse notch or groove, receiving a pin, *n*. This pin is attached to the end of a stem, N, out of its rotating center, and as such stem is turned or rotated the discharging-tube receives an endwise throw or motion. This stem is secured in a manner similar to the stem H, A^2 being the surrounding rim extending up from the casing A, N^1 the cap screwing down upon the collar n^1, and N^2 the operating-handle.

By preference the size of the stem N and eccentric position of the pin *n* are such as to give the tube S S′ a greater range of motion than the tube C, or sufficient to give it the positions shown in Figs. 1 and 2.

Within the head *s* is an enlarged chamber or space, s^1, communicating by openings s^2 with the open space between the tube S S′ and case A, and thus with overflow-port R. The part S′ screws into the end of S or chamber s^1, and continues the discharge-passage from the chamber.

A lipped or conical mouth, *u*, is made at the receiving end of S′, opening into chamber s^1, to reduce friction, and from the throat u^1 the passage gradually expands into the usual bell or conical mouth discharge u^2. The outer surface, *m*, of this end of the discharging-tube is made to fit nicely into the shoulder or ring v^2 when the tube is adjusted as in Fig. 1; also, the edge of a collar, *m*′, on the end of the tube fits against the outer face of this shoulder, thus making a tight packing at that point when thus arranged, and closing communication with the chamber or space between A and S S′, except through the overflow-openings s^2.

The tube S S′ is guided in its endwise adjustment by wings or ribs *v*, extending longitudinally along the part S′, and bearing against the inner walls of the shell or casing, or against the face of the shoulder r^2, and also, if desired, by additional ribs r^1, extending along the interior of the shell, and furnishing a bearing or guide for the enlarged head or chamber *s*. The tube S S′ will thus be held in place when withdrawn from the tube C, as shown in Fig. 2, and water ways or passages *a*′ will at the same time be provided outside of this discharging-tube, whereby the body of water escaping from the open discharge end of C, Fig. 2, will find discharge outside of the tube S S′, as well as through the tube; and to facilitate still further this outside discharge, perforations *o* may be made through the head *s* in any desired number.

The overflow-port R is controlled by a valve, *r*, closing against a seat, *r*′, and operating within the valve-chamber R′, which is inclosed by the rim K, extending down from casing A. An extension ferrule or guide, K′, screws into this rim K, and within it is a hollow nut or tube, W, working in screw-threads *w*′.

The valve *r* is attached by bars *w* to a hollow guide or stem, W′, which rests on the upper end of nut W. By screwing up this nut W the valve *r* will be seated and the overflow-port closed; or by partially unscrewing the nut the valve will descend by its own weight, unless held up by suction from within. Such suction will exist when the supply of water is below the capacity of the instrument; but when the supply of water is in excess, such excess will pass through the openings s^2, or out of the open end of tube C, when arranged as in Fig. 2, and thence to overflow-port R, and, pressing upon valve *r*, will open it and escape through hollow stem W′ and nut W. By moving the tube C toward the nozzle D the supply of water may be reduced to the capacity of the instrument, as indicated by the amount of this overflow. And, again, if from any cause the proper working of the device is interrupted, the steam, or steam and water, will open this valve, the nut W being unscrewed, and the steam escaping will give notice of such interruption.

This form of overflow-valve is designed more especially for use with the device when it is employed as a siphon-pump or ejector, as by closing the valve by screwing up nut W the entire water-supply will be passed to the discharge end of the device; but it may also be used when the device is used as an injector for supplying water to boilers, and especially wherever there is danger that the water-supply may become frozen, as by closing this valve as against inside pressure, and turning on a small jet or supply of hot steam through nozzle D, such steam will be passed back into the water-tank, and warm the water therein.

When, however, the device is used as an injector, and especially as a non-lifting injector, a modified form of overflow-valve (shown in Fig. 4) may be used, in which A is the shell or casing, K the rim inclosing the valve-chamber O′, and O is a short tube screwing into the port R and extending down inside the rim K. On the bottom of the tube O is an enlarged head, P, with a series of perforations, o^2, made through the upper face or rim, o^1, outside of the tube O, which perforations furnish an outlet for such tube into the chamber O′, and thence to the port below. An annular gravity-valve, *p*, is arranged in chamber O′, which seats upon the face o^1, and closes the perforations o^2. When pressure in the tube O is sufficient to raise the valve *p* the overflow will escape; otherwise the weight of valve *p* and the suction from within will both tend to hold it to its seat o^1.

Advantages attending this form of overflow-valve are, cheapness of construction and the arrangement by which the weight of the valve supplements the suction from within in holding the valve to its seat.

Instead of making the tube S slide inside

the tube C, as shown, it may be arranged to slide on or outside of tube C, and thereby form one continuous passage through the tubes when the tube S S′ is moved toward tube C, and when moved from it to withdraw from tube C, or open a discharge-passage outside of and around it; and in effecting this it is not essential that tube S S′ should be entirely withdrawn from tube C, as water ways or ports may be made leading from the interior of tube C to the space between the tube S S′ and shell A, and the telescoping end of tube S be so arranged as to cover or uncover such ports or ways as the tube is adjusted or moved; and such modifications I consider as coming within my invention.

The best manner of operating my invention will depend somewhat upon the work to be done.

First. When used as a siphon-pump or ejector to raise and discharge or force a large stream of water into the open air, the discharging-tube S S′ is moved as in Fig. 2, so as to open discharge-passages both inside and outside or around such tube, as described. The tube C is adjusted so as to open the inflow-water port around nozzle D, and, by preference, the overflow-valve is opened a little. Steam is then turned on through nozzle D, and, suitable connection being made from port E to water-supply, water will be drawn into and carried through the tube C by the action of the steam, and the greater portion of such water will be forced through and around the tube S S′, and discharged from the opposite end of the ejector. A small portion will, however, find its way through the open valve *r*, and the skilled workman, by testing the temperature of such overflow, can adjust the tube C by turning lever H^2, so as to regulate the water-supply to the steam-jet without affecting such jet. In this way the device can be made to work as an ejector and force-pump with the greatest economy. The desired adjustment of C being determined, the valve *r* may be closed by screwing up nut W, and the entire water-supply be passed through the discharge or open end of the instrument.

Second. When used as a lifting-injector for feeding water to a steam-boiler, connection is made from port E to water-supply and from the discharge-end to boiler by screw-thread connection *a*, or otherwise. The several parts are then adjusted, as in Fig. 2, as though intended for ejecting, and steam turned on, the boiler-connection being closed by a check-valve or otherwise. As soon as water has been lifted and the instrument filled therewith, which can be determined by the overflow at *r*, the lever and tube S S′ are shifted, as in Fig. 1, so as to secure a single inside passage, as described, when, by opening the boiler-connection, water will be forced into it through such passage by the action of the steam-jet. By observing the amount of overflow the tube C may be shifted or adjusted by lever H^2, so as to regulate the water-supply as desired.

Third. When used as an injector without lifting the water-supply, the parts are adjusted as in Fig. 1, preferably using the form of overflow-valve shown in Fig. 4, and by observing the amount of overflow through such valve the tube C may be adjusted so as to regulate the water-supply as desired.

By making the nozzle D conical in form, with its interior unobstructed, I secure a discharging-orifice of an area in cross-section equal, or nearly equal, to that of the combining-tube C, while the inflow end of D, being smaller, limits the size of the jet or quantity of steam passing through the nozzle; and by this construction I not only secure the best condition of the steam at the lifting-point of action for effecting such lift, but also, on account of the relative areas of combining-tube and nozzle, the water-supply alone may be reduced or increased without corresponding reduction or increase of the steam-jet, and thereby secure the best results in both lifting a column or stream of water and ejecting or forcing the same from the discharge end of the instrument.

The same device is thus adapted for use not only as an injector and ejector, but also as a force-pump to throw a comparatively large stream of water, and may be used for extinguishing fires as well as for the ordinary uses of injectors and ejectors.

I claim herein as my invention—

1. In a combined injector and ejector, an endwise-movable discharging-tube, adapted by its adjustment in one direction to close communication between the interior passage and the space or chamber surrounding such tube, and by its adjustment in the opposite direction to open such end communications, and having ports or passages *a′ c*, one or more, past and outside of the same, in combination with such combining-tube, and with the nozzle D and overflow R, substantially as set forth.

2. In combination with the combining-tube of an injector or ejector, an endwise-movable discharging-tube, adapted by its movement in one direction to connect with the combining-tube and form a single continuous water-passage through both tubes, and by its movement in the opposite direction to open discharge-passages both inside and outside of the discharging-tube, leading to a common discharge beyond the discharging-tube, substantially as set forth.

3. The combination of a valve, *r*, adapted to open and close the overflow-port R, valve-chamber R′, hollow stem W′, having openings from its interior to the valve-chamber, a separate supporting hollow nut, W, and guide or ferrule K′, substantially as set forth.

4. In combination with an injector, an overflow-tube, O, leading from the overflow-port, having enlarged head P, annular valve-seat o^1, and one or more ports, o^2, and annular valve *p*, adapted by its own weight and by suction from within to seat upon o^1 and close the port or ports, substantially as set forth.

5. The endwise-adjustable combining-tube C, in combination with the discharging-tube S S′, also adjustable endwise, and adapted to make in one adjustment a close connection with the adjacent end of the combining-tube, or, being adjusted away, to make a more or less open passage between it and such adjacent end of tube C, thereby opening passages both inside and outside the tube S S′, which lead to a common discharge, and in further combination with the nozzle D, also having a variable relation with reference to the adjacent flaring end of the tube C by the adjustment of the latter, substantially as set forth.

In testimony whereof I have hereunto set my hand.

LOUIS B. FULTON.

Witnesses:

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