(Model.)

# J. R. GOEHRING.

## DOUBLE TUBE INJECTOR.

No. 353,490. Patented Nov. 30, 1886.

FIG. 4.

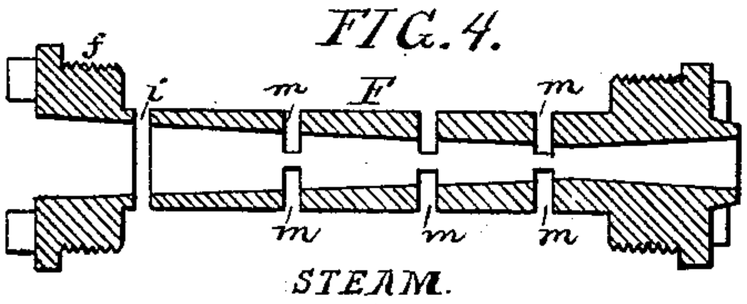



FIG. 3.

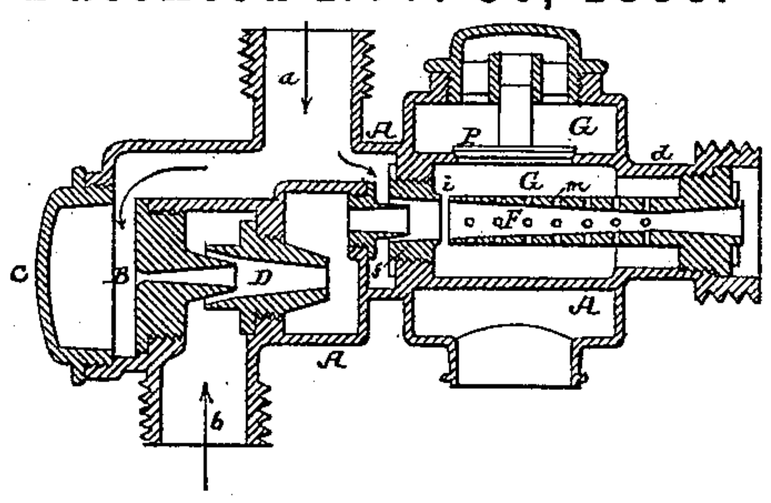



FIG. 1.

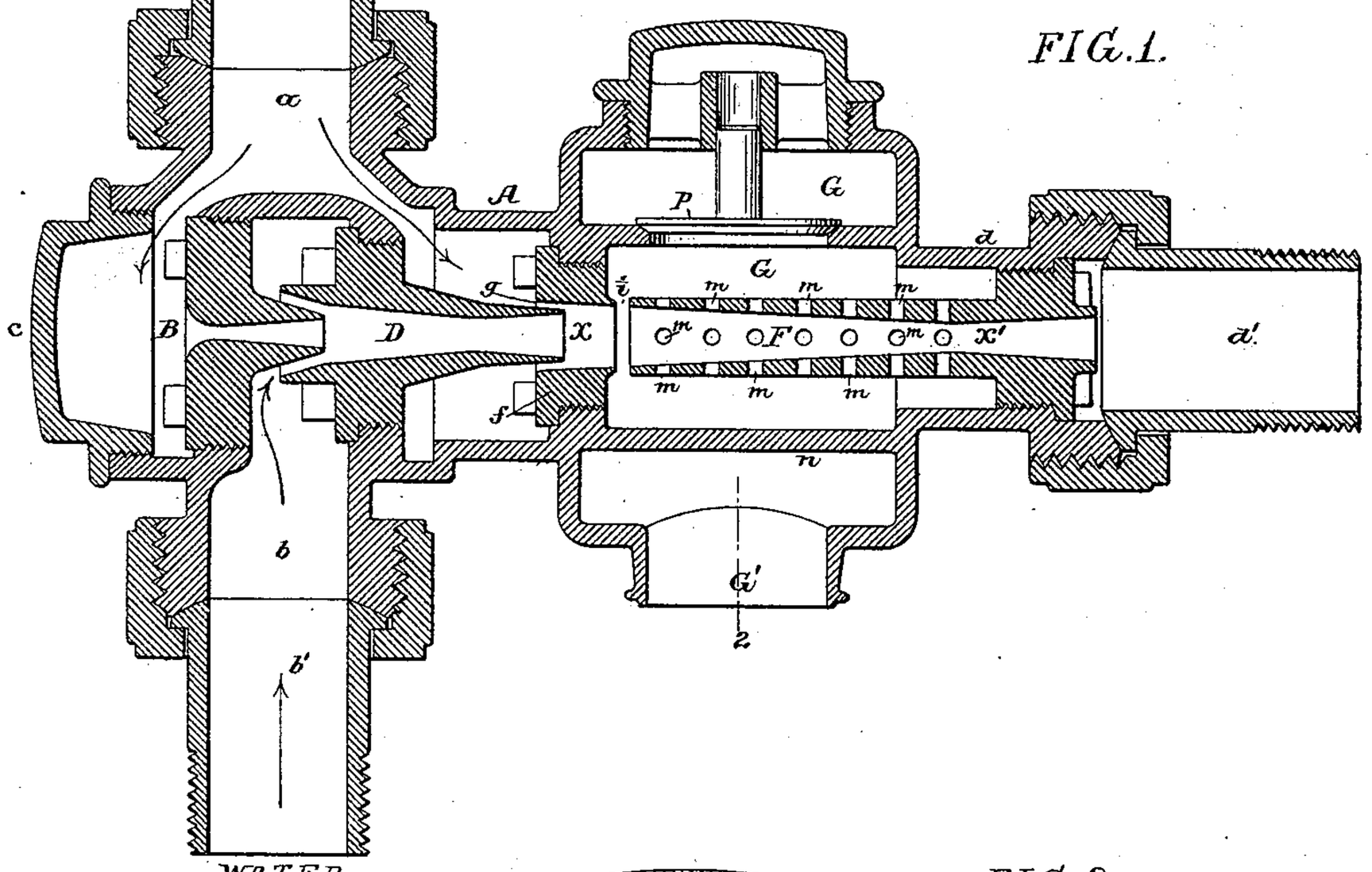
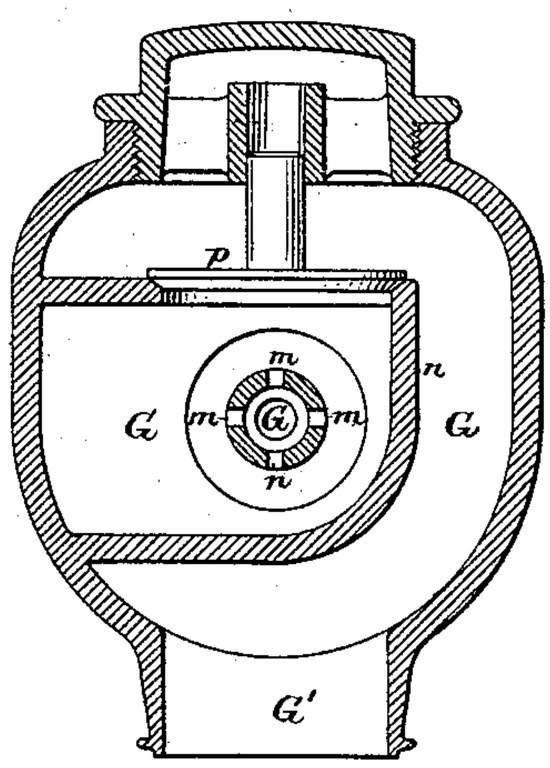



FIG. 2.

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# UNITED STATES PATENT OFFICE.

JOHN R. GOEHRING, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO HENRY BELFIELD AND T. BROOM BELFIELD, BOTH OF SAME PLACE.

## DOUBLE-TUBE INJECTOR.

SPECIFICATION forming part of Letters Patent No. 353,490, dated November 30, 1886.

Application filed August 9, 1886. Serial No. 210,425. (Model.)

*To all whom it may concern:*

Be it known that I, JOHN R. GOEHRING, a citizen of the United States, residing at Philadelphia, Pennsylvania, have invented certain Improvements in Double-Tube Injectors, of which the following is a specification.

My invention consists of certain improvements in that class of injectors known as "double-tube" injectors, in which two sets of steam-nozzles and combining-tubes are employed, the objects of my invention being to render the injector automatic in its action, to dispense with the use of special steam and overflow valves, and to simplify and cheapen the construction of the injector. These objects I attain in the manner which I will now proceed to describe, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal section, partly in elevation, of an injector constructed in accordance with my invention; Fig. 2, a transverse section, partly in elevation, on the line 1 2, Fig. 1; Fig. 3, a sectional view on a reduced scale, showing a modification of one feature of the invention; and Fig. 4, a sectional view of another modification.

My invention, as above stated, relates to that class of injectors in which two sets of steam-nozzles and combining-tubes are employed, the first or forward set lifting the water and imparting the primary forward impulse to the jet, and the second or rear set imparting an additional impulse, the object being to render the injector self-adjusting without the use of movable nozzles.

In the earlier types of injectors of this class—such as that shown in Giffard's English patent of July 23, 1858—each set had its own steam supply and overflow, and in the operation of the injector it became necessary to manipulate a number of valves in order to start the injector in the first instance, or when from any cause the supply-column became broken. Since the Giffard patent numerous modifications of the double-tube injector have been devised, with the view of simplifying the operation of the same; but, so far as I am aware, none of these modifications is available for the production of a practical instrument which can be operated by manipulating a single valve, and which will be perfectly automatic in its action—that is to say, capable of lifting the column of water in the first instance, forming the jet, projecting it into the boiler or other reservoir under pressure, and re-forming the supply-column, if the latter from any cause becomes broken.

My improved injector has been constructed with the view of attaining these objects, and practice has proven that it is efficient for the purpose.

A is the casing of the injector, having branches *a*, *b*, and *d*, to which are secured by suitable couplings the steam-supply pipe *a'*, the water-supply pipe *b'*, and discharge-pipe *d'*, respectively.

In the injector are suitable internally-threaded partitions, to which are secured the first or forward steam-nozzle, B, the first or forward combining-tube, D, and an annular plug, *f*, the latter forming the forward end of the second or rear combining-tube, F, the rear end of the first combining-tube, D, projecting some distance into the mouth of this plug *f*, and the annular space *g* intervening between the plug and the rear end of the combining-tube D, forming a second or rear steam-nozzle. The rear combining-tube thus extends from the discharge end *x* of the forward combining-tube, D, (where the steam from the nozzle *g* meets the water from the said tube,) to a point, *x'*, which is the point of least diameter of the tube F, the portion of said tube in the rear of this point *x'* being the delivery-tube. All of the steam-nozzles and combining-tubes are in the same axial line, the nozzle B, tube D, and plug *f* being introduced through an opening at one end of the casing, which opening is provided with a screw-cap, *c*, and the tube F being adapted to a threaded opening, to which it is introduced from the opposite end of the casing, the object of this construction being to simplify the casting and fitting together of the parts, and hence decrease the cost. The nozzle B and combining-tube D are so proportioned that the jet issuing into the combining-tube will cause a partial vacuum in the branch *b* and pipe *b'*, and thus tend to raise the column of water in the latter.

The continuity of the rear combining-tube,

F, is interrupted by a space, *i*, and by a series of perforations, *m*, forming overflow-passages, the area of the lateral discharge from these passages being greater than the combined areas of both steam-nozzles, so as to permit the escape into the overflow-chamber of the steam from both nozzles without causing back-pressure. The rear combining-tube is contained in the overflow-chamber G, which is separated into an inner and an outer portion by a partition, *n*, to an opening in which is adapted a valve, *p*, which will be closed to its seat by gravity. In starting the injector the pressure of steam in the inner portion of the overflow-chamber causes this valve to rise. The steam thus finds its way to the outer portion of the chamber and escapes through the discharge branch G′; but as soon as the jet is formed it overcomes the pressure in the boiler and passes through the rear combining-tube without escaping from any of the openings therein, the valve *p* then closing to its seat, so as to prevent the drawing in of any air to mingle with the jet.

It will be observed that both the forward steam-nozzle, B, and the rear steam-nozzle, *g*, communicate with a common steam-chamber, so that both nozzles are supplied with steam simultaneously on opening the valve in the steam-pipe, and there are no overflow-passages except those in the rear combining-tube—that is to say, between the points *x* and *x′*. The partial vacuum for causing the water to rise in the supply-pipe *b′* is therefore one due to the action of both steam-nozzles—that is to say, the first nozzle, instead of discharging against atmospheric pressure, as it would have to do if the first combining-tube communicated with an overflow-chamber, discharges into a partial vacuum caused by the action of the second nozzle; hence the partial vacuum produced in the supply-pipe is much nearer a perfect vacuum than it would be in the absence of the aid afforded by the second nozzle, and in consequence I am enabled to lift a column of water of a greater height than is possible when but a single nozzle is used, or when the first nozzle of the series discharges against atmospheric pressure, the vacuum, moreover, being such that when from any cause the column is broken it will be re-formed without the necessity of manipulating any portion of the instrument, the valve in the overflow-chamber being automatic in its action, so that it is free to open whenever there is any overflow, and free to close when the velocity of the jet is such as to cause it to pass through the combining-tube into the boiler.

Owing to the fact that the rear steam-nozzle of my improved injector is an annular one surrounding the discharge end of the forward combining-tube, the rear combining-tube is necessarily of considerable internal diameter, and I am therefore enabled to form in said combining-tube overflow-openings or escape-passages having an aggregate area equal to or greater than the combined area of the two steam-nozzles, thus permitting a free overflow of steam in starting the injector, while at the same time the continuity of the internal surface of the rear combining-tube is not interrupted to such an extent as will materially interfere with the free passage of the jet through the tube when said jet has been formed and has attained the proper velocity to permit it to enter the boiler.

Instead of forming perforations in the rear combining-tube, F, as shown, said tube may consist of a series of short sections with intervening spaces *i*, as shown in Fig. 4; but the use of the perforations is preferred, and the final overflow-openings in the tube should be at or near the point of smallest diameter of the same, in order to insure the proper formation of the jet and the imparting thereto of the velocity necessary to cause it to overcome the pressure which it has to resist.

The valve *p* in the overflow-chamber may be confined to its seat by suitable means when the feed-water is of a high temperature, or when it is desired to blow steam back into the water-supply pipe for thawing out the same or for any other purpose.

Although I have shown in the drawings but two sets of steam-nozzles and combining-tubes, more than two sets may be used, if desired, the overflow-chamber communicating with the rear combining-tube of the series.

Although for the purposes of facilitating the construction of the injector, and providing a straight course for the jet through the same, it is advisable to locate all of the nozzles and combining-tubes in the same axial line, the main features of my invention are applicable to injectors in which the parts are not so arranged—as shown, for instance, in Fig. 3.

I have described my injector as a lifting-injector, and it is especially designed as such; but it should be understood that the injector is operative as well if the water enters the same under pressure.

I am aware that it has been proposed to construct an injector having two or more sets of steam-nozzles and combining-tubes, and with overflow-passages formed wholly in the rear combining-tube of the series; but all such injectors, so far as I am aware, have been provided with valve mechanism whereby steam is caused to enter the nozzles successively, the jet from the first nozzle lifting the water and filling the injector before steam is allowed to pass to the second nozzle for forcing the water into the boiler. Such valve mechanism, it will be evident, would effectually defeat the object of my invention, the essential feature of which is the admission of steam simultaneously to both nozzles in starting the injector, so that the first nozzle discharges into a partial vacuum, caused by the action of the second nozzle.

I claim as my invention—

1. An injector having two or more sets of steam-nozzles and combining-tubes, the nozzles receiving steam simultaneously in starting the injector, and the overflow-passages being formed wholly in the rear combining-tube of

the series, and having an area equal to or greater than the combined areas of the steam-nozzles, all substantially as specified.

2. An injector having two or more sets of steam-nozzles and combining-tubes, all arranged in the same axial line, the nozzles receiving steam simultaneously in starting the injector, and the overflow-passages being formed wholly in the rear combining-tube of the series, and having an area equal to or greater than the combined areas of the steam-nozzles, all substantially as specified.

3. An injector in which forward and rear combining-tubes arranged in the same axial line are combined with a forward steam-nozzle discharging into the forward end of the first combining-tube, and a rear steam-nozzle formed by an annular space around the rear end of the forward combining-tube, both nozzles receiving steam simultaneously in starting the injector, and the overflow-passages being formed wholly in the rear combining-tube, and having an area equal to or greater than the combined areas of the steam-nozzles, all substantially as specified.

4. An injector having two or more sets of steam-nozzles and combining-tubes, the nozzles receiving steam simultaneously in starting the injector, and the overflow-passages being formed wholly in the rear combining-tube of the series, and having an area equal to or greater than the combined areas of the steam-nozzles, the point of final overflow being at or near the point of least diameter of said rear combining-tube, all substantially as specified.

5. An injector having two or more sets of steam-nozzles and combining-tubes, the nozzles receiving steam simultaneously in starting the injector, and the overflow-passages being distributed throughout the length of the rear combining-tube from its forward end to the point of least diameter, and having an area equal to or greater than the combined areas of the steam-nozzles, all substantially as specified.

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

JOHN R. GOEHRING.

Witnesses:
JOSEPH H. KLEIN,
HARRY SMITH.