

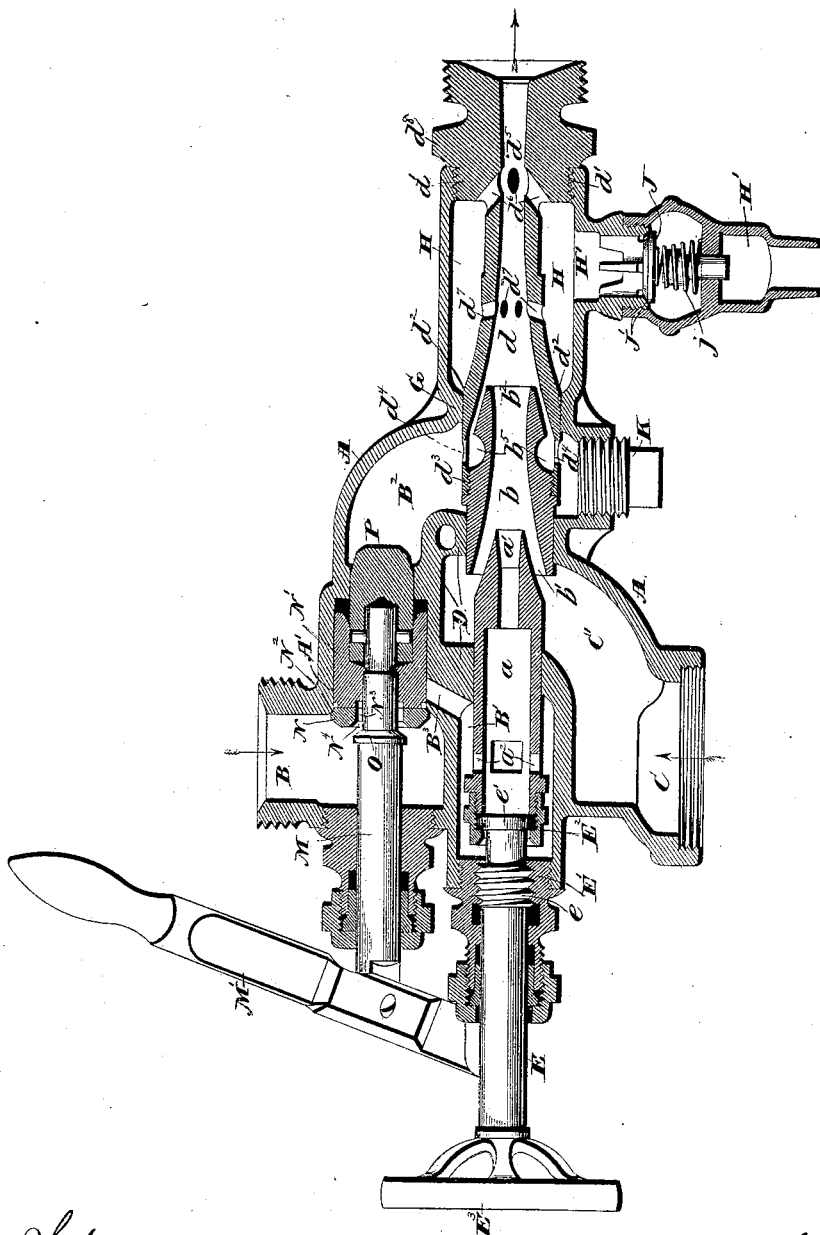
(Model.)

J. D. LYNDE.

INJECTOR.

No. 386,408.

Patented July 17, 1888.



Witnesses:
Chas. Williamson
Henry C. Hazard

Inventor:
John D. Lynde.
By Brindle & Russell
his attorney.

UNITED STATES PATENT OFFICE.

JOHN D. LYNDE, OF HADDONFIELD, NEW JERSEY.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 386,408, dated July 17, 1888.

Original application filed September 3, 1886, Serial No. 212,626. Divided and this application filed June 16, 1888. Serial No. 277,306. (Model.)

To all whom it may concern:

Be it known that I, JOHN D. LYNDE, of Haddonfield, in the county of Camden, and in the State of New Jersey, have invented certain
5 new and useful Improvements in Boiler-Injectors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which is shown a vertical longitudinal section of an injector embodying my
10 improvements.

My invention relates to that kind of injector which contains both a forcing apparatus and a lifting apparatus, so arranged that the lifting
15 apparatus takes water from a tank or other supply and delivers it to the forcing apparatus, the latter in turn taking the water so delivered and forcing it onward into a boiler or elsewhere, even against a pressure greater than
20 the steam used to operate the injector. In such combined lifting and forcing injectors a waste-opening has heretofore been provided, situated either in the combining-tube of the lifting apparatus or between such tube and
25 mouth of the combining-tube of the forcer or forcing apparatus. Such waste-opening communicates with the atmosphere, its object being to facilitate the starting of the lifter by affording an exit for the steam and air, first
30 passing into the combining-tube, before the water has been raised and its flow established through the combining-tube. Where this waste-opening is at a point between the discharge end of the lifter combining-tube and the
35 mouth of the combining-tube of the forcer, it must be closed after the lifter is well at work, so that all the water passing from the lifter combining-tube may enter the combining-tube of the forcer. For closing the waste-opening,
40 a valve has usually been provided, adapted to be manipulated at the proper time by the engineer. Injectors of this class are also provided with a waste-opening located either, as in the original Giffard injector, at or very near
45 the throat of the forcer combining-tube, in which case a valve is usually provided to prevent indraft of air through the opening after the injector is in operation, or at a point between the throat of the forcer combining-tube
50 and the check-valve in the delivery-pipe. A valve is then provided to close the opening

after the stream through the forcer has attained the required velocity.

In my improved injector, as will be set forth hereinafter, there is no necessity for a waste-
55 opening for the lifter apparatus either in its combining-tube or between that tube and the forcer combining-tube, except when water is to be lifted from a considerable depth below the injector, or when steam of high pressure
60 is used to actuate the injector.

In getting injectors of the described class into operation it sometimes occurs that steam is admitted to the forcer steam-jet tube before the current of water from the lifter is estab-
65 lished through the forcer combining-tube. As the steam which then issues from the forcer steam-jet tube cannot escape except through the throat of the forcer combining-tube, the area of which is necessarily small compared
70 with the area of the smallest bore of the forcer steam-jet tube or passage, or through the usual waste-opening at or near such throat, it passes back into or toward the discharge end of the lifter and creates a back-pressure to interfere
75 with and often prevent the working of the lifter.

In accordance with my invention an additional vent or waste-opening is provided in the forcer combining-tube, so as to enable the
80 forcer to start more readily than heretofore and prevent the forcer-steam from interfering with the proper action of the lifter.

My invention as covered by the present application consists in an injector of the class
85 described arranged with its lifter and forcer in axial line with each other, and the discharge end of the lifter combining-tube projecting into a prolongation of the mouth of the forcer combining-tube, so that an annular steam-jet
90 passage for the forcer is formed, such injector being provided with an additional waste-opening in the forcer combining-tube at a point between the mouth and throat of the tube where
95 the area in cross-section is about equal to or greater than the area in cross-section of the smallest portion of the forcer steam-jet passage.

It also consists in the injector of the class described, having the lifter and forcer in axial
100 line with each other, with the discharge end of the lifter combining-tube penetrating into

a prolongation of the mouth of the forcer combining-tube, so as to form an annular steam-jet passage for the forcer, the forcer combining-tube being provided with an additional waste-opening located at a point where the area in cross-section of the bore of the tube is about equal to or greater than the area in cross-section of the smallest portion of the forcer steam-jet passage, and a valve adapted to allow efflux of fluid through the opening to the atmosphere and to prevent the influx of air.

I do not in the present application claim, or cover by my claims, an injector of the class described, with the additional waste-opening, valved or unvalved, except as such injector is arranged with its lifter and forcer in axial line, so as to form the annular steam-jet passage for the forcer, as such an injector without the annular steam-jet passage is fully covered by the claims in my pending application No. 212,626, of which the present application is filed as a division.

In the drawings, A designates the casing having the inlet steam-opening B and the water-inlet opening C communicating with the water-chamber C' and adapted to be connected by suitable means with a well or other source of supply of water. The steam-inlet opening B communicates with the two steam-chambers B' B², which are separated from the water-chamber C' by the partition D. The lifter steam-jet tube *a a'* projects through a hole in partition D, in which it is fitted steam-tight, while being capable of longitudinal movement therein.

As a means for moving the tube to adjust it longitudinally, I have provided the stem E, threaded at *e*, and on its inner end provided with an enlargement or head, *e'*. The threaded portion of this stem works in the threaded opening of the nut or bonnet E' on the casing, while the stem enlargement or head *e'* is encircled and engaged by the nut E², which is screwed onto the prolongation of the lifter steam-jet tube *a a'*. With this construction, when the stem E is rotated in one direction or the other, the lifter steam-jet tube can be moved out or in without rotation. The bonnet or nut E' is provided with a stuffing-box, and the stem E has a hand-wheel, E², on its outer end. The prolongation of the lifter steam-jet tube has a chamber or passage within it, preferably larger than the bore of the jet end of the tube, and into this chamber steam is admitted from steam-chamber B' through the openings *a² a²*. The chamber B' is supplied with steam from the inlet steam-chamber B through the port B³. The lifter combining-tube *b*, which extends from the water-chamber C' through the partition D, is enlarged at its mouth *b²*. The bore of this tube is in axial line with that of the lifter steam-jet tube *a a'*.

Another tube, *d*, axially in line with the lifter combining-tube, is externally threaded at *d'*, near its outer end, and screwed into the internally-threaded end of the casing A. The

body of this tube at *d²* passes through and fits tightly an opening in the partition G within the casing, which partition separates the steam-chamber B² from the overflow or waste chamber H, surrounding the tube *d*, and communicating with the atmosphere through the waste passage or nozzle H'.

The inner end of tube *d*, situated within the steam-chamber B², is internally screw-threaded at *d³*, and is screwed onto the lifter combining-tube *b*. The bore of tube *d* converges or tapers down from its inner end in the direction of the flow of the fluid until the throat *d⁵* is reached, and from this throat it expands again, as shown.

The portion of said tube, which is immediately to the right of the discharge end *b²* of the lifter combining-tube *b*, constitutes the forcer combining-tube, while the outer portion of the tube with its flaring bore forms what is commonly called the delivery-tube. To this delivery end of the forcer combining-tube the pipe for the delivery of the water to the boiler is to be connected, such pipe being provided with the usual check-valve to prevent the flow of water from the boiler into the injector when the latter is not in operation.

The inner end portion of tube *d*, situated, as described, within the steam-chamber B², is provided with several holes, *d⁴ d⁴*, connecting the steam-chamber with the tube-bore.

The end of the lifter combining-tube is made smaller than the part of the bore of tube *d*, within which it is situated, and its exterior is also made tapering and concentric, or nearly concentric, with the interior surface of the tube *d*. This construction and arrangement leaves a tapering annular passage for the steam entering tube *d* through holes *d⁴ d⁴*.

The exterior surface of the portion of the lifter combining-tube *b*, which is within the mouth of tube *d*, is preferably provided with an annular groove, *b⁵*, to allow the steam to enter freely through openings *d⁴ d⁴* and flow forward over the taper end of the tube. The annular space between the end of tube *b* and the tube *d* forms an annular passage for the steam-jet of the forcer. The holes *d⁵ d⁵* in the forcer combining-tube *d*, near the throat thereof, are the waste or overflow openings, which are used in the injector shown and described in the United States patent to Giffard, No. 27,979.

At a point in the combining tube *d*, between the place where the water discharged from the lifter comes in contact with the steam of the forcer steam-jet and the throat of said tube, I provide the additional waste-openings *d⁷ d⁷*, to which I have referred hereinbefore. The area of the bore of tube *d*, where these openings are situated, should, for reasons which I will set forth, be about equal to or greater than the area in cross-section of the smallest portion of the forcer steam-jet passage. Both the waste-openings *d⁵ d⁵* and *d⁷ d⁷* communicate with the overflow or waste chamber H, already de-

scribed herein. Within the discharge passage or nozzle H', opening from this chamber, I place a valve, J, adapted to open outwardly to any pressure from within the chamber H. A spring, j, serves to hold this valve up against the valve-seat J', so as to keep the discharge-passage from chamber H normally closed. By this valve as arranged and operating ingress of air into chamber H will be prevented, while any steam or water issuing from openings d⁶ d⁶ or d⁷ d⁷ will be allowed to flow down and out.

By means of a wrench applied to the end of tube d at d² the tube d can be unscrewed, and both tubes d and b can be simultaneously withdrawn from the casing. Upon the unscrewing of one connection then the lifter and forcer combining-tubes and the part containing the forcer steam-jet passage can be removed.

The admission of steam first to the lifter and then to both the lifter and forcer together is controlled by valves, to be described, operated by means of the stem M, connected with and actuated by the hand-lever M', pivoted to the casing A in any desired way.

Extending within casing A from the chamber B and around stem M is a passage, A', at whose inner or entrance end is the puppet-valve N, forming my main steam-valve. Such valve is guided by means of the wings N' N' engaging the sides of passage A', and when closed engages a suitable valve-seat, N², around the edge of the passage end. In valve N is a central port, N³, through which the valve-stem M, of smaller diameter than the port, passes. Fixed on the stem within chamber B is another puppet-valve, O, which I call the "lifter steam-valve," and which when closed engages a seat, N⁴, around the port N³ in valve N and closes such port. To the end of stem M is attached the piston-valve P, having its seat in a cylindrical opening in that part of the casing which separates the steam-chambers B and B². The portion of this piston-valve around stem M is guided between the wings N' N' on the valve N in a recess formed therein. As the valves O and P are attached to the stem M, they must move with it in its longitudinal movements. As the valve N is not attached to the stem, such valve will not be opened by the drawing out of the stem until the end of piston-valve P strikes the end of the recess within the wings N' N'. Such recess is made deep enough, so that the valve O can be opened fully before the valve N is moved from its seat.

The piston-valve P is made of such length that it will not be withdrawn enough to open the cylindrical opening or passage in which it is seated and thereby open a free passage for steam into chamber B² until after the valve N has been opened.

The operation of my injector (shown and described) is as follows: With the apparatus properly connected with the boiler and water-supply, when it is desired to start it into op-

eration the lever M' is first moved to draw out stem M far enough to draw the lifter steam-valve O from its seat, so as to allow steam to pass from inlet-chamber B through the central port in valve N, port B³, and into chamber B', from which it passes by openings a² a² into the lifter steam-jet tube a a'. No steam is now passing from chamber B into the forcer steam-chamber B², as the piston-valve still closes the passage or opening between these chambers. The jet of steam discharged from the lifter steam-jet tube into and through the lifter combining-tube drives the air in such tube before it, and, exhausting the air from water-chamber C', draws water from the source of supply into said chamber and then into the lifter combining-tube around the nozzle of the steam-jet tube. The air driven out of the combining-tube and the mingled air and steam discharged from such tube before the flow of water through the lifter combining-tube is established pass out through the openings d⁶ and d⁷ in the forcer combining-tube d into the waste-chamber H and from such chamber, opening valve J, out to the atmosphere. Any steam leaking past the piston-valve P will also be discharged from the combining-tube d through the waste-openings d⁷ d⁷, together with fluid discharged from the lifter. As soon as the flow of water through the lifter is established the lever M' is moved farther, so as to draw out the valve stem M enough to open fully both the main steam-valve N and the piston-valve P. The steam from chamber B will then have full and free access to both chamber B' and chamber B², and from them to the lifter steam-jet tube a a' and the forcer steam-jet passage, respectively. The steam which issues from such passage coming in contact with the stream of water discharged from the lifter into the forcer combining-tube readily combines therewith and imparts velocity to it without (owing to the vent afforded by holes d⁷ d⁷) creating any injurious back-pressure to resist the current from the lifter. The water passing through tube d is first discharged through holes d⁷ d⁷, and then through openings d⁶ d⁶, until the stream has had imparted to it sufficient velocity to overcome the resistance of the check-valve in the pipe or passage leading to the boiler, when the injector will be in full operation. Any water issuing from the forcer combining-tube d through the waste-openings when the injector is being started or is in operation can escape down and out from chamber H past the valve J. By turning the hand-wheel E³ the lifter steam-jet tube a a' can, as indicated hereinbefore, be adjusted toward or from the mouth of the lifter combining tube, so as to diminish or increase the capacity of the passage for the water from chamber C' into the mouth of the combining-tube. The quantity of water raised and delivered by the lifter can thus be regulated to a certain extent. If, when the injector is being started, the valves N and P are opened too suddenly, or before the cur-

rent of water from the lifter is fully established, the discharge vent afforded by openings d' d' will tend to allow exit of the steam issuing from the forcer steam-jet tube, so that such steam shall not make back-pressure to hinder the action of the lifter. With the extra vent afforded by openings d' d' the injector will start, when in the absence of such openings it would be necessary to shut valves N and P and begin over again the operation of starting.

When the injector has been got into operation, its action is like that of all injectors of the class described. A freer vent for the lifter than that afforded by the holes d' d' can when required be provided by removing the plug K and inserting in its place a pipe and stop-cock. Such an additional vent-opening will only be necessary where high-pressure steam is used or the water is lifted from a considerable distance. It must be closed by the engineer after water has been lifted and is being delivered properly to the forcer.

I do not set forth herein the details for making the bore or interior shape of the several tubes of the lifter and forcer, as such details will be understood fully by those familiar with the art of constructing lifters and forcers and combining the two together for action. It is, however, necessary that the holes d' d' be, as indicated heretofore, located in the forcer combining-tube between the place where the steam issuing from the forcer steam-jet passage strikes the jet of water issuing from the lifter and the throat of the forcer combining-tube where the area in cross section of the tube-bore is about equal to or greater than the area in cross section of the smallest portion of the forcer steam-jet passage. If the openings be placed nearer the throat, the waste-vent will be too small to be efficient. They can be placed so near the mouth of the forcer combining-tube as to leave just sufficient length of combining tube or passage between them and such mouth to insure that there shall be the proper condensation of the steam from the forcer steam-jet passage and combining of the water and steam before the combined steam and water reach the holes. With such arrangement, when the injector is in operation, the stream of water in the forcer combining-tube will leap across the openings or holes d' d' and continue on through the tube into the boiler. Obviously, the nearer to the mouth of the forcer combining-tube the additional waste-openings can be situated without preventing the steam from the forcer steam-jet passage from acting efficiently the greater the vent which can be afforded for both the lifter and the forcer steam-jet.

I have shown the ordinary waste-openings, d'' d'' , placed, as usual, at or near the throat of the forcer combining-tube; but they may, if desired, be situated beyond such throat, or between it and the usual check-valve in delivery-pipe from injector. The chamber H and valved discharge opening or nozzle therefrom will then serve

merely to allow the discharge of the air, steam, and water issuing from the waste-openings d'' d'' . Wherever located the holes or openings d' d' should have a combined area in cross-section exceeding the bore of the combining-tube at the point where they are situated, so that the exit of the fluid from the combining-tube to the atmosphere shall be free and unhindered.

The lifting and forcing apparatus, as shown and described by me, can be considerably varied in the construction and in the manner and means of connecting the parts together or holding them in place in the casing without departure from my invention.

The lifter combining-tube can be fastened in place in the partition D independent of tube d . Such tube can also be made, if desired, in several pieces, one part, that designated by d' , being in one piece and fastened in partition G, so as to form with the end of the lifter-combining tube the forcer steam-jet tube or passage and a part of the combining-tube. The other portion of tube d , from the waste-openings d' d' on, can also be made in one or more separate pieces suitably fastened or held in place in the casing.

The construction shown in the drawings and heretofore described by me is, however, preferable, as permitting the most ready removal of the tubes.

I am aware that forcers have heretofore been made with a waste-opening located as are the holes d' d' ; but such opening has not been provided in an injector in which is combined a lifter and a forcer, and in which the lifter delivers the water to the forcer, so that such additional waste-opening shall serve, as I have set forth, both for a waste-opening for the lifter and to facilitate the starting of the forcer.

My injector, as shown and described, is rendered a compact one by the arrangement of the lifter and forcer in an axial line with each other, with the forcer steam-jet passage formed by the projection of the end of the lifter combining-tube into the prolongation of the mouth of the combining-tube of the forcer.

Having thus described my invention, what I claim is—

1. An injector having a lifter and a forcer arranged in axial line with each other, in which the discharge end of the lifter combining-tube penetrates into a prolongation of the mouth of the forcer combining-tube, thereby forming an annular forcer steam-jet passage, and in which the forcer combining-tube is provided with a waste-opening between its mouth and its throat, where the area in cross-section of its bore is equal to or greater than the area in cross-section of the smallest portion of the forcer steam-jet passage, substantially as and for the purpose specified.

2. An injector having a lifter and a forcer arranged in an axial line with each other, in which the discharge end of the lifter combining-tube penetrates into a prolongation of the

mouth of the forcer combining-tube, thereby
forming an annular forcer steam-jet passage,
and in which the forcer combining-tube is pro-
vided with a waste-opening between its mouth
5 and its throat at a point where the area in
cross-section of its bore is about equal to or
greater than the area in cross-section of the
smallest portion of the annular steam-jet pas-
sage, and also provided with a valve, whereby
10 the efflux of fluid to the atmosphere from the

waste-opening is permitted and the influx of
air prevented, substantially as and for the pur-
pose shown.

In testimony that I claim the foregoing I
have hereunto set my hand this 14th day of 15
June, 1888.

JOHN D. LYNDE.

Witnesses:

EDW. E. CULLEN,
ELMER P. HOWE.