(Model.) 3 Sheets—Sheet 1.

H. B. MURDOCK.

INJECTOR.

No. 304,227. Patented Aug. 26, 1884.

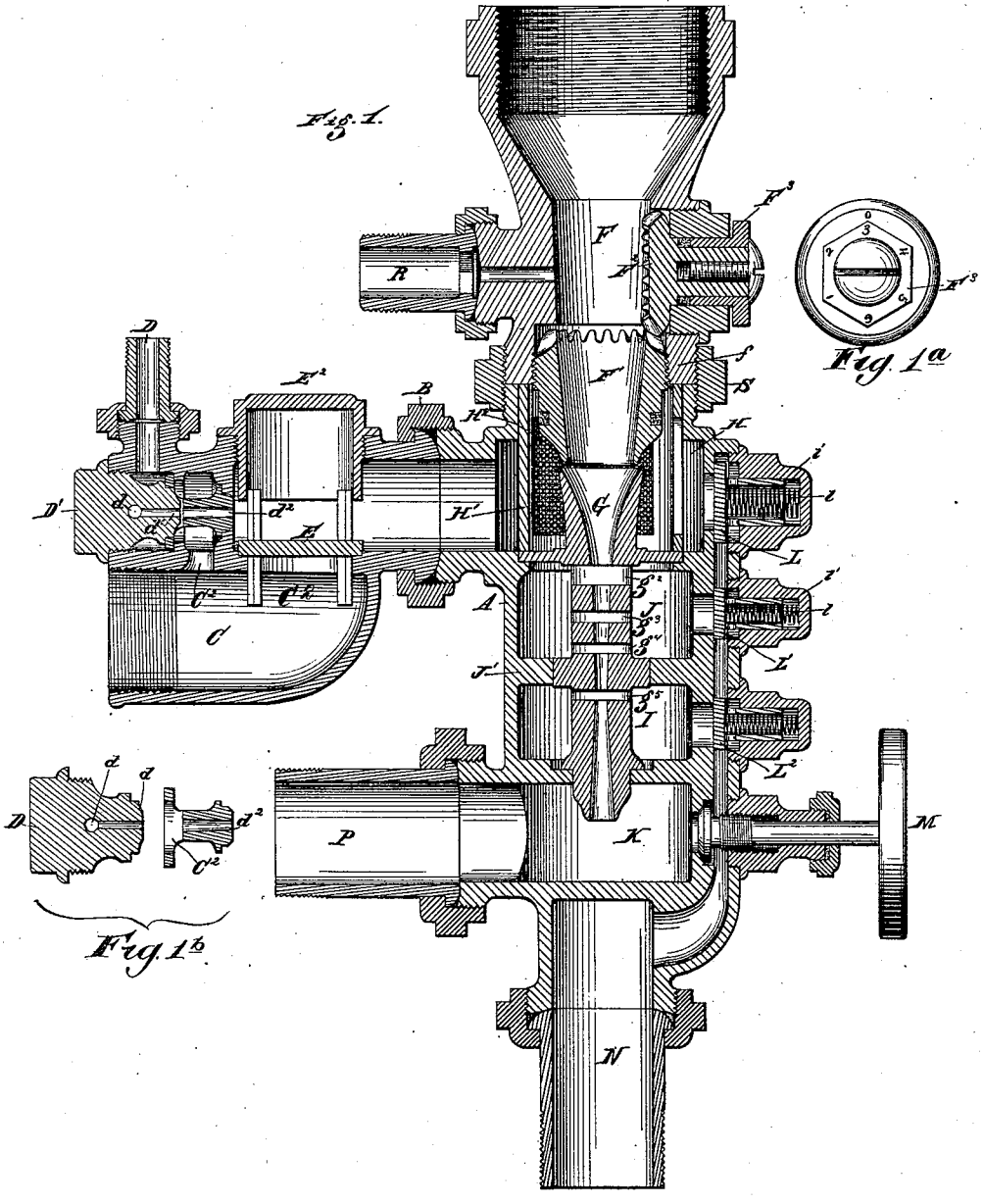


Fig. 1.

Fig. 1a

Fig. 1b

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Fig. 2.

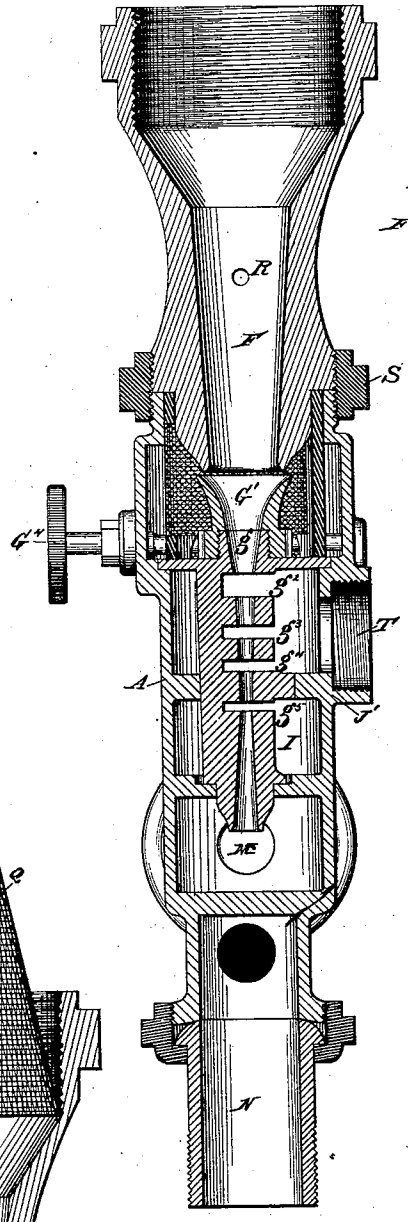


Fig. 3.

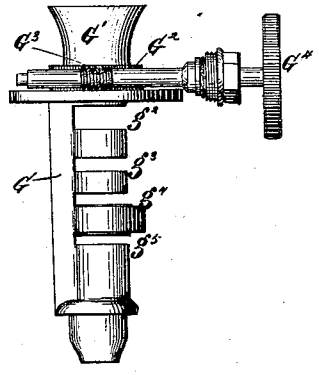
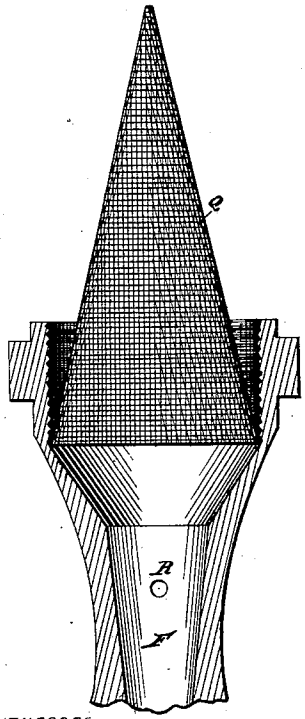


Fig. 4.



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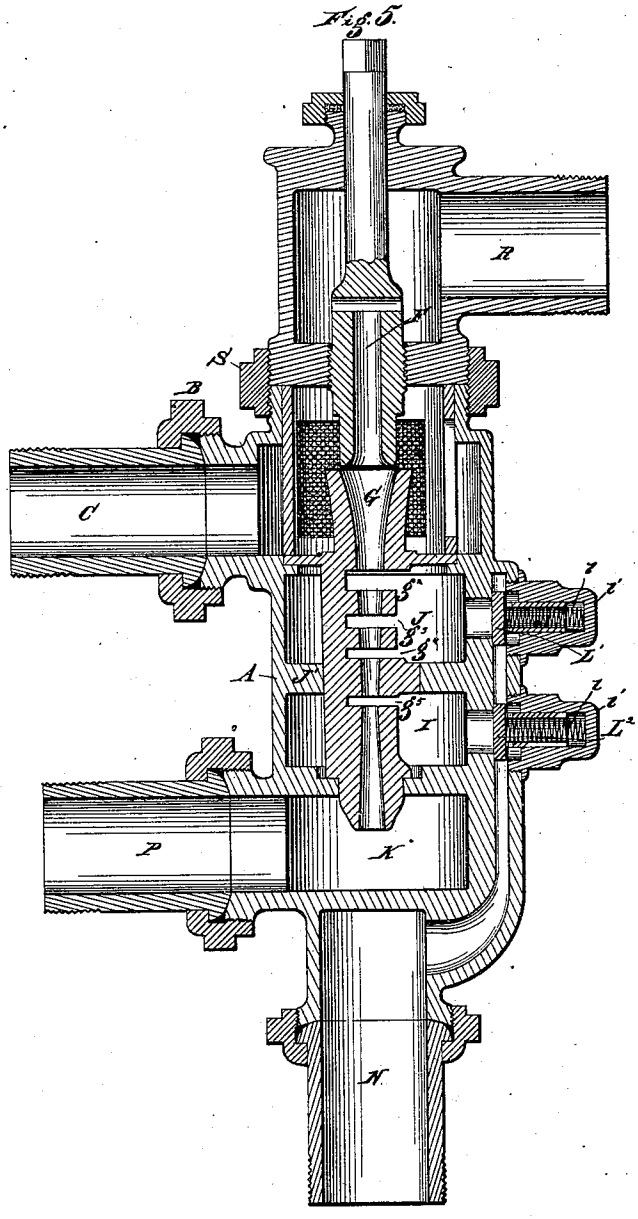
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Fig. 5.



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UNITED STATES PATENT OFFICE.

HORACE B. MURDOCK, OF DETROIT, MICHIGAN, ASSIGNOR OF ONE-HALF TO JOHN TRIX, OF SAME PLACE.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 304,227, dated August 26, 1884.

Application filed March 1, 1884. (Model.)

To all whom it may concern:

Be it known that I, HORACE B. MURDOCK, of Detroit, county of Wayne, and State of Michigan, have invented a new and useful Improvement in Injectors; and I declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form a part of this specification.

My invention consists of the combinations of devices and appliances hereinafter specified, and more particularly pointed out in the claims.

In the drawings, Figure 1 is a longitudinal central sectional view of an exhaust-injector embodying my invention, in which a portion of the force-tube or steam-jet tube is made adjustable toward or from the combining-tube, the latter being stationary. Fig. 1^a is an end view of the gear F^3. Fig. 1^b is a sectional view of the parts D and d^2 of the miniature injector detached from the other parts. Fig. 2 is a similar sectional view at right angles to that in Fig. 1, but the force-tube is made stationary, and the combining-tube is made adjustable toward or from the force-tube. Fig. 3 is a separate view of the combining-tube shown in Fig. 2. Fig. 4 illustrates a screen located at the entrance to the force-tube. Fig. 5 represents the same as embraced in a live-steam injector.

This invention relates to injectors generally, whether exhaust-steam injectors in which exhaust-steam is the motive power employed for feeding water into a boiler or other receptacle against the pressure from within, or live-steam injectors in which live steam is the motive power.

My invention contemplates the novel injector considered as a whole; and it contemplates, particularly, certain novel features, which will be hereinafter particularly described, and then pointed out by the claims.

A is the shell or case.

B is a suitable connection between the case of the injector proper and the lifter. The lifter consists of the inlet-tube C for water supposed to be drawn from a lower level.

D is a steam-inlet.

D′ is a plug perforated at *d* for the admission of steam from the nozzle *d′* and through the combining-tube d^2. This produces a miniature injector at this point.

C′ is the inlet or supply port through which water reaches this injector.

E is a valve which closes the passage between the inlet C and the passage C^2, through which water passes to the main injector.

The operation of this lifter is as follows: Steam admitted through D and through the miniature injector produces a suction through the port C′ and creates a partial vacuum beneath the tube E and holds it to its seat. The water following in to supply the vacuum is eventually driven forward by the miniature injector until it reaches the supply-chamber and provides a feed of water to the combining-tube of the main injector. The exhaust-steam passing through the main injector then relieves the miniature injector and produces a vacuum above the valve E. An equilibrium is thus established, so that subsequently water drawn by the main injector may pass up freely beneath the valve E and through that valve-opening.

It should be understood that the part of the mechanism above described need only be employed with exhaust-steam injectors where it is necessary to lift the water to the apparatus with live steam, and that wherever water is supplied from a head above the injector, or close to its level, or when the pressure in the boiler is not so great as to tax the operative powers of the main injector, or where the injector is operated with live steam, such a lifter would not be required. I would also have it understood that the miniature injector may be operated with exhaust-steam as well as by live steam.

E′ is a cap through which the valve E may be inserted and afford ready access to the same, and the peculiar construction of the miniature injector in the form of the plug D′ and the tube d^2, so as to be easily inserted or removed, as shown, is a novel and valuable feature of the said lifter.

I will now describe the injector proper.

F is the steam-jet tube or force-tube, and

which will be hereinafter termed the "force-tube."

G is the combining-tube.

H is the supply-chamber.

H′ is a cage for supporting a screen, H^2, to prevent foreign matters from entering the combining-tube, and to hold the combining-tube upon its seat.

I is the usual overflow-chamber.

J is what I term an "intermediate chamber." This is, so far as I am aware, a new feature in the construction of injectors.

K is the delivery-chamber.

L L′ L^2 are overflow-valves held in place by springs *l*.

M is a valve, which may be opened at will to establish communication between the relief-chamber and the waste or sewer connection N.

P represents the connection with the boiler or other chamber, into which water is being fed by the injector.

F′ represents the extremity of the force-tube. This may, as shown in Fig. 2, be made in a single piece with the body of the tube; or, as shown in Fig. 1, it may be made separate, but adapted to be adjusted nearer to or farther from the entrance to the combining-tube. If it is made adjustable, as shown in Fig. 2, I prefer to provide it with a gear at its top, engaging a pinion, F^2, this pinion being operated by a stem and hand-piece, F^3. This hand-piece may be provided with graduations, as shown in Fig. 1^a, whereby the operator may know just what adjustment he has made between the force-tube and the combining-tube.

f is a screw-thread engaging the section F′ with the main body of the tube, so that as the pinion F^2 is turned it will cause the part F′ to revolve and move up and down in the threads *f*. This adjustment may, however, be effected as shown in Fig. 5, in which the adjustable end is represented by the same letter, and is attached to a stem projecting directly out of the end of the shell and provided at this point with a hand-piece or wrench-seat, as shown.

Instead of making the extremity of the force-tube adjustable, the same effect may be produced by making the entrance G′ of the combining-tube adjustable, as shown in Figs. 2 and 3. In this case the portion G′ engages with the main body of the combining-tube by threads *g*. A worm-gear, G^2, is formed upon its base, and this, meshing with a worm, G^3, on the shaft of the hand-wheel G^4, affords a ready means for revolving the portion G′, and so adjusting it nearer to or farther from the extremity of the force-tube. I would have it understood that both of these contrivances may be employed—that is to say, the extremity of the combining-tube as well as the extremity of the force-tube may be made adjustable and both be employed in the same device. I prefer, however, generally to employ but one of the said devices, as either affords adequate means for the proper adjustment of the space between the force-tube and the combining-tube. It will be observed that the means for adjusting these portions F and G′ project to the exterior, and are so constructed as to admit of adjustment at any time while the machine is in operation. g^2, g^3, g^4, &c., are relief-passages.

The operation of the injector is substantially as follows: Steam entering the force-tube draws in the water from the supply-chamber by the vacuum produced in the extremity of the combining-tube. This water is impelled forward and accelerated in the combining-tube until it is discharged into the delivery-chamber beneath. We will suppose the injector to be working against, say sixty pounds of pressure. The water will at the outset overflow through each of the passages g^2, g^3, g^4, and g^5, and will find exit through the overflow-valves to the sewer or waste-pipe beneath. As the injector, however, continues to work and the water becomes accelerated in the combining-tube, a vacuum will soon be formed in the intermediate chamber, J, but will continue to overflow through the passage g^5 in the relief-chamber beneath. This will continue until the acceleration of the water in the combining-tube becomes sufficiently great to overcome entirely the resisting-pressure from the boiler, when all of the water will be injected into the boiler and there will be a vacuum in the overflow-chamber. Suppose, however, that the injector is required to work against a greater pressure of, say, one hundred pounds or more; then water entering the combining-chamber will be impelled forward, and there will be temporarily an overflow through each of the passages g^2 g^3 g^4 g^5. As the water becomes accelerated, it will discharge a sufficient amount into the boiler to create and maintain a vacuum in the intermediate chamber, while there will be a constant overflow of a portion of the water through the opening g^5 in the overflow-chamber, and this will be maintained until the pressure is so great as to cause a portion of the water to overflow into the intermediate chamber and find relief from that point. With the same combining-tube located in a chamber without the partition J′ the injector is capable of operating against a pressure of, say, sixty pounds, while with the other conditions the same and with the presence of the partition J′, the injector will operate against a pressure of one hundred pounds. In any event the capability of the injector as respects the resisting-pressure from within the boiler is very greatly increased by the employment of the intermediate chamber, J.

Q is a screen for intercepting foreign matters that might be driven in by the exhaust.

R is a steam connection whereby with the exhaust-steam injector free steam may be admitted into the force-tube, in order to operate the injector, in case it is desired to use it as a live-steam instead of an exhaust injector.

In this case, of course, the exhaust-steam passage would be closed off at some point by a valve.

I′ are caps, which suitably engage the casting and form a housing for the valve-stems and their springs. They can be easily removed so as to remedy any interior trouble.

The overflow valve and cap may be dispensed with, if desired, in the supply-chamber, as shown in Fig. 5, not being required with the live-steam injector; nor is it required with the exhaust-steam injector, except when there is too great a flow of water to the supply-chamber, or unless a lifter is employed when it is desirable. It will also be seen that by simply removing the connecting-collar S the whole interior mechanism can be removed from the end of the case A.

T in Fig. 2 represents a steam-orifice leading into the intermediate chamber, so that steam may be employed at this point to assist the injector, if desired, to heat the water beyond the temperature that it would otherwise derive. It is apparent that steam entering at this point would be taken in rapidly and act upon the water in the accelerating-tube.

The screen Q is preferably made in elongated form, preferably conical, as shown in Fig. 4, the effect being to provide as much or more space between the meshes of the screen than would exist in the area of the tube at the base of the screen, thereby intercepting impurities without interrupting the free passage of the exhaust.

It is apparent that the improvements are just as applicable to ejectors as to injectors, and, in fact, the device shown in Fig. 5 is equally well adapted for ejecting as for injecting; and I would have it understood that my invention embraces, and that my patent covers, the employment of the improvements, whether in an injector or an ejector.

What I claim is—

1. The combination, with an exhaust-steam injector, of a lifter consisting of a miniature injector, D d^2, the valve E, and adjacent water and steam passages, substantially as and for the purposes described.

2. In a water-lifter for an injector, the combination of a miniature injector for raising water, a water-inlet communicating with said injector, and a water-passage between said injector and main injector, and an automatically-operating valve located to temporarily close communication between said water-inlet and the passage between the miniature and main injectors, substantially as described.

3. In an injector, a force-tube provided with an adjustable section, F′, having its upper end formed with gear-teeth, said section engaging with the adjacent parts by a screw-thread or equivalent, in combination with a pinion, F^2, meshing with the gear-teeth of the adjustable section, and extended to the exterior of the casing, substantially as and for the purpose set forth.

4. In an injector, the rotatable entrance end to the combining-tube formed with a gear, with which meshes a gear extended to the outside of the casing, in combination with the adjustable section F′, having its upper end formed with gear-teeth, and the pinion F^2, meshing with the teeth of the section F′, and operated from the outside of the casing, substantially as and for the purpose set forth.

5. The combination, with the admission end of the force-tube, of an elongated screen for arresting impurities, substantially as described.

6. An injector consisting of a force-tube, a combining-tube, an overflow-chamber, and an intermediate chamber with free openings into the combining-tube from said two last-named chambers, substantially as and for the purposes described.

7. An injector consisting of a force-tube, a combining-tube, an overflow-chamber, an intermediate chamber communicating with the combining-tube through one or more openings in the side of the latter, and, in connection therewith, means for regulating the distance between the force-tube and the combining-tube by adjusting one with respect to the other, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

HORACE B. MURDOCK.

Witnesses:
N. S. WRIGHT,
M. B. O. DOGHERTY.