(Model.) 2 Sheets—Sheet 1.

H. HOLDEN & R. G. BROOKE.

INJECTOR.

No. 419,124. Patented Jan. 7, 1890.

Fig. 2.

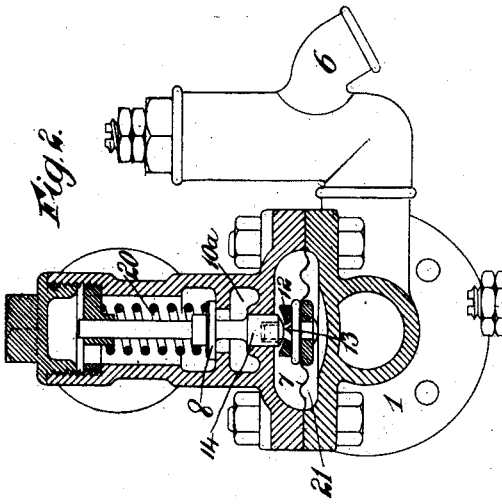


Fig. 4.

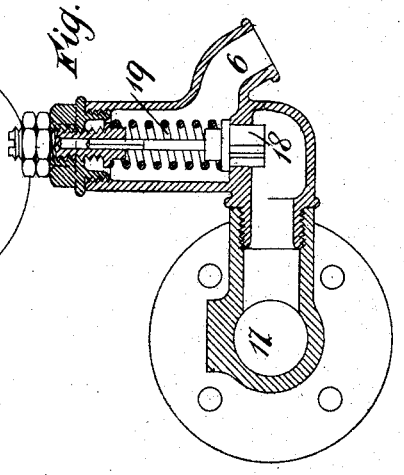


Fig. 1.

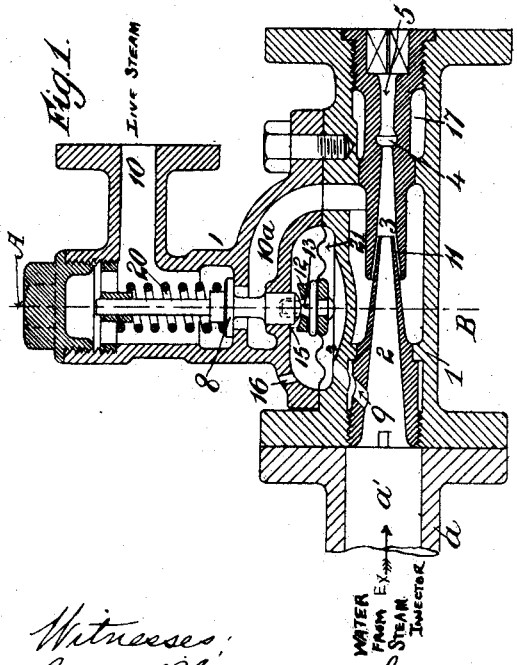
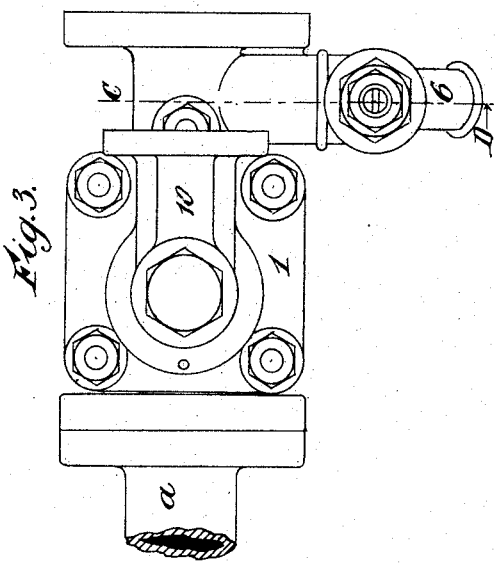


Fig. 3.



Witnesses:
Jos. V. Blackwood
William G. Doolittle

Harry Holden
Robt. G. Brooke
by W. G. Doolittle Atty

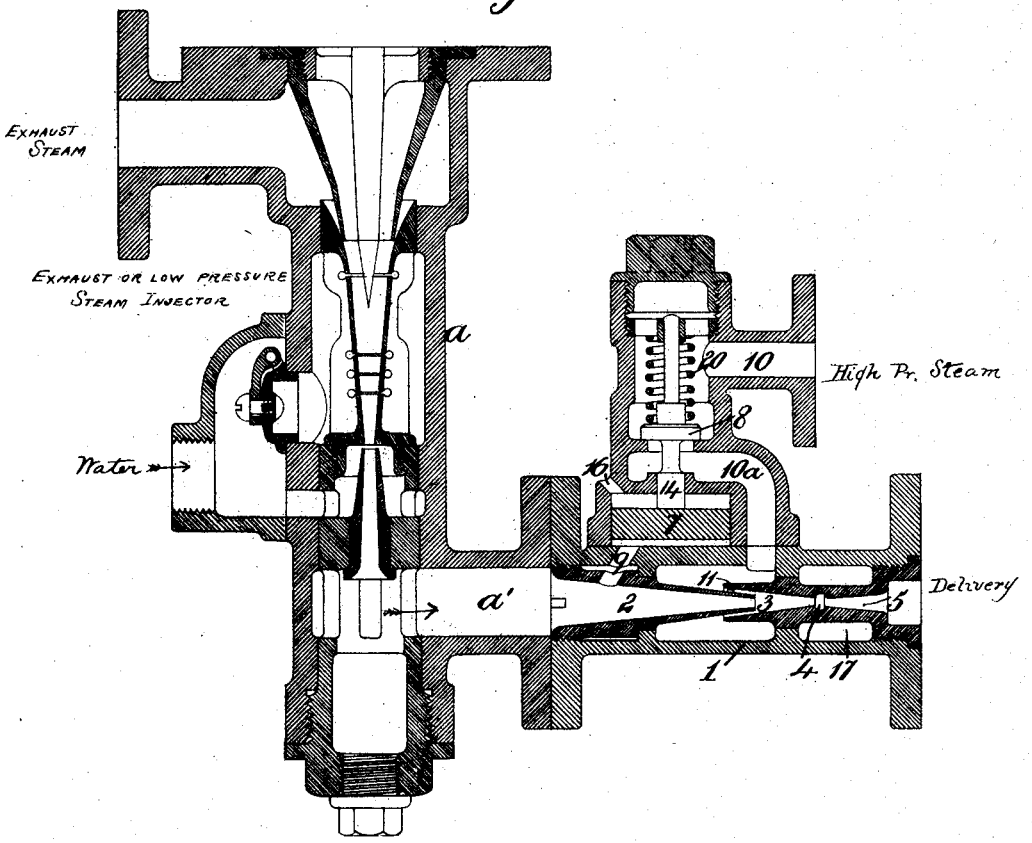
(Model.) 2 Sheets—Sheet 2.

H. HOLDEN & R. G. BROOKE.

INJECTOR.

No. 419,124. Patented Jan. 7, 1890.

Fig. 5.



Witnesses.
Jos. A. Blackwood.
H. J. Whitemore

Inventors.
Harry Holden & R. G. Brooke
By Wm. H. Dorsett
Attorney

UNITED STATES PATENT OFFICE.

HARRY HOLDEN AND ROBERT GRUNDY BROOKE, OF SALFORD, COUNTY OF LANCASTER, ASSIGNORS TO GEORGE FREDERICK GLASS HOOPER, OF WESTMINSTER, ENGLAND.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 419,124, dated January 7, 1890.

Application filed June 17, 1887. Serial No. 241,670. (Model.) Patented in England February 11, 1887, No. 2,177; in France May 10, 1887, No. 183,484; in Belgium May 11, 1887, No. 77,411; in Germany May 17, 1887, No. 41,191; in Italy July 5 1887, XLIII, 98; in Canada July 26, 1887, No. 27,268, and in Austria-Hungary September 25, 1887, No. 20,076.

To all whom it may concern:

Be it known that we, HARRY HOLDEN and ROBERT GRUNDY BROOKE, subjects of the Queen of Great Britain and Ireland, both residing at Salford, in the county of Lancaster, Kingdom of Great Britain and Ireland, have invented Improvements in Injectors, of which the following is a specification, and which has been patented to us as follows: Great Britain, No. 2,177, dated February 11, 1887; Germany, No. 41,191, dated May 17, 1887; Austria-Hungary, No. 20,076, dated September 25, 1887; France, No. 183,484, dated May 10, 1887; Belgium, No. 77,411, dated May 11, 1887; Italy, July 5, 1887, Reg. Att. Vol. XLIII, No. 98, and Canada, No. 27,268, dated July 26, 1887.

This invention relates to injectors in which both exhaust or low-pressure steam and high-pressure or live steam are used to impart velocity to water. It has reference particularly to apparatus in which both exhaust or low-pressure steam and high-pressure or live steam are used to project the water, the arrangement as we usually carry it out being such that a jet of water produced by exhaust or low-pressure steam has subsequently imparted to it an increased velocity and consequent penetrating power by high-pressure or live steam.

The object of our invention is to render the apparatus automatic both as regards starting and stopping, utilizing the pressure of water produced by the action of the exhaust or low-pressure steam for the purpose of automatically admitting high-pressure or live steam to mix and form a combined jet with such water for the purpose of increasing its velocity.

The invention can be carried out in various forms—that is to say, the exhaust or low-pressure injector and the high-pressure or live-steam injector may be combined in one instrument, forming a compound injector, or they may be separate instruments, the exhaust or low-pressure injector (which we will call the "exhaust-injector") being of any desired or suitable construction and the high-pressure or live-steam injector being a separate instrument, which we will call a "supplementary injector," designed to be attached to or connected with the exhaust-injector.

For convenience of description we select the latter type as and by way of illustration in describing the nature and practical application of our invention.

Referring to the accompanying drawings, Figure 1 is a central longitudinal section of a supplementary injector according to this invention. Fig. 2 is a cross-section of the same in the line A B of Fig. 1. Fig. 3 is a plan, and Fig. 4 is a section in the line C D of Fig. 3. Fig. 5 is a central longitudinal section of a supplementary injector according to this invention and an exhaust-injector.

This supplementary injector is designed to be applied to an exhaust-injector, as shown in Fig. 5; but the exhaust-injector may be of any other suitable construction.

By an exhaust-injector we mean one that imparts velocity to water for feeding a boiler, or for other purposes, by means of steam at or near atmospheric pressure—such, for example, as exhaust-steam from an engine, or high-pressure steam purposely wire-drawn, or low-pressure steam otherwise obtained.

We have called our improved injector, when made in separate form according to the example illustrated in the annexed drawings, a "supplementary injector." By "supplementary injector" we mean one that receives water from an exhaust-injector, (as hereinabove defined,) and which is so constructed as to cause the water so received to combine with a jet of high-pressure or live steam, whereby there is imparted to the water greater velocity and

consequent penetrating power than would be given to it by the action of the exhaust or low-pressure steam alone.

1 is the casing of the supplementary injector. 2 is the water-nozzle; 3, the combining-nozzle; 4, the overflow, and 5 the delivery-nozzle. The water entering under pressure from the exhaust-injector can only escape either into the boiler or out at the overflow 4 and cock 6. The jet of water produced by exhaust or low-pressure steam in the injector *a* enters the supplementary injector down the passage *a'* and the area of the nozzles or cones 2 and 3, as usually employed, is sufficiently small to cause a considerable pressure in the nozzle 2.

Now, our invention has for its object to render the apparatus automatic both as regards starting and stopping. To this end we utilize the pressure of water produced by the action of the exhaust or low-pressure steam (in the injector *a*) for the purpose of automatically admitting high pressure or live steam to mix and form a combined jet with such water for the purpose of increasing its velocity. This pressure actuates the diaphragm 7 and valve 8, or instead of a diaphragm a piston may be used, as shown in Fig. 5, if the chamber in which the diaphragm is shown be made cylindrical and of suitable proportions.

9 is a passage by which pressure reaches the diaphragm. When the pressure acting on the diaphragm is sufficient to open the valve 8, live steam enters at 10 and passes down the passage 10^a into the area 11 around the water-nozzle.

12 is a ring, of metal or other suitable material, carried by the diaphragm and surrounding the guide-pin 13, which is fixed to the diaphragm and enters a recess in the piston 14 at the lower end of the stem of the valve 8. The ring 12 serves to limit the motion of the diaphragm, and also as a valve to prevent steam passing the piston 14 by seating itself against a faced surface 15.

16 is a leak-hole to prevent accumulation of pressure on top of the diaphragm in case of any leakage past the ring 12.

17 is the overflow chamber and passage connected with the cock 6.

18 is a valve weighted, as required, by an adjustable spring 19.

The valve 8 may or may not be provided with a spring, according to circumstances. It is shown provided with a spring 20. When the exhaust-injector *a* starts, a pressure of water accumulates in the passage 9, space 21, (below the diaphragm or piston,) nozzle 2, and combining-nozzle 3, sufficient to lift the diaphragm (or piston) against the pressure of live steam (and of the spring 20, if used) on valve 8. Thus valve 8 is opened and "live" steam mingles with the water-jet and gives the required additional velocity. If the exhaust-injector stops, the pressure under the diaphragm (or piston) ceases, and so valve 8 closes and live steam is shut off.

It is to be remarked that though we have illustrated arrangements that will be found to work well, we do not bind ourselves to any of the precise details shown, as the same are capable of variation. Thus the diaphragm may be made of any suitable material or combination of materials such as will have sufficient strength and pliability.

We are aware it has before been proposed to use a supplementary injector worked by high-pressure or live steam; but the method of starting and working such a combination of exhaust and supplementary injectors, as heretofore usually practiced, has been so complicated as to interfere with their utility. Now, from the description hereinabove given of our invention, it will be understood that we simplify and render automatic the working and starting of the supplementary injector by arranging the same so that when the exhaust-injector is at work and is delivering water into the supplementary injector high-pressure steam will be automatically admitted instead of, as heretofore, by hand, so as to combine with the incoming water and to force it against the higher pressure it is required to work against; and moreover the high-pressure or live steam will be automatically shut off from the supplementary injector as and when required, so as to automatically prevent its blowing back through the injector, as it would do if not shut off directly on the exhaust-injector ceasing to work.

The matter herein claimed may be found, but not claimed, in our pending application, Serial No. 248,403.

What we claim is—

1. An injector comprising a passage for high-pressure or live steam, a valve controlling said passage, and means whereby pressure arising from a water-jet produced by exhaust or low-pressure steam will cause said valve to open and admit the live or higher pressure steam to said jet for the purpose of increasing the velocity thereof and so enabling said jet to exert a greater pressure than that due to the velocity caused by the exhaust or low-pressure steam alone.

2. In an injector, the combination of a casing provided with a pressure-chamber and with a passage for high-pressure or live steam, a nozzle or passage communicating with said chamber and along which a water-jet produced by exhaust or low-pressure steam is caused to flow, a valve 8, adapted to control the flow of high-pressure or live steam through said passage, and a diaphragm 7, (or piston,) located within said pressure-chamber and arranged to actuate said valve when subjected to unequal pressure on its opposite ends, for the purpose specified.

3. The injector hereinabove described, comprising casing 1, water-nozzle 2, combining-nozzle 3, overflow 4, delivery-nozzle 5, cock 6, diaphragm 7 (or piston) and its containing-chamber, valve 8, passage 9, passage 10, passage 10^a, area 11, leak-hole 16, to prevent accumulation of pressure on the top of the diaphragm or piston, overflow-chamber 17, and weighted valve 18, substantially as described, for the purpose specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HARRY HOLDEN.
ROBERT GRUNDY BROOKE.

Witnesses:
ROBERT WARDLE,
ROBT. TOMLINSON,
Both of 56 Brown Street, Manchester, Gentlemen.