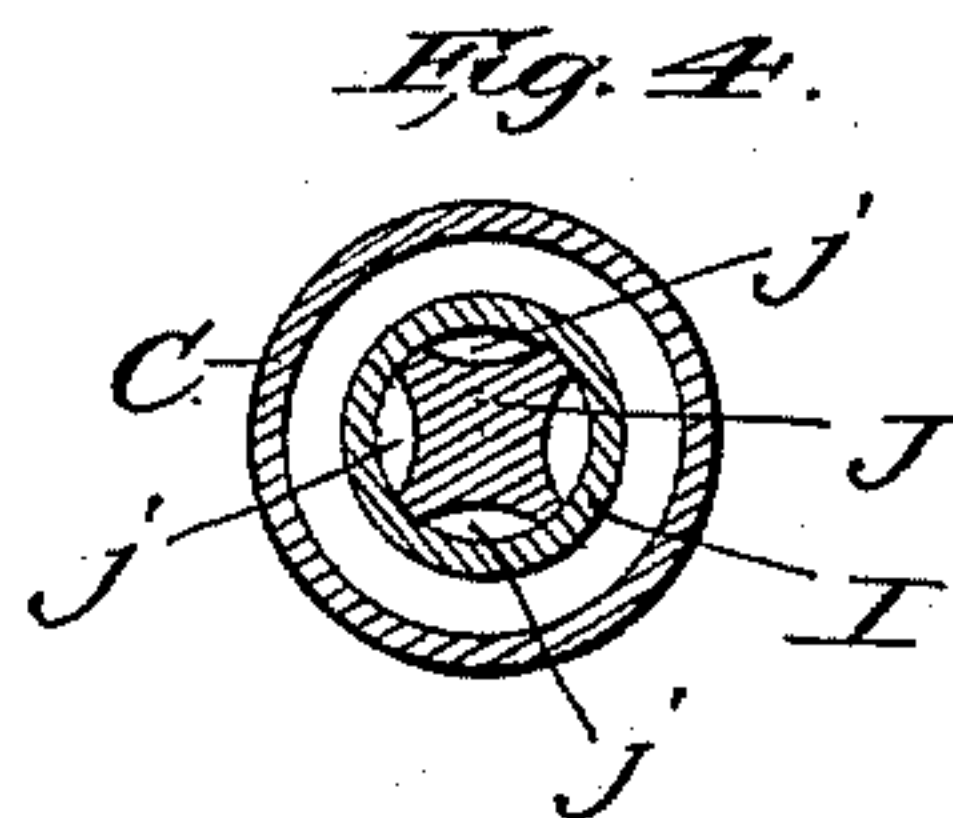
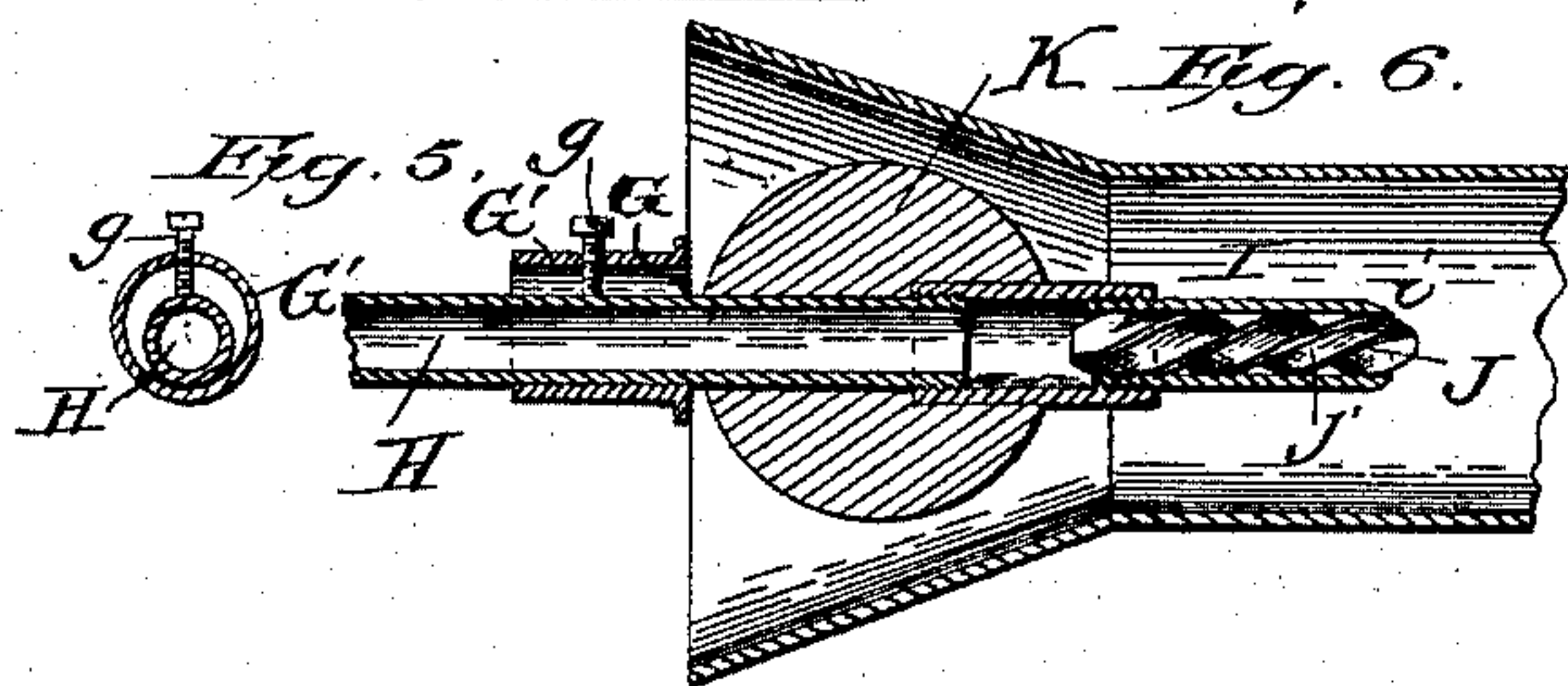
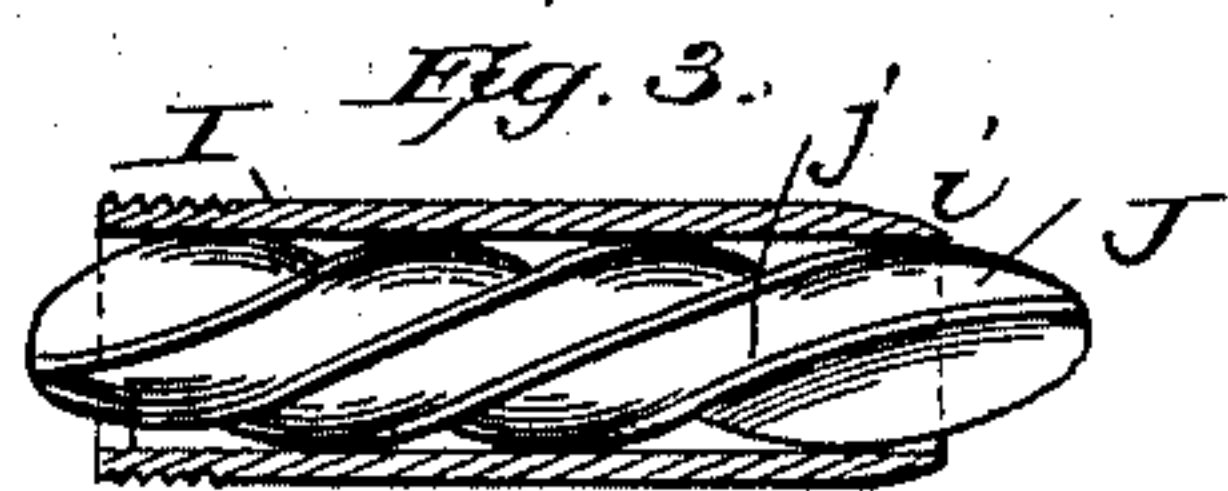
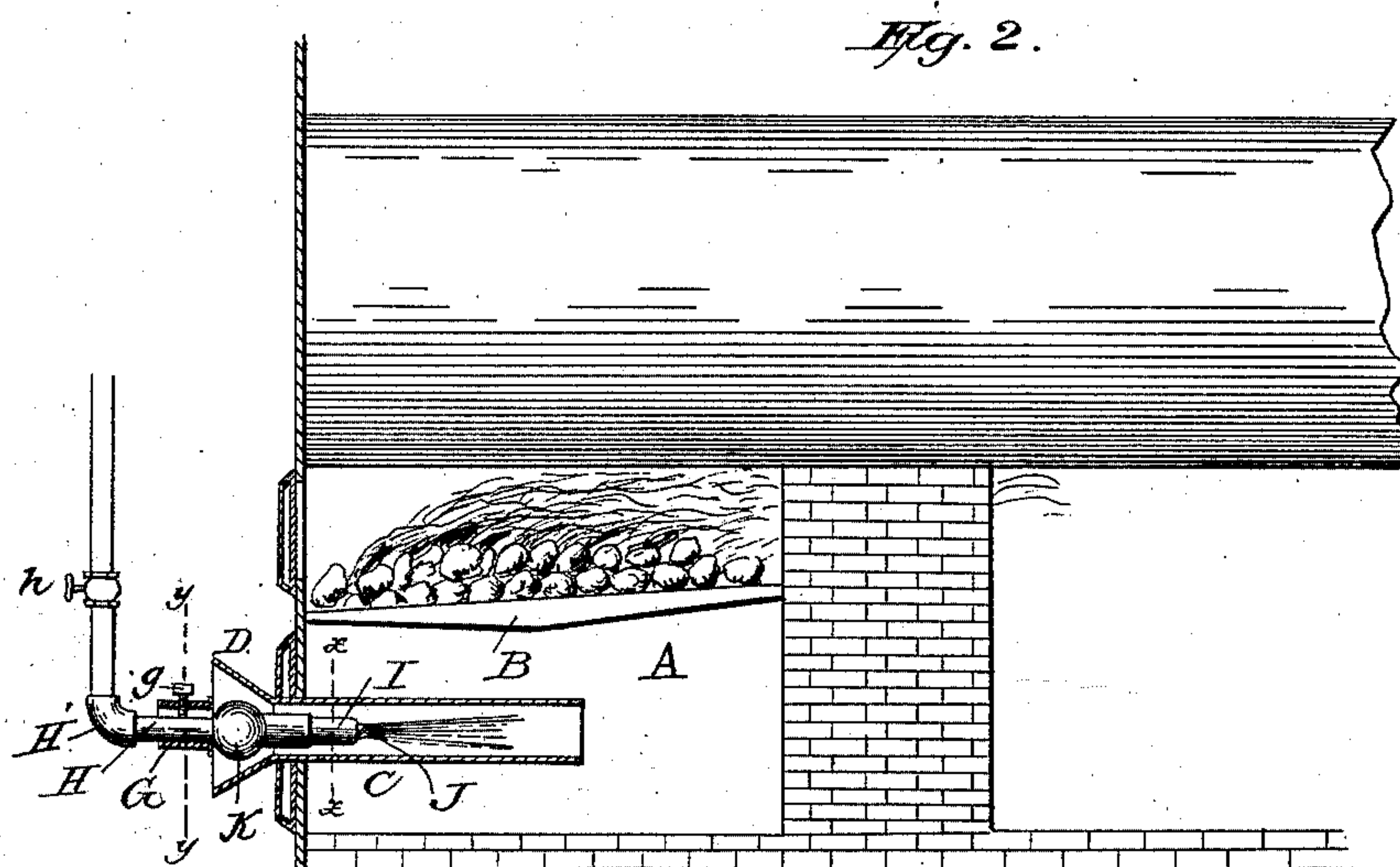
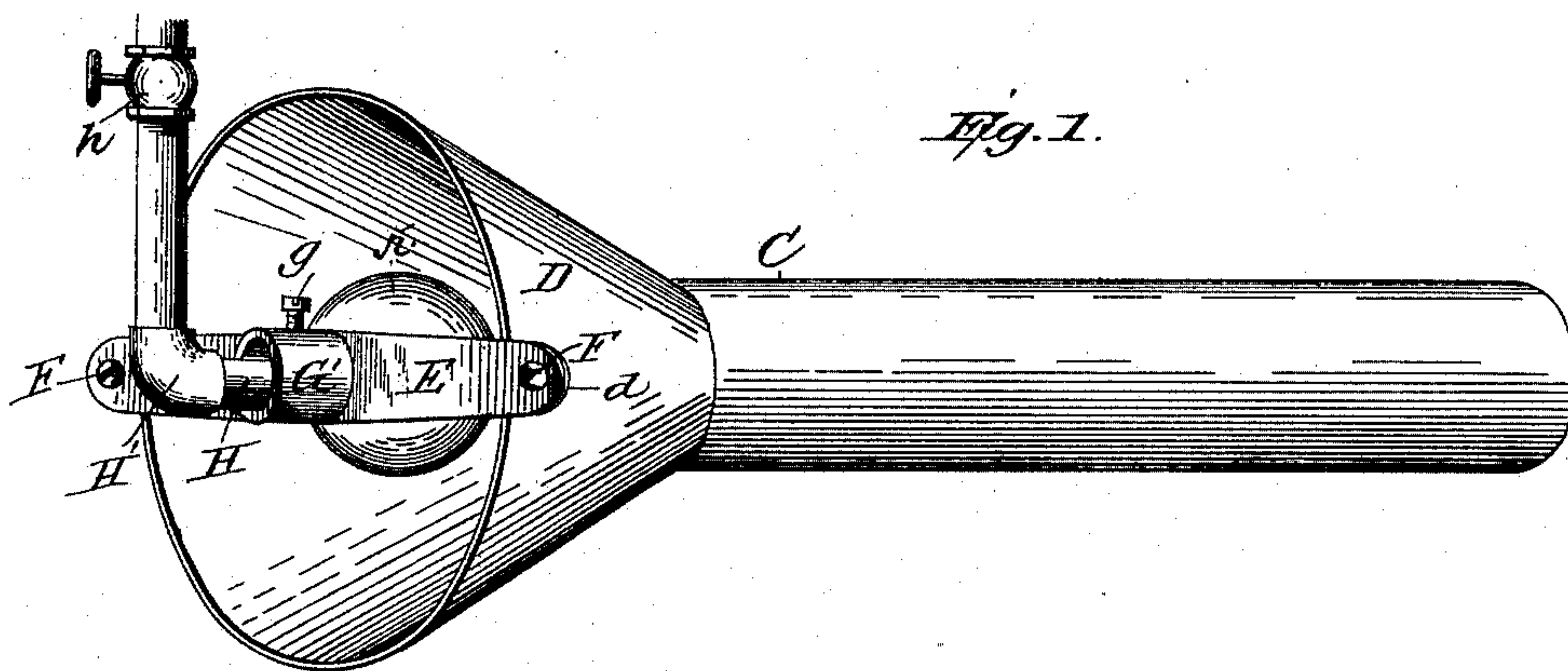


B. F. WHITE.  
FORCED DRAFT TUYERE.

Patented July 10, 1894.



WITNESSES:  
F. L. Durand,  
Anne L. Jones.

INVENTOR:  
Benjamin F. White,  
By James Cagney & Co  
Attorneys



# UNITED STATES PATENT OFFICE.

BENJAMIN F. WHITE, OF MANHEIM, PENNSYLVANIA, ASSIGNOR TO BENJAMIN H. HERSHEY AND MOSES HAGEY, OF SAME PLACE.

## FORCED-DRAFT TUYERE.

SPECIFICATION forming part of Letters Patent No. 522,815, dated July 10, 1894.

Application filed November 4, 1893. Serial No. 490,060. (No model.)

*To all whom it may concern.*

Be it known that I, BENJAMIN F. WHITE, a citizen of the United States, and a resident of Manheim, in the county of Lancaster and State of Pennsylvania, have invented certain new and useful Improvements in Forced-Draft Tuyeres; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a perspective view of my improved blower or tuyere, looking at it from the rear end. Fig. 2 is a longitudinal sectional view of the same. Fig. 3 is a detail view of the steam nozzle; part of the exterior tubing having been broken away to show the interior spiral steam-ducts. Fig. 4 is a vertical cross-section through the steam-nozzle on line  $x-x$  in Fig. 2; and Fig. 5 is a cross section through the steam-tube and its sleeve or holder, on the parallel plane denoted by the broken line marked  $y-y$  in the same figure.

Like letters of reference designate corresponding parts in all the figures.

This invention relates to devices for supplying a "forced draft" to the boilers of marine and other steam engines; *i. e.*, producing and supplying a strong draft of mixed atmospheric air and steam to the fire-box below the grate of the same for the purpose of accelerating combustion and rendering it more complete and perfect; and my improvement consists in the novel construction and combination of parts of a device—*or so-called tuyere*—of that class as will be hereinafter more fully described and claimed.

On the accompanying drawings, the letter A denotes the furnace or fire-box appertaining to a steam-generator (not shown) of any desired construction, and B the grate of the same.

The blower pipe, or tuyere pipe, is shown at C, and consists simply of a cylindrical tube of proper dimensions, open at both ends and provided at its rear end with a funnel-shaped enlargement D. The latter is spanned diagonally at its open end, by a bridge or cross-piece E, fastened removably upon the funnel,

at its large or outer end, by means of short nutted bolts F F, inserted through ears  $d d$  upon the funnel, diametrically opposite to each other.

The bridge E is provided at its middle, *i. e.* in alignment with the axis of the tube or cylinder C, with an outwardly projecting sleeve G', encircling a concentric circular aperture G in the bridge, and provided on one side with a binding screw or set-screw  $g$ . Through this central aperture G and its sleeve or collar G' is inserted the steam-tube H, the outer end of which has an elbow H', connecting it with the steam dome of the boiler or steam generator (not shown).

The inner end of tube H is screw-threaded interiorly to receive the contracted steam nozzle I, into which is inserted, longitudinally, the spirally twisted square plug J, the four sides of which are made concave, as illustrated more clearly at  $j j$  in Fig. 4; the twisted corners or edges of the plug impinging upon the inside of the nozzle-tube I. The outer end of this tube is beveled, as shown at  $i$ ; and the reduced and pointed end of the spirally twisted plug J projects through the beveled end of tube I, as shown at J'.

Upon the cylindrical steam tube H is fastened a sphere, K, of metal or other suitable material, either solid or hollow, so as to move with the tube, which may be adjusted forward or back by loosening the binding-screw  $g$ , thereby also adjusting the position of the ball or sphere K within the funnel D; *i. e.* moving it closer to, or farther from, the inlet to said tube from the funnel, for the purpose of regulating the flow of atmospheric air through the tube and distributing the same, as will be hereinafter explained.

From the foregoing description taken in connection with the drawings, the manner of operating this device will readily be understood.

Steam being turned on, so as to flow through tube H, the steam jet, in passing through the nozzle I, becomes divided up or segregated into four separate jets by means of the interior plug J, each one of which receives a spiral twist or deflection due to the spiral of the narrow chamber or passage formed between each of the concave sides  $i$  of the plug and the



contiguous side of the encircling tube. These jets of steam converge at the outlet *i* of the nozzle, but still maintain a spiral flow as they pass through the cylindrical jacket or conduit C into the fire-box below the grate. In passing through conduit C, a partial vacuum is established, which creates a draft therein in the direction of the arrows, the result of which is to suck or draw atmospheric air through the funnel D and into the tubular conduit C, where in a finely comminuted form, it mixes with the jet of steam and is injected, in the form of a fine spray of mixed steam and air, into the burning coal or other fuel, thus supplying the same with a large amount of oxygen and thereby greatly accelerating combustion.

The amount of steam fed into the injector I may be regulated by means of a valve or cock, *h*, placed in the elbow H', or at some other easily accessible point on the steam pipe, and the flow of air may be similarly and correspondingly regulated by adjusting the ball K, as indicated in dotted lines in Fig. 2, which is done simply by loosening the binding-screw *g* and moving pipe H a little forward or back in the sleeve or support G'. To permit of this adjustment of the pipe and ball (which is, however, within very narrow limits), pipe H may either be made with a telescopic or flexible joint, or its elbow H' may be made sufficiently long to give it the requisite amount of yield or flexibility.

The closer the ball is moved toward the inlet to cylinder C, the narrower will be, of course, the annular space or inlet between the ball and the mouth of the cylinder; and reversely, the farther it is moved back therefrom, the larger will be the annular inlet through which air is fed into the conduit. Besides this function of acting as a regulator, the ball K will divide the flow or stream of atmospheric air entering the conduit C through the funnel so as to form a hollow or annular jet, with a partial vacuum in the center, or in alignment with the axis of ball K and pipes H and I in which form it will readily commingle and become incorporated with the central spirally flowing jets of steam.

It will be observed that this device is exceedingly simple in its construction, and can be attached with very little trouble to any ordinary form of fire-box, requiring no alteration in the same beyond providing an aperture for the insertion of pipe C. It will be obvious that the regulator K need not be a sphere or ball, but that it may be oblong, oval, or of an egg-shape, and will still answer the same purpose; *i. e.*, regulate the amount of atmospheric air fed into the tube C, and break the same up so as to form a hollow stream.

Having thus described my invention, I claim and desire to secure by Letters Patent of the United States—

1. The combination of the cylindrical conduit C provided with the funnel D having centrally apertured bridge or cross-piece E provided with the sleeve G and binding-screw *g*; adjustable steam-pipe H; and nozzle-pipe I provided with the interior spiral plug J; substantially as and for the purpose shown and set forth.

2. The combination with the cylindrical conduit C having funnel D provided with the centrally apertured bridge or cross-piece E; adjustable steam pipe H provided with the spherical regulator K; and injector-nozzle I provided with the interior spiral plug J; substantially as and for the purpose shown and set forth.

3. The combination with the fire box A and grate B, of the cylindrical conduit C, provided with the funnel D having centrally apertured bridge or cross piece E, provided with the sleeve G and binding screw *g*; the adjustable steam pipe H, provided with spherical air regulator K; and the injector-nozzle I, provided with interior spiral plug J, substantially as and for the purpose shown and set forth.

In testimony that I claim the foregoing as my own I have hereunto affixed my signature in presence of two witnesses.

BENJAMIN F. WHITE.

Witnesses:

AMOS G. HAMAKER,  
H. F. MCCLOUD.