No. 674,184. Patented May 14, 1901.

F. STICKER.

STEAM INJECTOR.

(Application filed May 4, 1900.)

(Model.) 5 Sheets—Sheet 1.

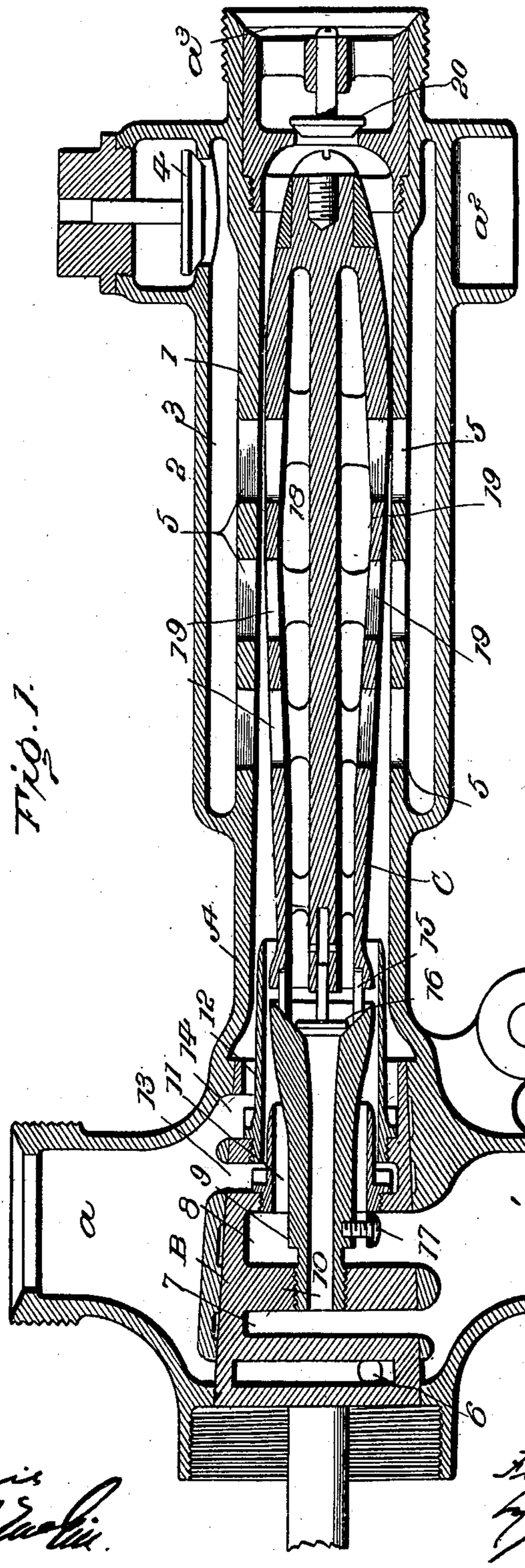

Fig. 1.

Witnesses

Inventor

Attorney

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(Model.) 5 Sheets—Sheet 2.

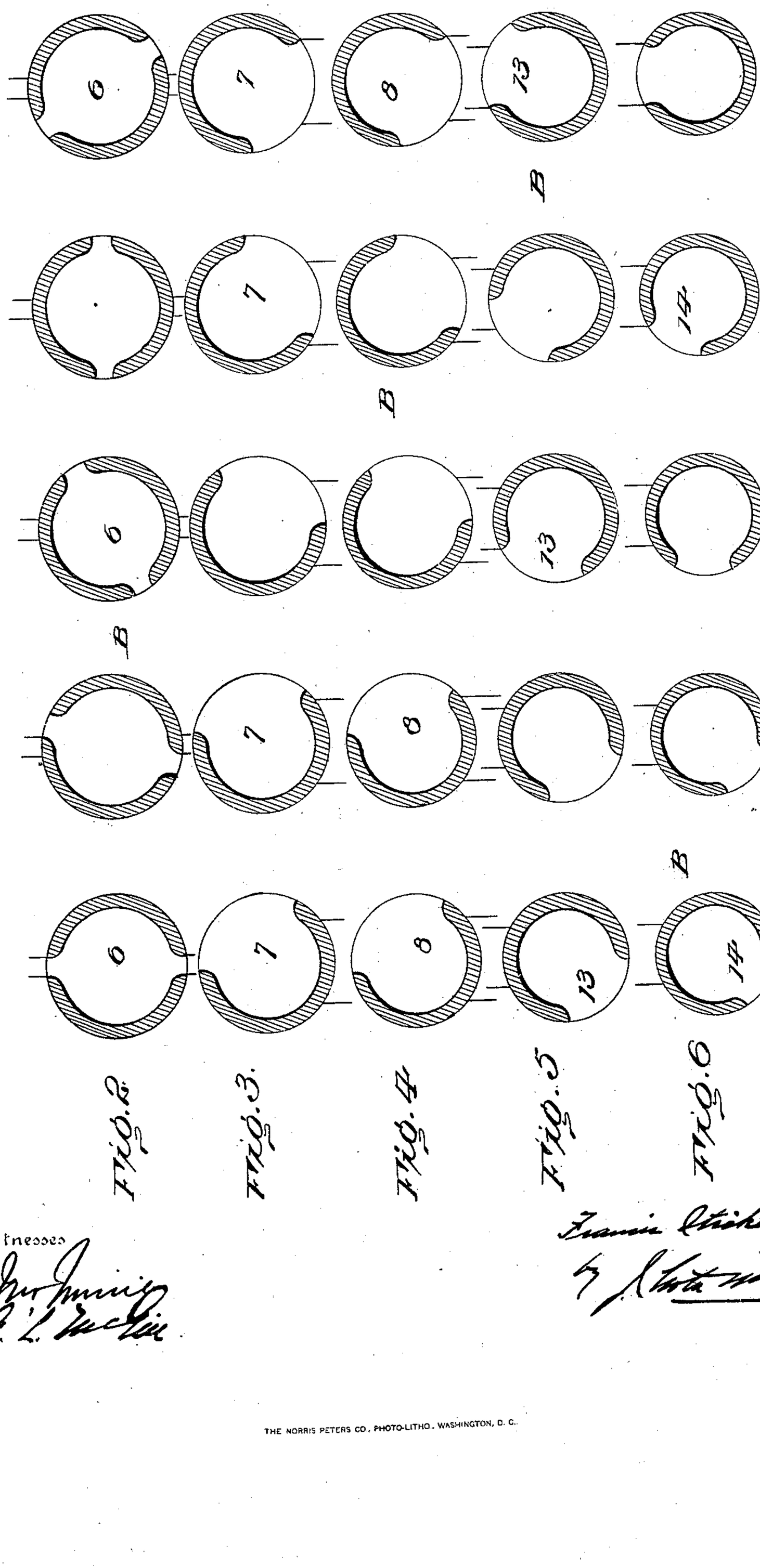

Fig. 2. Fig. 3. Fig. 4 Fig. 5 Fig. 6

Witnesses

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(Model.) 5 Sheets—Sheet 3.

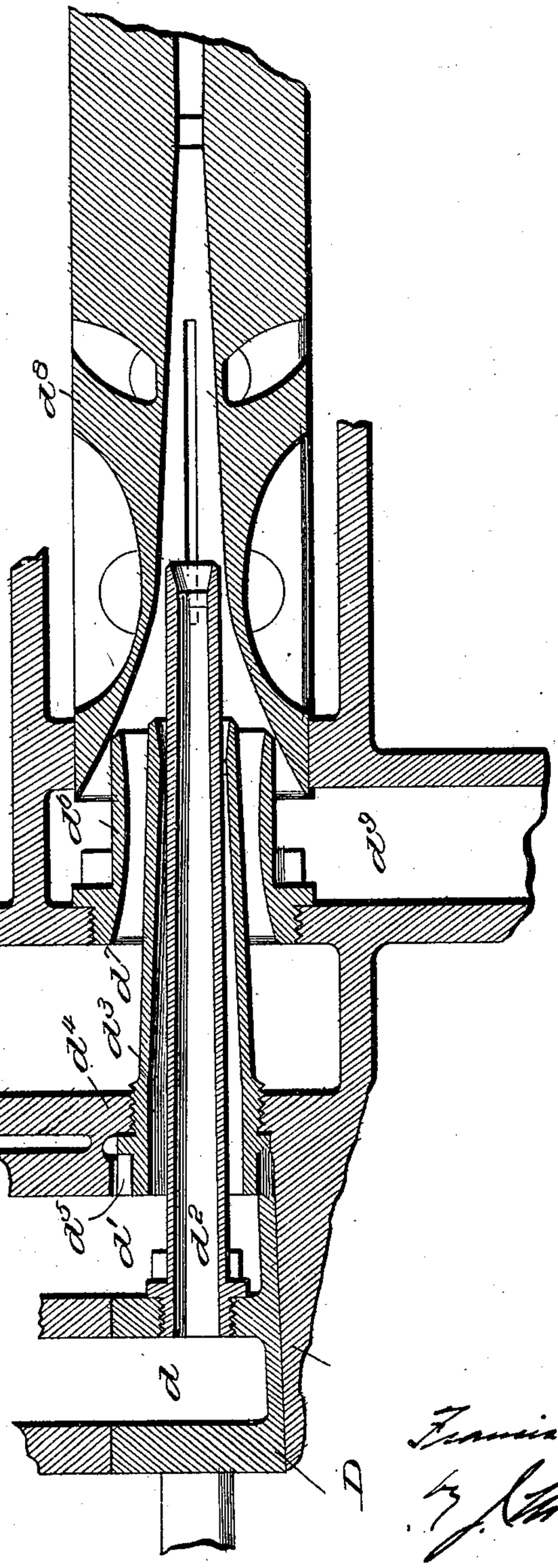

Fig. 7.

Witnesses

Inventor

Attorney

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(Model.) 5 Sheets—Sheet 4.

Fig. 8.

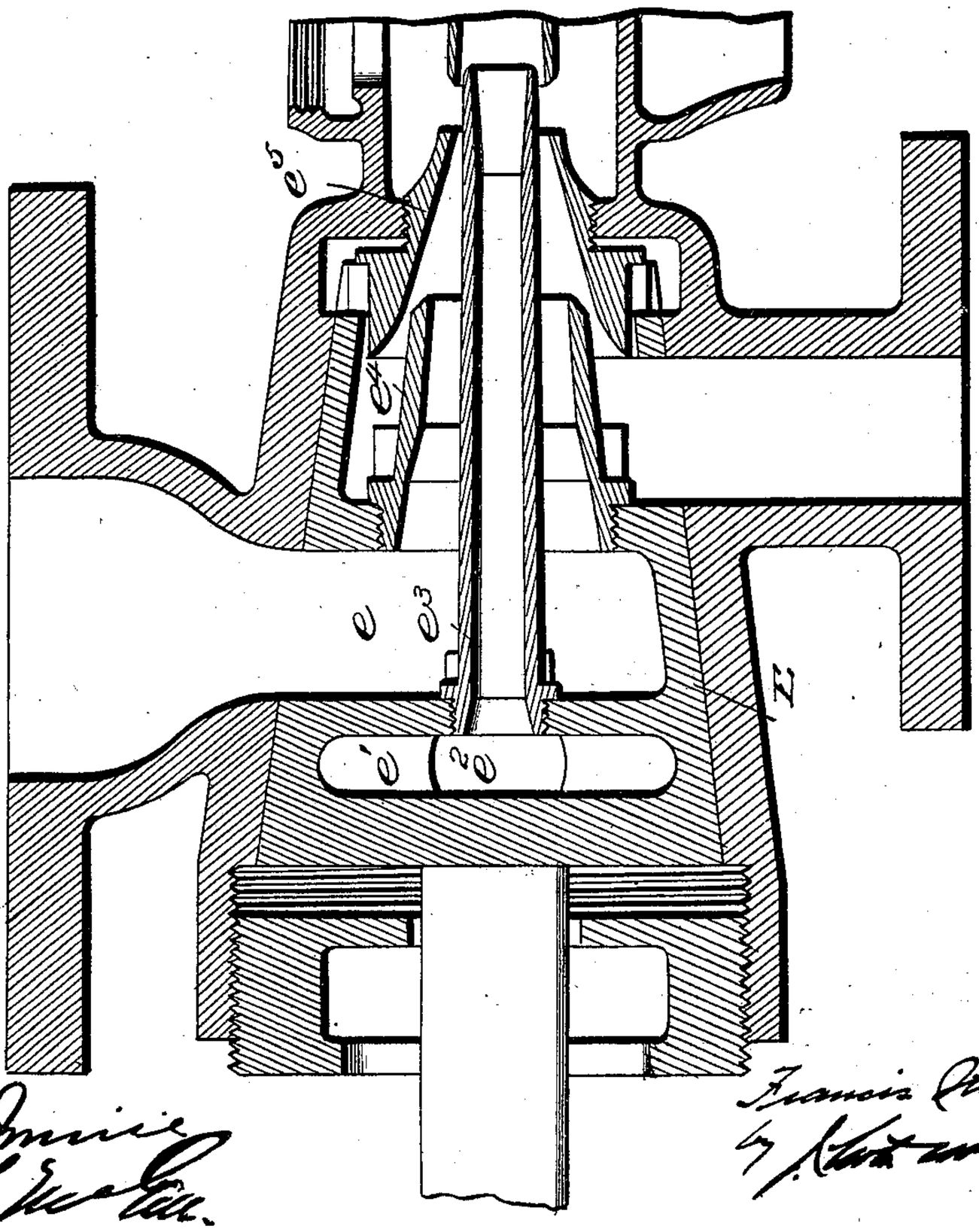
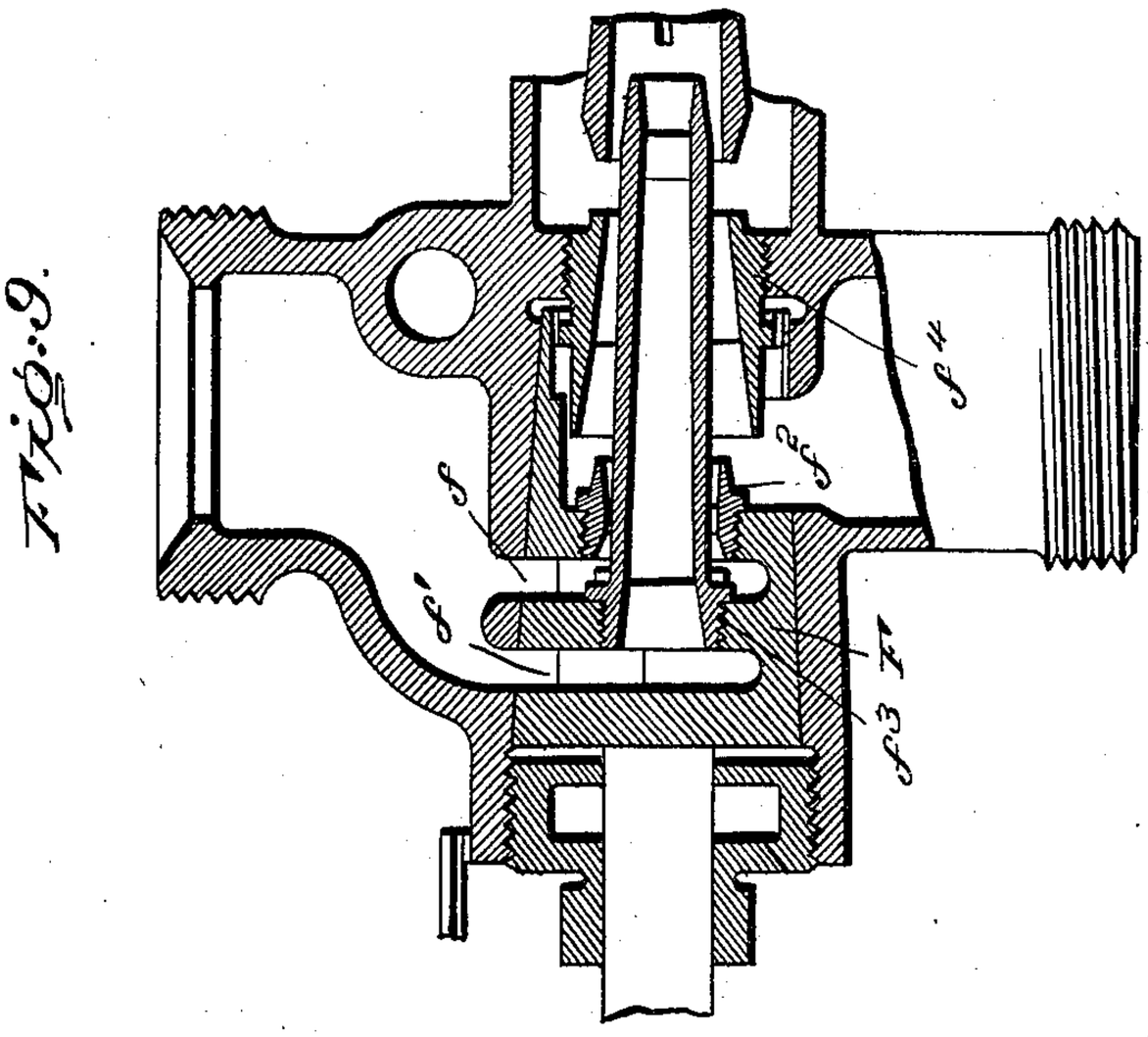


Fig. 9.



Witnesses

Inventor

Francis Sticker,
by Church & Church.
Attorney

No. 674,184. Patented May 14, 1901.

F. STICKER.

STEAM INJECTOR.

(Application filed May 4, 1900.)

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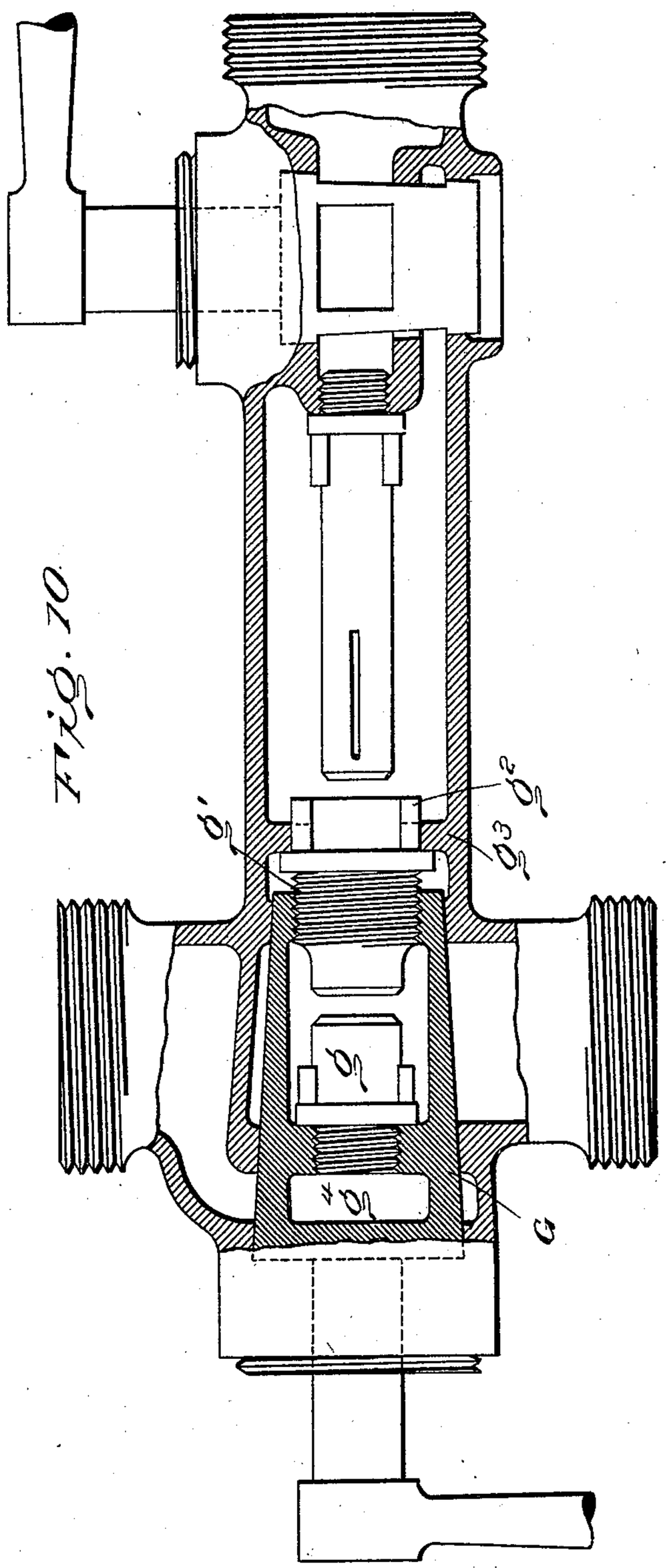

Fig. 10.

Witnesses

Inventor

Francis Sticker,

by Chas. L. Burdett

Attorney

UNITED STATES PATENT OFFICE.

FRANCIS STICKER, OF NEW YORK, N. Y., ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO CHARLES A. DRUCKLIEB, OF SAME PLACE.

STEAM-INJECTOR.

SPECIFICATION forming part of Letters Patent No. 674,184, dated May 14, 1901.

Application filed May 4, 1900. Serial No. 15,520. (Model.)

To all whom it may concern:

Be it known that I, FRANCIS STICKER, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Steam-Injectors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steam-injectors; and the contemplated improvements are applicable in the main to injectors operated by live steam alone or exhaust-steam with or without the addition of live steam.

One object of the invention is, primarily, to provide means which will enable a machine to perform a large variety of work under different conditions. It is well known that steam under different conditions shows different reactions upon coming in contact with water of different conditions as to quality and quantity, and hence the condition of one element must regulate that of the other in order to obtain satisfactory results. In other words, quantity as well as quality of steam must harmonize with quantity as well as quality of water. Steam of low pressure requires a different quantity as well as quality of water than steam of high pressure in order to perform a special work. The more perfect the contact of steam and water in right proportions to each other the more perfect will be the work performed. By my present improvements I am enabled to so equip various styles or types of injectors that good results may be obtained under every different state or condition of steam and different quantity and quality of water, or vice versa, means being provided for regulating the steam as well as the water to suit existing conditions. To these ends I employ a cock formed with a series of separate chambers, and into the partitions are screwed jets or tubes, one or more of which are stationary and one or more movable or adjustable longitudinally, whereby the capacity of the machine may be regulated by directly or indirectly controlling the water.

A further object of the present invention is to provide an improved combining or delivery tube or nozzle. It is well known that in the manufacture of steam-injectors great difficulties arise in making the tubes or nozzles, it being almost impossible to work out the interior curves necessary to the attainment of proper results. In fact, straight lines have heretofore taken the place of curved lines, and to imitate the curves a number of short straight lines is generally employed. This necessarily prevents the perfect smooth lines which are so essential for absolute correct working, and a number of sharp edges and interruptions is the result. The proper curves which should be observed in the bore of a tube or nozzle may be obtained by providing an injector-body with a cylindrical bore and placing therein a bulb or torpedo-like body, the outer contour of which represents the absolutely-proper shape required for the correct working of the machine. I have also found that by making this bulb-like body hollow additional water-supply may be had when the steam-conditions require, as when the established jet has not the proper density. When this occurs, a vacuum will be formed in this body and the necessary extra quantity of water will be supplied to the jet.

The invention will be hereinafter fully set forth, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical longitudinal sectional view of an injector equipped with my improvements. Figs. 2, 3, 4, 5, and 6 show in diagrammatical relation the several positions of the controlling cock or valve, which latter is indicated in section. The views of Fig. 2 show the different positions of the port controlling the steam-inlet for heating water in the tank, the views of Fig. 3 show the auxiliary water-inlet, those of Fig. 4 the main water-inlet, those of Fig. 5 the steam-inlet for the lifting device, and those of Fig. 6 the steam-inlet for the forcing device. Fig. 7 is a vertical sectional view, on an enlarged scale, showing some of the features of my present improvements as applied to an exhaust-injector. Fig. 8 is a similar view of a second modified form, showing a like application of the means for controlling the working capacity of the machine. Fig. 9 shows these improvements ap-

plied to still another form of injector. Fig. 10 shows some of the improvements applied to a single-tube machine.

Referring to the drawings, Fig. 1, A designates the casing; a, the steam-inlet; a', the water-inlet; a^2, overflow branch, and a^3 boiler-outlet. The casing A is shown in this figure as formed with a cylindrical portion 1 of approximately uniform diameter throughout its length and which is surrounded in part by an outer shell 2, forming an overflow-chamber 3, the discharge of which into branch a^2 effects the unseating of check-valve 4. Communication into chamber 3 is had through overflow-openings 5.

B is a tapered cock or valve fitted in a correspondingly-tapered seat in the receiving end of the casing. This cock is provided with a spindle which projects through an opening in the end of the casing, the cock being held firmly in its seat by suitable means. Within the cock is formed a steam port or chamber 6 for admitting steam to the water-tank for heating up the water when desired. Adjacent to this is a second chamber 7, which is termed an "auxiliary" water-chamber, and next to this is the main water-chamber 8. A tube 9 is screwed at one end into the partition 10, between chambers 7 and 8. This tube I denominate an "auxiliary water-inlet" tube. The main water-lifting tube 11 surrounds a portion of tube 9 and takes its water-supply from the main chamber 8. A third tube 12, which is denominated the "forcing-steam" tube, surrounds a portion of the water-lifting tube 11 and the auxiliary tube 9. The lifting-steam is admitted through port 13 to the space between tubes 11 and 12, while the forcing-steam enters through port 14 and passes on the outside of tube 12. In the turning of cock B the lifting-steam is first admitted and the further turning of the cock will admit the forcing-steam through port 14. The exterior of the auxiliary tube 9 is curved to give it the proper lines which should be observed in the bore of an injector-tube, and this outline being of bell-like formation the space between tube 9 and the exit end of water-lifting tube 11 may be increased or diminished by moving longitudinally the former. In this way the combining-space of the lifter, and hence the capacity of the machine, may be regulated.

C is a bulb-like body located within the cylindrical portion 1 of the casing and forming, in conjunction with the latter, the combining and delivery tube of the forcer. This body is curved on its exterior, so as to obtain between it and the surrounding portion of the casing the truly scientifically correct shape of a combining and delivery tube. At its forward end this body receives pins 15, projecting from tube 9, and it also has a central bore to receive the stem of a check-valve 16, which is normally seated over the end of the bore of tube 9. By thus connecting the tube 9 to body C, which latter remains stationary, the turning of cock B will effect the longitudinal movement of tube 9, which movement is limited by a stop 17. This movement of the tube increases or diminishes the space between itself and outlet end of tube 11. The body C is formed with a chamber 18 throughout its length, which chamber communicates through openings 19 with the space within the cylindrical portion 1 of the casing. In the boiler-outlet end of the casing is an ordinary check-valve 20, which is normally held to its seat by the boiler-pressure.

In practice the cock B is first turned to admit steam to port 13, which steam passing out to the overflow branch will create a vacuum within the casing and effect the lifting of the water into the main water-chamber 8, where it will be taken up by tube 11 under the action of the lifting-steam, and the steam and water are combined at the end of this tube and water appears at the overflow. The cock is further turned to admit steam through port 14, which steam will pass around the forcer-tube 12 and take up the steam and water of the lifter, and the steam being fully condensed within the combining space surrounding the body C the jet will be established and travel over said body and out through the boiler-outlet, unseating valve 20. The overflow finds its escape through openings 5. When the established jet has not the proper density, a vacuum will be formed in the chamber of the body C, the creation of which will effect the unseating of valve 16 and allow water to enter said chamber through the tube 9. This water being taken up by the column of steam and water within the combining space, the proper conditions are given or restored in the established jet of steam and water, whereupon the valve 16 may be reseated. When the machine is in active operation, the chamber of the body C forms a special water-reservoir.

From what has been said it will be observed that in the turning of the controlling-cock B the capacity of the machine is regulated. When this cock is so turned as to cause tube 9 to move away from body C, the outlet from lifting-tube 11 is decreased, and hence there is a less supply of water to the steam, while when the cock is turned in a reversed direction the supply of lifted water is increased. The cock also controls the steam-passages and through its different positions any desired regulation may be effected—that is, the injector may work under one-half steam and full water or one-half water and full steam or full steam and full water or any desired range of supply. Also it will be noted that where the established jet is not fully charged—that is, has not the proper density—a vacuum will be created within the body C and an additional supply of water will be drawn into such body, and thus increase the percentage of delivered water to the admitted steam. This will occur when-

ever a higher vacuum exists in the chamber of the body C than is in the main water-chamber. It will also be noted that the truly proper contour of a combining-tube is obtained by the curvature of the exterior of the auxiliary tube 9 and body C. In this way the true and proper mixing of the steam and water is obtained.

In Fig. 7 I have indicated the application of a single cock and a plurality of tubes or nozzles, some of which are stationary, to what is commonly called an "exhaust-injector"—that is, one working by exhaust-steam. In this figure the cock D is formed with two chambers d and d', the former for forcing live steam and the latter for lifting live steam. A tapered tube or nozzle d^2 is screwed in the partition between these two chambers. This is surrounded by a second tube or nozzle d^3, exteriorly threaded to work in a threaded opening in a partition d^4 and having lugs d^5, which are engaged by the end of cock D. Hence the turning of the cock will effect the longitudinal adjustment of tube or nozzle d^3 and in consequence the increase or decrease of the outlet-space of said latter tube, according as it is moved forward or backward in relation to the tube or nozzle d^2. The tube d^3 extends through a tube d^6, which receives the exhaust-steam from chamber d^7. All of the tubes extend into the combining-tube d^8, the forcer-steam tube d^2 being extended beyond the others. The water is admitted through chamber d^9.

In practice the exhaust-steam may be sufficient up to a certain pressure, but beyond this live steam is necessary. The supply of the lifting live steam is regulated, as before stated, by the longitudinal adjustment of tube d^3. The admission of forcing-steam to tube d^2 may be had by the turning of cock D. This is only necessary when the injector is working against a pressure in excess of that against which the exhaust-steam is sufficient.

In Fig. 8 I have indicated another form of exhaust-injector to be worked with or without an auxiliary live-steam jet for forcing purposes only. In this form the cock E is formed with two chambers e e', the former for exhaust-steam and the latter for live steam, which enters through a port e^2. The forcing-steam tube or nozzle e^3 leads from chamber e' and through the exhaust-steam tube e^4 and the lifting-tube e^5. Tubes e^3 and e^4 are stationary in cock E; but the water-tube e^5 is capable of longitudinal adjustment by the turning of said cock after the manner and by the means hereinbefore described.

In Fig. 9 I have shown the application of the tapered cock and series of tubes or nozzles to a different form of double-tube injector. In this arrangement the lifting-steam is admitted to cock F through chamber f and the forcing-steam through chamber f'. The two jets or nozzles f^2 and f^3, leading, respectively, from such chambers, are stationary within the cock, while the water tube or nozzle f^4 is adjustable longitudinally in the manner and by the means before mentioned.

In Fig. 10 I have indicated a single-tube injector of the type shown and described in Letters Patent No. 600,453, issued to me March 8, 1898, equipped with a tapered cock G, the rotation of which will regulate the capacity of the machine. The steam-inlet tube g is stationary within the cock, while the water-lifting tube g' is adjustable longitudinally, being formed with an exterior thread engaging a threaded opening in the cock and lateral lugs g^2, which fit in openings in a partition g^3 within the casing. In this as in the other forms the turning of cock G will increase or diminish the space between tubes g and g', and in this way the capacity of the machine will be regulated, the cock G also controlling the admission of steam which enters through chamber g^4.

I claim as my invention—

1. In a steam-injector a cock controlling the steam and water, a plurality of tubes mounted in said cock, and means for adjusting one of said tubes longitudinally, as set forth.

2. In a steam-injector, a cock controlling the steam and water, a plurality of tubes mounted in said cock, one tube being adapted to move longitudinally, and means for effecting such movement by the turning of said cock, substantially as set forth.

3. In a steam-injector, a cock for controlling the steam and water, a tube curved or tapered on its exterior, and a second tube encircling the former, and means for adjusting one tube longitudinally by the turning of said cock, substantially as set forth.

4. In a steam-injector, a cock having separate chambers, tubes mounted in said cock leading each from one of said chambers, and means for adjusting one of said tubes longitudinally, substantially as set forth.

5. In a steam-injector, a cock having separate chambers, tubes mounted in said cock leading each from one of said chambers, one tube being externally threaded and having lateral flanges, whereby it will be adjusted longitudinally by the turning of said cock, substantially as set forth.

6. In a steam-injector, a cock having separate ports for admitting successively lifting and forcing steam, tubes for such lifting and forcing steam mounted in said cock, and a water-tube, one of said tubes being adjustable longitudinally, the contour of one or more tubes being such that the capacity of the machine may be controlled by the adjustment of the longitudinally-adjustable tube, substantially as set forth.

7. A steam-injector having a body curved on its exterior, and a cylindrical portion surrounding said body, the space between the latter and said surrounding portion forming a steam and water mixing chamber, substantially as set forth.

8. A steam-injector having a cock formed

with a water-chamber and a lifting-steam port, a lifting-water tube leading from said water-chamber and around which the steam is designed to travel, a body within said tube having a curved portion, and means for adjusting said body longitudinally for increasing or decreasing the space between it and the outlet end of said water-lifting tube, substantially as set forth.

9. A steam-injector having a chamber communicating with the space for the passage of the established jet, and means for admitting water to said chamber and from it to the jet when the latter is not of proper density.

10. A steam-injector having its casing provided with a cylindrical portion, a body within said casing curved on its exterior throughout its length, forming, between itself and said cylindrical portion, a steam and water combining space, substantially as set forth.

11. A steam-injector having its casing provided with a cylindrical portion, a bulb-like body located in said casing curved throughout its length on its exterior, forming, between itself and said cylindrical portion, steam and water combining and delivery spaces, substantially as set forth.

12. A steam-injector having an auxiliary water-inlet, a chamber in communication with said inlet, and means for admitting water thereto when the established jet is not of proper density, as set forth.

13. A steam-injector having an auxiliary water-inlet, a chamber in communication with said inlet, said chamber being in communication with the space for the passage of the established jet, and a valve normally closing said auxiliary water-inlet, said valve being automatically unseated when the established jet is not of the proper density.

14. A steam-injector having its casing provided with a cylindrical portion, a body in said casing curved on its exterior to form, between itself and said cylindrical portion, a space for the passage of the established jet, said body having an interior chamber communicating with said passage, an auxiliary water-inlet opening into said chamber, and means for allowing water to pass from said auxiliary water-inlet into said chamber when the established jet is not of the proper density, substantially as set forth.

15. The combination with the casing having a cylindrical portion, of a body curved on its exterior and forming, between itself and said cylindrical portion, the space for the passage of the established jet, a chamber in said body communicating with said space, a cock having an auxiliary water-inlet, a tube in said cock leading from said auxiliary water-inlet to said chamber, and a valve normally seated over one end of said tube, substantially as set forth.

16. The combination with the casing having a cylindrical portion, of the body located within the latter curved on its exterior, forming, between itself and said cylindrical portion, a space for the passage of the established jet, said body having an inner chamber communicating with said space, the cock having lifting and forcing steam inlets, and main and auxiliary water-inlets, lifting and forcing tubes also mounted in said cock, an auxiliary tube surrounded by said former tubes and communicating with said auxiliary water-inlet, and a check-valve over the inner end of said latter tube, substantially as set forth.

17. The combination with the casing having a cylindrical portion, of the body located in the latter curved on its exterior, forming, between itself and said cylindrical portion, the space for the passage of the established jet, a chamber being formed in said body communicating with said space, a cock having lifting and forcing steam inlets and main and auxiliary water-inlets, lifting and forcing steam tubes also mounted in said cock, an auxiliary water-inlet tube curved on its exterior and surrounded by said lifting and forcing steam tubes, said auxiliary water-inlet tube engaging said cock at one end and said body at its other end, means for effecting the longitudinal adjustment of said auxiliary water-inlet tube by the turning of said cock, and a valve normally seated over one end of said auxiliary water-inlet tube, substantially as set forth.

18. A steam-injector having a cock extending through a steam-chamber, said cock having a port therein designed to admit steam to the water-inlet branch, substantially as set forth.

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

FRANCIS STICKER.

Witnesses:
ANNA T. MALLON,
L. HERZIG.