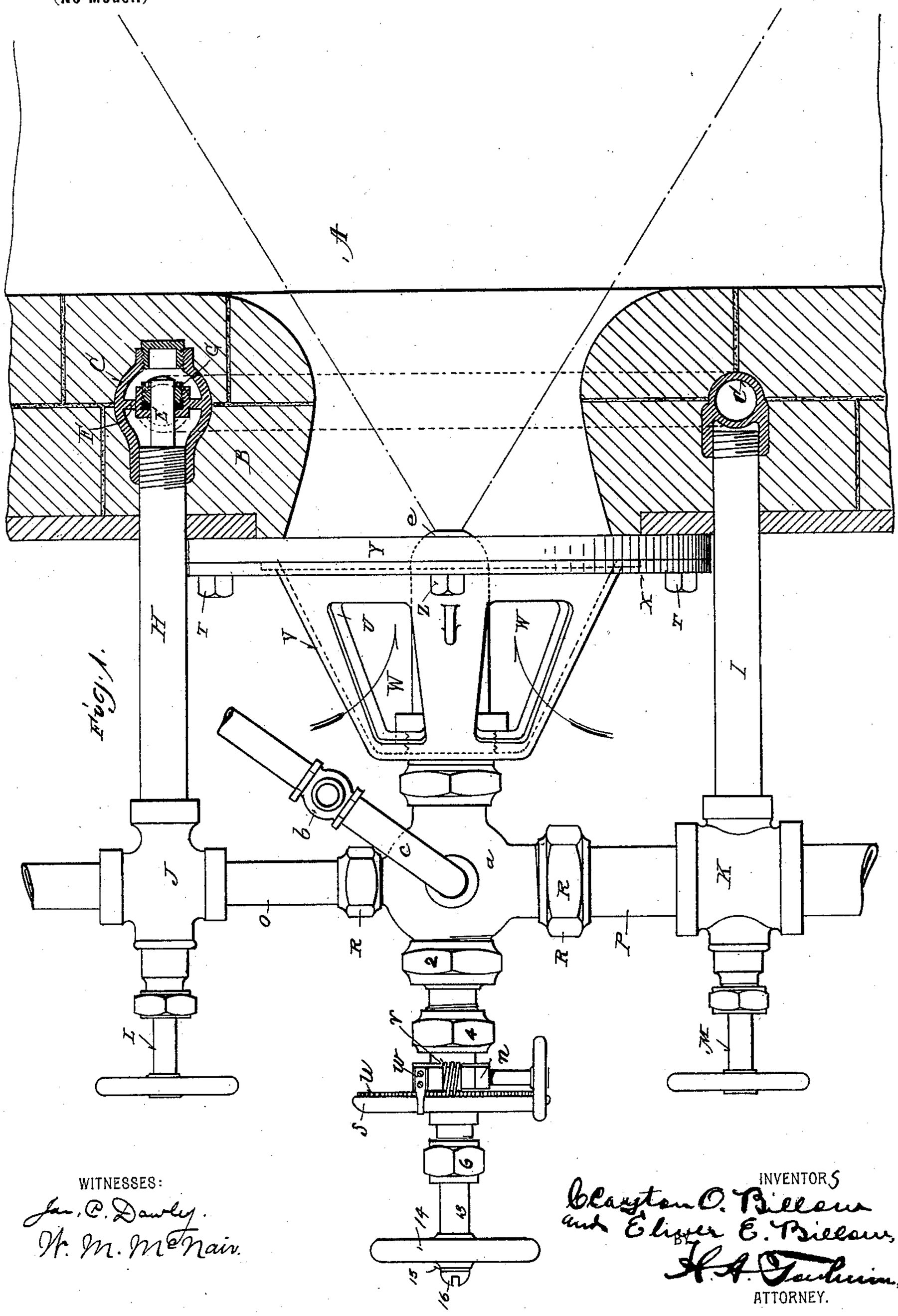
No. 630,320. Patented Aug. 8, 1899.

C. O. & E. E. BILLOW.

ATOMIZER.

(Application filed June 28, 1898.)

(No Model.) 4 Sheets—Sheet 1.



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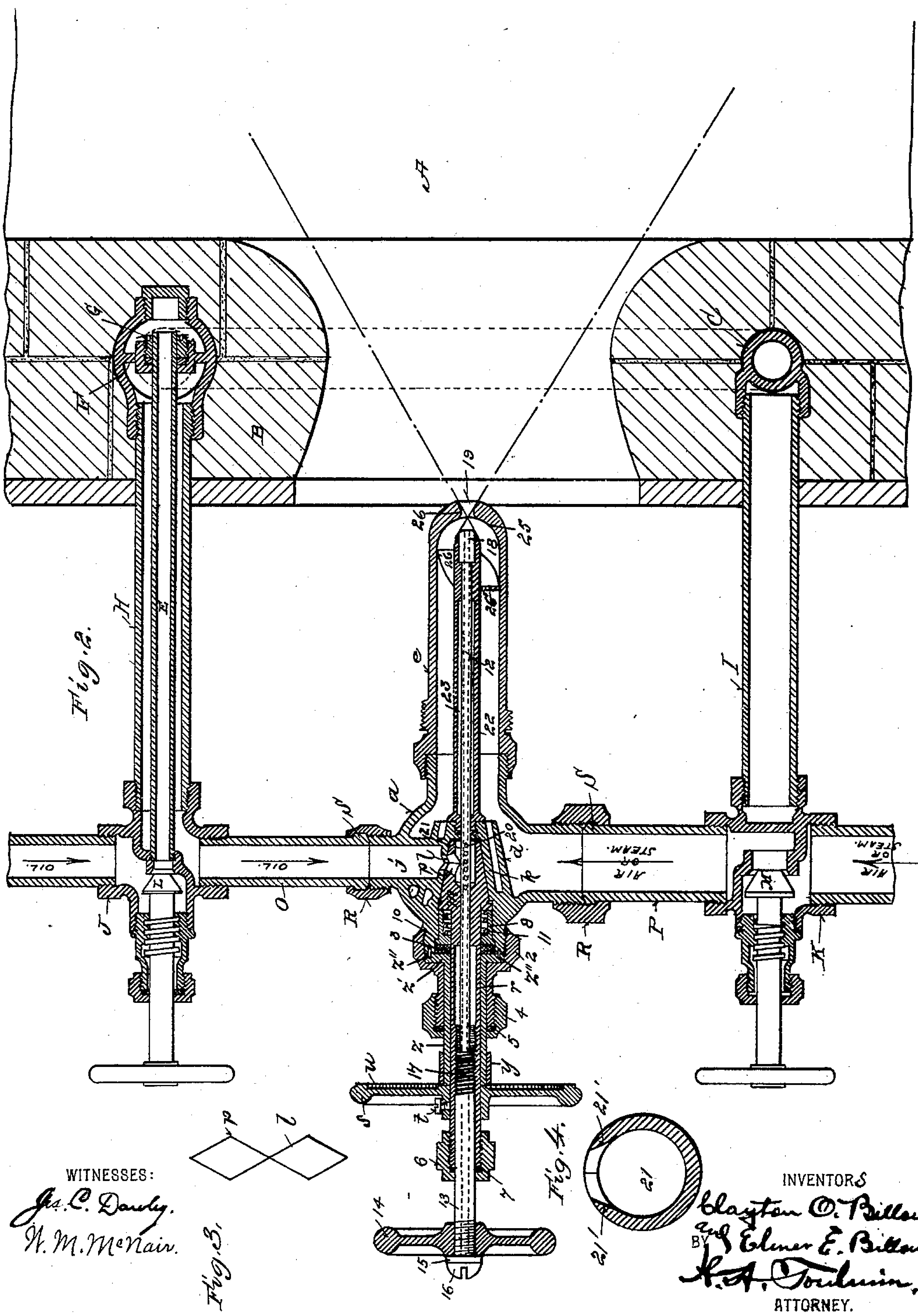

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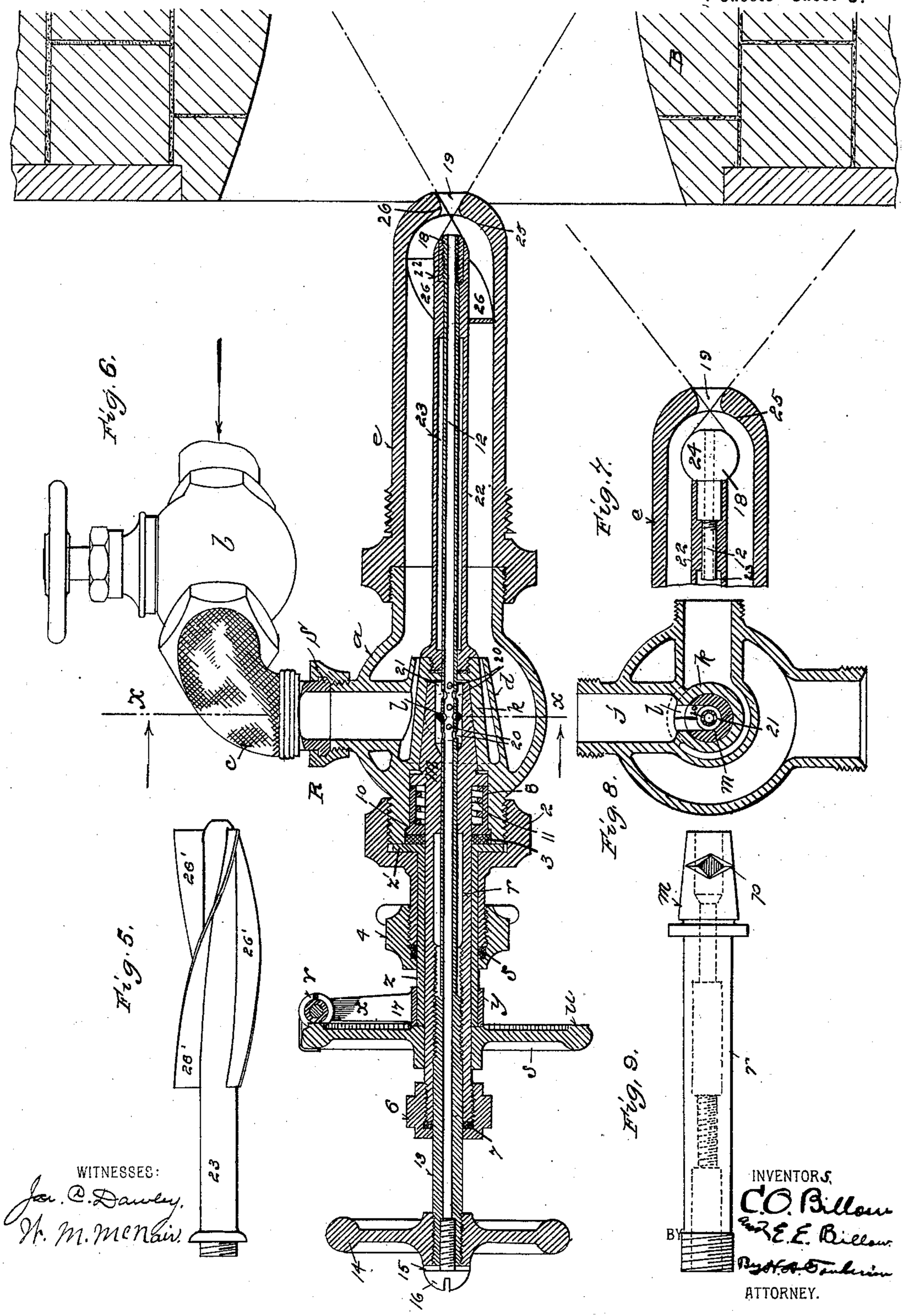

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(No Model.) 4 Sheets—Sheet 4.

Fig. 10.

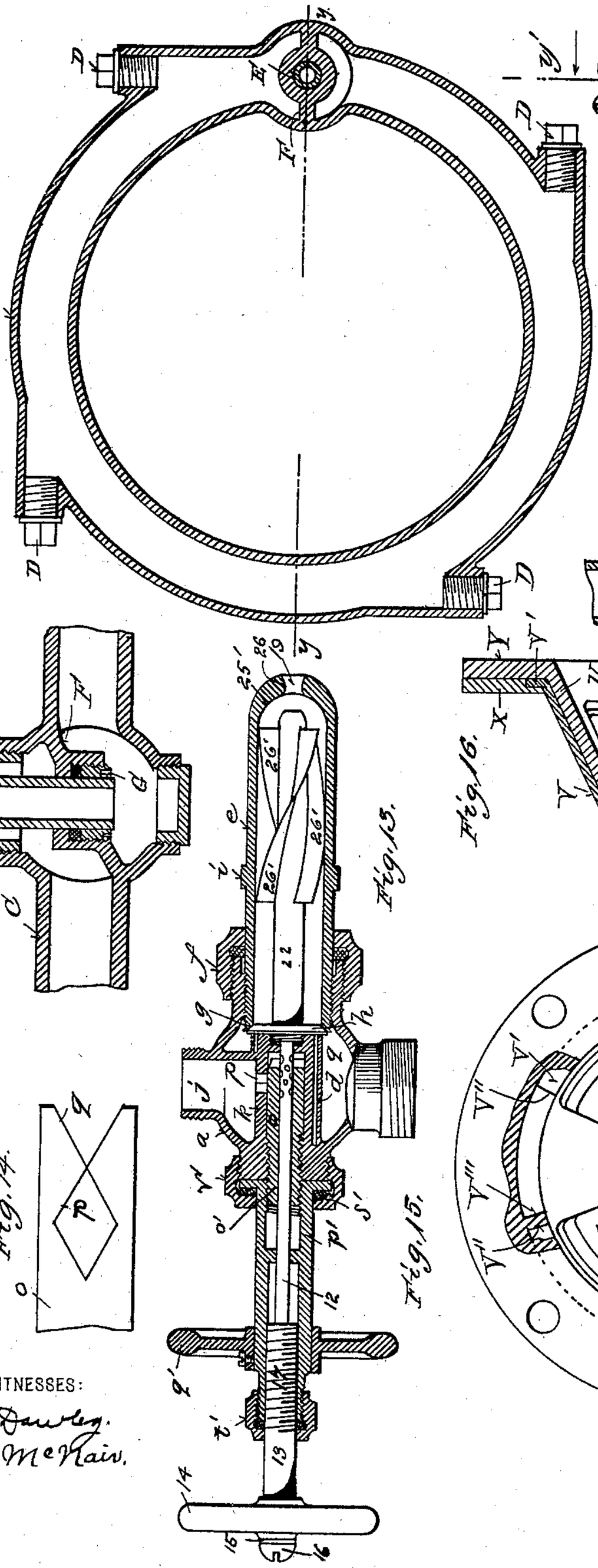

Fig. 11.

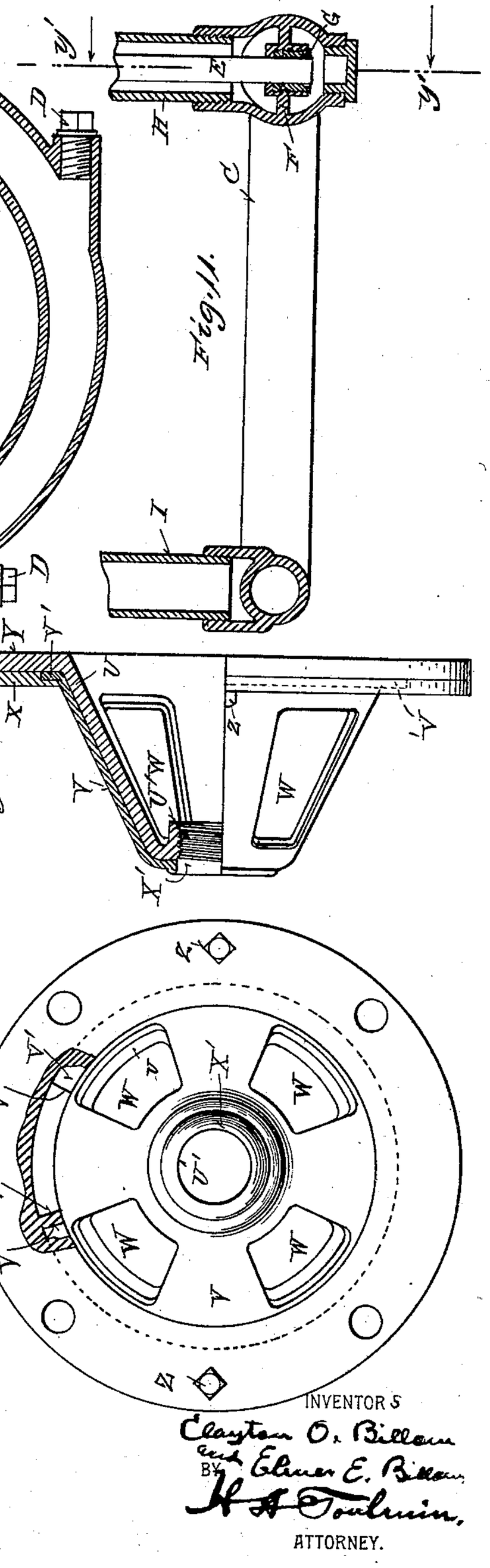

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

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ATOMIZER.

SPECIFICATION forming part of Letters Patent No. 630,320, dated August 8, 1899.

Application filed June 28, 1898. Serial No. 684,653. (No model.)

To all whom it may concern:

Be it known that we, CLAYTON O. BILLOW and ELMER E. BILLOW, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Atomizers, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements in atomizers for liquid fuel, such as a combination of hydrocarbon oil and steam or such oil and air.

We have several distinct objects in view, which are accomplished by this invention. Among these objects are, first, the uniform supply of air or steam through the atomizer and the variable yet regulated quantity of air to support combustion supplied through a suitable air-admitter; second, the provision of means, located in a hollow heated part of the furnace or fire-box where the fuel is being burned, for heating the oil preparatory to its introduction into the atomizer proper, and, third, the inclusion or union of all these objects and the means to carry them into effect in one complete apparatus.

Besides the above objects, separately and collectively considered in one apparatus, we have other and further objects in view and the means for carrying them into effect, as will be hereinafter fully pointed out, and particularly stated in the claims.

In the accompanying drawings, forming a part of this specification, and on which like reference letters and numerals indicate corresponding parts, Figure 1 is a plan view of our atomizer entire and a horizontal sectional view of a front wall of a boiler or other furnace, showing the apparatus applied and ready for use. Fig. 2 is a horizontal sectional view in plan, showing the same features save and excepting the air-admitter; Fig. 3, a detail diagram of the opening through which the oil is admitted to the atomizer proper; Fig. 4, a detail cross-sectional view of the oil cut-off, showing the form of the oil-opening in cross-section; Fig. 5, a detail elevation of the form of helical steam or air director selected for illustration; Fig. 6, a vertical sectional view of the atomizer proper along the central or axial line, with the steam valve and pipe in side elevation and the front furnace-wall in vertical section; Fig. 7, a detail sectional view of a part of the atomizer-nozzle, the oil-tube, its deflecting cut-off tip, and the casing for such tube, being a modification of what is shown in the other figures; Fig. 8, a transverse sectional view, on the line $x\,x$ of Fig. 6, of the atomizer-globe; Fig. 9, a detail plan view of the oil cut-off, showing particularly the peculiar-shaped oil-orifice; Fig. 10, a vertical sectional view through the circular part of the oil-heater; Fig. 11, a horizontal sectional view thereof on the line $y\,y$ of Fig. 10; Fig. 12, an enlarged detail vertical sectional view, on the line $y'\,y'$, looking in the direction of the arrows, of that part of the oil-heater where the oil enters and discharges; Fig. 13, a horizontal sectional view of the atomizer in a modified form, in which the oil cut-off is reciprocating instead of rotary and in which the valve is located between the inner end of the nozzle and the globe of the atomizer; Fig. 14, a detail plan view of such reciprocating cut-off, showing the oil-orifice in the globe, in diagram form, over the cut-off; Fig. 15, an elevation or face view of the air-admitter with a small portion broken away to facilitate illustration; Fig. 16, a partial vertical sectional view and side elevation of such air-admitter.

In Fig. 1 we have illustrated our entire apparatus assembled. In this figure a boiler or other fire-box A is indicated behind the front wall B of masonry, in which we show embedded the circular portion of our oil-heater, which consists of a hollow ring C, having removable core-plugs D at intervals to facilitate in its manufacture. (See Fig. 10.) This ring is supplied with oil through an inlet-pipe E, which at one end fits within a partition F, formed to constitute a stuffing-box G. This partition occupies an oblique position, as seen in Fig. 12, so that the inflowing oil in entering from the inlet-pipe E passes in one direction through the heater, so that such oil having made a circuit through the heater can pass out from the other side of such partition and into the outlet-pipe H.

Diametrically opposite to the pipe H is a similar pipe I, which, however, is dead, not being in communication with the interior of the hollow ring, but merely being connected to the ring, as shown. The function of this pipe I corresponds with one of the functions of the pipe H—namely, to support the oil-

supply and air or steam supply valve casings J and K, respectively—each casing having its valve proper, L and M, respectively, to control the one the admission of oil to the inlet-pipe E and the other the admission of air or steam to the atomizer proper.

The pipes O and P, being the oil and air or steam pipes, respectively, also act as immediate supports for the atomizer, and being screwed into the respective casings J and K and rotatably coupled with the atomizer they permit the latter to be vibrated or partially rotated, so as to direct it straight into the furnace or more or less toward the crown or toward the bottom. The form of connection between such pipes and the atomizer is particularly shown in Fig. 2, in which collars R screw upon the atomizer and fit over enlargements S on the pipes, so as to draw the parts tightly together and yet permit rotary play.

Referring again to Fig. 1, it will be seen that we secure, by means of bolts T or other convenient means, what we term our "air-admitter" to the outer front of the furnace-wall. The function of this air-admitter is to enable us to regulate the supply of air admitted to support combustion, the air admitted into the atomizer, as already indicated, being merely to act and assist in the operation of spraying. This air-admitter is preferably cone-shaped, with the apex removed or flattened down, and consists, as more clearly seen in Figs. 15 and 16, of an inner shell U and an outer shell V. The two shells fit snugly together, and the outer one is rotatable on the inner and both are provided with openings W, which when they register admit the full supply of air and when they partially register admit decreased quantities of air and which when the outer shell is turned to one extreme are closed, so as to exclude the air altogether, if such should be desired. To retain the shell V in place, an annulus X is secured to the flange Y of the inner shell by screws or bolts Z, and this annulus extends over the adjacent edge of the outer shell, so as to hold it from displacement. The outer shell is also flanged, as shown at V′, the flange extending under the annulus X and being cut out, as shown in Fig. 15, so that the resulting ends V″ may be adjusted to the projection V‴ on the annulus X. Thus a stop is formed for limiting the rotary adjustment of the outer shell. The inner shell is provided with a screw-threaded opening, as shown at U′, to receive a corresponding thread on the exterior of the atomizer, the outer shall having a coincident opening X′ also for the atomizer to pass through. Thus it will be seen that we have illustrated in Fig. 1 what we term the "complete apparatus," composed of the three general features—namely, the oil-heater, the air-admitter, and the atomizer proper.

Referring now to the atomizer proper—that is, the specific part of the apparatus, which is the atomizer *per se*—it will be seen that it consists of a globe or central body *a*. This globe receives air for atomizing purposes through the valve M and pipe P before described and receives steam when air is not used either through these same devices or through the steam-supply valve *b* and pipe *c*. (Shown in Figs. 1 and 6.) A shield or guard *d* occupies an interior position in the globe *a* and diverts the air or steam, as the case may be, from the globe and toward the nozzle *e*, which is secured to it either as shown in Figs. 1, 2, and 6, in which it is screwed upon an extension of the globe, or as shown in Fig. 13, in which it is screwed into an extension of the globe, the latter being a modification. In this form also a packing-collar *f* is used, because the nozzle is at times to be adjusted by rotating it on its threaded connection with the globe for the purpose of removing the valve-seat *g* on the inner end of the nozzle from contact with the valve *h*, so as to permit air or steam, as the case may be, to pass into the nozzle from the globe. A wrench-surface *i* is provided on the nozzle to enable it to be so turned when adjusted. An oil-passage *j* in the globe *a* terminates in a circular shell *k*, which shell is tapering in the preferred form, but parallel or cylindrical in the modified form. A diamond-shaped oil-orifice *l* is formed in this shell, while within the shell is mounted a cut-off *m* in the preferred form and *o* in the modified form. These cut-offs have each an oil-orifice, the preferred form being in the shape of a whole diamond, as shown at *p*, and the modified form in the shape of a half-diamond, as shown at *q*. In the preferred form the cut-off is rotatable, so as to present more or less of its diamond-shaped oil-orifice over the like-shaped orifice in the surrounding shell, whereby different quantities of oil may be admitted. In the modified form the cut-off is reciprocal, whereby more or less of its half-diamond-shaped orifice or cut-away part is presented over the diamond-shaped orifice of the shell. In either form the entire area of oil-orifice open for the passage of oil at any one time is concentrated as distinguished from what would be the case if a mere long straight or circular slit were depended upon for the admission of the oil, such slit or space being illustrated in the valve-casing J, closed by the valve L. By concentrating this area small solid particles floating in the oil can pass through, while at the same time the opening is sufficiently attenuated to prevent too much oil from passing. With an opening of the same area, which would admit the same quantity of oil, of the slit or long narrow type such foreign particles would not pass, but would gradually clog up such long opening, so that we have a distinct advantage derived from this concentration of the area of the oil-orifice by reason of these peculiar shapes. Again, there is a shearing action between the cut-off and the shell in either our preferred or modified form, which shearing action is utilized to cut into

any foreign floating matter which after use accumulates or catches in the matching oil-orifices.

Referring to the means for adjusting the cut-off *m*, it will be seen that such cut-off has a tubular portion or extension *r*, on which is mounted an adjusting-wheel *s*, a set-screw *t* being used to bind the wheel to the extension. This wheel has worm-gear teeth *u* on one face, which are actuated by a worm *v*, whose shaft is mounted in bearings *w*, supported by a standard *x* on a band *y*, fitted tightly upon a sleeve *z*, whose flange *z'* is fitted against an extension of the globe *a* and held from rotating by interlocking pins *z''*. To prevent the possibility of leakage, a packing-collar 2 is screwed upon this extension of the globe and fitted over the flange *z'*. Packing material 3 is placed within the extension and next to the flange and against the extension *r* of the cut-off. A further packing-collar 4 is screwed upon the tubular part of the packing-collar 2 and carries packing 5, which crowds against the sleeve *z* to further arrest any slight leakage that may escape past the packing 3 and along between the flange *z'* and the collar 2. A still further safeguard against possible leakage is provided through the packing-collar 6, which screws upon the extreme end of the extension *r* of the cut-off and carries a packing 7. This has a packing between the cut-off extension and the oil-tube, to which reference will be made presently. By manipulating the hand-wheel of the worm *v* the slightest possible adjustment of the cut-off is effected and the area of oil-orifice determined with the greatest nicety, while at the same time the cut-off remains locked through the instrumentality of these adjusting means.

Referring to the modified form, it will be seen that the cut-off *o* is adjusted lengthwise or reciprocally. This is done by threading its extension *o'* into engagement with a rotatable sleeve *p'*, which when rotated reciprocates the cut-off in one direction or the other. A hand-wheel *q'* is attached to this rotatable sleeve, while the sleeve itself is held against the end of the globe extension by a packing-collar *v'*, having a packing *s'*. A further packing-collar *t'* on the end of this rotatable sleeve packs the joint between such sleeve and the oil-tube to be presently referred to. This tube and the remainder of the features in the modified form are also shown in the main form, so that special reference to the modified form will at this point terminate.

Between the rotatable cut-off *m* and the flange *z'* and within the adjacent globe extension we place a cup 8, shouldered against the interior extension shown at 10 and held thereto by the solidity of the packing 3. This cup forms, in effect, a removable shoulder or stop for the cut-off of a positive nature to prevent the cut-off from being drawn rearward by the action of the oil-tube drawing on the cut-off extension *r*, as would be the case in the absence of the cup 8 should the oil-tube be rotated after its head or tip comes against the shoulder in the casing of that tube, as will hereinafter appear. Within this cup 8 is a helical spring 11, which keeps the cut-off normally seated.

We refer now to what is termed the "oil-tube," being the long tube 12, which is of two exterior diameters, the larger part 13 having a hand-wheel 14 and being closed by a gasket 15 and a screw-cap 16 and being screw-threaded, as shown at 17, to engage with a like thread on the interior of the cut-off extension *r*, by which means the oil-tube is lengthwise adjusted, so as to more or less or entirely throttle the air or steam, as the case may be, from escaping from the nozzle and so as to vary the effective opening by presenting the tube-head 18 more or less close to or removed from the orifice 19 of the nozzle. This oil-tube has a series of orifices 20, located within a chamber 21 of the cut-off, so as to receive the oil which enters therein. This oil it conducts to and through its head 18. This part of the oil-tube is within a tubular casing 22, which at one end is screwed into the closed end of the shell *k* and at the other end is reamed out to receive the head 18, while along its intermediate portion it is interiorly enlarged, as shown at 23, so as to leave an air-space between it and the oil-tube, which prevents so much heat being conducted from the steam to the oil-tube, as would otherwise be the case, or vice versa. This casing also forms a bearing for the extension of the tube where the head 18 works in the casing.

Referring to the function of the cup 8, it will now be seen that if the oil-tube is turned after its head 18 seats against the casing 22 it would draw the cut-off rearward but for the stop-like effect of the cup 8.

In Fig. 7 we have illustrated a modification in the form of the oil-tube head 18, the same being in this form enlarged to constitute a sphere 24. This sphere extends nearer to the interior walls of the nozzle, and hence widens out the spray of oil and air or oil and steam to a greater extent. At this point we would call attention to two peculiarities in our nozzle. One is that the interior of the discharging end is of a contour agreeing with the arc of a circle—say about half a circle—as seen at 25. The other is that the discharge-orifice is flared in both directions from a line 26, such line being distant from the inner wall about one-third the thickness of the nozzle in the discharging-orifice. This is to make the inner flare of the orifice short and the outer flare longer and to facilitate in widening or enlarging the resulting or issuing spray. The result of the circular contour, as shown at 25, is to cause air or steam to act to cut off the oil and prevent it from flowing from the oil-tube whenever the pressure of the air or the steam exceeds too much that of the oil—say an excess of pressure of twenty per cent. This makes an automatic cut-off when the steam or air pressure gets too high—a condi-

tion likely to occur with steam particularly—at which time it is highly desirable that the fuel should be automatically cut off. This peculiar contour of the nozzle adjacent to the discharging end of the oil-tube produces this important result.

The head 18 can be adjusted to and from the nozzle-orifice to vary the quantity of steam or air emitted or to throttle it altogether, while the quantity of oil is regulated by the relative position of the oil-orifices *l* and *p* in the preferred form or by the relative positions of the orifices *p* and *q* in the modified form.

Referring again to the oil-orifice in the preferred form of cut-off, it will be seen from Figs. 2 and 4 that such opening is widened from the outside of the cut-off inward to its chamber 21, as shown by the lines 21′. The object is to free the oil of any foreign matter which may work through the smallest part of the orifice.

Referring to the interior of the nozzle, it will be seen that we have arranged therein a series of helical blades or wings 26′, which are on the casing 22, as shown more clearly in Fig. 5, though if they were otherwise supported they would come within our contemplation, as the essential thing is that these helical wings or blades shall lie along the interior of the nozzle, so as to give the passing steam or air, which is under pressure, a twisting or revolving direction or effect, which we find advantageous.

It will be seen that the head 18 on the oil-tube when it seats against the casing 22 will prevent the oil-tube from being unscrewed too far or pulled out, as it acts as a stop to limit the outward screwing of the tube, it being understood that the head 18 is screwed onto said tube sufficiently tight to prevent its unscrewing therefrom when turning the tube with the hand-wheel 14.

Referring also to the worm and worm-gear adjustment of the rotatable cut-off and to the direct screw cut-off of the reciprocal cut-off, it will be understood that in each case the adjustment is under full and perfect control and that its precision and nicety are almost equal, if not quite equal, to a micrometer-movement.

Thus it will be seen that with our atomizer many important functions and operations are provided for and accomplished and that the apparatus also embodies numerous features of detail which render it highly efficient in practice and capable of meeting the varied and delicate conditions of actual use in this class of devices. It will be seen and understood, too, that our atomizer may be used in its threefold form, as shown in Fig. 1, in which there is the oil-heater, the atomizer proper, and the air-admitter, or that it may be used in its twofold form, as shown in Fig. 2, in which there is shown the oil-heater and the atomizer proper, or that it may be used in its single form, as shown in Fig. 6, in which only the atomizer proper is illustrated as applied to a furnace. Accordingly we wish to be understood as intending to use, as in fact we do, our apparatus in either or all of these forms or assemblages, particular applications and circumstances controlling as to these matters.

While in referring to the throttling effect of the oil-tube by adjusting it toward and against the inner end of the nozzle-orifice it is obvious that so long as the oil-tube and nozzle-orifice are thus relatively adjusted the throttling would be thus effected, and it would be within our invention even though such adjustment were not brought about by moving the tube itself.

It is further to be understood that the air and steam may be alternately introduced into the globe or body through the same passage—namely, the one to which the pipe P leads—and this is what is referred to in speaking of the globe or body having an air or steam inlet. Additionally, we show a separate steam-introducing means in Fig. 6, which when incorporated into the device is intended to save disconnecting the cock M from the air-pressure supply, the air being merely cut off by the valve M, while the steam is let in by the valve *b*. The oil-tube 12 and 13 having a hole clear through it enables it to be cleaned by simply removing the screw-cap 16.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In an oil-atomizer, an oil-heater consisting of a hollow ring having an oblique partition, an inlet-pipe to discharge oil on one side of the partition and an outlet-pipe to receive oil from the other side of the partition, said latter pipe constituting a support, and an oil-cock supported by one support and an air or steam cock supported by the other, and an atomizer proper, substantially as set forth, supported by said supports, and receiving oil through said oil-cock, and steam or air through said air or steam cock.

2. In an oil-atomizer, the combination with an oil-heater composed of a hollow ring adapted to receive heat from a furnace and having an oblique partition, an inlet-pipe to supply oil one side of the partition and a discharge and supporting pipe to receive oil from the other side of the partition and another supporting-pipe, an oil-cock and an air or steam cock supported by said supporting-pipes, an oil-pipe extending from the oil-cock and an air or steam pipe extending from that cock, and an atomizer proper rotatably connected to said pipes, whereby its nozzle may be directed to different parts of the fire-box.

3. In an oil-atomizer, an atomizer proper consisting of a globe or body adapted to receive air or steam and having an oil-passage and an interior shell with an oil-orifice, a cut-off in the shell having a similar orifice and means to adjust the cut-off, an oil-tube adapted to receive oil from the cut-off and extending in both directions from the cut-off, one end forming a discharge for the oil and the other the manipulating end, and a nozzle se-

cured to the globe or body, enveloping the oil-tube and adapted to receive the air or steam, said nozzle having a discharge-orifice opposite the oil-tube and said tube being longitudinally adjustable, whereby the oil is controlled by manipulating the cut-off and the air or steam is controlled at the discharge-orifice by manipulating the oil-tube.

4. In an oil-atomizer, an atomizer proper consisting of a globe or body having an air or steam inlet, an oil-passage and an interior shell having a diamond-shaped oil-orifice, a cut-off in the shell, having a similar orifice, and an extension with means to operate the cut-off through the extension, an oil-tube receiving oil from the cut-off and extending in both directions, one end to longitudinally adjust the tube and the other end to discharge the oil, and a nozzle to receive air or steam and secured to the globe or body and enveloping the oil-tube and having a discharge-orifice opposite the end of the tube, whereby oil is admitted through a concentrated area and is controlled, and whereby steam or air is controlled or throttled at the point of discharge.

5. In an oil-atomizer, an atomizer proper consisting of a globe or body having an air or steam inlet, an oil-passage and an interior shell with a diamond-shaped orifice, a cut-off in the shell having a similar orifice, and an extension, and means to adjust the cut-off through the extension, an oil-tube receiving oil from the cut-off and extending thence in both directions, one end for longitudinally adjusting said tube and the other end for discharging the oil, a nozzle to receive air or steam from the globe or body and secured thereto and having a discharge-orifice opposite the end of the oil-tube, and a series of helical wings within the nozzle and mounted upon said oil-tube, whereby oil is admitted in regulated quantities, whereby the air or steam is controlled or throttled at the point of discharge and whereby the air or steam is given a helical or twisting direction.

6. In an oil-atomizer, an atomizer proper consisting of a globe or body having an air or steam inlet, an oil-passage, an interior shell with a diamond-shaped orifice, a rotatable plug in the shell having a similar orifice and an extension carrying an adjusting-wheel, an oil-tube extending through the cut-off and receiving oil from it, one end of the tube having means to rotate it, a portion of the tube having a screw-threaded connection with the interior of the cut-off extension and the other end of the tube having a tip or head, a nozzle to receive air or steam from the globe or body, secured thereto and enveloping the oil-tube and having a discharge-orifice opposite said tip or head, said cut-off and oil-tube manipulating devices being in close proximity, whereby the operator may regulate the quantity of oil admitted and may control or throttle the steam or air at the point of discharge by manipulating the oil-tube.

7. In an oil-atomizer, an atomizer proper consisting of a globe or body having an air or steam inlet, an oil-passage, and an interior shell with a diamond-shaped orifice, a rotatable cut-off having a like orifice, an extension and a worm-operated adjusting-wheel on the extension, an oil-tube having a screw-threaded connection with the interior of said extension and extending through the cut-off with perforations to receive oil from it, a throttling-tip on one end of the tube and a hand device on the other, and a nozzle, to receive air or steam from the globe or body secured thereto and having a discharge-orifice opposite said tip, all for the purpose described.

8. In an oil-atomizer, an atomizer proper having a globe or body with an oil-passage and an interior shell having an oil-orifice, a cut-off mounted in the shell and also having an orifice, an extension from the cut-off carrying an adjusting worm gear-wheel, a sleeve over the extension having a flange secured to the globe or body, a collar screwed to the latter and extending over the former and a packing-collar screwed to said collar, a bearing-standard secured to said sleeve and a worm mounted in the bearing and meshing with said worm gear-wheel, an oil-tube extending through the cut-off and having a threaded connection with the interior of the cut-off extension and a hand-wheel to screw the tube back and forth in the extension, and a packing-collar on the cut-off extension and binding the tube.

9. In an oil-atomizer, an atomizer proper having a cut-off with an oil-orifice approximating diamond shape, the walls of the opening being beveled or inclined to one another so as to make the opening wider in the interior than on the exterior of the cut-off.

10. In an oil-atomizer, an atomizer proper having a globe or body, and an interior shell, a cut-off therein, means to close one end of the globe or body, a cup between said closed end and said cut-off and a spring within the cup and between one end of it and the cut-off.

11. In an oil-atomizer, the combination with an oil-heater, a part of which is adapted to receive heat from a furnace, an oil-cock and an air or steam cock supported by said oil-heater, and an atomizer proper connected with said cocks.

In testimony whereof we affix our signatures in presence of two witnesses.

CLAYTON O. BILLOW.
ELMER E. BILLOW.

Witnesses as to signature of Clayton O. Billow:

H. B. STIGER,
SAML. G. NEILER.

Witnesses as to signature of Elmer E. Billow:

WILLIAM J. HIGGS,
FLORENCE I. DOYLE.