No. 653,247.

Patented July 10, 1900.

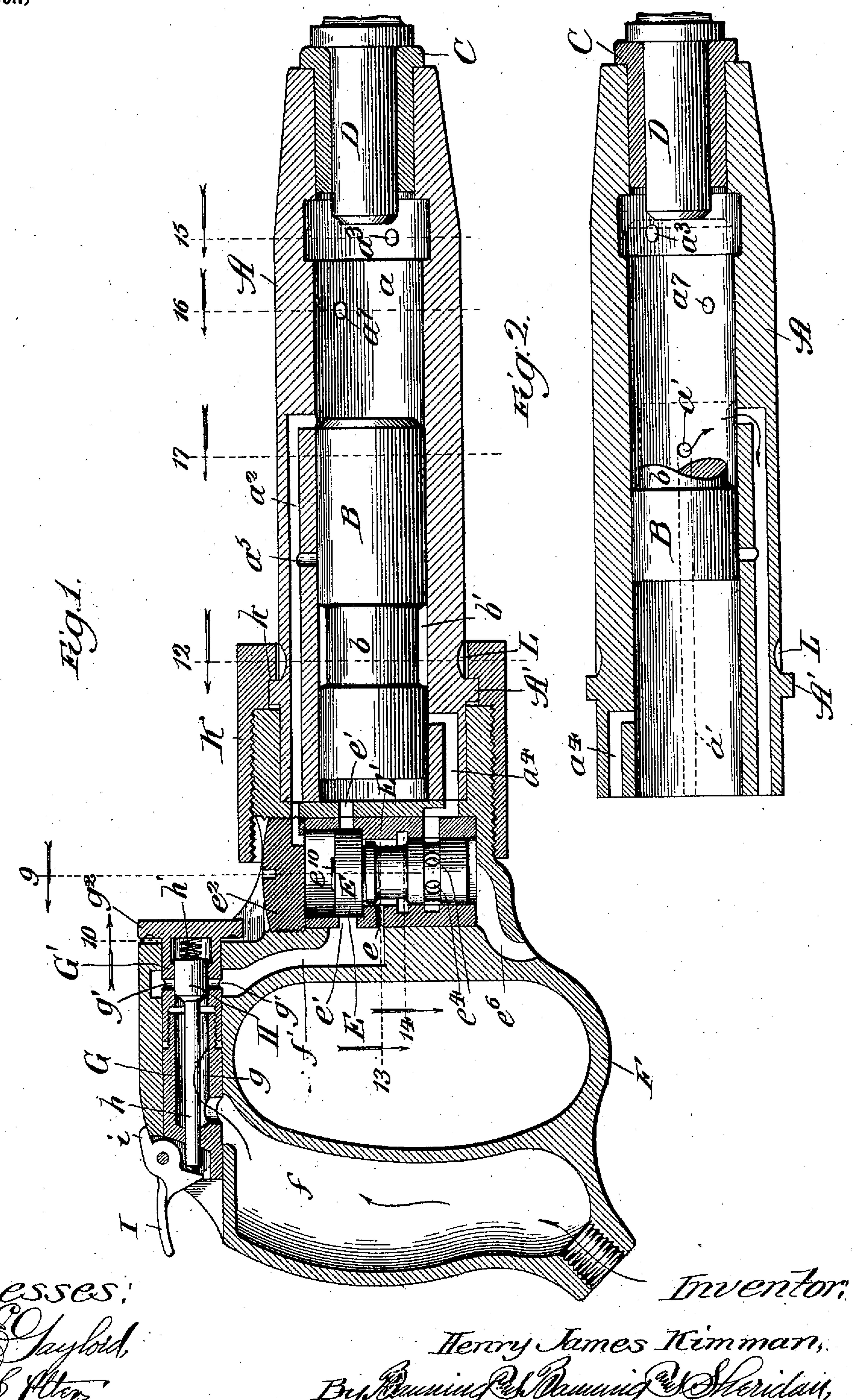
H. J. KIMMAN.

PNEUMATIC HAMMER.

(Application filed Oct. 16, 1899.)

(No Model.)

5 Sheets—Sheet 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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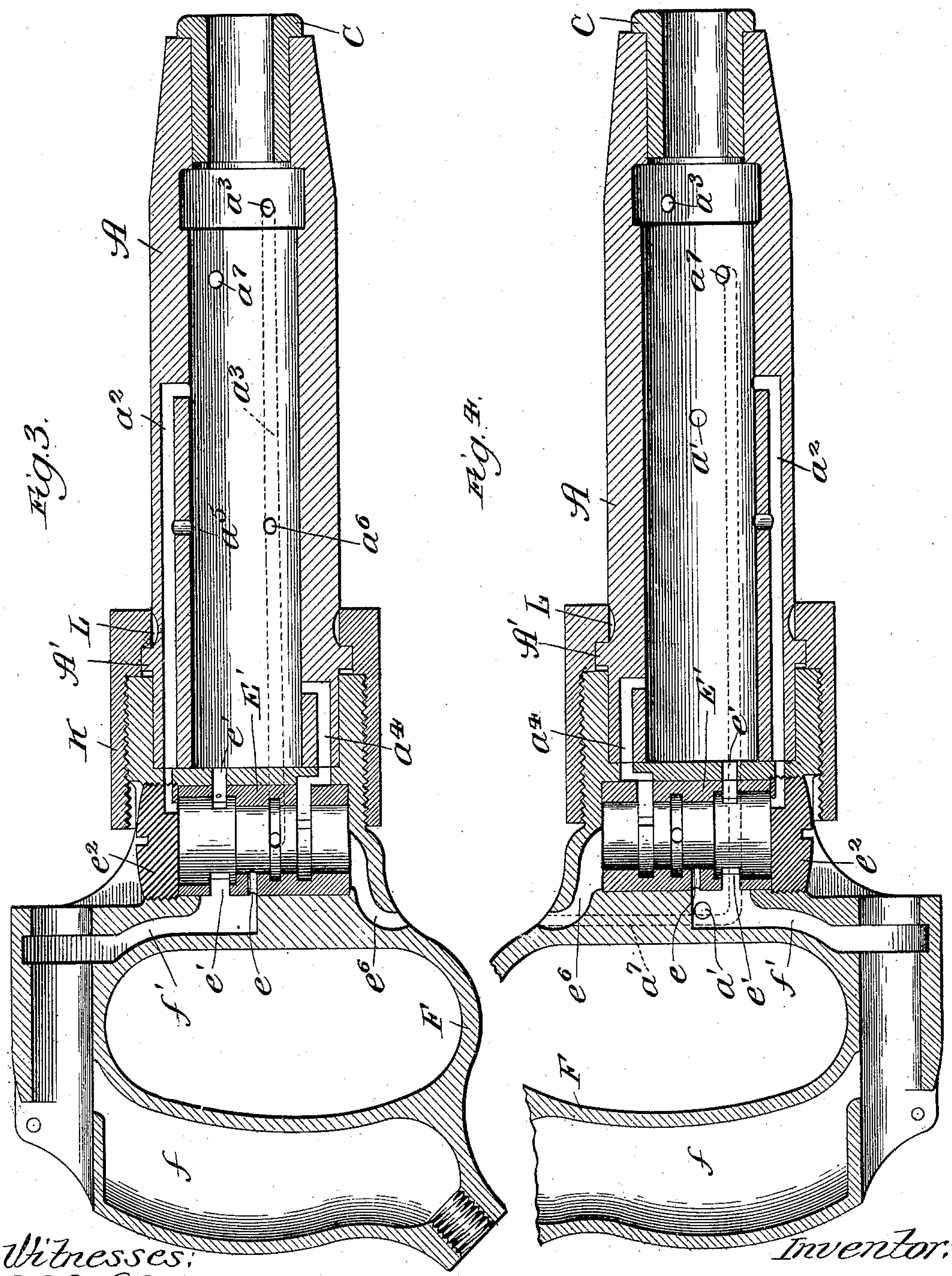

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Fig. 5.

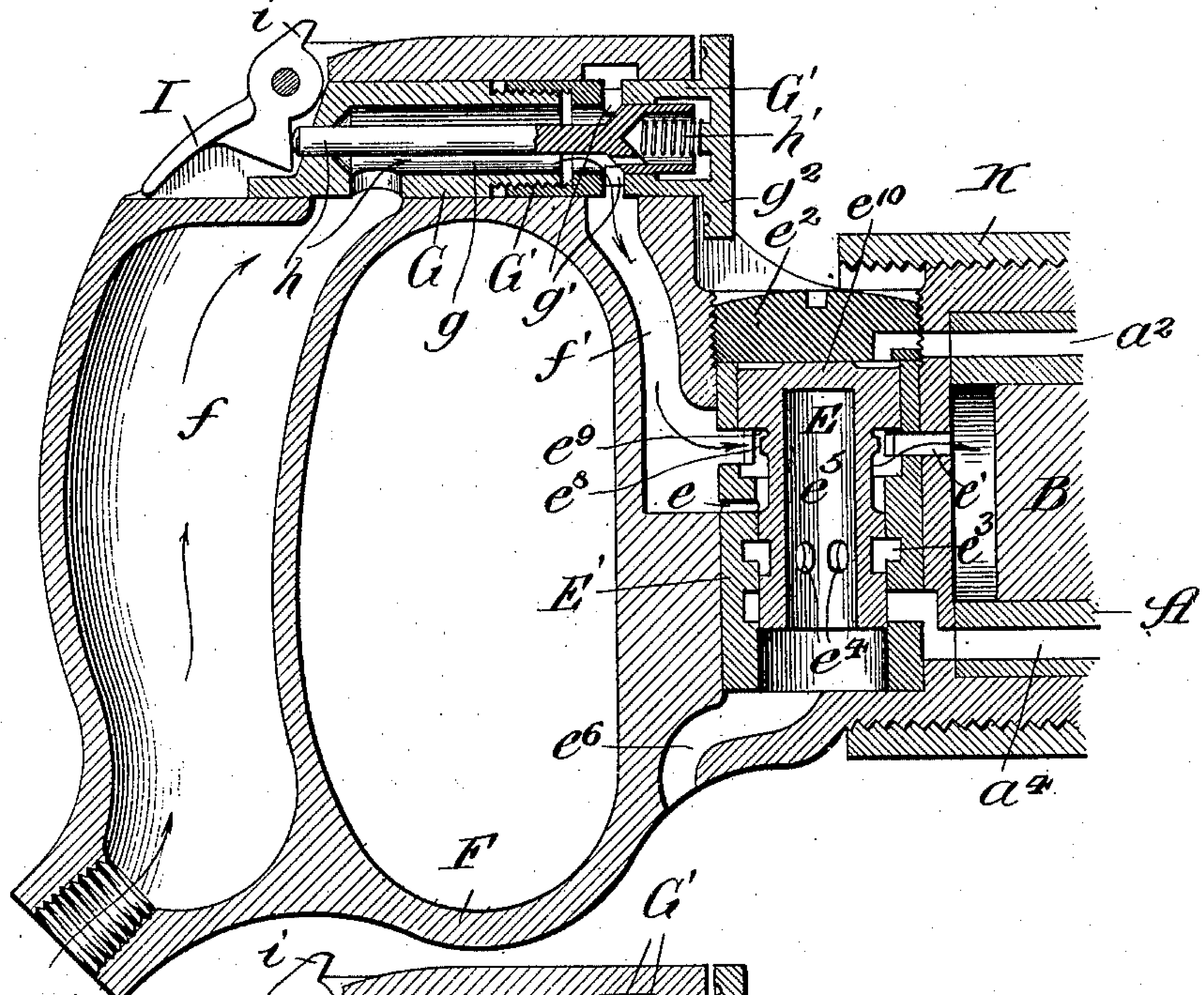
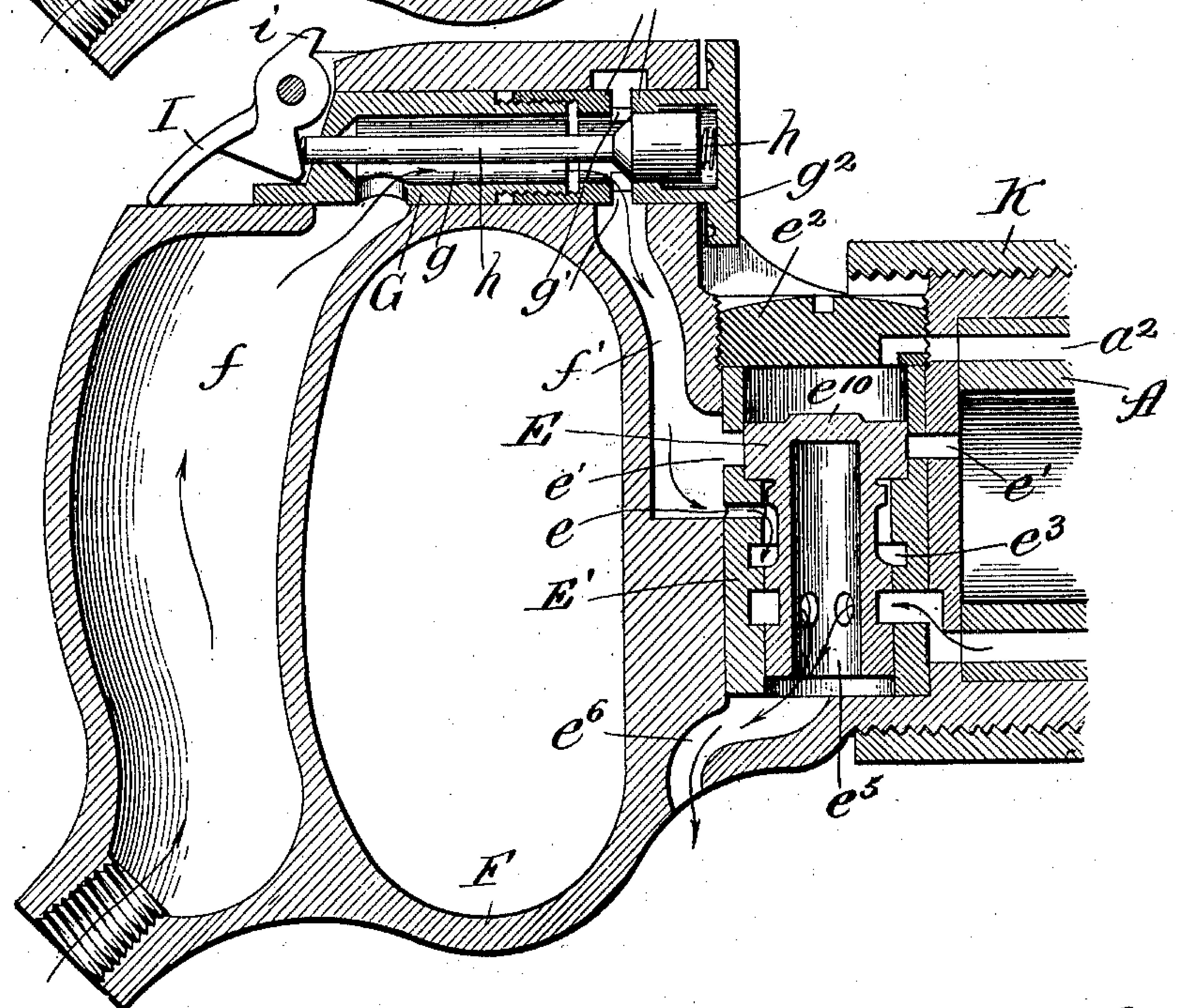


Fig. 6.



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5 Sheets—Sheet 4.

Fig. 7.

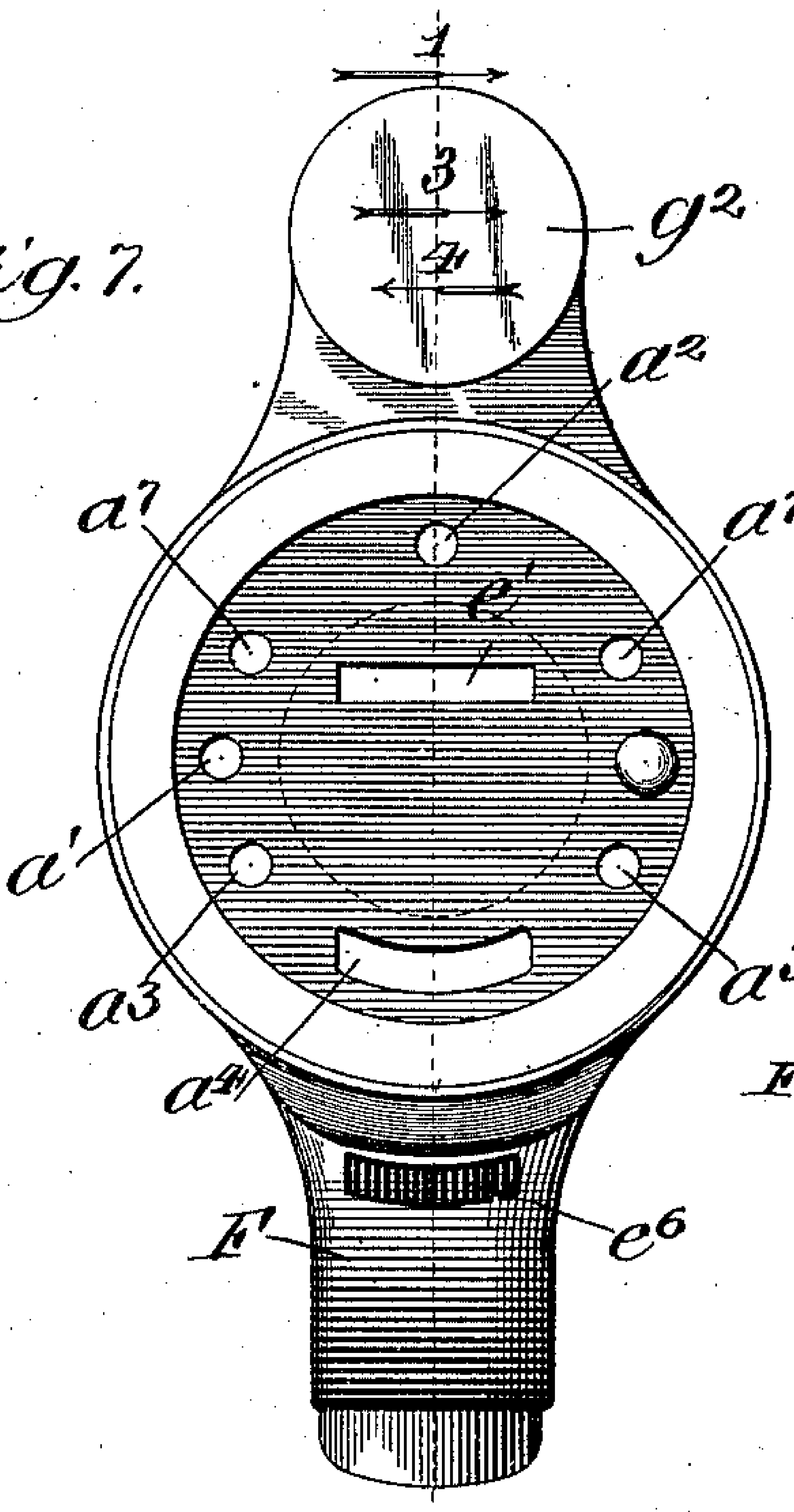

Fig. 8.

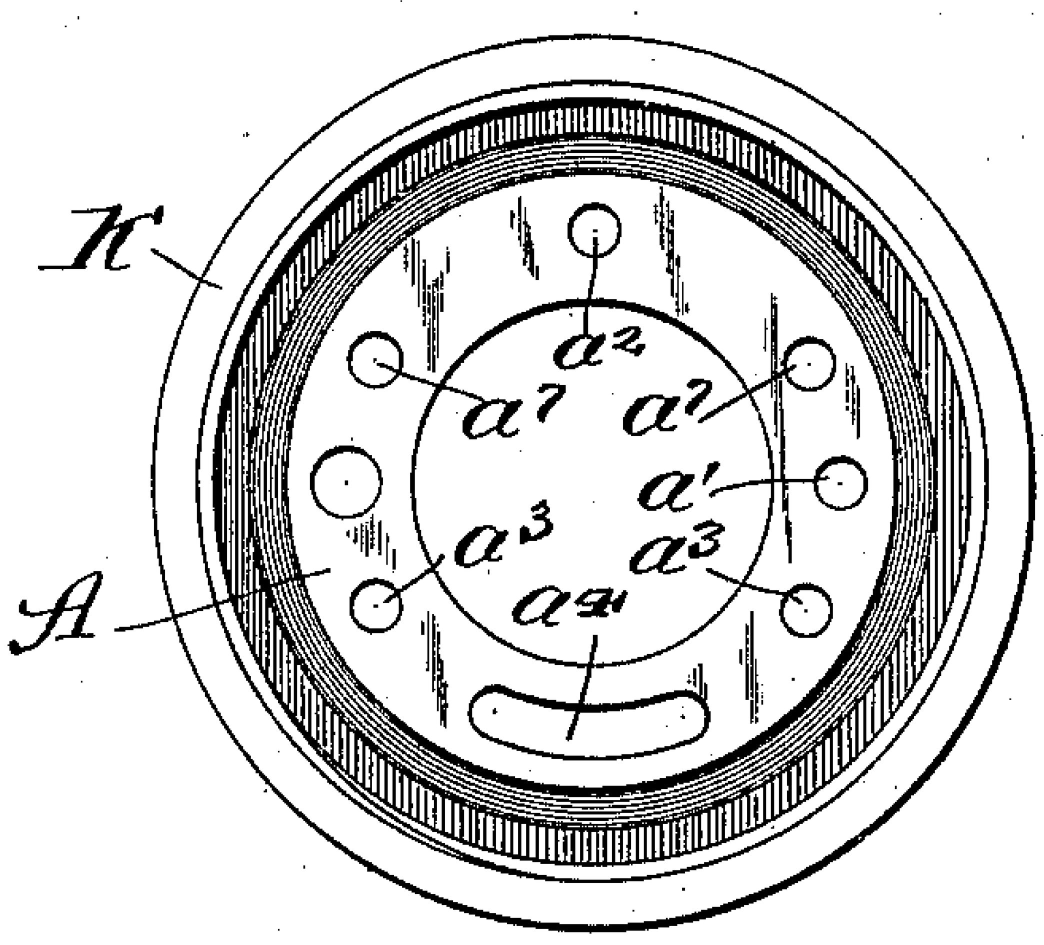

Fig. 10.

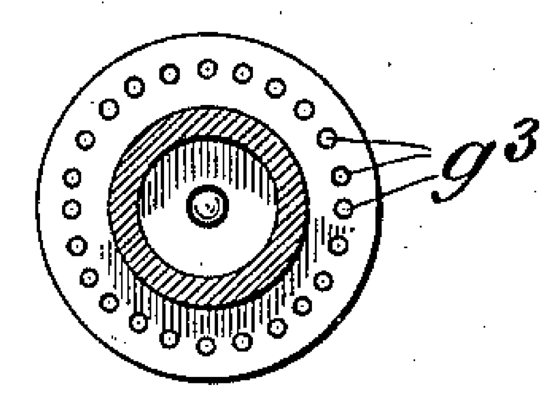

Fig. 9.

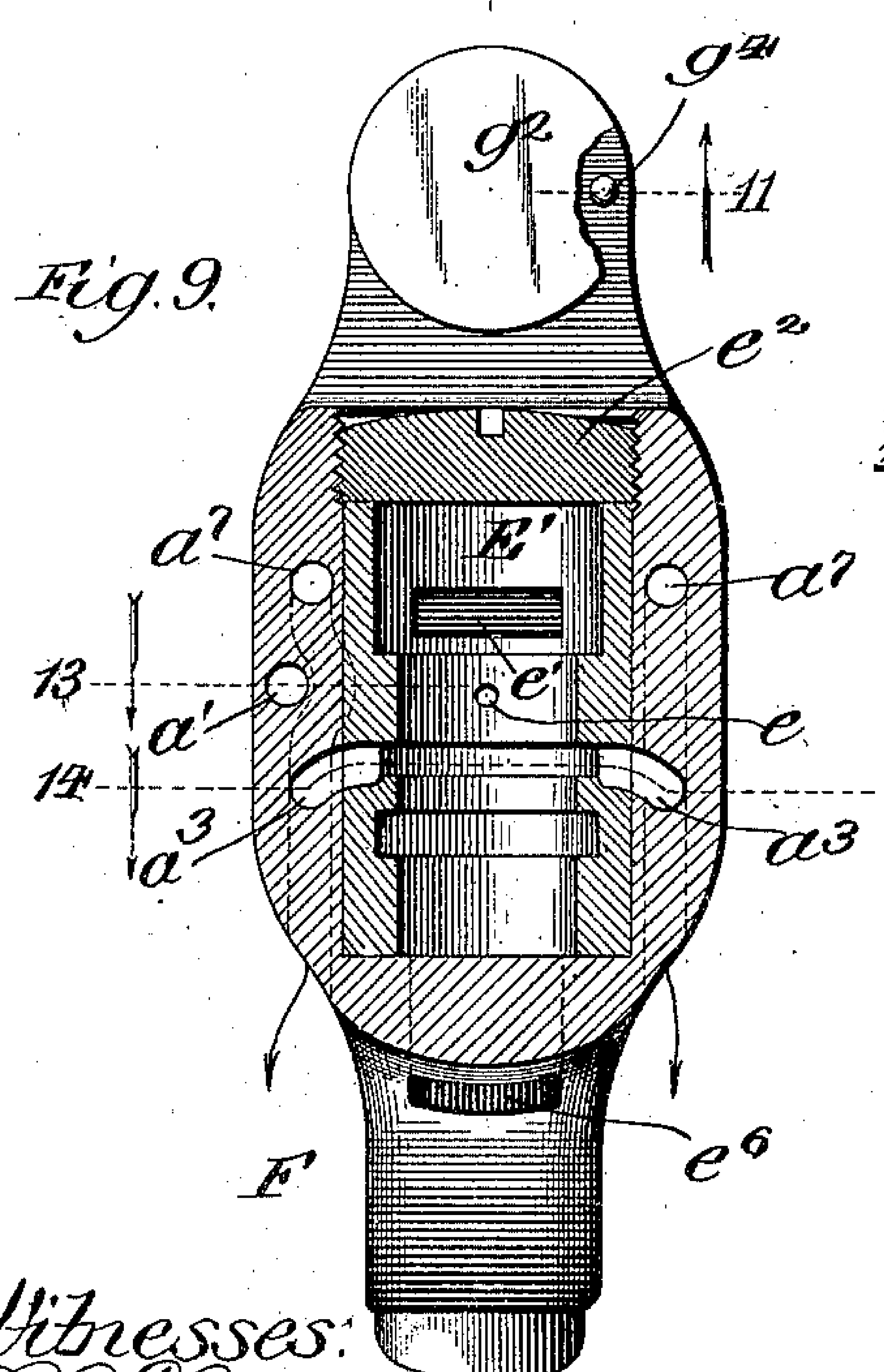

Fig. 11.

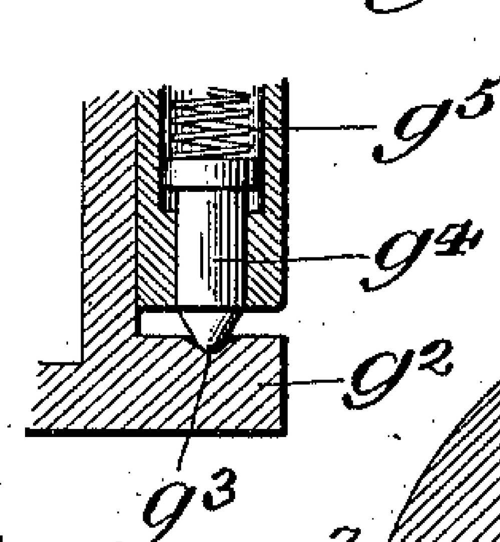

Fig. 12.

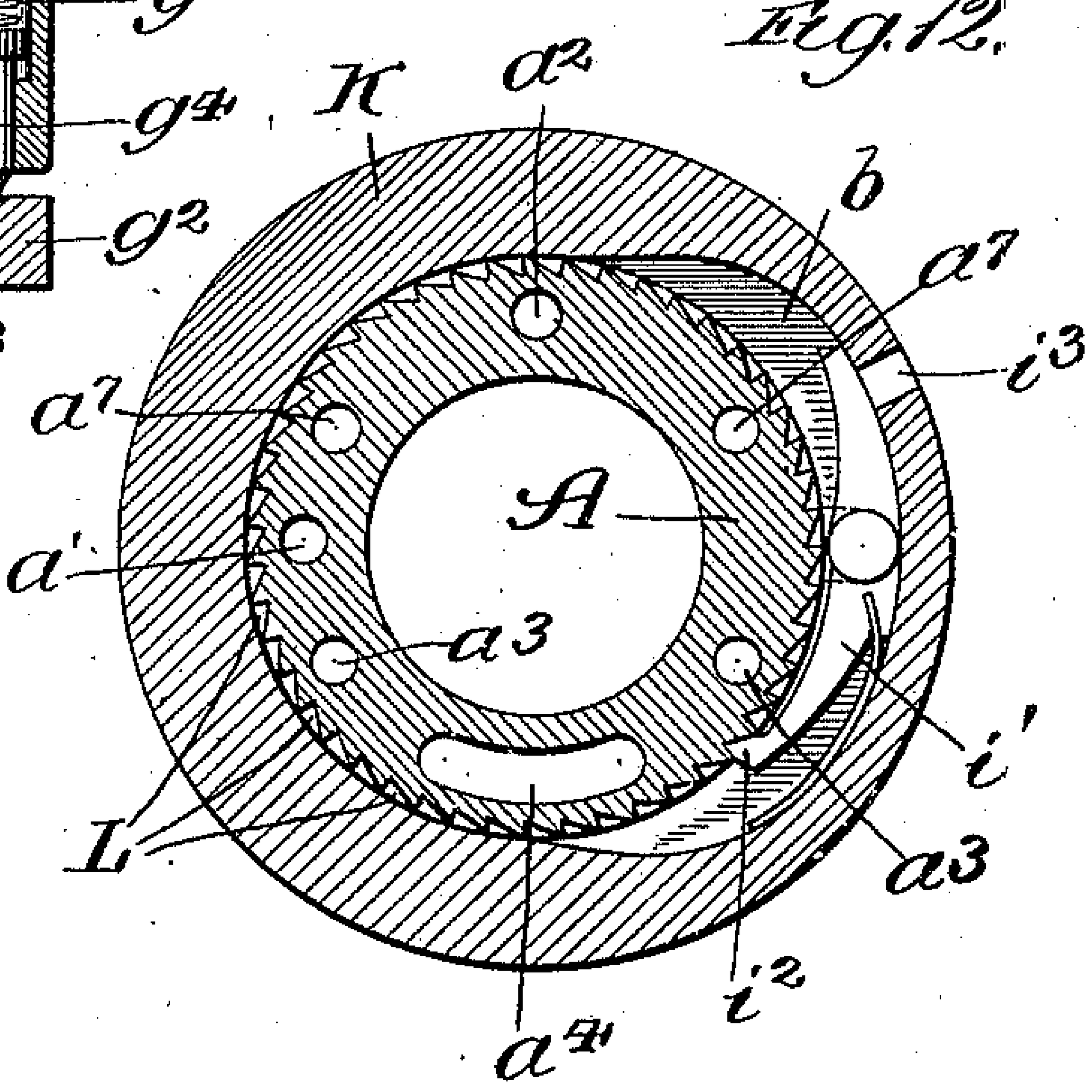

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Fig. 13.

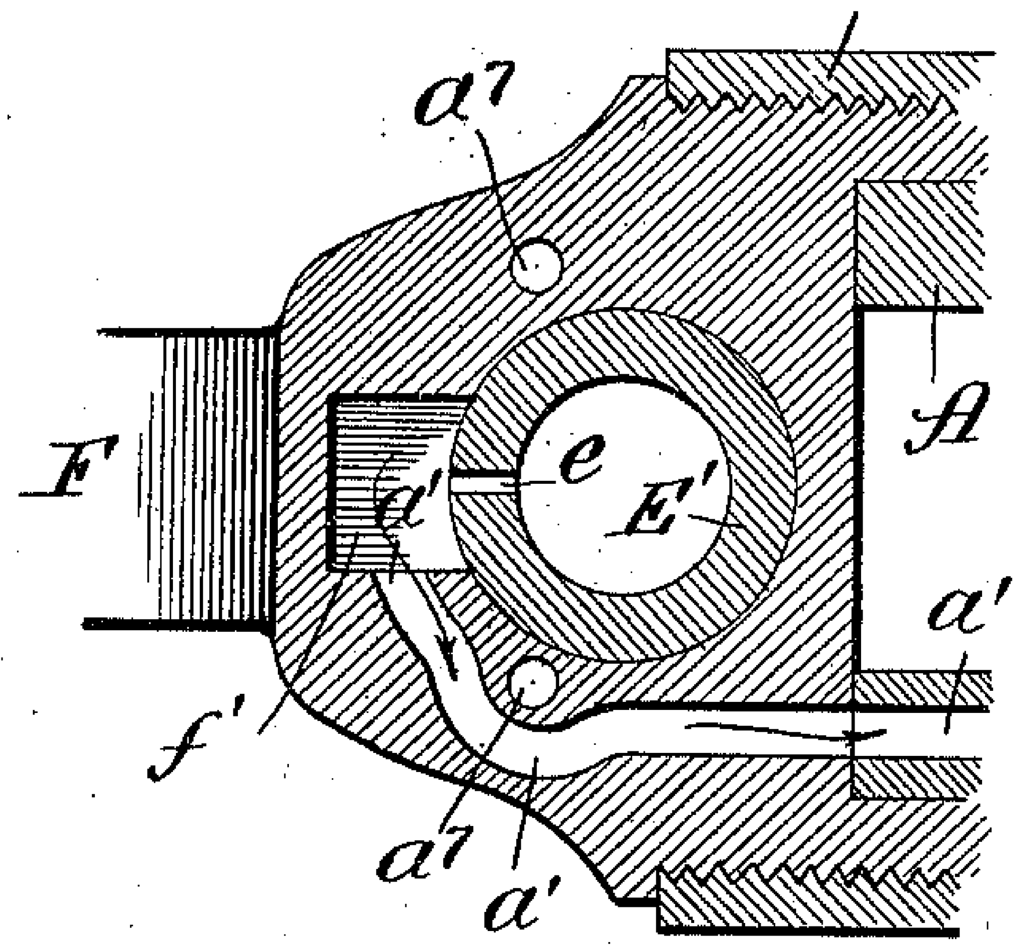


Fig. 14.

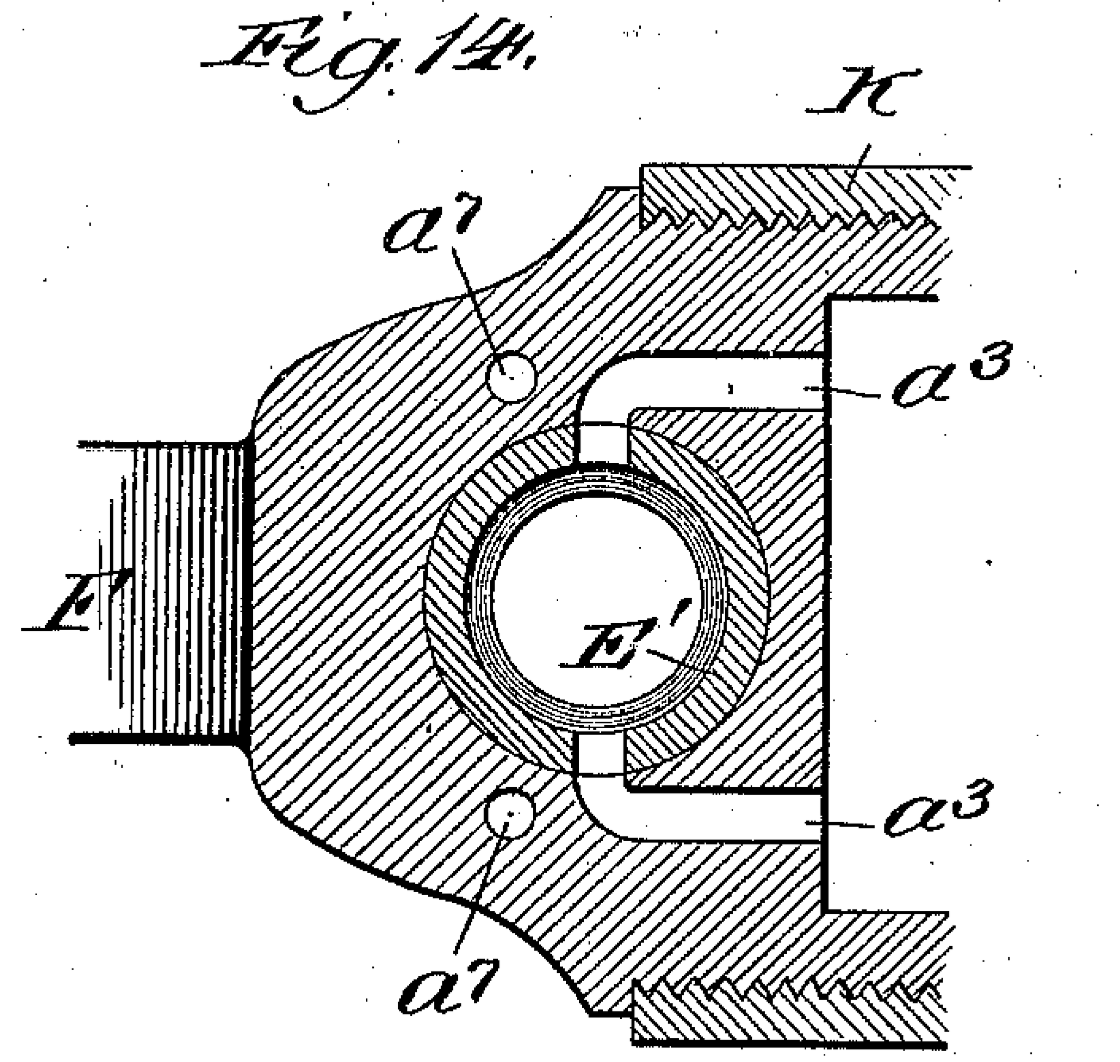


Fig. 15.

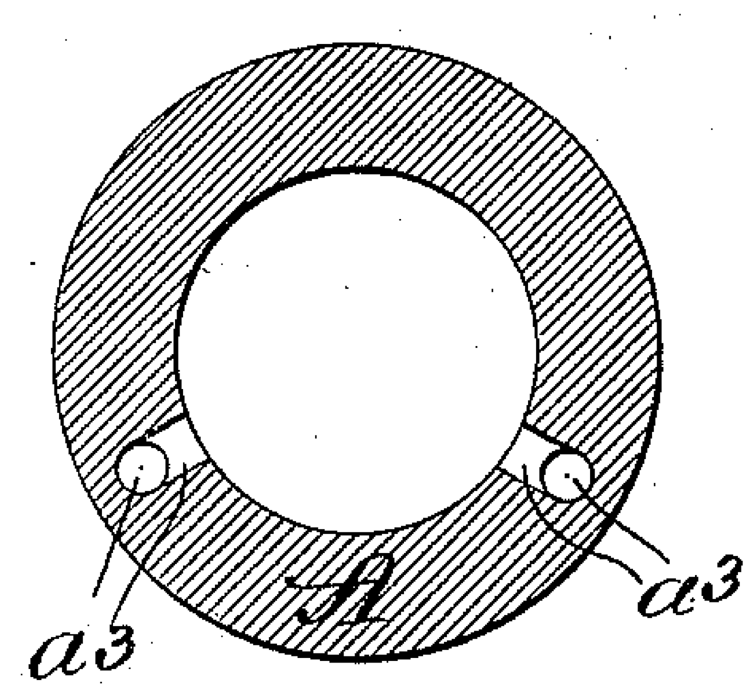


Fig. 16.

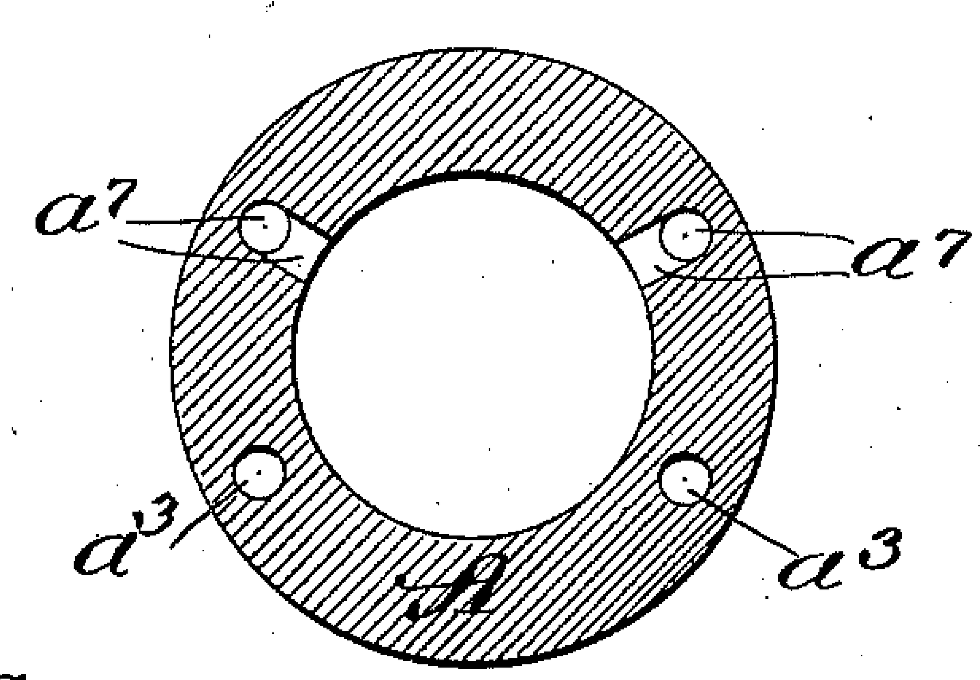
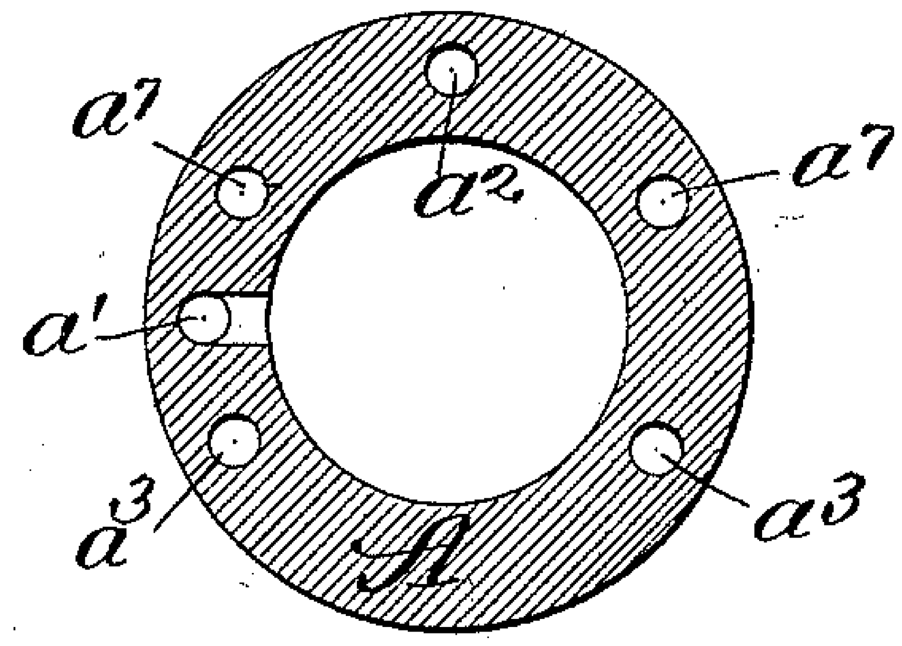


Fig. 17.



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UNITED STATES PATENT OFFICE.

HENRY JAMES KIMMAN, OF CHICAGO, ILLINOIS.

PNEUMATIC HAMMER.

SPECIFICATION forming part of Letters Patent No. 653,247, dated July 10, 1900.

Application filed October 16, 1899. Serial No. 733,750. (No model.)

To all whom it may concern:

Be it known that I, HENRY JAMES KIMMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Portable Pneumatic Hammers, of which the following is a specification.

This invention relates to a new and useful improvement in portable pneumatic hammers constructed and arranged to embody and operate upon the principles involved in what are known as "direct-acting engines."

It relates, further, to the arrangement of parts by which the hammer is made as compact as possible.

The object of the invention is to provide a simple, economical, and efficient portable pneumatic hammer; and the invention consists in the features, combinations, and details of construction hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical longitudinal sectional elevation of a hammer constructed in accordance with my improvements, taken on line 1 of Fig. 7 looking in the direction of the arrow; Fig. 2, a similar view of the opposite half of the cylinder from that shown in Fig. 1, with the hammer portion broken away, as shown in dotted outline, so as to contact the operating-tool; Fig. 3, a similar view to that shown in Fig. 1, with the operating-tool, piston-hammer, and throttle and controlling valves removed; Fig. 4, a similar view to Fig. 3, showing the other half of the mechanisms; Fig. 5, an enlarged view of the handle and upper part of the mechanisms shown in Fig. 1, with the throttle-valve open and the controlling-valve in position to admit the motive fluid to the one cylinder; Fig. 6, a similar view to that shown in Fig. 5, with the controlling-valve in its exhaust position; Fig. 7, a plan view of the handle portion removed from engagement with the cylinder and looking at it from below; Fig. 8, a plan view of the cylinder looking at it from above; Fig. 9, a cross-sectional view taken on line 9 of Fig. 1 looking in the direction of the arrow; Fig. 10, a sectional detail of the throttle-valve, taken on line 10 of Fig. 1; Fig. 11, an enlarged detail view taken on line 11 of Fig. 9; Fig. 12, an enlarged cross-sectional view taken on line 12 of Fig. 1 looking in the direction of the arrow; Figs. 13 and 14, enlarged sectional details taken on lines 13 and 14 of Fig. 1, showing the arrangement of the fluid-ducts; and Figs. 15, 16, and 17, cross-sectional views taken on lines 15, 16, and 17 of Fig. 1.

In the art to which this invention relates it is well known that it is desirable to construct a hammer with a view to having it as economical in the use of air as possible and at the same time providing mechanism by which the force of the blow may be regulated to suit the desire of the operator and be maintained in that position as long as desirable. It is further desirable to have the mechanism of the engine arranged in such manner that it can be taken apart and arranged in as economical and compact a manner as possible. To accomplish these ends are the principal objects of the invention.

In constructing a portable pneumatic hammer in accordance with my improvements I make what I term a "fluid-pressure cylinder" A of the desired size and strength. This cylinder is bored out the desired diameter, so as to provide a fluid-pressure chamber *a*, in which a piston-hammer B may reciprocate. One end—the front—of this cylinder is bored out the desired size to receive a shouldered bushing C, which forms a portion of the front wall of the cylinder and in which the stem of an operating-tool D may be inserted. This operating-tool may be either a riveting-hammer, an ordinary hammer, a chisel, a calking-tool, or the like, to meet the various requirements of machines of other manufacturers. In the operations of this tool it is well known that the piston-hammer reciprocates within the fluid-pressure cylinder a great number of times, and at one limit of its motion contacts the operating-tool, so that it is, in effect, what may be termed a "percussion-tool." One of the principal objects, then, is to apply the fluid under pressure as economically as possible, so as to reciprocate this piston-hammer. In order to accomplish this result, the cylinder is provided with a number of ports and passages, some of which are arranged to be opened and closed by the movements of a controlling-valve, which I will proceed to describe.

A "controlling" differential valve E is provided and arranged in the inlet and exhaust passages, so as to control and regulate the supply of air before it enters the cylinder. This controlling-valve is preferably arranged in a hardened-steel bushing E′ in the base of the handle portion F and, preferably, transversely thereof. This handle portion is preferably made hollow, or, in other words, provided with an inlet-passage divided into two parts f and f', interrupted by a "throttle-valve," hereinafter described.

In the operations of the tool fluid under pressure is admitted into the passage f', (see Fig. 1,) from which it passes through the opening e in the controlling-valve bushing and behind the head of the controlling-valve, thus forcing it into the position shown in Fig. 5. The fluid-pressure is then permitted to follow (see Figs. 1 and 5) and pass through the larger opening e' in the valve-bushing and hand portion into the cylinder back of the piston-hammer. This action forces the piston-hammer to its forward limit of motion, where it contacts the operating-tool, as shown in Fig. 2. The piston-hammer for a portion of its length is reduced in diameter, as shown at b, which, in connection with the cylinder, provides an annular chamber b', so that, as the piston-hammer nears its forward limit of motion fluid-pressure may pass through the passage a' into the annular chamber b', where it enters the passage a^2 and passes upwardly into the valve-bushing between its head e^2 and the head of the controlling-valve, thus forcing the controlling-valve back to the position shown in Figs. 1 and 6. The moving of the valve into this position permits fluid under pressure to enter the chamber of the valve through the passage e, around the annular portion e^3, from which it enters the passages a^3 and passes to the front end of the fluid-pressure chamber in the cylinder and between the piston-hammer and the front walls of the cylinder, thus acting to force the piston-hammer to its rearward limit of motion. During the backward movement of the piston-hammer the fluid at the rear part of the cylinder is forced out through the exhaust-passage a^4, and passing through the perforations e^4 of the controlling-valve enters its central chamber e^5, from which it passes out to the atmosphere through the passage e^6. During the backward movement of the piston-hammer the motive fluid which is between the head of the controlling-valve and the head of the valve-bushing is permitted to pass through the passage a^2 through the by-pass a^5 into the annular passage b', from which it passes through the by-pass a^6 into the passage a^3, through which it is conveyed or forced into the annular passage e^3 of the controlling-valve chamber. As the superior pressure has thus been exhausted from the front end of the controlling-valve, the high pressure on the rear side of the controlling-valve returns it again to the position shown in Fig. 5. This action brings the openings e^4 of the controlling-valve into alinement with the annular passage e^3 of the valve-chamber and permits the air to pass through such openings into the interior valve and out through the passage e^6 in the handle. As the piston-hammer continues its backward motion it passes the opening in the exhaust-passage a^4 and confines the air in the rear portion thereof, so as to permit it to act as a cushion and at the same time saves a quantity of air, which acts to accelerate or assist the hammer in its forward movement. At the same time one portion of the piston-hammer closes the by-ports a^5 and a^6 and opens the main passage a^2 to permit the remaining air, which may be confined between the head of the controlling-valve and its bushing, to be exhausted through the passages a^7, which are constantly open to the atmosphere.

It will be seen that the passage a' (see Figs. 2 and 13) is connected with the main inlet f' for the fluid-pressure, so that when the throttle-valve is open this passage is in constant communication with the supply of fluid-pressure.

During the forward motion of the piston-hammer it is desirable to exhaust the fluid-pressure in front of the same. To arrange for this, the passage a^7 is in constant communication with the outer atmosphere, so that the air which would otherwise be confined may pass out therethrough. When the piston-hammer, however, passes this port, so as to close it, the air is exhausted out through the passage a^3, which exhaust takes place because the controlling-valve is in the position shown in Fig. 5, which position brings the perforations e^4 of the controlling-valve into alinement with the annular chamber e^3, thus permitting the air to be forced out through the passage a^3 into the annular chamber e^3, and thence through the perforations e^4 into the interior of the controlling-valve, from whence it may pass out into the passage e^6 in the handle of the hammer.

The movements of the controlling-valve are positive in each direction and longitudinal of the valve. It is desirable that these movements be made with as small shock as possible, or, in other words, that a cushion of some kind be provided whereby the valve may move with the least inconvenience to the operator. In order to provide this result, (see Figs. 1, 5, and 6,) an annular head e^8 is arranged on the controlling-valve adjacent to its head portion and is of a diameter almost equal to the smaller bore of the valve-bushing. This annular head is arranged in such a manner as to provide a small groove a^9 between it and the large head of the valve. The front portion of the valve is provided with a boss or central offset e^{10}, as shown particularly in Figs. 5 and 6. As the valve is moved in one direction toward the right the air must naturally pass out through the opening a^2 rather slowly and as a consequence acts with a cushioning effect between the head of the valve and the head of the valve-chamber. When the valve is moved toward the other side of the chamber, as shown in Fig. 6, the annular head e^3 first enters the small bore in the valve-chamber and as a consequence reduces the area of the free portion of such bore, which acts to retard the passage of the air through the bore and permits the excess of air to act as a cushion for the valve in that direction.

It is highly desirable that a throttle-valve be provided of such construction and arrangement that fluid under pressure may be shut off entirely, the maximum amount provided, or any desired amount between the maximum amount and complete shut-off be supplied. This result is desirable for the reason that different kinds of work require a different blow of the hammer. For instance, for calking or riveting light and rapid blows are required, while for the operation of heavy chipping in iron or steel a heavy blow is desired, which requires the full amount of fluid-pressure. In order to accomplish this result, I provide a throttle-valve bushing, which is made in two parts G and G', having screw-threaded engagement with each other, one of which, G, is rigidly or practically immovably engaged with the handle, as shown in Fig. 1, the other part having threaded engagement therewith, whereby the valve-bushing may be relatively shortened or lengthened, as desired. This throttle-valve bushing is provided with a central chamber g, having communication with the main inlet f, and by means of its transverse perforations g' with the continuation f' thereof. In this central longitudinal chamber a controlling-valve H is movably mounted—that is, arranged to reciprocate or move backwardly and forwardly in the chamber thereof—so as to open and close the passages or ports g', and thus open or close the inlet-passage which connects the source of fluid-pressure supply with the chamber of the controlling-valve. This controlling-valve is provided with a stem h, arranged, preferably, so that it extends out through one end of the valve-bushing, where it may be contacted by a pivoted lever or trigger I, which in turn is pivoted to the upper part of the valve-bushing, as shown particularly in Figs. 1, 5, and 6. This operating-trigger is so pivoted to the valve-bushing that it may be moved over to contact the handle, as shown in Figs. 5 and 6, and the construction is such that at all times this operating-trigger or pivoted lever may be moved over by the thumb of the operator, so as to contact the handle, as shown in the last-named figure, thus limiting its movement in one direction. It is also provided with a small projecting lug i, which limits its movement in the other direction, this movement being due to the action of the helical spring h', which is inserted between the head of the throttle-valve and the head of the valve-bushing, as shown particularly in Figs. 1, 5, and 6. The action of this helical spring is such as to keep the throttle-valve normally closed, as shown in Fig. 1.

As the parts are arranged in Figs. 1, 5, and 6, the movement of the operating-trigger so as to contact the wall, as shown in Figs. 5 and 6, is such as to move the throttle-valve to open the passages to their greatest extent, and thereby permit the maximum supply of motive fluid to enter the controlling valve-chamber. If at any time it should be desirable to use a light stroke and cut off a portion of the supply of motive fluid all that is necessary to do is to turn the knurled head g^2 of the throttle-valve bushing in a direction opposite to the movements of the hand of a watch—in other words, to the left—which action unscrews the bushing and lengthens it out, so as to move the ports g' toward the front of the handle. This action, it will be seen, moves the ports in such a manner that the entire swing of the operating-trigger cannot move the throttle-valve sufficiently to entirely open these ports. A further turning of the valve-bushing in the same direction will move it to such an extent longitudinally as to prevent the movements of the throttle-valve from uncovering the passages or ports g' to any extent. It is desirable that some mechanism be provided to act as a check and prevent the free rotation of this valve-bushing. In order to accomplish this result, the inner face of the bushing-head, as shown in Fig. 10, is provided with a plurality of indentations g^3, arranged to receive the pointed end of an indexing or retarding pin g^4, the operations of which are controlled by a helical spring g^5, which acts to keep the pin in engagement with one of the recesses or depressions g^3, but will permit extraneous force to turn the valve-bushing in either direction.

A handle F, as above described, is provided and recessed or cupped at the front end of the base portion to receive one end of the fluid-pressure cylinder. In order to effectually clamp the handle or head portion and the fluid-pressure cylinder together, a sleeve K is provided, having an interior threaded surface arranged to engage with an exterior threaded surface of the handle portion. This sleeve is also provided with a shoulder k, adapted to abut against the shoulder A' of the fluid-pressure cylinder, so as to force such cylinder backward into contact with the inner cup-surface of the handle portion. These threads are preferably made in a right-hand manner, but this is not essential and the threads can be made either right or left, as desired.

In order to lock the sleeve and cylinder together, or, in other words, prevent independent rotations thereof, which might permit the handle and cylinder to be disengaged during the operations of the tool, I provide the cylinder with an annular-toothed portion L. (Shown particularly in Figs. 3, 4, and 12.) The sleeve is provided with a slot l on the inside of its shoulder portion, and pivotally mounted in this slot is a click or pawl l', having one end provided with a projection l^2, adapted to engage the teeth on the cylinder, and the other end extending backwardly and across an opening l^3 in the sleeve. During the engagement of the parts and as the sleeve is turned to the right the click or pawl rides over the annular toothed portion and prevents the opposite movement of the parts. When it is desired to disengage the parts, a pin or other object may be pushed in through the opening l^3, so as to engage the heel of the click and force it out of engagement with the annular toothed portion, which permits the ring to be turned to the left until the teeth or projections on the click ride on the upper surface of the cylinder. The pin or other object may then be withdrawn and the rotation of the sleeve toward the right continued.

I claim—

1. In a portable pneumatic hammer having an inlet-passage for the admission of motive fluid, the combination with a throttle-valve controlling such passage of a sleeve in which the valve is mounted made in two parts, one part substantially immovably secured to the hammer and the other part adjustably secured to the immovable part of the sleeve so as to change the relation of the port-openings therein relative to said throttle-valve, substantially as described.

2. In a pneumatic hammer having an inlet-passage for the admission of the motive fluid, the combination with a throttle-valve controlling said passage of an adjustable sleeve in which said valve is mounted, a spring for moving the valve in one direction to close the inlet-passage, and a trigger or operating-lever arranged to have a uniform swing or motion and be limited in its motion in each direction, whereby the controlling-valve may be moved the same distance each time, substantially as described.

3. In a pneumatic hammer having an inlet-passage for the admission of the motive fluid, the combination with a throttle-valve controlling said passage of a sleeve in which said sleeve is mounted formed in two parts one of which is relatively or substantially immovably secured in the hammer and the other having threaded engagement therewith so as to shorten or extend the length of the valve-bushing and thereby change the relation of the port-openings relative to said throttle-valve, and means for retarding the rotation of the movable part of the valve-bushing, substantially as described.

4. In a pneumatic hammer having an inlet-passage for the admission of the motive fluid, the combination with a throttle-valve controlling said passage of a sleeve in which said valve is mounted formed in two parts, one of which is relatively immovably secured in the hammer and the other having threaded engagement therewith so as to shorten or extend the length of the valve-bushing and thereby change the relation of the port-openings relative to said throttle-valve, a head on the movable part of the valve-bushing having its inner surface adjacent to a portion of the hammer and provided with a series of indentations or the like on such surface, and a spring-pressed pin arranged to engage with the indentations in the sleeve-head and retard the free rotation of the bushing, substantially as described.

5. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a piston-hammer reciprocatingly mounted therein, a handle provided with an inlet-passage for supplying the motive fluid and attached to the fluid-pressure cylinder, valve-bushing transversely of the handle neck or rim adjacent to the fluid-pressure cylinder, and having a central longitudinal passage or bore of different diameters forming a valve-chamber, a controlling-valve of differential diameters in the valve-chamber of the bushing, and a screw-plug entered into the handle neck or rim, engaging and holding the bushing in place and forming a head for the valve-chamber and provided with a port communicating with the valve-chamber, substantially as described.

6. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a piston-hammer reciprocatingly mounted therein, a handle having a neck or rim with a cup-shaped recess for the insertion of one end of the fluid-pressure cylinder and forming a head for the end of the fluid-pressure cylinder, a sleeve engaging with the handle neck or rim and with the fluid-pressure cylinder to hold the parts together, a valve-bushing transversely of the handle neck or rim adjacent to the head of the fluid-pressure cylinder, and having a central longitudinal passage or bore of different diameters forming a valve-chamber, a controlling-valve of differential diameters in the valve-chamber of the bushing and a plug screw-threaded into the handle neck or rim and engaging and holding the bushing in place, and forming a head for the controlling valve-chamber and provided with a port communicating with the valve-chamber, substantially as described.

7. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder provided with an annular shoulder at its rear end, a handle having a neck or rim provided with an exterior screw-thread, a sleeve having a shoulder at its front end arranged to engage the shoulder of the fluid-pressure cylinder and provided with an interior thread to engage the screw-thread of the handle neck or rim, ratchet-teeth on the exterior of the fluid-pressure cylinder forward of the shoulder and a pawl carried by and wholly incased within the sleeve and operating to engage the ratchet-teeth and prevent rotation of the parts in one direction and permit rotation thereof in an opposite direction, substantially as described.

8. In a portable pneumatic hammer, the

combination of a fluid-pressure cylinder provided with an annular shoulder or rim at its rear end, a handle having a neck or rim provided with a socket to receive the rear end of the fluid-pressure cylinder and with a threaded outer periphery, engaging teeth on the exterior of the fluid-pressure cylinder forward of and adjacent to the shoulder or rim thereon, a threaded sleeve engaging the threaded periphery of the handle neck or rim and provided with a shoulder or flange at its front end to engage the shoulder or rim on the fluid-pressure cylinder, a recess in the shoulder or flange having an opening or perforation leading therefrom out through the periphery of the sleeve, and a spring-pressed click located wholly within the recess and operating to engage the teeth on the fluid-pressure cylinder and permit rotation of the parts in one direction and prevent rotation of the parts in the other direction until a pin or other object is inserted in the perforation and the click disengaged from the teeth, substantially as described.

9. In a portable pneumatic hammer having an inlet-passage for the admission of the motive fluid, the combination with a throttle-valve of a controlling-valve bushing inserted in the hammer and provided with a bore of large and small diameters, a differential valve in said controlling-valve bushing provided with a large-headed portion for the large bore of the bushing and a reduced portion for the reduced bore of the bushing and further provided with an annular ring or bead arranged adjacent to the large head of the valve so that as the valve is forced in one direction the area of the free opening in the valve-bushing is reduced so as to restrict the passage of air therein and act as a cushion for the valve, substantially as described.

10. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a reciprocating piston-hammer in the cylinder, a handle provided with an induction-passage for the fluid-pressure and with a neck or rim for attachment to the fluid-pressure cylinder, a bushing in the handle neck or rim transversely thereof, a central longitudinal chamber in the bushing of different diameters, a valve having a head or disk traversing the larger diameter of the chamber and a body or stem traversing the smaller diameter of the chamber, and an initial induction-port in the bushing communicating with the chamber thereof for supplying fluid-pressure to the inner face of the valve head or disk and initially moving the valve, substantially as described.

11. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a reciprocating piston-hammer in the cylinder, a handle provided with an induction-passage for the fluid-pressure and with a neck or rim for attachment to the fluid-pressure cylinder, a bushing in the handle neck or rim transversely thereof, a central longitudinal chamber in the bushing of different diameters, a valve having a head or disk traversing the larger diameter of the chamber and a body or stem traversing the smaller diameter of the chamber, an initial induction-port in the bushing communicating with the chamber thereof back of the valve head or disk for supplying fluid-pressure to initially move the valve, and a full induction-port controlled by the valve head or disk, substantially as described.

12. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a reciprocating piston-hammer in the cylinder, a handle provided with an induction-passage for the fluid-pressure and with a neck or rim for attachment to the fluid-pressure cylinder, a bushing in the handle neck or rim transversely thereof, a central longitudinal chamber in the bushing of different diameters, a valve having a head or disk traversing the larger diameter of the chamber and a body or stem traversing the smaller diameter of the chamber, an annular groove in the valve body or stem adjacent to the head or disk, an initial induction-port in the bushing communicating with the annular groove of the valve body or stem, and a full induction-port controlled by the valve head or disk, substantially as described.

13. In a portable pneumatic hammer, the combination of a fluid-pressure cylinder, a reciprocating piston-hammer in the cylinder, an induction-passage for the fluid-pressure, a bushing interposed between the fluid-pressure cylinder and the induction-passage and provided with a central longitudinal chamber of different diameters, a valve having a head or disk traversing the larger diameter of the chamber, and a body or stem traversing the smaller diameter of the chamber, an initial induction-port in the bushing, a full induction-port in the bushing communicating with the induction-passage and with the fluid-pressure cylinder and controlled by the valve head or disk, and an annular groove in the valve body or stem communicating with the full induction-passage, substantially as described.

14. In a portable pneumatic hammer, the combination of a valve-bushing located transversely of the hammer-body and provided with a central longitudinal valve-chamber of different diameters, an initial fluid-pressure induction-port and a full fluid-pressure induction-port in the bushing, an annular passage for eduction in the bushing, a valve traversing the chamber of the bushing, a head or disk on the valve controlling the full induction-port, a groove in the body or stem of the valve communicating with the initial induction-port, a groove in the body or stem of the valve for communication with the eduction-passage of the bushing, and eduction-openings from the eduction groove or passage of the valve leading into the interior of the valve body or stem, substantially as described.

15. In a portable pneumatic hammer, the combination of a valve-bushing located transversely of the hammer-body and provided with a central longitudinal valve-chamber of different diameters, an initial fluid-pressure induction-port and a full fluid-pressure induction-port in the bushing, an annular passage for eduction in the bushing, a valve traversing the chamber of the bushing, a head or disk on the valve controlling the full induction-port, a groove in the body or stem of the valve communicating with the initial induction-port, a groove in the body or stem of the valve for communication with the eduction-passage of the bushing, eduction-openings from the eduction groove or passage of the valve leading into the interior of the valve body or stem, and an eduction-passage through the wall of the chamber, substantially as described.

16. In a portable pneumatic hammer, the combination of a controlling valve-chamber of different diameters and provided with an initial induction-port, a full induction-port and an eduction-port, and a reciprocating valve located and operating in the chamber and having a head or disk and a body or stem corresponding to the large and small diameters respectively of the bushing-chamber and provided with a central longitudinal chamber, an exterior channel or groove, a depressed portion forming an annular passage around the body or stem, an annular passage or channel around the body of the stem communicating with the eduction-port, and eduction-openings between the annular eduction passage or channel and the interior chamber of the valve for the induction and eduction of fluid-pressure, substantially as described.

17. In a portable pneumatic hammer, the combination of a fluid-pressure induction-passage and a fluid-pressure eduction-passage, a valve-bushing located transversely of the induction-passage and having a chamber of different diameters and provided with an initial induction-port, a full induction-port, and an eduction-port, a controlling-valve in the bushing-chamber having a head or disk and a body or stem corresponding respectively to the large and small diameters of the bushing-chamber and provided with an interior longitudinal chamber and an exterior annular groove, an exterior annular passage and an exterior channel with openings therefrom leading into the valve-chamber for inducting and educting fluid-pressure, substantially as described.

18. In a portable pneumatic hammer, the combination of a bushing having therein a valve-chamber with an induction and eduction port, a cap closing one end of the bushing and provided with a port, a valve traversing the chamber of the bushing and having a contact end engaging the face of the bushing and furnishing a pressure-space between the bushing and the valve for cushioning effect, substantially as described.

19. In a portable pneumatic hammer, the combination of a handle having fluid-pressure induction and eduction passages, a valve-bushing located transversely of the induction-passage, a chamber of different diameters in the bushing and having induction and eduction ports, a valve in the bushing-chamber controlling the induction and eduction ports and having an interior chamber and provided with an exterior annular groove, an exterior annular passage, and an exterior annular chamber with openings leading therefrom into the interior chamber of the valve, and a hammer-tube provided with induction and eduction fluid-pressure passages and ports controlled by the movements of the valve for operating a reciprocating piston-hammer in the chamber of the hammer-tube, substantially as described.

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Witnesses:

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