

(No Model.)

4 Sheets—Sheet 1.

T. H. PHILLIPS.
IMPACT TOOL.

No. 592,166.

Patented Oct. 19, 1897.

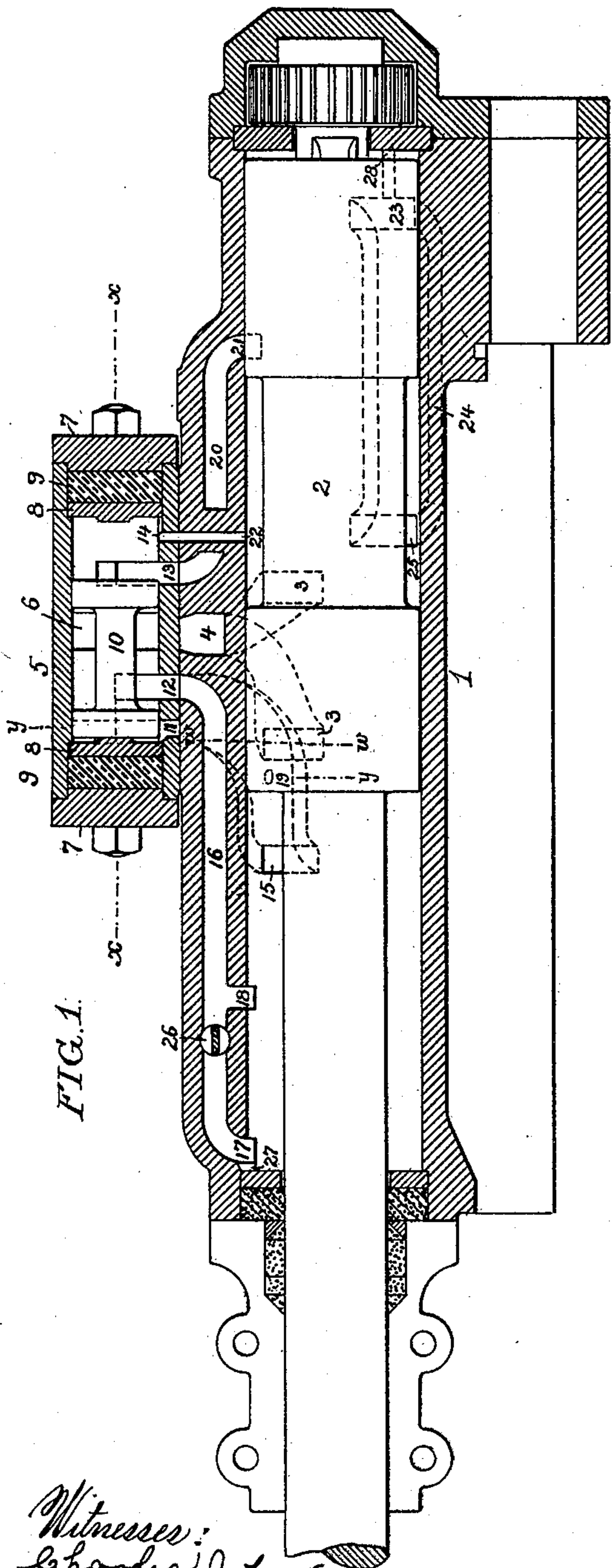


FIG. 1.

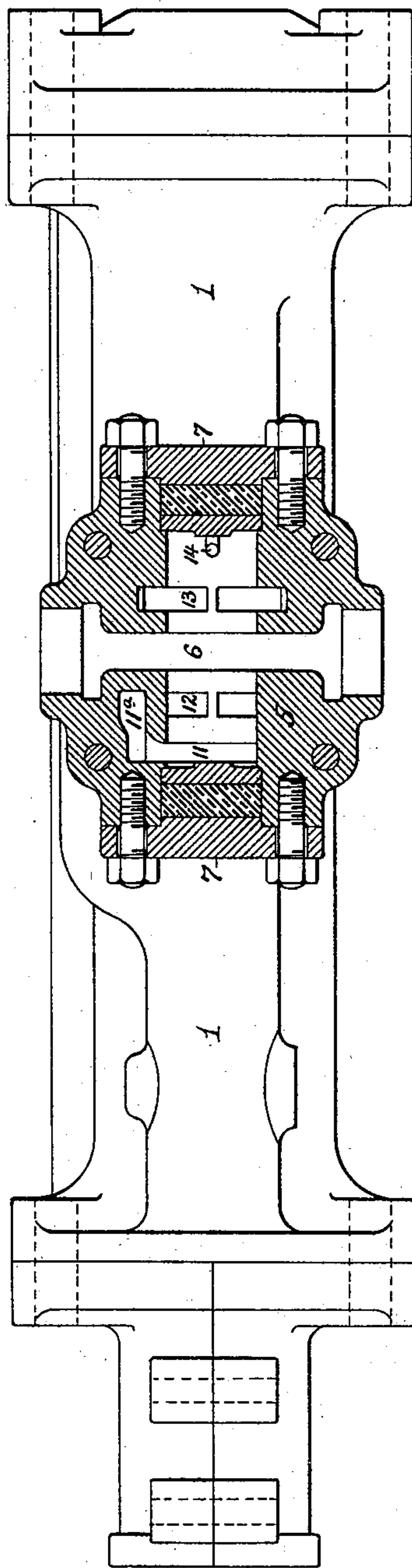


FIG. 2.

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James C. Krayner.

Inventor:
Thomas H. Phillips,
by his Attorneys,
Howson & Howson

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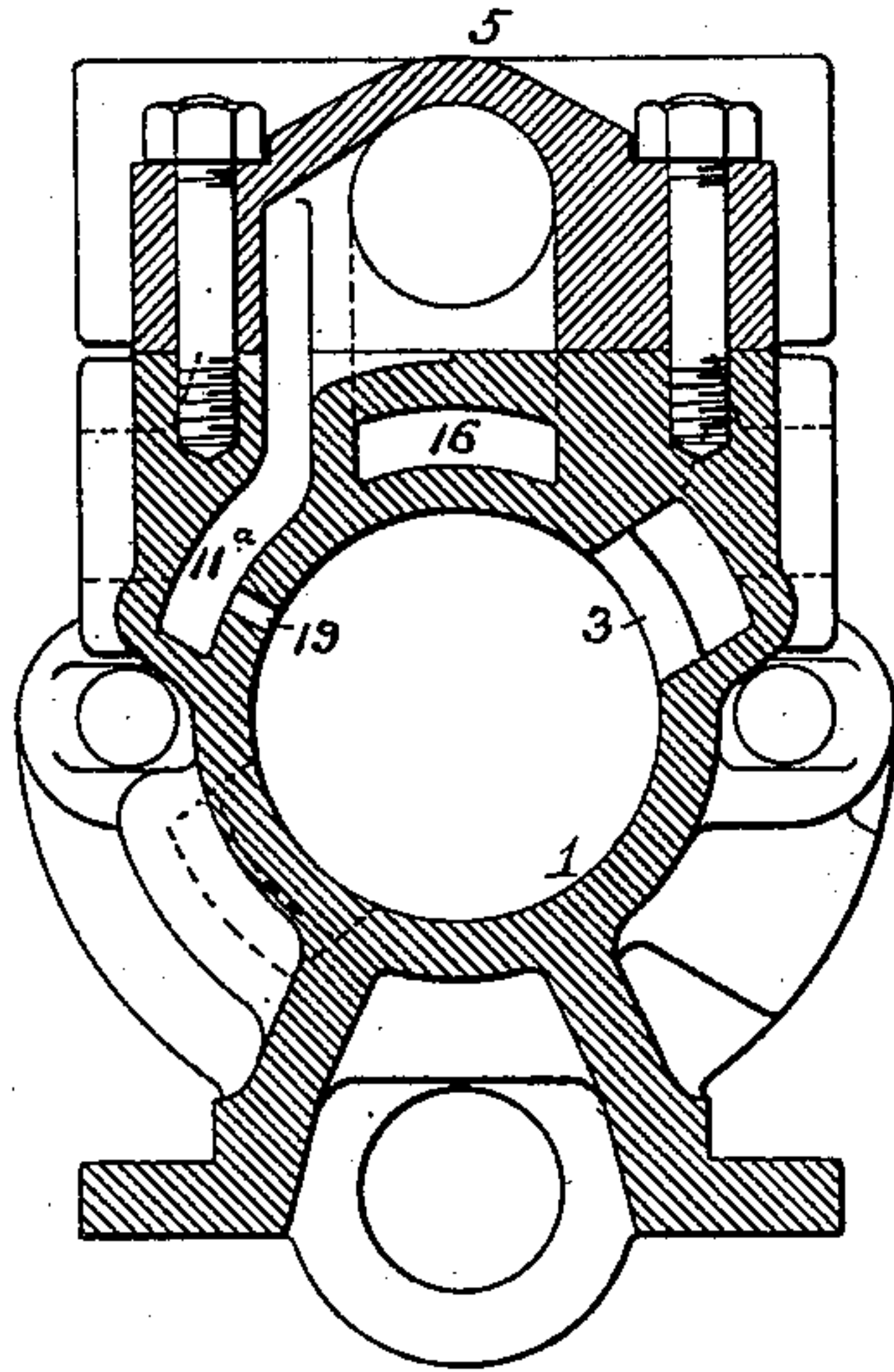


FIG. 3.

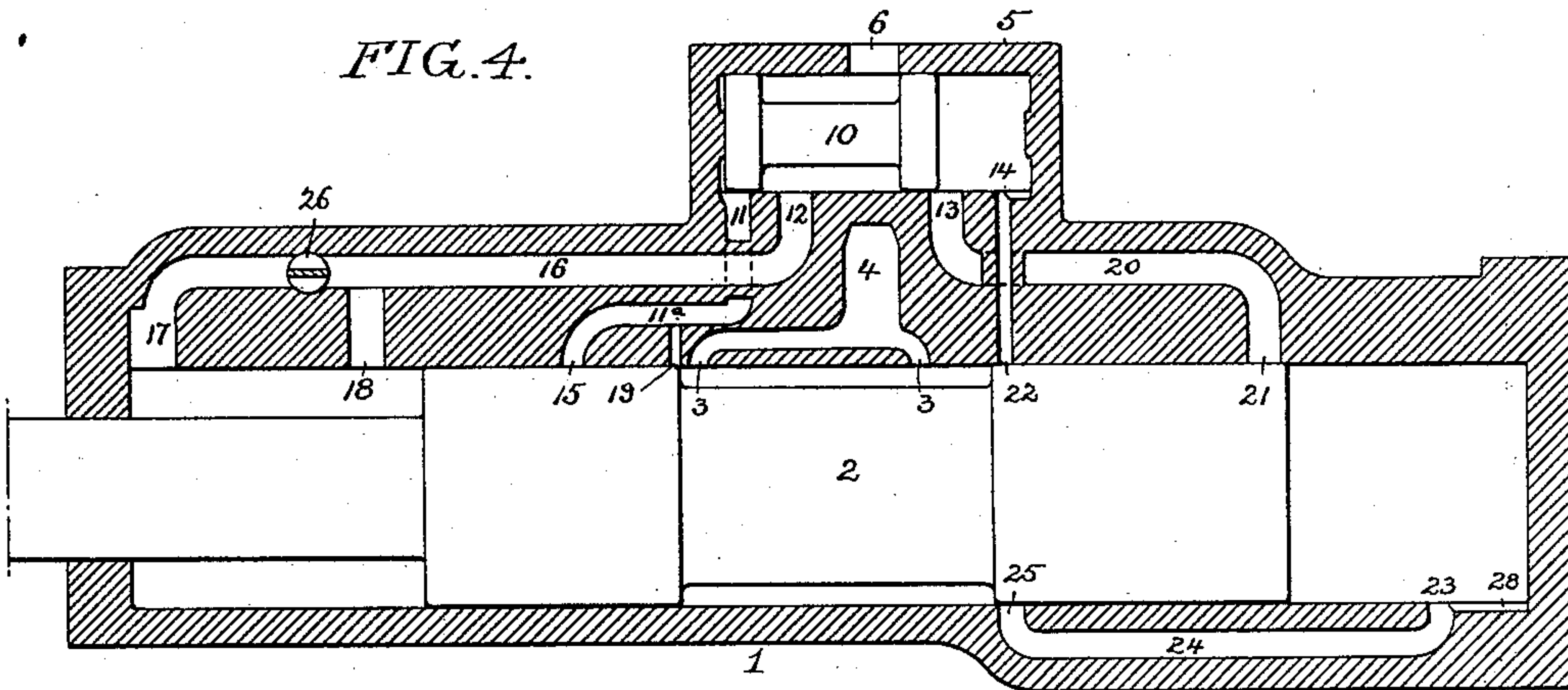


FIG. 4.

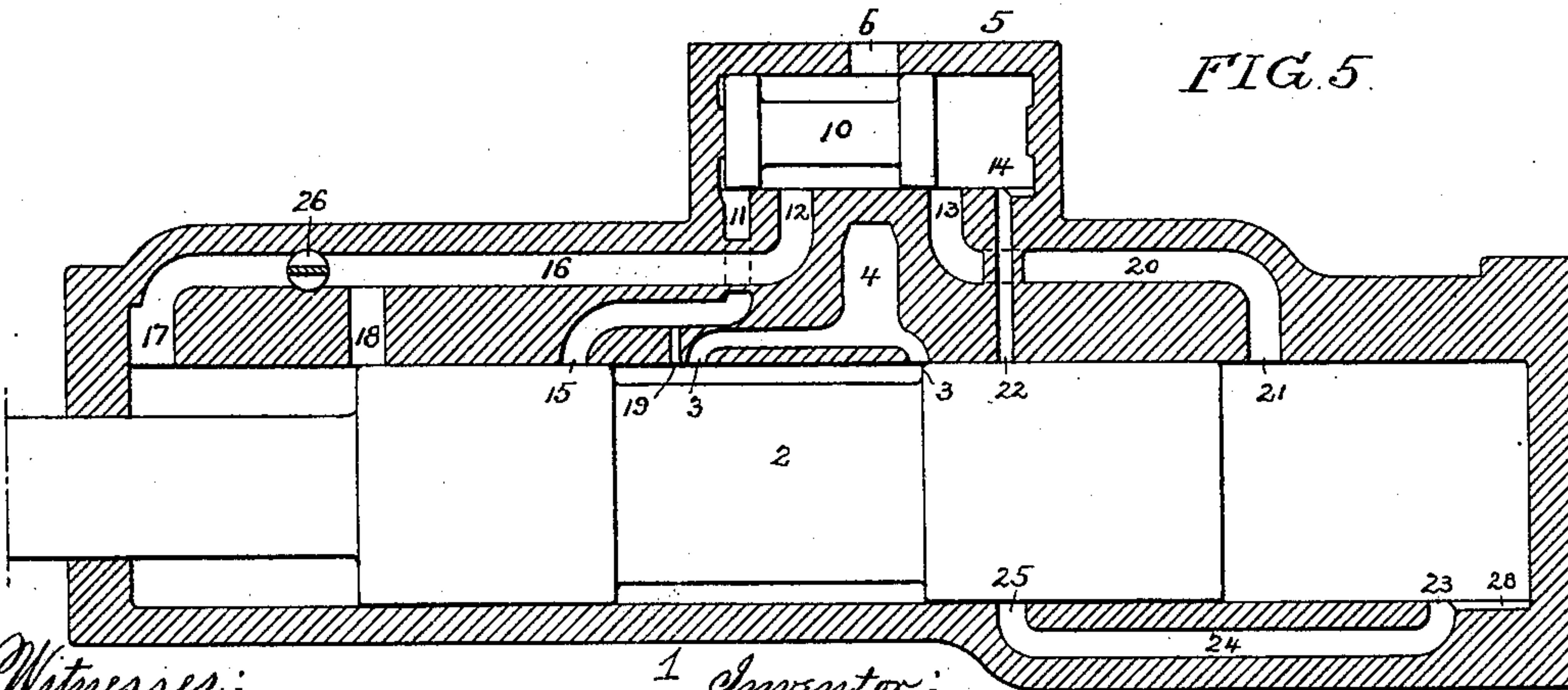


FIG. 5.

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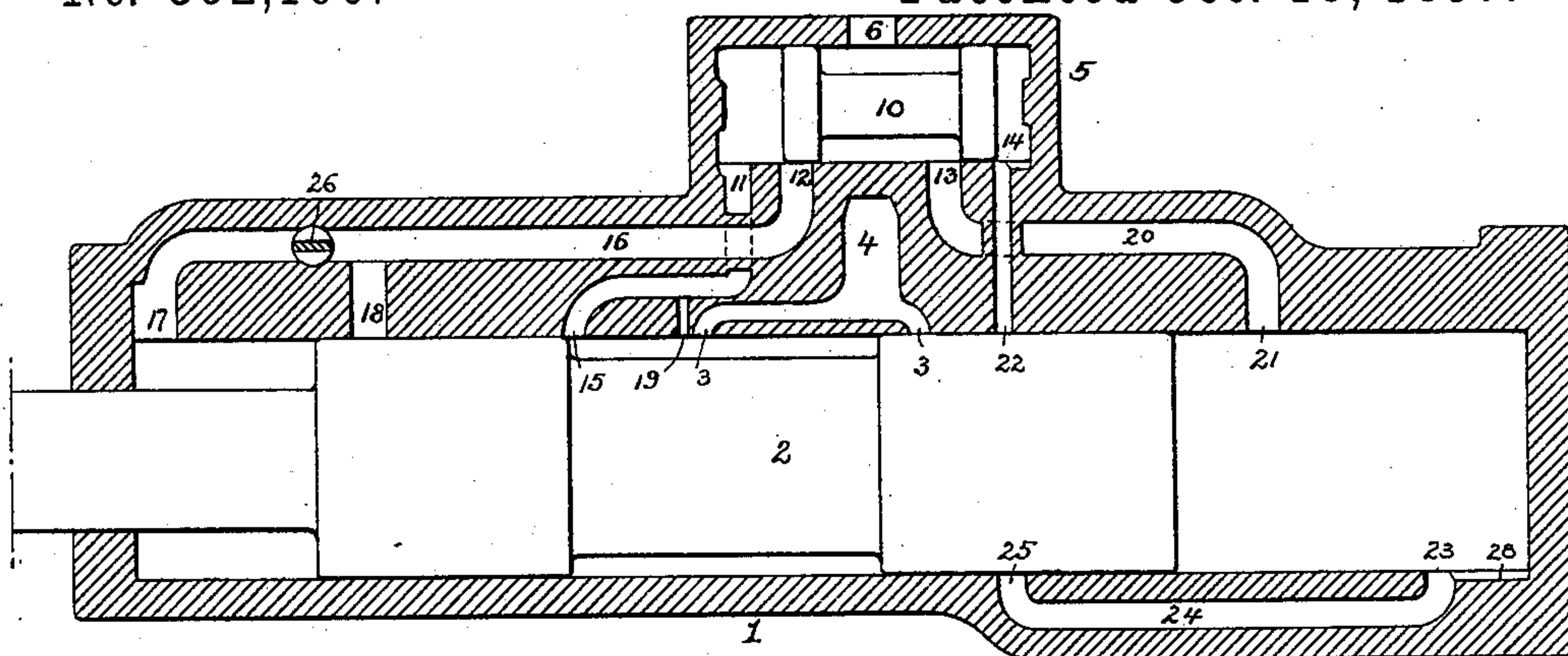
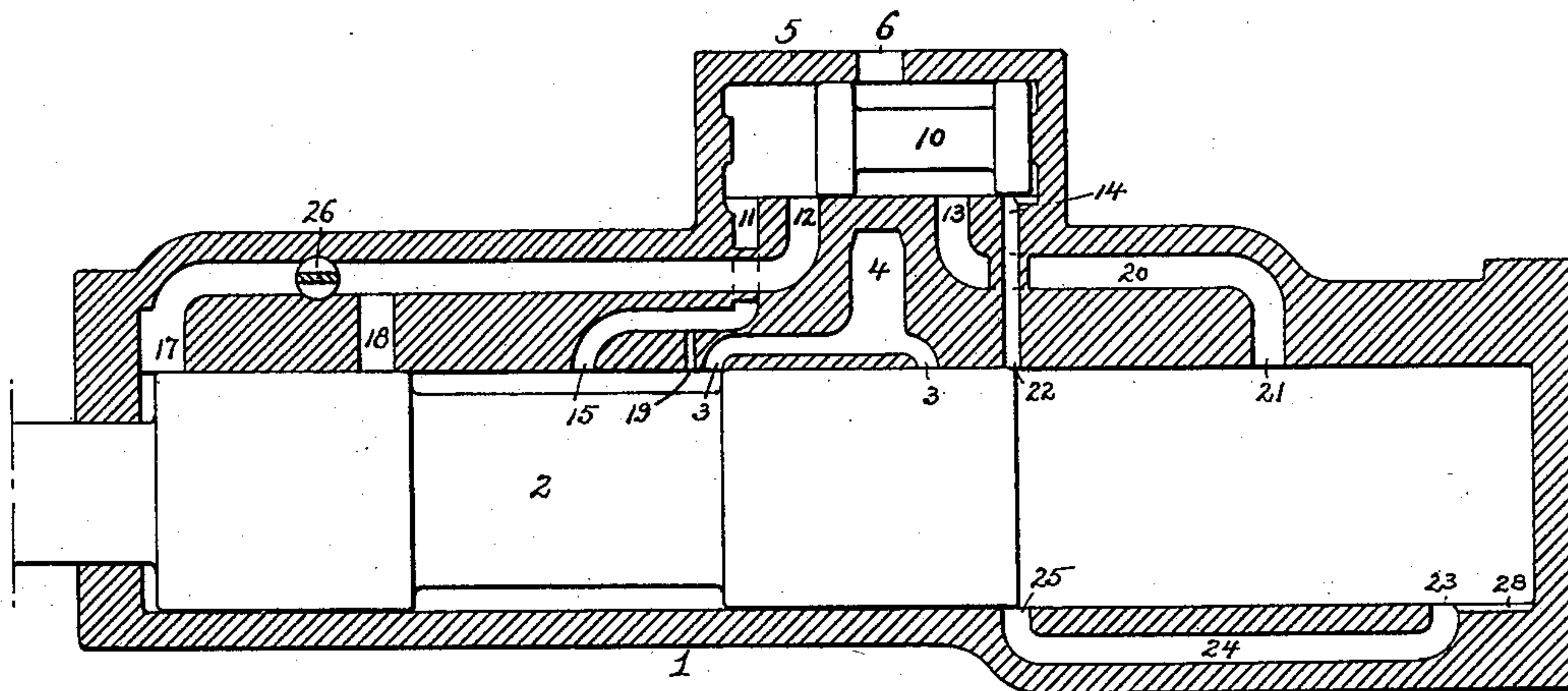


FIG. 7



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T. H. PHILLIPS.
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4 Sheets—Sheet 4.

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FIG. 8

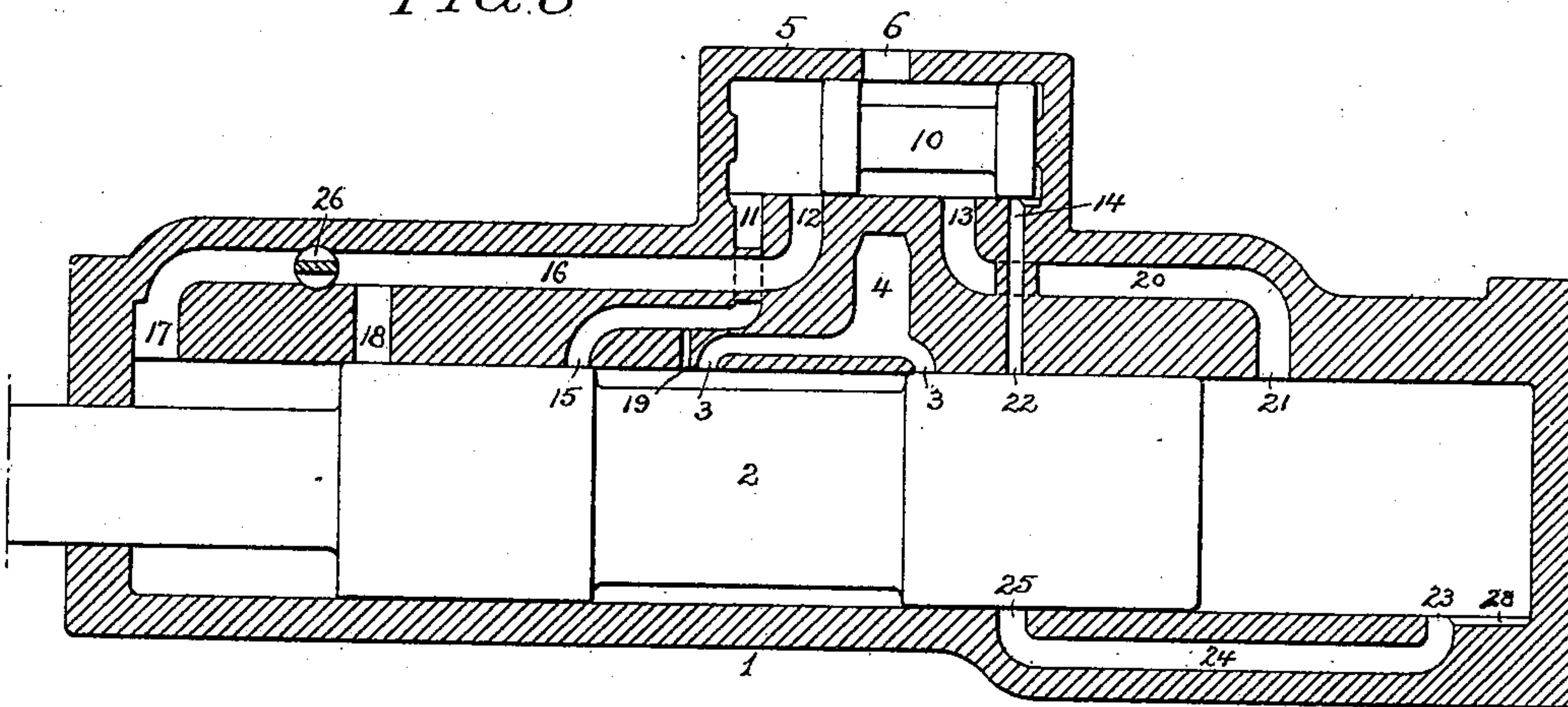
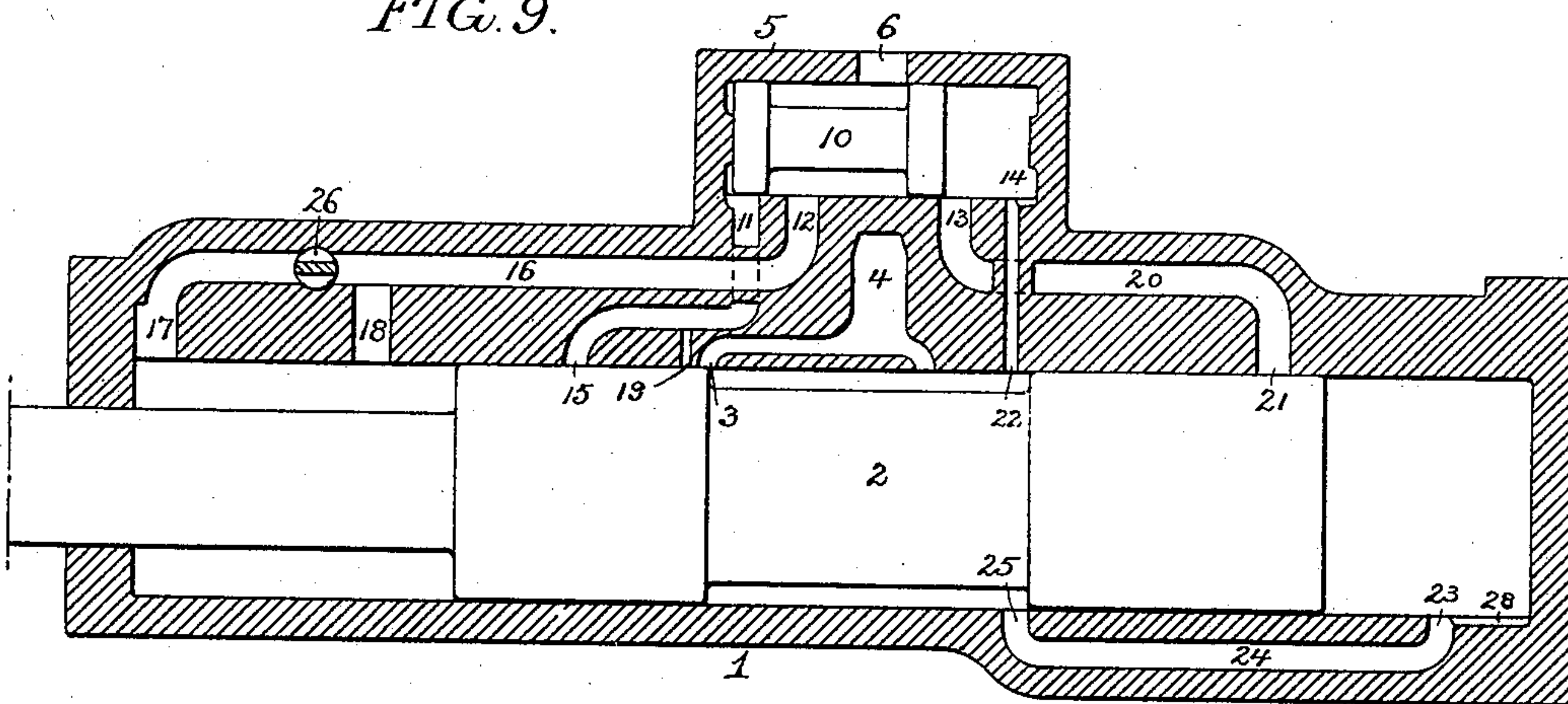


FIG. 9.



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UNITED STATES PATENT OFFICE.

THOMAS H. PHILLIPS, OF ST. DAVIDS, PENNSYLVANIA.

IMPACT-TOOL.

SPECIFICATION forming part of Letters Patent No. 592,166, dated October 19, 1897.

Application filed April 30, 1897. Serial No. 634,601. (No model.)

To all whom it may concern:

Be it known that I, THOMAS H. PHILLIPS, a citizen of the United States, residing in St. Davids, Pennsylvania, have invented certain
5 Improvements in Impact-Tools, of which the following is a specification.

My invention consists of certain improvements in impact-tools, such as rock-drills using steam, compressed air, or other expan-
10 sible motive fluid, which, for convenience, in this specification I will refer to simply as "steam."

The objects of my invention are, first, to insure the free exhaust of the steam from the
15 rear end of the cylinder, so as to avoid back pressure on the piston on the return stroke; second, to delay the admission of steam to the front end of the cylinder until the blow has been struck, thereby securing an un-
20 cushioned blow; third, to accomplish these results by the employment of a single valve and to so control the movement of said valve that it will be cushioned and prevented from violently striking the buffer at either end of
25 the valve-chest, and, fourth, to simplify and cheapen the construction of the tool. These objects I attain in the manner hereinafter set forth, reference being had to the accompanying drawings, in which—

30 Figure 1 is a longitudinal section of an impact-tool constructed in accordance with my invention. Fig. 2 is a view partly in elevation and partly in sectional plan on the line $x x$, Fig. 1. Fig. 3 is a transverse section
35 partly on the line $y y$ and partly on the line $w w$, Fig. 1, omitting the valve; and Figs. 4, 5, 6, 7, 8, and 9 are diagrams illustrating the operation of the tool.

The cylinder 1 contains the piston 2, which
40 is constructed, as usual, with opposite heads having between them a central recessed portion, forming a live-steam chamber which is in constant communication with the main inlet through one or other, or both, of the
45 steam-inlet ports 3, the latter communicating in any available manner with the steam-inlet channel 4, to which steam may be admitted from either side, as most convenient, the opening at the other side being properly
50 closed.

Mounted upon the cylinder at one side of the same is a valve-chest 5, having central ports

or passages 6, communicating with exhaust-channels at opposite sides of the chest, so that the exhaust may be taken from either side, 55 the other side being closed. The valve-chest has suitable end caps 7 and internal buffer-plates 8, between which and the end caps are placed springs or masses of elastic or semi-elastic material 9, so that elastic buffers are 60 provided at each end of the valve-chest for receiving the impact of the valve 10. The latter is an ordinary spool-valve having opposite end disks connected by a contracted stem so as to form a central channel or cham- 65 ber, and it operates in conjunction with certain ports 11, 12, 13, and 14, formed in the valve-chest. The port 11 communicates directly, and the port 12 communicates, through the valve-chest and a port 11, with a passage 70 11^a, which communicates with the interior of the cylinder through a port 15, located in said cylinder some distance in advance of the longitudinal center of the same, and the port 12 communicates with a passage 16, which has a 75 port 17 at the front end of the cylinder and another port 18 some distance inward from said end port. A port 19 of limited area provides a communication between the interior of the cylinder and the passage 11^a at a point 80 some distance rearwardly from the port 15. The port 13 communicates with a passage 20, which terminates in a port 21, located in the cylinder some distance in advance of the rear end of the same, and the port 14 communi- 85 cates with a passage 22, which leads directly from said port to the cylinder. A port 23 near the rear end of the cylinder communicates through a passage 24 with a port 25, formed in the cylinder at a point some dis- 90 tance in advance of the port 23, the forward edge of the port 25 and the forward edge of the passage 22 being preferably in the same transverse plane.

In the passage 16, between the ports 17 and 95 18 of the same, is located a choke-plate 26 of the character set forth in my Patent No. 561,030, dated May 26, 1896, the purpose of this choke-plate being to provide for restricting the flow of steam into the front end of the 100 cylinder through the port 17 as desired. A passage 27 leads from the port 17 to the plate which closes the front end of the cylinder, so that steam can enter the cylinder at its ex-

treme forward end, and a passage 28 leads from the port 23 to the plate which closes the rear end of the cylinder, said passage 28 being of limited area in cross-section to assist in cushioning the piston.

The operation of the tool will be understood on reference to Fig. 1, and to the diagrammatic views Figs. 4 to 9, inclusive. As shown in Fig. 1, the piston is at the extreme rear end of its stroke and steam is entering the rear end of the cylinder through the rear port 3, the central chamber of the piston, the port 25, passage 24, port 23, and passage 28, the valve 10 occupying a position at the forward end of the valve chest, so that the forward end of the cylinder is open to the exhaust through the ports 17 and 18, passage 16, and ports 12 and 6. Steam under pressure enters the rear end of the valve-chest through the passage 22 and port 14, so as to maintain the valve in its forward position in the chest. As the piston moves forward in the cylinder the first effect of the movement is to cut off the flow of steam into the rear end of the cylinder by the closing of the port 25 by the rear head of the piston, as shown in Fig. 4, this same movement also closing the passage 22. Steam now acts expansively in the rear end of the cylinder to continue the forward movement of the piston, and the port 21 is uncovered so as to open communication between the rear end of the valve-chest and the rear end of the cylinder and equalize the pressure therein. As the piston continues to move forward its front end uncovers the small port 19, as shown in Fig. 5, and thus permits steam in limited volume to enter the passage 11^a, and thence, through the port 11, to gain access to the forward end of the valve-chest. By this means pressure is accumulated in the forward end of the valve-chest, but as this pressure is exerted against the pressure, somewhat reduced by expansion, at the rear end of the chest, it does not effect a quick rearward movement of the valve 10, but simply serves to overcome the inertia of said valve, or move it slowly rearward, so that by the time the front head of the piston, in its forward movement, uncovers the port 15, as shown in Fig. 6, and thereby admits the full volume of steam to the front end of the valve-chest, the valve is in condition to move promptly under this pressure. The first effect of the movement of the valve is to uncover the port 13, as shown in Fig. 6, and thereby open the rear end of the cylinder to the exhaust through port 21, passage 20, and ports 13 and 6. The ports 12 and 13 are so disposed in respect to the valve that the port 13 is opened to the exhaust before the port 12 is opened to the steam, so that while there is a free exhaust of the steam from the rear end of the cylinder in order to prevent back pressure upon the piston on the return stroke, the admission of steam to the forward end of the cylinder is delayed because of this action of the valve, and also because the final portion of

the rearward movement of the valve is retarded by the cushioning effect of the steam trapped in the rear end of the valve-chest, which steam must be forced from said rear end of the valve-chest either forwardly around the rear disk of the valve, or rearwardly around the rear head of the piston, or partly through both avenues of escape, the disks of the valve and heads of the piston having a reasonably neat fit in the valve-chest and cylinder, respectively. Hence by the time the port 12 is opened, as shown in Fig. 7, and steam in any considerable volume can enter the front end of the cylinder and act upon the forward head of the piston, the latter, owing to the greater velocity with which it moves as compared with that of the valve, has reached the forward limit of its stroke, as shown in Fig. 7, and the blow has been delivered. Hence there is no cushioning of the blow, such as results from the premature admission of steam to the forward end of the cylinder. The piston is now forced rearwardly in the cylinder, the full steam-pressure being exerted until the piston reaches the position shown in Fig. 8, where the front head of the piston closes the port 15 and thus cuts off the flow of steam into the forward end of the cylinder, with the exception of the limited flow through the port 19, this flow being also cut off soon after. The expansion of the steam in the forward end of the cylinder begins, however, as soon as the port 15 is closed, and continues until the piston reaches the position shown in Fig. 9, so as to again open the port 25 and passage 22 and permit live steam to enter the rear end of the cylinder and the rear end of the valve-chest. The admission of steam to the rear end of the cylinder, it will be observed, is not controlled by the valve. Hence the movement of the latter cannot delay the admission of steam in full volume to said rear end of the cylinder, so as to properly cushion the piston on the back stroke and prevent injury to the rear head of the cylinder by contact of the piston therewith. As the valve moves forward in the valve-chest it opens the front end of the cylinder to the exhaust through the ports 17 and 18, passage 16, and port 12, the final movement of the valve being cushioned in the same manner as its backward movement by the necessity of forcing the trapped steam from the front end of the valve-chest, either backwardly around the forward disk of the valve or forwardly around the front head of the piston, or both. Free exhaust of steam from the front end of the cylinder is provided by the port 18 irrespective of the obstructive action of the choke-plate 26. The ports 19 and 22 are preferably so disposed in reference to each other and to the heads of the piston that one will be opened just as the other is closed, so that there will always be live-steam pressure in one or other end of the valve-chest. As the valve is moved by the difference in pressure in the front and rear ends of the valve-chest, it must of necessity move

less rapidly than if one end of the valve-chest was open to the exhaust and there was no back pressure upon the valve, and as the volume of steam to be exhausted from the rear end of the cylinder is considerably larger than that to be exhausted from the front end it is important that the valve be started promptly on its rearward movement. Hence steam is admitted in limited volume to the front end of the valve-chest in order to overcome the inertia of the valve or start the same before the steam is admitted in full volume to said front end of the valve-chest by the uncovering of the port 15. Instead of using the small port 19 in the rear of the main port 15, a passage of contracted area—such, for instance, as the passage 27 or 28—may lead rearwardly from the port 15 to the desired extent, the result—namely, the admission of steam to the valve-chest in limited volume before the opening of the port 15—being the same in either case.

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

1. An impact-tool in which are combined a cylinder, a valve-chest, a valve in said chest, a reciprocating piston whereby the flow of steam to the valve-chest is governed, passages for admitting steam to and exhausting it from the ends of the cylinder, and a passage for conveying steam from the cylinder to the front end of the valve-chest, said passage communicating with the cylinder through a main port, and through a contracted passage which is opened to the steam in advance of the opening of the main port, for the purpose specified.

2. An impact-tool in which are combined a cylinder, a valve-chest, a reciprocating piston, a reciprocating valve, passages for admitting steam to and exhausting it from the rear end of the cylinder, an induction and exhaust passage leading from the valve-chest and having two ports in the cylinder, one at the front end of the same, and one some distance rearwardly from said front end, and a choke-plate located in said passage between said ports, the ports being so disposed that the unobstructed port will be covered by the

piston while steam is being admitted through the valve, whereby the admission of steam to the front end of the cylinder is wholly through the port controlled by the choke-plate, but the exhaust of steam from said front end of the cylinder is through both ports, substantially as specified.

3. The combination in an impact-tool, of a cylinder having induction and eduction ports, a reciprocating piston in said cylinder, a valve-chest, and a single valve contained therein, said valve controlling the exhaust from both ends of the cylinder and the inlet to the forward end of the same, the inlet of steam to the valve-chest and to the rear end of the cylinder being controlled by the piston, substantially as specified.

4. The combination in an impact-tool, of a cylinder having a reciprocating piston therein, a valve-chest containing a valve adapted to reciprocate therein, and ports and passages for admitting steam from the cylinder first to one end of the valve-chest and then to the other end of the same, the valve-chest having outlets at the ends only through the passages by which steam enters the chest, the piston closing the cylinder end of each inlet-port to the chest when the valve is cushioning, whereby steam trapped in either end of the chest is forced to escape around the disk of the valve or the head of the piston, or both, substantially as specified.

5. The combination in an impact-tool, of a cylinder having a piston adapted to reciprocate therein, a valve-chest having an induction-port communicating with the forward end of the cylinder, and an exhaust-port communicating with the rear end of the cylinder, and a valve adapted to reciprocate in said chest but so disposed in respect to said ports that the exhaust-port will be opened in advance of the inlet-port, substantially as specified.

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

THOMAS H. PHILLIPS.

Witnesses:

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JOS. H. KLEIN.