C. F. DUVAL & H. McDERMOTT.

PNEUMATIC HAMMER.

APPLICATION FILED JULY 15, 1910.

998,477.

Patented July 18, 1911.

3 SHEETS—SHEET 1.

Fig. 1.

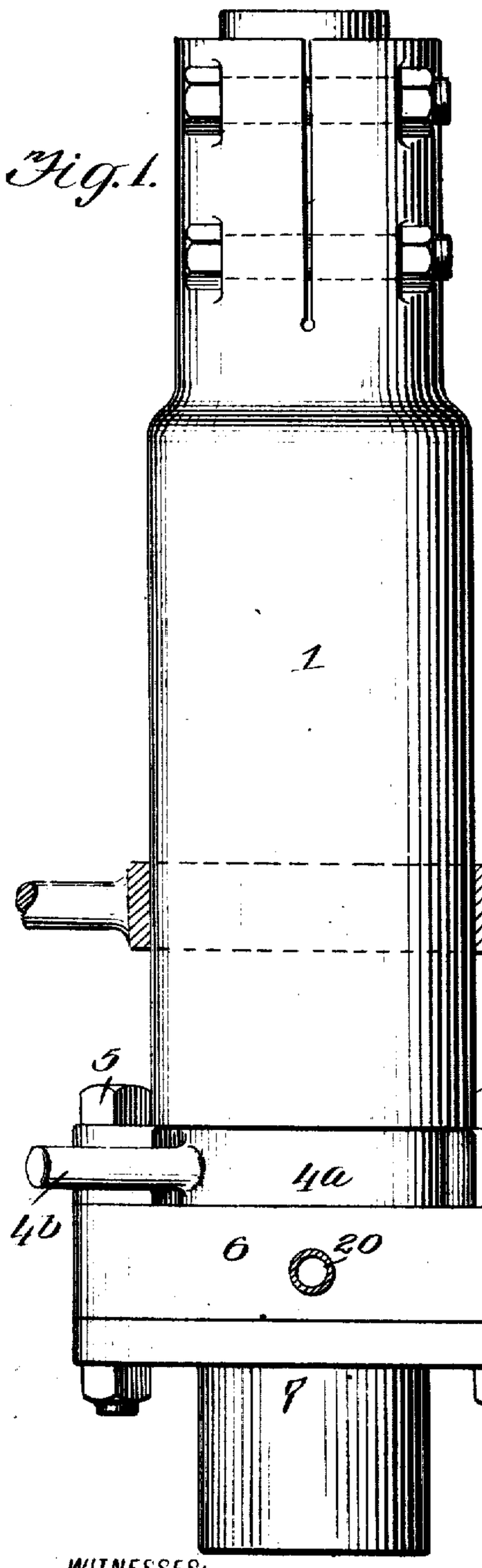

Fig. 2.

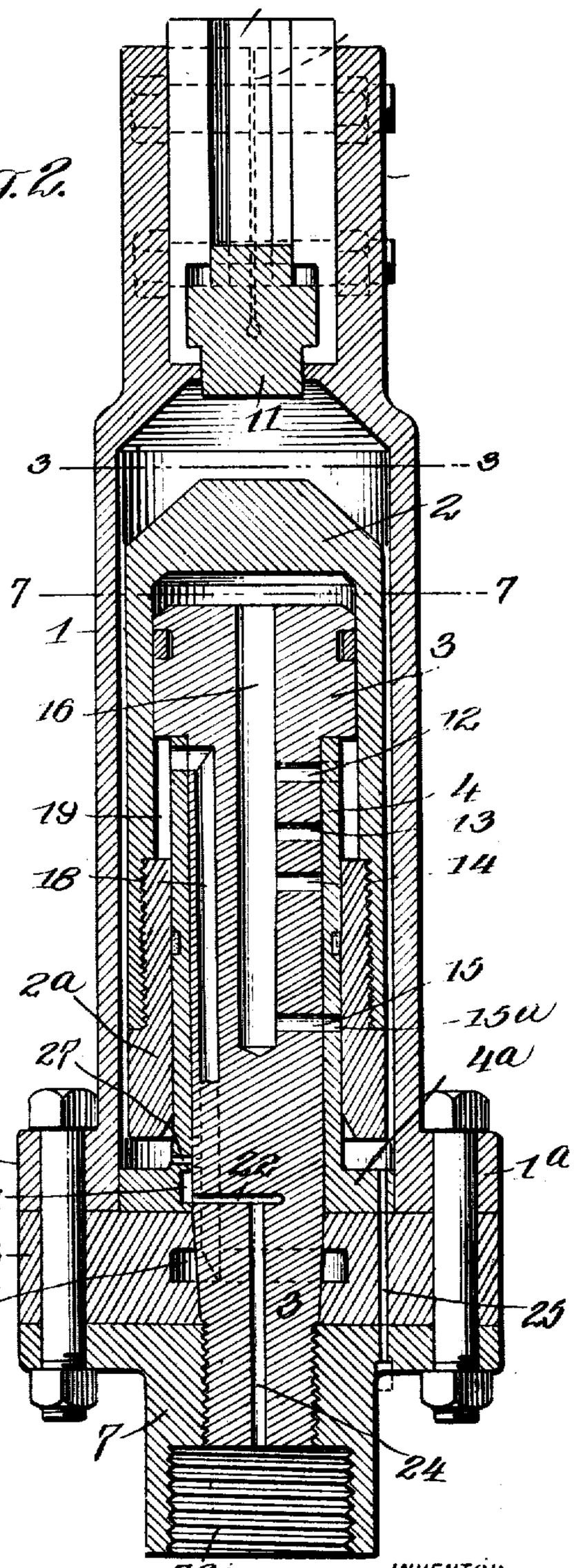

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Fig. 4.

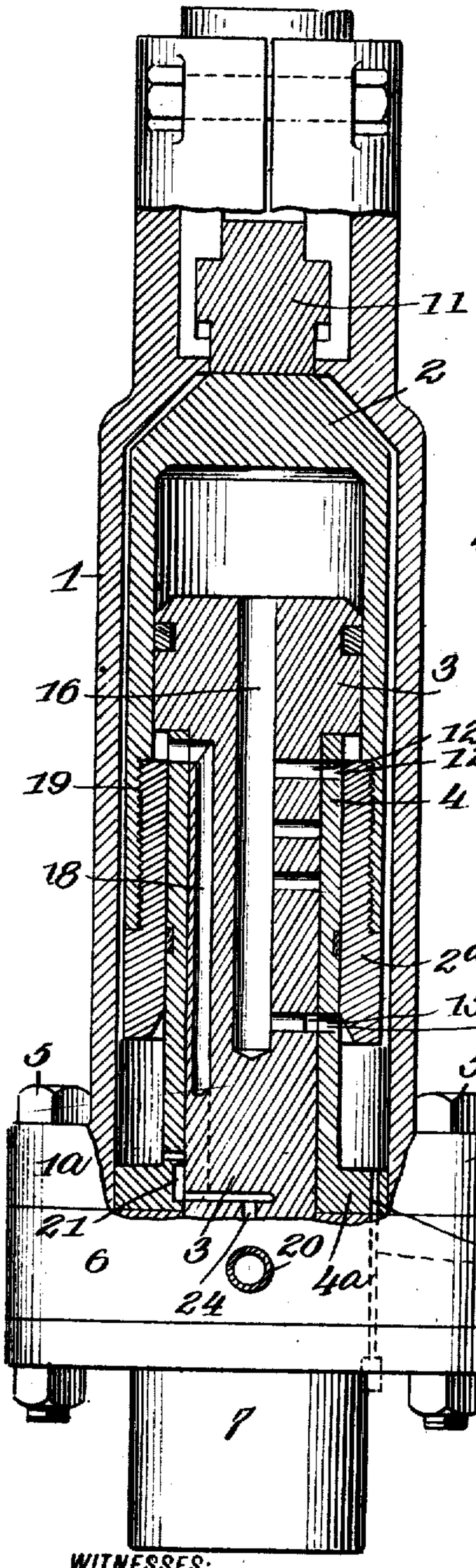


Fig. 5.

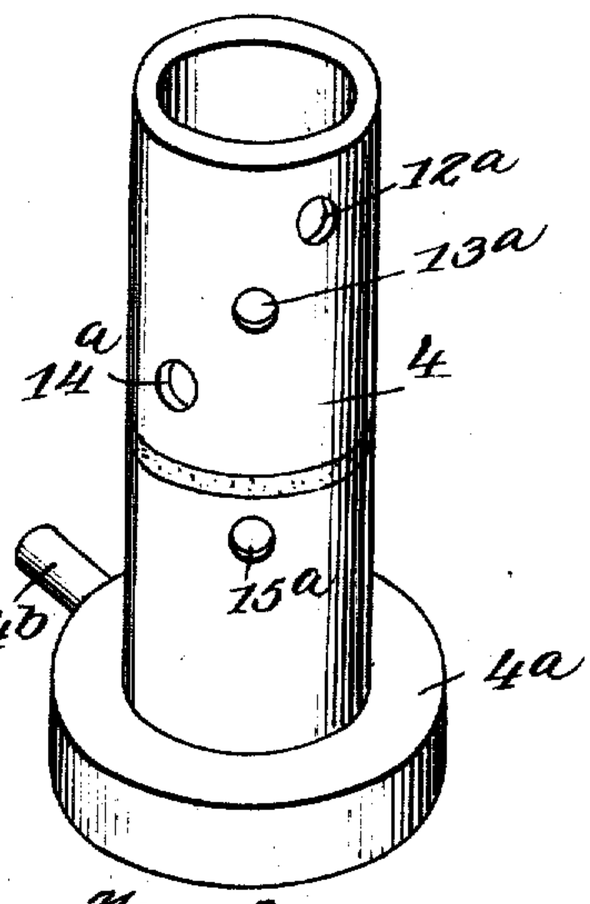


Fig. 6.

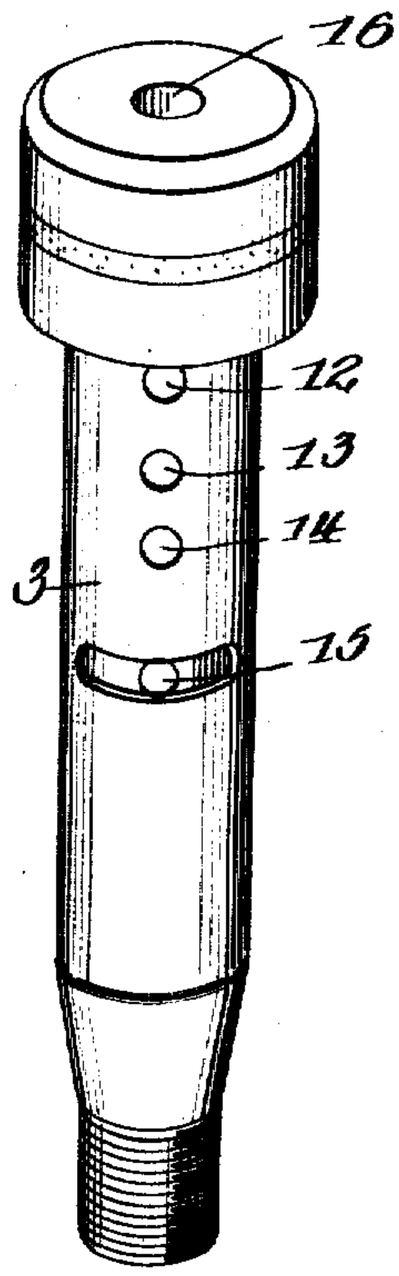


Fig. 3.

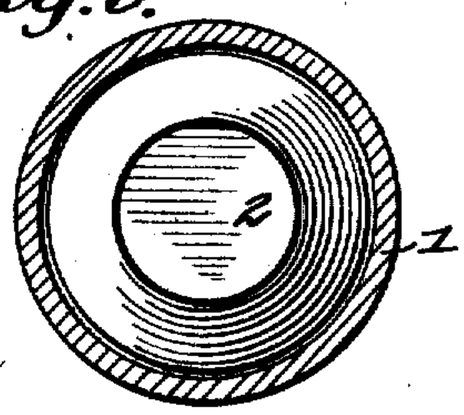
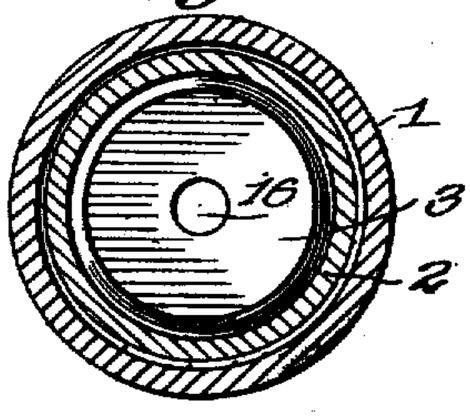


Fig. 7.



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3 SHEETS—SHEET 3.

Fig. 13.

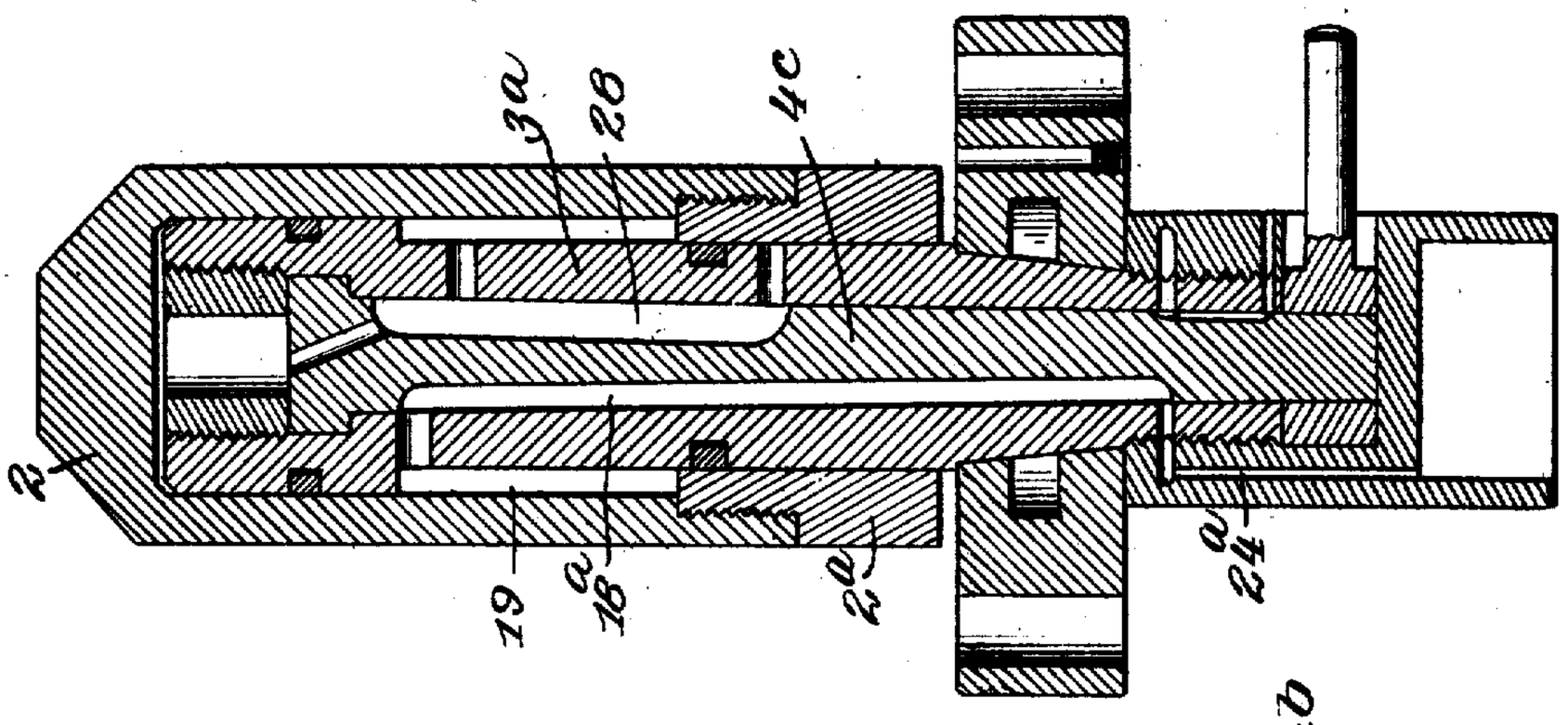


Fig. 10.

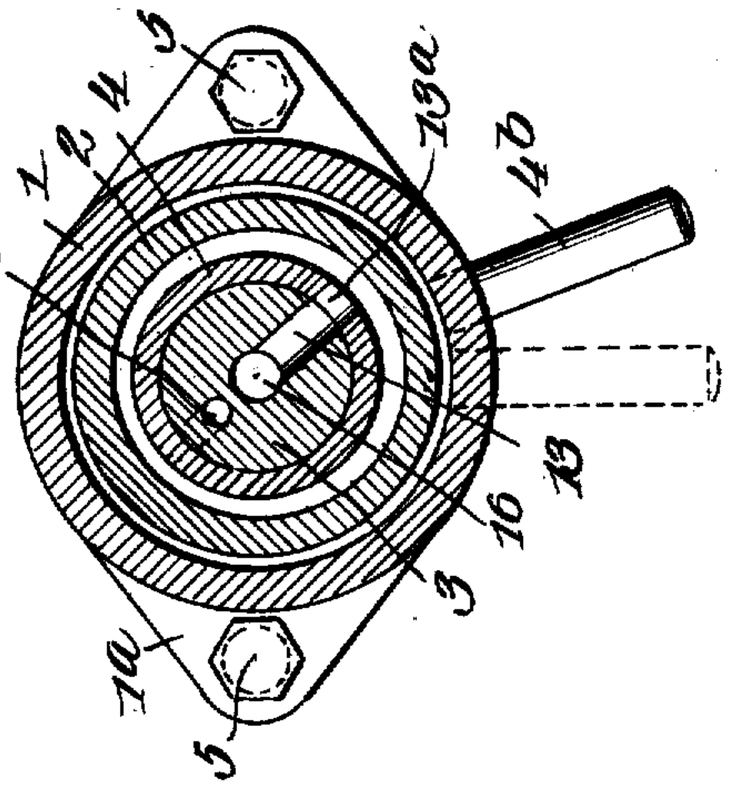


Fig. 11.

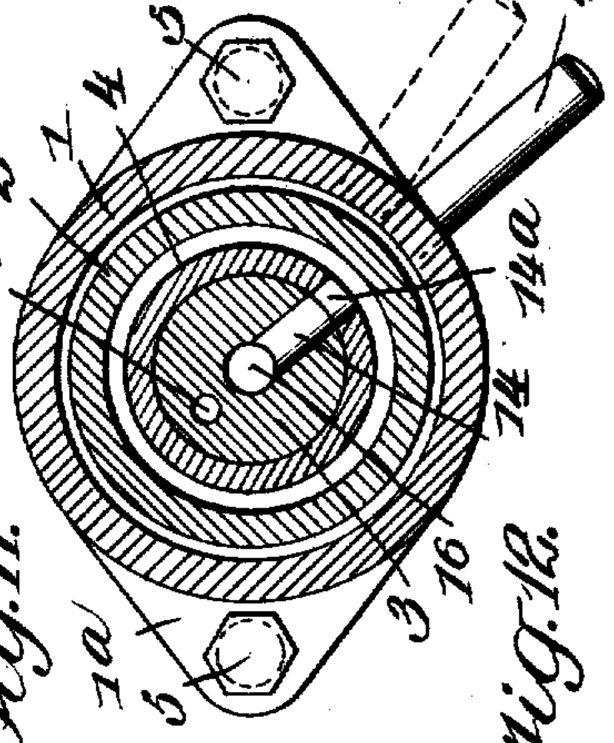


Fig. 12.

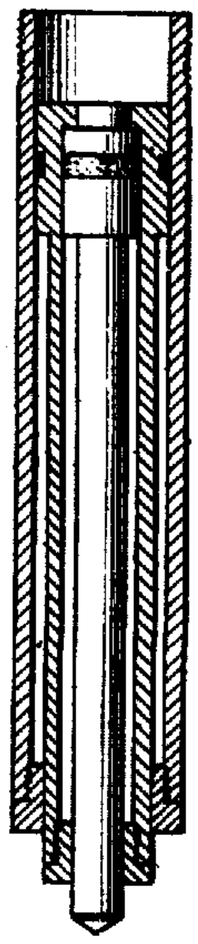


Fig. 8.

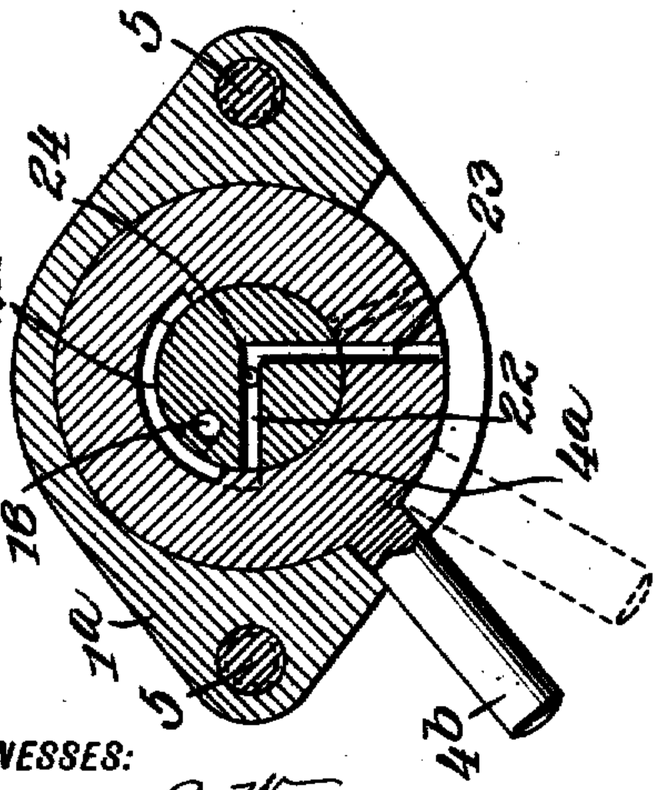
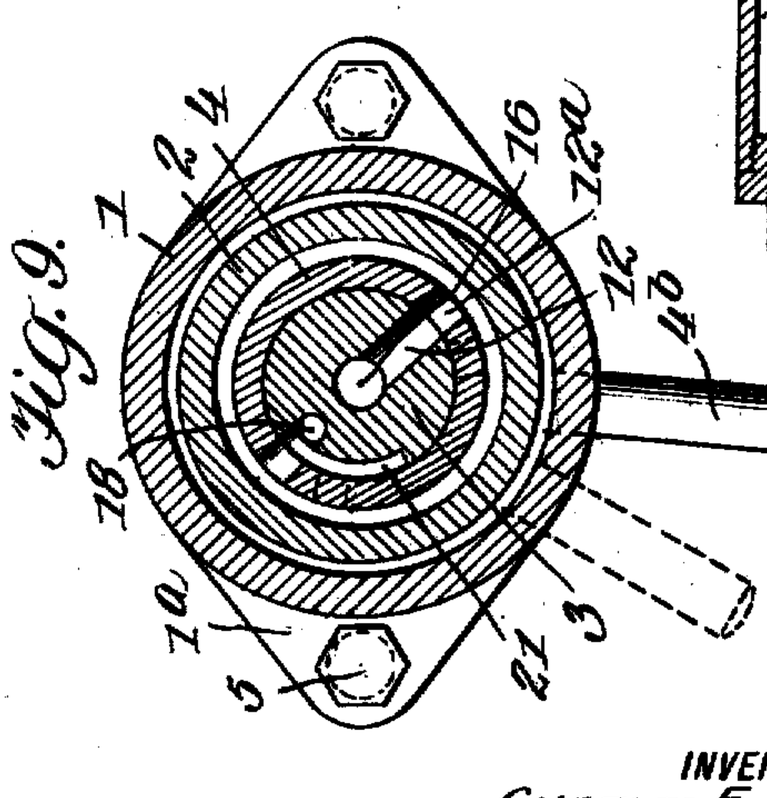


Fig. 9.



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PNEUMATIC HAMMER.

998,477. Specification of Letters Patent. Patented July 18, 1911.

Application filed July 15, 1910. Serial No. 572,121.

To all whom it may concern:

Be it known that we, CHARLES F. DUVAL and HENRY MCDERMOTT, citizens of the United States, and residents of Leadville, in the county of Lake and State of Colorado, have invented certain Improvements in Pneumatic Hammers for Rock-Drills and other Machines, of which the following is a specification.

Our invention is an improvement in that class of percussive tools which are used for drilling rock or other material, also for riveting, chipping metal, calking boilers, and other analogous operations.

A distinguishing feature of our invention is the construction and arrangement of the hammer proper, or the reciprocating portion of the tool by which blows are struck, it being protected by a casing and reciprocating without frictional contact therewith, and having a chamber which receives a fixed guide that is provided with inlet and exhaust ports and surrounded by an annular, manually-controlled valve having similar ports, whereby the admission and exhaust of the motive fluid is governed in such manner as to produce at will variable strokes of the hammer—which is a result of much importance in tools of this class.

Another important feature is the cushioning of the hammer on the return stroke.

The invention further includes other features as hereinafter indicated.

In the accompanying drawings, Figure 1 is a side view of our improved tool. Fig. 2 is a central longitudinal section of the same. Fig. 3 is a cross section on the line 3—3 of Fig. 2. Fig. 4 is a longitudinal section of the tool corresponding to Fig. 2, save that the hammer is shown in striking position. Fig. 5 is a perspective view of the annular valve provided with inlet and exhaust ports. Fig. 6 is a perspective view of the hammer guide provided with ports. Fig. 7 is a cross section on the line 7—7 of Fig. 2. Figs. 8, 9, 10 and 11 are cross sectional views representing different adjustments and positions of the annular valve with reference to the abutment on which the hammer is guided in its reciprocation. Fig. 12 is a longitudinal sectional view of an extensible feed. Fig. 13 is a longitudinal section of a modified form of the pneumatic hammer or tool.

Referring particularly to Fig. 1, the numeral 1 indicates the body of the cylindrical casing, and 2, the hollow reciprocating hammer proper which the casing incloses and protects, while 3 indicates a fixed guide on which the hammer slides without contact with the casing and 4, the annular rotatable valve which controls admission of the motive fluid to the hammer.

The inner end of the casing 1 is provided with a radial flange 1^a which is secured by bolts 5 to a cylindrical block 6 and a flanged nut 7. Said block 6 is bored to receive the hammer guide 3, and the flanged nut 7 is screwed on the inner end of the guide, as shown. The nut is provided with an internal socket 7^a that adapts it for attachment to a device commonly known as the "feed"—see Fig. 12—the same consisting in this case of a series of telescoping sections adapted for extension by air pressure, and serving in practice as a rest or support for the pneumatic hammer as a whole.

The hollow hammer 2 has a hollow truncated head and a thickened butt 2^a which is secured to it by means of a screw-joint. This construction favors convenient assemblage of the parts, besides effecting economy in construction.

The guide 3 is cylindrical and its head is enlarged, or has greater diameter than its body, which is provided with a series of radial inlet ports 12, 13 and 14 and an exhaust port 15, all of which communicate with a central bore 16 that opens at the head or outer end of the guide.

The annular valve 4 has a series of ports 12^a, 13^a, 14^a, and 15^a—see Fig. 5—and is provided at its butt or inner end with a radial flange 4^a which, as shown in Fig. 1, is provided with a radial handle 4^b, by which the valve may be adjusted rotatably to control admission and exhaust of the motive fluid. The latter is admitted first to a small annular chamber 17 formed in the block 6 and surrounding the inner end of the hammer guide. From such chamber, a passage 18 leads forward or outward in the guide 3 and opens at its outer end into an annular space 19 that is formed between the flange 4 and hammer 2 and the thickened butt 2^a of the latter and the head of the guide 3.

The motive fluid is conducted to the tube by a flexible hose in the usual way, the same, in practice, being attached at 20 (Fig. 1). The pressure of the motive fluid in the passages 17 and 18 and annular chamber or space 19 is constant or always the same as

in the flexible hose and the tank or boiler with which it is connected. It is apparent that since this pressure acts against the shoulder of the hammer guide and the butt 2^a of the hammer, the tendency is to retract the hammer and hold it retracted until such pressure is overcome by a superior one, which is always the case when the motive fluid is admitted by any one of the live ports 12, 13, 14, so as to act against the head of the hammer. In such case, owing to the greater area of the hammer head, as compared with the shoulders of the hammer butt, the effect is to drive the hammer forward and into contact with the striking pin 11 with a rapidity and force corresponding to the pressure of the motive fluid.

As shown in Fig. 5, the ports or openings 12^a, 13^a, 14^a, and 15^a in the sleeve valve 4 are arranged upon a spiral line, so that no two of them shall communicate simultaneously with the corresponding ports 12, 13, 14, and 15 in the hammer guide.

As shown in Figs. 2, 8 and 9, the valve head or butt 4^a has an interior arc slot 21 with which a right angular passage 22 in the hammer-guide 3 communicates. When the valve is in the neutral position shown in Fig. 8, as when the tool is not in use, the bore or passage 22 is in communication with another 23 which is formed in the valve butt. From the right angular bore 22, another 24—see Fig. 1—leads to the socket 7^a where the feed is attached. Thus, in the position of the valve shown by full lines (Fig. 8) the air or other fluid which presses upon the feed during the operation of the tool is allowed to exhaust through the port 23, thus relieving all pressure on the feed so that the tool may be removed from its position or otherwise manipulated as required. The arc slot 21 communicates by a lateral passage with the longitudinal port or passage 18 formed in the hammer guide 3 and communicating with the annular space or chamber 19, as before described.

As before intimated, Fig. 8 illustrates in full lines the neutral position of the valve, and the same position is also illustrated in Fig. 2. Figs. 9, 10, and 11 illustrate different positions according as the motive fluid is admitted through one or another of the three ports 12, 13, and 14 in the hammer guide. The full lines in Fig. 9 illustrate the first position; that is to say, when the valve 4 is adjusted by means of its handle 4^b to bring the port or opening 12^a of the valve into conjunction with the port 12 in the hammer guide. As before stated, there is a constant pressure of the motive fluid in the annular chamber 19, and, therefore, when the valve is adjusted as stated, this pressure acts instantly through the bore 16 of the hammer guide and forces the hammer against the striking-pin 11—see Fig. 4. Before the hammer strikes, its butt 2^a has covered the live port 12^a in the valve and consequently the motive fluid acts expansively during the final movement of the hammer. The instant the hammer strikes, the motive fluid is exhausted through ports 15 and 15^a which are then uncovered and the exhaust is into the outer air through port 25—Figs. 2 and 5. All pressure upon the head of the hammer being thus relieved, the pressure of the fluid in the annular chamber 19 acting against the butt 2^a of the hammer forces the latter back until the ports 12^a and 12 are again uncovered, when the operation before described is repeated, the hammer being forced forward and giving a stroke as before. Thus, the hammer oscillates rapidly and gives a series of rapid blows on the striking-pin. If, now, the valve 4 be turned further, or into the position shown by full lines in Fig. 10, its port 13^a will register with port 13 of the hammer guide and the hammer will again be forced forward to strike upon the pin 11. Similarly also the exhaust 15 being uncovered, the air or other fluid is exhausted from the hammer and the pressure of the fluid in the annular space 19 acting against the hammer butt 2^a, again forces it backward until the ports 13^a and 13 are again uncovered, when the hammer stroke is repeated. The operation is precisely the same with reference to the third position illustrated in Fig. 11, where ports 14^a and 14 in the valve and hammer guide, respectively, are put in conjunction. It will be seen that the movement of the hammer always covers the ports through which the motive fluid is admitted to the bore of the hammer guide to act upon the hammer head before the hammer completes its stroke, so that the latter is effected by the expansive action of the fluid. It will be further seen that when the hammer finishes its stroke, the exhaust ports are uncovered in every case. It will be understood that the valve remains fixed or held by friction in the position to which it may be adjusted, whether that be neutral, as in Fig. 8, or the different working positions shown in Figs. 9, 10, and 11. In other words, the valve is only adjusted when it is desired to vary the stroke or stop the operation of the feed.

From the foregoing description, it will be apparent that the stroke of the hammer is varied in length, rapidity, and force according to the distance of the valve ports 12^a, 13^a, and 14^a from the head of the hammer. In other words, when the motive fluid is admitted through the ports 12^a and 12 nearest the hammer head, in the return movement of the hammer the butt 2^a uncovers such ports sooner than it could uncover the other ports, and consequently the motive fluid under pressure is again admitted through the ports

12ª and 12, as before, and the operation of the hammer is repeated. If the valve be adjusted to admit motive fluid through the lower ports 14ª and 14, the hammer is allowed to return or slide back a longer distance before its butt 2ª can uncover said ports. Therefore, when the motive fluid is admitted through the outer port, the operation of the hammer is rapid but the strokes are comparatively light, and when admitted through the rear ports 14ª and 14, the stroke of the hammer is longer and heavier; while if the motive fluid be admitted through the intermediate ports 13ª and 13, the stroke will be intermediate in rapidity and force. In brief, when the motive fluid is admitted through the outer ports, the momentum of the hammer is least and when admitted through the rear ports in the valve and hammer guide, the momentum is greatest, and the blows vary accordingly both in rapidity and force.

In the modification shown in Fig. 13, the hammer guide is constructed hollow throughout, and the valve is arranged within it instead of surrounding it as in the construction first described. The valve is provided with a radial handle as before, and the hammer guide has inlet and exhaust passages, as in the first case, while the valve is constructed with longitudinal grooves 28 and 18ª, the latter communicating with the annular chamber 19 and with a passage leading to the socket where the "feed" may be attached.

The operation will be apparent without further description.

We claim:

1. A pneumatic hammer comprising a chambered hammer proper, a fixed guide on which said hammer reciprocates, the same being provided with lateral inlet and exhaust ports, and a valve provided with corresponding ports and adapted for adjustment to admit motive fluid to actuate the hammer.

2. A pneumatic hammer comprising a hollow hammer proper, a fixed guide on which the hammer reciprocates, a rotary valve having inlet and exhaust ports corresponding with those of the hammer guide, the hammer serving in its reciprocations to cover and uncover the ports whereby the hammer is worked expansively, substantially as described.

3. A pneumatic hammer comprising a hollow hammer proper, a fixed guide therefor provided with a series of ports, a rotary valve having corresponding ports so located that when the motive fluid is admitted to a guide port it is cut off from the others whereby the hammer may be worked with a variable stroke, substantially as described.

4. A pneumatic hammer comprising a hollow handle proper, a fixed guide on which the same reciprocates, a rotary valve applied to the guide and both having inlet and exhaust ports adapted to be brought into coincidence by adjustment of the valve, the ports of the valve being arranged out of alinement in such manner that any one may be brought into register with a corresponding one in the guide, substantially as described.

5. A pneumatic hammer comprising an outer casing, a fixed guide arranged within and concentric with said casing, a hollow hammer adapted to slide on the guide, a rotary valve applied to the guide, the two having inlet and exhaust ports which are adapted to be brought into coincidence by adjustment of the valve, the guide also having a longitudinal bore leading to its outer end for conducting motive fluid into contact with the hammer head, substantially as described.

6. A pneumatic hammer comprising a casing, a hammer guide fixed concentrically within the same, a hollow hammer adapted to slide on the guide, the latter having an enlarged head and reduced body and inlet and exhaust ports communicating with a longitudinal bore leading to the head of the guide, a rotary valve applied to the guide and having corresponding ports adapted to be brought into coincidence with those of the guide, the hammer having a butt portion provided with a shoulder whereby an annular chamber is formed between the same and the head of the guide, a port for motive fluid formed in the guide and communicating with such annular chamber whereby upon adjustment of the valve to admit motive fluid under pressure to the head of the hammer, the latter is caused to give a stroke, exhaust then taking place and the pressure of the motive fluid in the annular chamber acting against the shoulder of the hammer serves to return it to the original position, substantially as described.

7. A pneumatic hammer comprising a casing, a hammer guide arranged concentrically within the same, a hollow hammer adapted to slide on said guide, and a rotary valve applied to the latter, both guide and valve having inlet and exhaust ports adapted to be brought into coincidence, the inlet ports of the valve being so arranged that only one at a time can be brought into coincidence with a port in the guide, the arrangement of the exhaust port with reference to the head of the guide being such that as the hammer makes its stroke, it uncovers the said port, and the chamber being provided for the motive fluid wherein it is under constant pressure and acts against the rear portion of the hammer having a less area than the head of the same, substantially as described.

8. A pneumatic hammer comprising a casing, a guide fixed concentrically therein,

a hollow hammer adapted to slide on the guide and having a rear shoulder comprising less area than its head, the guide being provided with inlet and exhaust ports, a rotary valve similarly provided with ports over which the rear portion of the hammer is adapted to slide so as to cover and uncover them, as described, a chamber being formed around the valve to which the motive fluid under pressure has access at all times, a differential pressure being thus established, one tending to retract the hammer and the greater serving to actuate it for a stroke, substantially as described.

9. A pneumatic hammer comprising a casing, a fixed hammer guide therein, a hollow hammer reciprocating on said guide, a rotary valve applied to the guide and both provided with inlet and exhaust ports adapted to be brought into coincidence upon rotation of the valve, a base block to which the casing is secured, the same being provided with an inlet for the motive fluid under pressure, a longitudinal port in the guide communicating with such chamber, an annular space being formed around the valve and guide within the hammer to which the motive fluid has constant access under pressure, substantially as described.

10. A pneumatic hammer comprising a casing, a fixed guide therein and provided with inlet and exhaust ports, a rotary valve similarly provided with ports, a hollow hammer adapted to slide on the guide and inclosing a portion of the valve, the guide having an enlarged head and the hammer a rear shoulder between which two parts a chamber is formed, a supply port communicating therewith through which motive fluid is supplied under constant pressure, the valve butt being provided with an arc slot adapted when the valve is in a certain position to communicate with the aforesaid supply port, another port formed in the abutment and communicating with the socket adapted for attachment of the feed, whereby, when the valve is in working position, pressure is constantly applied to the feed and when the valve is in the neutral position, the pressure is relieved, substantially as described.

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