No. 693,939. Patented Feb. 25, 1902.

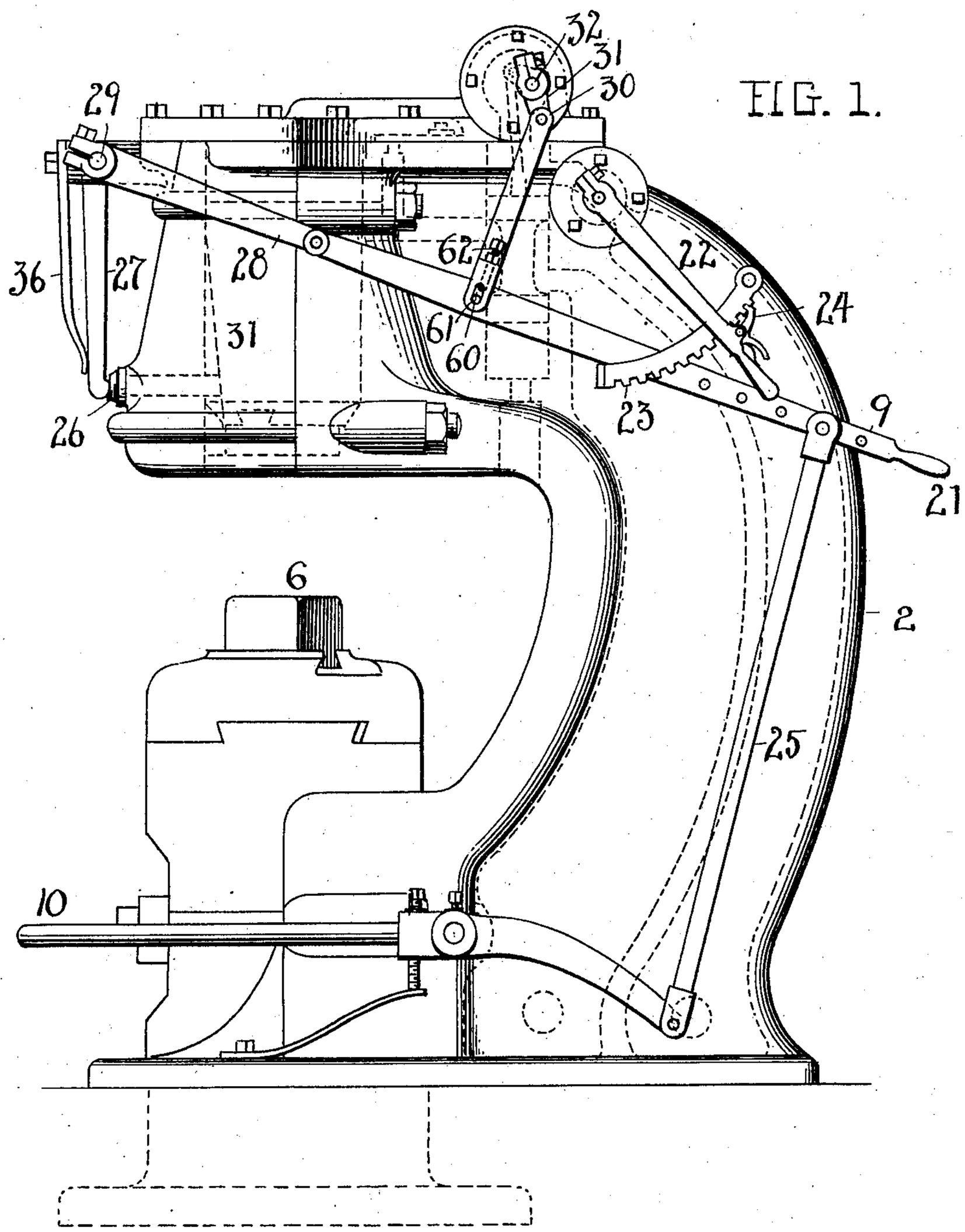
M. A. YEAKLEY.

PNEUMATIC HAMMER.

(Application filed Oct. 12, 1900.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.



ATTEST

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M. A. Sherman

INVENTOR

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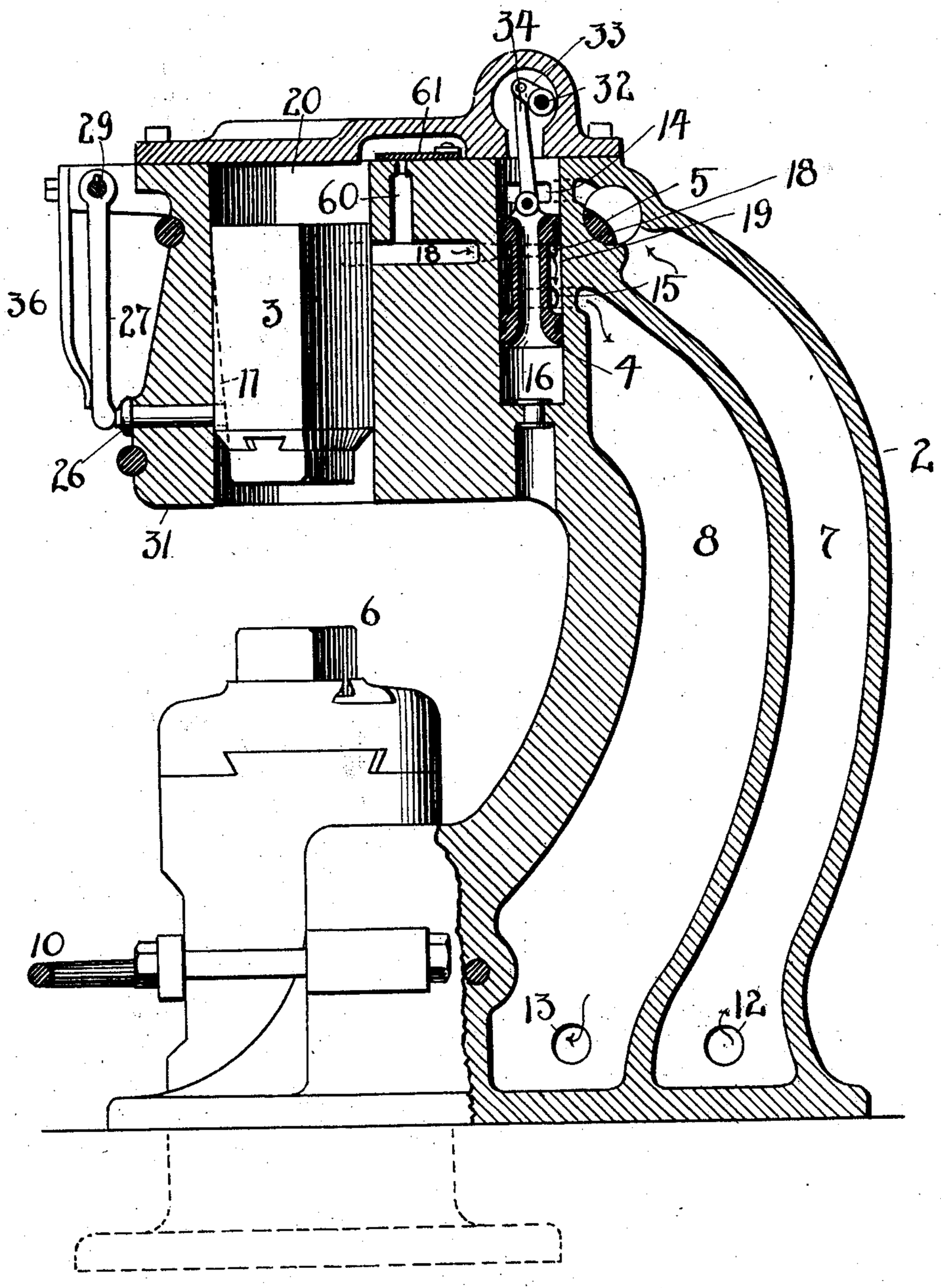
(No Model.) 4 Sheets—Sheet 2.

FIG. 2.



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(No Model.) 4 Sheets—Sheet 3.

FIG. 3.

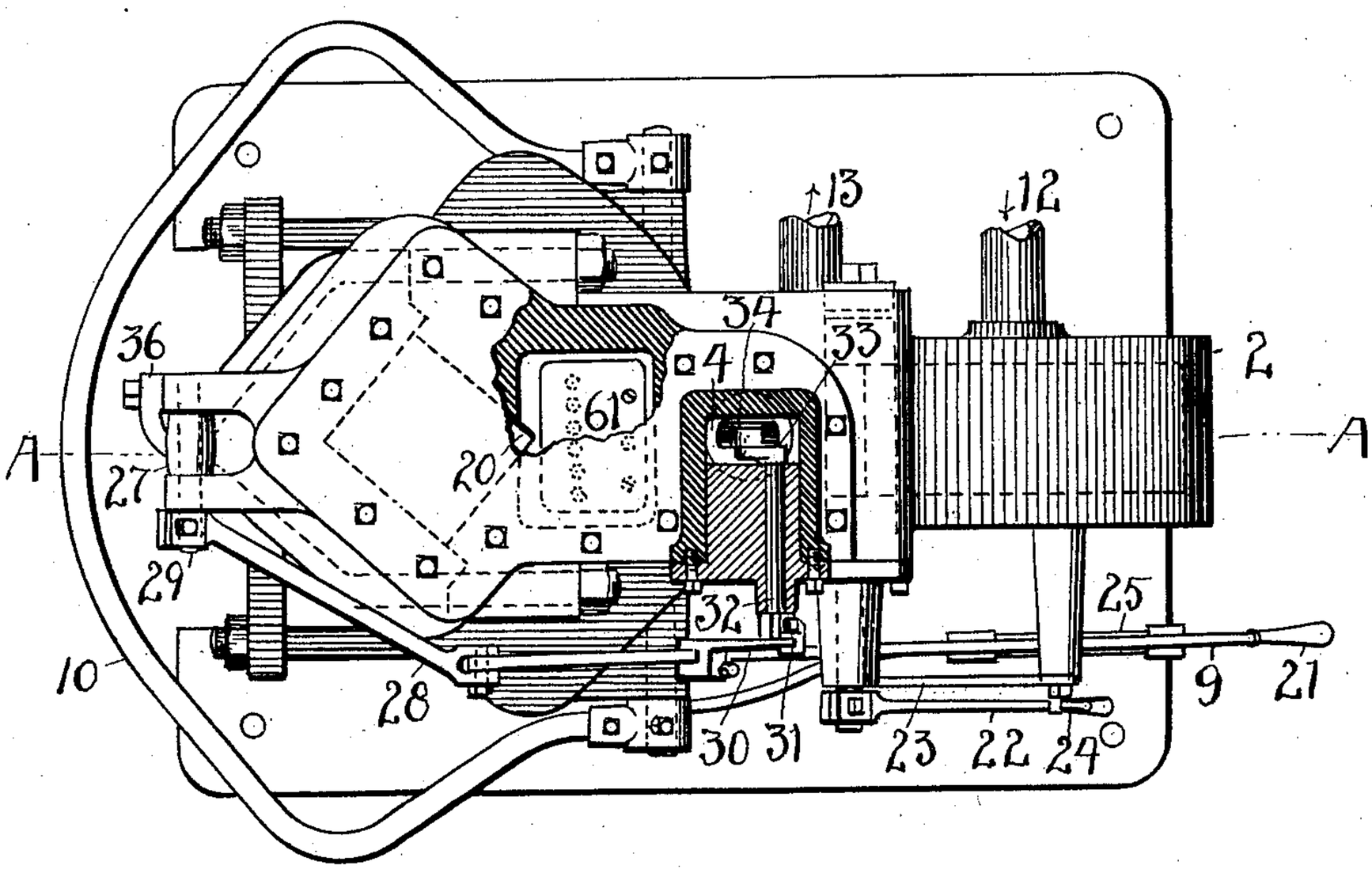

FIG. 4.

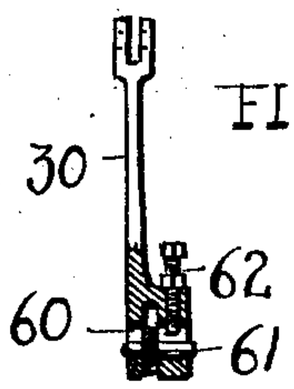

FIG. 5.

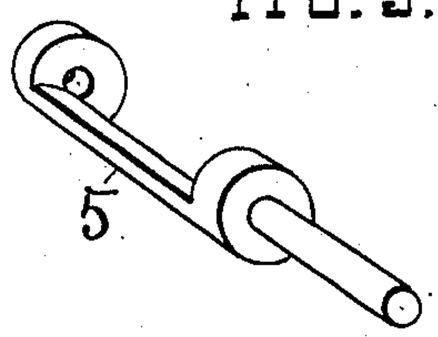

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FIG. 6.

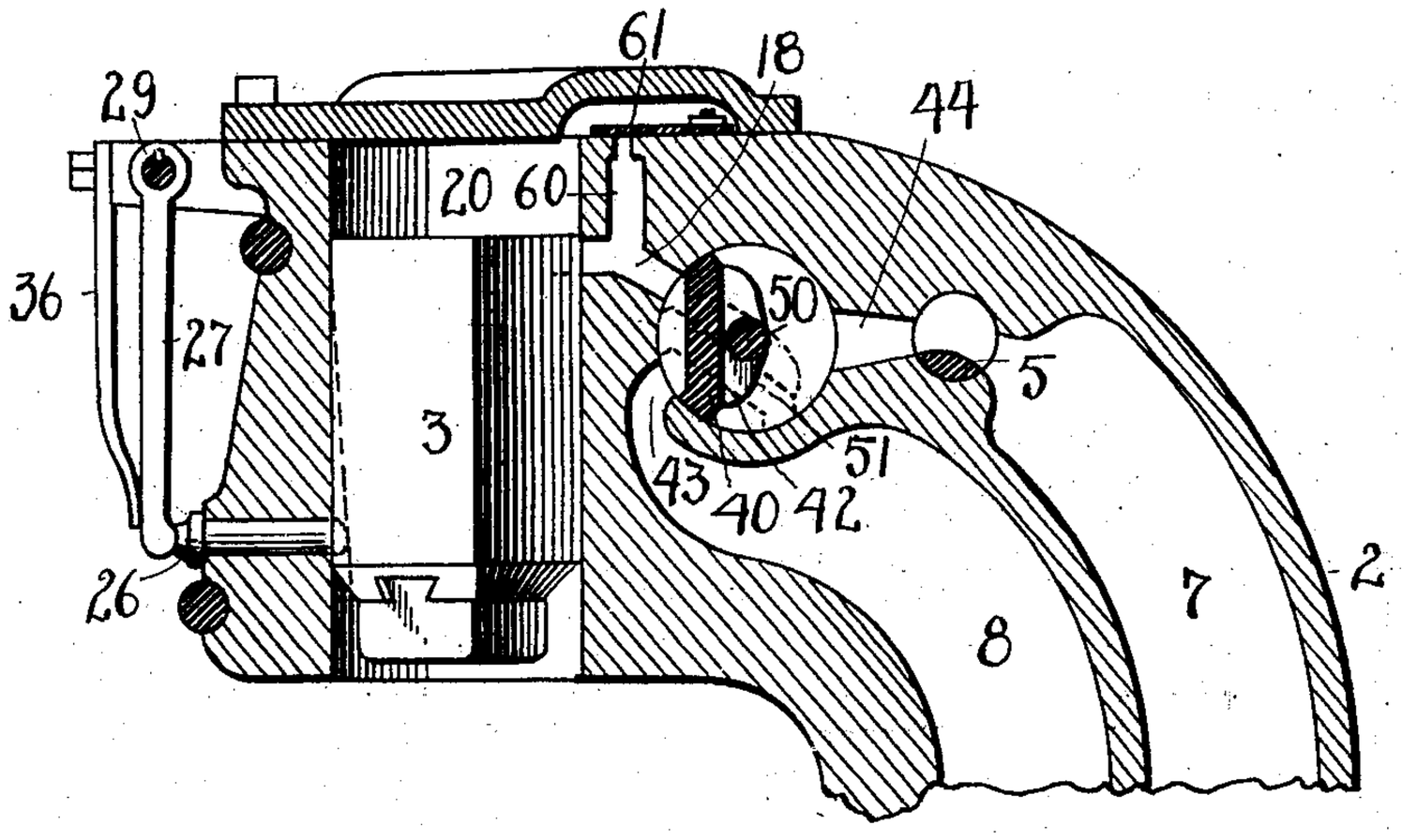


FIG. 7.

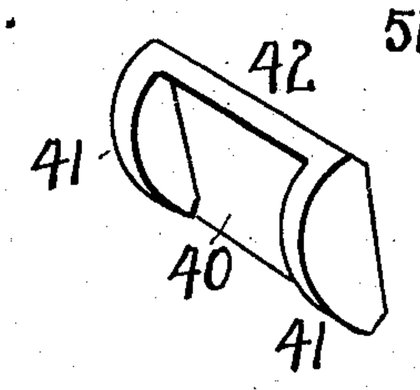
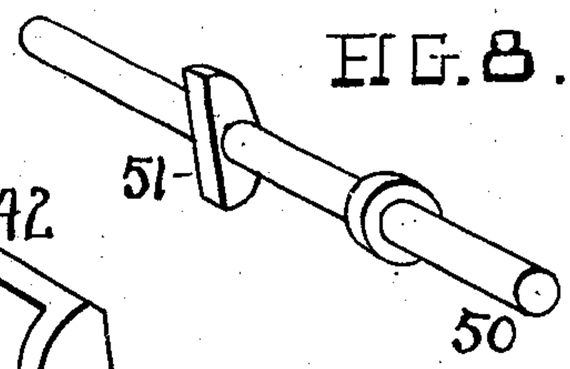


FIG. 8.



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UNITED STATES PATENT OFFICE.

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PNEUMATIC HAMMER.

SPECIFICATION forming part of Letters Patent No. 693,939, dated February 25, 1902.

Application filed October 12, 1900. Serial No. 32,835. (No model.)

To all whom it may concern:

Be it known that I, MELVIN A. YEAKLEY, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Pneumatic Hammers; and I do declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to pneumatic hammers, and is an improvement on a pneumatic hammer patented to me September 29, 1896, No. 568,395.

In the accompanying drawings, Figure 1 is a plain side elevation of my improved hammer in one of its forms. Fig. 2 is a vertical central sectional elevation thereof on a line corresponding, substantially, to A A, Fig. 3. Fig. 3 is a plan view of the hammer with a portion of the top sectioned away, as will appear hereinafter. Fig. 4 is a detail view, partly in section, of the connecting-link between the valve-shaft and operating-lever; and Fig. 5 is a perspective detail view of the pressure-regulating valve. Fig. 6 is a vertical sectional elevation of the upper part of the hammer, with a modified construction of the main valve; and Fig. 7 is a perspective view of the main valve shown in Fig. 6. Fig. 8 is a perspective view of the controlling mechanism for the valve shown in Fig. 7, as hereinafter described.

The main points of difference between the present construction of hammer and that shown and described in my patent above mentioned are fully set forth in the description and claims herein; but I may mention here that in said patent I employ a pump exclusively to produce both pressure and vacuum for the pneumatic operation of the hammer, and a single air-passage from said pump to the main valve and thence to the hammer proper serves both pressure and exhaust purposes, alternately, and, secondly, in said patent the main valve is under exclusive hand or foot control, or both, and there is no mechanism for controlling said valve automatically or otherwise than by hand or foot. In my present invention I depend on a storage-chamber for the pressure and on a vacuum chamber or space for the exhaust, and these chambers are in direct communication with the hammer-chamber; secondly, the action of the main valve is mechanically and automatically controlled from the hammer in addition to hand and foot control, as heretofore, as hereinafter described, and, thirdly, separate passages connect the pressure and the exhaust chambers with the main-valve chamber, and there is a separate valve in the pressure-passage to regulate the pressure admitted. These and other differences in construction and operation, more or less material in character, distinguish the present invention from my former invention, all as will hereinafter plainly appear.

Having reference now again to the drawings, Figs. 1 to 5, inclusive, 2 represents the body or frame of the hammer, which may be formed in as many pieces as convenient or advantage of construction may suggest, it being understood that the said frame as well as some of the operating parts are castings, so that suitable proportion will be observed, according to the size of the hammer and the uses of the parts in the operation.

For convenience of description and reference in this specification the part 3 will be referred to as the "hammer," though it is sometimes known as a "ram," and by other names as well. The part 4 is referred to as the "main valve," part 5 as the "pressure regulating or controlling valve," part 6 as the "anvil," and the internal spaces 7 and 8 in the upright portion of the main frame as the "pressure" and "vacuum or exhaust" chambers, respectively.

In Fig. 1, 9 is the main lever, and 10 the treadle.

The chambers 7 and 8 may be located as here shown, or they may be otherwise located or fashioned, if preferred, and serve my purpose as well, assuming, of course, that in any case they have the requisite capacity and such operating relationship with the pump or pumps or their equivalent as may be required. The "pump," so called, is not shown herein, and for that matter there might be two pumps—one connected with the inlet 12 to chamber 7 and the other with outlet 13 to chamber 8—so that one pump would serve as pres-

sure-pump and the other as exhaust or vacuum pump, or one pump might be made to serve both purposes, if preferred. In any event, however, and whatever the character of the pressure and vacuum mechanism connected with the openings 12 and 13 for pressure and exhaust, respectively, I have planned in the form of the invention shown herein to employ the principle of pneumatic pressure and vacuum or exhaust independently of the means for producing either. Hence immediate communication of the hammer-chamber with the chambers 7 and 8 will be presumed to be sufficient to operate the hammer, assuming that these are at all times in operating condition and regardless of whether they are at the time under action by pump or otherwise through openings 12 and 13 to supplement and maintain operations—that is, I rely on stored pressure for the blow and on vacuum for exhaust, and both are furnished by chambers 7 and 8; but as a matter of practice I always expect to operate pressure and exhaust mechanism in connection with chambers 7 and 8 while the hammer is in operation. This makes the hammer indirectly, but not directly, dependent upon such mechanism, and in this way I get a much more evenly balanced operation than is possible by a direct pump connection, where the pulsing of the pump is communicated to the hammer.

Each of the chambers 7 and 8 has its own passage 14 and 15, respectively, connecting with the valve-chamber 16 of the main valve 4, and a single passage 18 connects said valve-chamber with the hammer-chamber 20. The main valve 4 is a slide-valve in this instance and is adapted to alternately bring the passages 14 and 15 into open relation with the passage 18, so that when either passage 14 or 15 is open to 18 the other is closed. As shown in Fig. 2, the exhaust from the hammer is open through passage 18 and the hollow space 19 about valve 4, and pressure-passage 14 is closed. When valve 4 descends, it uncovers passage 18 at its entrance to valve-chamber 16 and opens said passage for pressure to enter from chamber 7 to the hammer or hammer-chamber 20. Thus it occurs that the exhaust is always through the open way about the hollow 19 outside of valve 4, while the pressure enters from above said valve when it descends, and said valve is open lengthwise through its center and equally exposed at both ends to air from passage 14 to balance its operation.

The auxiliary or pressure-regulating valve 5 is rotary, and its entire construction is clearly disclosed in Fig. 5. A handle 22, Fig. 1, fixed on the spindle of said valve, serves to rotate it more or less according to the volume of the pressure wanted at any given time, and segmental rack or ratchet 23, engaged by pawl 24 on said handle, fixes the adjustment of the handle and valve. This or equivalent mechanism for making such adjustment may be used.

Main valve 4 has three independent means of control—one by hand through engagement with the grip 21 on lever 9, another through treadle 10 and connecting-link 25, and the third automatically from or by the hammer 3, through slide-bolt 26, levers 27 and 28, and link 30. The slide-bolt 26 enters horizontally through the hammer-cylinder 31 near its lower portion, and the hammer 3 has an inclined surface 11 lengthwise, gradually deepening from above, downward and inward, so that when the hammer is up the bolt will be depressed its full depth of movement and when the hammer is down it will be pushed out its full depth of movement. This movement is utilized through levers 27 and 28, rigid with each other on transverse rock-shaft 29, to operate valve 4 automatically through link 30. Said link is connected at one end to short arm 31, clamped on the outer extremity of valve-controlling shaft 32, while a crank-arm 33 on the other end of said shaft is connected by link 34 with valve 4. Thus it occurs that the shaft 32 is rotated and the valve 4 operated in respect to the passages 14 and 15 to open and close them in turn by the line of mechanism between bolt 26 and said valve. This mechanism comprises lever 9, to one end of which lever 28 is pivotally attached, and since said lever is rigid with rock-shaft 29, carrying lever 27, likewise rigid with said shaft, it not only follows that these levers must move together at all times, but also that in some cases the lever 28 becomes a fulcrum for main lever 9, thus assuming that the parts be positioned as in Fig. 1 and stationary. Then as the operator depresses treadle 10 the lever 9 turns on its pivot with lever 28, the valve-shaft 32 is turned, the main valve is lowered, and atmospheric or power pressure is admitted to the hammer, or the same operation may be effected by simply gripping and raising lever 9. Again, assume that the main lever be held stationary at its handle end by or through treadle 10 and link 25. Then link 25 becomes the fulcrum of lever 9 and the operation of the hammer continues automatically through the parts operatively connecting bolt 26 and main valve 4. A strong spring 36 bears against lever 27 to keep it and bolt 26 always in right working relations. Link 25 is adjustable both on the treadle-arm and on link 9 to adapt it to varying conditions in the operation of the hammer and for more or less throw of the main valve 4.

In Figs. 6, 7, and 8 the same parts are shown as in Fig. 2 in so far as the head of the hammer is concerned; but instead of a sliding main valve I use a rotary valve 40. This valve has segmental ends 41 and a flat outer side 42, and it occupies a cylindrical chamber having an exhaust-passage 43 open to the inner side of the valve and an inlet or pressure passage 44 at its opposite or outer side, said passages communicating, respectively, with chambers 7 and 8. The space in said valve between its segmental ends 41 forms a

cavity or opening large enough to cover passage 18 and passage 43 at the same time, as shown. The dotted lines, Fig. 6, show the exhaust-passage closed and the pressure-passage open to the hammer. The single passage 18 connects the valve-chamber with the hammer-chamber, as in Fig. 2. The rotatable shaft 50 has a straight-edged valve-operating piece 51 fixed thereto and adapted to bear against the side 42 of the valve, so that when said shaft 50 is turned either direction it will turn valve 40 in like manner and degree, and the valve turns on its rounded ends 41. The valve-operating mechanism shown in with valve 4 or its equivalent can be used to operate valve 40, and through its rotations it opens or closes the several passages at corresponding times and with the same operative effects obtained by valve 4.

As seen in both Figs. 2 and 6, the hammer is raised by reason of exhaust to a point above the direct passage 18, which is both inlet and outlet in turn, and the momentum of sudden exhaust would carry it violently up against the top of its chamber if there were no cushion of air therein. This is provided for, as shown, and since the direct passage is thus closed I provide an indirect passage 60, with valve 61, seated from above, so that initial pressure on the hammer occurs through this channel; but it is automatically closed against exhaust. For convenience the hammer is described as standing upright, as shown in the drawings; but this is not to be construed arbitrarily, as the hammer will work horizontally, if desired, and in other positions as well.

The storage and vacuum chambers are in this instance within the hammer-frame. They might be otherwise located, and any sufficient space, such as capacious pipes between the hammer and the pressure and exhaust pumps, would fall within my invention if they should break the impulse or the direct suction of the pump or pumps.

The hammer 3 serves as a piston in the hammer-chamber and is fitted so that the exhaust from closed end will allow the atmospheric pressure below to carry the hammer upward, and when the exhaust is closed off and the inner compressed atmosphere is open to said end of the hammer-chamber it will drive the hammer to the open end.

The term "chamber" as used herein to define the spaces 7 and 8 is understood to be comprehensive enough to cover any equivalent of the chambers herein shown, and which will afford a measure of stored compressed air and a corresponding vacuum.

Assuming that lever 9 be raised and held stationary by treadle 10 and link 25, the hammer starts at this instant to lower through pressure over it. As the hammer gets nearly down the pressure is automatically cut off by valve 4 through mechanism from bolt 26, and the movement of said valve occurs simultaneously with the descent of the hammer. At the time pressure is cut off the compressed air over the hammer expands to follow and force the hammer down until valve 4 gets up over passage 18 and begins to open the same to the exhaust. Then the velocity of the hammer carries it the rest of the way down, while the exhaust is being widely opened and atmospheric pressure is acting in the reverse way of the hammer. As the hammer strikes at its lowest point it is reversed by striking, and, being raised, spring 36 moves bolt 26 inward, which causes valve 4 to be moved down by reason of the movements of levers 27, 28, and 9 and link 30. When the hammer is near its limit of upstroke, valve 4 closes passage 18 and cuts exhaust off. The hammer is, however, still being forced up by atmospheric pressure on the bottom of the hammer, and as it moves farther up the valve 4 opens the pressure-passage to the hammer-chamber. Then the velocity of the hammer going up makes it go against the pressure and move to its limit, and thus open pressure-passage 4 to inlet-passage 18. As the pressure gets stronger the upward movement of the hammer is stopped and reversed, and so on repeatedly until the automatic operations are interrupted by hand or treadle action lowering the grip end 21. This lifts valve 4 so high that the lever movement from the hammer and bolt 26 cannot move valve 4 far enough to open the pressure, but keeps the exhaust on and holds the hammer up. When the treadle is up, the hammer carries up and stands still. When the treadle is half-way down and held there, the hammer will work and strike automatically. When the treadle is pressed clear down, the hammer will press down and stand still, because valve 4 will be held too low to permit the exhaust to act. The same effects are obtained in the use of rotary valve 40 by the same movements.

The lower end of link 30 is shown with an open slot engaged over lever 9 and a limiting-slot 60 at right angles thereto, in which works a pin 61, projected through lever 9. Set-screw 62 is adapted to bear on said pin at higher or lower elevations. The object of slot 60 is to provide for the reversal of the valve as the hammer moves to the end of its stroke each way by the automatic valve-operating mechanism above described, and set-screw 62 serves to make the play in this link connection with lever 9 longer or shorter. If the play be all taken up, the valve will always move promptly with the hammer, or if the set-screw be withdrawn there will always be a measure of movement of the hammer which will not affect the valve. When the hammer ascends and covers passage 18, there is supposed to be enough air within the chamber over the hammer to cushion it beneath the cover or top 6, secured across the top of the structure, and valve 61 closes escape of air by passage 60. When the treadle is up, if pressed clear down quick the hammer will strike and remain down with downward pressure, and when the treadle is relieved and

allowed to ascend quickly the hammer will rise and hold at its suspended position. These movements are accomplished by the operation of the foot before the automatic has time to act, making it wholly a foot movement. Two separate air-passages could connect the hammer-chamber and valve-chamber, and a valve in each passage to open and close them would do this same work as the one valve shown here does.

What I claim is—

1. In pneumatic hammers, a hammer-chamber and a valve-chamber and a valve therein, separate vacuum and pressure passages opening into said valve-chamber and a single passage connecting the valve-chamber with the hammer-chamber, substantially as described.

2. A hammer-chamber and hammer therein, a valve-chamber and a valve therein, a single passage connecting said chambers and single pressure and vacuum passages entering the said valve-chamber, and a source of pressure open to said pressure-passage and a sustained exhaust open to said exhaust-passage, substantially as described.

3. In pneumatic hammers, a hammer-chamber and separate pressure and vacuum chambers united therewith by passages, a valve-chamber and a valve located in the line of said passages between the hammer-chamber and the pressure and vacuum chambers, said valve constructed and arranged to open one of said chambers at a time to the hammer-chamber and to close the other, substantially as described.

4. In pneumatic hammers, a hammer-chamber, a valve-chamber and pressure and vacuum chambers having each a single passage entering said valve-chamber and a valve in said valve-chamber constructed to open one of said passages at a time to the hammer-chamber and to close the other, so that only one of said chambers is open at a time to the hammer-chamber, substantially as described.

5. The hammer-chamber and the pressure and vacuum chambers, respectively, a valve-chamber between said chambers and the hammer-chamber, and passages between said several chambers, and a valve in the valve-chamber controlling all said passages and constructed and arranged to establish communication between the hammer-chamber and either of the other chambers at will and to cut out the chamber not used at the time, substantially as described.

6. The hammer-chamber and the separate pressure and vacuum chambers and the passages connecting said several chambers, a valve controlling said passages, a shaft to actuate said valve, and combined hand and treadle mechanism to operate said shaft, substantially as described.

7. The pressure and the vacuum chambers respectively and a single valve controlling the entrance to said chambers and the discharge therefrom, in combination with the hammer-chamber and hammer therein, and mechanism for operating said valve having actuating contact with said hammer, substantially as described.

8. In a pneumatic hammer, a hammer-chamber and hammer therein having a vertically-inclined surface and a valve in position to control the pressure and the exhaust from said chamber, in combination with a bolt having sliding engagement with the inclined surface on the hammer, levers actuated by said bolt and operating connections from said levers to said valve, substantially as described.

9. In a pneumatic hammer, a hammer-chamber and a hammer therein, in combination with separate vacuum and pressure chambers, respectively, a passage from each of said chambers to the hammer-chamber above the hammer, and valve mechanism controlling the passage from each of said chambers into the hammer-chamber, substantially as described.

Witness my hand to the foregoing specification this 26th day of September, 1900.

MELVIN A. YEAKLEY.

Witnesses:

R. B. MOSER,

M. A. SHEEHAN.