M. MAXIMILIAN.

PNEUMATIC HAMMER.

APPLICATION FILED JULY 14, 1909.

952,707. Patented Mar. 22, 1910.

2 SHEETS—SHEET 1.

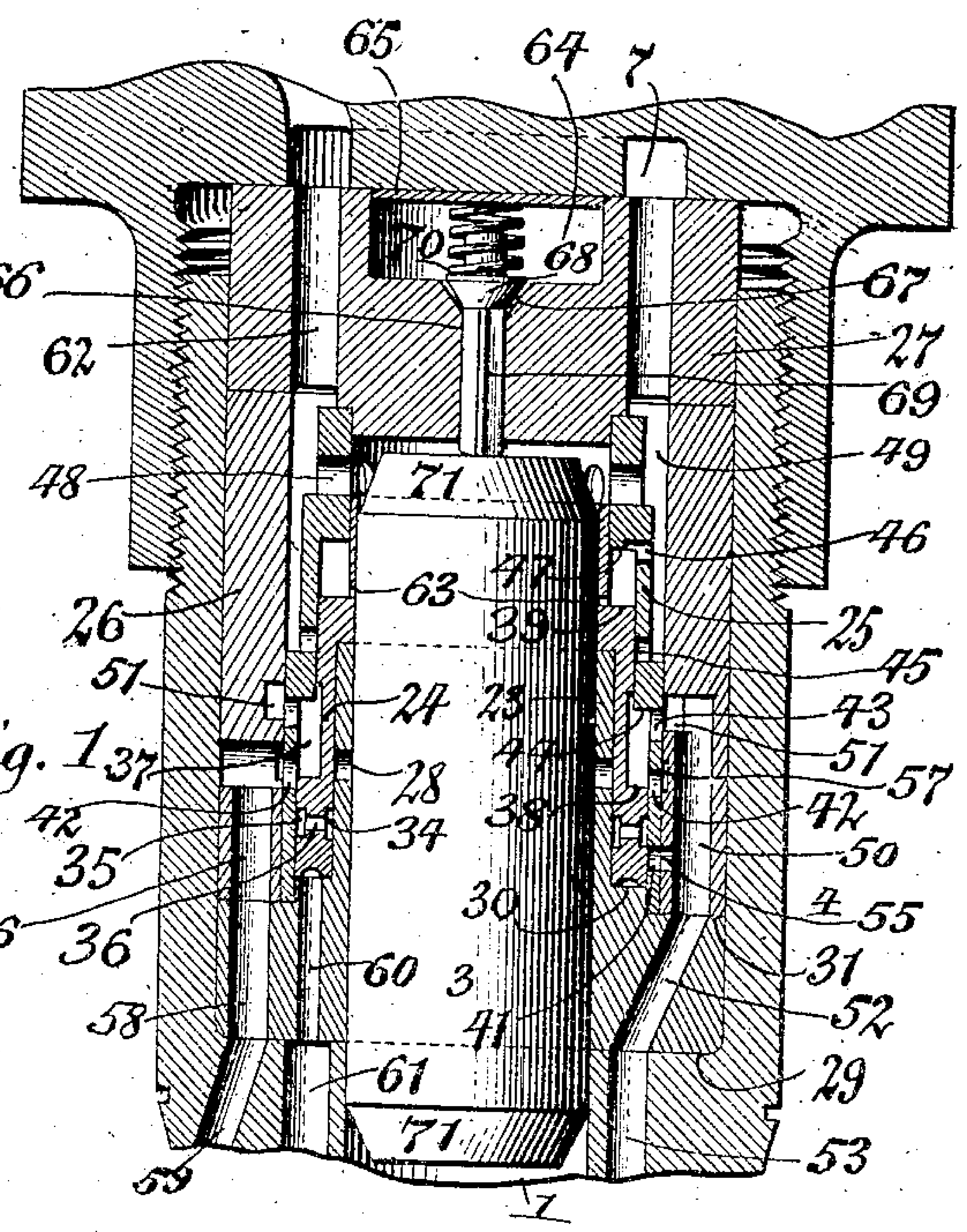

Fig. 1.

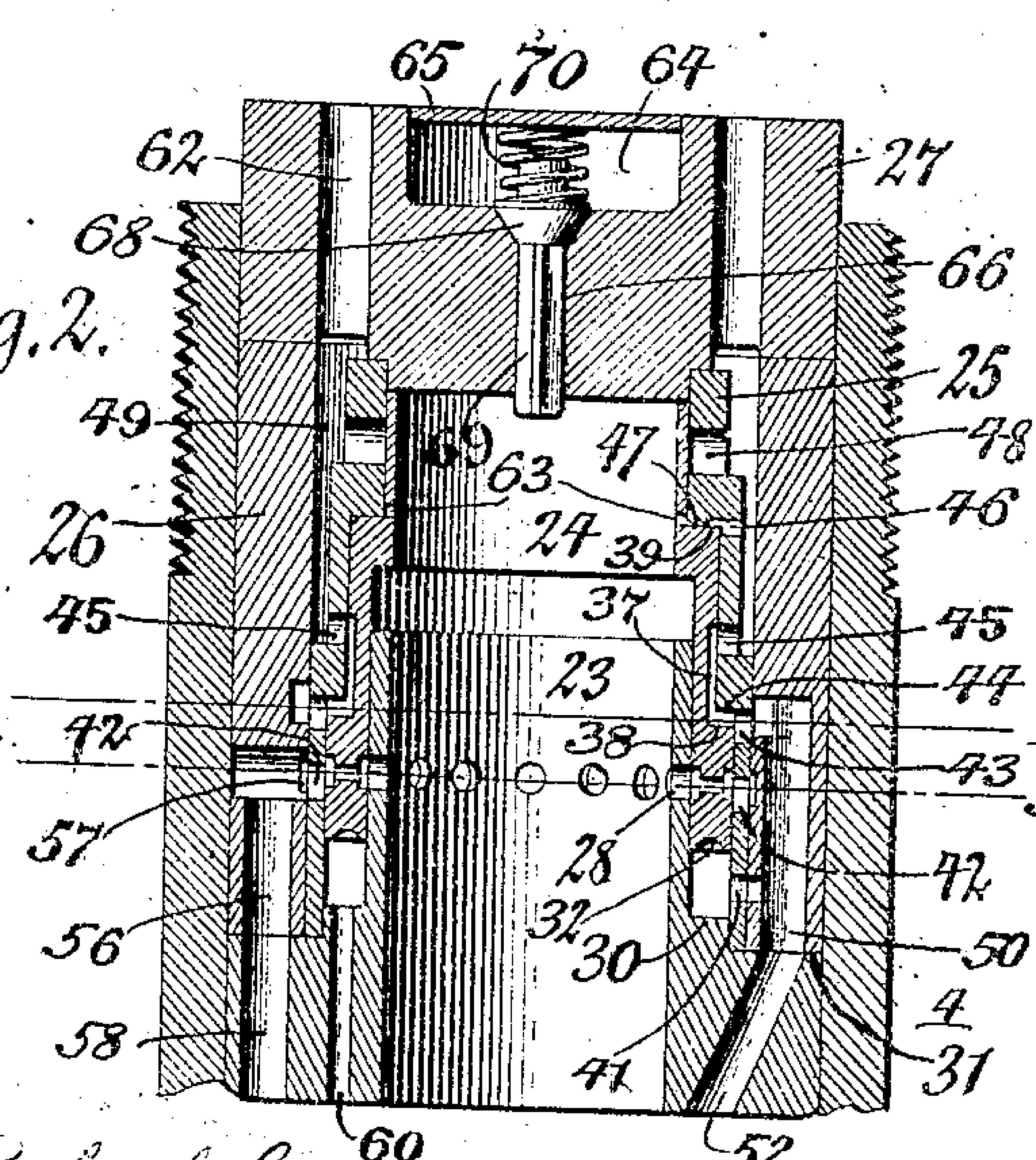

Fig. 2.

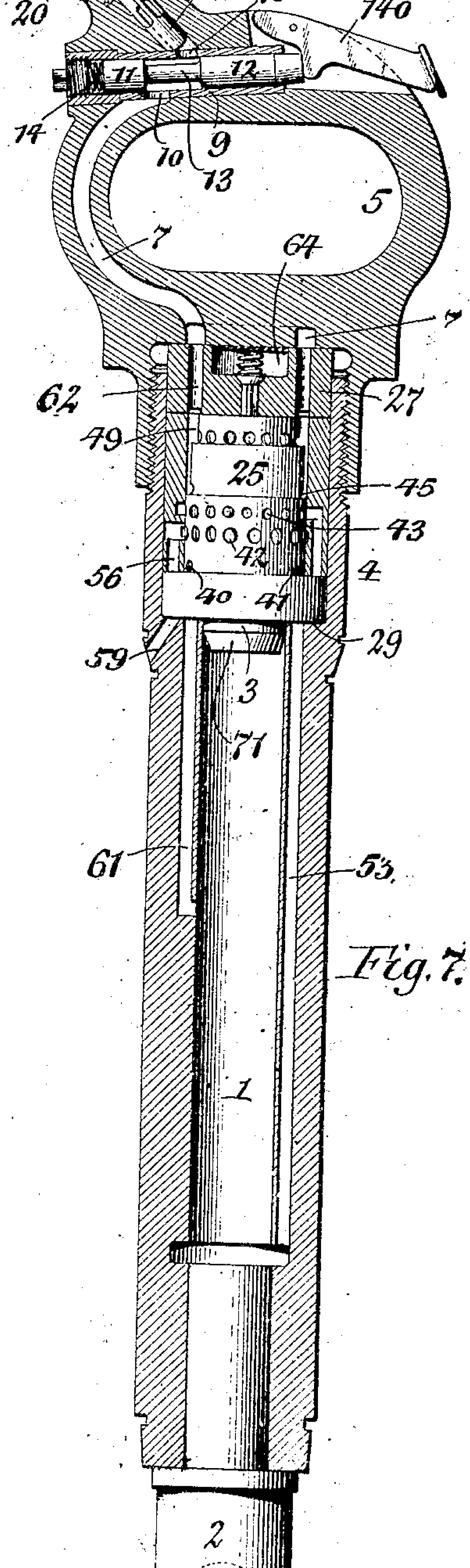

Fig. 7.

Richard Sommer
John H. Shoemaker
Witnesses.

Max Maximilian Inventor
by Geyer & Popp Attorneys.

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2 SHEETS—SHEET 2.

Fig. 3.

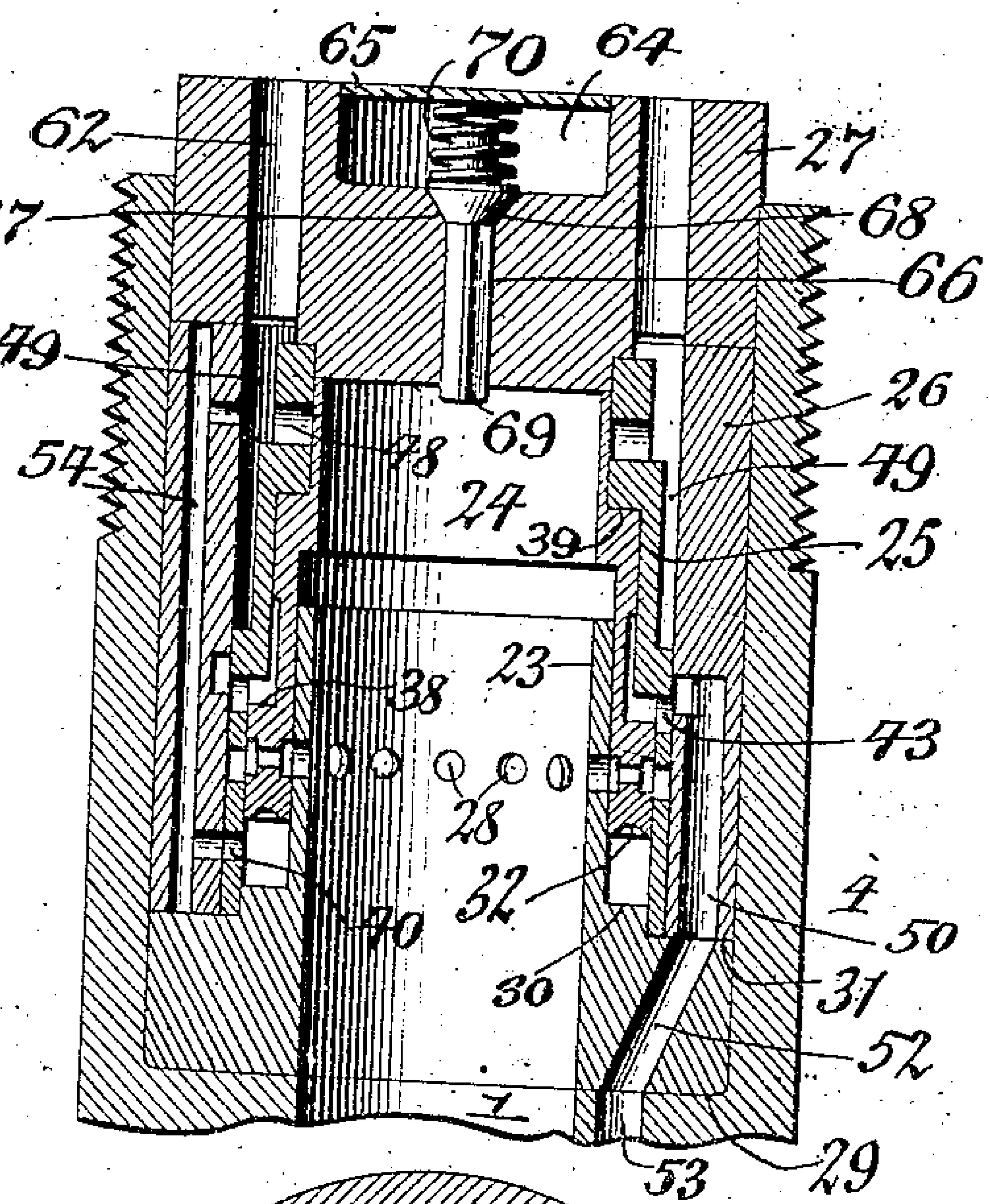


Fig. 4.

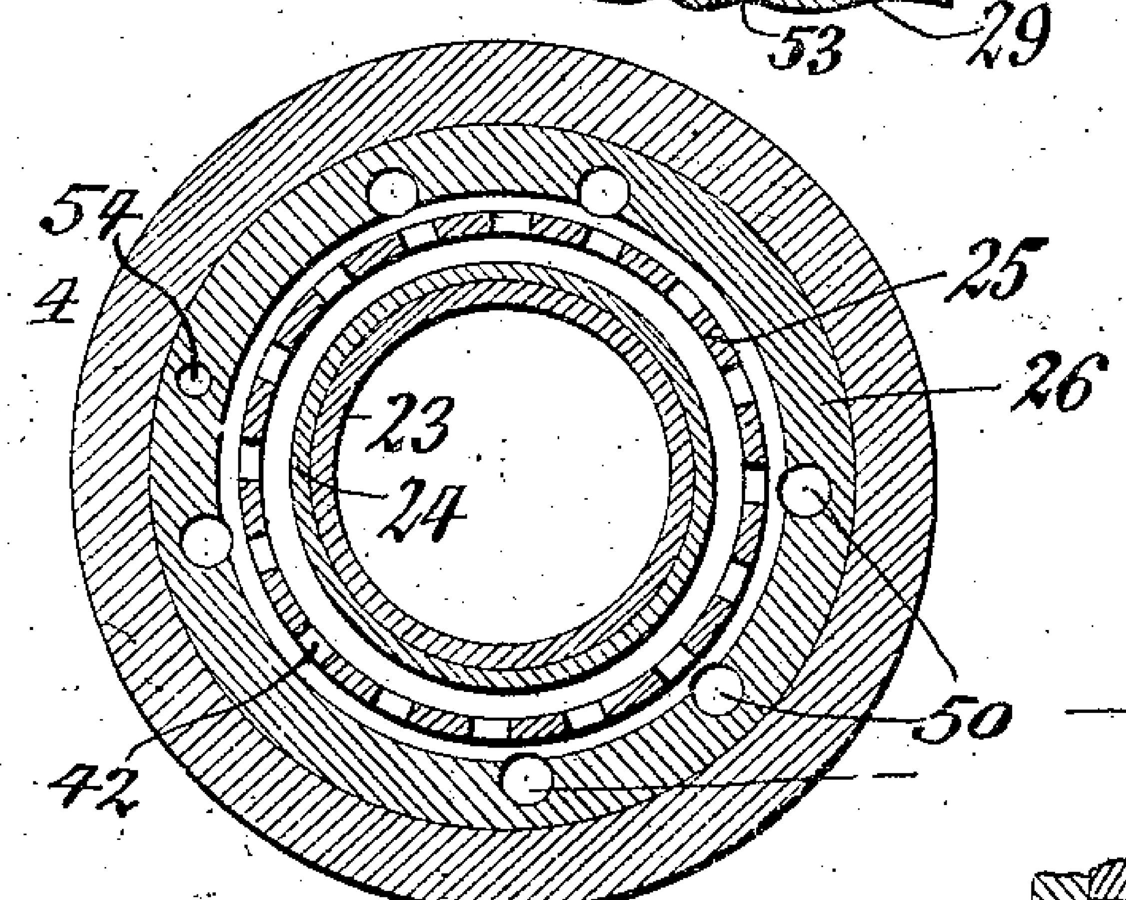


Fig. 6.

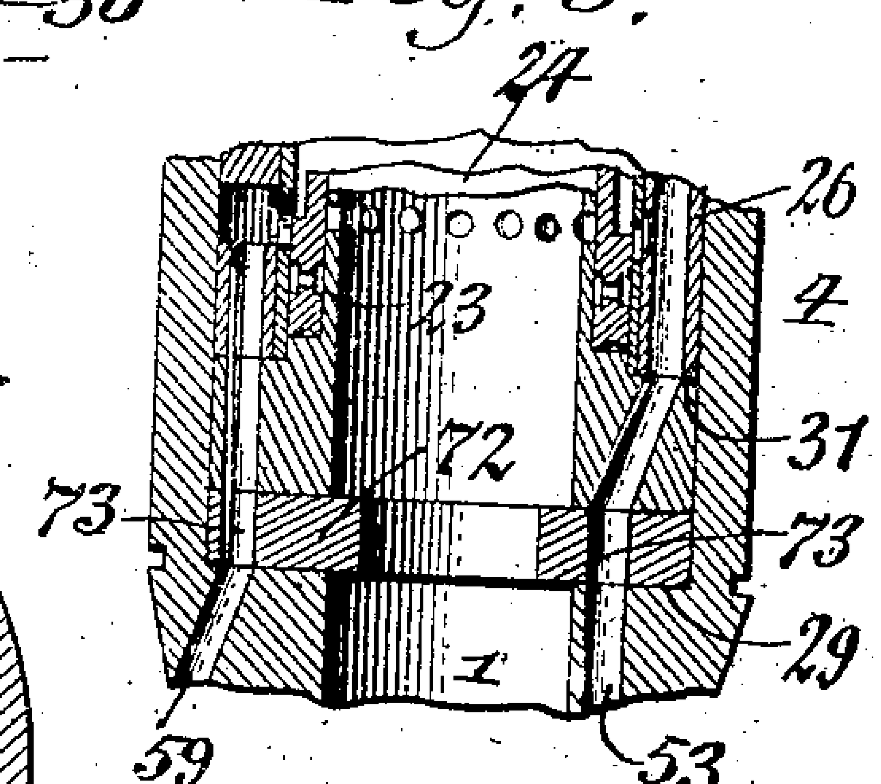
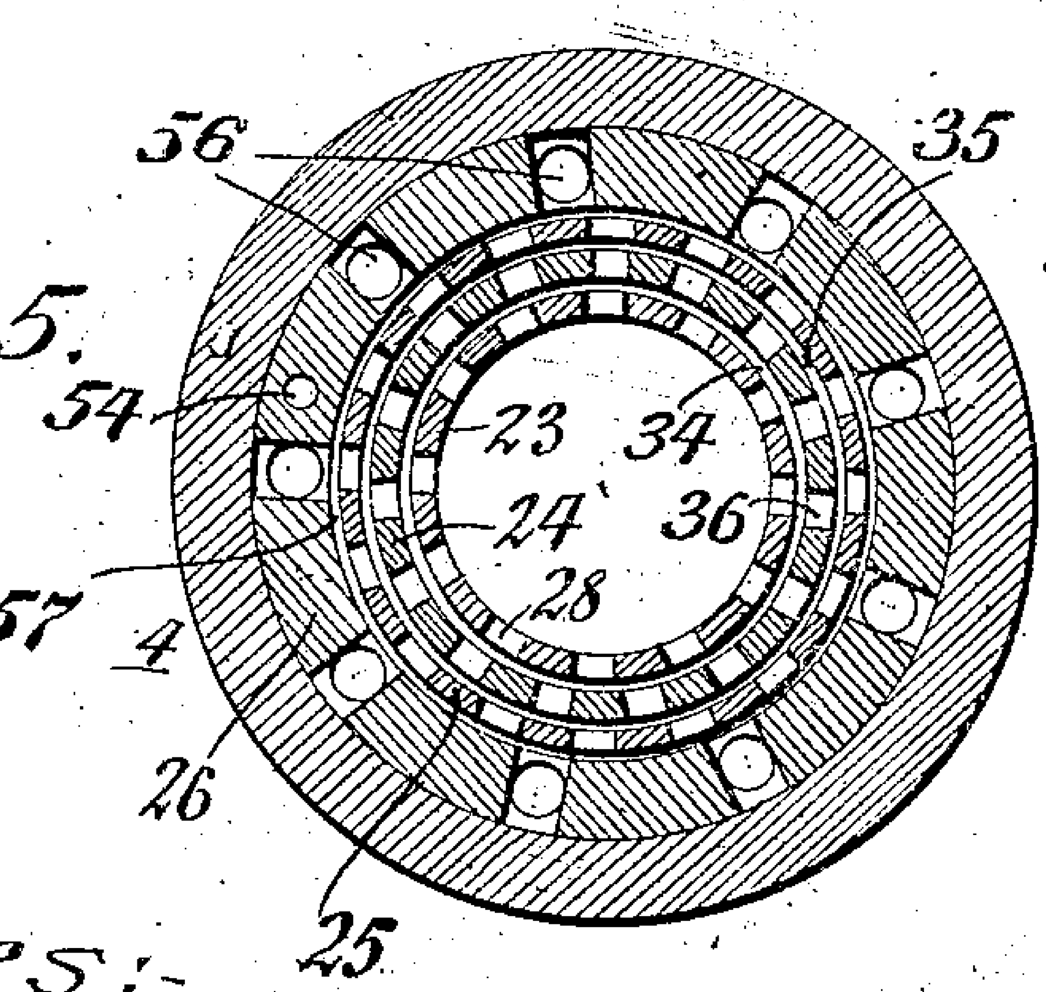


Fig. 5.



Witnesses:-
Richard Sommer.
John H. Shoemaker

Inventor
Max Maximilian,
by Geyer & Popp
Attorneys

UNITED STATES PATENT OFFICE.

MAX MAXIMILIAN, OF BUFFALO, NEW YORK.

PNEUMATIC HAMMER.

952,707. Specification of Letters Patent. Patented Mar. 22, 1910.

Application filed July 14, 1909. Serial No. 507,462.

To all whom it may concern:

Be it known that I, MAX MAXIMILIAN, a subject of the Emperor of Germany, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Pneumatic Hammers, of which the following is a specification.

This invention relates to pneumatic hammers which are used for riveting, chipping and similar purposes.

In hammers of this character as heretofore constructed it has been necessary to first shut the valve in the main air supply tube or hose before the hammer could be detached from this air supply tube, otherwise the air would be wasted and the tube would be violently whipped by the action of the escaping air and endanger the workman.

One of the objects of this invention is to provide means for automatically cutting off the escape of air from the supply tube the instant that the same is disconnected from the pneumatic hammer, thereby avoiding the necessity of turning off the air in the main air supply tube and also avoiding the possibility of being injured.

In prior pneumatic hammers it has also been customary to form the seat for the air reversing valve directly on the valve box which necessitated replacing the entire box when the valve seat became worn. My improved pneumatic hammer is designed to overcome this objection by providing the valve box with a separate seat or guide for the air reversing valve which is removable and therefore easily renewable when worn out without necessitating the renewal of the entire valve box.

Another feature of novelty in my improved pneumatic hammer consists in so organizing the reversing air valve mechanism that the piston during its reciprocating movement passes into and out of the reversing valve which latter for this purpose is preferably made of tubular form and movable lengthwise between inner and outer tubular guides or valve seats and thus permits of materially shortening the hammer.

For the purpose of enabling the piston to be started promptly from the extreme upper or rear end of its stroke, the upper end of the piston is beveled or tapered so as to permit the compressed air to operate upon the same more efficiently in effecting the initial portion of its downward or forward movement, the piston being preferably tapered or beveled at both ends so as to avoid the necessity of special care on the part of the operator in introducing the piston into the power cylinder.

Another improvement in this hammer consists in providing means, whereby the piston may be permitted to make a long stroke for doing heavy work or stopped short of its full stroke when a short stroke is required for light work.

Another object of this invention is to provide simple means for lubricating the piston and operating the lubricating means by motion derived from the piston.

In the accompanying drawings consisting of 2 sheets: Figure 1 is a fragmentary longitudinal section of a pneumatic hammer embodying my improvements and showing the air reversing valve in the position in which air is admitted to the upper end of the power cylinder and the dead or spent air is exhausted from the lower end thereof. Fig. 2 is a fragmentary view similar to Fig. 1 but showing the air reversing valve in the position in which the live or compressed air is admitted to the lower end of the power cylinder and the dead or spent air is exhausted from the upper end of the same. Fig. 3 is a fragmentary longitudinal section, taken on a line different from Figs. 1 and 2, and showing the live air connections whereby air is admitted to the lower end of the reversing valve for aiding in raising the latter and holding the same in its elevated position. Figs. 4 and 5 are transverse sections in the correspondingly numbered lines in Fig. 2, respectively. Fig. 6 is a fragmentary longitudinal section of the pneumatic hammer, showing means for stopping the movement of the piston short of its full or long stroke when a short stroke of the same is desired. Fig. 7 is a sectional elevation of the hammer on a reduced scale.

Similar characters of reference indicate corresponding parts throughout the several views.

In its general organization, my improved pneumatic hammer comprises a power cylinder 1 which is provided at its front or lower end with a rivet set 2 or other tool which is to be operated, a piston 3 reciprocating lengthwise in the power cylinder, a valve chest 4 arranged at the upper or rear end of the power cylinder, a handle 5 detachably connected with the upper or rear end of the valve chest by a screw joint or otherwise, an air supply tube or hose 6 connected with the handle, a manually controlled throttle valve arranged in the handle and adapted to control the supply of compressed air to the hammer, and an air reversing valve mechanism arranged within the valve chest and operating to place the opposite ends of the power cylinder alternately in communication with the compressed air supply and the atmosphere.

The throttle valve is arranged in the main air delivery conduit 7 which leads from the inlet nipple 8 at the upper end of the handle downwardly to the reversing valve mechanism and may be of any suitable construction but preferably consists of a tubular valve seat 9 arranged in a correspondingly-shaped opening extending across the delivery conduit or passage 7 and having two openings 10 arranged on opposite sides in line with the adjacent parts of the delivery conduit, a cylindrical slide valve having enlarged end portions 11, 12 engaging with the bore of the valve seat and a reduced central part 13 connecting the enlarged end parts, a spring 14 bearing against the inner end of the throttle valve and operating to move the same backwardly, so that the front part of the valve closes the lower port 10 and cuts off the supply of air to the hammer, and a trigger 140 pivoted on the upper part of the handle and adapted when depressed to engage with the outer end of the valve and shift the latter forwardly, so that the enlarged front part thereof uncovers the lower port 10 and permits the compressed air to pass to the reversing valve mechanism and the power cylinder.

The automatic check valve whereby the escape of air from the main supply tube is cut off upon detaching this tube from the handle of the hammer is preferably combined with and forms part of the means whereby this tube is detachably connected with the hammer, the means for this purpose shown in the drawings being preferred and constructed as follows:

15 represents the tubular casing or housing of the check valve which is provided at its rear end with a nipple 16 inserted in the front end of the main air supply tube and permanently secured thereto by means of a clamp 17 or otherwise. The front end valve casing and having a valve stem 22 which extends forwardly through the delivery nozzle beyond the front end of the same. Upon screwing the nozzle 18 into the nipple 8 the front end of the valve stem 22 engages with the periphery of the tubular valve seat of the throttle valve or other stationary abutment, whereby the check valve is moved rearwardly away from its seat and air is permitted to pass from the supply tube or hose into the delivery conduit of the pneumatic hammer. Upon unscrewing the nozzle of the check valve casing from the nipple of the delivery conduit 7, the pressure of the air in the supply tube against the back of the check valve forces the latter against its seat in the casing, thereby automatically cutting off the escape of air from the tube. By this means it is unnecessary to first turn off the air in the main supply tube near the air compressor or the main supply pipe as has been customary heretofore, thereby not only saving time but also preventing injury to the workman as frequently occurs when the air supply tube is detached from the pneumatic hammer without first cutting off the air supply to the tube.

The air reversing valve mechanism comprises generally an inner tubular valve guide or seat 23, a tubular reversing valve 24 arranged around the upper part of the inner guide, an outer tubular valve guide or seat 25 surrounding the tubular valve, a tubular valve box 26 surrounding the outer valve guide, and a circular top, plug or cap 27 extending over the opening within the bore of the inner and outer valve guides and valve and resting with its underside against the upper ends of the outer valve guide and valve box while its upper side engages with the underside of the handle 5.

The inner valve guide or seat has its bore of the same diameter as that of the power cylinder and arranged axially in line therewith and has an upper narrow part which is provided with an annular row of upper exhaust ports 28 through which the spent air is permitted to escape from the upper end of the power cylinder and a lower wide part which is seated with its underside on a shoulder 29 formed between the power cylinder and the valve chest while its upper side is provided with an upper annular shoulder 30 of small diameter which faces upwardly is provided with an annular groove 32. Above its lower edge and in its wide part, the reversing valve is provided with inner and outer annular grooves, 34, 35, which are formed respectively in the bore and the periphery of this valve and are connected by a plurality of radial openings or passages 36. Above the annular channels or grooves 34, 35 and the connecting passages 36 the wide lower part of the reversing valve is provided in its periphery with an annular transfer passage 37, the lower side of which forms a pressure face or shoulder 38. Above this transfer passage the upper narrow part of the reversing valve is provided in its periphery with an annular upwardly facing shoulder or pressure face 39.

The outer tubular guide rests with its lower end on the lower shoulder of the inner guide and is provided above its lower edge with a valve retaining port 40 and a vent port 41 which are adapted to be closed by the lower part of the valve when the same is lowered and to be uncovered by this part of the valve when the same is raised. Above the retaining and vent ports, the outer guide is provided with an annular row of main air ports 42 which are arranged transversely opposite the upper cylinder exhaust ports 28 of the inner guide and serve as part of the outlet or passageway for the air exhausted from both ends of the power cylinder. Above the main ports, the outer guide is provided with an annular row of alternating ports 43 which serve at one time as air admission ports through which compressed air passes into the lower end of the power cylinder and at another time as exhaust ports for carrying the air from the lower end of the power cylinder to the atmosphere. In line with these alternating ports the outer valve guide or seat is provided in its bore with a downwardly facing annular shoulder 44 and above this shoulder and the alternating ports, the outer guide is provided with an annular row of lower piston shifting ports 45, whereby the air is admitted to the lower end of the power cylinder for raising the piston. Above the lower piston shifting ports the outer guide is provided with an upper valve shifting port 46 to which air passes for moving the reversing valve downwardly. Transversely in line with the upper valve shifting port the bore of the outer valve guide is provided with a downwardly facing shoulder 47 which is arranged opposite the upwardly facing shoulder 39 of the reversing valve. Above the last mentioned shoulder of the outer guide the latter is provided with an annular row of upper piston shifting ports 48 whereby air is admitted to the upper end of the power cylinder for pushing or moving the piston downwardly in the cylinder.

The valve box fits with its periphery into the bore of the valve chest, its lower end rests upon the lower shoulder of the inner guide, the lower part of its bore engages with the lower large or wide part of the outer guide, while the upper part of its bore opposite the ports 45, 46, 48 of the outer guide is separated by an intervening passage 49 from the upper part of the outer guide, this passage being preferably formed by reducing this part of the outer guide, as shown in Figs. 1 and 2. In its lower part the valve box is provided with a plurality of longitudinal passages 50 each of which opens inwardly into an annular passage or groove 51 formed in the bore of the valve box and communicating with the alternating ports of the outer guide while its lower end communicates with an oblique passage 52 in the enlarged lower part of the inner guide, this last mentioned passage in turn communicating with a longitudinal passage 53 formed in the wall of the power cylinder and extending to the lower end of the bore of this cylinder, as shown in Figs. 1 and 2.

On one side the valve box is provided with a longitudinal passage 54 which opens at its upper end into the passage 49 between the upper part of the bore of the valve box and the upper part of the outer guide while its lower end communicates with the valve retaining port 40 of the outer guide, as shown in Fig. 3. On its opposite sides the valve box is provided with a passage 55 which places the vent port 41 in communication with the nearest longitudinal air passage 50.

In the lower part of the valve box and alternating with the longitudinal passages 50 the same is provided with a plurality of longitudinal passages 56 each of which communicates at its upper end with an annular passage 57 formed in the bore of the valve box in line with the main exhaust ports 42 of the outer valve guide while its lower end communicates with an exhaust passage 58 formed in the lower enlarged part of the inner guide and the last mentioned passage in turn communicating with an exhaust passage 59 formed in the adjacent part of the wall of the power cylinder and opening to the atmosphere.

60 represents a plurality of longitudinal passages arranged in the enlarged lower part of the inner valve guide and each opening at its upper end through the upper shoulder of this guide while its lower end communicates with a longitudinal air passage 61 arranged lengthwise in the wall of the power cylinder and opening through the bore of said cylinder about midway of the length thereof and operating to admit air from the cylinder underneath the reversing valve for lifting the latter during the last part of the downward or forward stroke of the piston.

The downward movement of the reversing

valve is limited by engagement of its lower end with the upper shoulder of the inner guide, as shown in Fig. 1. The upward movement of the reversing valve is limited by engagement of its upper shoulder 39 with the downwardly facing shoulder 47 of the outer guide, as shown in Fig. 2. The cap or top of the reversing valve mechanism is provided with a plurality of air passages 62 which communicate at their upper ends with the main air delivery conduit 7 while their lower ends communicate with the air passage 49. Transversely in line with its upper shoulder 39 the reversing valve is provided with one or more vent ports 63.

In the position of the parts shown in Fig. 1, the piston is in its highest position and the reversing valve is lowered for admitting compressed air into the space above the piston for propelling the same downwardly while the lower end of the power cylinder is connected with the atmosphere for permitting the air to exhaust therefrom. In this position of the reversing valve the compressed air passes successively from the delivery conduit 7 downwardly through the passages 62 in the top or cap, thence downwardly through the passage 49 between the valve box and upper part of the outer guide, thence through the upper ports 48 of the outer valve guide, and thence into the space above the upper end of the piston, whereby the latter is moved forwardly or downwardly by the pressure of the air against the same. Some of the compressed air also enters through the ports 46, 63 and bears against the upper end of the piston and assists in propelling the same forwardly after the sam has passed the ports 63 during the initial portion of its downward movement. The valve is at this time held in its lower or foremost position by the pressure of the air against the upper edge of the same and also against the upwardly facing shoulders 38 and 39 thereof. While the piston is thus being moved downwardly the spent or dead air in front or below the same is expelled and passes successively from the lower end of the power cylinder through the passages 53 of the power cylinder, the passages 52 in the inner guide, the passages 51, 50 in the valve box, thence through the alternating ports 43, transfer passage 37, annular passage 57 and longitudinal passages 57, 56, 58, 59, to the atmosphere.

After the piston has completed about one-half of its downward or forward stroke, the rear end of the same uncovers the lower end of the passages 61 in the power cylinder permitting live or compressed air to pass upwardly through these passages and thence through the passages 60 in the inner guide into the space below the lower end of the reversing valve, thereby causing the latter to be raised. After this valve has bean partially raised, the lower portion thereof uncovers the retaining air port 40, thereby permitting additional live air to pass directly from the upper part of the valve box through the passage 54 into the space below the reversing air valve, whereby the upward movement of the same is assisted and effected more quickly than if the same were raised solely by the air supplied by the longitudinal passages 61. The instant that the reversing valve has been thus raised into its uppermost position, as shown in Fig. 2, the live or compressed air is diverted and caused to pass successively from the space 49 between the valve box and the upper part of the outer guide through the lower piston shifting ports 45, annular transfer passage 37, alternating ports 43, annular passage 51, longitudinal passages 50, 52, 53 to the lower end of the power cylinder, thereby causing the piston therein to be raised or moved backwardly by the pressure of the air against the lower or front end of the same. The spent or dead air above the piston during this time is expelled and passes successively through the ports 28 in the inner guide, the passages 34, 35, 36 in the lower part of the valve, the ports 42 in the outer guide and thence through the passages 57, 56, 58 and 59 to the atmosphere. After the piston during its return or backward movement has passed the lower end of the air passages 61, the space below the lower end of the reversing valve is placed in communication with the lower end of the power cylinder into which the live air is entering but this does not affect the position of the reversing valve. During the last part of the upward or return stroke of the piston the same covers the exhaust ports 28 in the inner guide. After the piston reaches this uppermost position, the pressure of the air against the upwardly facing shoulders 38, 39 of the reversing valve preponderates over the pressure of the air against the lower end of the reversing valve, thereby causing the same to be moved downwardly into its lowermost position, as shown in Fig. 1, and causing the air connections to be again reversed for propelling the piston with a forward stroke. During the upward movement of the reversing valve the air confined between the upper shoulders 39, 47 of the valve and outer guide is permitted to escape through the vent ports 63, thereby preventing the movement of the valve in this direction from being cushioned and permitting the same to be shifted quickly in this direction. As the reversing valve is moved downwardly, the air below the same is permitted to pass freely from the space below this valve through port and passage 41, 55, in the lower part of the outer guide and the valve box to the adjacent longitudinal passage 50 in the latter, thereby preventing the downward movement of the reversing valve from being cushioned and permitting the same to move quickly in this direction.

For the purpose of permitting automatic lubrication of the piston and reversing valve mechanism while the same is in operation the following means are provided: 64 represents a reservoir for grease or oil formed in the upper part of the cap or plug 27 and having its top normally closed by a cover 65. Centrally in the bottom of this reservoir the same is provided with an outlet passage 66 which communicates with the bore of the reversing valve mechanism and the power cylinder and which is pivoted at its upper end to the valve seat 67. 68 represents a lubricating valve engaging with the seat 67 and provided with a stem 69 which projects downwardly through the passage 66 into the space in the reversing valve mechanism. This valve is normally or yieldingly held in its closed position by means of a spring 70 which is preferably interposed between the top of the valve and the underside of the cover 65. During the last part of each upward stroke of the piston its upper or rear end engages with the stem of the lubricating valve and lifts the latter from its seat, thereby opening the passage 66 and permitting a small quantity of the oil in the reservoir, or the grease therein which has been melted by the heating of the hammer, to escape therefrom into the reversing valve mechanism and power cylinder for lubricating these parts.

For the purpose of enabling the compressed air upon entering the upper end of the space within the reversing valve mechanism to obtain a prompt hold upon this end of the piston and move the same quickly downward, this end of the piston is beveled upwardly, as shown at 71 in Figs. 1 and 2. In order to avoid the necessity of special care on the part of the operator when introducing the piston into the power cylinder, both ends of the piston are thus beveled, as shown in the drawings, so that it is immaterial which end is placed uppermost into the power cylinder.

Heavy riveting or other heavy work requires a comparatively long stroke of the piston while the light work can be accomplished by a shorter stroke. To permit of thus obtaining either a short or a long stroke in this pneumatic hammer, a stop device is provided which is adapted to project into the path of the piston and limit its return or backward movement short of the full stroke but which when removed from the hammer permits the piston to again return or move backwardly its full stroke when a heavy blow is required. This stop device preferably consists of a ring 72 which is adapted to be clamped between the underside of the inner guide and the shoulder of the power cylinder and which projects into the path of the piston and is provided with openings 73 which connect the adjacent passages in the power cylinder and the inner guide. When this ring is in place it forms a stop which is engaged by the upper end of the piston and prevents the latter from entering the reversing valve mechanism, thereby shortening the stroke of the same accordingly. When a long stroke of the piston is required, this stop plate or ring can be easily removed by unscrewing the handle from the valve chest and taking the valve mechanism out of the chest, thereby permitting the piston to again enter the valve mechanism and work with a long stroke. By this means the use of air may be economized and the operator relieved from unnecessary vibration when doing light work.

I claim as my invention:

1. A pneumatic hammer comprising a power cylinder, a power piston arranged in said cylinder, a lubricating chamber arranged at the front end of the cylinder and having an outlet in its bottom, a valve for closing the outlet having a stem projecting forwardly into the cylinder in position to be engaged by the rear end of the piston for opening the valve, and a spring for closing said valve.

2. A pneumatic hammer comprising a power cylinder, a piston reciprocating in said cylinder, and a removable stop adapted to be arranged in the path of said piston for producing a short stroke of the same and to be removed from the path of said piston to permit the latter to take a long stroke.

3. A pneumatic hammer comprising a power cylinder, a tubular guide arranged at the rear end of the cylinder, a piston adapted to reciprocate lengthwise in the cylinder and guide for producing a long stroke of the same, a stop ring adapted to be placed between said cylinder and guide and adapted to arrest the piston for producing a short stroke of the same.

4. A pneumatic hammer comprising a power cylinder, a piston reciprocating in the cylinder, and a valve mechanism for alternately admitting air into and permitting the same to exhaust from opposite ends of the cylinder comprising an inner tubular guide arranged at the rear end of the cylinder and having a bore of the same diameter as the cylinder and having an exhaust port extending from its bore to its periphery, an outer tubular guide having an upper piston shifting air port adapted to lead to the upper end of the cylinder, an upper valve shifting air port, a lower piston shifting air port adapted to lead to the lower end of the cylinder, an alternating air supply and exhaust port, an exhaust port communicating with the atmosphere, and a lower valve shifting air port, and a tubular reversing valve movable lengthwise between said in-

ner and outer valve guides and having its upper end adapted to cover and uncover the upper piston shifting ports and having a passage adapted to connect said alternating port of the outer guide with said lower piston shifting port or said exhaust port of the outer guide, and an exhaust passage adapted to connect and disconnect the exhaust ports of the inner and outer guides.

5. A pneumatic hammer comprising a power cylinder, a piston reciprocating in said cylinder, and a valve mechanism for alternately admitting air to and exhausting the same from opposite ends of the cylinder comprising an inner tubular guide having a bore of the same diameter as the cylinder and having exhaust ports for the upper end of the cylinder, an outer tubular guide having upper piston shifting air supply ports, upper valve shifting air supply ports, lower piston shifting air ports, alternating air supply and exhaust ports, main exhaust ports and lower valve shifting air ports and provided in its bore opposite said upper valve shifting ports with a downwardly-facing upper shoulder and provided opposite said alternating ports with a lower downwardly-facing shoulder, and a tubular reversing valve adapted to reciprocate lengthwise between said inner and outer guide and having an upper end of the same bore as the cylinder and inner guide and adapted to cover and uncover the upper piston shifting air ports and provided in its periphery with a passage adapted to connect said alternating ports either with said lower piston shifting port or said main exhaust port, an exhaust passage adapted to connect and disconnect said main exhaust ports and said upper cylinder exhaust ports, said valve being also provided on the upper part of its periphery with an upwardly facing shoulder which is arranged opposite the upper shoulder of the outer guide, and a downwardly facing shoulder in its bore opposite the upper end of the inner guide and having vent ports in line with its upper shoulder, the lower end of said valve being adapted to cover and uncover said lower valve shifting ports.

Witness my hand this 6th day of July, 1909.

MAX MAXIMILIAN.

Witnesses:
THEO. L. POPP,
ANNA HEIGIS.