No. 819,905. PATENTED MAY 8, 1906.

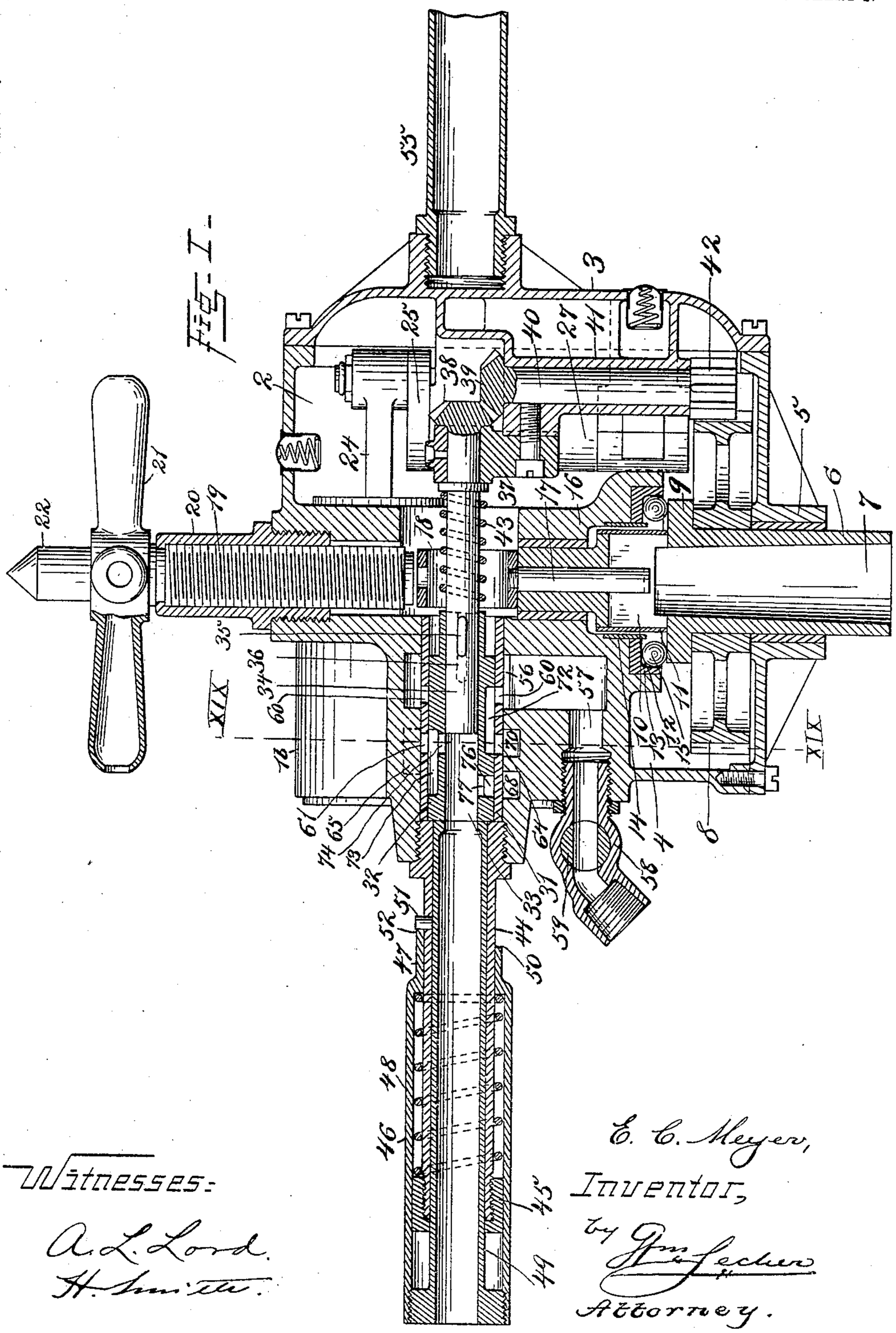
E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 1.

FIG. 1.



Witnesses:

A. L. Lord.

H. Smith.

E. C. Meyer,

Inventor,

by Jno. Lecher

Attorney.

No. 819,905. PATENTED MAY 8, 1906.

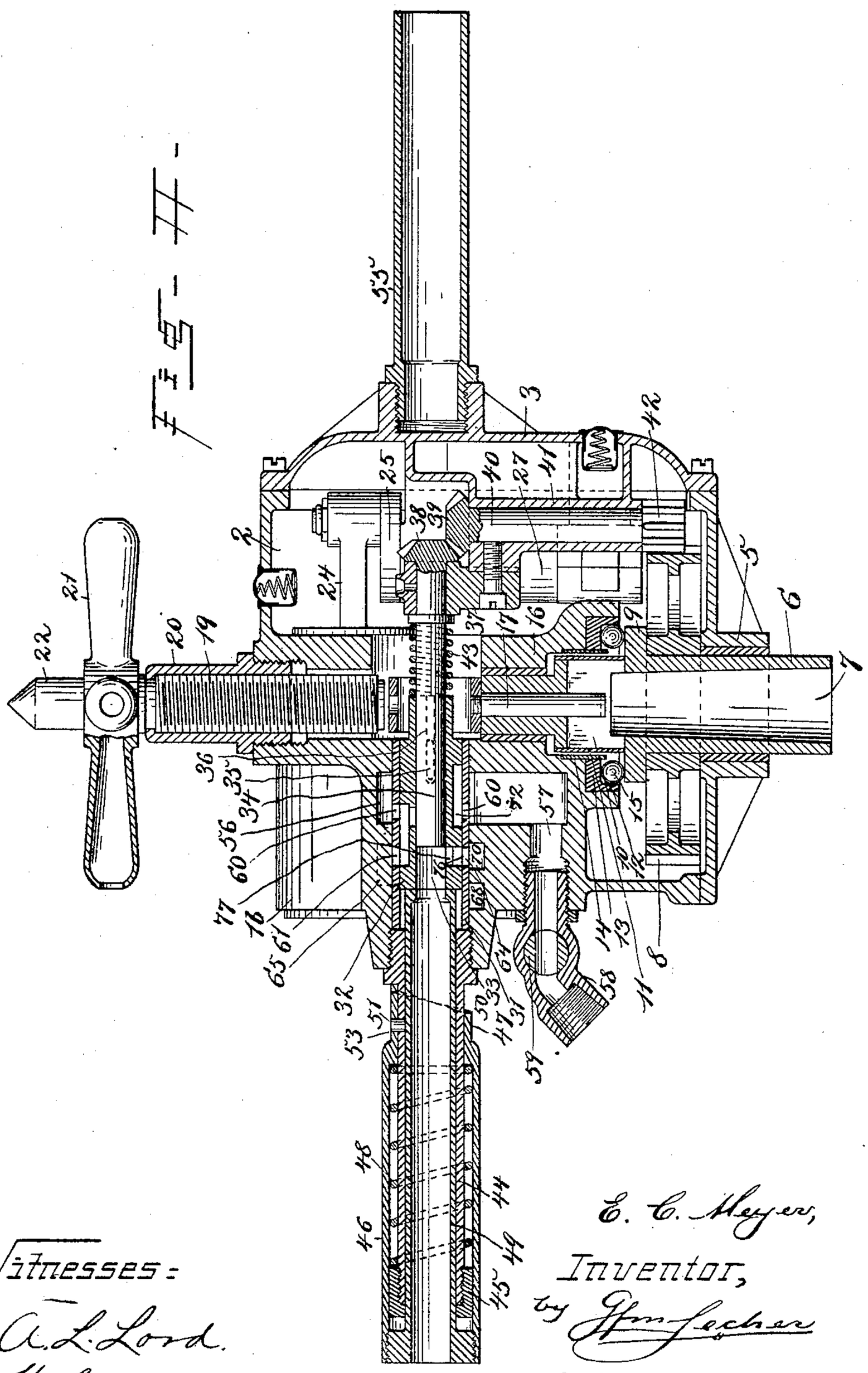
E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 2.

FIG. 2.



Witnesses:

A. L. Lord.

H. Smith

E. C. Meyer,

Inventor,

by Jno. Locher

Attorney.

No. 819,905. PATENTED MAY 8, 1906.

E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 3.

Fig. III.

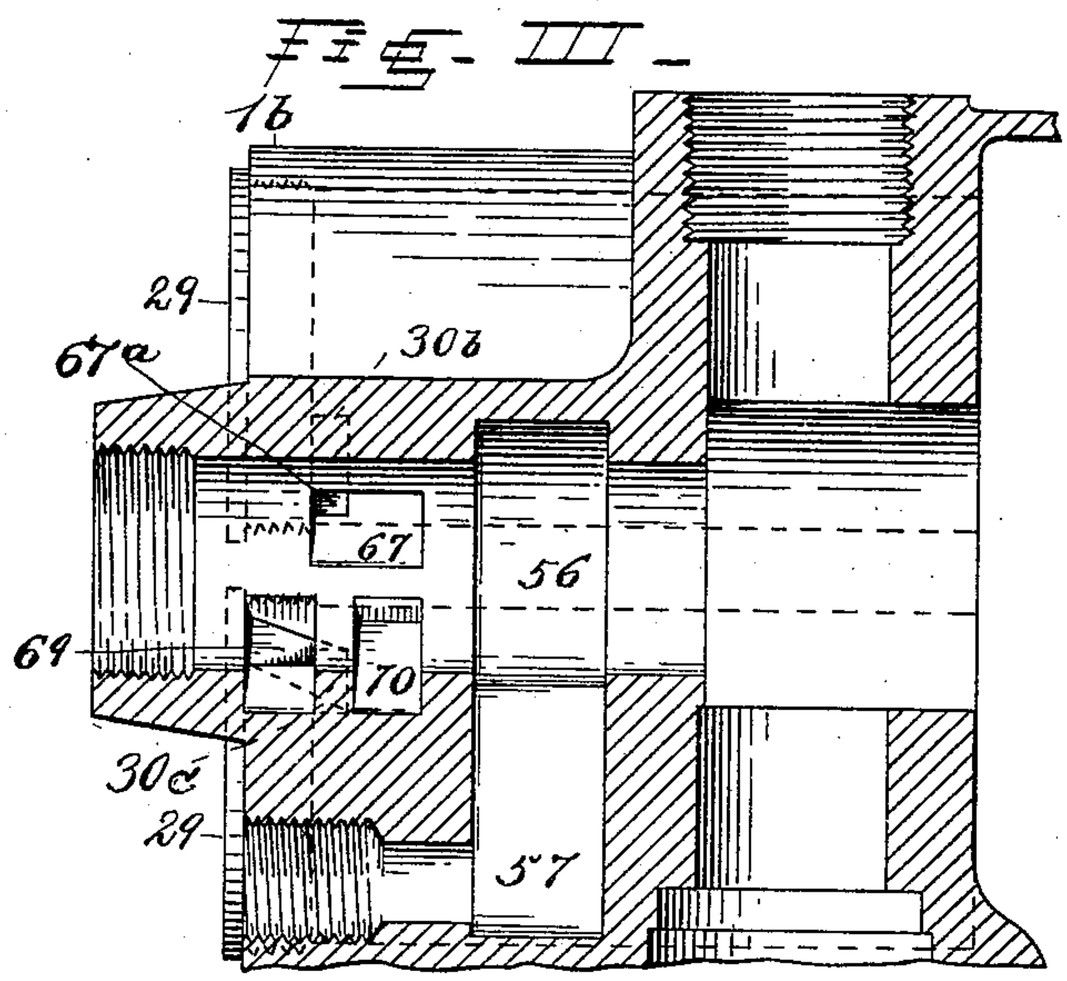


Fig. IV.

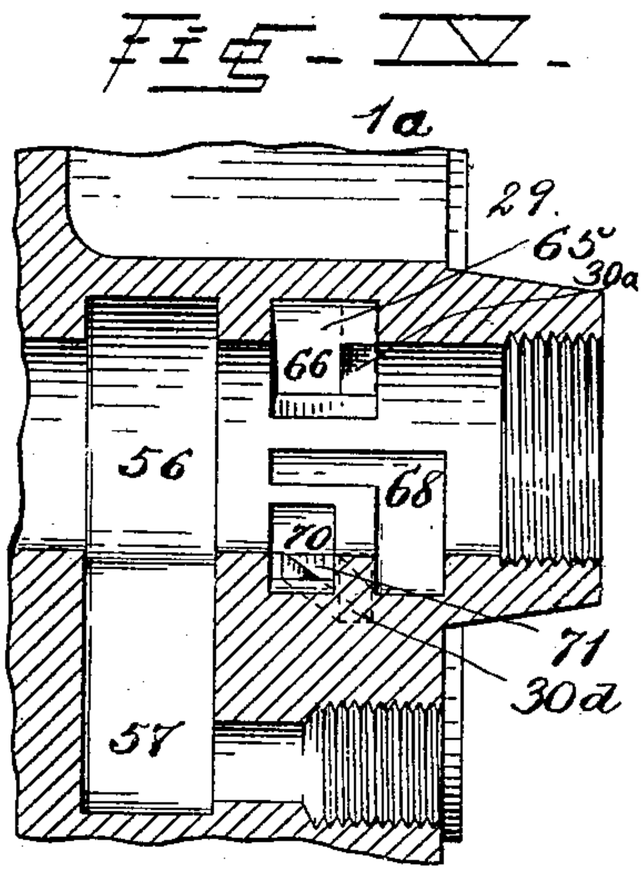
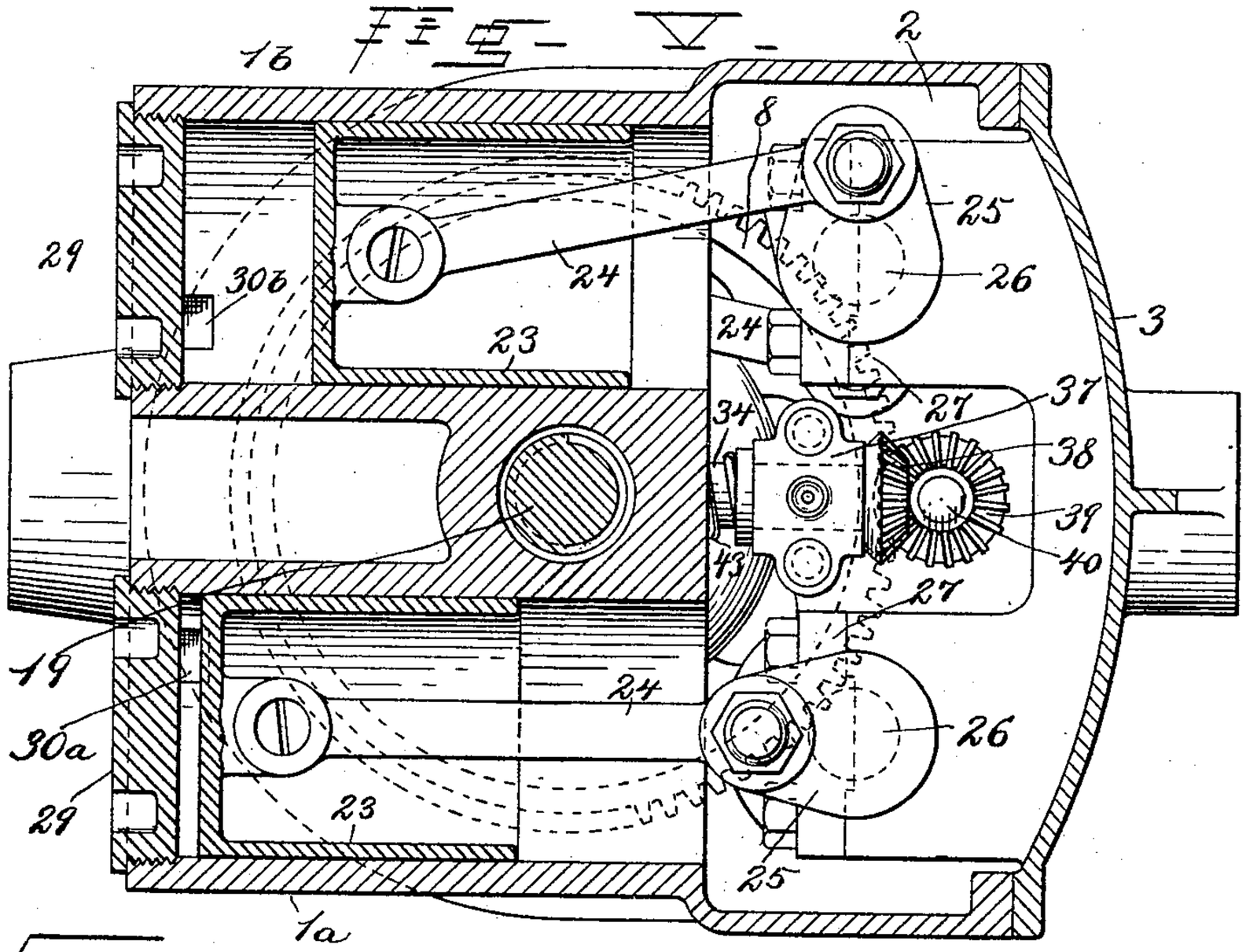


Fig. V.



Witnesses:

A. L. Lord

H. Smith

Inventor,

E. C. Meyer,

by Wm. Secor

Attorney.

No. 819,905. PATENTED MAY 8, 1906.

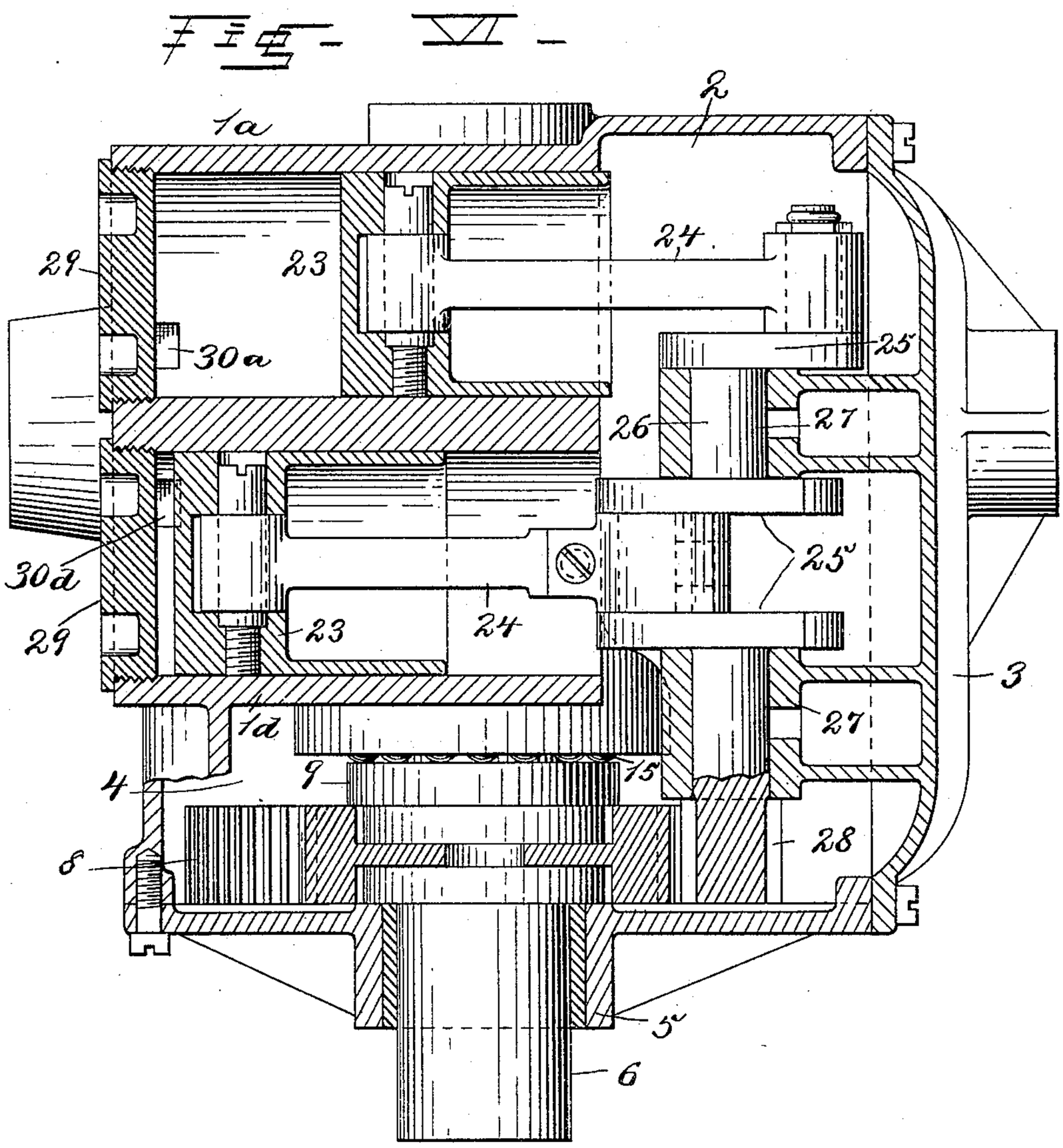
E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 4.

FIG. VI.



Witnesses:

A. L. Lord.

H. Smith

E. C. Meyer,
Inventor,
by Wm. Fecher
Attorney.

No. 819,905. PATENTED MAY 8, 1906

E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 5

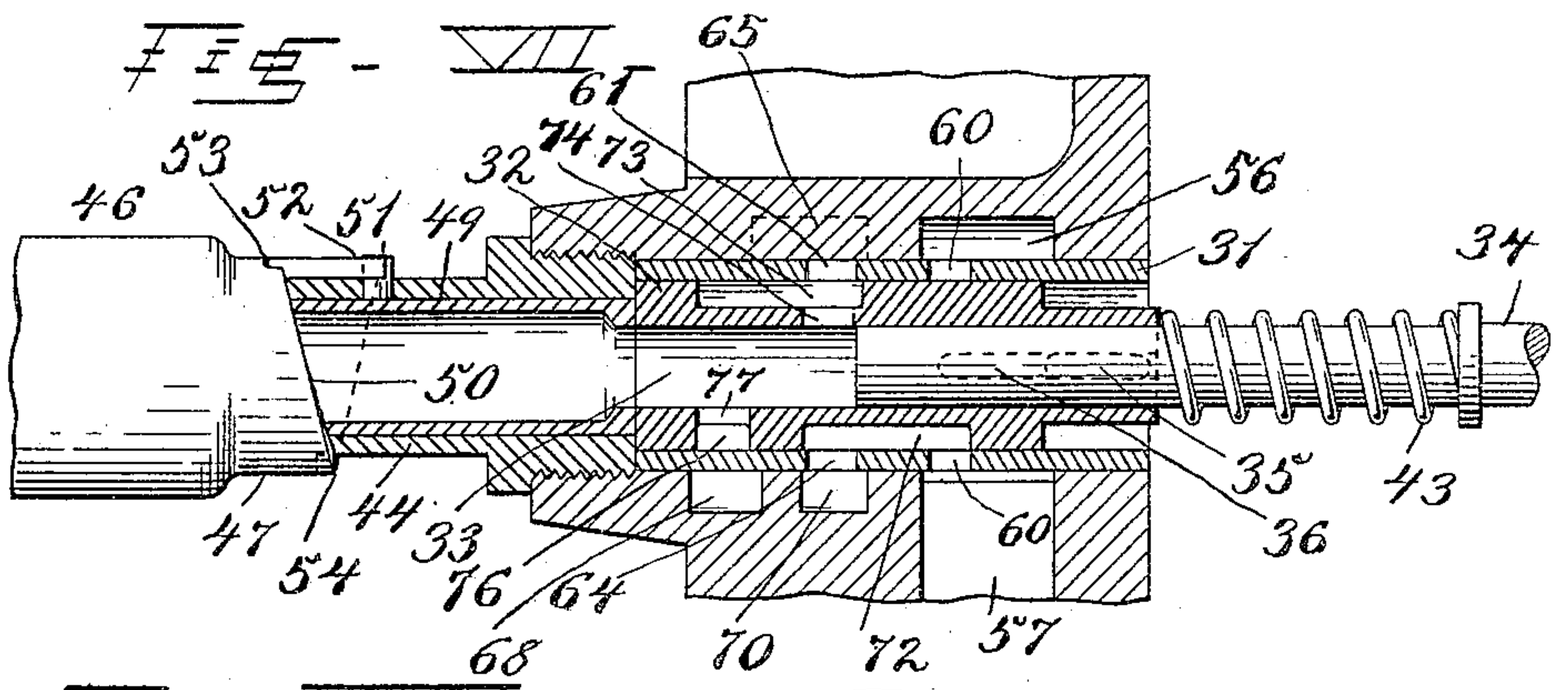


FIG. VIII.

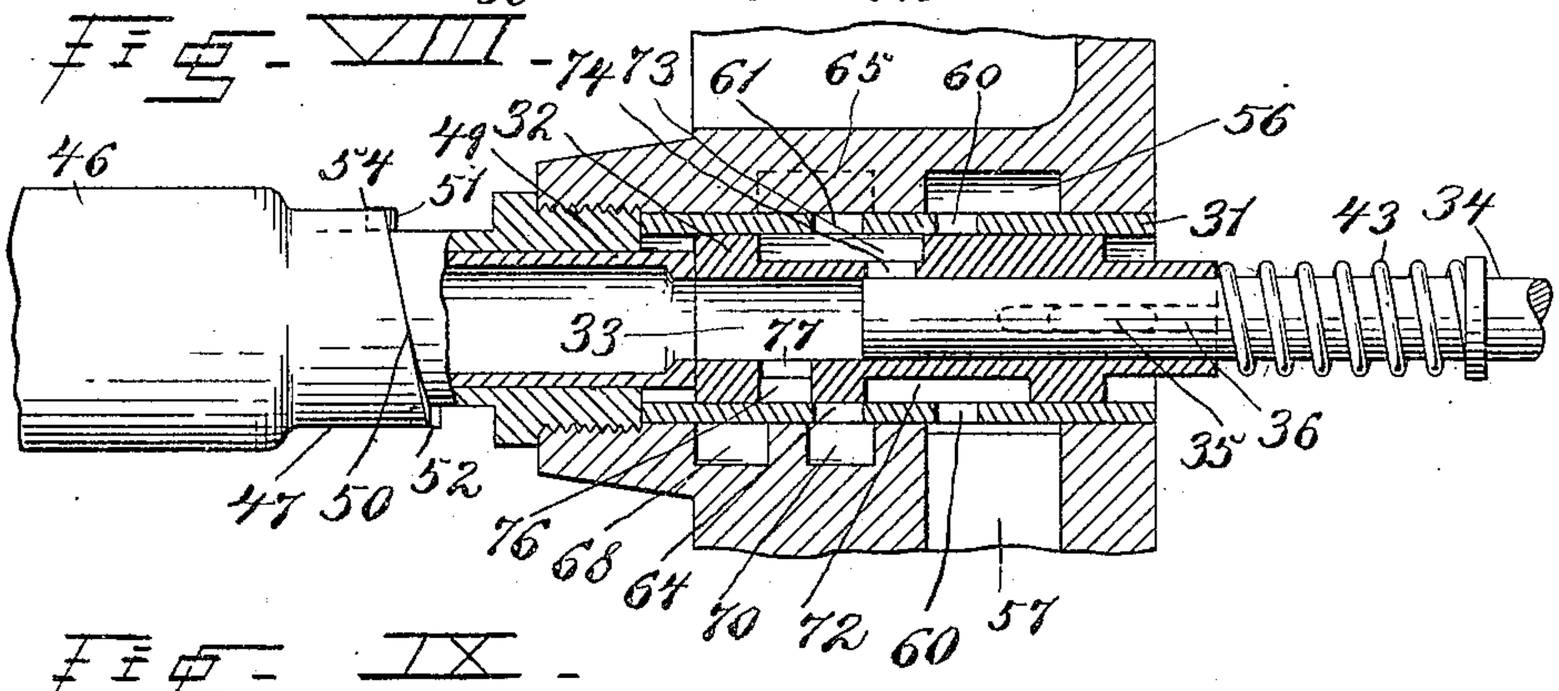


FIG. IX.

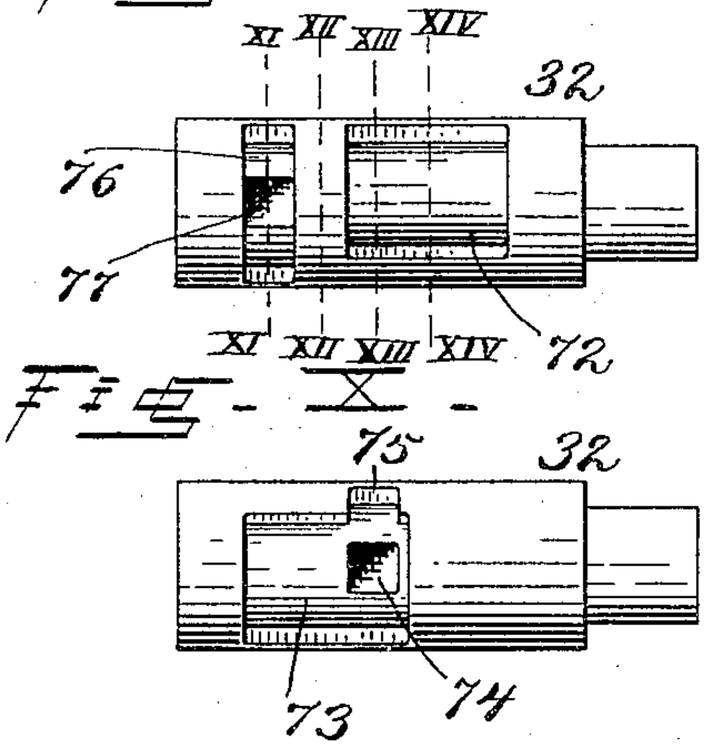


FIG. X.

FIG. XI.

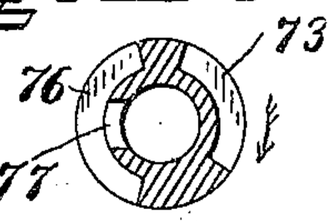


FIG. XII.

FIG. XIII.

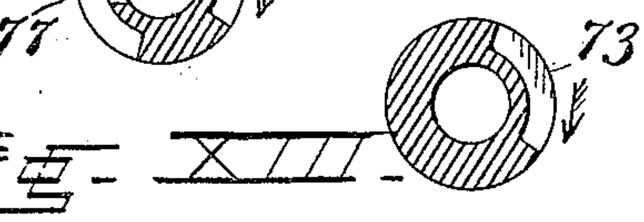
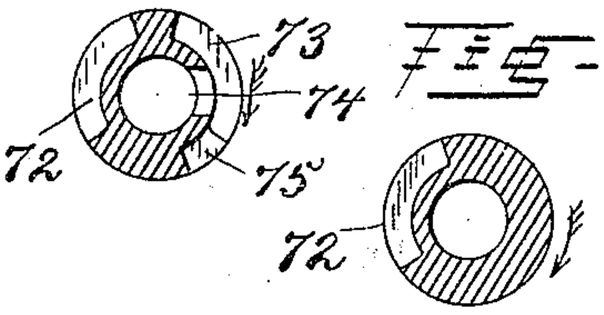


FIG. XIV.



Witnesses:

A. L. Lord.

H. Smith

E. C. Meyer,
Inventor,

by Geo. Fecher

Attorney.

No. 819,905. PATENTED MAY 8, 1906.

E. C. MEYER.

ENGINE.

APPLICATION FILED DEC. 26, 1902.

6 SHEETS—SHEET 6.

Fig. XV.

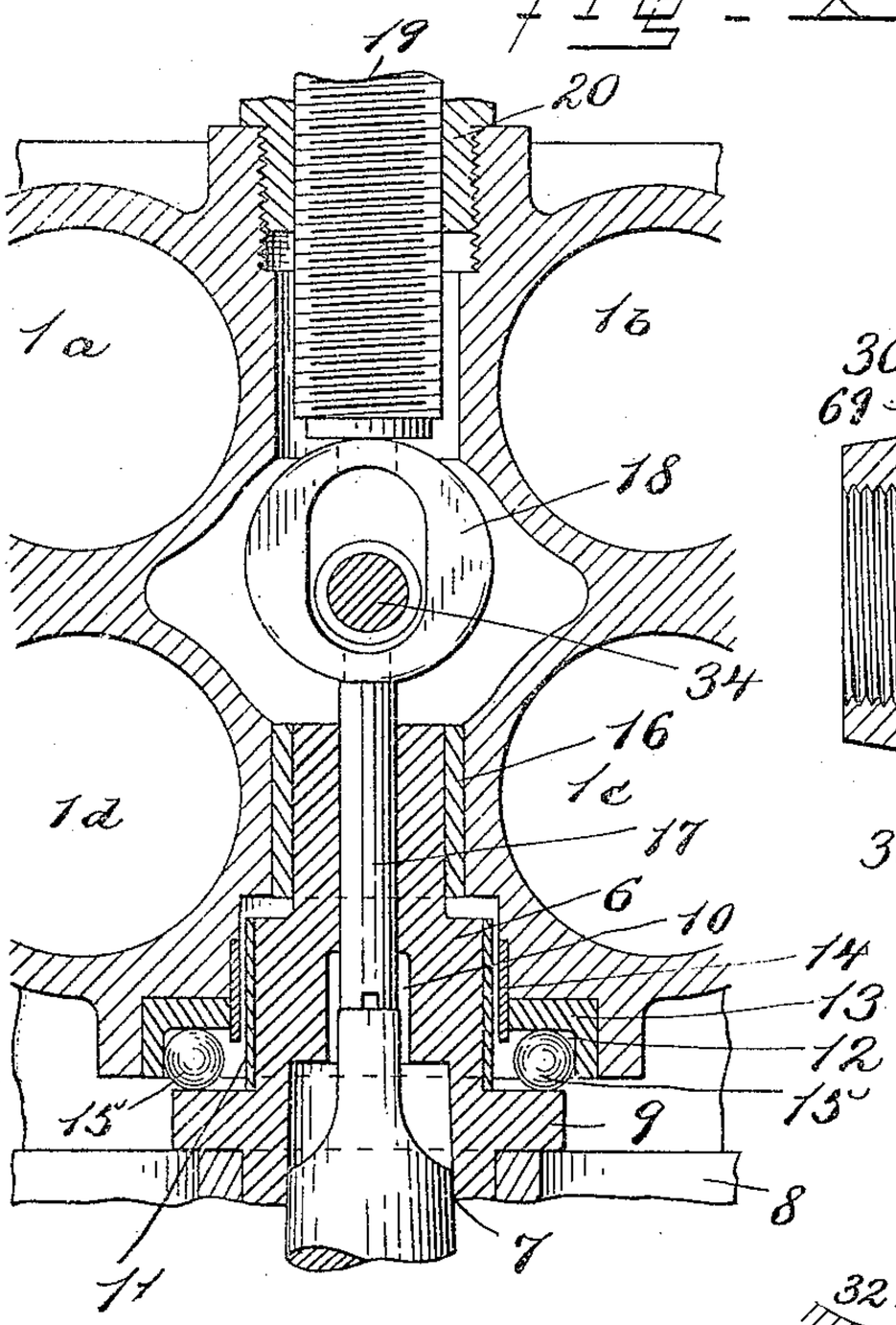


Fig. XVI.

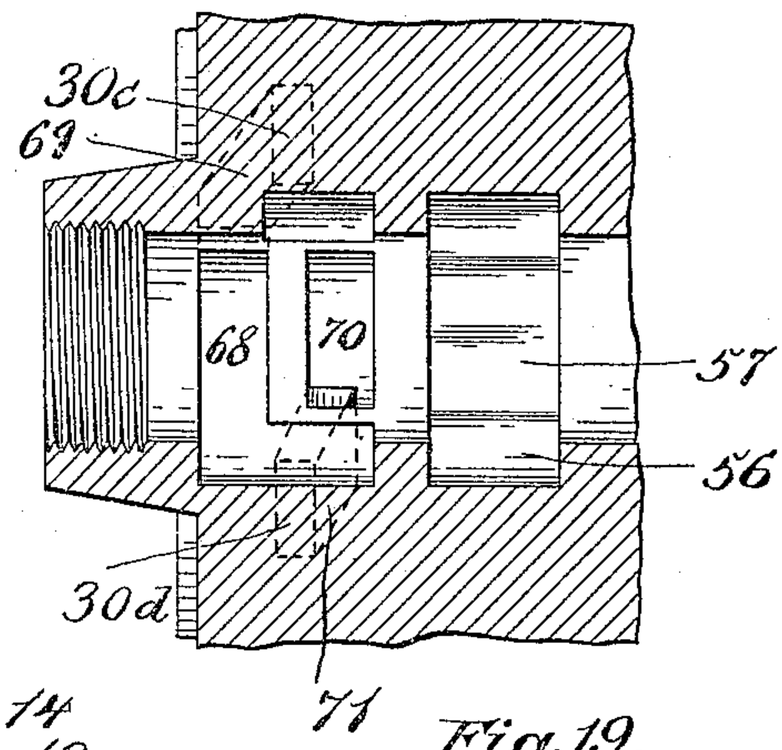


Fig. 19.

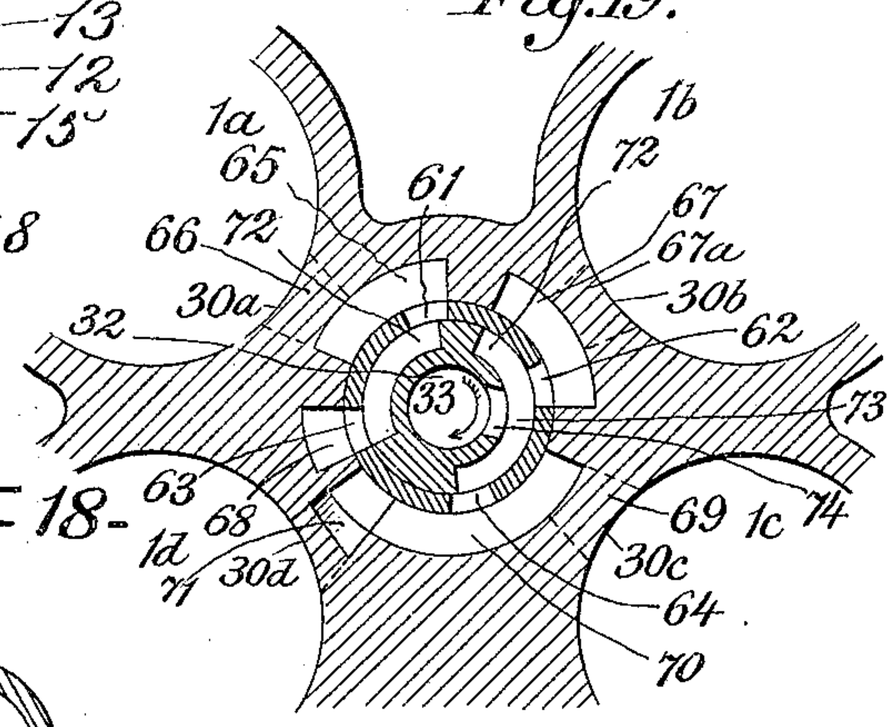


Fig. XVII.

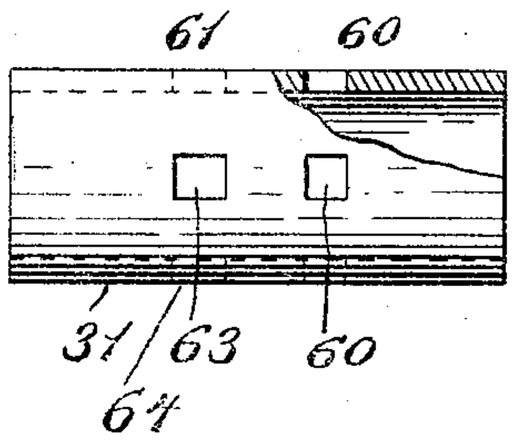
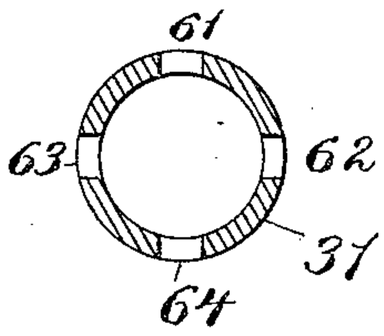


Fig. 18.



Witnesses:

A. L. Lord.

H. Smith

E. C. Meyer,

Inventor,

by Geo. H. Fisher

Attorney.

UNITED STATES PATENT OFFICE.

ERNEST C. MEYER, OF CLEVELAND, OHIO, ASSIGNOR TO THE CLEVELAND PNEUMATIC TOOL COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

ENGINE.

No. 819,905. Specification of Letters Patent. Patented May 8, 1906.

Application filed December 26, 1902. Serial No. 136,714.

To all whom it may concern:

Be it known that I, ERNEST C. MEYER, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented certain new and useful Improvements in Engines, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The annexed drawings and the following description set forth in detail one mechanical form embodying the invention, such detail construction being but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings, Figure I represents an axial section of my improved engine, showing it constructed for use as a drilling or boring engine and showing the valve in position to cause the engine to drive the drill in the boring direction; Fig. II, an axial section of the engine, showing the valve in the reversing position; Fig. III, a vertical section of the valve-chamber with its bushing removed; Fig. IV, a similar section looking in the opposite direction; Fig. V, a horizontal section through the upper pair of cylinders; Fig. VI, a vertical section through the two cylinders nearest to the observer; Fig. VII, an axial section through the valve and valve-chamber, showing the valve in position to cause the engine to drive the drill in the boring direction; Fig. VIII, the same view, but illustrating the valve in position to stop the engine; Figs. IX and X, side views of the valve; Figs. XI, XII, XIII, and XIV, transverse sections, respectively on the lines XI XI, XII XII, XIII XIII, and XIV XIV in Fig. IX; Fig. XV, an axial detail view of the center of the engine, showing the device for forcing the drill out of its socket; Fig. XVI, a horizontal section looking downward of the valve-chamber with the bushing removed; Figs. XVII and XVIII, a side view and end view, respectively, of the bushing for the valve-chamber; and Fig. XIX, a transverse vertical section on the line XIX XIX in Fig. I of the rotating valve.

The engine which embodies my present invention is illustrated as applied to a portable drilling-machine, usually termed an "air-drill," on account of compressed air being the generally-used motive fluid, and of the type termed "piston-drill," on account of the employment of one or more pistons and piston-cylinders to give rotary motion to the drill or boring-tool from the reciprocations of such piston or pistons. The engine is applicable, however, to all purposes where rotary motion is to be produced from the action of a motive fluid, such as in reamers, flue-expanders, hoists, or any other purpose where an engine is employed.

In the description of the engine the normal direction of rotation is termed "forward" and the contrary direction is termed "reverse."

The engine is inclosed within a casing formed with four parallel cylinders 1^a, 1^b, 1^c, and 1^d, arranged one pair above the other and having their open inner ends opening into a crank and shaft chamber 2, closed at one side by a removable cover 3. Beneath the cylinders is formed a gear-chamber 4, having one side opening into the lower end of the crank and shaft chamber. The bottom of the gear-chamber is formed with a central bearing 5, in which a shaft 6, formed with a tool-socket 7, is journaled. A cog-wheel 8 is secured to this shaft above the bearing, and a thrust-collar 9 is formed on the shaft above the cog-wheel.

The socket has a transverse slot 10 at its upper end for the reception of the nib of the drill. A sleeve 11 is fitted around the slotted portion of the shaft. An annular ball-race 12 is formed in the center of the top of the gear-chamber and has a hardened lining 13, rectangular in cross-section. Said ball-race is above the thrust-collar 9, and a sleeve or annular flange 14 is secured to form an inner wall for the ball-race. Antifriction-balls 15 are interposed between the thrust-flange and the annular ball-race. The upper end of the shaft 6 is journaled in a central bearing 16. A pin 17 is fitted to slide in an axial bore in the upper end of the shaft and projects down into the slot of the tool-socket. A yoke 18 is secured to the upper end of said pin, and the lower end of a feed-screw 19 may bear against the upper side of said yoke. The feed-screw is threaded in a sleeve or screw-bearing 20 in the upper side of the engine-casing. When the drill is inserted in the socket, the nib of the drill-shank pushes the pin and yoke up-

ward. When it is desired to remove the drill from the socket, the feed-screw may be screwed inward until it will push the yoke and pin downward, and thus force the drill out of the socket. The feed-screw has the usual handle 21 for turning and a bearing-point 22, which may rest against whatever abutment is provided to support the drill and form a rigid support for the feed-screw. A trunk-piston 23 slides in each of the cylinders and has a connecting-rod 24 pivoted to its bottom. The outer ends of each pair of connecting-rods are pivoted to diametrically opposite cranks 25 upon two crank-shanks 26, journaled in vertical bearings 27 upon the cover 3 of the crank and shaft chamber. The cranks of one crank-shaft are at right angles to the cranks of the other shaft, so that the four cranks will be at right angles to each other. The lower ends of the crank-shafts have pinions 28, which mesh with the cog-wheel 8. The outer ends of the cylinders are closed by means of caps 29, preferably screwed into said ends, and ports 30^a, 30^b, 30^c, and 30^d are formed at said ends of the cylinders. A valve-chamber is formed in the web uniting the four cylinders and has a tubular bushing 31 secured in it. A cylindrical valve 32 is fitted to rotate and slide in said bushing and has an axial bore 33 through it. A stem 34 fits into said bore and has a key 35 through it, the ends of which fit into grooves 36 in the bore of the valve, so that the valve may rotate with the stem and slide in its longitudinal relation to the same. The valve-stem is journaled in a horizontal bearing 37, supported from the cover of the crank and shaft chamber, and a bevel-gear 38 is secured upon the ends of the stem. This bevel-gear meshes with a bevel-gear 39 upon the upper end of a shaft 40, journaled in a vertical bearing 41 upon the cover. The lower end of this shaft has a pinion 42, which meshes with the cog-wheel. The valve will thus be rotated from the cog-wheel which is rotated from the reciprocations of the pistons. A coiled spring 43 is placed around the valve-stem and bears against the valve and the bearing for the stem, forcing the valve outward. The outer end of the valve normally abuts against a handle-tube 44, screwed into the side of the engine-casing, and said tube has a collar 45 secured upon its outer end. A sleeve 46 has a contracted inner portion 47 fitted upon the tube, and a coiled spring 48, within the sleeve, bears against the collar upon the handle-tube and the shoulder formed by the contracted portion of the sleeve, so as to normally force the sleeve inward upon the tube. An exhaust-tube 49 fits in the handle-tube and has its inner end bearing against the end of the valve. The outer end of this exhaust-tube is enlarged, and the valve end of the handle-sleeve 46 is screwed upon this enlargement so that the exhaust-tube and handle-sleeve move together. The inner contracted end of the handle-sleeve has a spiral edge 50 of one convolution and bears against a stud 51, secured in the handle-tube. A notch 52 is formed at the highest end of the spiral edge to engage the stud and hold the sleeve in its outermost position, holding the valve in the outermost and normal position for forward revolation of the engine. A notch 53 is formed at the lowest point of the spiral edge to engage the stud and hold the sleeve in its innermost position, holding the valve in the inner-post position for reverse revolution of the engine. A notch 54 is formed midway between the two notches to engage the stud and hold the sleeve and valve in an intermediate position, when the latter will close the exhaust-ports, and thus stop the engine, as will be explained later.

A handle 55 is secured in the removable side cover of the engine-casing diametrically opposite the exhaust-handle, so that the engine may be manually handled and held by said two handles. The valve-chamber has an annular inlet-chamber 56 near its inner end, into the bottom of which chamber an inlet-chamber 57 leads. A nipple 58, having a stop-cock or throttle-valve 59, is secured in the engine-casing to lead into the inlet-chamber, and said nipple is threaded for the attachment of an air-hose or other flexible connection to the supply of motive fluid. The bushing 31 in the valve-chamber has four ports 60 at right angles to each other, which ports communicate with the inlet-chamber, and thus are the live-air ports of the valve-chamber. In hereinafter referring to the four cylinders in describing the valve and valve-chamber parts and their operation the terms "forward" and "rear" and "upper" and "lower" will be applied with the supposition that the observer is standing in front of the machine when held as in Figs. I and II, so that in the section Fig. XIX the left-hand cylinders are the forward cylinders and the right-hand cylinders the rear cylinders, the sections being taken looking toward the exhaust-handle. The bushing in the valve-chamber has four ports 61, 62, 63, and 64, the upper one 61 of which communicates with a recess 65 in the valve-chamber wall, extending forward from the vertical axial plane of the chamber and communicating with a channel 66, which opens into the port 30^a of the upper forward cylinder 1^a. The rear lateral port 62 opens into a recess 67 in the valve-chamber wall, which recess extends rearward from the vertical axial plane of the chamber and communicates with a channel 67^a, which opens into the port 30^b of the upper rear cylinder 1^b. The forward lateral port 63 opens into a recess 68 in the forward side of the valve-chamber, which recess extends outward, then downward at a right angle, then

across rearward under the bushing, where it communicates with a rearwardly and inwardly inclined channel 69, opening into the port 30^c of the rear lower cylinder 1^c. The lower port 64 opens into a recess 70 in the bottom of the valve-chamber, which recess extends across forward under the bushing and opens into a forwardly and outwardly inclined channel 71, opening into the port 30^d of the forward lower cylinder 1^d. The cylindrical valve has a rectangular recess 72 extending around the valve slightly in excess of one-fourth of its periphery and extending longitudinally of the valve, so as to bring the two sets of ports in communication with each other when the valve is in the normal position with its outer end abutting against the exhaust-handle tube, as shown in Fig. VII. This recess is the feed-recess when the valve is in its normal position, bringing the cylinder-ports of the valve-bushing successively into communication with the live-air ports of the bushing as the valve is rotated, and thus successively conveying live air to the several cylinders. When the valve is shifted inward to reverse the engine, this recess remains in communication with the live-air ports of the bushing, but makes no connection with any distributing-ports, as shown in Fig. II. The circumferential width of the feed-recess is sufficiently in excess of one-fourth of the entire circumference of the valve to admit of one port being fully in communication with the recess, while the adjoining port is partly in communication with the recess. A similar recess 73 is formed on the opposite side of the valve and at a distance from the inner end of the valve equal to the distance of the recess 72 plus the length of the inward throw of the valve when the latter is shifted to reverse. This recess serves as an exhaust-recess when the valve is in its normal position, being successively brought to connect with the distributing-ports or cylinder-ports of the valve-bushing as the valve is rotated to receive the exhausting air and convey it to the interior bore of the valve and then out through the exhaust-handle through a slot 74 through its bottom and near the inner end of the recess. This slot is so located that it will be closed by the valve-stem when the valve is slid inward to reverse, so that the recess may then act as a feed-recess, being then in position to connect the live-air ports and the distributing-ports in the same manner as the first recess when the valve is in its normal position, all as shown in Fig. II. This feed and exhaust recess 73 is nearer to the leading edge of the feed-recess than to the rear edge of the same considering the normal rotation of the valve, and the forward edge of the former recess has a notch 75 at the point normally registering with the distributing-ports, so as to make the circumferential area of the recess for exhaust purposes greater than the live-air or feed area and give the exhaust a lead over the feed.

A short recess 76 is formed in the same side of the valve as the feed-recess 72 and forms an exhaust-recess when reversing. The forward edge of this recess is in line with the forward edge of the feed-recess, and the rear edge of the recess is beyond the rear edge of said feed-recess, the circumferential width of this exhaust-recess being equal to the circumferential width of the exhaust portion of the feed and exhaust recess and the relative position of this exhaust-recess to the feed and exhaust recess being the same as the relative position of said latter recess to the feed-recess. This exhaust-recess has a slot 77 through its bottom and into its interior bore to allow the exhaust-air to pass from the recess and out through the exhaust-handle. When the valve is in its normal position for forward revolution, this exhaust-recess registers with the solid portion of the valve-bushing and is consequently idle. When the valve is pushed inward to reverse, the exhaust-recess registers with the distributing-ports in the bushing and coöperates with the feed and exhaust recess, which then operates as a feed-recess.

In practice, assuming the engine is being employed as an air-drill, the machine is either grasped by the handles and held and fed to the work or the machine is placed with the end of the drill against the work and the feed-screw is brought to bear against a suitable rigid abutment, so as to enable the drill to be fed into the hole it is drilling by means of the feed-screw. The air-hose is connected to the inlet-nipple, and the cock in the same is opened. Compressed air will now flow into the inlet-channel and recess and will pass through the live-air ports in the valve-bushing as said ports are uncovered by the feed-recess in the valve, the valve being in its outer position, as shown in Fig. I. We will assume that the valve is first in the position illustrated in Fig. XIX, where the distributing-port to the upper forward cylinder is just opened to the feed-recess and live air is entering the same, driving that piston outward. The forward lateral distributing-port which feeds into the lower rear cylinder is also open to the feed-recess, and the piston in said cylinder is also driven forward, the former piston, however, being at the beginning of the first quarter and the latter piston being at the beginning of the second quarter of the crank revolution. The lower forward and the upper rear cylinders are exhausting. After the valve rotates further the port for the upper forward cylinder still receives live air to finish the first quarter of the crank-throw; but live air is cut off from the lower rear cylinder, where the piston finishes the second quarter of the crank-throw by expansion. The other two cylinders still exhaust. After further rota-

tion of the valve the upper forward cylinder still receives air, the lower rear cylinder continues to actuate its piston by expansion, the lower forward cylinder still exhausts, and the upper rear cylinder has its exhaust cut off, the piston therein being at a standstill ready to advance when live air is admitted. In the next position the live air is being cut off from the upper forward cylinder to allow expansion to finish the second quarter crank-throw, the lower rear cylinder exhausts on the beginning of the third quarter crank-throw, the upper rear cylinder receives air to begin the first quarter of the crank-throw, and the lower forward cylinder exhausts on the last quarter of the crank-throw. In the next position the live air is cut off from the upper forward cylinder in which expansion will be employed to finish the second quarter of the crank-throw, the lower rear cylinder is exhausting in the third quarter of the crank-throw, the upper rear cylinder receives air for the first quarter of the crank-throw, and the lower forward cylinder exhausts on the last quarter of the crank-throw. In the next position the upper forward cylinder still has live air cut off from it, and its piston is at the end of its outstroke at the finish of the second quarter of the crank-throw, the lower rear cylinder is exhausting at the beginning of the last quarter of the crank-throw, the upper rear cylinder receives air for the beginning of the second quarter of the crank-throw, and the lower forward cylinder has exhaust cut off and its piston at the end of its instroke ready to begin its outstroke on admission of live air behind it. In the next position the upper forward cylinder begins to exhaust and its piston begins the instroke at the beginning of the third quarter of the crank-throw, the lower rear cylinder exhausts on the last quarter of the crank-throw, the upper rear cylinder begins to have its air-feed cut off on the second quarter of the crank-throw, and the lower forward cylinder has live air admitted to begin the outstroke of its piston at the beginning of the first quarter of its crank-throw. In the next position the upper forward cylinder exhausts for the instroke of the piston, the lower rear cylinder exhausts on the last quarter of the crank-throw, the upper rear cylinder has its feed cut off and its piston is forced out by expansion on the last quarter of the crank-throw, and the lower forward cylinder has live air admitted to continue the outstroke of its piston on the first quarter of its crank-throw. In the next position the upper forward cylinder exhausts, the lower rear cylinder has exhaust cut off and its piston at the end of its instroke, the upper rear cylinder is cut off from feed and operates by expansion, and the lower forward cylinder has live-air feed. In the next position the upper forward cylinder exhausts, the lower rear cylinder receives live air to begin its outstroke, the upper rear cylinder exhausts, and the lower forward cylinder receives live air. In the next position the upper forward cylinder still exhausts, the lower rear cylinder receives live air, the upper rear cylinder exhausts, and the lower forward cylinder is cut off to admit of the outstroke of the piston continuing by expansion. In the next position the upper forward cylinder has exhaust cut off and its piston standing still, preparatory to again go forward, the lower rear cylinder receives live air, the upper rear cylinder exhausts, and the lower forward cylinder is still cut off to act by expansion. In the next position one cycle of the valve and of the piston and cranks is completed.

The recesses of the valve, which are operative in the forward rotation of the engine, are the feed-recess and the feed and exhaust recess operating as exhaust-recess with its exhaust-port uncovered by the valve-stem. During the entire revolution of the valve there is never less than one cylinder open to the live air, and when the cranks of one shaft are on the center one of the cylinders actuating the cranks on the quarter is fully open to live air, so that the engine will not have any dead-center. The space between the rear edge of the exhaust-recess and forward edge of the feed-recess is shorter circumferentially than the space between the rear edge of the feed-recess and forward edge of the exhaust-recess, so that the change from exhaust to feed is quickly made, while a longer interval of expansion takes place between feed and exhaust.

When it is desired to stop the engine, the cock which serves as throttle-valve may be turned to close the air-supply; but it is preferable during the continuous use of the engine to utilize the controlling-handle formed by the sleeve upon the exhaust-pipe. During forward motion of the engine the controlling-handle is in its outermost position, keeping the valve in its outermost position, the highest notch upon the handle-sleeve engaging the stud. When the engine is to be stopped, the handle-sleeve is rotated to bring the middle notch into engagement with the stud. This will bring the valve into an intermediate position, as shown in Fig. VIII, in which position the recess in the valve will be brought out of register with the live-air ports and distributing-ports, and the exhaust-opening in the feed and exhaust recess will be closed by the valve-stem, and the exhaust-opening in the exhaust-recess will be brought to register with the solid portion of the valve-bushing, so that both feed and exhaust will be cut off from the cylinders and the engine will be stopped. Intermediately between the full forward-movement position and the stop position of the valve the latter may be held so as to distribute limited feed

of live air and exhaust of spent air, thereby controlling varied forward speed of the engine.

When the engine is to be reversed, the controlling-handle sleeve is rotated to have the lowest notch engage the stud and to thus push the valve to its innermost position against the spring. This will place the feed-recess in register with the live-air ports alone without communication with the distributing-ports, will place the feed and exhaust recess so as to close the exhaust-opening and to connect the live-air and distributing ports, and will bring the exhaust-recess in register with the distributing-ports. The ports which during the preceding forward motion were exhausting will thus feed and the ports which were feeding will exhaust, thereby reversing the motion of the engine. This is illustrated in Fig. II.

While this engine is illustrated as applied to a portable drilling-machine, it is evident that it may be used for any purpose where rotary motion is required, and while compressed air is referred to as the motive fluid any other fluid under pressure may be used. The forward and reverse movement, as well as stopping of the engine, is accomplished by changing the position of the distributing-valve without the use of link-motion or reverse-gearing between the power-shaft and driven shaft or other such complication and without touching the throttle-valve. All motion and stopping is controlled from one of the handles by which the engine is held and manipulated. The entire structure is compact and simple. By removing the cover at the side of the casing the crank-shafts, valve-driving shaft and stem, pitmen, and pistons may be removed and the entire mechanism of the engine rendered accessible. The drill or other tool may be easily and conveniently removed from the socket, and the tool-socket may be formed close up in the casing, as no access to the tool-shank from the sides is necessary to remove the tool, the latter being pushed out endwise by the feed-screw, yoke, and pin. As the feed-pipe is connected to the casing away from the handles, the drag of the air-hose will not be exerted upon the handle, and the manipulation of the engine by the handles will be easy. The advance, reverse, and stop is under easy control of one hand holding the engine. As each two cylinders and their pistons are connected to one crank-shaft and the two crank-shafts and the valve-driving shaft are geared to one gear-wheel, the action of all parts will be synchronous.

Other modes of applying the principle of my invention may be employed for the mode herein explained. Change may therefore be made as regards the mechanism thus disclosed, provided the principles of construction set forth respectively in the following claims are employed.

I therefore particularly point out and distinctly claim as my invention—

1. In an engine, the combination with a piston-cylinder and piston therein, of a valve-chamber having an inlet-port and a distributing-port, and a revolving distributing-valve having means for longitudinally shifting it and formed with a feed-recess which may connect the inlet and distributing ports in one longitudinal adjustment of the valve, a feed and exhaust recess having an exhaust-opening and which may register with the distributing-port in such adjustment and connect the inlet and distributing ports in another longitudinal adjustment and have the exhaust-opening closed, and an exhaust-recess which may register with the distributing-port in such last adjustment.

2. In a portable engine of the character described, a main casing, an exhaust-tube upon said casing and forming one manipulating-handle and operatively connected to the distributing-valve of the engine to control the forward and reverse rotation and the stoppage of the engine and movable to be operated by the hand holding the handle, a diametrically-opposed closed handle, and an inlet-nipple upon the casing for the attachment of the motive-fluid-supply tube.

3. In a portable engine of the character described, two diametrically-opposed laterally-projecting manipulating-handles, one of said handles operatively connected to the distributing-valve of the engine to control the forward and reverse rotation and the stoppage of the engine and movable to be operated by the hand holding the handle.

4. In a portable engine of the character described, a laterally-projecting handle-tube having exhaust-passage through it, a distributing-valve having an exhaust-passage connected to the handle-tube passage and movable to cut off exhaust from the engine, and a handle-sleeve movable upon the handle-tube and constructed to move the valve with it to adjust it for distribution for forward or reverse movement or to cut off the exhaust and thus stop the engine.

5. In a portable engine of the character described, the combination of an engine-casing having an engine within it and an axial shaft rotated by the same, a distributing-valve for the engine, an inlet-nipple on the side of the casing for attachment of the motive-fluid-supply tube, a laterally-projecting handle-tube upon the casing and having exhaust-passage through it, a handle-sleeve rotatable upon such tube and connected to the distributing-valve to move the same to forward, reverse and stop positions, and a diametrically opposite handle upon the casing.

6. In an engine, the combination with a

plurality of piston-cylinders and pistons therein, of a cylindrical valve-chamber having an annular set of inlet-ports and an annular set of distributing-ports communicating with the piston-cylinders, a cylindrical valve connected to be rotated from the pistons and provided with a feed-recess which may register with and connect the inlet-ports and distributing-ports, a feed and exhaust recess which may register with and connect the inlet and distributing ports and having an exhaust-opening, and an exhaust-recess which may register with the distributing-ports and formed with an exhaust-opening, and means for longitudinally sliding the valve so as to bring the feed-recess to register with the inlet-ports and distributing-ports and the feed and exhaust recess to register with the distributing-ports and have its exhaust-opening uncovered or to shift the valve to have the feed and exhaust recess register with the inlet-ports and distributing-ports and have its exhaust-opening closed and the exhaust-recess to register with the distributing-ports.

7. In an engine, the combination with a plurality of piston-cylinders and pistons therein and a rotary distributing-valve for such cylinders and longitudinally movable to place it in distributing position for forward or reverse motion of the engine or for stopping the same and having an axial exhaust-passage, of an exhaust-pipe communicating with such exhaust-passage and capable of being longitudinally adjusted to longitudinally shift the distributing-valve.

8. In an engine, the combination with a plurality of piston-cylinders and pistons therein, and a rotary valve connected to be rotated from the pistons and longitudinally movable to distribute motive fluid to the cylinders for forward and reverse movement and for stopping the engine and formed with an axial exhaust-passage, of a tubular exhaust-handle registering with the exhaust-passage of the valve, an exhaust-tube within such tubular handle, and a handle-sleeve revoluble and longitudinally movable upon the tubular exhaust-handle and connected to the exhaust-tube, whereby said tube and the distributing-valve will be longitudinally shifted to control the engine by manipulation of the handle-sleeve.

9. In an engine, the combination with a plurality of piston-cylinders and pistons therein, and a rotary valve connected to be rotated from the pistons and longitudinally movable to distribute motive fluid to the cylinders for forward and reverse movement and for stopping the engine and formed with an axial exhaust-passage, of a tubular exhaust-handle registering with the exhaust-passage of the valve, an exhaust-tube within such tubular handle, a handle-sleeve revoluble and longitudinally movable upon the tubular exhaust-handle and connected to the exhaust-tube and formed with a spiral end edge, and a stud against which such edge bears and rigid on the tubular exhaust-handle, whereby said tube and the distributing-valve will be longitudinally shifted to control the engine by manipulation of the handle-sleeve.

10. In an engine of the character described, the combination of two pairs of single-acting piston-cylinders arranged parallel and each pair in a plane parallel to the plane of the other, pistons in said cylinders and having pitmen, two crank-shafts geared together and having each two diametrically-opposed cranks and each pair of cranks at right angles to the other and having the pitmen connected to them, a cylindrical valve-chamber having four distributing-ports connected by channels to the ends of the cylinders and annularly arranged at four quarters of the cylindrical chamber and having the channels of the one pair of cylinders connected to consecutive distributing-ports in the valve-chamber and crossing each other, and a rotary valve in the valve-chamber having a feed-recess and exhaust-recess in its sides, whereby the feed to and exhaust from the cylinders in each pair is consecutive and crossing over from the last cylinder in one pair to the first cylinder in the next pair.

11. In an engine of the character described, the combination with a plurality of piston-cylinders and pistons therein, and a cylindrical valve-chamber having a circumferential series of distributing-ports to the cylinders, of a cylindrical valve in such chamber and connected to be rotated from the pistons and formed in its sides with a circumferential feed-recess and a circumferential exhaust-recess, the circumferential distance between the rear edge of the feed-recess and forward edge of the exhaust-recess being greater than between the rear edge of the exhaust-recess and the forward edge of the feed-recess, whereby the period of expansion after admission will be longer than the period between the exhaust and admission.

12. In an engine of the character described, the combination with a plurality of piston-cylinders and pistons therein, and a cylindrical valve-chamber having a circumferential series of distributing-ports to the cylinders, of a cylindrical valve in such chamber and connected to be rotated from the pistons and formed in its sides with a circumferential feed-recess and a circumferential exhaust-recess, the circumferential width of the feed-recess being less than the circumferential width of the exhaust-recess and the circumferential distance between the rear edge of the feed-recess and forward edge of the exhaust-recess being greater than between the rear edge of the exhaust-recess and the forward edge of the feed-recess, whereby the period of admission will be shorter than the

period of exhaust and the period of expansion after admission will be longer than the period between exhaust and admission.

13. In an engine of the character described, the combination with a plurality of piston-cylinders, of a cylindrical distributing-valve chamber having circumferentially-arranged ports to said cylinders, and a cylindrical valve in such chamber connected to be rotated and formed with circumferential feed and exhaust recesses and constructed to be longitudinally shifted to bring such recesses in relation to said ports for forward or reverse motion or stoppage of the engine.

14. In an engine of the character described, the combination with actuating-cylinders and a rotary distributing-valve constructed to control motive fluid for such cylinders for forward or reverse movement or stoppage of the engine by being longitudinally adjusted, of a handle-tube axially arranged in its relation to such valve, an exhaust-tube within the handle-tube and having its end abutting against the valve, a handle-sleeve upon the handle-tube and connected to the exhaust-tube and formed with a spiral inner end edge notched at predetermined points of its convolution, a stud rigid in the handle-tube and having such spiral edge bearing against it and engaging the notches in the same, a spring forcing the handle-sleeve inward, and a spring forcing the valve outward.

15. In an engine of the character described, the combination of the engine-casing, the rotary shaft formed with the tool-socket 7 and journaled axially within the casing, the axial feed-screw threaded in the casing, the horizontal valve-stem 34 intersecting the axial line of the casing, and the pin 17 having the yoke 18 encircling the valve-stem and capable of being engaged by the inner end of the feed-screw.

16. In an engine of the character described, the combination of the engine-casing formed with two pairs of cylinders, the cylinders of each pair being parallel to each other and the two pairs of cylinders being imposed one pair upon the other, an axial shaft journaled in the casing and carrying a cog-wheel, pistons in the cylinders and having pitmen, two crank-shafts each having diametrically opposite cranks standing at right angles to each other and having the pitmen pivoted to them, a shaft having a pinion engaging the cog-wheel and having a bevel-gear at its end, a distributing-valve for the cylinders, and a valve-stem for such valve and having a bevel gear-wheel at its end engaging the other bevel-gear.

17. In an engine of the character described, the combination of four piston-cylinders arranged in pairs, one pair imposed upon the other, a cylindrical bushing in a bore through the web between the cylinders and having four distributing-ports arranged at right angles to each other, one of said ports communicating with the first of the upper pair of cylinders, the next following port communicating with the second of said cylinders, the next following of said ports communicating with the first of the lower pair of cylinders and the next following of said ports communicating with the second of the lower pair of cylinders, and a rotary valve in said bushing rotating in the direction of the ports described and formed with a feed-recess in one side and an exhaust-recess in the other side and registering with the ports.

18. In an engine of the character described, the combination of the cylinders 1^a, 1^b, 1^c and 1^d, having the ports 30^a, 30^b, 30^c and 30^d; a valve-chamber formed with the recess 65 and channel 66, the recess 67 and channel 67^a, the recess 70 and channel 71 and the recess 68 across said recess 70 and having channel 69; the bushing 31 formed with the inlet-ports 60 and the distributing-ports 61, 62, 64 and 63, respectively communicating with said recesses, and the rotary valve within said bushing and formed with a feed-recess 72, the feed and exhaust recesses 73 75 having the exhaust-opening 74 and also formed with the axial exhaust-port 33.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 23d day of July, 1902.

ERNEST C. MEYER.

Witnesses:

WM. SECHER,

H. SMITH.