C. B. RICHARDS.

FLUID OPERATED TOOL.

APPLICATION FILED JULY 9, 1908.

929,111.

Patented July 27, 1909.

2 SHEETS—SHEET 1.

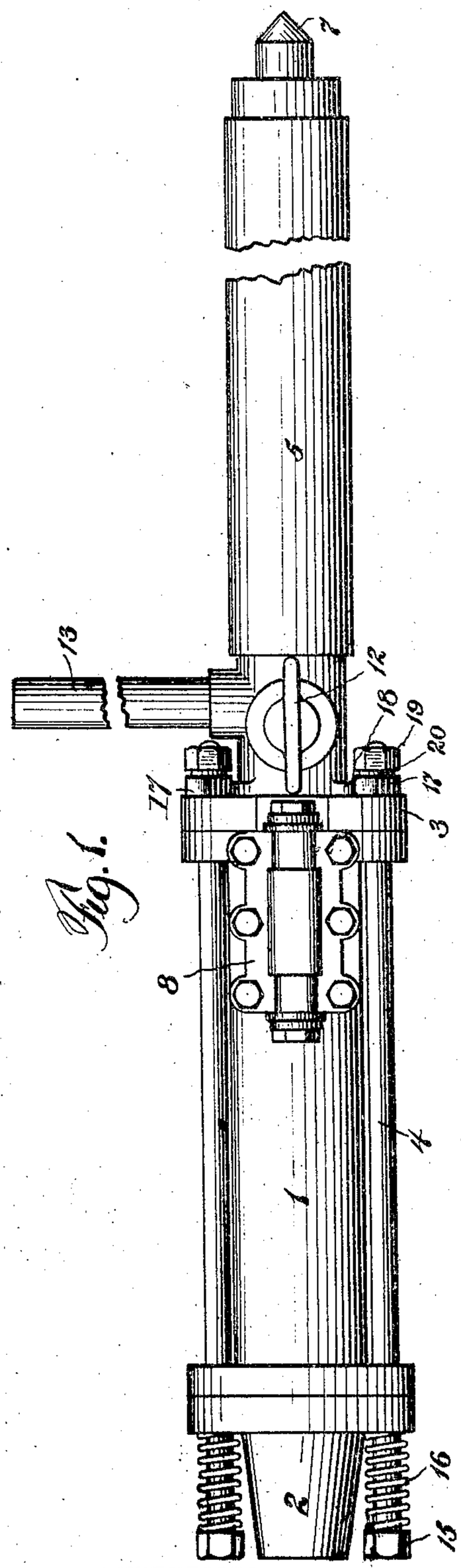

Fig. 1.

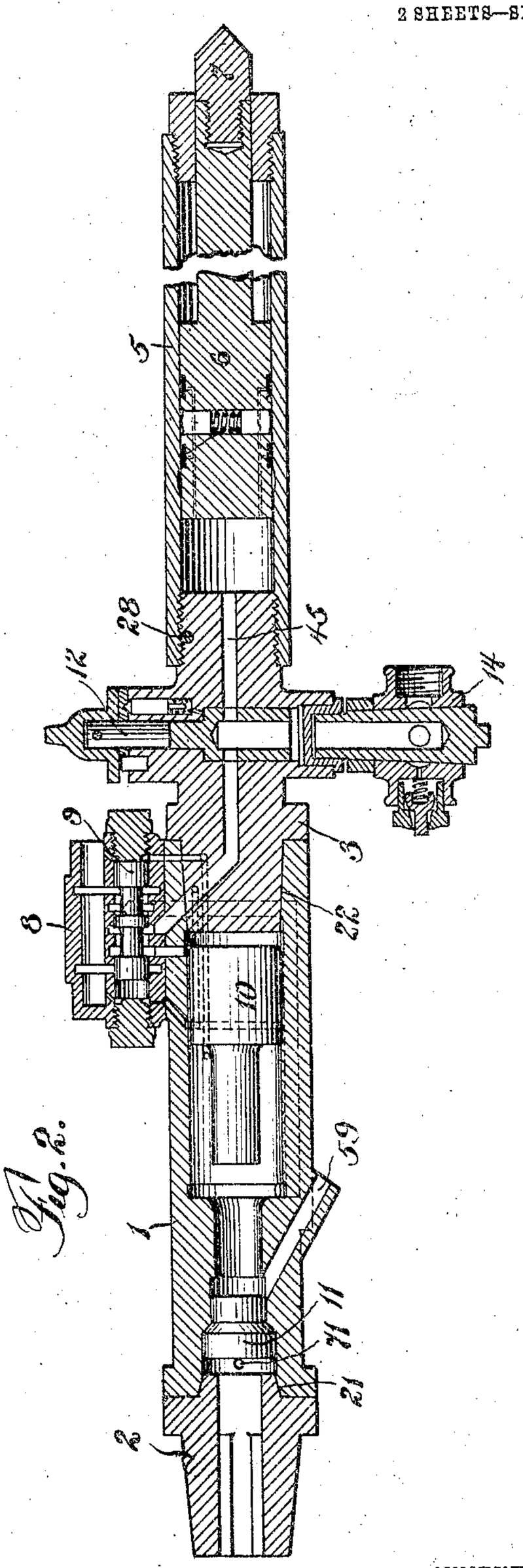

Fig. 2.

WITNESSES

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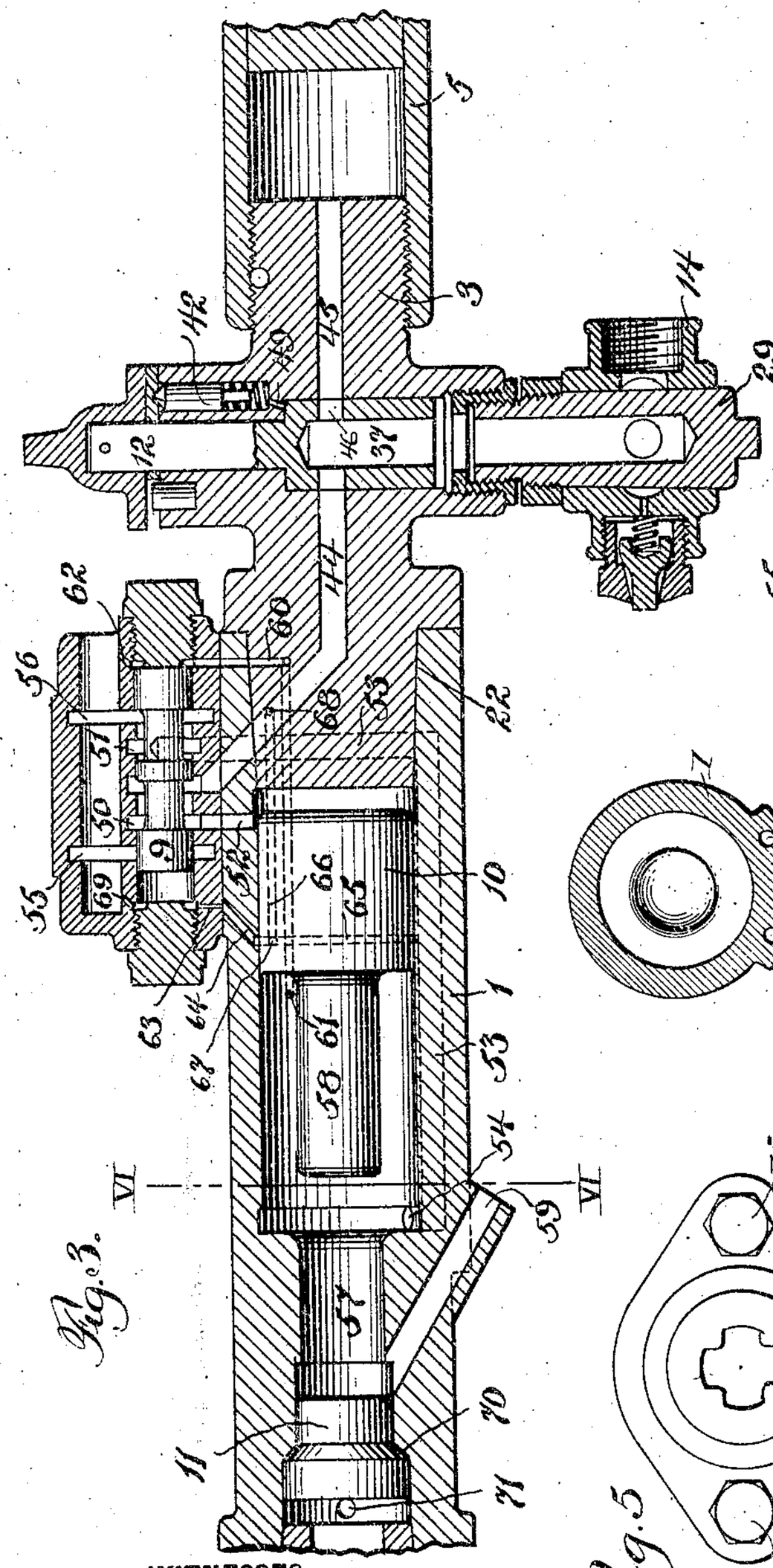

Fig. 3.

Fig. 6.

Fig. 5.

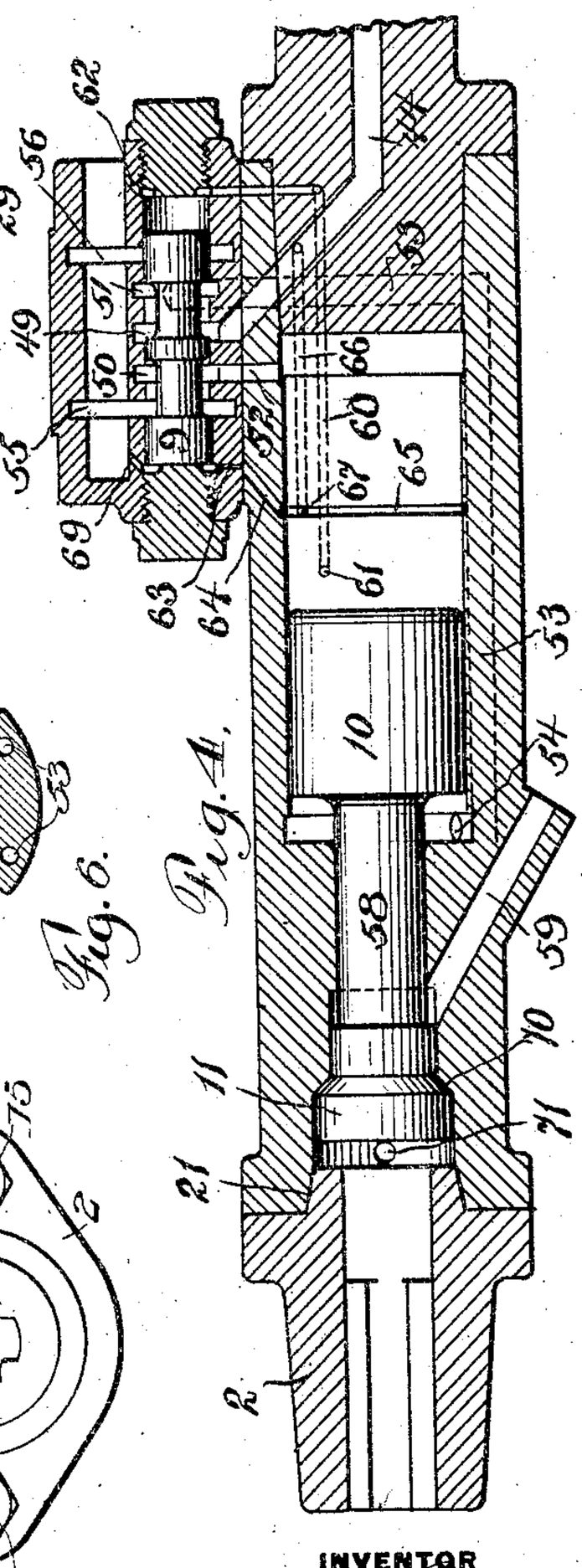

Fig. 4.

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES B. RICHARDS, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CLEVELAND ROCK DRILL COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

FLUID-OPERATED TOOL.

No. 929,111. Specification of Letters Patent. Patented July 27, 1909.

Application filed July 9, 1903. Serial No. 442,684.

To all whom it may concern:

Be it known that I, CHARLES B. RICHARDS, 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 Fluid-Operated Tools, of which the following is a specification.

The invention relates in general to fluid operated tools and more particularly to fluid operated drills. It has for some of its primary objects; the provision of new and improved valve mechanism; the provision of an arrangement whereby a free exhaust is secured on the forward stroke of the piston hammer and a maximum velocity in the forward movement of the piston hammer, coupled with a quick return thereof; the provision of improved means for securing the chuck and cylinder head in position. These and other objects which will appear to those skilled in the art are secured by my construction, which is illustrated in its preferred form in the accompanying drawings, wherein:—

Figure 1 is a plan view of the drill,

Figure 2 is a longitudinal section through the drill,

Figure 3 is an enlarged partial longitudinal section with the valve and other operating parts in one extreme position,

Figure 4 is a view similar to that of Figure 3, but with the valve and other operating parts in their other extreme position,

Figure 5 is an end view of the drill, and Figure 6 is a section on the line X—X of Figure 3.

The embodiment in which the invention is illustrated constitutes what is known as a "stoping drill", which drills are commonly placed in a vertical position or at such an angle to the horizontal as will permit the rock cuttings to fall from the hole being drilled. It will be understood, however, that the invention is not limited to drills of this particular type and that many of the features of invention are of broad application and are limited in scope only by the terms of the claims.

Referring first to the general arrangement of parts as shown in Figures 1 and 2, 1 is the cylinder, 2 is the chuck, 3 is the head which is secured to the chuck by means of the rods 4, 5 is the feed cylinder provided with the piston 6 carrying the center 7, 8 is the valve chest bolted to the cylinder 1 as indicated in Figure 1, 9 is the piston valve for controlling the admission of fluid to the cylinder 1, 10 is the piston hammer, 11 is the striking anvil adapted to bear at its front end against the rear end of the drill steel which extends through the chuck 2, 12 is the admission valve for controlling the admission of fluid pressure both to the valve chest 8 and the feed cylinder 5, 13 is a handle by means of which the drill may be rotated back and forth about its axis as the cutting progresses, and 14 is a swivel block or body through which an operating fluid is admitted, and which carries a holder for supplying lubricant.

The means for fastening the chuck and head securely to the cylinder constitutes one of the features of my invention. As indicated in Figure 1, the holding rods 4 pass through flanges on the head, cylinder and chuck, and are provided at their front ends with heads 15, between which heads and the flange of the chuck the springs 16 are interposed. The rear ends of the rods are provided with the square nuts 17 which are prevented from turning by means of the lugs 18. The rods are prevented from turning by means of the hexagonal nuts 19 and the interposed spring washers 20. In order to increase the tightness of the joint between the chuck and cylinder and between the head and cylinder, the engaging surfaces 21 and 22 are tapered. This taper fit further provides for a tight joint at the points at which the air passages cross the joint.

The feed cylinder 5 is screw threaded to the head 3 and is secured in position by means of the tapered pin 28. A pair of passages 44 and 45 in the head 3 lead respectively to the valve mechanism and the feed cylinder and fluid is supplied thereto through the hollow plug 29 and the hollow stem 37 of the rotary controlling valve 12, which valve is operated by means of a handle 38 and is held yieldingly by means of the spring pin 42 in any desired position.

The passage 44 communicates directly with a groove 49 in the valve chamber, and this groove 49 communicates with the grooves 50 and 51 on either side thereof, depending upon the position of the piston valve 9, Figure 3 illustrating the valve in such position that the groove 49 is in communication with the groove 50, while Figure 4 illustrates the parts in such position that

the groove 49 communicates with the groove 51. The grooves 50 and 51 communicate respectively with the passages 52 and 53 leading to opposite ends of the cylinder, two passages 53 preferably being used as indicated in Figure 10, which passages open at 54 into the extreme front end of the enlarged portion of the cylinder. The exhaust grooves 55 and 56 are provided on the outside of the grooves 50 and 51. In the position shown in Figure 3 exhaust is occurring through the passage 53, the groove 51 and the groove 56, while with the parts in the position shown in Figure 4 exhaust is occurring through the passage 52, the groove 50 and the groove 55. It will be seen that the passages 52 and 53 alternately act as admission and exhaust passages depending upon the position of the piston valve 9. The front end of the piston cylinder is reduced as indicated at 57 to receive the reduced front end 58 of the piston hammer 10, and exhaust occurs from this reduced portion 57 by means of the rearwardly extending exhaust passage 59. This arrangement gives a very free forward exhaust so that the hammer piston moves forward at a high velocity, and strikes a maximum blow upon the anvil 11.

The means whereby the valve 9 is operated constitutes another feature of my invention. The chamber at the rear of this valve 9 is connected to the piston cylinder by means of the passage 60 opening into the cylinder at 61. Exhaust from the chamber at this end of the valve takes place through the small passage 62. Pressure is applied to the chamber at the front end of the valve 9 through the passage 63 which is smaller than the passage 60. This passage 63 communicates with a passage 64 which opens into a groove 65 in the cylinder wall. Pressure is supplied directly to this groove 65 by means of the passage 66 opening into the groove at 67 and into the passage 44 at 68. A small exhaust passage 69 leads from the chamber at the front of the valve 9 into the open chamber thereabove.

The operation of the valve mechanism is as follows. When the parts are in the position shown in Figure 3, pressure is being admitted behind the piston 10 tending to force it ahead. At this time the valve 9 is held in the position shown by reason of the pressure admitted to the chamber at the front end of the valve 9 by means of the passage 66, groove 65 and passages 64 and 63. At this time there is practically no pressure tending to force the valve 9 in the opposite direction for the reason that the chamber at the rear end of the valve is connected with the cylinder at the front end of the piston 10 from which practically all the pressure has been exhausted through the passages 53 and 59, and because of the exhaust passage 62 which is always open. The piston 10 now moves forward successively uncovering the openings 67 and 61. Cylinder pressure is thus admitted to the passages 64 and 60, and because of the large capacity of the passage 60 as compared with the passage 63 the pressure on the rear of the piston 9 preponderates and the valve is thrown to the position shown in Figure 4. This movement opens the passage 52 on the rear side of the piston 10 to the exhaust groove 55 and at the same time puts the passage 53 in communication with the admission passage 44, so that the piston is driven to the rear. When the rear end of the piston 10 covers the passages 61 and 67 fluid is admitted to the chamber at the front end of the valve 9 through the passages 66, 64 and 63, and the valve is moved to the position shown in Figure 3, such movement occurring without resistance as substantially all fluid pressure has been exhausted from the chamber at the rear of the valve 9 through the passages 60 and 62. The valve 9 is thrown when the piston 10 is still some distance from the rear end of the cylinder in order that pressure may be admitted through the passage 52 to cushion the piston and prevent it striking the head 3. The parts are thus brought to their starting positions. It will be noted that the reduced forward end 58 of the piston entirely leaves the reduced portion 57 of the cylinder, so that exhaust commences to occur on the back stroke of the piston 10 through the passage 59 as soon as the part 58 passes out of the portion 57. This cutting off of pressure on the front side of the piston combined with the throwing of the valve 9 to admit pressure upon the rear of the piston stops the rearward motion thereof very suddenly. A very rapid operation is thus secured as the piston 10 may be moved rearward at a very high velocity, stopped suddenly and moved forward at a high velocity due to the free exhaust, and this is accomplished without unnecessary impact upon the operating parts.

The striking anvil 11 is provided with a tapered shoulder 70 which fits against a corresponding shoulder on the cylinder, the object attained being a tight fit between the anvil and cylinder, so that no air passes through to the front of the drill. This is an advantageous arrangement as a flow of air up about the drill steel is undesirable, in that it scatters the dust and dirt in such a way as to interfere with the view of the operator. A passage 71 is provided in front of the anvil to permit of the discharge of any dirt which may work into the space between the chuck and anvil. The opening through the chuck for the reception of the drill is preferably made in the cruciform shape indicated in Figure 5, so that the steel will not turn in the chuck and the rear end of the steel rests against the anvil 11. By reason of its two

diameters the anvil 11 limits the entrance of the steel into the machine, so that no collar or shoulder need be formed on the drill steel. In operation the drill is turned back and forth by means of the handle 13, which rocking movement makes the drill steel cut out a round hole and presents the different cutting points to uncut portions of the rock. The springs 16 resting against the flange of the chuck reduce the shock in case the anvil 11 strikes the chuck instead of the steel.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is the following:—

1. In combination with the cylinder of a fluid-operated tool provided with flanges at its opposite ends, a flanged chuck fitting one end of the cylinder and a flanged head at the other end thereof, connecting rods provided with heads at one end and screw threads at the other end extending through the flanges, springs interposed between the heads on the rods and the opposing flange, a pair of nuts on each of the screw-threaded ends of the rods, interposed spring means between each pair of nuts, and means for preventing the inner nut of each pair from turning.

2. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having pressure receiving surfaces to move it in opposite directions, means for intermittently applying a lower pressure than that in the cylinder to one of the surfaces and means for applying a still lower pressure to the other of such surfaces.

3. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means for intermittently supplying fluid to one of the surfaces from the cylinder to move the valve in one direction, and means for intermittently supplying fluid to the other surface direct from the source of fluid supply for moving the valve in the other direction.

4. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means for intermittently supplying fluid to one of the surfaces from the cylinder to move the valve in one direction controlled by the piston and means for intermittently supplying fluid to the other surface direct from the source of fluid supply for moving the valve in the other direction.

5. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means controlled by the piston for intermittently supplying fluid to one of the surfaces from the cylinder to move the valve in one direction, and means controlled by the piston for intermittently supplying fluid to the other surface direct from the source of fluid supply for moving the valve in the other direction.

6. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means controlled by the piston for intermittently supplying fluid at different rates of flow to both surfaces from the cylinder whereby the valve is moved in one direction and means controlled by the piston for intermittently supplying fluid to one surface for moving the valve in the other direction.

7. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means controlled by the piston for intermittently supplying fluid at different rates of flow to both surfaces from the cylinder whereby the valve is moved in one direction and means controlled by the piston for intermittently supplying fluid direct from the source of fluid supply to one surface for moving the valve in the other direction.

8. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means for intermittently supplying fluid to one of the surfaces from the cylinder to move the valve in one direction, means controlled by the piston for intermittently supplying fluid to the other surface direct from the source of fluid supply for moving the valve in the other direction and means for continuously exhausting the fluid supplied to the surfaces.

9. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cylinder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means controlled by the piston for intermittently supplying fluid to one of the surfaces from the cylinder to move the valve in one direction, means controlled by the piston for intermittently supplying fluid to the other surface direct from the source of fluid supply for moving the valve in the other direction, and means for continuously exhausting the fluid supplied to the surfaces.

10. In a fluid-operated tool, the combination with a cylinder and piston, of a valve for controlling the admission of fluid to the cyl-

inder having a pair of pressure receiving surfaces for moving the valve in opposite directions, means controlled by the piston for intermittently supplying fluid at different rates of flow to both surfaces from the cylinder whereby the valve is moved in one direction, means controlled by the piston for intermittently supplying fluid direct from the source of fluid supply to one surface for moving the valve in the other direction, and means for continously exhausting the fluid supplied to the surfaces.

11. The combination with a fluid-operated tool having a piston, a cylinder therefor, and a valve chamber carrying a valve for controlling the admission of fluid to the cylinder, of means for reciprocating the valve comprising two passages of different capacity connected to the valve chamber at opposite ends of the valve and to the cylinder and having the ends communicating with the cylinder so arranged that both such ends are uncovered to secure the shifting of the valve in one direction as the piston approaches the end of its stroke, and both of such ends are covered and one brought into communication directly with the source of air supply to shift the valve in the other direction as the piston approaches the other end of its stroke.

12. The combination with a fluid-operated tool having a piston, a cylinder therefor, and a valve chamber carrying a valve for controlling the admission of fluid to the cylinder, of means for reciprocating the valve comprising two passages of different capacity connected to the valve chamber at opposite ends of the valve and to the cylinder, and a third passage leading from the source of fluid supply to the cylinder and adapted to be placed in communication with the passage of smaller capacity when the piston covers both of their openings to the cylinder, the openings of the first two passages into the cylinder being so arranged that both of such openings are uncovered as the piston approaches one end of its stroke and both of such openings closed as the piston approaches the other end of its stroke.

13. The combination with a fluid-operated tool having a piston, a cylinder therefor, and a valve chamber carrying a valve for controlling the admission of fluid to the cylinder, of means for reciprocating the valve comprising two passages of different capacity connected to the valve chamber at opposite ends of the valve and to the cylinder, a groove in the cylinder wall communicating with the passage of smaller capacity and a third passage leading from the source of fluid supply to the groove, the openings of the first two passages into the cylinder being so arranged that both of such openings are uncovered as the piston approaches one end of its stroke and both of such openings closed as the piston approaches the other end of its stroke.

14. The combination with a fluid-operated tool having a piston, a cylinder therefor, and a valve chamber carrying a valve for controlling the admission of fluid to the cylinder, of means for reciprocating the valve comprising two passages of different capacity connected to the valve chamber at opposite ends of the valve and to the cylinder, a third passage leading from the source of fluid supply to the cylinder and adapted to be placed in communication with the passage of smaller capacity when the piston covers both of their openings to the cylinder, the openings of the first two passages into the cylinder being so arranged that both of such openings are uncovered as the piston approaches one end of its stroke and both of such openings closed as the piston approaches the other end of its stroke, and exhaust passages leading from the ends of the valve chamber.

15. In combination in a fluid-operated tool provided with a cylinder and a hammer piston therein, of passages connected to opposite ends of the cylinder, valve mechanism comprising a valve chamber, ports leading to the passages, and a reciprocatory valve provided intermediate its ends with controlling means for the ports for alternately admitting fluid to the said passages and alternately permitting an exhaust therefrom, and means for reciprocating the valve, comprising a passage of small capacity controlled by the piston and alternately establishing communication between the cylinder and the chamber at one end of the valve and between a direct source of fluid supply and such chamber and a passage of larger capacity extending from a point intermediate the ends of the cylinder to the chamber at the other end of the valve, in position to be uncovered by the hammer as it approaches the end of its stroke, and continuous open exhaust passages leading from the valve chamber at each end of the valve.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

CHARLES B. RICHARDS.

Witnesses:
GEO. H. HALL,
F. W. GREVE.