No. 862,770. PATENTED AUG. 6, 1907.

H. P. TAYLOR.

PERCUSSIVE DRILL.

APPLICATION FILED SEPT. 7, 1905. RENEWED JAN. 14, 1907.

2 SHEETS—SHEET 1.

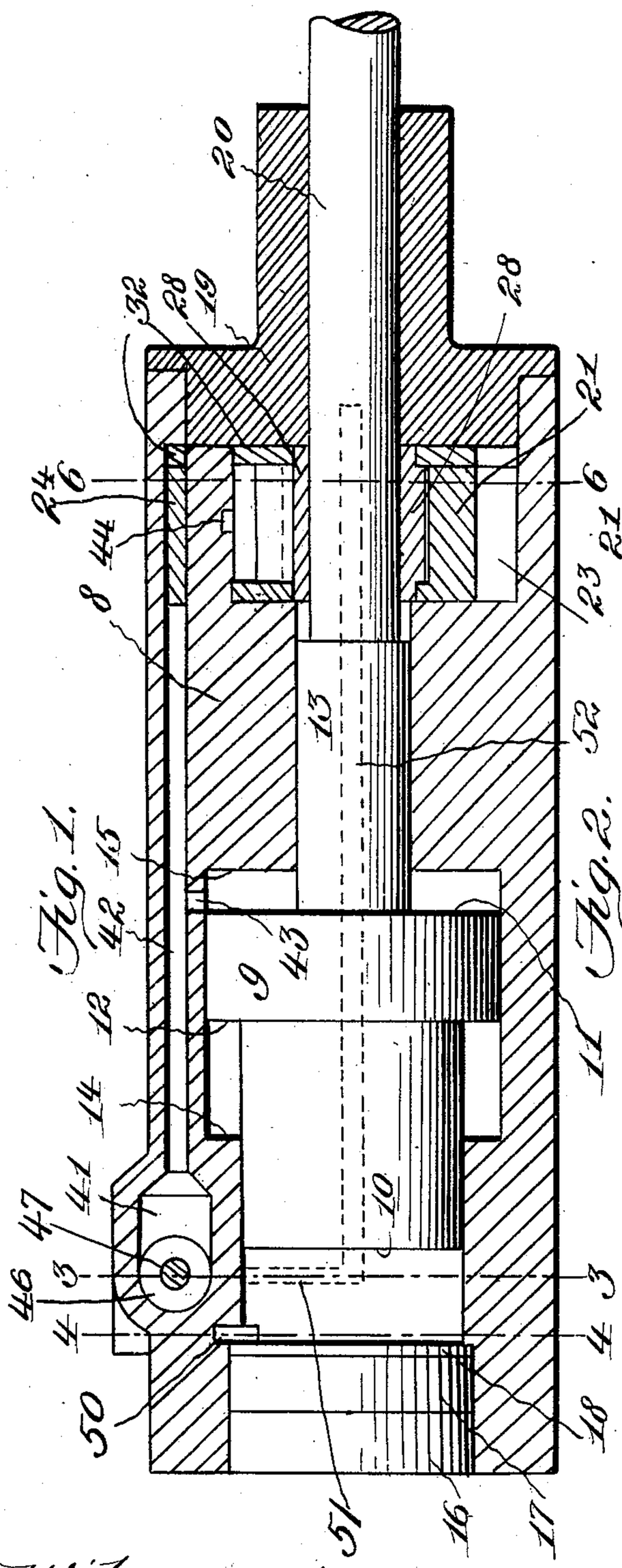

Fig. 1.

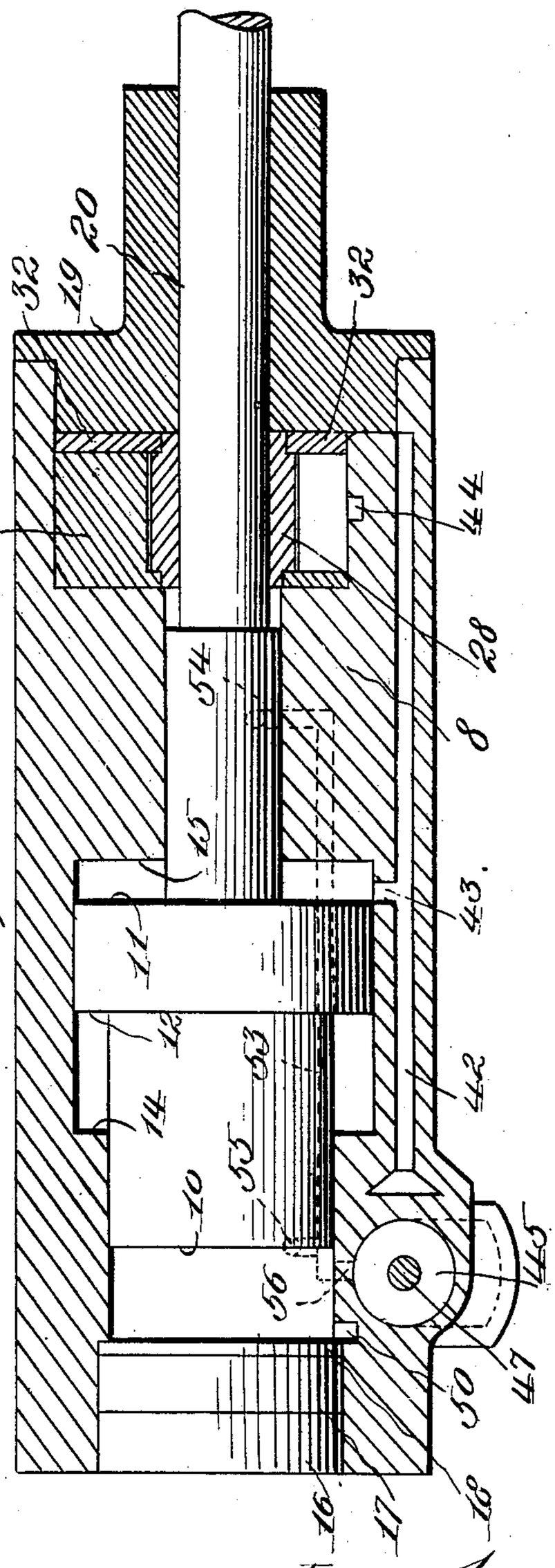

Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 3.

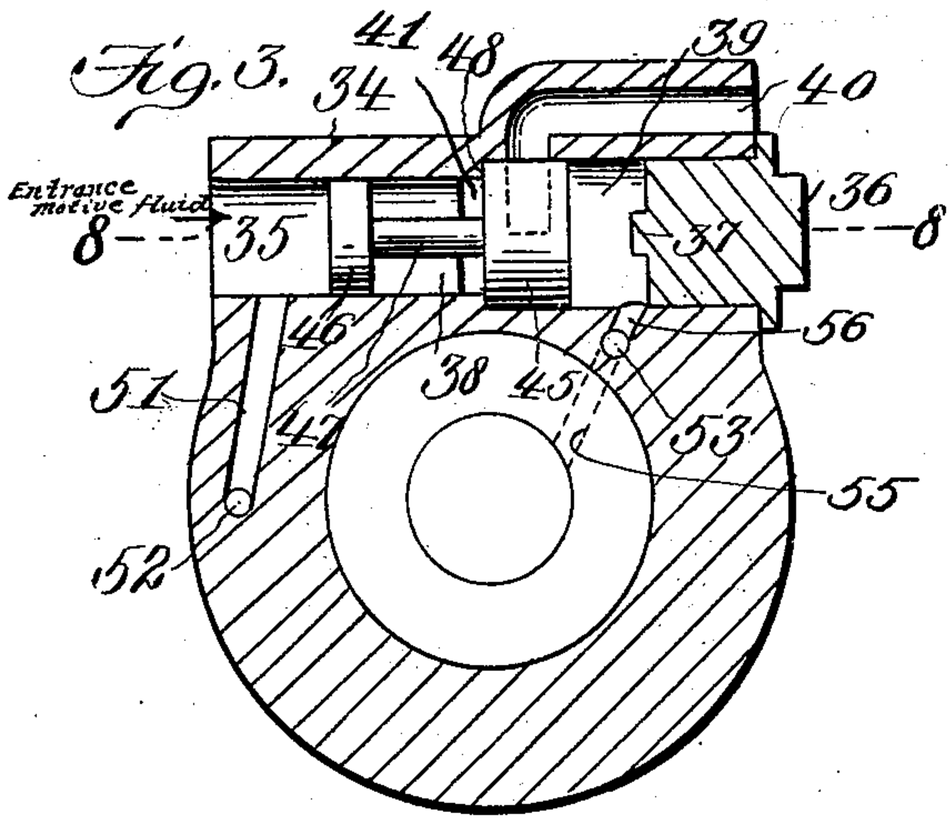


Fig. 4.

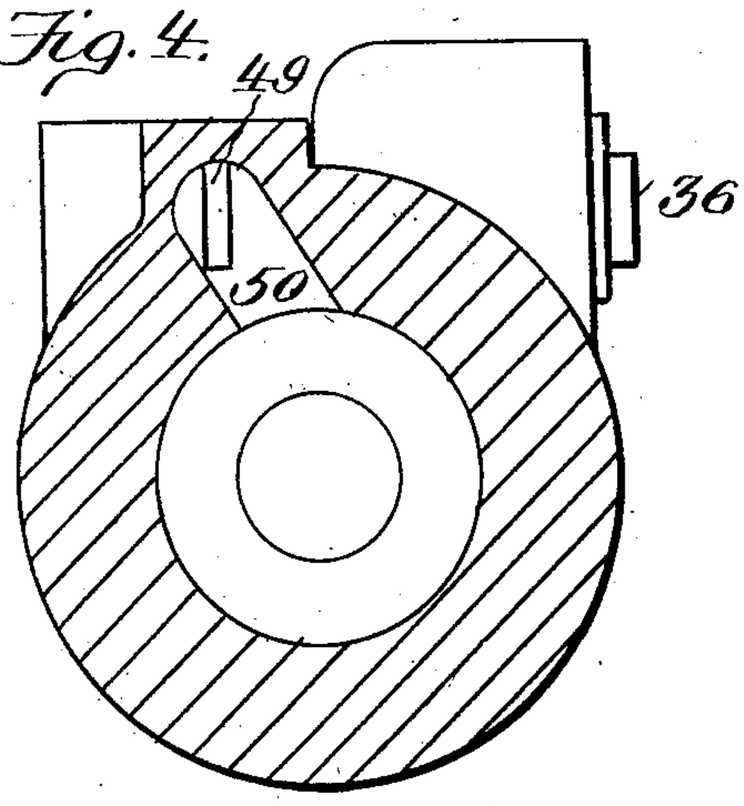


Fig. 5.

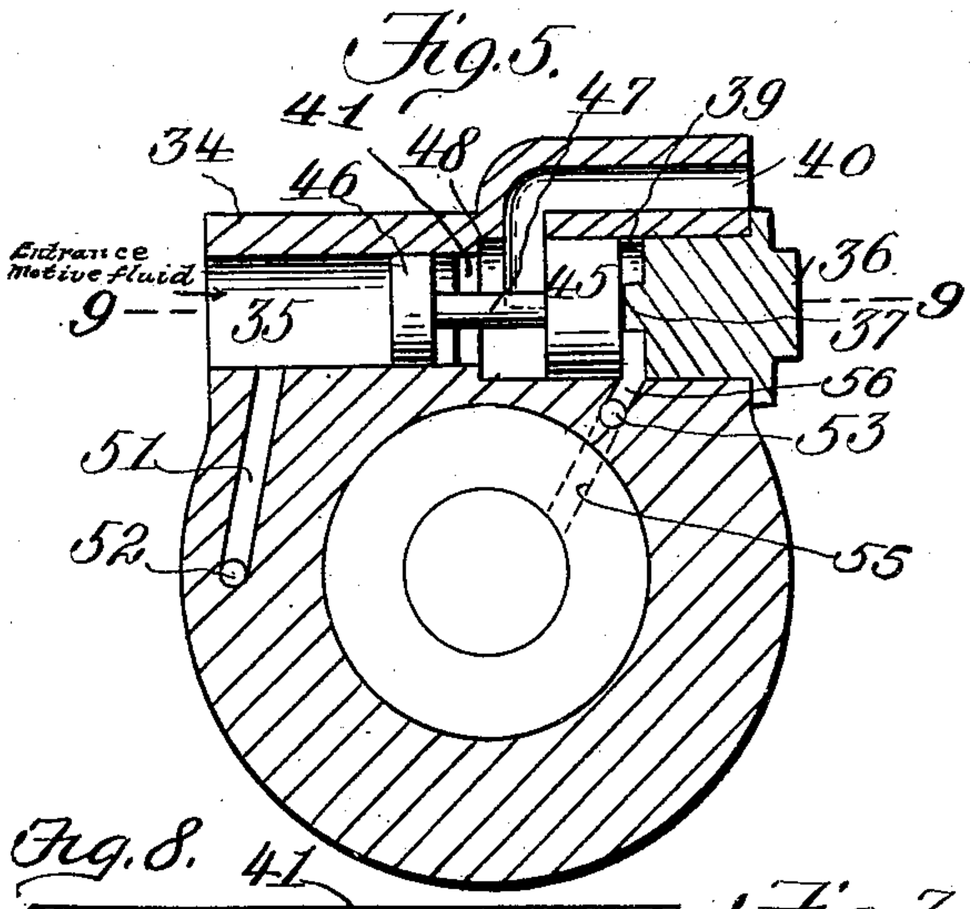


Fig. 6.

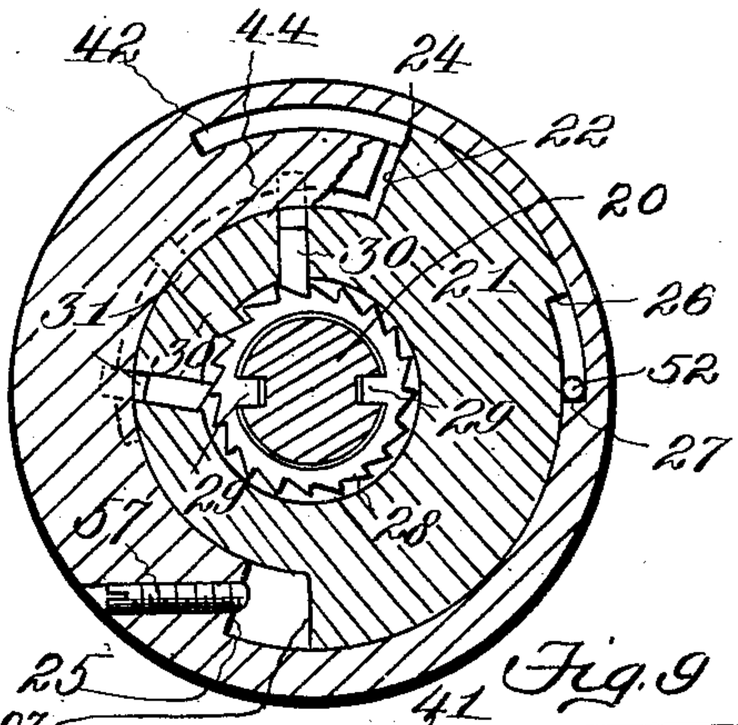


Fig. 8.

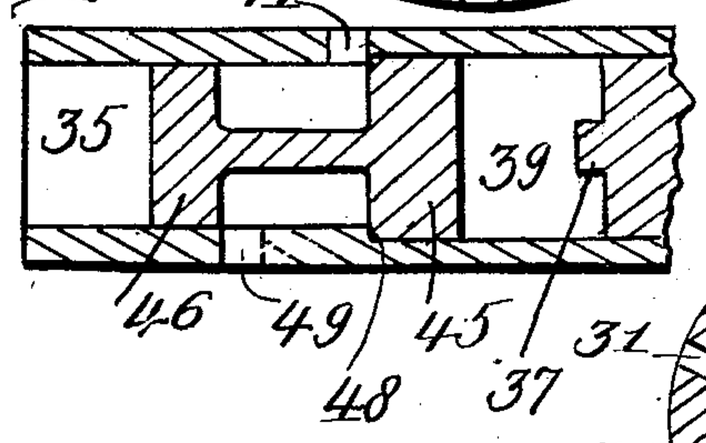


Fig. 7.

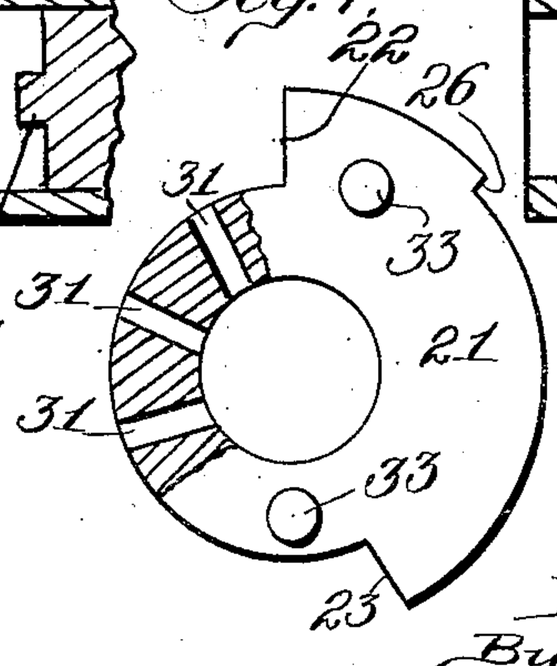
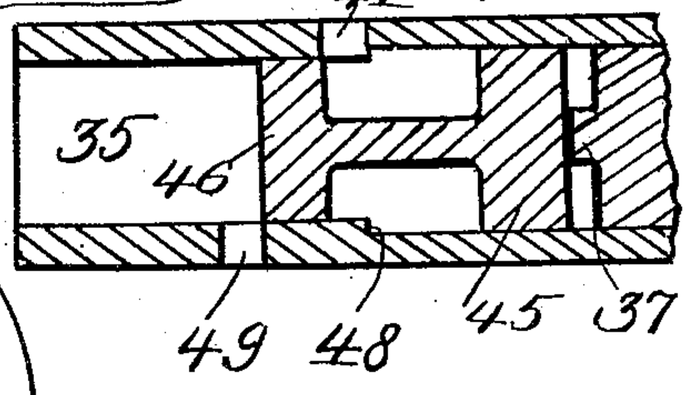


Fig. 9.



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UNITED STATES PATENT OFFICE.

HARRY P. TAYLOR, OF SALT LAKE CITY, UTAH.

PERCUSSIVE DRILL.

No. 862,770. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed September 7, 1905, Serial No. 277,439. Renewed January 14, 1907. Serial No. 352,294.

To all whom it may concern:

Be it known that I, HARRY P. TAYLOR, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented new and useful Improvements in Percussive Drills, of which the following is a specification.

This invention relates to percussive drills in which the cutting operation is effected by a succession of blows, and has for its object to render such hammers or devices applicable for use as drills, and more especially for drilling rock or stone.

Primarily the object of the invention resides in utilizing the exhaust of motive fluid after the hammer has been operated in one direction for rotating an impulse device to turn the drill in lieu of employing a direct current from the motive fluid supply, and by employing the exhaust in such a manner, an intermittent rotation of the drill which coincides with the strokes of the hammer is obtained. Furthermore, the exhaust is not only utilized to intermittently rotate the drill, but also used to reciprocate the hammer in one direction.

The invention further aims to provide a percussive device for the purpose hereinbefore referred to which shall be simple in its construction, strong, durable, formed of few parts, efficient in its use and comparatively inexpensive to manufacture.

With the foregoing and other objects in view, the invention consists of the novel construction, combination and arrangement of parts hereinafter more specifically described and illustrated in the accompanying drawings which form a part of this specification, and wherein is shown the preferred embodiment of the invention, but it is to be understood that changes, variations and modifications can be resorted to which fall within the scope of the claims hereunto appended.

In the drawings, wherein like characters of reference denote corresponding parts throughout the several views: Figure 1 is a longitudinal section of a percussive device in accordance with the invention, looking to one side of the drill; Fig. 2 is a longitudinal sectional view looking to the other side of the drill; Fig. 3 is a section on the line 3—3, Fig. 1; Fig. 4 is a section on the line 4—4, Fig. 1; Fig. 5 is a view similar to Fig. 3 with the motive fluid regulating valve shifted; Fig. 6 is a section on the line 6—6, Fig. 1; Fig. 7 is a detail of the axial piston; Fig. 8 is an enlarged diagrammatic sectional plan of a portion of the valve casing on line 8—8, Fig. 3, and Fig. 9 is a like view on the line 9—9, Fig. 4.

Referring to the drawings by reference characters, 8 denotes the cylinder in which reciprocates the hammer 9. Said hammer is provided with pressure-bearing surfaces 10 and 11, the latter being of greater area than the former, and is further formed with a peripheral shoulder 12 and a striking end 13 which projects from the major portion of the hammer, and is of less diameter. The hammer 9 snugly fits the cylinder 8, but the fit is such as not to interfere with the reciprocations of the hammer. The cylinder 8 is formed with two shoulders 14, 15 which oppose, respectively, the shoulder 12 and the pressure-bearing surface 11 of the hammer 9. The said shoulders 14, 15 act as stops to arrest the movement of the hammer during the reciprocation thereof when occasion so requires. The cylinder 8 is closed at one end through the medium of the cap 16 and against said cap is arranged an elastic buffer 17 retained in position by the washer 18. At the other end of the cylinder 8, the same is closed through the medium of the cap 19 which constitutes a socket for the tool 20, the latter extending through said cap and into the portion of the cylinder in which operates the striking end of the hammer 9 so the end of the tool will be in the path of the hammer 9 so that when the hammer 9 reciprocates in one direction, it will impart a blow to the tool. At that end of the cylinder 8, in which is arranged the cap 19, a chamber is formed and in which is mounted an oscillatory axial piston 21 provided with a wing 22 and an abutment 23, one face of the former being of greater area than the latter, and one face of the wing 22 and the said abutment when occasion so requires, abut against the shoulders 24, 25, said shoulders 24, 25 constituting a part of one wall of the chamber in which is arranged said axial piston. The wing 22 has one face thereof of greater area than the other face, and said face of smaller area is indicated by the reference character 26, and is adapted to abut against, when occasion so requires, a shoulder 27 which constitutes a part of one of the walls of the chamber in which is arranged said axial piston.

The axial piston 21 is provided with a centrally-arranged opening so as to enable said piston 21 to surround a rotatable ratchet wheel 28 which is connected through the medium of the lugs 29 with the tool 20 so as to cause, when said ratchet wheel 28 is revolved, the rotation of the tool 20 in a manner as hereinafter referred to. The ratchet wheel 28 is intermittently rotated through the medium of a plurality of fluid pressed dogs 30 carried by the axial piston 21, and the said dogs 30 are shiftably mounted in the radially extending openings 31 formed in said piston 21.

To retain the ratchet wheel 28 in position so as to prevent longitudinal movement thereof to any great extent, a retaining plate 32 is arranged against and ecured to one face of the axial piston 21 through the medium of the lugs 33 formed on said piston. The said plate 32 is removable so that access can be had when occasion requires to remove or replace the ratchet wheel 28. The axial piston 21, ratchet-wheel 28 and dogs 30 are termed, for convenience, a rotating mechanism for the tool 20, and the said rotating mechanism is operated through the medium of the exhaust of motive fluid in a manner as hereinafter referred to.

Upon the top of that end of the cylinder in which is arranged the cap 16, a valve-casing 34 is mounted,

which communicates at one end, as at 35, with a motive fluid supply, and has the other end thereof closed by a cap 36 having an inwardly-extending protuberance 37. The casing 34 forms a valve chamber of two different diameters, the smaller indicated by the reference character 38 and the other by the reference character 39, and communicating with said portion 39 of the valve-chamber is an exhaust port 40 to the atmosphere, and opening into that portion 38 of the valve chamber is an exhaust port 41 which communicates with a channel 42, the latter extending longitudinally of the wall of the cylinder 8 and opening into a port 43 for conducting the exhaust of motive fluid from the interior of the cylinder to the pressure-bearing surface 11. Said channel 42 is also adapted to conduct the exhaust of motive fluid from the interior of the cylinder to against the wing 22 of the axial piston 21. Said channel 42 also opens into a passage 44 for conducting the motive fluid against the dogs 30.

Within the valve chamber is arranged a double-acting valve formed of two disks 45, 46, the former of greater area than the latter and the said disks 45, 46 are connected together by the stem 47. The disk 45 operates within that portion 39 of the valve chamber, and the disk 46 operates within that portion 38 of the valve chamber. The disk 45 finds a seat against the protuberance 37, and also against the shoulder 48. The disk 45 when occasion so requires, is adapted to close the outlet 40 and the said double-acting valve, when occasion so requires, is adapted to establish communication between the port 41 and the port 40. The valve casing 34 is further provided with a port 49 opening into a fluid supply passage 50 formed in the wall of the cylinder 8. The said passage 50 is formed in the cylinder so as to open into the interior of the cylinder in close proximity to the washer 18 and in advance of the pressure-bearing surface 10 of the hammer 9, so as to supply a charge of motive fluid to the interior of the cylinder 8 so that the said charge will impact against the pressure-surface 10 and move the hammer 9 towards the shank of the tool.

Communicating with the inlet of the valve casing 34 is a depending port 51 which opens at its lower end in a longitudinal passage 52 opening into the chamber in which is arranged the axial piston 21. The passage 52 opens into the chamber in which is arranged the axial piston at a point intermediate the face 26 of the wing 22 and the shoulder 27 formed in the cylinder 8, and by such an arrangement, a continuous pressure is had against the face 26 of the wing 22. A longitudinally-extending channel 53 is provided which opens at one end, through the medium of a port as at 54, into that portion of the cylinder in which operates the striking end of the hammer 9, and the said port 54 is adapted to be closed when occasion so requires by the striking end of the hammer 9. The channel 53 also communicates with a port 55 which opens into the cylinder at a point near the outer end thereof, so that when the hammer 9 moves forward to strike the tool 20, said port 55 will be opened; but on the opposite movement of the hammer 9, said port 55 will be closed. The channel 53 also communicates with a port 56 which opens into the portion 39 of the valve chamber at a point between the disk 45 and the cap 36.

To regulate the distance of the movement of the axial piston 21, a set-screw 57 is provided which extends through the cylinder 8 and is adapted to engage the wing 23 to arrest the movement thereof in one direction.

The operation of the percussive device is as follows: The motive supply enters at 35, Fig. 3; hence the pressure of the supply is against the valve-disk 46 continuously. It will be assumed that the hammer 9 has just been acted on by the motive fluid and thrown against the shank of the tool 20, as shown in Figs. 1 and 2, thus opening the port 55, Fig. 2, and thus establish communication through the port 56 and passage 53 between the interior of the cylinder and the valve chamber between the disk 45 and cap 36. As the motive fluid supply through the port 55, channel 53 and port 56 to behind the disk 45 is at the same pressure as that against the disk 46, and owing to the different areas of the disks 45, 46, the disk 45 being the greater, the double-acting valve will move to the left and take the position shown in Fig. 3. This position of the valve shuts off the air supply from the port 49 and opens port 49 and passage 50 to port 41. The motive fluid which has acted upon the pressure-bearing surface 10 is caused to pass from the cylinder through the passage 50, port 49, port 41, channel 42, into port 43 and against the enlarged pressure-bearing surface 11 of the hammer 9, and such action reciprocates the hammer 9 in a rearward direction. The motive fluid against pressure-bearing surface 10 when the hammer is in its forward position has the same pressure as the supply at the instant of cutoff, because the throwing of the valve and the striking of the blow are practically simultaneous, or in other words, when the hammer has reached its forward position, *i. e.*, struck its blow, the space formed behind the hammer in the cylinder is full of motive fluid under practically the same pressure as the supply. Now this motive fluid has stored up energy, due to its pressure, which it will turn into work when opportunity offers. This opportunity offers when the valve takes the position shown in Fig. 3, as the pressure-bearing surface 11 is of greater area than the pressure-bearing surface 10, which gives the motive fluid the chance to occupy greater volume at less pressure. As the motive fluid goes off at practically full stroke, its expansive force is still intact. This expansive force is used to return the hammer and turn the rotating mechanism. As long as the motive fluid is cut off on the forward stroke so as to leave sufficient expansive force in the motive fluid to return the hammer and turn the rotating mechanism, the drill will operate in a manner as stated. The motive fluid also travels through channel 42 and against the wing 22 of the piston oscillating the latter in one direction and owing to the action of the motive fluid upon the dogs 30, they will engage in the teeth of the ratchet wheel 28 and thereby rotate the tool 20.

When the hammer 9 reaches the end of its stroke in a rearward direction, it uncovers port 54, the latter opening into channel 53, and the latter opening into the port 56, thus allowing the motive fluid to escape from behind the disk 45. When port 54 is uncovered the motive fluid in the portion 39 of the valve-chest escapes to the atmosphere as the drill shank 20 is not a tight fit in the cap 19. The escape of the motive fluid permits of the double-acting valve being immediately shifted to the position shown in Fig. 5, the shifting being due to the constant pressure upon the

disk 46. This position of the valve allows the motive fluid supply to enter into the channel 50 through the port 49 and into the cylinder and against the pressure-bearing surface 10 so as to throw the hammer 9 in a forward direction, or to impart a blow to the tool. The position of the valve in Fig. 5 also causes communication to be established between the port 41 and the port 40 which opens the valve chamber to the atmosphere. The position of the valve in the figure also causes the exhaust of motive fluid through channel 42 from the wing 22 of greater area of the axial piston 21, and also exhausts the motive fluid which has acted upon the pressure-bearing surface 11 through port 43 into channel 42 thence to the atmosphere through ports 41 and 40. The constant motive fluid pressure through the port 51 and passage 52 against the shoulder 26 of the axial piston 21, immediately turns the said piston to the left when looking to the rear to the position shown in Fig. 6 when the exhaust takes place through the channel 42. The dogs 30 ride over the ratchet wheel as the piston 21 turns to the left. The ratchet wheel 28 is not a part of the piston 21 and only rotates when the dogs 30 are caused by the action of the motive fluid to engage the ratchet during the oscillation of the piston 21 to the right when looking to the rear. The pressure from the channel 42 is communicated to the tops of the dogs 30 through means of the port 44, and the pressure acts as a spring, thus eliminating the employment of springs, which are likely to get out of order.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A percussive device comprising a reciprocatory hammer operated in both directions by a charge of working fluid, a tool-rotating mechanism, means for supplying a charge of working fluid against one end of the hammer for reciprocating it in one direction, and means for conducting the said charge of working fluid from the said end of the hammer to against another portion of the hammer and to said tool rotating mechanism, causing thereby the operation in one direction of said tool rotating mechanism and the reciprocation of the hammer in an opposite direction to that caused by the supplying of the charge against the end of the hammer.

2. A percussive device comprising a reciprocatory hammer operated in both directions by a charge of working fluid, a tool-rotating mechanism, means for supplying a charge of working fluid against one end of the hammer for reciprocating it in one direction, means for conducting the said charge of working fluid from the said end of the hammer to against another portion of the hammer and to said tool-rotating mechanism, causing thereby the operation in one direction of said tool-rotating mechanism and the reciprocation of the hammer in a direction opposite to that caused by the supplying of the charge against the end of the hammer, and means for exhausting the said charge of working fluid during the supply of another charge of working fluid to the other end of the hammer.

3. A percussive device comprising a reciprocatory hammer operated in both directions by a charge of working fluid, a tool-rotating mechanism, means for supplying a charge of working fluid against one end of the hammer for reciprocating it in one direction, means for conducting the said charge of working fluid from the said end of the hammer to against another portion of the hammer and to said tool-rotating mechanism, causing thereby the operation in one direction of said tool-rotating mechanism and the reciprocation of the hammer in an opposite direction to that caused by the supplying of the charge against the end of the hammer, and means for operating the said tool rotating mechanism in an opposite direction.

4. A percussive device comprising a reciprocatory hammer operated in both directions by a charge of working fluid, a tool-rotating mechanism, means for supplying a charge of working fluid against one end of the hammer for reciprocating it in one direction, means for conducting the said charge of working fluid from the said end of the hammer to against another portion of the hammer and to said tool-rotating mechanism, causing thereby the operation in one direction of said tool rotating mechanism and the reciprocation of the hammer in a direction opposite to that caused by the supplying of the charge against the end of the hammer, means for exhausting the said charge of working fluid during the supply of another charge of working fluid to the other end of the hammer, and means for rotating the said mechanism in an opposite direction during the exhausting of the said charge.

5. A percussive device comprising a cylinder provided with a chamber, a tool-rotating mechanism arranged in said chamber, a reciprocatory hammer operating in said cylinder, a longitudinally-extending passage opening into said chamber for constantly supplying fluid pressure against said tool-rotating mechanism, a valve casing, a fluid pressure inlet for said casing, a port leading from said inlet to said passage, a longitudinally-extending channel 53, a port 54 leading from said channel to the interior of the cylinder, a port 55 leading from said channel 53 to the interior of the cylinder, a port 56 leading from said channel 53 to the interior of the valve casing, a channel 42 communicating at one end with the interior of the valve casing and at its other end opening into said chamber for supplying fluid pressure to said tool-rotating mechanism, a port 43 leading from said channel 52 to the interior of the cylinder for supplying fluid pressure against said hammer, a channel 50 leading to the interior of the cylinder for supplying fluid pressure against said hammer, a port 49 for establishing communication between the channel 50 and the interior of the valve casing, a port 40 leading from the interior of the valve casing to the atmosphere, and a pair of disk valves operating within said casing and of different area with respect to each other.

6. A percussive device comprising a fluid pressure operated tool rotating mechanism, said mechanism consisting of a ratchet wheel adapted to be connected to the tool, a fluid pressure operated axial piston surrounding said ratchet wheel and provided with a wing having the pressure bearing surfaces thereof of different area, said piston further provided with an abutment, and fluid pressure operated dogs loosely mounted in and extending through said piston and engaging with the ratchet wheel for operating the latter when the piston is actuated.

7. A percussive device comprising a fluid pressure operated tool rotating mechanism, said mechanism consisting of a ratchet wheel adapted to be connected to the tool, a fluid pressure operated axial piston surrounding said wheel and provided with a wing having the pressure bearing surfaces thereof of different area, said piston further provided with an abutment and with a plurality of openings, and fluid pressed dogs loosely mounted in said openings and adapted to engage with the ratchet wheel for operating the latter when the piston is actuated.

8. A percussive device comprising a fluid pressure operated tool rotating mechanism, said mechanism consisting of a ratchet wheel adapted to be connected to the tool and having the teeth thereof arranged on its periphery, a fluid pressure operated axial piston surrounding the peripheral teeth of said wheel and provided with a plurality of radially extending openings, and fluid pressed dogs loosely mounted in said openings and adapted to engage with the peripheral teeth of the ratchet wheel for operating the latter when the piston is actuated.

9. A percussive device comprising a fluid pressure operated tool rotating mechanism, said mechanism consisting of a ratchet wheel adapted to be connected to the tool and having the teeth thereof arranged on its periphery, a fluid pressure operated axial piston surrounding the peripheral teeth of said wheel and provided with a wing having the pressure bearing surfaces thereof of different area, said piston further provided with an abutment and a plurality of radially extending openings, and fluid pressed dogs

loosely mounted in said openings and adapted to engage with the ratchet wheel for operating the latter when the piston is actuated.

10. A percussive device comprising a fluid pressure operated tool rotating mechanism, said mechanism consisting of a ratchet wheel adapted to be connected to the tool and having the teeth thereof arranged around its periphery, a fluid pressure operated axial piston surrounding the peripheral teeth of the ratchet wheel provided with a wing having the pressure bearing surfaces thereof of different area, said piston further provided with a plurality of radially extending openings, and fluid pressed dogs loosely mounted in said openings and adapted to engage with the teeth of the ratchet wheel for operating the latter when the piston is actuated.

11. A percussive device comprising the combination with a tool, a ratchet wheel connected therewith and provided with peripheral teeth, said wheel when operated adapted to rotate the tool, a fluid pressure oscillatory axial piston provided with a centrally arranged opening to permit the piston to inclose the ratchet wheel, said piston further provided with a plurality of radial openings extending from the periphery to the centrally arranged opening, and fluid pressed dogs loosely mounted in said openings and adapted to engage said ratchet wheel for operating the latter when the piston is actuated.

12. A percussive device comprising the combination with a tool, of a ratchet wheel connected therewith and adapted when operated to rotate the tool, a fluid pressure oscillatory axial piston provided with a wing and further provided with a series of radially extending openings, said piston inclosing said ratchet wheel, and fluid pressed dogs loosely mounted in the openings and adapted to engage the ratchet wheel to operate the latter when the piston is actuated.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

HARRY P. TAYLOR.

Witnesses:
ROBT. H. ARMSTRONG,
L. H. TAYLOR.