D. S. WAUGH.

FLUID PRESSURE MOTOR.

APPLICATION FILED SEPT. 25, 1909.

974,543. **Patented Nov. 1, 1910.**

3 SHEETS—SHEET 1.

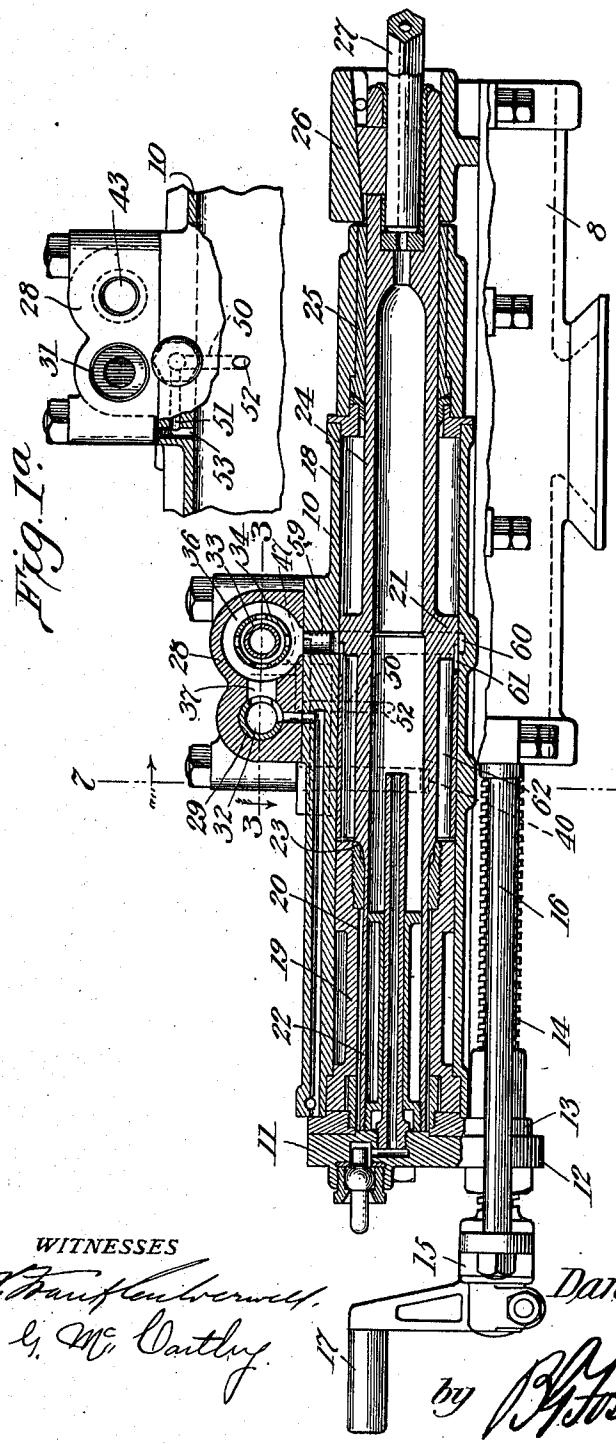

Fig. 1.

Fig. 1a.

WITNESSES

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3 SHEETS—SHEET 2.

Fig. 2.

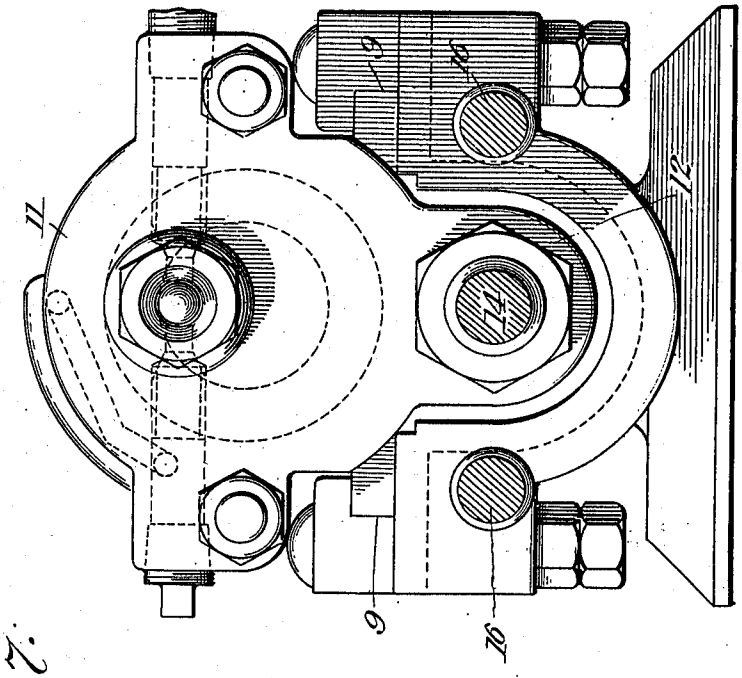
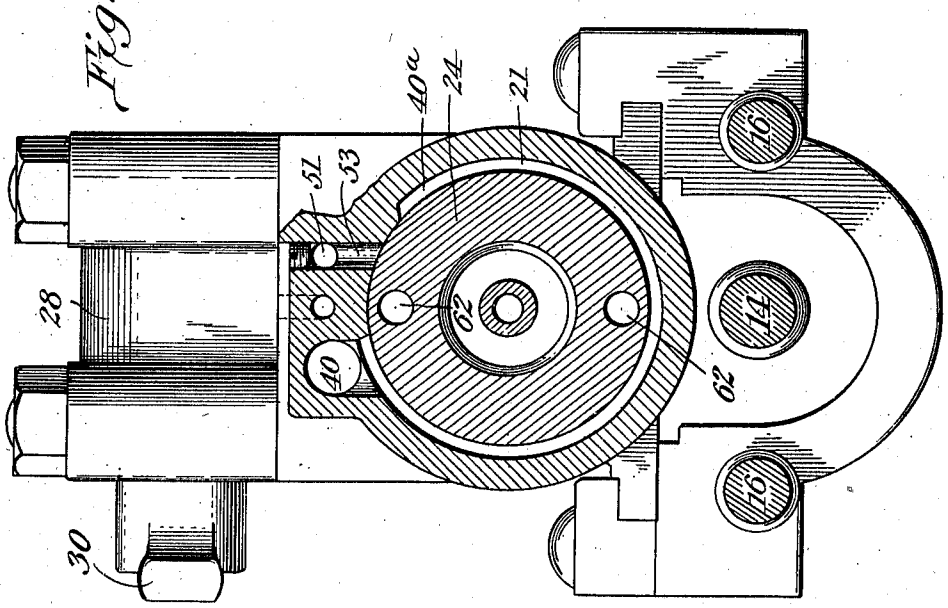


Fig. 7.



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3 SHEETS—SHEET 3.

Fig. 6.

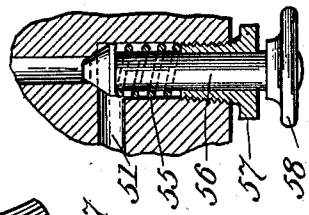


Fig. 5.

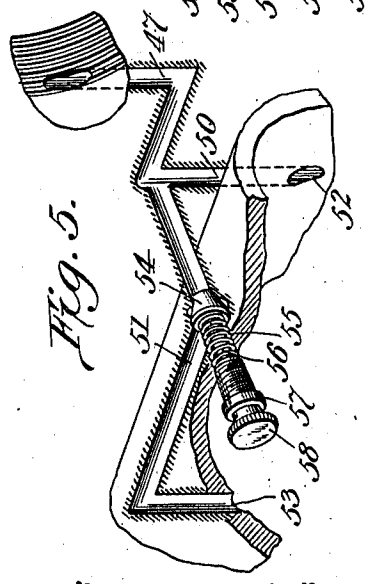


Fig. 3.

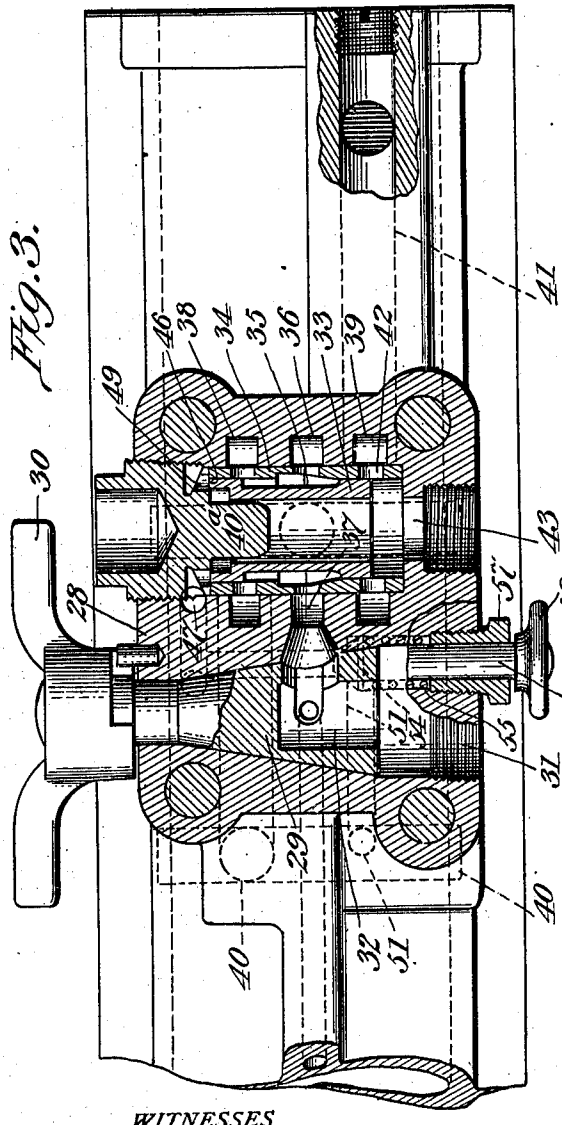
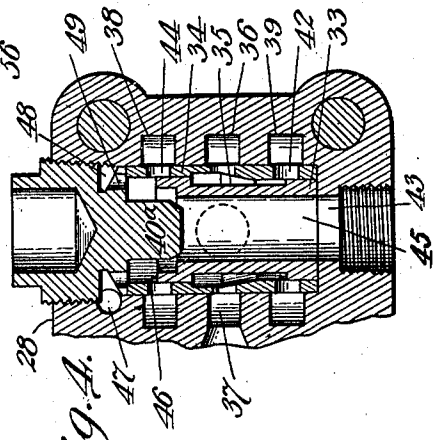


Fig. 4.



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UNITED STATES PATENT OFFICE.

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FLUID-PRESSURE MOTOR.

974,543. Specification of Letters Patent. Patented Nov. 1, 1910.

Application filed September 25, 1909. Serial No. 519,543.

To all whom it may concern:

Be it known that I, DANIEL SHAW WAUGH, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Fluid-Pressure Motors, of which the following is a specification.

The present invention relates to motors operated by motive fluid under pressure, and while especially involving improvements in motors for rock drilling machines, is not necessarily limited to this particular type.

One of the primary objects of the present invention is to provide novel and effective means for cushioning the piston on its return stroke and initiating its working stroke so that jar and vibration to the motor as a whole is materially reduced, thus greatly prolonging the life of the machine.

A further and important object is to provide mechanism, whereby the stroke of the piston can be varied to suit the conditions under which the drill is operated.

The preferred form of construction is illustrated in the accompanying drawings, wherein:—

Figure 1 is a longitudinal sectional view through the motor. Fig. 1ª is a detail view partly in section, illustrating the relation of the valve-controlling ports. Fig. 2 is a rear elevation of the same. Fig. 3 is a horizontal sectional view on the line 3—3 of Fig. 1 and on an enlarged scale. Fig. 4 is a detail sectional view through the automatic valve, similar to Fig. 3, but showing the valve in a reversed position. Fig. 5 is a detail perspective view diagrammatic in its character, and illustrating the passageway that conducts motive fluid to the rear end of the automatic valve. Fig. 6 is a detail sectional view illustrating the controlling valve for one of the branches of said passageways. Fig. 7 is a detail sectional view on the line 7—7 of Fig. 1.

Similar reference numerals designate corresponding parts in all the figures of the drawings.

In the embodiment disclosed, a supporting shell 8 is employed, which is provided with guideways 9, in which the cylinder member 10 of the motor is slidably mounted. This cylinder member has a head 11 secured to its rear end, and said head is provided with a depending ear 12 carrying a sleeve or nut 13 that has a threaded engagement with a feed screw 14. This feed screw is journaled at one end in the shell 8, and its other end is journaled in a cross head 15 connecting the ends of rearwardly projecting bolts 16 that are secured to the rear end of the shell. A handle crank 17, fixed to the feed screw 14, constitutes means for rotating the same, and thus effecting the longitudinal movement of the cylinder member 10. The said cylinder member is provided with a bore, the front portion of which constitutes a piston chamber 18, and arranged in the rear portion of this bore is a tubular plug 19 having a central longitudinal bore 20 of less diameter than the piston chamber, and constituting an extension thereof.

A piston 21 reciprocates in the hollow piston chamber 18, and has a reduced tubular extension 22 that operates in the bore 20 of the plug 19. At the juncture of the extension 22 with the main body of the piston, a shoulder 23 is produced, which shoulder constitutes a pressure surface for motive fluid, as hereinafter explained. The piston 21 has a forwardly extending neck 24 that projects through a suitable packing box 25 carried by the front end of the cylinder member, and a tool-holding chuck 26 is carried by the projecting end of the said neck 24. This chuck is arranged to receive a drill bit 27 or other suitable tool.

The cylinder member has mounted upon its upper side, a transversely disposed valve casing 28, in which is mounted a rotary initial or throttle valve 29 that is tapered, and is provided with an exposed actuating handle 30. Motive fluid under pressure from any suitable source is conducted to one end of the valve through the inlet passage 31, and enters a chamber 32 formed in the larger inner end of the valve 29. Disposed alongside of the throttle valve 29 is an automatic fluid operated valve 33 that is arranged in a cage 34 detachably fitted in the valve casing 28. The automatic valve 33 and the manner in which it operates is fully disclosed in and is covered by my former Patent, No. 919,270, dated Apr. 20, 1909, so that an extended description thereof is believed to be unnecessary. It is sufficient to state that the valve has an annular groove 35, which is always in communication with a central groove 36 formed in the valve casing, and said groove 36 is in communica-

tion with the motive fluid supply through a port 37 when the initial or throttle valve 29 is open, as illustrated in Fig. 3. Arranged on opposite sides of the channel 36, and formed in the valve casing 28 are other annular channels 38 and 39, from which extend passageways or ports 40 and 41 that communicate with the piston chamber 18 on opposite sides of the main body of the piston 21. As a result, it will be obvious that if the valve 33 is in the position shown in Fig. 3 and if the throttle valve 29 is opened, the motive fluid will pass from the channel 36 by way of the channel 35, into the channel 38, and thence to the passageway 40. At the same time, the end of the valve 33 has uncovered a port 42 communicating with the channel 39, and with the exhaust port 43, so that motive fluid which may be in the piston chamber 18, in advance of the piston, can escape through the passage 41, ports 42 and 43, into the open air. On the other hand, when the valve is at the opposite limit of its movement, as shown in Fig. 4, then the motive fluid, under pressure, will pass from the channel 36, through the channel 35, into the channel 39, and thence to the front end of the piston chamber, while the exhaust in rear of the piston can take place through the passageway 40, the channel 38, and ports 44 into the bore 45 of the valve, whence it can escape through the exhaust port 43. The rear end of the valve has a pressure area or surface 46, and motive fluid is conducted against this surface through a passage 47 communicating with the chamber 48 that has ports 49 opening into the rear end of the valve cage. The passageway 47 leads from the rear portion of the piston chamber, and has two branches 50 and 51, the branch 50 having an inlet port 52 communicating with the piston chamber 18 in advance of the inlet end 53 of the branch 51. This arrangement will be clear by reference to Fig. 5. A manually operated valve 54 controls the passage of motive fluid from the piston chamber, through the port 53 and branch 51 into the passageway 47, said valve 54 being preferably in the form of a plug that is held in closed position by a coiled spring 55. The valve has a stem 56 projecting through a bushing 57 located in one side of the valve casing, and secured to the outer end of the stem is an exposed actuating knob or head 58.

A port 59 leads from the annular channel 36, and opens into an annular channel 60 formed in the cylinder member around the piston chamber 18, and substantially midway between its ends. The piston 21 has an annular channel 61 that moves into and out of register with the channel 60. This channel 61 constitutes a port communicating with one or more longitudinal passageways 62 formed in the piston and opening through its rear end at the shoulder or pressure surface 23.

The operation of the apparatus is substantially as follows:—The actuating or motive fluid being admitted to the channel 36 by turning the throttle or initial valve 39 to the position shown in Fig. 3, it is free to flow through the port 59 into the channel 61 when the piston is in the position illustrated in Fig. 1. Passing therefore through the longitudinal passages 62, it will enter the piston chamber in rear of the piston, exerting a force that moves the piston forward until the shoulder 23 uncovers the port 40. In the meantime, the motive fluid in the valve chamber has acted on the unequal area exposed, and has forced the valve into the position shown in Fig. 3, so that the motive fluid passes into the chanel 38 and thence through the passageway 40 into the piston chamber behind the piston. At the same time, the exhaust of the motive fluid in advance of the piston takes place through the passage 41, channel 39, and ports 42 and 43. The piston, however, having moved to a position to uncover the port 40, the channel 61 of said piston moves out of communication with the channel 60 so that the piston is continued in its forward movement by the pressure supplied through the port 40. When the piston in its forward movement uncovers the port 52 of the passageway 47, motive fluid under pressure is admitted through said passageway 47 and ports 49 against the rear end of the valve, overcoming the pressure in the opposite direction, due to the unequal areas of the valve, and moving the valve to the position shown in Fig. 4. This closes communication between the channel 39 and the exhaust port 43 and admits motive fluid under pressure from the channel 36 through the port 42 into the channel 39, and thence through the passageway 41 into the piston chamber 18 in advance of the piston. This fluid pressure acting on the piston effects the return movement thereof, while the motive fluid contained in the piston chamber in rear of the piston is expelled through the port and passageway 40, the ports 44 and the bore 45 of the valve. The plug 40^a, extending into the hollow valve, sufficiently obstructs the passage of the exhaust to hold the valve in the position illustrated in Fig. 4 until the piston in its return movement closes the port 52 and again brings the passageways 62 of the piston into communication with the port 59. The valve then reacts under the differential pressure, and moves to the position shown in Fig. 3, while the motive fluid, which passes through the passageways 62 into the rear end of the piston chamber, behind the piston, cushions said piston at the end of its return stroke, and initiates the forward or working stroke.

As it often becomes desirable or necessary to shorten the stroke or travel of the piston, this may be done in the present structure by opening the valve 54 and holding it open against the action of the spring 55. When the valve 54 is thus opened and the piston in its forward travel uncovers the port 53 of the branch 51, the motive fluid from the piston chamber will pass through said branch, through the passageway 47 to the rear end of the valve, and shift it, hastening the cycle of said valve, and shortening the stroke of the piston, as will be obvious.

From the forgoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

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

1. In a fluid pressure motor, the combination with a cylinder member, of a reciprocating piston therein, having a working and a return stroke, a valve casing located on one side of the cylinder member and having a valve chamber provided with an internal annular channel, motive fluid supply means communicating with the channel, and a port extending from the channel to the interior of the cylinder member, said casing also having another port leading from the chamber to the rear portion of the cylinder member, and an automatic valve operating in the casing and controlling the passage of motive fluid from the annular channel to the last mentioned port, while permitting motive fluid at all times to pass from the annular channel to the first mentioned port, said piston having a passageway opening through its rear end and also having an inlet port that moves into and out of register with the first mentioned port of the valve casing.

2. In a fluid pressure motor, the combination with a cylinder member, of a reciprocating piston therein having a working and a return stroke, a valve casing located on one side of the cylinder member transversely thereof and having a valve chamber provided with an internal annular channel, a cage detachably located in the chamber and having openings that communicate with the annular channel, said valve casing having a port extending from the annular channel to the interior of the cylinder member between its ends and also having another port leading from the chamber to the rear portion of the cylinder member, motive fluid supply means communicating with the channel, and an automatic reciprocating valve operating in the cage and controlling the passage of motive fluid from the annular channel to the last mentioned port while permitting motive fluid at all times to pass from the annular channel to the first mentioned port, said piston having a longitudinal passageway opening through its rear end, and said passageway having an inlet port that moves into and out of register with the first mentioned port of the valve casing.

3. In a fluid pressure motor, the combination with a cylinder member and a reciprocatory piston operating therein, of means for supplying motive fluid to the cylinder to reciprocate the piston, said means including an automatic fluid operated valve, a passageway for conducting motive fluid from the interior of the cylinder member against one end of the valve, said passageway having a plurality of inlet ports communicating with the cylinder member at different points and successively covered and uncovered by the piston, a valve for controlling one of the ports, a spring operating against the valve to normally hold the same in closed position, and an exposed operating handle for moving the valve against the action of the spring to open the port.

4. In a fluid pressure motor, the combination with a cylinder member and a reciprocatory piston operating therein, of means for supplying motive fluid to the cylinder to reciprocate the piston, said means including an automatic fluid operated valve, a passageway for conducting motive fluid from the interior of the cylinder member against one end of the valve, said passageway having a plurality of inlet ports communicating with the cylinder member at different points and successively covered and uncovered by the piston, a sliding plug valve movable into and out of one of the ports for closing the same, said valve having a stem projecting from one side of the cylinder member and provided with an exposed operating handle, and a spring surrounding the stem and bearing against the valve for normally moving the same to closed position.

In testimony whereof, I affix my signature in presence of two witnesses.

DANIEL SHAW WAUGH.

Witnesses:

WILLIAM H. LEONARD,

HERBERT E. FISKE.