

Oct. 25, 1932.

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1,884,648

DRILLING MECHANISM

Filed Aug. 27, 1927

2 Sheets-Sheet 1

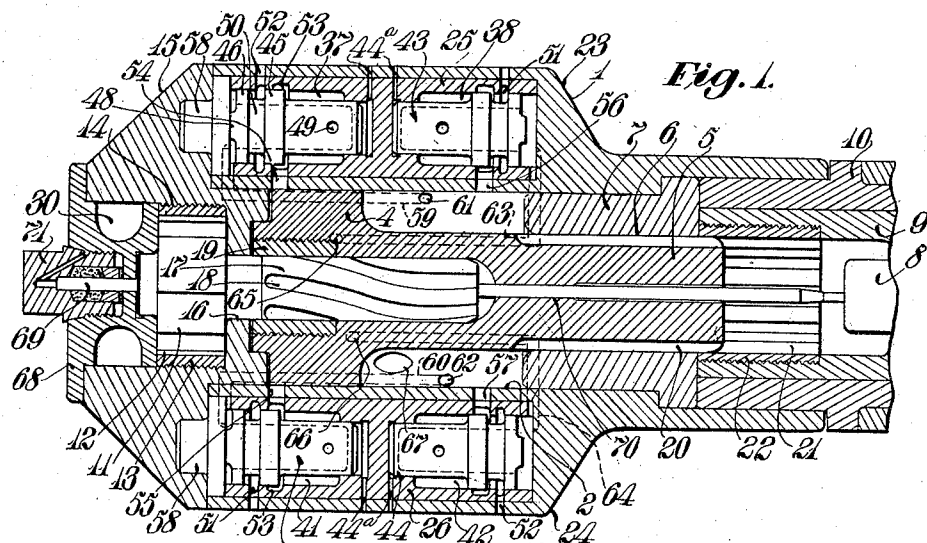


Fig. 1.

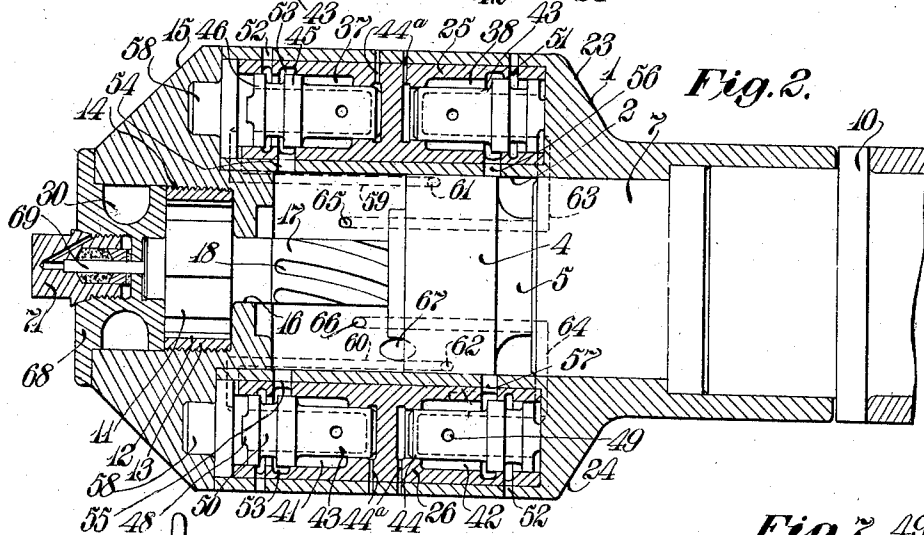


Fig. 2.

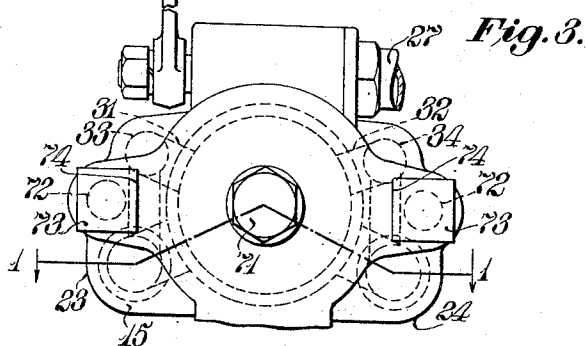


Fig. 3.

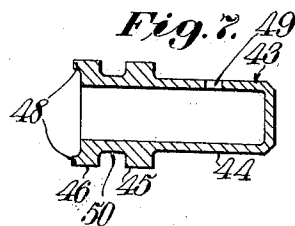


Fig. 4.

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Fig. 4.

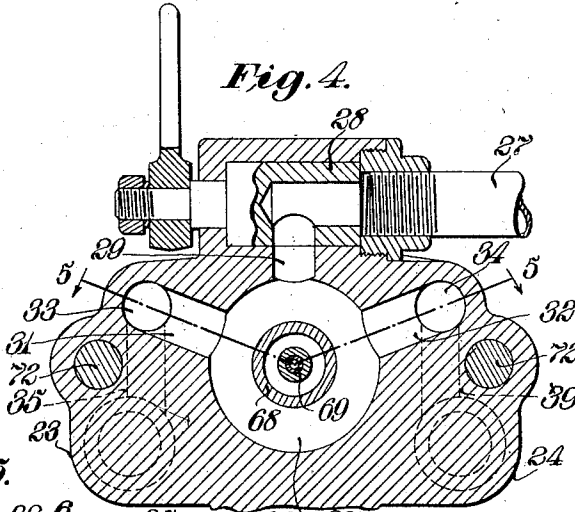


Fig. 5.

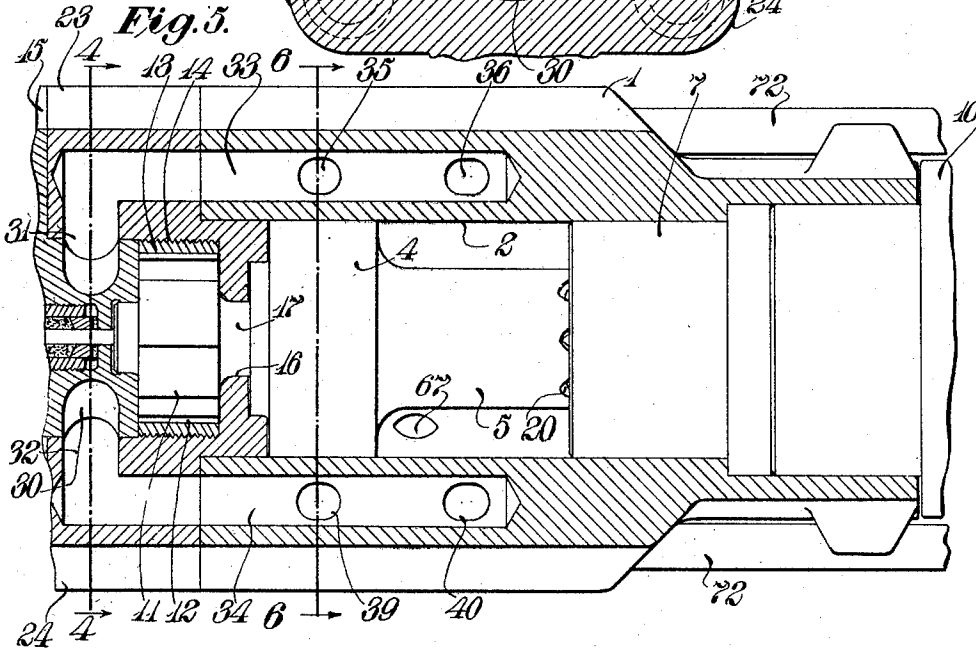
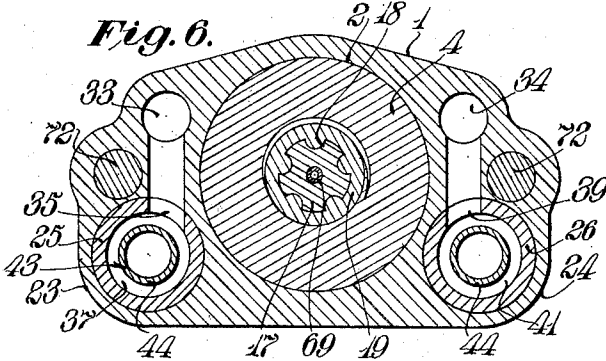


Fig. 6.



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Att'y.

UNITED STATES PATENT OFFICE

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DRILLING MECHANISM

Application filed August 27, 1927. Serial No. 215,958.

My invention relates to drilling mechanisms and more particularly to fluid distribution means for pressure fluid actuated rock drills of the impact type.

One object of my invention is to provide an improved fluid distribution means for percussive motors. In the design of the larger sizes of rock drills, difficulty has been experienced with the usual type of fluid distribution means employing a single multi-spool valve, due to the fact that in order to provide the necessary valve opening to conduct the large amount of fluid required, the valve casing and the valve itself had to be made relatively large and bulky. This large valve casing and valve projecting from one side of the rock drill cylinder also made the machine difficult to handle because of the comparatively large unbalanced weight of the valve mechanism. There are also other disadvantages of an extra large valve and valve casing which are thought to be apparent to any one skilled in the art. Another important object of this invention therefore is to eliminate the necessity for a large valve in the larger sizes of drilling machines. Another object is to provide a plurality of independently operable fluid distribution valves. A further object is to provide fluid distribution means symmetrically arranged so as to produce a better balanced machine. A still further object is to provide a plurality of fluid distribution valves for each end of the cylinder which shall operate in differently timed relation. Other objects and advantages will hereinafter more fully appear.

In the accompanying drawings I have shown for purposes of illustration one form which the invention may assume in practice. In these drawings,—

Fig. 1 is a longitudinal sectional view of my improved drilling motor taken on the line 1—1 of Fig. 3.

Fig. 2 is a view similar to Fig. 1, showing the moving parts in a different position.

Fig. 3 is a rear end elevation view of the drilling tool.

Fig. 4 is a vertical section on the line 4—4 of Fig. 5.

Fig. 5 is a longitudinal section on the line 5—5 of Fig. 4.

Fig. 6 is a vertical sectional view on the line 6—6 of Fig. 5.

Fig. 7 is a detail view showing one of the valves in vertical section.

In the illustrative construction there is shown a rock drill of the pressure fluid actuated, impact type comprising a cylinder 1 having a bore 2 in which a piston 4 is reciprocally mounted. The piston 4 is provided with a forwardly projecting striking bar 5 reciprocally mounted within a bore 6 of a buffer ring 7, and this striking bar is adapted to impart a series of blows on a hollow drill steel 8. The drill steel 8 is mounted in the usual manner in a chuck sleeve 9 which is rotatably secured in the chuck housing 10.

The drill steel 8 is adapted to be intermittently rotated during reciprocation of the hammer piston and this is accomplished by a usual ratchet and pawl mechanism including a pawl carrier 11 carrying usual pawls which cooperate with internal ratchet teeth 12 formed within a ratchet ring 13. This ratchet ring is secured by screw threads in the bore 14 of the rear cylinder head 15. Herein, preferably formed integral with this pawl carrier and projecting forward through the bore 16 in the cylinder head and within the rear end of the cylinder bore, is a rotation bar 17 having spiral grooves 18 on its periphery. The spiral grooves 18 cooperate with spiral lugs in a rifle nut 19. The striking bar 5 of the piston has formed on the periphery thereof straight longitudinally extending flutes or grooves 20 which cooperate with straight lugs 21 carried by a chuck nut 22 threadedly mounted in the chuck sleeve 9. During forward movement of the hammer piston, the pawls slip over the teeth of the ratchet ring and consequently the hammer piston delivers an unimpeded blow to the shank of the drill steel 8 and upon the return stroke of the hammer piston the pawls engage the ratchet teeth 12, thereby preventing rotation of the rotation bar 17 and consequently during this return stroke, the piston is rotated a certain amount. Rotation of the hammer piston is transmitted through straight grooves 20, the striking bar, 100

straight lugs 21 on the chuck nut, and the sleeve 9 to the drill steel 8. The construction described above is common in rock drills of the type disclosed and further description of the same is not considered necessary.

Cylinder 1 has preferably formed integral therewith laterally positioned valve casings 23 and 24 and in these casings are mounted valve bushings 25 and 26 respectively having bores therein forming valve chests. As illustrated in Fig. 4, motive fluid is supplied to each of these valve chests from a supply connection 27 and a manually controlled throttle valve 28 through a straight passage 29 to an annular groove 30 and thence by way of radial passages 31 and 32 to longitudinally extending passages 33 and 34 respectively; from the passage 33 motive fluid is conducted through ports 35 and 36 into the valve chests 37 and 38 respectively on one side of the cylinder and from the passage 34 motive fluid is supplied through ports 39 and 40 to the valve chests 41 and 42 respectively on the opposite side of the cylinder. A valve 43 is slidably mounted in each of the valve chests, the details of construction of this valve being best illustrated in Fig. 7. The valve is hollowed out for nearly its entire length and has a guiding portion 44 and two enlarged spools 45 and 46 which are preferably of the same diameter. Other important features of this valve are the stop lugs 48, the passage 49 and the annular fluid conducting groove 50 between the spools 45 and 46. The adjacent ends of the valve chests are vented to the atmosphere through passages 44^a in the valve bushings and valve casings to relieve the pressure on the ends of the guiding portions 44. Each of the valve bushings has formed therein annular exhaust grooves 51 opening to the atmosphere through passages 52, and similar inlet grooves 53, those for the rearwardly disposed valves opening into the cylinder through passages 54 and 55 and those for the front end of the cylinder communicating with the same through ports 56 and 57. Buffer plugs 58 engage the rear end of the cylinder and each of the valve bushings for the purpose of holding the latter in the proper position. Suitable means are provided for throwing the valves from one position to another which preferably take the form of passages independently controlled by the piston. In this instance, the throw passages 59 and 60 for the valves adjacent the rear end of the cylinder communicate with the cylinder by way of the ports 61 and 62 respectively which will be noted to be spaced apart longitudinally a slight amount. Similar throw passages 63 and 64 communicate with the valve chests adjacent the front end of the cylinder and with the cylinder at 65 and 66 respectively, and these ports are also preferably spaced longitudinally a slight amount. A relatively large

exhaust port 67 is located centrally of the cylinder for the purpose of conducting away a part of the exhaust when uncovered by the piston.

In the bore 14 of the rear cylinder head 15 is mounted a supporting head member 68 which supports the rear end 69 of a water conducting tube. This tube extends forwardly through the rotation mechanism and through a bore 70 in the striking bar of the piston and into the rear end of the drill steel 8. Cleansing fluid may be supplied by any usual connection through the member 71 attached to the supporting head. It will be understood that this supporting head, the rear cylinder head, cylinder and chuck housing are held together by usual side rods 72 which have flat sided heads 73 on their rear ends, one of the flat sides engaging against the cooperating flat surface 74 formed integral with the supporting head 68.

In describing the operation of my improved drilling apparatus it will be assumed that in starting the moving parts are in the positions shown in Fig. 1. At this time the throttle valve 28 is opened and motive fluid is supplied from the connection 27 through passage 29, groove 30, radial passages 31 and 32, longitudinally extending passages 33 and 34 and fills the annular space around the reduced portion 44 of each of the valves. The valves for the rear end of the cylinder are held in the position shown in Fig. 1 by unbalanced fluid pressure acting on the enlarged spools 45 which allow motive fluid to flow through the annular passages 53 and passages 54 and 55 to the rear end of the cylinder. The piston is then moved forward under the force of the actuating fluid and delivers a blow on the drill steel 8. The valves adjacent the front end of the cylinder are held in their rear position as illustrated in Fig. 1 by fluid pressure which flows through the ports 49 and hollowed out portions of the valve to act on the end surface of the enlarged spool 46. The area thus exposed to live fluid pressure is greater than the exposed area on the spool 45 whereby these valves are held in their rearward or exhaust position. The front end of the cylinder is then open to exhaust through the passages 56 and 57 and annular grooves 50 and exhaust ports 52. During the forward movement of the piston the port 65, and at a slightly later time the port 66, are uncovered and at approximately the same times the ports 61 and 62 are covered. Pressure will then build up on the rear side of the valve adjacent the rear end of the cylinder by motive fluid flowing through the ports 49 and since this fluid can no longer escape through the ports 61 and 62, these valves will be thrown to the position shown in Fig. 2, thereby opening the rear end of the cylinder to the exhaust by way of the passages 54 and 55, annular grooves 50 and exhaust ports 52.

At about the same moment, or possibly a trifle sooner, the rear end of the cylinder will be opened to atmosphere through the large exhaust port 67. It will be observed that the front surfaces of the large spools 46 on the valves for the front end of the cylinder are now in communication with the atmosphere through the throwing passages 63 and 64, ports 65 and 66 and the rear end of the cylinder. These valves are then shifted to the position shown in Fig. 2 by live pressure acting on the unbalanced area of the spool 45, in which position the front end of the cylinder will be in communication with the live pressure through passages 56 and 57 and annular passages 53. The piston will now begin its return stroke and cover the ports 65 and 66 in turn, thereby allowing pressure to be built up in the front ends of the valve chests 38 and 42, and these valves will be thrown to the position shown in Fig. 1. The passages 61 and 62 will then be uncovered in turn and the holding pressure on the rear valves will be released due to the drop in pressure through the valve controlled exhaust ports and piston controlled exhaust port, and they will also be shifted to the position shown in Fig. 1. The same cycle of events as has just been described will be repeated over and over during the normal operation of the drill. It will also be apparent that the central port 67 will serve to conduct a large portion of the exhaust fluid and thus aids in the prevention of the building up of back pressure, and also eliminates the trouble due to freezing in the regular exhaust passages.

From this description it will be observed that a plurality of valves are provided for each end of the cylinder which will be thrown at slightly different times and thereby reduce the time element between the closing of the exhaust and re-admission of motive fluid to the cylinder, thus speeding up the drilling operation. It will also be clear that with a given diameter of valve, twice the amount of motive fluid may be conducted to the cylinder and thus the sizes of the valves for the larger rock drills may be materially reduced. This construction also is much more compact and better balanced than the single valve construction.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a pressure fluid motor, a cylinder, a piston reciprocable in said cylinder, and fluid distribution means for effecting reciprocation of said piston including a plurality of

fluid actuated fluid distributing valve means for controlling fluid admission to only one end of said cylinder, means for operating said valve means in differently timed relation including passages controlled by said piston for controlling pressure fluid flow between said cylinder and said valve means for controlling throwing of the latter, and independently operable fluid distribution means for only the opposite end of said cylinder.

2. In a pressure fluid motor, a cylinder, a piston reciprocable in said cylinder, and fluid distribution means for effecting reciprocation of said piston including a plurality of fluid actuated fluid distribution valves for each end of said cylinder, said valves having pressure areas adapted to be subjected to fluid pressure, and the valves for one end of said cylinder being operable independently of the valves for the opposite end, and fluid pressure means controlled independently by said piston for operating the valves for one end of the cylinder in differently timed relation including passages controlled by said piston for controlling pressure fluid flow between said cylinder and the pressure areas on said valves for said end.

3. In a drilling mechanism, the combination with a cylinder and a piston reciprocable therein, of a plurality of distribution valves at each end of the cylinder, the valves for one end being operable independently of the valves for the opposite end, and a piston controlled valve controlling passage leading from each valve to different points in the cylinder whereby one of the valves for one end of the cylinder is thrown earlier than another.

4. In a drilling mechanism, the combination with a cylinder, a piston reciprocable therein, a head block and fluid distribution means comprising a plurality of valve chests arranged in pairs circumferentially of said cylinder, a fluid supply connection in said head block, a throttle valve for controlling the same, a plurality of passages communicating with said passage in the head block and extending longitudinally of the cylinder adjacent said pairs of valve chests, each of said latter passages communicating with the valve chests of one pair at longitudinally spaced points, means for supplying and exhausting said cylinder through said valve chests, and a valve in each chest controlling such supply and exhaust.

5. In a fluid actuated motor, a cylinder, a piston reciprocable therein, a valve chest providing bores of different diameters, a valve for controlling fluid distribution for said motor presenting portions slidably fitting each of said bores, fluid supply means communicating with the larger bore, a passage leading to said cylinder controlled by said valve and communicating with the larger bore, and a vent passage controlled by

said piston and opening into the larger bore at the end of the latter remote from the smaller bore, said valve having a passage opening through its larger end and through the side of its smaller portion for supplying pressure fluid to said remote end of said larger bore.

6. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a plurality of reciprocable fluid distributing valves for controlling the supply and exhaust of fluid for only one end of the cylinder, said valves being fluid actuated and having pressure areas adapted to be subjected to pressure fluid, fluid pressure means for independently throwing said valves in differently timed relation including passages controlled by said piston for controlling pressure fluid flow between said cylinder and said valves, and independently operable fluid distribution means for only the opposite end of said cylinder.

7. In a pressure fluid motor, a cylinder, a piston reciprocable in said cylinder, and fluid distribution means for effecting reciprocation of said piston including four independently operable fluid actuated fluid distribution valves, two of said valves controlling the supply and exhaust of pressure fluid for one end of said cylinder, and the other two valves controlling the supply and exhaust of fluid for the opposite end of said cylinder, said valves having areas adapted to be subjected to the action of pressure fluid, and passage means controlled by said piston for controlling pressure fluid flow between said cylinder and the pressure areas on said valves independently to cause throwing of the latter in differently timed relation.

8. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a plurality of fluid distributing valves at each end of the cylinder, each of the valves controlling the supply of pressure fluid to and the exhaust from only one end of the cylinder, and the valves for one end being operable independently of the valves for the opposite end, and throwing passage means controlled by the piston including a piston controlled throwing passage leading from each valve to different points in the cylinder whereby one of the valves for one end of the cylinder is thrown earlier than another at the same end.

9. In a pressure fluid motor, fluid distributing valve mechanism comprising a valve chest having differential bores and annular grooves in the walls of the larger bore, an exhaust port connecting one groove to atmosphere, a fluid conducting passage communicating with the other groove, a differential valve reciprocably mounted in said bores and having a sleeve-like body portion fitting the

smaller bore and spaced spools fitting the larger bore, a fluid inlet passage communicating with the larger bore longitudinally of the valve chest between said grooves and said smaller bore, said valve, upon reciprocation, alternatively connecting said fluid conducting passage with the fluid inlet passage and exhaust port.

10. In a pressure fluid motor, fluid distributing valve mechanism comprising a valve chest having differential bores and annular grooves in the walls of the larger bore, an exhaust port connecting one groove to atmosphere, a fluid conducting passage communicating with the other groove, a differential valve reciprocably mounted in said bores and having a sleeve-like body portion fitting the smaller bore, and spaced spools fitting the larger bore, a fluid inlet passage communicating with the larger bore longitudinally of the valve chest between said grooves and said smaller bore, said valve, upon reciprocation, alternatively connecting said fluid conducting passage with the fluid inlet passage and exhaust port, and a vent passage connecting one end of said smaller bore to atmosphere.

11. In a pressure fluid motor, a cylinder, a piston in said cylinder, and fluid distribution means including a valve chest providing aligned bores of different diameters, a valve having portions fitting said bores, means for venting the end of the smaller bore remote from the larger bore, means for supplying fluid under pressure to the larger bore at a point spaced from its end remote from the smaller bore, means forming a motive fluid distribution passage leading between the cylinder and said larger bore and communicating with the latter at a point therein between the point of fluid supply thereto and the end of said bore remote from the smaller bore, exhaust means communicating with said larger bore still nearer the last mentioned end of the latter bore, and means formed in the valve for constantly connecting the end of the valve remote from the smaller bore with the fluid supply to the valve chest, and piston controlled means for controlling the pressure at the end of the larger bore remote from the smaller bore.

In testimony whereof I affix my signature.
ELMER G. GARTIN.