June 2, 1931. E. G. GARTIN 1,807,839

FLUID PRESSURE MOTOR

Filed Dec. 27, 1920 2 Sheets-Sheet 1

Fig. 1.

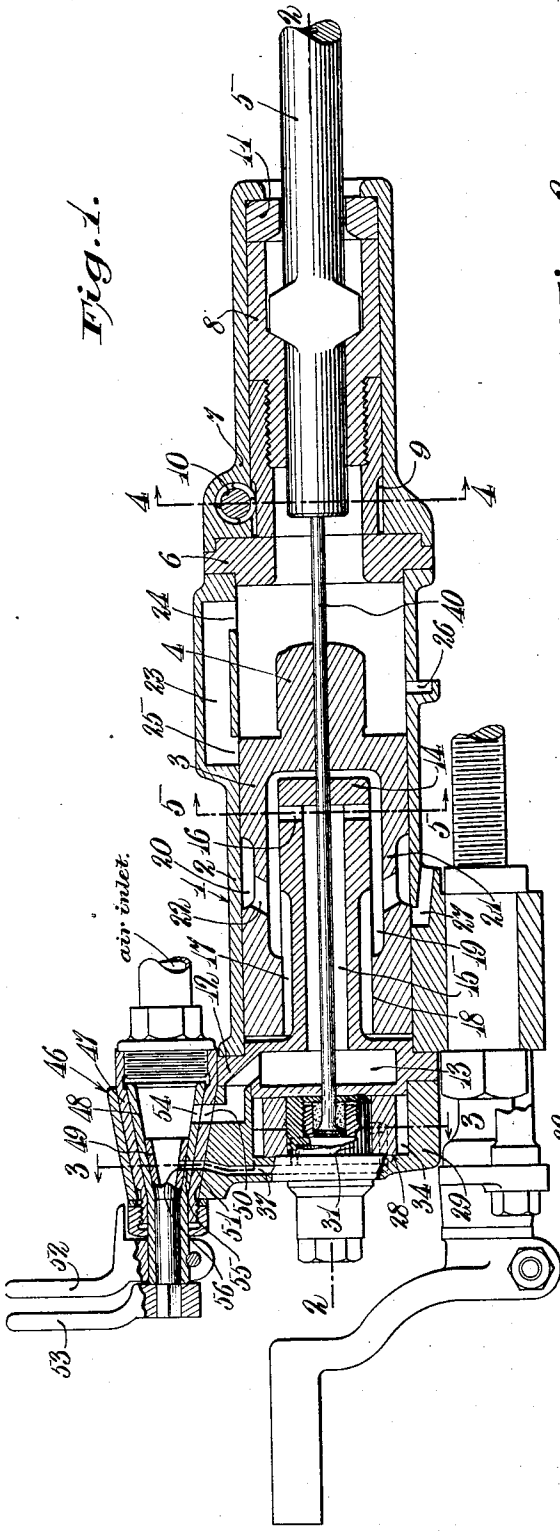
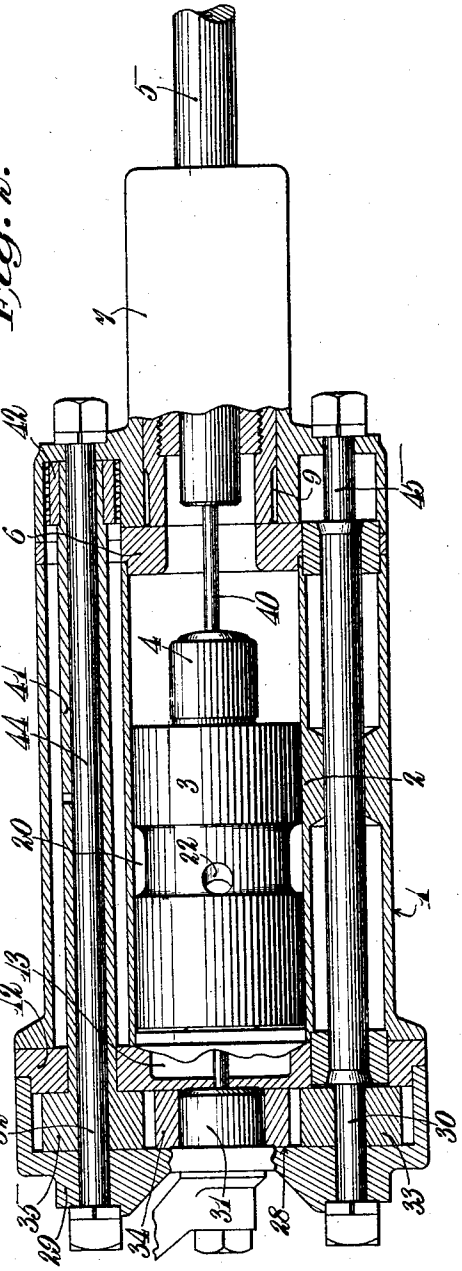


Fig. 2.



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Fig. 3.

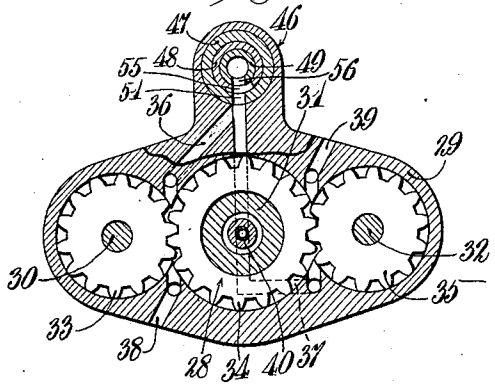


Fig. 4.

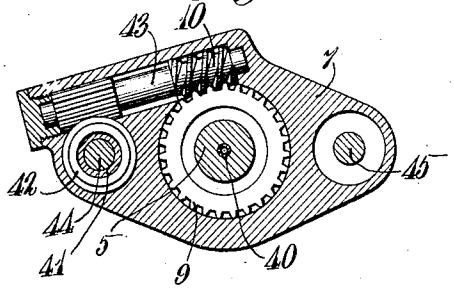
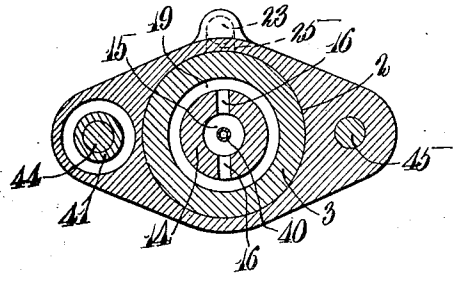


Fig. 5.



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1,807,839

UNITED STATES PATENT OFFICE

ELMER G. GARTIN, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS

FLUID PRESSURE MOTOR

Application filed December 27, 1920. Serial No. 433,388.

My invention relates to fluid pressure motors.

An object of my invention is to provide an improved fluid pressure motor. Another object of my invention is to provide an improved fluid pressure motor of the valveless type. Another object of my invention is to provide an improved fluid pressure motor especially adapted for use in combination with a rock drill. A still further object of my invention is to provide an improved fluid pressure motor of the percussive type and improved rotating mechanism cooperating therewith to effect actuation and rotation of a rock drill bit. A still further object of my invention is to provide an improved controlling mechanism for a system such as that last mentioned. A still further object of my invention is to provide an improved rotation mechanism for use in rock drilling mechanisms.

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

In these drawings:—

Fig. 1 is a central longitudinal section through the cylinder, rotation mechanism and controlling mechanism of a tool embodying the illustrative form of my improved construction.

Fig. 2 is a view in horizontal longitudinal section through the cylinder of the motor shown in Fig. 1, the section being taken on line 2—2 of Fig. 1.

Fig. 3 is a transverse section through the rotation mechanism, on the line 3—3 of Fig. 1.

Fig. 4 is a transverse section on the line 4—4 of Fig. 1 showing a portion of the mechanism for transmitting rotation to the chuck.

Fig. 5 is a transverse section through the cylinder of the percussive motor taken on the line 5—5 of Fig. 1.

In rock drilling operations, it is a well-known fact that it is not desirable to run the percussive or other drilling motor too rapidly at the moment when a hole is being started, or in "spotting" a hole, as the operation is technically termed. In motors adapted for rock drilling work of the class in which a separate driving motor is used for the rotation mechanism and in which separate valves are used to control the rotation and the tool actuating motors, it is obvious that if the rotation motor be given its full air supply while the tool motor is being run relatively slowly, and if the drill is pressed tight to the work, a very severe grinding action will take place on the drill bit and accordingly the drill will be very rapidly dulled.

In the accompanying drawings and in the following specification, I disclose a mechanism whereby the speed of the drilling motor and of the rotation motor are synchronized in such a manner as to proportion the speed of the one to the other in the most desirable ratio. In the illustrative form of my mechanism, a percussive tool of the class described is shown, being generally indicated by the numeral 1. This tool is provided with a percussive motor having a cylinder 2 within which reciprocates a piston 3 having a striking nose 4 to cooperate with a usual hollow drill steel 5. The forward end of the cylinder 2 is closed by a cylinder head 6 and secured to the forward extremity of the latter is a chuck housing 7 in which a chuck 8 is rotatably mounted, the chuck 8 in its rear portion being provided with a series of teeth 9 to cooperate with a worm 10 whose functions and details of construction will be later explained in greater detail. To retain the steel 5 in the chuck, a locking ring 11 of well-known construction is provided.

The rear end of the cylinder is closed by a head 12 which is hollow in construction, being provided with a chamber 13 occupying substantially its entire diameter. Projecting inwardly from this head member 12 is a generally cylindrical member 14 whose interior is bored out, as indicated at 15, and is in fluid communication with the chamber 13. The forward extremity of the member 14 is cylindrical and transversely extending ports 16 conduct fluid from the bore 15 to the exterior periphery of the member. At a point back of the cylindrical portion of the member 14, and between the cylindrical portion and the head member 12 is a second portion,

which while substantially cylindrical in outline, is provided with a series of grooves 17 to conduct fluid to the rear end of the cylinder as will later be described. The piston 3 is bored out at its rear end as indicated at 18, the rear part of the bored out portion being a snug, but freely sliding fit for the member 14. The forward portion of this chamber is, however, enlarged as indicated at 19, an elongated annular groove being cut therein and this groove serves to connect the passages 16 with the grooves 17 as will later be more specifically described. The piston is also provided with an annular groove 20 concentrically arranged with the groove 19 and separated therefrom by a wall 21 which is perforated at different points by passages 22 which serve to conduct the fluid within the groove 19 outwardly to the groove 20. The forward end of the cylinder wall is provided with one or more bypasses 23 having a port 24 located adjacent the extreme forward end of the cylinder, but separated therefrom by a slight distance to permit cushioning in case the drill motor be operated without a steel being in the chuck. A second port 25 serves to permit the ingress of fluid to the bypass 23 when the groove 20 overruns the port 25. Suitable exhaust ports 26 and 27 are arranged at such distances from the ends of the cylinder as to be opened by the ends of the piston at suitable times in its reciprocation.

The operation of the motor, as so far described, is as follows,—

Live fluid is admitted to the chamber 13 by way of a port which will be later described and passes longitudinally through the member 14 by way of the bore 15 and thence radially by way of the passages 16 and into the internal groove 19 and the external groove 20. When the piston is in the position indicated in Fig. 1, it is obvious that the groove 19 communicates by way of the longitudinal grooves 17 with the rear end of the cylinder and so fluid is conducted to act upon the rear end of the piston 3. The exhaust port 26 is open at this time so that no pressure substantially above that of the atmosphere exists in the front end of the cylinder. The piston 3 will accordingly move forward under the action of the live fluid upon its rear end until such time as the rear end of the groove 19 passes beyond the forward end of the grooves 17 at which moment cut-off will occur and expansion will commence. At about this same time, but slightly afterward, the groove 20 will come into communication with the port 25 and motive fluid will begin to pass by way of passages 23 and port 24 to the front end of the cylinder to effect the return stroke at such time as pressure becomes sufficient for that purpose. Port 26, of course, is closed prior to the opening of port 25. Near the end of the forward stroke of piston 3, the rear end of the piston overruns port 27 and fluid is discharged from the rear end of the cylinder and shortly thereafter the piston will move back upon its rearward stroke. This rearward stroke will be under the action of live fluid until the grove 20 passes beyond the rear side of the port 25 at which time expansion will begin in the front end of the cylinder. Shortly after, admission will again take place toward the rear end of the cylinder, and near the end of the rearward stroke, port 26 will open and fluid from the forward end of the cylinder will exhaust. It will be noted that an annular area equal to the transverse sectional area of the member 14 is always subject to pressure tending to force the piston forward. A single complete double cycle having been described, the operation of the motor will evidently be merely a repetition of the events so far pointed out.

Cooperating with the percussive motor, I have provided means for effecting rotation of the drill steel 5 in such manner as to cause the steel to rotate during the drilling operation. For this purpose, I employ a rotary motor, generally indicated by 28 and best illustrated in Fig. 3, this rotary motor being coaxially arranged with the cylinder of the percussive motor. The motor 28 comprises a rotor casing 29 in which there are rotatable upon parallel shafts 30, 32 and a stub shaft 31, three rotors 33, 35 and 34, rotors 33 and 35 meshing with rotor 34 which is disposed between them. Fluid is admitted to the teeth of rotors 33 and 34 by means of a passage 36 and by way of a passage 37 between the teeth of rotors 34 and 35 and, after acting upon the teeth, is exhausted by way of passages 38 and 39. The stub shaft 31 provides a bearing upon its peripheral surface for the rotor 34 and also likewise provides a mounting for the cleansing fluid tube 40 and the passage 37 supplies pressure fluid both to the cleansing fluid tube 40 and to the pair of toothed rotors 34 and 35. The operation of motors of the type indicated is well-known and need not accordingly be here more fully described. For the purpose of transmitting the rotary motion from the motor 28, I have provided the rotor 35 with a sleeve 14 which extends longitudinally of the tool and parallel to the axis thereof for substantially the full length of the percussive motor, and, at the forward end of the sleeve 41, I have provided a worm 42 to cooperate with a transversely extending shaft 43 which will be described in greater detail hereafter. The shafts 30 and 32 upon which the rotors 33 and 35 turn, constitute also the side rods for holding the several component elements of the tool together, the side rods as a whole being designated as 44 and 45. The worm 42 cooperates with the shaft 43 which is mounted in suitable bearings in a transverse housing at the forward end of the tool and this shaft is provided at a point adjacent the

worm 42 with teeth to mesh with the teeth of the worm and to cause rotation of the shaft upon rotation of the rotor 35. At its opposite end, the shaft 43 is provided with a worm 10 which meshes with the teeth 9 of the chuck member. Accordingly, it will be obvious that rotation of the rotor 35 will cause rotation of the drill steel 5 and that by suitably varying the pitch of the teeth in the worms and the number of teeth in the worm wheels, any desired variation in the rate of driving can be obtained, while at the same time, a very positive and powerful drive is obtained because of the worm construction.

For the purpose of effecting control of the percussive motor and of the rotation motor, I have provided valve mechanism generally indicated by the numeral 46 and this valve mechanism is supplied by means of an air inlet, so designated, with pressure fluid. The valve mechanism 46 consists generally of a bushing member 47, conical in bore and in exterior shape and a pair of hollow, sleeve-like valve members: that marked 48 being for the purpose of controlling the supply of pressure fluid to the motor and that designated 49 for the purpose of controlling the rotation. These control the supply of fluid to their respective mechanisms by way of passages 50 and 51, passage 51 branching to the passages 36 and 37. Separate control handles 52 and 53 serve to operate the two valve sleeve members. It will be noted that the member 48 is of considerably greater length than the member 49 and that a port 54 is formed therein to cooperate with the port 50 and that this port is in such position as not to be controlled by the member 49. The passage 51, however, is controlled by ports 55 in the sleeve members 48, and 56 in the sleeve member 49, and these ports are so arranged with respect to the handles 52 and 53 that they are normally in alinement at the time that the handles 52 and 53 are in alinement and also the port 54 is so arranged that at the time that communication is opened to the passage 51 by way of ports 55 and 56, communication is also established through port 54 and passage 50. Port 55 as shown in Fig. 3 is, however, of greater angular length in a counter-clockwise direction than port 54. The inner valve member 49 is held tightly seated in the valve member 48 by the pressure of the air acting longitudinally thereof, such pressure creating sufficient friction between the ground surfaces of the valve members to cause the inner one to rotate with the outer one. It will thus be obvious that since the valve member 49 is disposed within the valve member 48, that movement of the valve member 48 will carry along with it the member 49 and accordingly, it is possible, by manipulation only of handle 52, to start up the tool motor and also the rotation motor simultaneously and thereby avoid excessively rapid operation of the steel while the motor is idle. However, if for any reason it is desirable to stop rotation while allowing the percussive action to continue, the tool handle 53 can be turned slightly to interrupt the communication between the ports 55 and 56. Also if it is desired to continue the rotation, as for instance in backing out of a hole, while the percussive action is discontinued, this may also be accomplished by turning the handle 52 farther, as this will close communication between ports 54 and 50 while still leaving port 55 in communication with port 51. From the foregoing, it will be obvious that I have provided means for simultaneously taking care of the control of both motors in dependent relation, or means whereby either one can be operated without operation of the other. In the normal starting of the tool, however, the percussion and rotation will commence simultaneously so that rotation of the drill steel, while no percussive action is taking place, will not grind off the cutting edges of the steels.

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 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. A rock drilling apparatus comprising a hollow drill steel, means for causing the same to hammer the rock, means for causing the drill steel to rotate during hammering action, means for supplying cleansing fluid to the drill steel, means for effecting simultaneous initiation of all of said operations, and means for interrupting the rotation and cleansing fluid pressure supply without interrupting the hammering action.

2. A drilling mechanism comprising a drilling motor adapted to actuate a drill steel and including side rods for maintaining parts thereof in operative relation, a rotation motor for said drill steel including intermeshing gears one of which is disposed coaxially with the axis of said drilling motor while others are disposed coaxially with said side rods, and cleansing means for said drill steel including means forming a support for one of said motor gears and a cleansing tube arranged coaxially with one of said gears and projecting forwardly within said mechanism.

3. A drilling mechanism comprising a drilling motor of the hammer type adapted to actuate a drill steel and including side rods adapted to maintain parts thereof in operative relation, means for rotating the drill steel including intermeshing toothed rotors, one of which is disposed coaxially with the axis of said drilling motor while others are disposed coaxially with said side rods, and a

transmission sleeve surrounding one of said rods, and cleansing means for said drill steel including a member forming a support for one of said rotors and a tube arranged coaxially with one of said rotors and projecting forwardly within said mechanism.

4. A drilling mechanism comprising a drilling motor of the hammer type adapted to actuate a drill steel, means for rotating the drill steel including intermeshing toothed rotors one of which is disposed coaxially with the axis of said drilling motor, and cleansing means for the drill steel including a cleansing tube projecting forwardly within said mechanism into the steel and a gland plug forming a support for one of said rotors and for said cleansing tube.

5. A rock drill comprising a drilling motor having a plurality of parts, parallel side rods for holding said parts together, a drill steel receiving chuck carried within the front end of the drill, a rotation motor for said chuck disposed at the rear end of said drilling motor and comprising intermeshing spur gears, namely, a central gear arranged coaxially with the longitudinal axis of said drilling motor and side gears meshing with said central gear and arranged coaxially with said side rods, and transmission means between one of said side gears and said chuck including compound worm reduction gearing at the end of the drill adjacent said chuck and operatively connected to the latter.

In testimony whereof I affix my signature.

ELMER G. GARTIN.