

Aug. 16, 1949.

A. FEUCHT
FLUID PRESSURE MOTOR FOR ROCK
DRILL FEEDING MECHANISMS

2,479,004

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4 Sheets-Sheet 1

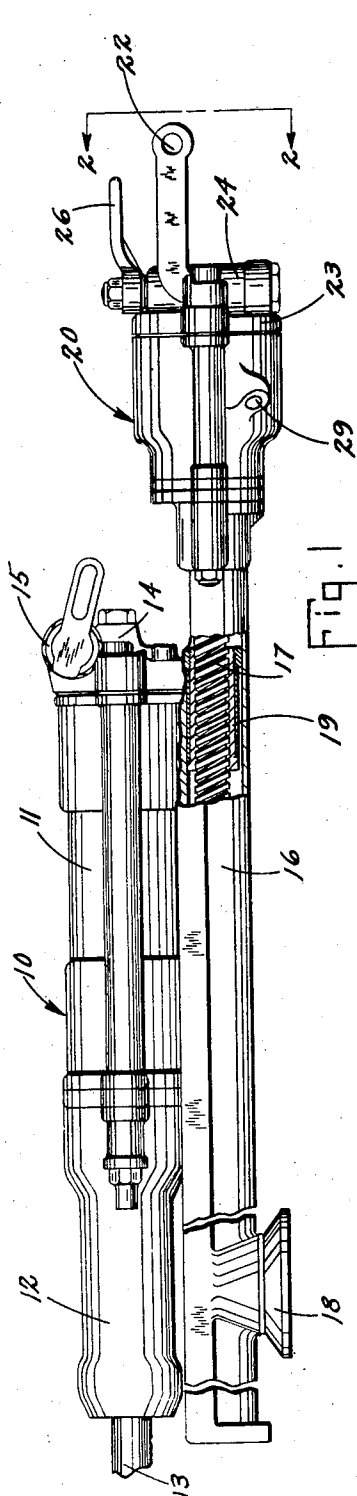


Fig. 1

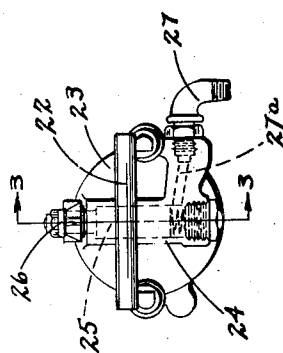


Fig. 2

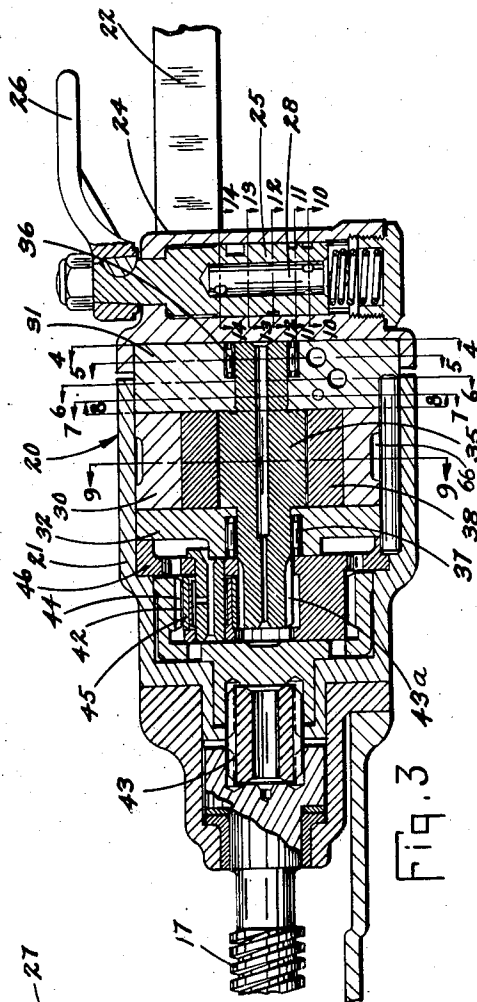


Fig. 3

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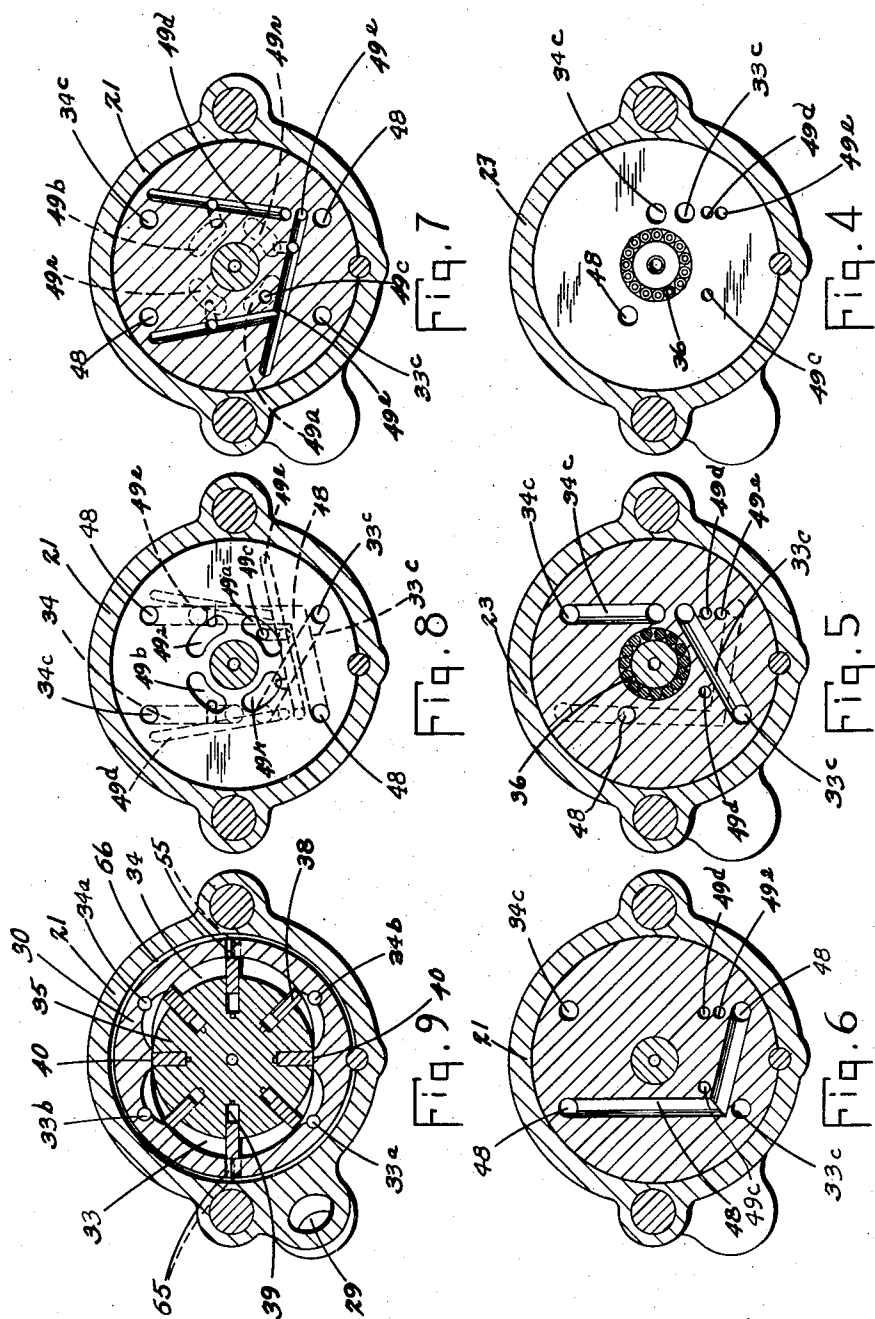
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4 Sheets-Sheet 2



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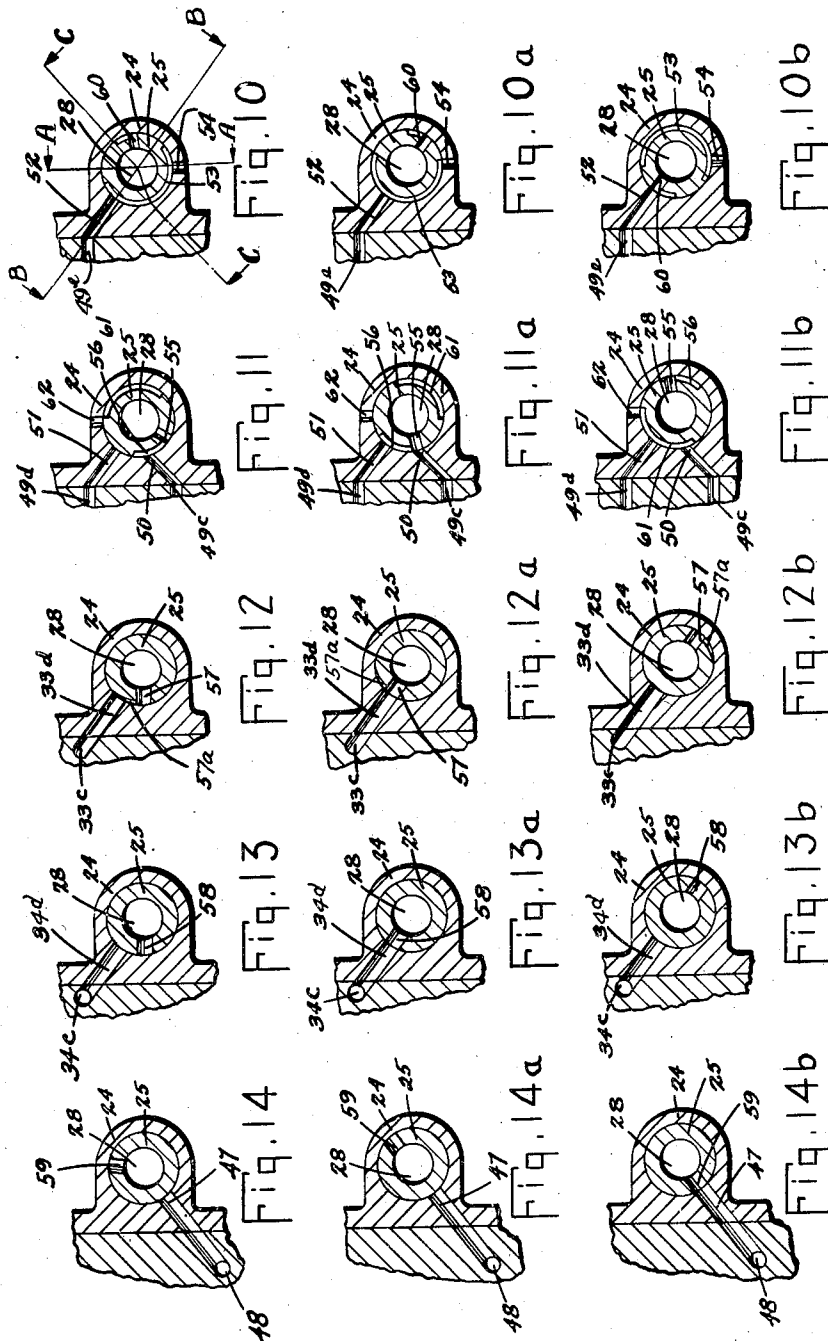
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4 Sheets-Sheet 3



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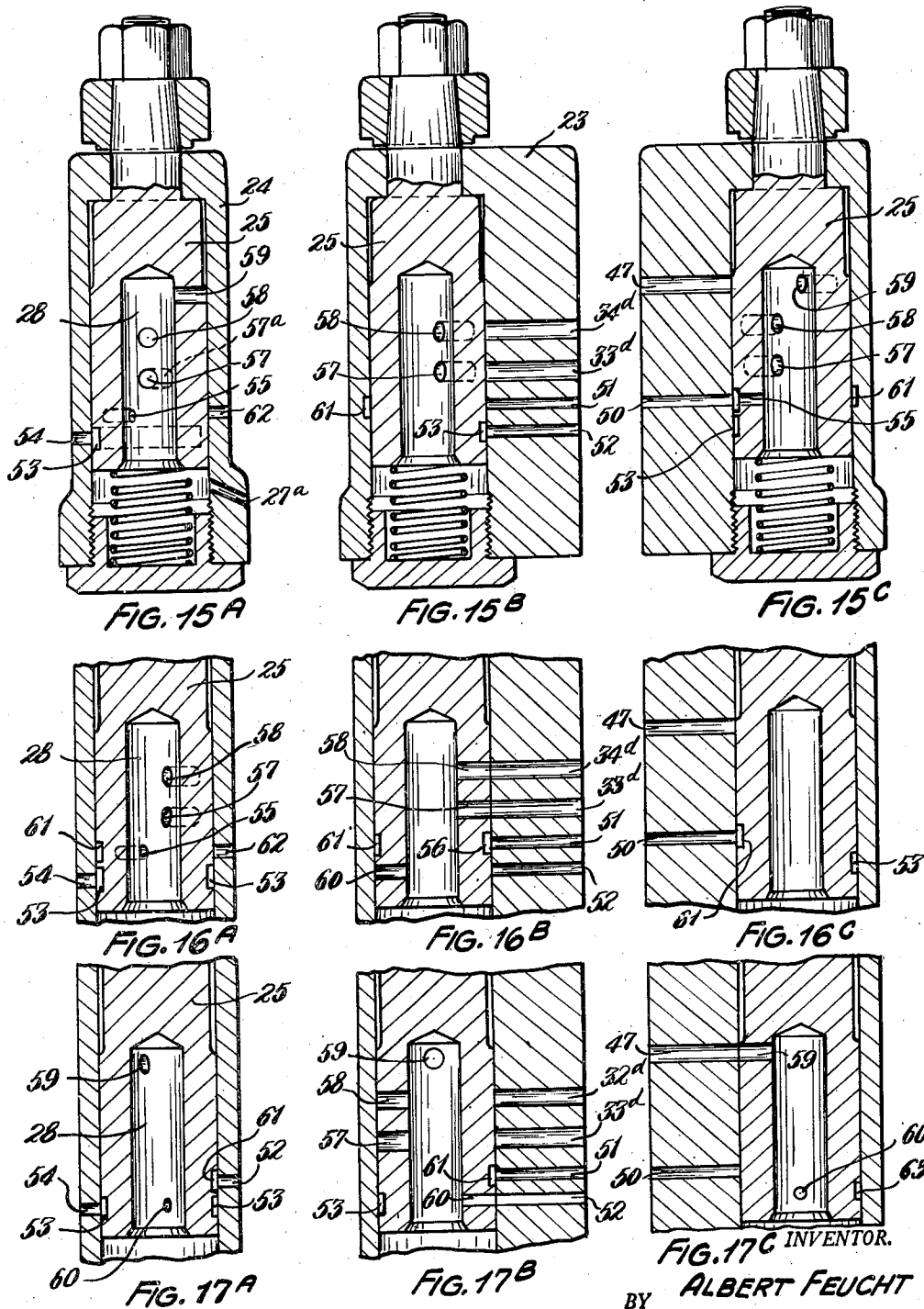
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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FLUID PRESSURE MOTOR FOR ROCK DRILL
FEEDING MECHANISMS

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7 Claims. (Cl. 121—92)

1

This invention relates to feed mechanism for rock drills, and has to do more particularly with a control valve so constructed and arranged as to direct pressure fluid selectively either to one or to a plurality of units of a multi-unit motor by which the feed mechanism is driven. The control means of the invention is designed for use primarily with rock drills of the drifter type, and is so illustrated herein.

This application is a continuation-in-part of my copending application Serial No. 492,559, filed June 28, 1943, and now abandoned.

An object of the invention is the provision of control means for a multi-chambered feed motor operated by pressure fluid for affording either a low or a high powered forward feed movement and a high powered backward movement.

Another object of the invention is the provision of a novel control valve for feed mechanism, to be used in a rock drill or the like, by which either a relatively small amount of power or force or a relatively large amount of power or force is selectively obtainable for feeding the drill steel or bit forward while it is in operation, and a considerable amount of power is obtainable for withdrawing the drill steel from tight holes.

A further object is the provision of a single control valve means of the character described for use in feed mechanism embodying a multiple unit motor, by which a single unit of the motor may be operated for obtaining a relatively small amount of power or force or a plurality of units of the motor may be operated simultaneously for obtaining a higher amount of power or force.

The invention may be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the appended claims.

In the accompanying drawings

Fig. 1 is a side elevation, with portions broken away, showing a rock drill embodying my novel feed mechanism control.

Fig. 2 is an end view looking toward the feed mechanism and in the direction indicated by line 2—2 of Fig. 1.

Fig. 3 is a longitudinal sectional view taken substantially on the line 3—3 of Fig. 2, showing my control valve associated with the motor of a feed mechanism that may be used in connection with the invention.

Figs. 4 to 8 inclusive are transverse sectional views taken through the motor of the feed mechanism on section lines 4—4 to 8—8 inclusive of Fig. 3.

2

Fig. 9 is another transverse sectional view taken through the feed motor on line 9—9 of Fig. 3 and showing the multiple working chambers or cylinders.

Figs. 10 to 14 inclusive are sectional views taken through the feed motor control valve at different points thereof, as indicated by section lines 10—10 to 14—14 inclusive of Fig. 3, with the valve in the position for feeding the rock drill forward at low speed or power.

Figs. 10a to 14a inclusive are similar sectional views taken on the same section lines but with the valve in the position for the forward feeding of the rock drill at full speed or power.

Figs. 10b to 14b inclusive are similar sectional views taken on the same section lines but with the valve in the position for actuating the feed mechanism in reverse at full speed or power or force.

Figs. 15A, 15B and 15C are longitudinal sectional views through the control valve taken substantially on the lines A—A, B—B and C—C respectively of Fig. 10 with the valve plug in the position for low power forward feed.

Figs. 16A, 16B and 16C are similar sectional views on the same section lines with the valve plug in the position for high power forward feed, and

Figs. 17A, 17B and 17C are similar sectional views on the same section lines with the valve plug in the position for reverse feed.

More detailed reference will now be made to the drawings, in Fig. 1 of which I show a power tool 10 embodying a feed mechanism with which my control valve may be associated. The tool 10 is of the rock drill type comprising a fluid motor or cylinder 11 containing the usual or conventional fluid actuated reciprocable hammer. The front end of the cylinder 11 is provided with a chuck housing 12 adapted to receive the drill steel 13 to which the blows of the hammer are delivered. At its other end the cylinder 11 is provided with the usual back head 14 having an air inlet connection for the motive fluid and a valve 15 for controlling the operation of the tool or rock drill.

The rock drill 10 is supported for forward and backward movement by a feed tube 16 containing a feed screw 17 and provided adjacent its forward end with the conventional cone 18 for mounting the apparatus on a tripod or other suitable support. The rock drill 10 may be mounted on the feed tube 16 as by providing the cylinder 11 with suitable guide portions which are slidable in guideways carried by the feed tube.

The feed screw 17 is connected with the rock drill 10 by means of a feed nut 19 provided on the cylinder 11 adjacent the rear end thereof and through which nut the feed screw extends.

The rock drill 10 is moved forwardly or backwardly on the feed tube 16 by rotating the feed screw 17 and for this purpose I provide a fluid motor 20 which is mounted on the rear end of the feed tube and is connected with the feed screw to drive the same. The motor 20 is a multiple-unit or multiple-cylinder reversible fluid motor by which the feed screw 17 can be driven at different speeds or with different amounts of power or force so as to obtain the desired forward or backward feeding movement of the rock drill 10. In the operation of rock drills, and particularly rock drills of the drifter type, it is desirable to be able to feed the rock drill forward at a relatively slow rate during the drilling operation. It is also desirable, at times, to advance the drill at a relatively rapid rate such as when the drill steel is being moved up to the work or while the rock drill is being used in soft material. It is also desirable to be able to move the rock drill 10 backwardly at a relatively rapid rate so as to quickly withdraw the steel and, in some cases, with a considerable amount of power for withdrawing the steels from tight holes.

Through the selective operation by means of my improved control valve of the multiple-unit motor 20, the feed mechanism is able to accomplish all of these desired results in a highly satisfactory manner. As will be further explained hereinafter the slow speed forward feeding movement of the drill 10 is obtained by using a single unit or cylinder of the feed motor 20 for driving the feed screw 17, and the forward feeding of the drill at a higher rate of speed is obtained by operating a plurality of units or cylinders of the motor simultaneously in driving the feed screw. Likewise, the rearward movement or retracting of the rock drill 10 at a relatively rapid rate or with considerable power is obtained by using a plurality of units or cylinders of the motor simultaneously for driving the feed screw.

The feed motor 20 is provided with an outer housing 21 which includes the back head or cover member 23 and has a suitable handle 22 connected therewith. The cover member 23 has a hollow portion thereon providing a valve chamber or casing 24 in which a hollow valve plug 25 is rotatably mounted for actuation by means of the hand lever 26 for controlling the supply of compressed air or other motive fluid to the feed motor 20. A suitable air inlet connection 27 is provided on the cover member 23 and communicates with the interior or recess 28 of the valve plug through the passage 27a. An exhaust opening 29 is provided at a suitable point in the wall of the outer housing 21 for discharging the exhaust of the motor to atmosphere.

A cylinder ring 30 disposed in the outer housing 21 between the end plates 31 and 32 contains a pair of lobe-like working chambers or cylinders 33 and 34 (see Fig. 9). A rotor 35 mounted in the bearings 36 and 37 of the end plates 31 and 32 is rotatable in the cylinder ring 30 and carries a plurality of radial vanes 38 which are slidable in pockets 39 and traverse the chambers or cylinders 33 and 34 during rotation of the rotor. As shown in Fig. 9 the periphery of the rotor is in running contact with the cylinder ring at substantially diametrically opposed points or abutment sections 40 so as to separate the chambers or cylinders 33 and 34 from each other. The

torque or power developed by the feed motor 20 is delivered to the feed screw 17 through reduction gearing 42 and a flexible coupling 43. The reduction gearing 42 may include a drive pinion 43a on the inner end of the rotor, an outer ring gear 44 and one or more pinions 45 mounted in a stationary carrier 46 and meshing with the ring gear and drive pinion.

As shown in Fig. 9 the chamber 33 is provided adjacent its ends with a pair of main fluid supply ports 33a and 33b and the chamber or cylinder 34 is provided adjacent its ends with a similar pair of main fluid supply ports 34a and 34b. For forward feeding of the rock drill 10 at a low speed or power only the chamber or cylinder 33 is used, during which time motive fluid is supplied to this chamber through the main port 33a and the chamber 34 remains idle. For forward feeding of the rock drill at increased speed or power both chambers 33 and 34 are used simultaneously, during which time motive fluid is supplied to the chamber 33 through the main port 33a and to the chamber 34 through the main port 34a. During reverse feeding of the rock drill both chambers 33 and 34 are used simultaneously, at which time motive fluid is supplied thereto through the main reverse ports 33b and 34b. The main forward ports 33a and 34a in the cylinder ring 30 are connected by passages 33c and 34c in the end plate 31 with corresponding ports of the valve chamber 24, these latter ports appear in Figs. 12, 13 and 14 and are designated 33d and 34d. Since the main reverse ports 33b and 34b in the cylinder ring 30 are used simultaneously they are both connected with the port 47 of the valve chamber 24 by the common passage 48 in the end plate 31.

It is desirable in the operation of the feed motor 20 to supply pressure fluid to the vane pockets 39 to secure a proper seating of the vanes 38 against the cylinder ring 30 during travel of the vanes through the working or pressure segments of the chambers 33 and 34, and to vent or exhaust the vane pockets during their travel through the idle segments so as to reduce the expenditure of power needed to move the vanes inwardly as they approach the abutment sections 40. Fig. 8 shows the inner face of the end plate 31 as having an annular series of ports 49a, 49b and 49r therein with which the vane pockets communicate in succession for supplying pressure fluid thereto, or exhausting the pockets to atmosphere, in timed relation to the rotation of the rotor 35. The port 49a supplies pressure fluid to the vane pockets of the working sector of the chamber 33 during low speed forward feeding of the rock drill and, during forward feeding at increased speed or power, the ports 49a and 49b simultaneously supply pressure fluid to the vane pockets of the working sectors of both chambers 33 and 34. Passages 49c and 49d connect the ports 49a and 49b with corresponding ports 50 and 51 of the valve chamber 24 and a passage 49e common to both of the ports 49r connects the latter with a corresponding port 52 of the valve chamber 24. During reverse movement of the rock drill, pressure fluid is simultaneously supplied to the vane pockets of the working sectors of both chambers 33 and 34 through the two ports 49r. It will be understood also that during both forward and reverse feeding of the rock drill the vane pockets of the idle sectors of the chambers 33 and 34 are vented to atmosphere as will be presently explained in greater detail.

The fluid supply passage 27a communicates at all times with the recess 28 of the valve plug 25

so that pressure fluid will be continuously supplied thereto. As shown in the sectional views of Sheets 3 and 4 of the drawings the valve plug 25 and valve chamber 24 are provided with appropriate ports and passages by which the proper flow of motive fluid is obtained to the cylinder chambers 33 and 34 to produce the above described operation of the feed motor in accordance with the rate of feed and direction of movement desired. Figs. 10 to 14 inclusive and Figs. 15A, 15B and 15C show, by appropriate sectional views the relative arrangement and location of the ports and passages of the valve when the valve plug 25 is in the position for obtaining the relatively slow rate of forward feed which is desired during drilling in hard material or during starting of the drilling operation. At this time only one unit of the motor 20 is used to actuate the feed screw 17 or, in other words, motive fluid is supplied only to the working chamber or cylinder 33.

In Figs. 10a to 14a inclusive and Figs. 16A, 16B and 16C I show the relative positions of the ports and passages when the valve plug 25 has been shifted for obtaining a full forward feed by using both cylinder chambers 33 and 34 simultaneously. Figs. 10b to 14b inclusive and 17A, 17B and 17C show the relative arrangement of the ports and passages when the valve plug 25 is in the position to obtain reverse movement of the rock drill at maximum feeding speed or power.

Referring further to the ports and passages of the valve plug 25 and the valve chamber 24, it is pointed out that Fig. 10 shows the venting of the vane pockets of the idle sectors of the chambers 33 and 34 of the feed motor 20 to atmosphere during low speed forward feeding of the rock drill, such venting being accomplished through the arcuate groove 53 of the valve plug and the port 54 of the valve chamber. Fig. 11 shows pressure fluid being supplied through the port 55 and arcuate groove 56 of the valve plug for the vane pockets of the working sector of the single chamber or cylinder 33 being used in the slow forward feeding movement. As shown in Fig. 12 the valve plug 25 is also provided with a port 57 having an arcuately extending passage 57a of tapering depth communicating therewith. Fig. 12 shows pressure fluid being supplied through the port 57 and the passage 57a for obtaining the desired accurately controlled slow forward feeding of the rock drill when only one of the working chambers or cylinders of the feed motor is being used. The tapering depth of the arcuate passage 57a permits a sensitive and accurate control to be obtained for the slow forward feeding movement by rotating the valve plug through small distances to bring more or less of the passage 57a in register with the port 33d.

Fig. 13 shows the valve plug 25 as having a port 58 which is used for supplying motive fluid to the other chamber or cylinder of the feed motor. For the position of the valve plug as shown in Fig. 13 the port 58 is closed. Fig. 14 shows the valve plug as having a port 59 for supplying motive fluid to both chambers or cylinders of the feed motor for reverse operation thereof. Fig. 14 shows the port 59 closed.

As mentioned above, Figs. 10a to 14a and Figs. 16A, 16B and 16C show the valve plug 25 in the position corresponding with the forward feeding of the rock drill at full speed or power. Accordingly, Fig. 10a shows the arcuate passage 53 of the valve plug still in register with the port 52 for venting the idle vane pockets. Fig. 11a shows

the arcuate passage 56 of the valve plug as now being connected with both of the ports 50 and 51 for supplying pressure fluid to the vane pockets of the working sectors of both cylinder chambers 33 and 34. Figs. 12a, 13a and 16B show the ports 57 and 58 of the valve plug 25 in register with the passages 33d and 34d respectively, for supplying pressure fluid to both of the chambers or cylinders 33 and 34. Since the feed motor is now operating in a forward direction, Fig. 14a shows the reverse port 59 of the valve plug as being out of register with the port 47.

As above mentioned, Figs. 10b to 14b, inclusive, and Figs. 17A, 17B and 17C, show the position of the valve plug 25 when the feed motor 20 is operating in reverse and, accordingly, Figs. 10b and 17b show pressure fluid being supplied through the port 60 and the passages 52 and 49e to the vane pockets of the working sectors of both of the chambers or cylinders 33 and 34. Fig. 11b shows the idle vane pockets of both chambers or cylinders 33 and 34 being vented to atmosphere through the arcuate passage 61 of the valve plug 25 and the port 62 of the valve chamber 24. Since the feed motor is now operating in a reverse direction, the ports 57 and 58 for forward operation, are shown closed in Figs. 12b and 13b. Figs. 14b and 17C show the port 59 of the valve plug 25 in register with the port 47, for supplying motive fluid to both of the chambers or cylinders 33 and 34.

During the operation of the feed motor 20 the expanded motive fluid is exhausted from the cylinder chambers 33 and 34 through exhaust openings 65 which extend through the cylinder ring 30. These exhaust openings communicate with an annular exhaust space 66 extending between the cylinder ring 30 and outer housing 24 and which annular space communicates with atmosphere through the exhaust opening 29.

The series of views 15A, 16A and 17A are all taken on the plane of the section line A—A Fig. 10, but show the valve plug in the three principal operative positions of the latter, the position of 15A being that for admitting pressure fluid to one motor chamber 33 for driving the feed screw forward at low speed or power, that of 16A for admitting pressure fluid to both chambers of the motor for forward feed at high speed or power, and that of 17A for admitting pressure fluid to both chambers through the reverse intake ports thereof for driving the feed screw reversely at high speed or power. In addition to the principal positions of the valve there are intermediate positions for throttling the admission of pressure fluid more or less, particularly for regulating the flow of pressure fluid through the graduated passage 57a.

Similarly the series of views 15B, 16B and 17B are all taken approximately upon the plane indicated by the line B—B of Fig. 10 but with the valve in the three main operative positions to cause forward travel at low or high speed or reverse travel, and Figs. 15C, 16C and 17C are taken on the plane indicated by the line C—C of Fig. 10 with the valve in its three principal positions.

It will be noted therefore that the three views in each horizontal set, 15A, 15B and 15C for example, represent three different sections through the valve and its casing with the valve plug in a single position, while each vertical set of views, 15A, 16A and 17A for example, represent the same section through the valve casing but with the valve plug in its three different principal positions.

From the foregoing description and accompanying drawings it will now be readily seen that I have provided novel means for controlling the feed of pressure fluid to the feed motor of a power tool of the rock drill type by which either a slow speed accurately controlled forward movement of the drill or a relatively rapid forward movement, can be obtained as desired. Likewise, the feeding of the drill in the reverse direction can be obtained at a desired rapid rate for quickly moving the rock drill away from the work or with considerable power for withdrawing the steel from a tight hole. It will also be seen that the desired variation in the speed or power with which the feeding movement of the drill is carried out is obtained by using either a single unit or cylinder or a plurality of units or cylinders of the feed motor. Furthermore, the control of the feed motor so as to utilize either a single unit or cylinder or a plurality of units or cylinders can be very easily effected by a simple manipulation of a single control valve.

While I have illustrated and described my improved mechanism in considerable detail it will be understood of course that I do not wish to be limited to the particular details and arrangements herein disclosed, but regard my invention as including all changes and modifications which come within the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. In a fluid pressure motor for rock drill feeding mechanism having a plurality of actuating units, a pressure fluid supply conductor, a forward intake passage for each of said units, a reverse intake passage for at least one of said units, valve means comprising a single rotary plug having an angular position in which one of said forward intake passages only is connected with said supply conductor, a second position in which both of said forward intake passages are connected with said supply conductor, and a third position in which said reverse intake passage is connected with said supply conductor.

2. Mechanism as defined in claim 1, wherein said valve means comprises means for throttling down the connection between said supply conductor and said first named forward intake passage.

3. In a rotary vane type fluid pressure motor for rock drill feeding mechanism having two working chambers each of which has an intake port and an exhaust port, a rotor provided with vanes and vane pockets, a pressure fluid supply conductor, an end plate against which said rotor bears, said end plate having two angularly spaced recesses with which each of said pockets communicates consecutively as the rotors turns, valve means comprising a single rotary plug for controlling the flow of motive fluid from said supply conductor either to one of said intake ports or to both of said intake ports simultaneously, said valve means also controlling the flow of motive fluid to one of said recesses or to both of said recesses simultaneously.

4. In a rotary vane type fluid pressure motor for rock drill feeding mechanism having a working chamber provided with a centrally disposed exhaust port and a pair of intake ports disposed respectively on opposite sides of said exhaust port, a rotor provided with vanes and vane pockets, a pressure fluid supply conductor, an end plate

against which said rotor bears, said end plate having two angularly spaced recesses with which each of said pockets communicates consecutively as the rotor turns, valve means comprising a single rotary plug for controlling the flow of motive fluid from said supply conductor to either one of said intake ports and for simultaneously controlling the flow of motive fluid to one of said recesses, and for controlling the flow of exhaust from the other of said recesses.

5. In a rotary vane type fluid pressure motor for rock drill feeding mechanism having two working chambers each of which has an intake port and an exhaust port, a rotor provided with vanes and vane pockets, a pressure fluid supply conductor, an end plate against which said rotor bears, said plate having four angularly spaced recesses with which each of said pockets communicates consecutively as the rotor turns, valve means comprising a single rotary plug for controlling the flow of motive fluid from said supply conductor either to one of said intake ports or to both of said intake ports simultaneously, said valve means also controlling the flow of motive fluid to one of said recesses or to two opposed recesses simultaneously, and at the same time opening the two remaining recesses to exhaust.

6. In a rotary vane type fluid pressure motor for rock drill feeding mechanism having two working chambers each of which is provided with a centrally disposed exhaust port and a pair of intake ports disposed respectively on opposite sides of said exhaust port, a rotor provided with vanes and vane pockets, a pressure fluid supply conductor, an end plate against which said rotor bears, said plate having four angularly spaced recesses with which each of said pockets communicates consecutively as the rotor turns, valve means comprising a single rotary plug for controlling the flow of motive fluid from said supply conductor either to one of the intake ports of one working chamber or to that port and the corresponding port of the other chamber for single or double motor actuation in the forward direction, or alternatively for directing flow of motive fluid to the other intake ports of both chambers for actuation of the motor in reverse direction, said valve means also controlling the flow of motive fluid to one of said recesses during single forward actuation, to that recess and the diametrically opposed recess during double forward actuation of the motor, and for directing motive fluid to the two remaining recesses during reverse actuation of the motor.

7. Mechanism as defined in claim 6, wherein said single valve plug also connects with exhaust the recesses which communicate with the pockets behind vanes which are idle.

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