

Sept. 17, 1946.

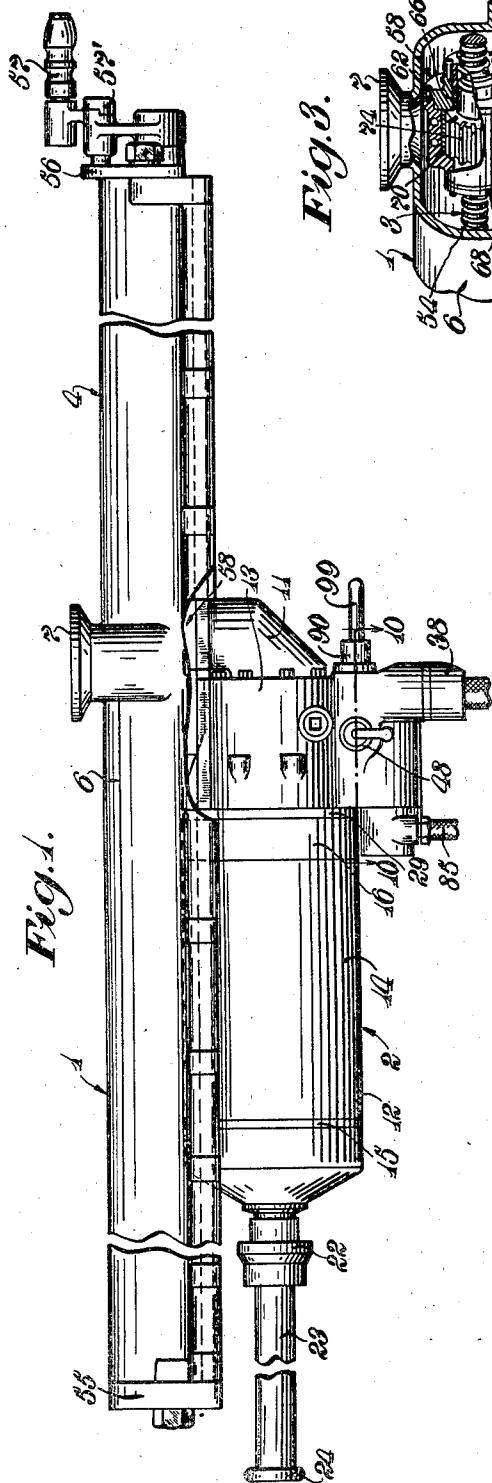
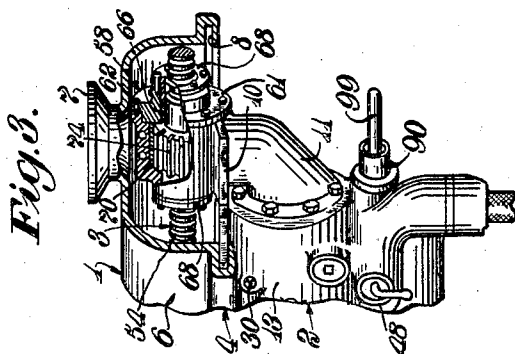
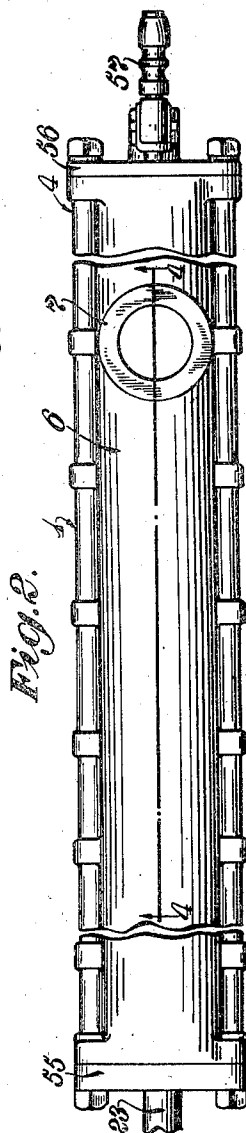
W. W. PAGET

2,407,679

DRILLING APPARATUS

Filed Dec. 21, 1942

3 Sheets-Sheet 1



Inventor:
Win W. Paget.
by
Luis A. Maxson
Atty.

Sept. 17, 1946.

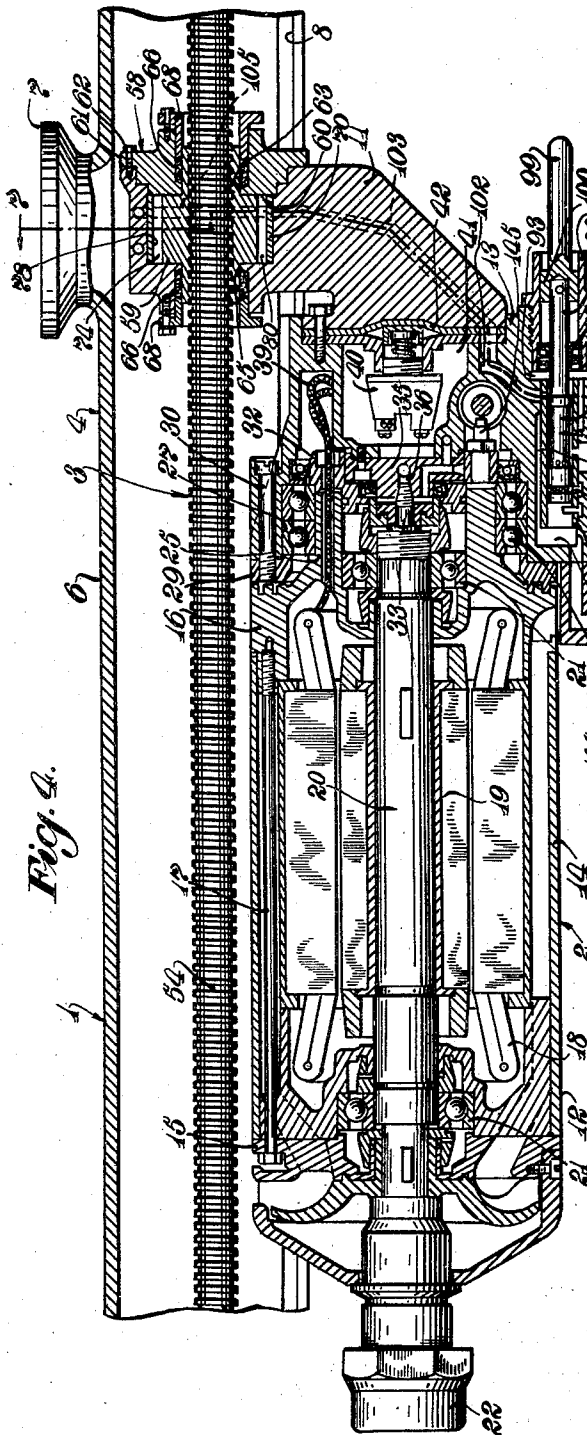
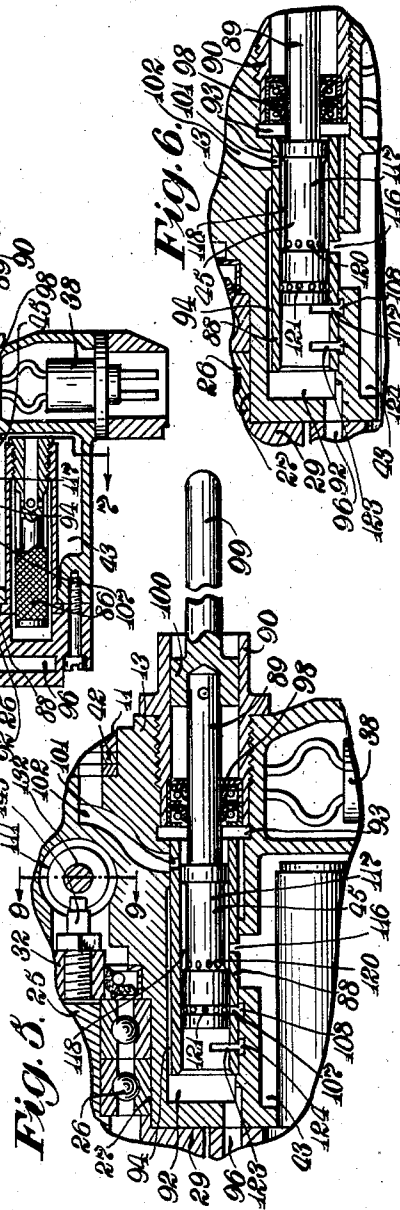
W. W. PAGET

2,407,679

DRILLING APPARATUS

Filed Dec. 21, 1942

3 Sheets-Sheet 2



Inventor:
Win W. Paget.
by *Ami A. Maxson.*
Att'y.

Sept. 17, 1946.

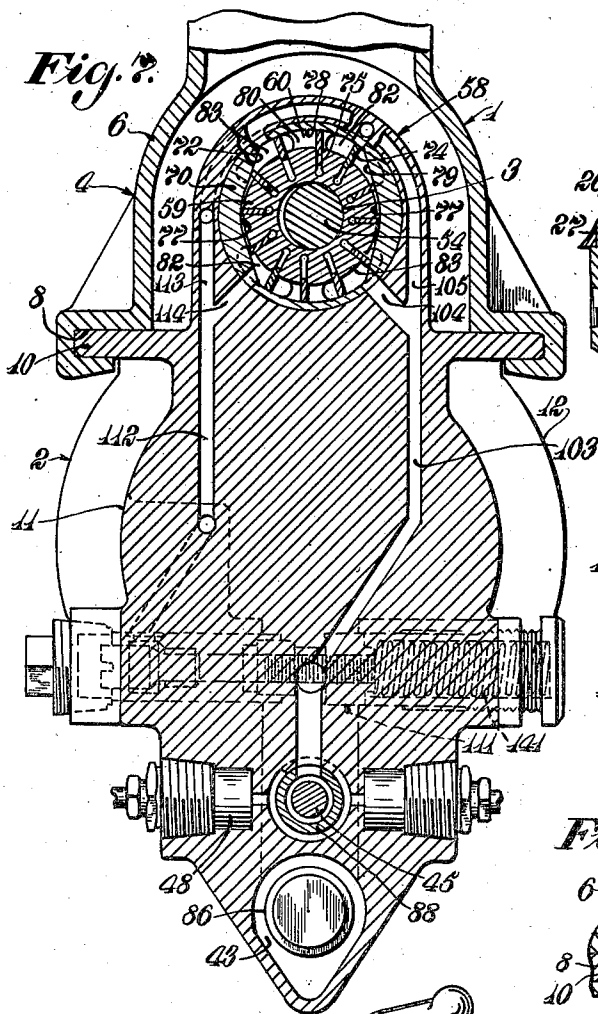
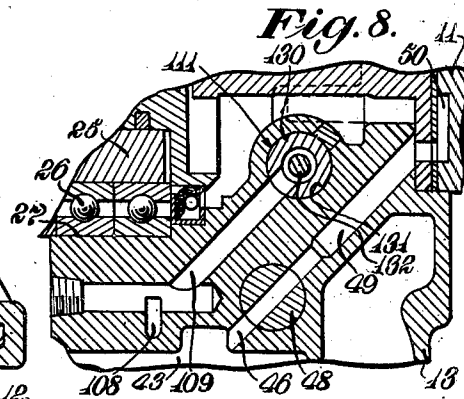
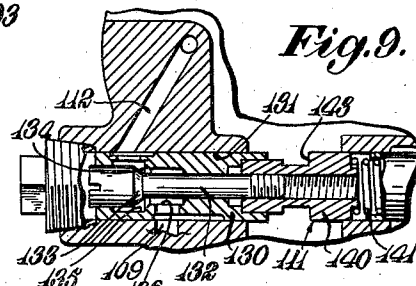
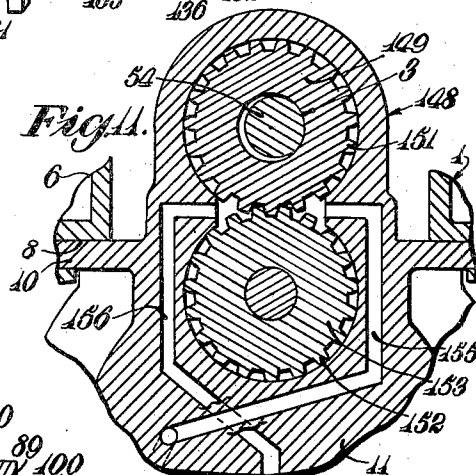
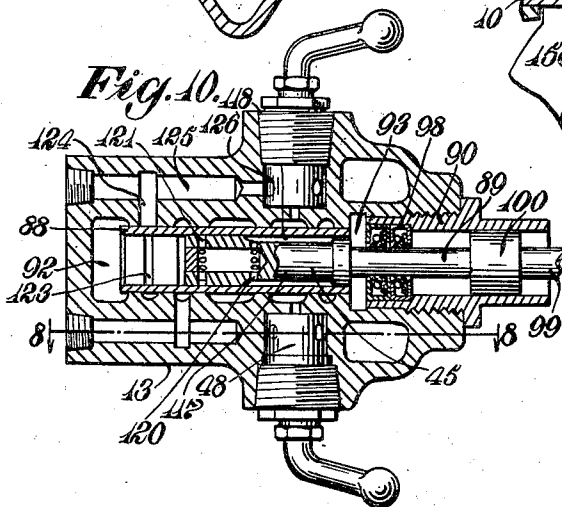
W. W. PAGET

2,407,679

DRILLING APPARATUS

Filed Dec. 21, 1942

3 Sheets-Sheet 3



Inventor:
Win W. Paget
by
Louis A. Maxcom
Att'y.

UNITED STATES PATENT OFFICE

2,407,679

DRILLING APPARATUS

Win W. Paget, Michigan City, Ind., assignor to
Joy Manufacturing Company, a corporation of
Pennsylvania

Application December 21, 1942, Serial No. 469,646

6 Claims. (Cl. 255—45)

1

This invention relates to drilling apparatus, and more particularly to feeding means for a drilling apparatus of the rotary type.

It is an object of this invention to provide an improved drilling apparatus. It is another object to provide improved means for feeding a drilling apparatus. Still another object is to provide an improved fluid actuated feeding device for a drilling apparatus of the rotary type, said feeding device having means associated therewith for controlling the rate of feed of said drilling apparatus in accordance with the resistance to rotation of the drill bit. Another object is to provide improved feeding means for a drilling apparatus, said feeding means including a fluid actuated motor of the rotary type having its rotor in threaded engagement with a feed screw. Still another object is to provide a fluid actuated motor of the rotary type supported for bodily movement with a drilling apparatus and having its rotor in threaded engagement with a feed screw whereby a feeding of the drilling apparatus is obtained on relative movement between said rotor and said feed screw. Other objects and advantages will appear in the course of the following description.

In the accompanying drawings, in which, for purposes of illustration, a drilling apparatus in which the illustrative embodiment of my invention is embodied is disclosed, together with a modification thereof:

Fig. 1 is a side elevational view of a drilling apparatus having my invention incorporated therein.

Fig. 2 is a plan view of the drilling apparatus shown in Fig. 1.

Fig. 3 is a perspective view of a portion of the drilling apparatus with parts broken away to show the improved feeding means.

Fig. 4 is an enlarged vertical sectional view taken on the plane of the line 4—4 of Fig. 2.

Fig. 5 is an enlarged fragmentary sectional view taken in the plane of Fig. 4 and showing the feed control valve in its forward feeding position.

Fig. 6 is a view similar to Fig. 5 but showing the feed control valve in its reverse feeding position.

Fig. 7 is an enlarged cross sectional view taken substantially on the planes of the line 7—7 of Fig. 4.

Fig. 8 is a fragmentary sectional view taken on the line 8—8 of Fig. 10.

Fig. 9 is a vertical sectional view taken on line

2

9—9 of Fig. 5, illustrating the torque-controlled valve means.

Fig. 10 is an enlarged horizontal sectional view taken on the line 10—10 of Fig. 1.

Fig. 11 is a fragmentary cross sectional view illustrating a modification of the feeding means.

In the accompanying drawings there is shown a drilling apparatus, generally designated 1, comprising bit rotating means, generally designated 2, feeding means, generally designated 3, and supporting and guiding means, generally designated 4.

The supporting and guiding means comprises an elongated troughlike guide member 6 open at its lower side and having a swivel plate 7 at its upper side adapted to be secured in the saddle mounting of a conventional rock drill support. Formed along the sides of the guide member, as shown in Fig. 7, are guideways 8 slidably receiving flanges 10 formed on a rear head member 11 of the bit rotating means 2 for supporting and guiding the latter for movement relative to the work.

The bit rotating means 2 includes a rotating motor 12 carried by a control head 13 attached, as by screws, to the rear head member 11. The motor is herein of the high speed electric type and includes a casing 14 provided with front and rear heads 15 and 16 held in assembled relation with respect to the casing by usual tie bolts 17. The motor is provided with field windings 18 and an armature rotor 19, the latter having a shaft 20 which is journaled in bearings 21, 21 suitably supported in the motor heads. Attached to the forward end of the shaft 20 is a chuck 22 for receiving the shank of a hollow drill rod 23 carrying a drill bit 24. The rear motor head has a cylindric projection 25 mounted for limited rotation in ball bearings 26 supported within a bore 27 formed in the control head 13. The bearings 26 are retained in the bore 27 by a retaining ring 29 secured, as by screws 30, to the control head; and the cylindric projection is held against axial displacement with respect to its bearings by an end plate 32 secured, as by screws, to the projection 25. Extending through a bore in the shaft 20 is a liquid conducting tube 33 which is threaded at its rear end within a member 35 secured to the control head 13, and cleansing liquid is supplied through a passage 36 in the member 35 to the tube 33 where it is conducted to the hollow drill rod and through the latter to the drill hole. Electric energy may be conducted to the motor 12 from any convenient source through a conventional connector plug

38 mounted on the control head 13 and connected through wiring 39 to the motor, and a switch 40 is provided for effecting starting and stopping of the motor, this switch being arranged in a chamber 41 formed in the control head, as shown in Fig. 4.

The switch 40 is adapted to be actuated to its closed position by a diaphragm 42 to which liquid may be supplied at a pressure from a chamber 43 under the control of a manually actuated valve 45. Liquid is also supplied from the chamber 43, Fig. 8, to a passage 46 communicating, under the control of a manually operated valve 48, with a passage 49 opening into a groove 50 in the head member 11. The groove 50 communicates with the passage 36 leading to the liquid conducting tube 33 in the motor power shaft. It will be seen that in the absence of liquid in the chamber 43 at the proper pressure, the motor switch 40 will be opened so that drilling will not take place without an adequate supply of cleansing liquid to the drill hole. The drill motor and its control means are similar to that disclosed in my copending application, Serial No. 268,792, now Patent No. 2,288,541, granted June 30, 1945, and further description of the same herein is accordingly unnecessary.

Referring to the drill feeding means, it will be noted that there is provided a feed screw 54 extending longitudinally through the troughlike guide member 6 in parallelism with the guideways 2, and the feed screw is journaled at its front and rear ends in plates 55 and 56 attached, as by screws, to the ends of the guide member. Fixed to the rear end of the feed screw is an operating handle 57 whereby the feed screw may be manually rotated to effect feed of the drilling apparatus. Connected to the operating handle 57 is a locking plunger 57' adapted to fit openings in the end plate 56 for locking the feed screw against rotation. Associated with the feed screw is a hydraulic feed motor, generally designated 58, and having a rotor 59 threadedly engaging the feed screw and rotatably mounted as later described. There is a chamber 60 formed within the head member 11 and opening through one wall thereof. A cover plate 61 attached to the head member 11, as by screws 62, closes the open end of the chamber 60, and has a bore 63 providing a bearing for a reduced end of the rotor 59. A bore 65 in the head member 11 provides a bearing for the other end of the rotor, this end also being reduced. Surrounding the reduced ends of the rotor are packings 66 held in fluid tight engagement with the ends by sleeve shaped members 68 attached to the head member 11 and the cover plate 61, to prevent the escape of liquid from the chamber 60.

Arranged within the chamber 60 is a ring shaped member 70 surrounding the rotor 59 and having an inner peripheral surface 72 which is engaged by the outer radial ends of vanes 74 slidably mounted in slots 75 formed in the rotor and extending longitudinally of the latter. The surface 72 is shaped so as to provide two diametrically positioned arcs 77 (Fig. 7) close to the outer periphery of the rotor and substantially concentric with the latter. The arcs 77 extend in a circumferential direction for a distance equal at least to the angular distance between a pair of adjacent vanes so as to provide a continuous seal preventing the flow of operating fluid between the rotor and the ring 70 along the arcs. The surface 72 on the ring also has two diametrically positioned arcs 78 spaced from the outer

periphery of the rotor and joined by surfaces 79 to the ends of the arcs 77 to provide working chambers 80. Formed in the head member 11 and the cover plate 61 at the ends of the chamber 60 are arcuate grooves 82, 82 and 83, 83 opening into the ends of the working chambers 80, as shown in Fig. 7. When operating pressure fluid is supplied to the working chambers through the grooves 82, 82 and is vented from the working chambers through the grooves 83, 83, the fluid acts on the vanes 74 to turn the rotor in a counter-clockwise direction, as viewed in Fig. 7, and effect a forward feed of the drilling apparatus. When the grooves 82, 82 are connected to exhaust and fluid is supplied under pressure to the working chambers through the grooves 83, 83, the rotor is caused to turn in a clockwise direction and effect a rearward feed of the drilling apparatus. The adjacent ends of the grooves 82, 83 within each of the working chambers are spaced apart a distance equal at least to the angular distance between a pair of adjacent vanes so as to prevent a free passage between the inlet and exhaust through which operating fluid might pass through the motor without performing its working function. Any suitable means, such as appropriately arranged and controlled passage means in the rotor, may be provided for supplying operating fluid from the working chambers to the grooves 75 at the inner ends of the vanes 74 so that the fluid may act on the vanes for holding the latter against the surface 72 on the ring 70, or any other suitable means for maintaining the desired projection of the vanes may be used. Such devices, being well known in the art, need no illustration here.

Operating fluid for the feed motor is supplied from a connection 85 (Fig. 1) to the chamber 43 through a strainer 86, and this fluid is delivered to the feed motor under the control of the valve 45. The valve 45 slidably fits a valve bushing 88 arranged within the control head and is provided with a stem 89 projecting rearwardly through a sleeve shaped member 90 threaded into an opening in the control head. At the front and rear ends of the valve bushing are chambers 92 and 93 connected together by a groove 94 and communicating with exhaust through a passage 96. Sealing rings 98 are supported within the sleeve member 90 and sealingly engage the valve stem 89 for preventing the escape of operating fluid from the chamber 93 rearwardly along the valve stem. The rear end of the valve stem is secured to an operating handle 99 having an enlarged portion 100 slidably fitting within the sleeve member 90 whereby the valve 45 may be adjusted to any of its positions within the valve bushing.

Opening through the valve bushing near the rear end of the latter is a port 101 communicating with a passage 102 in the control head. The passage 102 opens into a passage 103 extending through the head member 11 to forked passages 104 and 105 (Fig. 7) opening into the grooves 83. Near the forward end of the valve bushing is a port 107 for supplying operating fluid from the interior of the valve bushing to a groove 108 which opens, as shown in Fig. 8, into a forward feed passage 109. Fluid supplied to the passage 109 is conducted under the control of a torque-controlled valve, generally designated 111, to a passage 112 opening, as shown in Fig. 7 into branch passages 113 and 114 leading to the arcuate grooves 82 of the feed motor. Formed in

5

the valve bushing between the ports 101 and 107 is a port 116 connecting the supply chamber 43 to the interior of the bushing. The valve 45 is provided with a reduced portion 117 between its ends so as to form an annular space 118 between the inner surface of the valve bushing and the reduced portion of the valve through which fluid may pass from the port 116 to the port 101 when the valve is in its most rearward position, as shown in Fig. 6. Formed in the valve 45 are radial ports 120 and 121 opening into a chamber within the valve for connecting the ports 116 and 107 in the valve bushing in communication with each other when the valve is in the position shown in Fig. 5. Opening through the valve bushing in advance of the port 107 is a port 123 communicating with a groove 124 for supplying pressure fluid, as shown in Fig. 10, to a passage 125 communicating past a manually controlled valve 126 with a passage leading to the diaphragm 42 for the motor switch 40. When the valve 45 is in its most forward position pressure fluid is supplied from the chamber 43 through the annular space 118 surrounding the valve 45 to the port 107, and is also supplied through the space 118, the ports 120, the chamber within the valve and the ports 121 to the port 123 in the valve bushing.

The torque-controlled valve 111 comprises, as shown in Fig. 9, a valve sleeve 130 arranged within a transverse bore 131 in the control head. Extending through the valve sleeve is a valve member 132 having a valve portion 133 cooperating with a valve seat 134 at the junction of stepped bores 135 and 136 formed within the valve sleeve for controlling the flow of operating fluid from the forward feed passage 109 to the passage 112. The valve member 132 is threaded into a sleeve shaped member 140, and a spring 141 acts against the member 140 for urging the valve portion 133 away from the valve seat 134. Formed in the sleeve shaped member 140 is an annular groove 143 for receiving a pin 145, Fig. 4, fixed to the plate 32 at the rear end of the drill motor. During the operation of the drill motor, the motor casing tends to rotate in a direction opposite to the direction of rotation of the rotor. Since the rear motor head 16 is connected rigidly to the motor casing and the plate 32 is connected to the rear motor head, there is a tendency to move the pin 145 in a direction to force the valve member 132 toward its closed position against the action of spring 141 during operation of the drill motor. Spring 141 is designed to hold the motor casing against rotation when the resistance to rotation of the drill bit is below a predetermined value. If the resistance to rotation of the drill bit exceeds the predetermined value, the valve member 132 is moved toward its closed position for reducing or cutting off the flow of operating fluid through the forward feed passages to the feed motor 58.

The operation of the mechanism described above is as follows. To effect a feeding of the drilling apparatus toward the work by means of the feed motor 58, the operator grasps the handle 99 for the valve 45 and moves the latter to the position shown in Fig. 5. Operating fluid then flows from the supply chamber 43 through the port 116 in the valve bushing and the ports 120, 121 in the valve 45 to the port 107 opening into the groove 108. Then fluid is conducted through the groove 108 to the forward feed passage 109 where it is conducted past the torque-controlled valve 111 to the passage 112 leading to the branch

6

passages 113, 114 opening into the arcuate grooves 82. The operating fluid passes from the grooves 82 into the spaces between the vanes carried by the rotor and acts against the vanes to turn the rotor in a direction to effect feed of the drilling apparatus in a forward direction along the feed screw. As the vanes pass over the arcuate grooves 83, 83, the fluid is discharged from the spaces between the vanes through the grooves 83 to the branch passages 104, 105 where it is conducted to the passages 103 and 102 leading to the space 93 at the rear end of the valve 45. The fluid is discharged from the space 93 through the groove 94 and the space 92 at the forward end of the valve bushing to the exhaust passage 96. When the drill bit has been moved into engagement with the work, the operator then moves the valve 45 into its extreme forward position so that operating fluid may be delivered from the supply chamber 43 through the ports 120, 121 in the valve to the groove 124 where it enters the passages 125 and is conducted under the control of the manually operated valve 126 to the diaphragm 42 closing the switch 40 and starting the drill motor. At the same time, fluid is delivered from the chamber 43 through the annular space 118 surrounding the valve 45 to the groove 108 where it is delivered to the forward feed passages for effecting the forward feed of the drilling apparatus during drilling.

As long as the resistance to the rotation of the drill bit does not exceed a predetermined value, the torque-controlled valve will remain open so that operating fluid may flow to the feed motor for operating the latter to effect feeding of the drilling apparatus in a forward direction. When the resistance to rotation of the drill bit exceeds a predetermined value, the motor casing turns and causes the pin 145 to force the torque-controlled valve toward its closed position against the action of the spring 141 thereby reducing or completely cutting off the flow of operating fluid to the feed motor 58.

If it is desired to feed the drilling apparatus in a rearward direction the operator grasps the operating handle 99 and moves the valve 45 into the position shown in Fig. 6. At this time operating fluid is delivered from the supply chamber 43 through the annular space 118 surrounding the valve to the reverse feed passages 102 and 103 communicating with the arcuate grooves 83 of the feed motor through branch passages 104 and 105. The fluid entering the feed motor through the grooves 83 acts on the vanes 74 for rotating the rotor of the feed motor in a direction to effect a reverse feed of the drilling apparatus along the feed screw. As the vanes pass over the arcuate grooves 82, the fluid is discharged from the feed motor to the branch passages 113, 114 where it is conducted through the passage 112 past the torque-controlled valve to the passage 109 and through the groove 108 and the port 107 in the valve bushing to the space 92 where it is discharged to the exhaust passage 96.

The feeding of the drilling apparatus either in a forward or rearward direction may be controlled by rotating the feed screw manually through the operating handle 57 connected to the rear end of the feed screw while operating fluid is being supplied to the feed motor. By rotating the feed screw in the direction in which the rotor of the feed motor is turning, the rate of feed of the drilling apparatus may be reduced, and an increased rate of feed is theoretically obtained by rotating the feed screw in a direction opposite to

7

that of the rotor though, as a practical matter, the rate of feed will be likely to be as high already as is practicable.

In a modification of the invention shown in Fig. 11, a feed motor, generally designated 148, is provided with a rotor 149 threadedly engaging the feed screw 54 and having teeth 151 around its periphery meshing with teeth 152 around the periphery of a rotor 153 supported on the head member 11 for rotation on an axis parallel to the axis of the feed screw. Passages 155 and 156 are provided in the head member 11 for supplying and discharging operating fluid relative to the rotors at opposite sides of their meshing portions, the passages being connected selectively to supply and exhaust under the control of the valve 45, as in the preferred form of the invention. When operating fluid is supplied to the rotors through the passage 155, the rotor 149 is caused to rotate in a counter-clockwise direction, as viewed in Fig. 11, and effect a forward feeding of the drilling apparatus. As the rotors turn on their axes, fluid supplied from the passage 155 is carried in the spaces between the teeth of the rotors to the passage 156 which will be connected to exhaust. By supplying operating fluid to the feed motor through the passage 156 and discharging the fluid from the motor through the passage 155, the rotor 149 is caused to rotate in a direction to effect a rearward feeding of the drilling apparatus. The supply of liquid under pressure to the passage 155 is regulated by a torque-controlled valve as in the preferred form of the invention. By adjusting the valve 45 to trap liquid in both the supply and discharge spaces of the motor, the rotor will be locked against rotation in either direction.

As a result of this invention it will be noted that improved feeding means for a drilling apparatus have been provided. The connection of the rotor of the feed motor in threaded engagement with the feed screw makes a very compact arrangement that is particularly adapted for feeding the drilling apparatus relative to the work. Other advantages of the invention will be apparent to those skilled in the art.

While there are in this application specifically described one form and a modification thereof which the invention may assume in practice, it will be understood that this form and modification of the same are shown for purposes of illustration and that the invention may be further 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 drilling apparatus, a drilling motor of the rotary type, means for supporting and guiding said drilling motor for movement relative to its work, and means for feeding said drilling motor along said supporting and guiding means, said feeding means including a feed screw extending longitudinally of said supporting and guiding means, a fluid actuated feeding motor fixed with respect to said drilling motor as regards relative longitudinal movement and having a rotatable member directly subjected to the action of an operating fluid and threadedly engaging said feed screw, means for supplying operating fluid to said feeding motor, and means responsive to the torque load on said drilling motor for controlling the supply of operating fluid to said feeding motor.

2. In a drilling apparatus, a drilling motor of the rotary type, means for supporting and guid-

8

ing said drilling motor for movement relative to its work, and means for feeding said drilling motor along said supporting and guiding means, said feeding means including a hydraulic feeding motor having a rotor to which an operating liquid is supplied under pressure, a feed element extending axially through said rotor and operatively engaging the latter, means for supplying an operating liquid to said feeding motor, and means responsive to the torque load on said drilling motor for controlling the supply of liquid to said feeding motor.

3. In a drilling apparatus, a drilling motor of the rotary type, means for supporting and guiding said drilling motor for movement relative to its work, and means for feeding said drilling motor along said supporting and guiding means, said feeding means including a feeding motor movable bodily with said drilling motor and having a fluid actuated rotor, a feed screw extending axially through said rotor and in threaded engagement with the latter, means for rotating said feed screw to regulate the feeding of said drilling motor during the operation of said feeding motor, means for supplying operating fluid to said feeding motor, and means responsive to the torque load on said drilling motor for controlling the supply of fluid to said feeding motor.

4. In a drilling apparatus, the combination comprising a drilling motor for rotating a drill bit, means for supporting and guiding said drilling motor for movement relative to its work, means for feeding said drilling motor along said supporting and guiding means, said feeding means including a fluid actuated motor having a rotor subjected directly to the action of an operating fluid, a rotatable feed element extending axially through said rotor and operatively engaging the latter, said rotor and said feed element operating to effect feeding of said drilling motor on relative rotation therebetween, means for controlling the rotation of said feed element, and means responsive to the torque loads on said drilling motor for controlling the supply of operating fluid to said feeding motor.

5. In a drilling apparatus, the combination comprising a drilling motor for rotating a drill bit, means for supporting and guiding said drilling motor for movement relative to its work, means for feeding said drilling motor along said supporting and guiding means, said feeding means including a hydraulic motor having a rotor subjected directly to the action of an operating liquid, a feed screw rotatably supported by said supporting and guiding means and extending axially through said rotor and in threaded engagement with the latter, manually operated means for rotating said feed screw, and means responsive to the torque loads on said drilling motor for controlling the supply of operating liquid to said feeding motor, said last mentioned means operative at a predetermined maximum load for cutting off the supply of operating liquid to said feeding motor.

6. In a drilling apparatus, the combination comprising a drilling motor for rotating a drill bit, said motor including an element which provides the reaction necessary for the rotation of said drill bit, a motor support on which said motor element is mounted for limited rotation relative to said support and is normally held against said relative rotation but is adapted when said motor is overloaded to move relative to said support, feeding means for effecting feed of a drill bit rotated by said drilling motor, said feeding

9

means including a fluid actuated feeding motor having a rotor subjected directly to the action of an operating fluid, a feed screw extending axially through said rotor and in threaded engagement with the latter, and means responsive to the loads on said drilling motor for controlling

10

the supply of operating fluid to said fluid actuated feeding motor, said last mentioned means being actuated by said motor element upon rotation thereof relative to said motor support.

WIN W. PAGET.