

April 3, 1951

H. H. VANDERZEE
DRILLING APPARATUS

2,547,609

Filed June 9, 1945

5 Sheets-Sheet 1

Fig. 1.

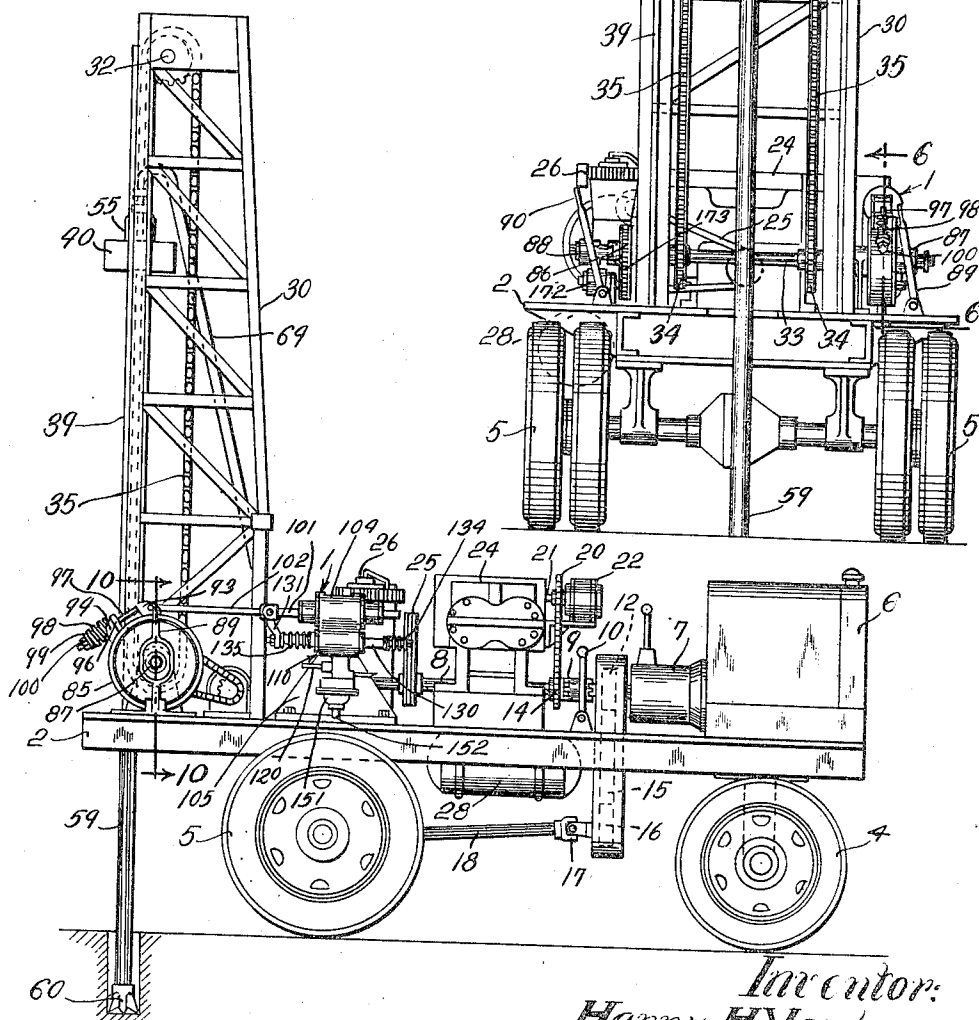
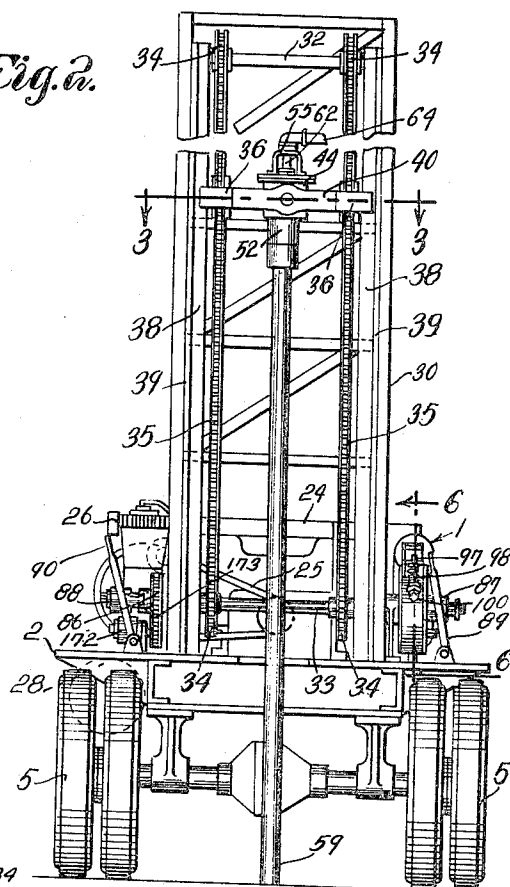


Fig. 2.



Inventor:
Harry H. Vanderzee.
by *Chas. A. Maxson,*
Att'y.

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H. H. VANDERZEE

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Fig. 3.

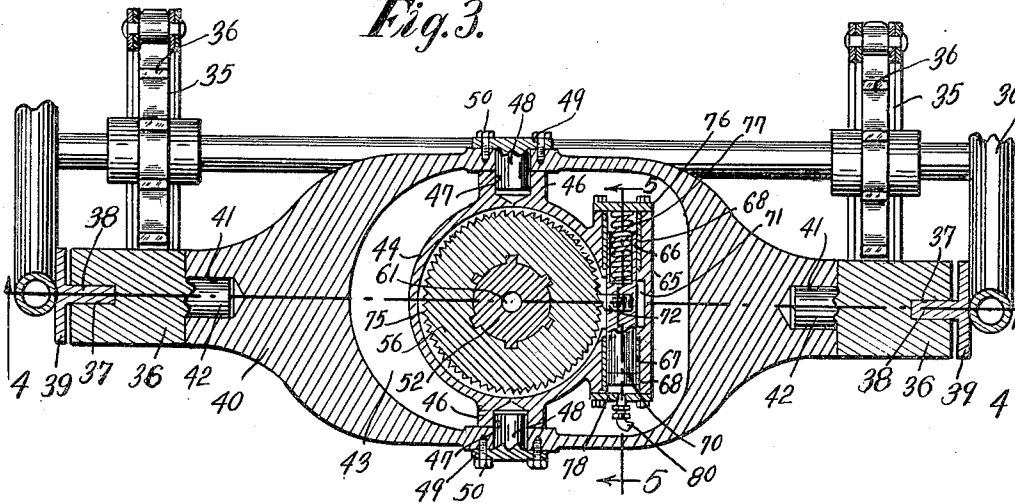


Fig. 4.

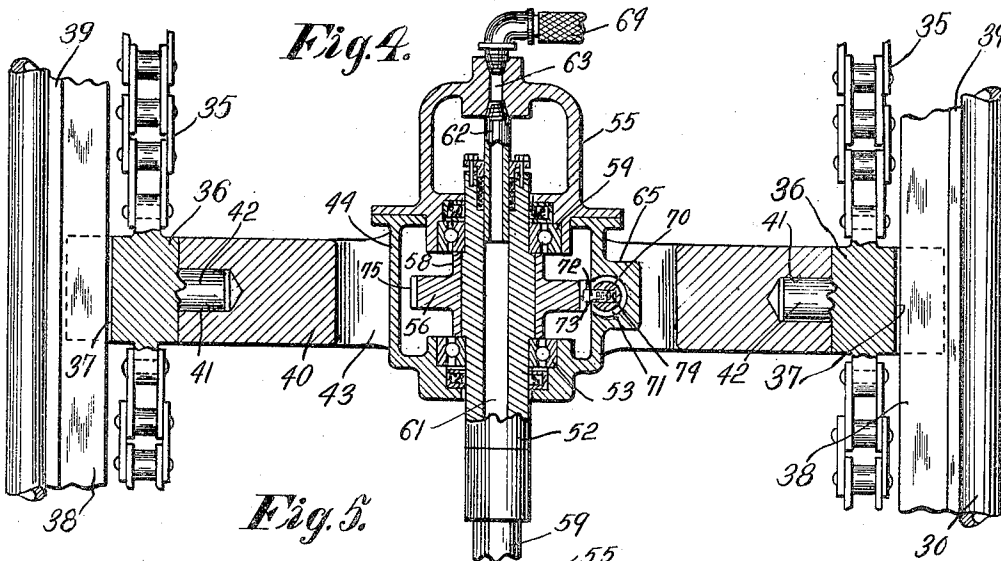
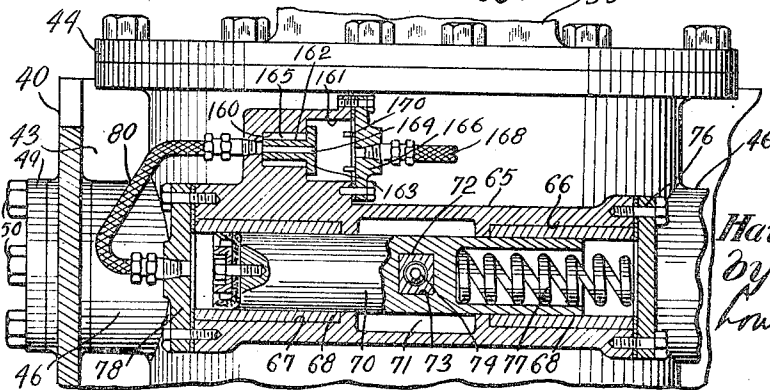


Fig. 5.



Inventor:
Harry H. Vanderzee.
by
Louis A. Maxm.
Atty.

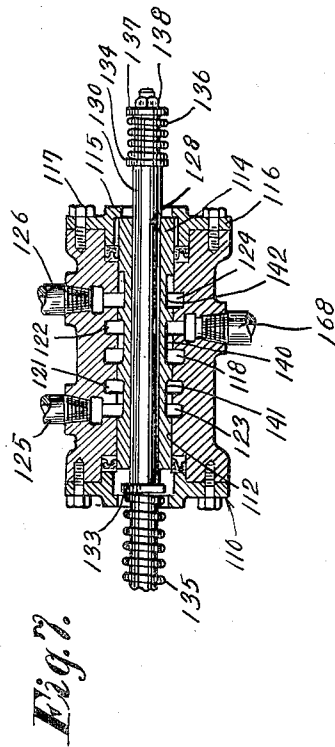
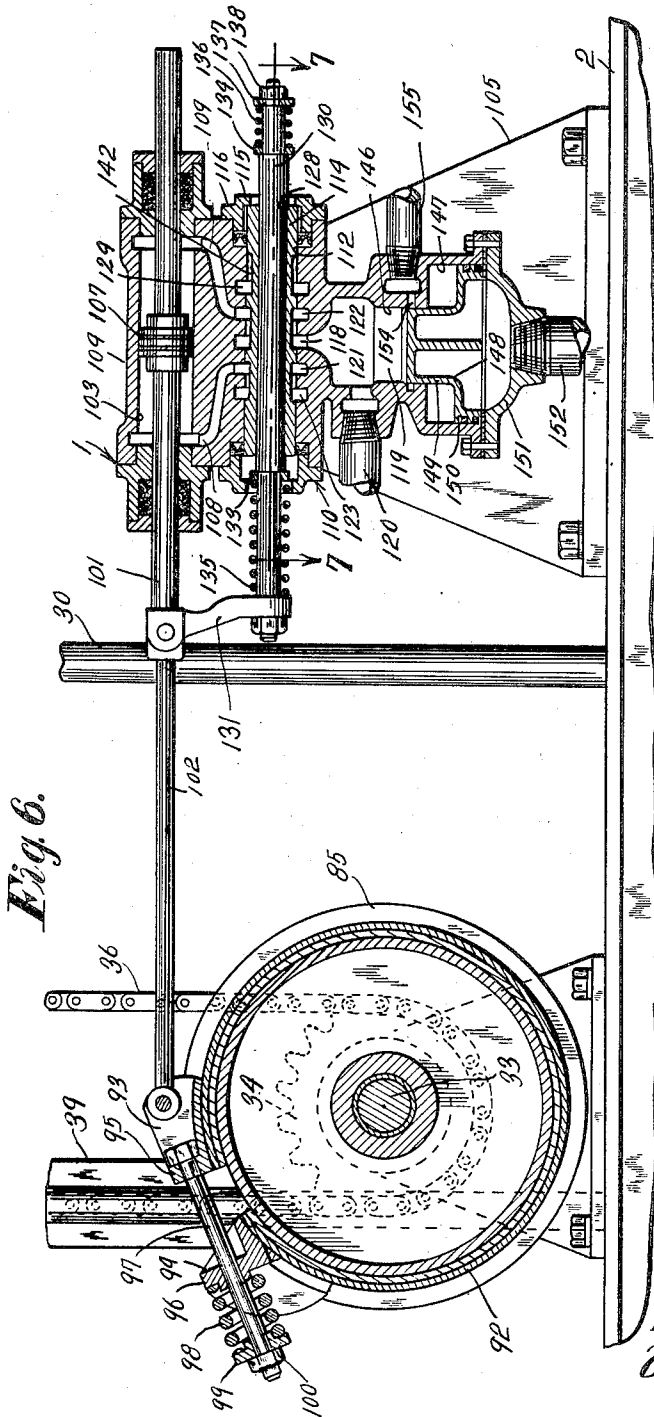
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5 Sheets-Sheet 3



Inventor:
Harry H. Vanderzee.
by Louis A. Maxson,
Att'y.

April 3, 1951

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DRILLING APPARATUS

2,547,609

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Fig. 8.

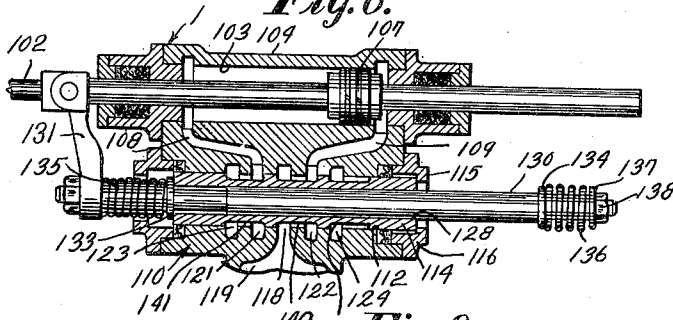


Fig. 9.

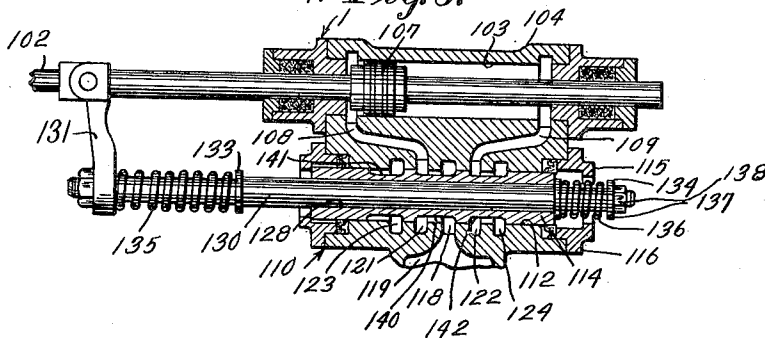
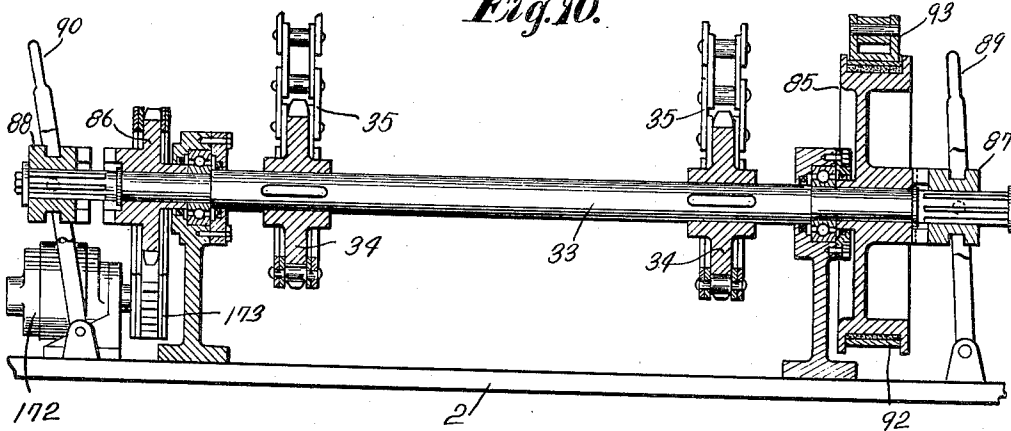


Fig. 10.



Inventor:
Harry H. Vanderzee.
by Louis B. Maxson,
Atty.

April 3, 1951

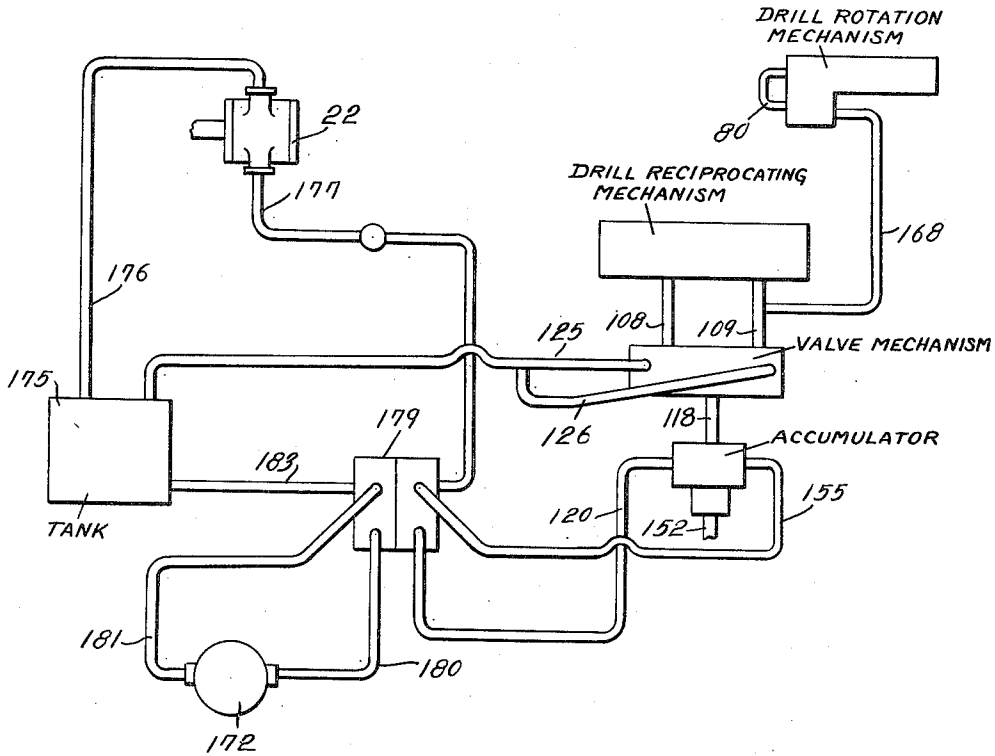
H. H. VANDERZEE
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Fig. 11.



Inventor:
Harry H. Vanderzee.
by Louis A. Maxson.
Atty.

UNITED STATES PATENT OFFICE

2,547,609

DRILLING APPARATUS

Harry H. Vanderzee, Racine, Wis., assignor to
Joy Manufacturing Company, a corporation of
Pennsylvania

Application June 9, 1945, Serial No. 598,524

9 Claims. (Cl. 255-22)

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My invention relates to drilling apparatus, and more particularly to drilling apparatus of the drill reciprocating type.

By providing for the drilling tool of a hammer type drill, a reciprocating means which operates to move the drilling tool a slightly greater distance in one direction than in the other during each reciprocation thereof, it will be seen that a feeding of the drilling tool will be obtained. Such reciprocating means may comprise in a preferred form of my invention a friction drive which connects a power operated reciprocating device in driving relation with the drilling tool, the drive slipping slightly in one direction to provide the desired feeding of the tool. In actual operation a slipping may take place in the friction drive during reciprocating movements in each direction, the slipping in one direction being slightly greater than that in the opposite direction. By providing manually operated means which regulates the amount of slipping in one direction, there is obtained a control of the rate of feed.

An object of my invention is to provide an improved drilling apparatus. Another object is to provide a drilling apparatus having improved means for reciprocating the drilling tool. Still another object is to provide improved reciprocating and feeding means for the drilling tool of a drilling apparatus. Yet another object is to provide improved means operating to reciprocate a drilling tool in such a manner as to effect a feeding of the latter. Another object is to provide, in an improved reciprocating means for a drilling tool, an improved friction drive which slips slightly in one direction of each reciprocation so as to provide a feeding of the tool. Still another object is to provide an improved friction drive for reciprocating a drilling tool, the drive being adapted to slip a small amount in one direction and having associated therewith means for varying the amount of slippage in the drive. These and other objects will appear more fully in the course of the following description.

In the accompanying drawings there is shown for purposes of illustration one form which my invention may assume in practice.

In these drawings:

Fig. 1 is a side elevational view of a drilling apparatus in which my invention is incorporated.

Fig. 2 is an end elevational view of the drilling apparatus shown in Fig. 1.

Fig. 3 is an enlarged cross-sectional view taken on the plane of the line 3-3 of Fig. 2.

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Fig. 4 is a fragmentary sectional view taken on the plane of the line 4-4 of Fig. 3.

Fig. 5 is an enlarged vertical sectional view taken on the plane of the line 5-5 of Fig. 3.

Fig. 6 is an enlarged vertical sectional view taken on the plane of the line 6-6 of Fig. 2.

Fig. 7 is a horizontal sectional view taken on the plane of the line 7-7 of Fig. 6.

Figs. 8 and 9 are fragmentary sectional views taken on the plane of Fig. 6 and showing parts in different positions.

Fig. 10 is an enlarged vertical cross-sectional view taken on the plane of the line 10-10 of Fig. 1.

Fig. 11 is a schematic diagram showing the hydraulic control system.

In the illustrative embodiment of the invention there is shown a drilling apparatus, generally designated 1, mounted on a frame 2 which is supported for movement over the ground by front steering wheels 4 and rear driving wheels 5. An engine 6 mounted on the frame operates through a transmission 7 to drive a power shaft 8, and a clutch member 9 slidably mounted on the shaft 8 is movable by a lever 10 to positions for connecting selectively a pulley 12 and a chain sprocket 14 in driven relation with the shaft. A belt 15 operatively engages the pulley 12 and drives a pulley 16 which is connected through a universal joint 17 and a drive shaft 18 in driving relation with the wheels 5. The chain sprocket 14 is connected through a chain 20 to a shaft 21 which drives an oil pump 22 and a mud pump 24. A belt 25 driven by the shaft 8 operates to drive a compressor 26 which supplies air under pressure to a receiver 28.

Mounted on the frame 2 at its rear end is a mast 30 rotatably supporting adjacent its upper and lower ends, as shown in Fig. 2, transversely extending shafts 32 and 33. Fixed to each of the shafts 32 and 33 adjacent its ends are chain sprockets 34, and chains 35 extend around the chain sprockets and are connected at their ends, as shown in Fig. 4, to members 36 which are provided at their outer sides, see Fig. 3, with grooves 37 slidably receiving flange portions 38 of guide members 39 extending longitudinally of the mast at opposite sides of the latter. Extending transversely of the mast between the members 36 is a member 40 having bores 41 at its opposite ends rotatably receiving inwardly projecting portions 42 on the members 36. Formed in the mid-portion of the member 40 is an opening 43, and a generally cylindrical casing 44 extends through the opening 43 and is provided at diametrically

opposite points with projecting portions 46 having bores 47 which rotatably receive portions 48 projecting inwardly through openings in the sides of the member 40 and formed on plate members 49 attached to the sides of the member 40, as by screws 50. It will be seen that the member 40 and the casing 44 are similar to parts of a universal joint, making it possible for the casing to be moved angularly in any direction.

Extending axially through the casing 44 is a shaft 52 which is rotatably supported by bearings 53 and 54, the bearing 53 being carried by the lower end of the casing and the bearing 54 being carried by a cover plate 55 fixed to the top of the casing. A ratchet wheel 56 is fixed to the portion of the shaft 52 extending between the bearings 53 and 54, and hub portions 58 formed on the ratchet wheel engage the inner races of the bearings to prevent axial movement of the shaft relative to the casing. Connected to the lower end of the shaft 52 in any suitable manner is a drill rod 59 carrying a drill bit 60 at its lower end. Extending axially through the shaft 52 is a passage 61 which is connected at its upper end by a conduit 62 and a passage 63 in the cover plate 55, in communication with a hose 64 leading to a supply of water under pressure. Water delivered to the passage 61 is conducted through suitable passage means in the drill rod and bit to the bottom of the hole for washing away cuttings.

Formed on one side of the casing 44 is a projecting portion 65 having aligned bores 66 and 67 containing cylindrical linings 68 in which opposite ends of a piston 70 are reciprocally received. The adjacent ends of the bores 66 and 67 open into a space 71 communicating with the interior of the casing 44, and a pawl 72 is reciprocally received in a recess 73 in the side of the piston portion extending through the space 71. A spring 74 acts between the inner end of the recess 73 and the pawl for urging the latter into engagement with ratchet teeth 75 formed on the wheel 56. Acting between one end of the piston 70 and a plate 76 closing the outer end of the bore 66 is a spring 77 which yieldingly urges the piston toward the bore 67. Opening through a cover plate 78 for the outer end of the bore 67 is a conduit 80 which is intermittently connected by means which will shortly be described, in communication with means delivering a liquid under pressure and with a liquid discharge. When liquid is supplied under pressure to the bore 67, the piston 70 is moved against the force of the spring 77 and the pawl 72 operates to rotate the ratchet wheel 56 through a small angle. Rotation of the ratchet wheel causes the shaft 52 and the drill rod 59 to rotate and change the angular position of the drill bit for cutting material. When liquid is vented from the bore 67, the piston 70 is moved by the spring 77 and the pawl slides over the teeth 75 to a new position on the ratchet wheel.

Rotatably supported on one end of the shaft 33 at the lower end of the mast, as shown in Fig. 10, is a brake drum 85, and rotatably supported on the opposite end of this shaft is a sprocket wheel 86. Clutch members 87 and 88 are slidably keyed to the shaft 33 and are adapted to be actuated by levers 89 and 90 pivotally supported on the frame 2 for controlling, respectively, the connection of the brake drum 85 and the ratchet wheel 86 to the shaft.

Surrounding the brake drum 85 is a brake

band 92 having fixed to its ends, as shown in Fig. 6, members 93 and 94 providing radially extending flange portions 95 and 96. A bolt 97 extends through openings in the flange portions 95 and 96, and a spring 98 acts between the flange portion 96 and a plate 99 abutting a nut 100 on the bolt for yieldingly holding the brake band in engagement with the drum. Pivotally connected to the member 93 and to a piston rod 101, is a rod 102. The piston rod 101 extends axially through a bore 103 formed in a cylinder block 104 supported by brackets 105 on the frame 2. Slidably contained within the bore 103 is a piston 107 which is fixed to the rod 101, and passages 108 and 109 open into opposite ends of the bore 103 for conducting a liquid relative to the latter under the control of a valve mechanism, generally designated 110, so as to effect a reciprocation of the piston 107. The valve mechanism 110 comprises a valve receiving bore 112 formed in the cylinder block 104 with its axis parallel to the axis of the bore 103, and a valve member 114 slidable longitudinally in the bore 112 and engageable at its ends with flange portions 115 formed on annular members 116 fixed, as by screws 117, to the cylinder block at opposite ends of the bore 112. Surrounding the mid-portion of the bore 112 is an annular groove 118 opening into a chamber 119 of an accumulator to which a liquid such as oil is delivered by a conduit 120. Spaced longitudinally of the bore 112 at opposite sides of the groove 118 are annular grooves 121 and 122 communicating respectively with the passages 108 and 109, and spaced outwardly from the grooves 121 and 122 are grooves 123 and 124 communicating, as shown in Fig. 7, with exhaust conduits 125 and 126. The valve member 114 is provided with an axial bore 128, and a rod 130 is slidable in the bore 128 and is connected by an arm 131 to the rod 102 for actuation by the latter. The end portions of the rod 130 are slightly reduced in cross section so as to provide shoulders which are engageable by annular members 133 and 134. The distance between the shoulders is somewhat greater than the length of the valve member 114, and the annular members 133 and 134 are yieldingly held against the shoulders by springs 135 and 136, the spring 135 acting between the arm 131 and the member 133, and the spring 136 acting between the annular member 134 and another annular member 137 abutting a nut 138 threaded on the end of the rod. Formed in the valve member 114 are longitudinally spaced annular grooves 140, 141 and 142, the groove 140 operating as a supply groove and the grooves 141 and 142 operating as exhaust grooves. When the valve member engages the flange portion 115 on the annular member 116 at the right-hand end of the valve bore, as shown in Fig. 6, the groove 140 connects the groove 118 in communication with the groove 122 and the groove 141 connects the groove 121 in communication with the groove 123. In the opposite limiting position of the valve member the groove 140 connects the groove 118 with the groove 121, and the groove 142 connects the grooves 122 and 124.

Formed in the lower portion of the chamber 119, as shown in Fig. 6, are stepped coaxial bores 145 and 147, and a piston 148 is provided with stepped portions 149 and 150 which are reciprocable in the bores 146 and 147, respectively. A cap 151 covers the lower end of the bore 147, and a conduit 152 extends through an opening in the cap and connects the space beneath the piston

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148 in communication with the air receiver 28. It will be seen that the air pressure acting on the piston 148 urges the latter upwardly against the action of the liquid in the chamber 119. If the pressure on the liquid in the chamber 119 becomes enough greater than the air pressure in the receiver 28, the piston 148 is forced downwardly and, as it approaches its lower position, the piston portion 149 uncovers a port 154 opening into the bore 146 and communicating with an exhaust conduit 155. Liquid then escapes through the conduit 155 until the pressure on the liquid is reduced to a point at which the piston 148 is again raised by air pressure and overruns port 154.

Referring to Fig. 5, it will be noted that the conduit 80 for conducting fluid relative to the piston 70 of the drill rotating mechanism opens into one end of a bore 160 formed in the projecting portion 65 of the casing 44. The other end of the bore 160 opens into an enlarged bore 161, and a valve member 162 is reciprocable in the bore 160 and has a head portion 163 engageable with the shoulder between the bores. Extending axially through the valve member 162 is a passage 164, and formed in the periphery of the portion of the valve member fitting the bore 160 are longitudinal grooves 165. When the valve member has its head portion 163 engaging the shoulder between the bores, the passage 164 provides the only communication between the bores, and the flow of fluid through this passage is somewhat restricted. When the head portion 163 is moved away from the shoulder, the bores 160 and 161 communicate with each other through the grooves 165 as well as the passage 164. Closing the bore 161 is a cover plate 166, and a conduit 168 communicates with the bore 161 through a port in this cover plate and leads, as shown in Fig. 7, to the groove 122 surrounding the valve bore 112. Formed on the cover plate are projecting abutment portions 170 which prevent the valve member from moving into engagement with the cover plate so as to cut off communication between the bore 161 and the conduit 168.

When the groove 122 is connected to the supply groove 118 by the valve 114, oil flows through the conduit 168 to the bore 161 where it acts on the valve member 162 and forces the latter to a position with its head engaging the shoulder between the bores. The oil is then conducted through the passage 164 and the conduit 80 to the piston 70 for moving the latter against the spring 77. When the groove 122 is connected to the exhaust groove 124, the oil escapes from the piston 70 through the conduit 89 and acts on the valve member 162 to move it into engagement with the abutment portions 170. The passage 164 as well as the grooves 165 in the valve 162 conduct the oil from the conduit 80 to the bore 161 and the conduit 168.

The sprocket wheel 86 on the shaft 33 is adapted to be driven by a hydraulic motor 172 through a chain 173. It will be seen that a raising of the drilling tool may be obtained by operating the clutch lever 90 to connect the sprocket wheel 86 to the shaft 33 through the clutch member 88, and then operating the motor 172, after the clutch member 87 is actuated to disconnect the brake drum 85 from the shaft 33.

The hydraulic system includes, as shown in Fig. 9, the oil pump 22 taking oil from a tank 175 through a conduit 176 and discharging it through a conduit 177 to a valve box 179 containing two

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manually operated valve devices, one controlling the flow of oil through the conduit 120 to the chamber 119 of the accumulator and the other controlling the flow of oil through a conduit 180 to the hydraulic motor 172. Excess oil supplied to the chamber 119 is returned to the valve box through the conduit 155 and oil supplied to the motor 172 is returned to the valve box through a conduit 181, the return side of the valve box being connected to the tank 175 through a conduit 183.

The operation of the mechanism described is as follows: Assuming that the drilling apparatus has been moved to a position for drilling, the clutch lever 10 is actuated to connect the pump 22 in driven relation with the power shaft 8, and, at the same time, the compressor 26 is driven by the power shaft to deliver air under pressure to the receiver 28. The clutch lever 89 is actuated to connect the brake drum 85 to the shaft 33, and the clutch member 88 is positioned to disconnect the sprocket wheel 86 from the shaft 33. The valve device in the valve box controlling the flow of oil to the accumulator is opened so that oil passes through conduit 120 to the chamber 119. If the valve 114 is in the position shown in Fig. 6, the oil passes from the chamber 119 through the groove 118, the valve groove 140, the groove 122 and the passage 109 to the bore 103 at the right-hand end of the piston 107. The opposite end of the bore 103 is connected at this time through passage 108, groove 121, valve groove 141 and groove 123 to the discharge conduit 125 which leads to the tank 175. The oil acting on the right-hand end of piston 107 moves the latter to the left forcing oil out of the bore 103 at the opposite end of the piston, and the rods 101, 102 and 130 move to the left with the piston. The connection of the rod 102 to the brake band 32 is such that it acts with the spring 92 in pulling the band about the drum 85 when traveling to the left. The drum will then be rotated in a counter-clockwise direction with minimum slippage between the drum and the brake band, and the chains 35 will be actuated to force the drill rod downwardly. As the rod 130 moves to the left the annular member 134 engages the valve member 114 and moves it into engagement with the flange portion 115 on the annular member 116 at the left-hand end of the bore 112. Any further movement of the rod 130 to the left merely results in a compression of the spring 136. While the valve member 114 is at the right-hand end of the bore 112, oil passes from the groove 122 to the conduit 168 which conducts it, as shown in Fig. 5, to the bore 161 where it acts on the valve member 162 and forces the latter to the left with its head portion 163 engaging the shoulder between the bores 160, 161. The oil then passes through the passage 164 and the conduit 80 to the piston 70 for moving the latter against the action of the spring 77 and effecting a rotation of the ratchet wheel 56. The flow of oil through the passage 164 is restricted so as to prevent movement of the piston 70 at such a rate as to cause the ratchet wheel to spin.

When the valve member 114 reaches the left-hand end of the bore 112, oil is supplied from the chamber 119 through the groove 118, the valve groove 140, the groove 121 and the passage 109 to the left-hand end of the bore 103. At the same time oil is vented from the right-hand end of the bore 103 through passage 108, groove 122, valve groove 142, groove 124 and con-

duit 126 to the tank 175. Oil is also vented from the piston 79 through conduits 89, 163, grooves 122, valve groove 142, groove 124 and conduit 123 to the tank. The flow of oil from conduit 89 through bore 160 causes the valve member 162 to move into engagement with the abutment portions 170 so that the escape of oil may take place through the valve grooves 165 as well as the passage 164, the rate of escape being sufficient to permit rapid movement of the piston 79 by the spring 77. Movement of the piston 76 by the spring 77 results in a sliding of the pawl 72 over the ratchet teeth 75 to engage the ratchet wheel at a different point. Oil supplied to the left-hand end of the bore 103 operates to move the piston 107 and the rods 102 and 130 to the right, the rod 102 pulling on the brake band in such a manner as to release it slightly from the drum and cause a slight slipping of the band on the drum. As the rod 130 moves to the right, the annular member 133 engages the valve member 114 and moves it to the right-hand end of the bore 112, connecting the left-hand end of the bore to discharge and the right-hand end to oil supply. It will be seen that by reason of the slipping of the brake band on the drum, the rotation of the drum in a clockwise direction will be slightly less than in a counter-clockwise direction, the difference in rotation determining the amount of feeding of the drilling tool. By adjusting the nut 130 on the rod 91, the amount of slippage may be regulated so as to give any desired rate of feed. To raise the drilling tool out of the hole, the clutch member 87 is actuated to disconnect the brake drum from the shaft 33 and the clutch member 88 is moved to connect the sprocket wheel 86 to the shaft. The valve device in the valve box 179 controlling the supply of oil to the motor 172 is then actuated to supply oil to the latter for driving the sprocket wheel 86 in a direction to raise the drill rod. The accumulator plays the important function of reducing shocks and of, while there is being used a relatively efficient force transmitting hydraulic fluid, providing a velocity of impact much greater than would be possible with fluid transmitted without the accumulator from the pump through all of the necessary passages.

As a result of my invention there is provided an improved drilling apparatus of the drill reciprocating type. The drill operating mechanism produces a reciprocating action for effecting a cutting of material, and the reciprocating action is such that a feeding of the drilling tool is obtained.

While there is in this application specifically described one form which the 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 drilling apparatus, a feeding and actuating mechanism for a drilling implement including means for supporting a drilling implement, means guiding said supporting means for movement in a direction longitudinal of the drilling implement, and means for reciprocating said supporting means on said guiding means including rotary guides rotatably supported by said guiding means at opposite ends of the latter, a flexible element circulating about said rotary guides and operatively connected to said support-

ing means, a friction drum operatively connected to one of said rotary guides for driving the same to effect circulation of said flexible element, a friction band operatively engaging said drum, and power operated means connected to said friction band for oscillating the latter and operating to effect a slipping between said band and said drum during the reversal at one end of each oscillation.

2. In a drilling apparatus, a feeding and actuating mechanism for a drilling implement including means rotatably supporting a drilling implement, means guiding said supporting means for movement in a direction longitudinal of the drilling implement, fluid actuated means carried by said supporting means for effecting a stepped rotation of said drilling implement, means for reciprocating said supporting means on said guiding means including a friction drum operatively connected with said supporting means and upon oscillation reciprocating the latter, a friction band operatively engaging said drum, means yieldingly engaging opposite ends of said friction band for holding the latter in yielding engagement with said drum, a piston reciprocable in a cylinder bore and connected to one end of said friction band, means alternately connecting the opposite ends of said piston to a fluid supply and to exhaust, and means connecting said fluid actuated means in communication with the space at one end of said piston

3. In a drilling apparatus, a feeding and actuating mechanism for a drilling implement including means for supporting a drilling implement, means guiding said supporting means for movement in a direction longitudinal of the drilling implement, and means for reciprocating said supporting means on said guiding means including rotary guides rotatably supported by said guiding means at opposite ends of the latter, a flexible element circulating about said rotary guides and operatively connected to said supporting means, a friction drum operatively connected to one of said rotary guides for driving the same to effect circulation of said flexible element, a split friction band operatively engaging said drum, power operated means connected to one end of said friction band for oscillating the latter, and means coacting with the other end of said friction band for yieldingly biasing it towards said first mentioned end.

4. In a drilling apparatus, in combination, a reciprocating drilling implement, and an actuating mechanism for imparting a rapid reciprocation to the drilling implement to effect the drilling of a hole with a percussive action including a hydraulically operated motor of the reciprocating type, means for operatively connecting said motor to said drilling implement, a liquid pump, a conduit for delivering liquid from said pump to said motor, a chamber to which said conduit delivers liquid and from which liquid is delivered to said motor, said chamber having a movable wall associated therewith, and means for causing said movable wall to exert, irrespective of the position of said wall relative to said chamber, a substantially uniform pressure upon the liquid within said chamber including means providing a surface subjected to a substantially constant gaseous pressure acting in a direction to reduce the effective volume of said chamber.

5. In a drilling apparatus, in combination, a reciprocating drilling implement, and an actuating mechanism for imparting a rapid reciprocation to the drilling implement to effect the drill-

ing of a hole with a percussive action including a hydraulically operated motor of the reciprocating type, means for operatively connecting said motor to said drilling implement, a liquid pump, a conduit for delivering liquid from said pump to said motor, a chamber to which said conduit delivers liquid and from which liquid is delivered to said motor, said chamber having a movable wall associated therewith, means for causing said movable wall to exert, irrespective of the position of said wall relative to said chamber, a substantially uniform pressure upon the liquid within said chamber including means providing a surface subjected to a substantially constant gaseous pressure acting in a direction to reduce the effective volume of said chamber, and means governed by the position of said movable wall for venting liquid from said chamber.

6. In a drilling apparatus, the combination comprising a reciprocatory percussive drilling implement, and mechanism for reciprocating said implement to effect drilling with a percussive action and for feeding said implement toward the work as the hole deepens during drilling comprising a frictional slip driving device including a friction band and drum drive, reciprocating means for actuating said friction band to cause oscillatory motion of said drum, said band slipping a slight amount at the end of the working stroke of the implement when the latter is sufficiently resisted by the work, and a slightly greater amount upon the other stroke, to cause drum oscillation through a distance greater in the latter direction than in the former, means for transforming the oscillatory motion of said drum to a reciprocatory motion, and means for transmitting said reciprocatory motion to said drilling implement.

7. In a drilling apparatus, the combination comprising a reciprocatory percussive drilling implement, and mechanism for reciprocating said drilling implement to effect drilling with a percussive action and for feeding said drilling implement toward the work during its reciprocation and as the hole deepens comprising a frictional drive device including an oscillatory friction drum, a friction band operatively engaging said friction drum, power operated means for oscillating said friction band and including means operating to effect different frictional engagements between said band and said drum during the opposite movements of each oscillation, means for transforming the oscillatory motion of said drum to a reciprocatory motion, and means for transmitting such reciprocatory motion to said drilling implement.

8. In a drilling apparatus, the combination comprising a reciprocatory percussive drilling

implement, and mechanism for reciprocating said implement to effect drilling with a percussive action and for feeding said implement toward the work during reciprocation thereof and as the hole deepens including a frictional driving device and transmission connections between said driving device and said drilling implement, said driving device including an oscillatory friction drum, a friction band surrounding said drum and having ends movable relative to each other for varying the frictional engagement between said band and said drum, means for yieldingly urging the ends of said friction band toward each other and adapted to yield to permit slippage of said band when said implement is resisted by the work, and power operated means connected to one end of said band and operating to effect oscillation of the latter.

9. In a drilling apparatus, the combination comprising a reciprocatory percussive drilling implement, and mechanism for reciprocating said drilling implement to effect drilling with a percussive action and for feeding said implement toward the work during reciprocation thereof and as the hole deepens including a fluid operated reciprocatory motor having an automatically actuated fluid distributing valve means, means for transforming the reciprocatory motion of said motor to an oscillatory motion including an oscillatory transmission device, means for transforming said oscillatory motion to a reciprocatory motion, means for transmitting such reciprocatory motion to said drilling implement, and means for rotating said drilling implement during actuation thereof including a fluid operated cylinder and piston mechanism and means controlled by said fluid distributing means for supplying fluid to and venting fluid from said cylinder and piston mechanism.

HARRY H. VANDERZEE.

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