

Feb. 26, 1952

R. A. McCALLUM

2,586,842

DRILLING APPARATUS

Filed Oct. 16, 1944

5 Sheets-Sheet 1

Fig. 1.

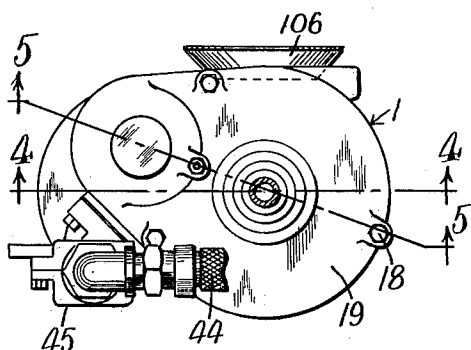


Fig. 3.

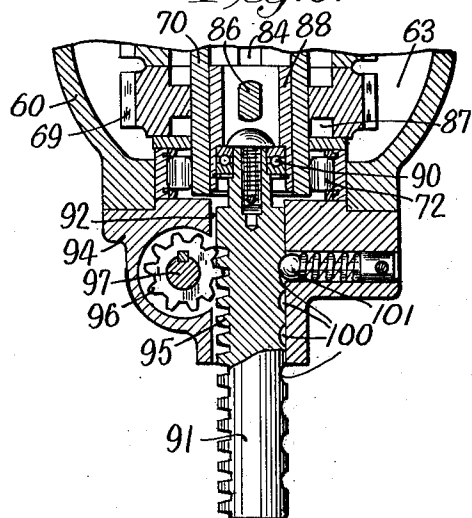
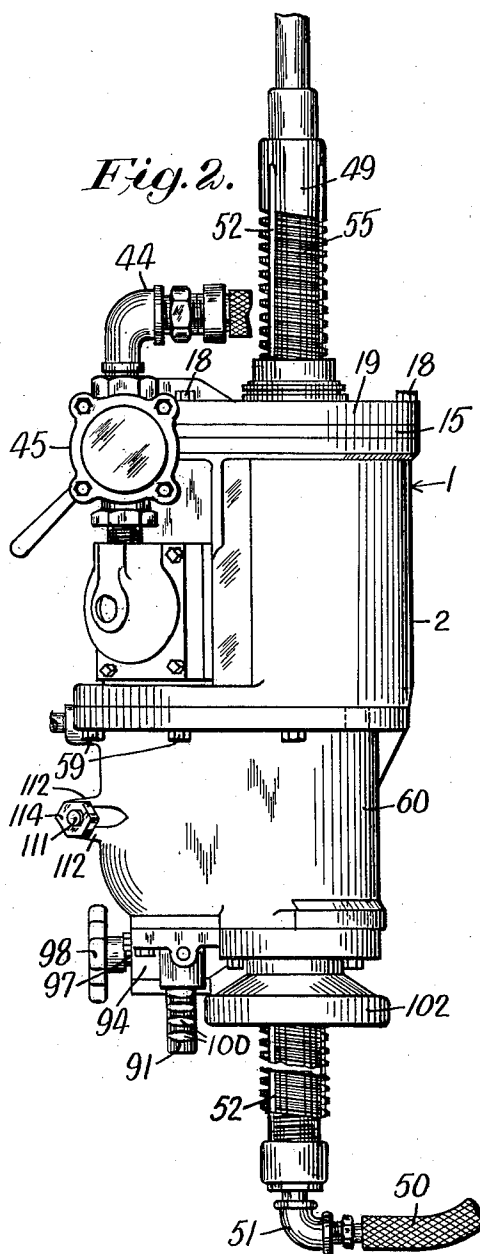


Fig. 2.



Inventor:
Robert A. McCallum.
by Louis A. Maxson.
Atty.

Feb. 26, 1952

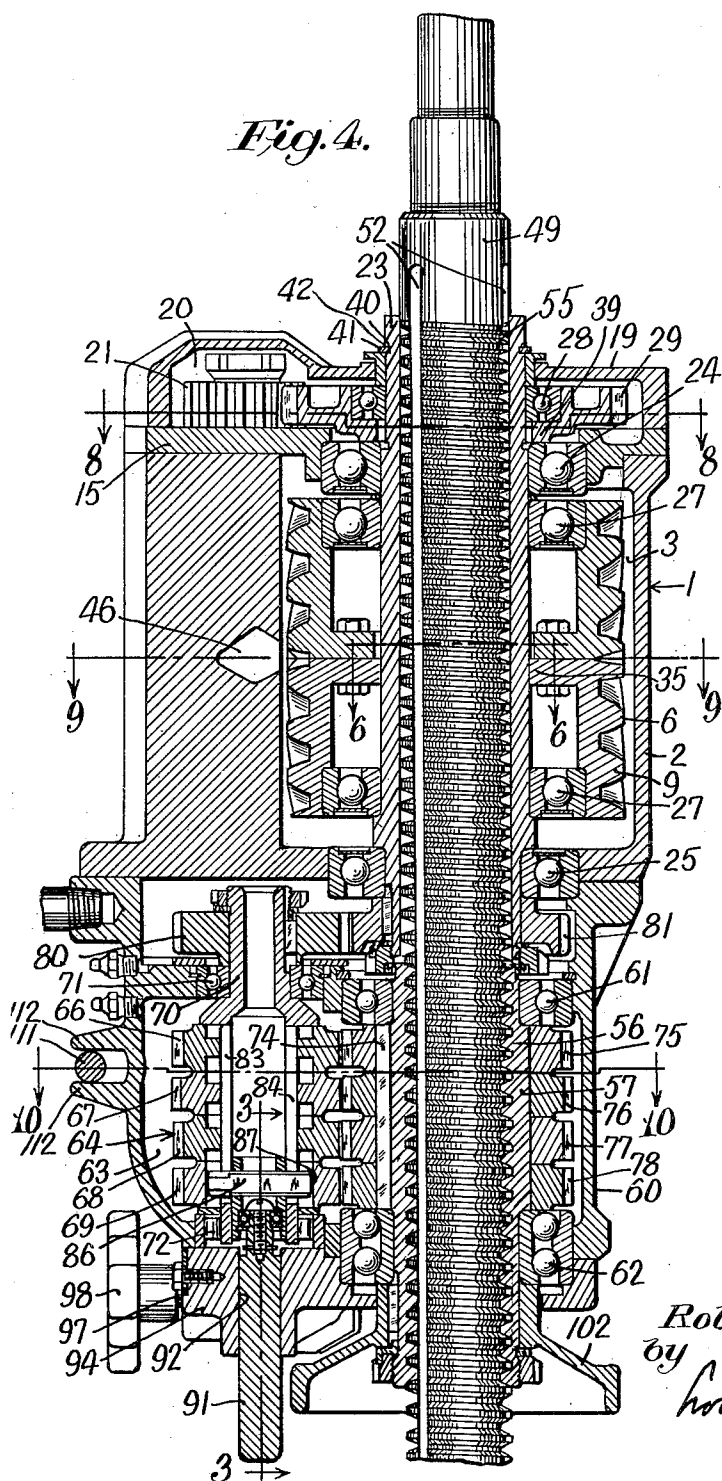
R. A. McCALLUM

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Inventor:
Robert A. McCallum
by Louis A. Maxson.
Atty.

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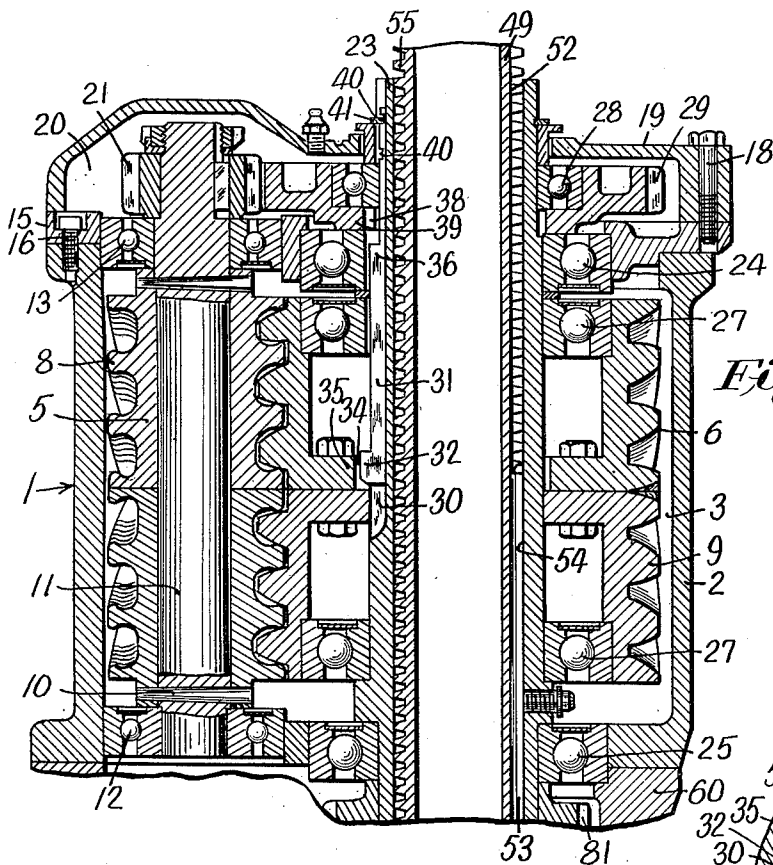


Fig. 5.

Fig. 6.

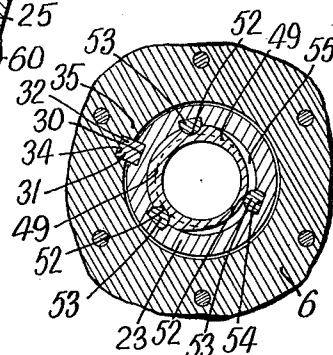
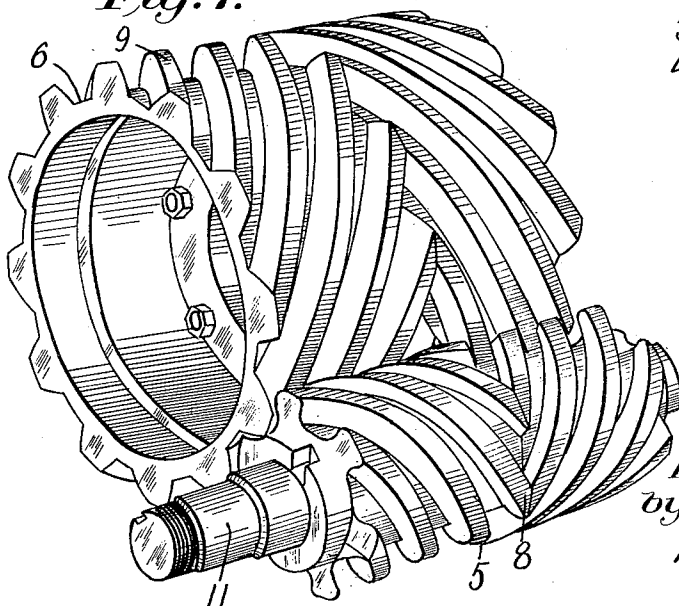


Fig. 7.



Inventor:
Robert A. McCallum.
by
Lewis A. Maxson.
Atty.

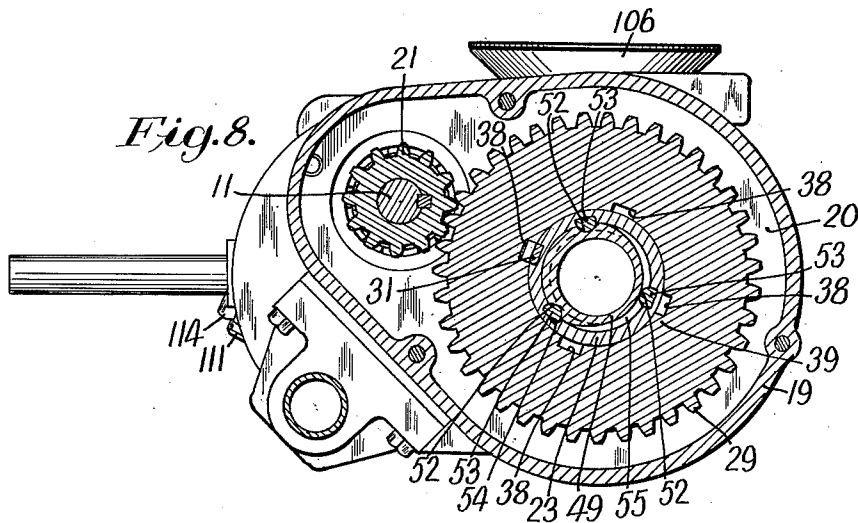
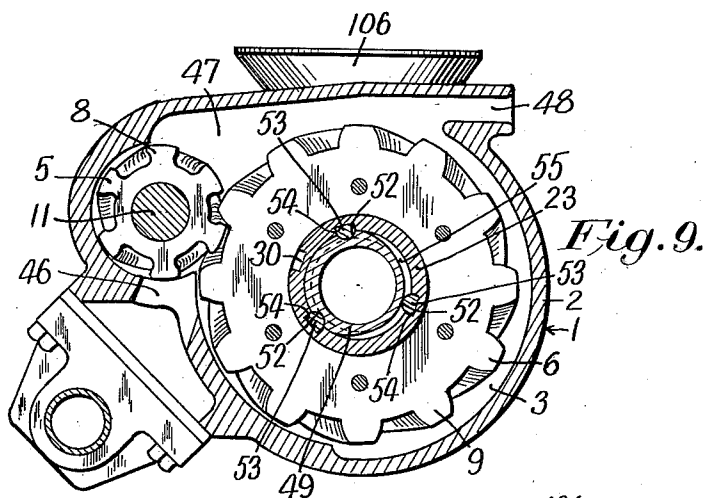
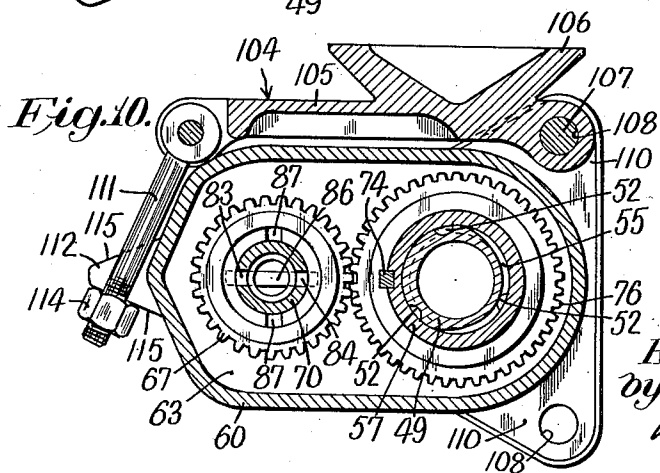
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Inventor:
Robert A. McCallum
by Louis A. Maxson
Atty.

Feb. 26, 1952

R. A. McCALLUM
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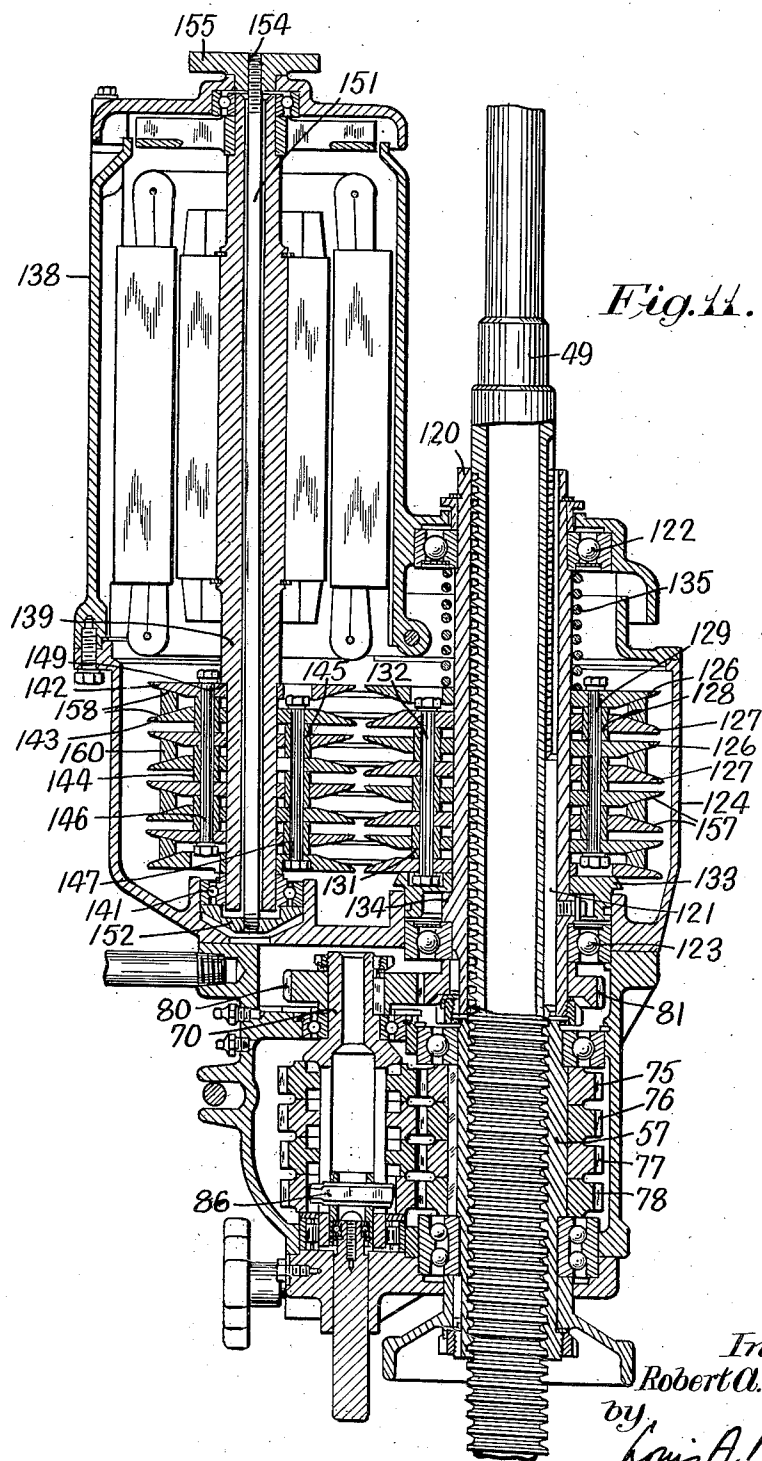


Fig. 11.

Inventor:
Robert A. McCallum
by
Louis A. Maxson,
att'y.

UNITED STATES PATENT OFFICE

2,586,842

DRILLING APPARATUS

Robert Anthony McCallum, Michigan City, Ind.,
 assignor to Joy Manufacturing Company, a
 corporation of Pennsylvania

Application October 16, 1944, Serial No. 558,848

8 Claims. (Cl. 255—47)

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My invention relates to drilling apparatus, and more particularly to improvements in the rotating and feeding means of a drilling apparatus of the high speed rotary type especially designed for use in drilling blast holes in rock or the like.

An object of my invention is to provide an improved drilling apparatus. Another object is to provide an improved drilling apparatus of the rotary type. Still another object is to provide an improved rotary drilling apparatus having improved rotating and feeding means. Yet another object is to provide in a rotary type drilling apparatus improved means which is adjustable to effect different rates of rotation, and improved feeding means which is adjustable to effect for each rate of drill rotation different rates of feed. Another object is to provide improved supporting means for a drilling apparatus. Still another object is to provide for a drilling apparatus an improved supporting means which is adapted to be connected to the drilling apparatus at different points whereby the latter may be supported in different positions. These and other objects of my invention will hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration two forms which my invention may assume in practice.

In these drawings:

Fig. 1 is an end elevational view of a drilling apparatus having one form of my invention incorporated therein.

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

Fig. 3 is an enlarged fragmentary sectional view taken on the plane of the line 3—3 of Fig. 4.

Fig. 4 is an enlarged longitudinal sectional view taken on the plane of the line 4—4 of Fig. 1.

Fig. 5 is an enlarged longitudinal sectional view of a portion of the drilling apparatus, this view taken on the plane of the line 5—5 of Fig. 1.

Fig. 6 is a cross-sectional view taken on the plane of the line 6—6 of Fig. 4.

Fig. 7 is a perspective view of the motor rotors for the drilling apparatus.

Fig. 8 is a cross-sectional view taken on the plane of the line 8—8 of Fig. 4.

Fig. 9 is a cross-sectional view taken on the plane of the line 9—9 of Fig. 4.

Fig. 10 is a cross-sectional view taken on the plane of the line 10—10 of Fig. 4.

Fig. 11 is a longitudinal sectional view of another form of the invention.

In the form of the invention shown in Figs. 1 to 10 inclusive the high speed rock drilling appa-

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ratus of the rotary blast hole type includes a rotary motor 1 shown herein as being of the fluid actuated type, but it will be obvious that motors of other types may be used if desired. The motor 1 has a casing 2 providing a chamber 3 which receives, as shown in Figs. 5 and 9, fluid actuated rotors 5 and 6. Formed on the rotors 5 and 6, as shown in Fig. 7, are teeth 8 and 9 which mesh with each other and against which fluid acts to cause the rotors to rotate. The rotor 5 is fixed, as by pins 10, to a shaft 11 which is rotatably mounted in bearings 12 and 13 carried by the motor casing and by a plate 15 attached, as by bolts 16, to one end of the casing. Fixed to the outer side of the plate 15, as by bolts 18, is a member 19 cooperating with the plate 15 to form a chamber 20 into which the shaft 11 projects, and attached to the portion of the shaft received within the chamber 20 is a gear 21. Extending axially through the rotor 6 is a sleeve-shaped member or hollow drill spindle 23 rotatably supported in bearings 24 and 25 carried respectively by the plate 15 and the motor casing 2. Bearings 27 carried by the sleeve-shaped member 23 rotatably support the rotor 6, and a bearing 28 carried by the member 23 rotatably supports a gear 29 which meshes with the gear 21 in the chamber 20. The gears 21 and 29 are so designed that the gear 29 is rotated by the gear 21 at a speed somewhat below that of the rotor 6. Formed in the member 23 is a longitudinal groove 30 receiving a key 31 which has a portion 32 adapted to be received in a notch 34 formed in an inwardly projecting portion 35 of the rotor 6. The key 31 also has another portion 36 which is receivable in one of the notches 38 formed in an inwardly projecting portion 39 of the gear 29. When the key 31 is in the position shown in Fig. 5, the sleeve-shaped member 23 is connected to the rotor 6 for rotation therewith; and the gear 29 rotates on the bearing 28 free of the member 23. With the key moved to a position so that its portion 36 extends into the notch 38 in the gear 29 and its portion 32 is removed from the notch 34, the member 23 is connected to rotate with the gear 29, and the rotor 6 turns freely on the bearings 27. The key 31 is provided with notches 40 by means of which it is adjusted to the desired positions in the groove 30 and then held in such positions by a conventional split snap type locking ring 41 which is seated in an annular groove 42 on the exterior periphery of the sleeve member 23. The upper end of the key 31, which projects externally of the drill housing as shown in Fig. 5, may be suitably gripped by the operator to ef-

fect sliding of the key endwise in the groove 30, and as the key is moved endwise the ring 41 is expanded and snaps into a notch 40 when the latter is brought into registry with the groove 32. Thus, the snap ring 41 may lock the key 31 in either of its two adjusted positions.

Motor operating fluid is delivered from a conduit 44 under the control of a manually operated valve 45 to a passage 46 formed in the motor casing and opening, as shown in Figs. 4 and 9, into the chamber 3 at a point midway between the ends of the rotors. The fluid acts on the rotor teeth 8 and 9 to cause the rotors to turn on their bearings, and the fluid is then carried in the spaces between the teeth on each rotor to a chamber space 47, shown in Fig. 9, which communicates with a discharge passage 48.

Extending axially through the sleeve-shaped member 23 is a hollow shaft 49 to one end of which a drilling implement is adapted to be connected, and to the other end of which a cleansing liquid is supplied from a hose connection 50 through a conventional swivel 51. Formed in the shaft 49 are longitudinal grooves 52 slidably receiving, as shown in Fig. 6, keys 53 which are fixed in grooves 54 formed in the inner wall of the sleeve-shaped member 23. It will be seen that the shaft 49 will be caused to rotate with the member 23 but may slide longitudinally relative to the latter. Formed on the shaft 49 are threads 55 meshing with the threads 56 of a feed nut 57. Attached to the motor casing, as by bolts 59, is a casing 60 carrying bearings 61 and 62 which rotatably support the feed nut, and the casing 60 forms a chamber 63 in which the feed nut and its rotating means, generally designated 64, is enclosed.

The rotating means for the feed nut includes a series of gears 66, 67, 68 and 69 mounted freely to turn on a hollow shaft 70 which is rotatably supported on bearings 71 and 72 carried by the casing 60. Surrounding the feed nut and fixed to the latter, as by a key 74, are gears 75, 76, 77 and 78 meshing respectively with the gears 66, 67, 68 and 69. Thus there are provided four pairs of gears each providing a different reduction. Fixed to one end of the hollow shaft 70 is a gear 80 meshing with a gear 81 fixed to the sleeve-shaped member 23. Opening through opposite walls of the hollow shaft 70 are slots 83 and 84 extending throughout the portion of the shaft surrounded by the gears 66, 67, 68 and 69. A key 86 extends through the slots 83 and 84 transversely of the shaft 70 and is adapted to have its ends received in grooves 87 formed in the inner portions of the gears 66, 67, 68 and 69, as shown in Figs. 4 and 10. The key 86 is carried by a cylindrical member 88 reciprocally received within the shaft 70 and rotatably connected through a bearing 90 to a rod 91 which extends through an opening 92 in a plate member 94 attached to the lower end of the casing 60. Formed on the rod 91 is a rack portion 95, and a pinion 96 engages the teeth of the rack portion and is fixed to a shaft 97 which is rotatably supported by the plate member 94. Attached to the shaft 97 is an operating handle 98 by means of which the pinion 96 is rotated so as to move the rod 91 for positioning the key 86. Formed in the rod 91 are notches 100 which are adapted to receive a spring pressed ball 101 for holding the rod in the desired positions. Attached to the outer end of the feed nut is a member 102 which may be grasped by the operator of the drill for holding the feed nut against rotation while the shaft 49 is rotated by

the drill motor so as to effect reverse feeding of the drilling implement, or for rotating the feed nut relative to the shaft 49 when the motor is stopped so as to effect either a forward or reverse feed.

The drilling apparatus is provided, as shown best in Fig. 10, with supporting means, generally designated 104, which is being claimed in my co-pending divisional application Ser. No. 75,667, filed February 10, 1949. This supporting means comprises a support member 105 having formed integral therewith a swivel plate 106 adapted to be clamped in a saddle mounting or any other suitable support. The support member 105 is mounted at one end on a pin 1007 which is receivable in openings 108 formed in flange portions 110 made integral with the casing 60 at opposite ends of the latter. The other end of the support member has a bolt 111 pivotally connected thereto, and this bolt extends between flange portions 112 on the casing 60, Figs. 4 and 10, and has a nut 114 threaded on its outer end and engageable with the flange portions 112 for clamping the support member firmly to the casing 60. The openings 108 in the flange portions 110 are located at opposite corners of the casing 60 so that the support member may be positioned at either side of the drilling apparatus, and the sides 115 of the flange portions 112 are oppositely inclined so that the nut 114 may engage either side. It will be seen that the supporting member 105 may be clamped to either side of the casing 60 thereby permitting the drilling apparatus to be mounted for drilling in opposite positions relative to the supporting means.

In setting up the drilling apparatus, the support member 105 is placed at the side of the casing 60 to permit drilling in the desired direction and is clamped to the casing by extending the pin 107 through the openings 108 and threading the nut 114 on the bolt 111 until it firmly engages the surfaces 115 at one side of the flange portions 112. If a high speed of rotation for the drilling implement is desired, the key 31 is moved to the position shown in Fig. 5 so that the rotor 6 is connected through the key portion 32 to the sleeve-shaped member 23 for driving the latter. Since the shaft 49 is keyed directly to the member 23 it will rotate at the same speed. To drive the drilling implement at a lower speed it is only necessary to move the key 31 to a position so that its portion 36 extends into a notch 38 in the gear 29 and its portion 32 is removed from the notch 34 in the rotor 6. As the sleeve member 23 rotates, it drives the hollow shaft 70 through the gears 80, 81, and one of the gears 66, 67, 68 and 69 rotates with the shaft 70 depending on the position of the key 86. The one of the gears 75, 76, 77 and 78 meshing with the gear driven by the shaft 70 causes the feed nut 57 to be rotated in the same direction as the shaft 49 but at a faster speed, thereby effecting feeding movement of the shaft 49 in a direction to move the drilling implement toward its work. It will be seen that four different rates of feed may be obtained for each speed of rotation of the shaft 49, the rates of feed for the high speed of rotation of the shaft 49 being greater than those obtained through the same connections when the shaft is rotated at a slower speed. To feed the drilling implement in a rearward direction, the key 86 is moved to a position between the gears 66, 67, 68 and 69 so that all of these gears are free of the shaft 70 and the driving of the feed nut is discontinued. The drill operator then

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grasps the member 102 and holds the feed nut against rotation while the shaft 49 is rotated by the drill motor. To move the drilling implement forward quickly to the face of the work, the feed nut may be rotated manually through the member 102 while the drill motor is stopped and the shaft 49 is stationary as regards rotation.

In the form of the invention shown in Fig. 11 the feeding and supporting means for the shaft 49 is like that described in the first form of the invention, and like parts have been given like reference numerals. The rotating means, however, includes a tubular member 120 through which the shaft 49 extends and to which the latter is connected, as by a key 121, for rotation therewith. The member 120 is rotatably supported by bearings 122 and 123 carried by a casing 124. Surrounding the member 120 and fixed, as by keys, against rotation relative thereto but movable longitudinally thereof are several pairs of pulley members 126 and 127. The pulley members 126 are spaced apart by blocks 128, and a clamping rod 129 extends through openings in the pulley members and the blocks for holding the members 126 together to move as a unit. The pulley members 127 are spaced by blocks 131 and clamped together in a similar manner by a rod 132. The lower pulley member 127 abuts a collar 133 rotating with the tubular member 120 and held against movement axially of the member 120 by a shoulder 134 formed on the latter. A spring 135 acts between the upper pulley member 126 and the inner ring of the bearing 122 for yieldably urging the pulley members 126 toward the members 127. There may be provided in place of the spring, if desired, a manually operated means for adjusting the positions of the pulley members 126 relative to the members 127. Connected to the casing 124 is a power unit shown herein as an electric motor 138 having a power shaft 139 projecting into the casing 124 in parallelism with the shaft 49 and rotatably supported at its lower end by a bearing 141 carried by the casing 124. Surrounding the power shaft are pairs of pulley members 142 and 143 fixed to rotate with the power shaft but movable longitudinally thereof. The pulley members 142 and 143 are spaced respectively by blocks 144 and 145, and are clamped together by bolts 146 and 147. The lower pulley member 143 engages the inner ring of the bearing 141, and the upper pulley member 142 abuts a shoulder 149 on the power shaft. Extending axially through the power shaft is a rod 151 which is threaded into a plate 152 engaging the lower side of the bearing 141. The upper end of the rod 151 is threaded into an opening 154 extending through a member 155 which is rotatably supported by the upper end of the motor 138. The member 155 is adapted to be manually rotated so as to cause the rod 151 to be threaded into the opening 154 for adjusting the position of the plate 152. When the plate 152 is raised, the bearing 141 is moved upwardly with it forcing the pulley members 143 toward the members 142. The adjacent faces of the pairs of pulley members 126, 127 and 142, 143 are beveled, as at 157 and 158, so as to provide a V-shaped groove for receiving a pulley belt 160. Instead of providing means for adjusting manually the spacing between the pulley members 142 and 143 there may be provided means for yieldably urging these members toward each other, this arrangement being desirable if the spacing of the pulley members 126 and 127 is determined by manually operated means.

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When the rod 151 is adjusted to position the pulley members 143, the pulley belts 160 are forced to positions at which their opposite sides engage the beveled surfaces of the pulley members. As the belts are forced outwardly over the beveled surfaces 158 they are pulled inwardly over the beveled surfaces 157 forcing the pulley members 126 away from the pulley members 127 against the action of the spring 135. The speed at which the tubular member 120 is driven depends on the adjustment of belts on the pulley members.

The driving of the feeding means is effected by the gear 81 fixed to the member 120 and meshing with gear 80 carried by the tubular shaft 70. The rate of feed is governed, as described in the first form of the invention, by positioning the key 86 to connect one of the gears 66, 67, 68 and 69 to the shaft 70 so that it drives the feed nut 57 through the one of the gears 75, 76, 77 and 78 meshing therewith. It will be seen that for each change in the speed of rotation of the shaft 49, a corresponding change in the rate of feed is obtained through each of the sets of feeding gears.

As a result of my invention there is provided an improved drilling apparatus having improved rotation and feed control means. Feeding may be effected at different speeds for each speed of rotation of the drilling implement, and the speed of rotation may be readily adjusted.

While there are in this application specifically described two forms which the invention may assume in practice, it will be understood that these forms of the same are 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. A drilling apparatus comprising, in combination, a fluid actuated motor having a pair of geared rotors meshing with each other, means for supplying an operating fluid to said rotors, a drive sleeve extending axially through one of said rotors, gearing driven by the other of said rotors and including a gear coaxial with said sleeve, means for connecting selectively said drive sleeve in driven relation with the one of said rotors through which it extends and with said gear, a drill shaft extending through said drive sleeve and connected for rotation therewith, and means for feeding said drill shaft through said drive sleeve, said feeding means including threads on said drill shaft, a feed nut threadedly engaging the threads on said drill shaft and means for connecting said feed nut in driven relation with said drive sleeve.

2. A drilling apparatus comprising, in combination, a fluid actuated motor having a pair of geared rotors meshing with each other, means for supplying an operating fluid to said rotors, a drive sleeve extending axially through one of said rotors, gearing driven by the other of said rotors including a gear coaxial with said sleeve, a key slidably mounted in a groove in said drive sleeve and engageable selectively with the one of said rotors through which said drive sleeve extends and with said gear, a drill shaft extending through said drive sleeve and connected for rotation therewith, and means for feeding said drill shaft through said drive sleeve, said feeding means including threads on said drill shaft, a feed nut threadedly engaging the threads on said

drill shaft and means for connecting said feed nut in driven relation with said drive sleeve.

3. A drilling apparatus comprising, in combination, a fluid actuated motor having a pair of geared rotors meshing with each other, means for supplying an operating fluid to said rotors, a drive sleeve extending axially through one of said rotors, gearing driven by the other of said rotors including a gear coaxial with said sleeve, means for connecting selectively said drive sleeve in driven relation with the one of said rotors through which it extends and with said gear, a drill shaft extending through said drive sleeve and connected for rotation therewith, and means for feeding said drill shaft through said drive sleeve, said feeding means including threads on said drill shaft, a feed nut threadedly engaging the threads on said drill shaft, a plurality of gears each providing a different speed and arranged coaxially with said feed nut and fixed to the latter for rotation therewith, gears meshing with said plurality of gears and means for connecting said last mentioned gears selectively in driven relation with said drive sleeve.

4. In a drilling apparatus, in combination, a drill spindle, a fluid actuated motor having geared rotors meshing with each other, one of said rotors arranged coaxial with said spindle, speed changing gearing driven by another of said rotors including a driving element coaxial with said spindle and rotating at a speed different from the speed of rotation of said one of said rotors, and means for connecting selectively said one of said rotors and said driving element in driving relation with said spindle whereby the latter may be driven at either of two different speeds.

5. In a drilling apparatus, a casing, a shaft journaled within said casing, a pressure fluid operated motor comprising a pair of intermeshing toothed rotors, one of which is coaxial with and surrounds said shaft, a rotatable member coaxial with said shaft, speed reducing gearing connecting said other rotor and said member whereby said member rotates at a speed different from that of the speed of said one rotor, and shiftable means operable at will for alternatively connecting said one rotor and said member in driving relation with said shaft.

6. In a drilling apparatus, a casing, a shaft journaled within said casing, a pressure fluid operated motor comprising a pair of intermeshing toothed rotors, one of said rotors being of substantially larger diameter than the other and arranged coaxial with said shaft, a rotatable member coaxial with said shaft, speed reducing gear connecting said smaller rotor and said member for rotating the latter at a speed different from the speed of said large rotor, and shiftable means for alternatively connecting said large rotor and said member in driving relation with said shaft.

7. In a drilling apparatus, the combination comprising a drill spindle having a keyway ex-

tending longitudinally thereof, a motor having a motor rotor element coaxial with said spindle and through which said spindle extends, speed reducing gearing driven by said motor including a driven element coaxial with said spindle and rotating at a speed substantially slower than the speed of rotation of said motor rotor element, a sliding key engaging said keyway and movable selectively into engagement with said elements whereby said drill spindle may be driven at either of two different speeds, a drill rotating element having splined connection with said drill spindle whereby said rotating element may rotate with said spindle while axial movement of said rotating element relative to said spindle is permitted, and means for feeding said rotating element axially relative to said spindle including speed reducing gearing driven by said spindle.

8. In a drilling apparatus, the combination comprising a drill housing, a tubular shaft journaled in said housing, a tubular feed nut journaled in said housing in longitudinal alignment with said shaft, an externally threaded feed screw extending axially through said shaft and said nut and splined to said shaft for rotation therewith and for axial movement relative thereto, said feed nut having internal threads engaging the external threads on said feed screw, a fluid operated motor having intermeshing rotors actuated by pressure fluid, one of said rotors being arranged in coaxial relation with said shaft and through which said shaft extends, a driving connection between one of said rotors and said shaft including a driven element secured to the outer end of said shaft for driving the latter, speed reducing gearing between the inner end of said shaft and said feed nut for rotating the latter at a speed different from the speed of rotation of said shaft whereby said feed nut may effect axial movement of said feed screw relative to said shaft, and a drilling implement driven by said feed screw.

ROBERT ANTHONY McCALLUM.

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