

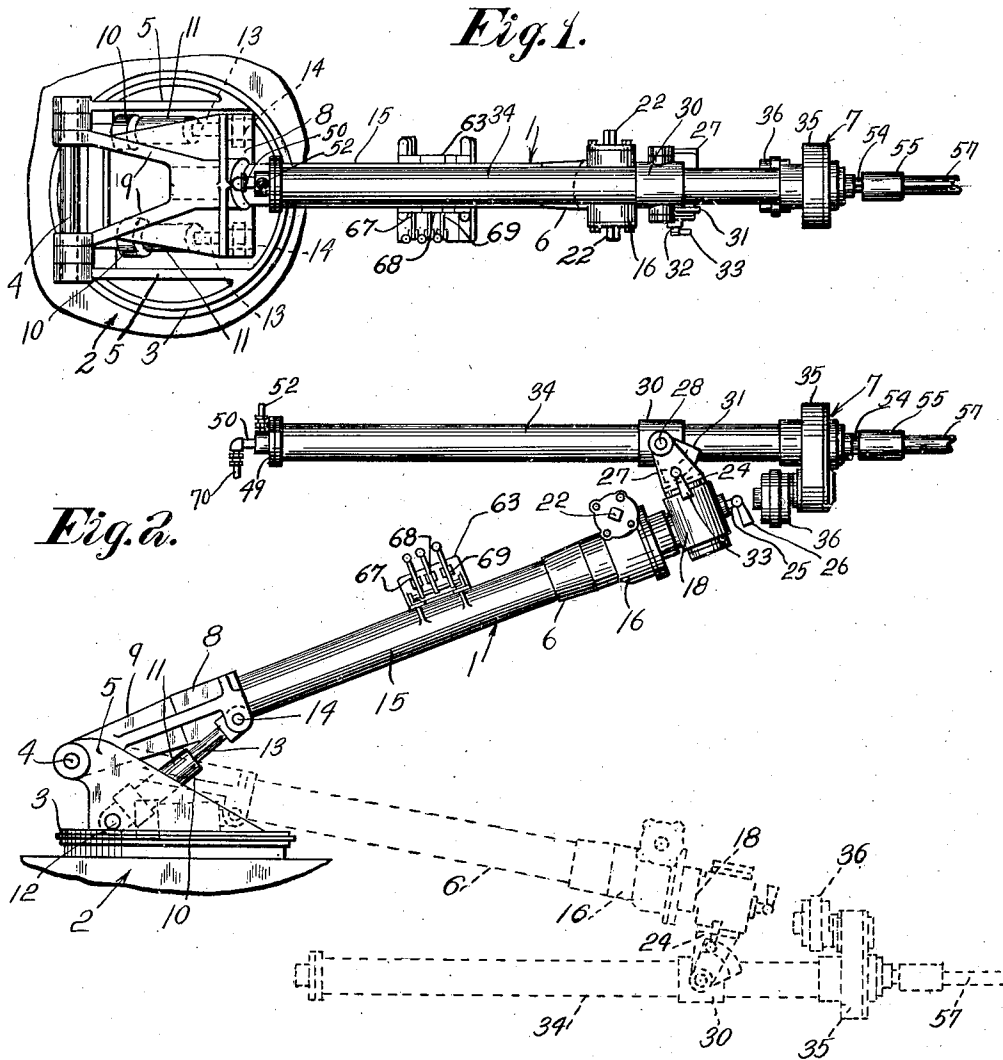
Dec. 13, 1949

R. A. LEHNER
DRILLING APPARATUS

2,491,273

Filed March 24, 1945

3 Sheets-Sheet 1



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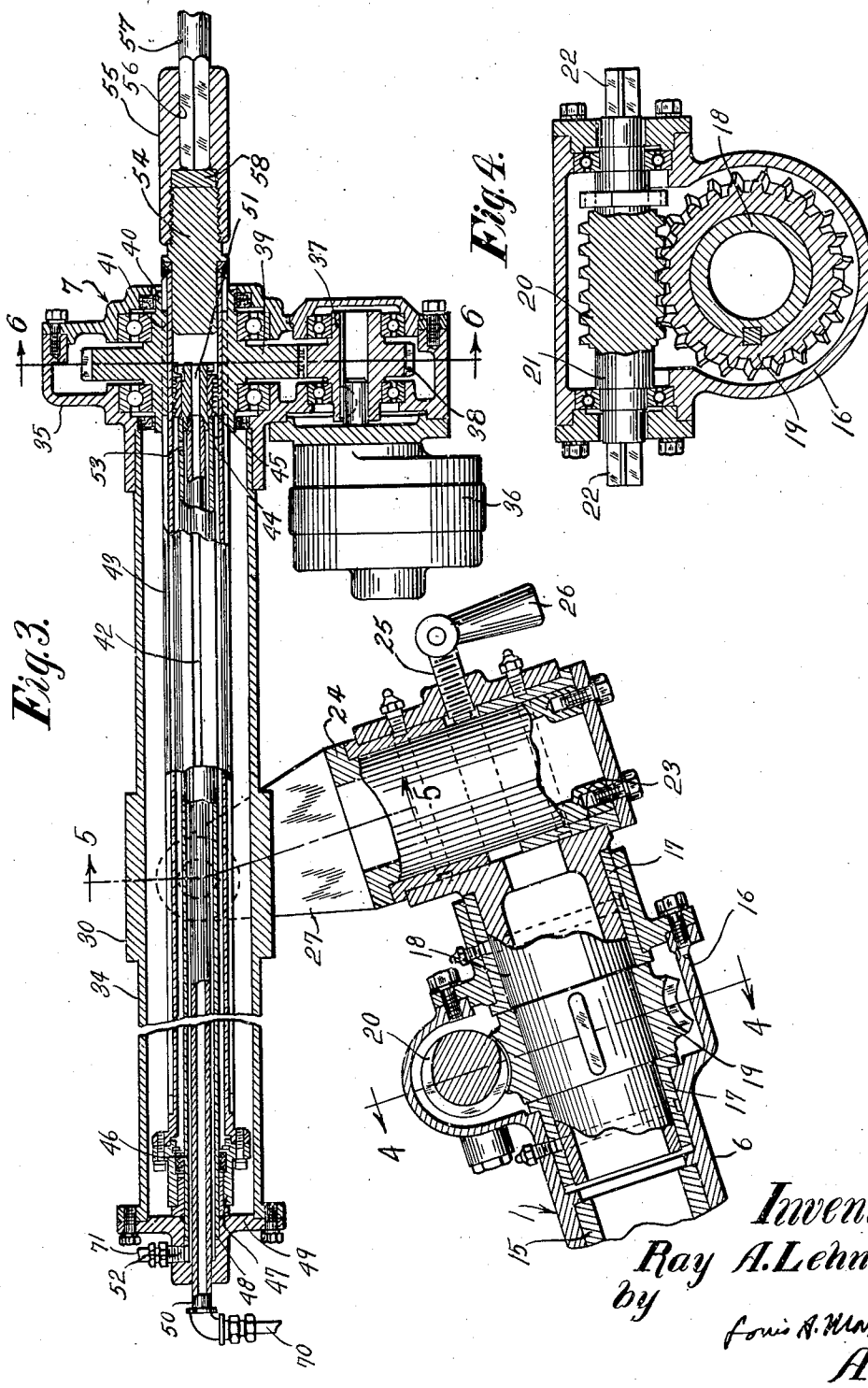
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Fig. 5.

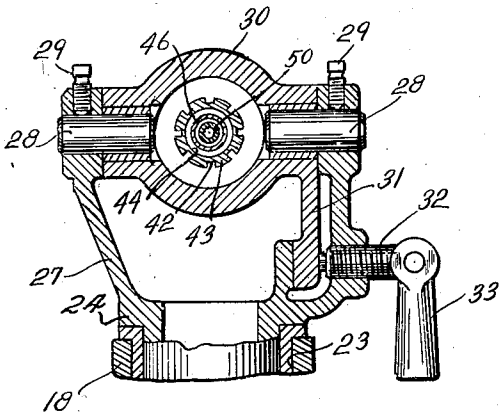


Fig. 6.

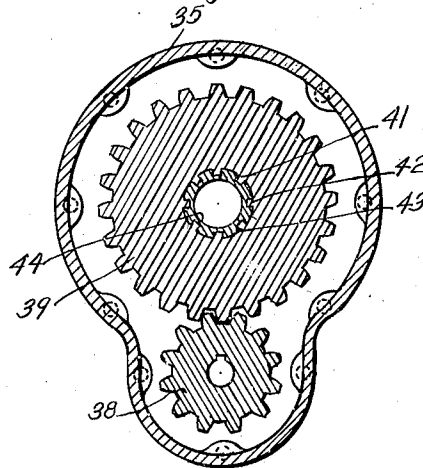
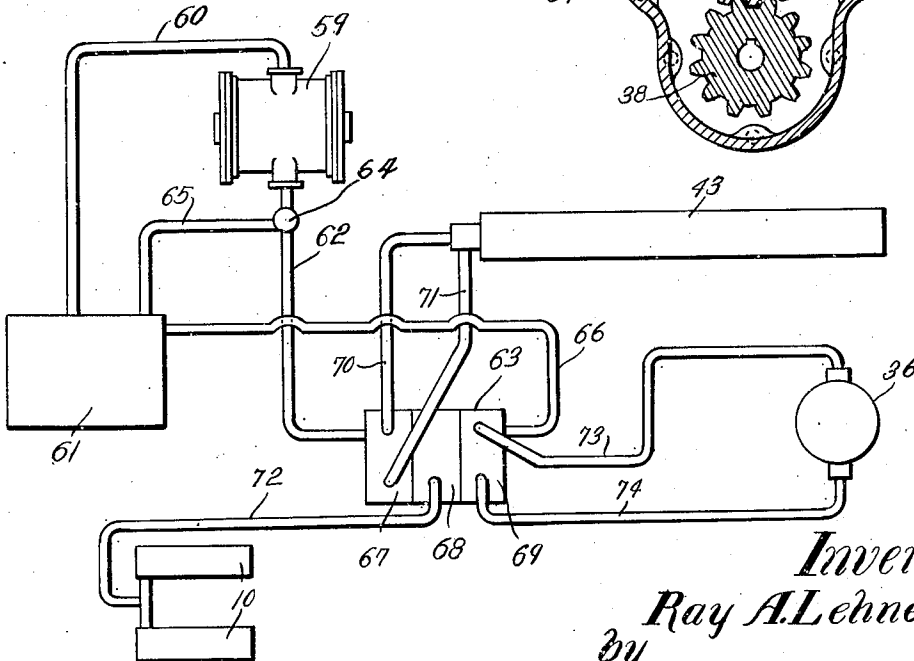


Fig. 7.



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UNITED STATES PATENT OFFICE

2,491,273

DRILLING APPARATUS

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Application March 24, 1945, Serial No. 584,608

5 Claims. (Cl. 255—46)

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This invention relates to drilling apparatus and more particularly, but not exclusively, to improvements in a rotary coal drill of the fluid operated type for drilling blast holes in a coal seam.

An object of the present invention is to provide an improved drilling apparatus. Another object is to provide an improved rotary coal drill of the fluid operated type whereby blast holes may be drilled in the coal face in an improved manner. A further object is to provide an improved rotary drill having improved feeding and rotating means for the drilling implement. Yet another object is to provide an improved feeding and rotating means for a drilling implement wherein an element of the feeding means is associated with an element of the rotating means in an improved manner. Still another object is to provide an improved feeding and rotating means embodying a feeding and rotating element common to both the feeding and rotating functions. A further object is to provide an improved fluid operated coal drill. A still further object is to provide an improved drilling apparatus embodying a novel combination and arrangement of parts whereby the drill structure is simplified. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

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

In these drawings:

Fig. 1 is a plan view of a drilling apparatus constructed in accordance with an illustrative embodiment of the invention.

Fig. 2 is a side elevational view of the drilling apparatus shown in Fig. 1, the lowered position of the drilling tool being indicated in dotted lines.

Fig. 3 is an enlarged view in central longitudinal section taken through the drilling tool and a portion of its adjustable support.

Fig. 4 is a cross-sectional view taken substantially on line 4—4 of Fig. 3.

Fig. 5 is a cross-sectional view taken substantially on line 5—5 of Fig. 3.

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 3.

Fig. 7 is a diagrammatic view illustrating the hydraulic system.

In this illustrative embodiment of the invention the improved drilling apparatus generally designated 1 may be supported on a portable base, generally designated 2, of any appropriate form, and under certain conditions the drilling apparatus may be mounted on a coal cutting machine

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so that it can operate in conjunction with the cutting mechanism of the machine. Evidently the drilling apparatus, due to its design, may be associated with other types of equipment and mounted in various manners, and it is not desired to limit the invention to any particular form of supporting base.

Carried by the base 2 is a horizontal turntable 3 which may be rotated in any suitable manner either by hand or by power. Pivotaly mounted on a transverse shaft 4 supported by brackets 5 on the turntable to swing in a vertical direction is an elongated boomlike support or boom frame 6 on the outer extremity of which a drilling tool 7 is swivelly mounted. The boom frame 6 includes a rear frame portion 8 having spaced arms 9 pivotally mounted on the shaft 4 between the brackets, and extending between the frame portion 8 and the turntable is a pair of extensible lifting jacks 10. The jacks are herein fluid operated and have cylinders 11 pivotally mounted at their rear ends at 12 on the turntable brackets 5 and containing pistons having their piston rods 13 pivotally connected at 14 to the frame portion 8 of the boom frame beneath the latter. Secured to the frame portion 8 and extending outwardly therefrom is a tubular support 15 having a housing 16 secured to its outer end, and this housing has bearing sleeves 17, 17 arranged therein in which a rotatable support 18 is journaled for rotation about the longitudinal axis of the boom frame. Enclosed within the housing is worm gearing including a worm wheel 19 keyed to the rotatable support intermediate the support bearings, and a worm 20 meshes with the worm wheel and is fixed to a transverse shaft 21 suitably journaled within the housing 16. This shaft has polygonal end portions 22, 22 shaped to receive a suitable turning lever or crank. The teeth of the worm gears are self-locking and serve to lock the rotatable support 18 in adjusted position with respect to the boom. The rotatable support 18 has formed in its outer portion a transverse bore 23 in which a cylindrical portion of a rotatable support 24 is journaled for rotation about an axis at right angles to the axis of rotation of the rotatable support 18. Threaded in an opening in the support 18 is a set screw 25 having an operating handle 26 and engageable with the cylindrical portion of the rotatable support 24 for locking the latter in its adjusted position with respect to the support 18. The rotatable support 24 has an outer yoke shaped portion 27 supporting pivot pins 28 held in position in bores in the yoke arms by set screws

29. The pivot pins support bearing sleeves on which a supporting frame 30 is pivotally mounted to rock about a transverse axis with respect to the rotatable support 24. The pivotal axis for the frame 30 is located at one side of the longitudinal axis of the boom frame as shown in Fig. 2. The drilling tool 7 is carried by the rocking frame 30 as later explained, and the rocking support has a frame sector 31 integral therewith and engageable by a set screw 32 threaded within an opening in the yoke frame 27 and having an operating handle 33. The set screw is engageable with the frame segment 31 for locking the rocking frame 30 in its adjusted position on its pivot with respect to the rotatable support 24. It is accordingly evident that the boom frame may be swung in a vertical direction with respect to the turntable and in a horizontal direction with the turntable, the supports 18 and 24 may be adjusted about their respective axes, and the rocking frame 30 may be tilted about its pivot, to vary the supported position of the drilling tool 7. The adjustable supporting structure above described is disclosed and claimed in my copending application Ser. No. 662,641, filed April 16, 1946, which is a division of the present application.

Now referring to the specific structure of the drilling tool, it will be observed that carried by the rocking frame 30 and rigidly secured thereto as by welding is an elongated tubular housing or tubular support 34 arranged so that its longitudinal axis and the pivotal axis of the frame 30 lie in a common longitudinal plane. Carried at the forward end of the tubular housing 34 is a drill housing 35 by which a motor 36 is carried. This motor is of a conventional fluid operated type, herein hydraulically operated, and has its power shaft keyed to a shaft 37 suitably journaled within the drill housing. Secured to the shaft 37 is a gear 38 meshing with and driving a spur gear 39 likewise arranged within the drill housing. The gear 39 is formed on a tubular shaft 40 journaled within the drill housing and which has splines 41 engaged in longitudinal splineways 42 formed on the exterior of a rotatable and reciprocable tubular element 43. The bearings for the shaft 40 are located at opposite sides of the spur gear 39, as shown in Fig. 3, and dirt seals are arranged between the housing and the shaft to keep out dirt. The tubular element or drill spindle 43 is herein in the form of a reciprocable feed cylinder having a bore 44 containing a feed piston 45; the latter being fixed to a stationary piston rod 46. The piston rod extends rearwardly through the packed rear head 47 of the feed cylinder and is rigidly secured at 48 to an end plate 49 in turn secured as by screws to the rear end of the tubular housing 34. The feed piston is disposed within the confines of said tubular shaft 40, so that a transverse plane cutting the gear 39 passes through the piston. Fluid under pressure may be supplied through a pipe or tube 50 extending centrally within the piston rod, which is herein of tubular form, to an axial passage 51 in the feed piston, the passage 51 communicating with the front end of the cylinder bore in advance of the piston. A pipe connection 52 communicates with the space between the inner wall of the tubular piston rod and the exterior of the tube 50, and this space communicates through a port 53 with the cylinder bore at the rear side of the feed piston. Secured within the forward portion of the tubular element 43 is a cylindrical portion of a plug member 54, and this plug is welded to the tubular

element and provides the front cylinder head. Threaded to this plug 54 is a chuck 55 having a polygonal socket 56 for receiving the polygonal shank of a conventional drilling implement 57, such as an auger drill steel. Secured between the chuck and the forward end of the plug 54 is a hard metal disk 58 against which the inner end of the shank of the drilling implement abuts. When the tubular element 43 is retracted, the rearward portion of the plug 54 lies within the tubular shaft 40 in adjacency to the stationary feed piston.

The hydraulic system, as shown in Fig. 7, embodies a motor driven pump 59 having its intake connected by a conduit 60 to a liquid tank 61. The pump and tank may be arranged within the base 2 beneath the turntable if desired; or in the event the drilling apparatus is mounted on a coal cutting machine, the pump and tank may be embodied within the machine. The pump discharge is connected through a conduit 62 to a conventional valve box 63, herein desirably mounted on the boom frame near the drilling tool, as shown in Fig. 2. The discharge conduit 62 is connected through a conventional relief valve 64 and conduit 65 back to the tank so as to by-pass the pressure line in the event of overload. The valve box has a pressure passage with which the pressure line 62 communicates and a discharge passage connected through a return conduit 66 back to the tank. The valve box contains three conventional control valves 67, 68 and 69, herein preferably balanced slide valves, and the valve 67 controls the connection of flexible conduits 70 and 71 leading to the pipes 50 and 52 respectively, respectively with the supply and discharge passages of the valve box. The valve 68 controls the connection of a conduit 72 which leads to the lower ends of the cylinders of the boom-lift jacks 10, selectively with the supply and discharge passages of the valve box. The valve 69 controls the connection of flexible conduits 73 and 74 leading to the opposite sides of the rotating motor 36, with the supply and discharge passages of the valve box.

The general mode of operation of the improved apparatus is as follows: When the drilling apparatus is suitably positioned with respect to the face of the coal seam to be drilled, liquid under pressure may be supplied from the pump to the jack cylinders under the control of the valve 68 to effect swinging of the boom frame upwardly about its pivot with respect to the turntable 3, and the valve may be positioned to trap the liquid within the jack cylinders to lock the boom frame in adjusted position. When the valve 68 is positioned to connect the conduit 72 to the exhaust, the boom frame may be lowered, as desired. The worm gearing 19, 20 may be manually operated to rotate the support 18 with respect to the boom frame to locate the drilling tool about the boom frame axis as desired, and the gear teeth of the worm gearing lock the support 18 in adjusted position with respect to the boom frame. The set screw 25 may be loosened to turning of the rotatable support 24 about its axis with respect to the support 18 and thereafter the set screw may be tightened firmly to lock the support in adjusted position. The setscrew 32 may be loosened to permit rocking of the tilting frame 30 with respect to the support 24 to vary the inclination of the drilling tool with respect to the longitudinal axis of the boom frame, and, by tightening the set screw against the frame segment 31, the drilling tool may be

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firmly locked in its adjusted position. The valve 69 may then be positioned to supply liquid under pressure from the pump to the motor 36 to effect rotation of the tubular element 43 together with the drilling implement 57, and, as the drilling implement is rapidly rotated, the valve 67 may be positioned to admit liquid under pressure through the conduit 70 and tube 50 to the forward end of the feed cylinder bore 44 at the forward side of the stationary feed piston 45 to feed the drilling implement forwardly toward the work. When it is desired to retract the feed cylinder, this may be accomplished by positioning the valve 67 to connect the conduit 70 to exhaust and to supply liquid under pressure to conduit 71 and pipe connection 52 and port 53 to the feed cylinder bore at the rear side of the feed piston. The drilling tool may be adjusted with the rotatable support 18 about the longitudinal axis of the boom frame and may be adjusted about rectangularly related axes relative to the rotatable support 18, thereby enabling adjustment of the drilling tool through a wide range of drilling positions with respect to the boom frame. By mounting the boom frame for vertical swinging movement on, and for horizontal turning movement with, the turntable, the boom frame may be adjusted in vertical and horizontal planes with respect to the base, thereby providing a wide range of operation of the drilling tool. By locating the valve box on the boom frame near the drilling tool, control of the drilling motor, the boom frame and the feeding means is facilitated.

As a result of this invention, an improved drilling apparatus is provided whereby blast holes may be drilled in a coal face at various locations, and, by the provision of the improved adjustable support and swivel mounting for the drilling tool, the latter may be easily and quickly adjusted to the desired drilling position with respect to the work. It will be evident that by the provision of the improved fluid operated rotating and feeding means for the drilling implement, improved operation and more flexible control are attained. By associating the feeding means with the rotating means in the manner disclosed, the structure of the drilling tool is simplified. Other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form is shown for purposes of illustration only 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, the combination of a front gear housing having front and rear walls, gearing enclosed in said housing, a motor carried by said housing for driving said gearing, a short tubular shaft journaled in the front and rear walls of said housing, said gearing including a driving gear secured to said tubular shaft intermediate said housing walls, a tubular housing secured to the rear wall of said gear housing in coaxial relation with said shaft and gear and projecting rearwardly from said gear housing, a rear closure for said tubular housing, a reciprocable tubular drill spindle extending axially through and having splined connection with said

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tubular shaft and, when retracted, extending rearwardly from said shaft into said tubular housing, said spindle having a bore and a rear head closing said bore, a closure member for the forward end of said spindle bore and by which a chuck for a drilling implement is carried in advance of said housing, a stationary feed piston contained in said spindle bore and disposed within the confines of said tubular shaft and surrounded by said driving gear, said piston having a rearwardly extending piston rod secured at its rear end to said housing closure, said rear spindle head carrying packing means sealingly engaging the exterior surface of said piston rod, and means associated with said housing closure for supplying fluid under pressure through said piston rod to the spindle bore at the opposite sides of said feed piston.

2. In a drilling apparatus, the combination comprising a front gear housing having front and rear walls, gearing enclosed in said housing, a motor carried by said housing for driving said gearing, a short tubular shaft, said gearing including a driving gear secured to said tubular shaft, bearings supported within the front and rear walls of said housing at the opposite sides of said gear and in which said tubular shaft is journaled, seals supported within said housing walls at the outer sides of said bearings and sealingly engaging the exterior cylindrical end surfaces of said shaft to prevent leakage of lubricant from said gear housing, a tubular housing secured to the rear wall of said gear housing in coaxial relation with said shaft and gear and projecting rearwardly from said gear housing, a rear closure for said tubular housing, a reciprocable tubular drill spindle extending axially through and having splined connection with said short tubular shaft and, when retracted, extending rearwardly from said shaft into said tubular housing, said spindle having a bore and a rear head closing said bore, a closure member for the forward end of said spindle and by which a chuck for a drilling implement is carried in advance of said gear housing, a stationary feed piston contained in said spindle bore and disposed within the confines of said tubular shaft and surrounded by said driving gear, said piston having a rearwardly extending tubular piston rod secured at its rear end to said housing closure, said rear spindle head carrying packing means sealingly engaging the exterior of said piston rod, and means associated with said housing closure for supplying fluid under pressure through said tubular piston rod to said spindle bore at the opposite sides of said feed piston.

3. In a drilling apparatus, the combination comprising a front gear housing having front and rear walls, gearing enclosed in said housing, a motor carried by said housing for driving said gearing, a short tubular shaft, said gearing including a driving gear secured to said tubular shaft, bearings supported within the front and rear walls of said housing at the opposite sides of said gear and in which said tubular shaft is journaled, seals supported within said housing walls at the outer sides of said bearings and sealingly engaging the exterior cylindrical end surfaces of said shaft to prevent leakage of lubricant from said gear housing, a tubular housing secured to the rear wall of said gear housing in coaxial relation with said shaft and gear and projecting rearwardly from said gear housing, a rear closure for said tubular housing, a reciprocable tubular drill spindle extending axially through and having splined connection with said short

tubular shaft and when retracted extending rearwardly from said shaft into said tubular housing, said spindle having a bore and a rear head closing said bore, a closure member for the forward end of said spindle and by which a chuck for a drilling implement is carried in advance of said gear housing, a stationary feed piston contained in said spindle bore and disposed within the confines of said tubular shaft and surrounded by said driving gear, said piston having a rearwardly extending tubular piston rod secured at its rear end to said housing closure, said rear spindle head carrying packing means sealingly engaging the exterior of said piston rod, said front spindle closure member, when said spindle is retracted, extending within the confines of said tubular drive shaft in advance of and in adjacency to said stationary feed piston, and means associated with said housing closure for supplying fluid under pressure through said tubular piston rod to said spindle bore at the opposite sides of said feed piston.

4. In a drilling apparatus, the combination comprising a front gear housing having front and rear walls, gearing enclosed in said housing, a motor carried by said housing for driving said gearing, a short tubular shaft, said gearing including a driving gear secured to said tubular shaft, bearings supported within the front and rear walls of said housing at the opposite sides of said gear and in which said tubular shaft is journaled, seals supported within said housing walls at the outer sides of said bearings and sealingly engaging the exterior cylindrical end surfaces of said shaft to prevent leakage of lubricant from said gear housing, a tubular housing secured to the rear wall of said gear housing in coaxial relation with said shaft and gear and projecting rearwardly from said gear housing, a rear closure for said tubular housing, a reciprocable tubular drill spindle extending axially through and having splined connection with said short tubular shaft and, when retracted, extending rearwardly from said shaft into said tubular housing, said spindle having a bore and a rear head closing said bore, a closure member for the forward end of said spindle and by which a chuck for a drilling implement is carried in advance of said gear housing, a stationary feed piston contained in said spindle bore and disposed within the confines of said tubular shaft and surrounded by said driving gear, said piston having a rearwardly extending tubular piston rod secured at its rear end to said housing closure, said rear spindle head carrying packing means sealingly engaging the exterior of said piston rod, and means associated with said housing closure for supplying fluid under pressure through said tubular piston rod to said spindle bore at the opposite sides of said feed piston, said fluid supply means including a stationary conduit secured to said housing closure and extending axially through said tubular piston rod and secured at its front end to said piston, said piston having an axial passage connecting said conduit with said spindle bore in advance of said piston.

5. In a drilling apparatus, the combination comprising a front gear housing having front and rear walls, gearing enclosed in said housing, a motor carried by said housing for driving said gearing, a short tubular shaft, said gearing in-

cluding a driving gear secured to said tubular shaft, bearings supported within the front and rear walls of said housing at the opposite sides of said gear and in which said tubular shaft is journaled, seals supported within said housing walls at the outer sides of said bearings and sealingly engaging the exterior cylindrical end surfaces of said shaft to prevent leakage of lubricant from said gear housing, a tubular housing secured to the rear wall of said gear housing in coaxial relation with said shaft and gear and projecting rearwardly from said gear housing, a rear closure for said tubular housing, a reciprocable tubular drill spindle extending axially through and having splined connection with said short tubular shaft and, when retracted, extending rearwardly from said shaft into said tubular housing, said spindle having a bore and a rear head closing said bore, a closure member for the forward end of said spindle and by which a chuck for a drilling implement is carried in advance of said gear housing, a stationary feed piston contained in said spindle bore and disposed within the confines of said tubular shaft and surrounded by said driving gear, said piston having a rearwardly extending tubular piston rod secured at its rear end to said housing closure, said rear spindle head carrying packing means sealingly engaging the exterior of said piston rod, and means associated with said housing closure for supplying fluid under pressure through said tubular piston rod to said spindle bore at the opposite sides of said feed piston, said fluid supply means including a stationary conduit secured to said housing closure and extending axially through said tubular piston rod and secured at its front end to said piston, said piston having an axial passage connecting said conduit with said spindle bore in advance of said piston, there being an annular space surrounding said conduit within said tubular piston rod rearwardly of said piston, a fluid conduit secured to said housing closure and communicating with said annular space, and a port traversing the forward portion of said tubular piston rod for connecting the front end of said annular space with said spindle bore rearwardly of said feed piston.

RAY A. LEHNER.

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Certificate of Correction

Patent No. 2,491,273

December 13, 1949

RAY A. LEHNER

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 66, before the word "turning" insert *permit*;
and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of October, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.