

June 14, 1949.

E. L. ALEXANDER ET AL

2,472,999

PORTABLE DRILLING RIG

Filed June 4, 1945

3 Sheets-Sheet 1

Fig. 1.

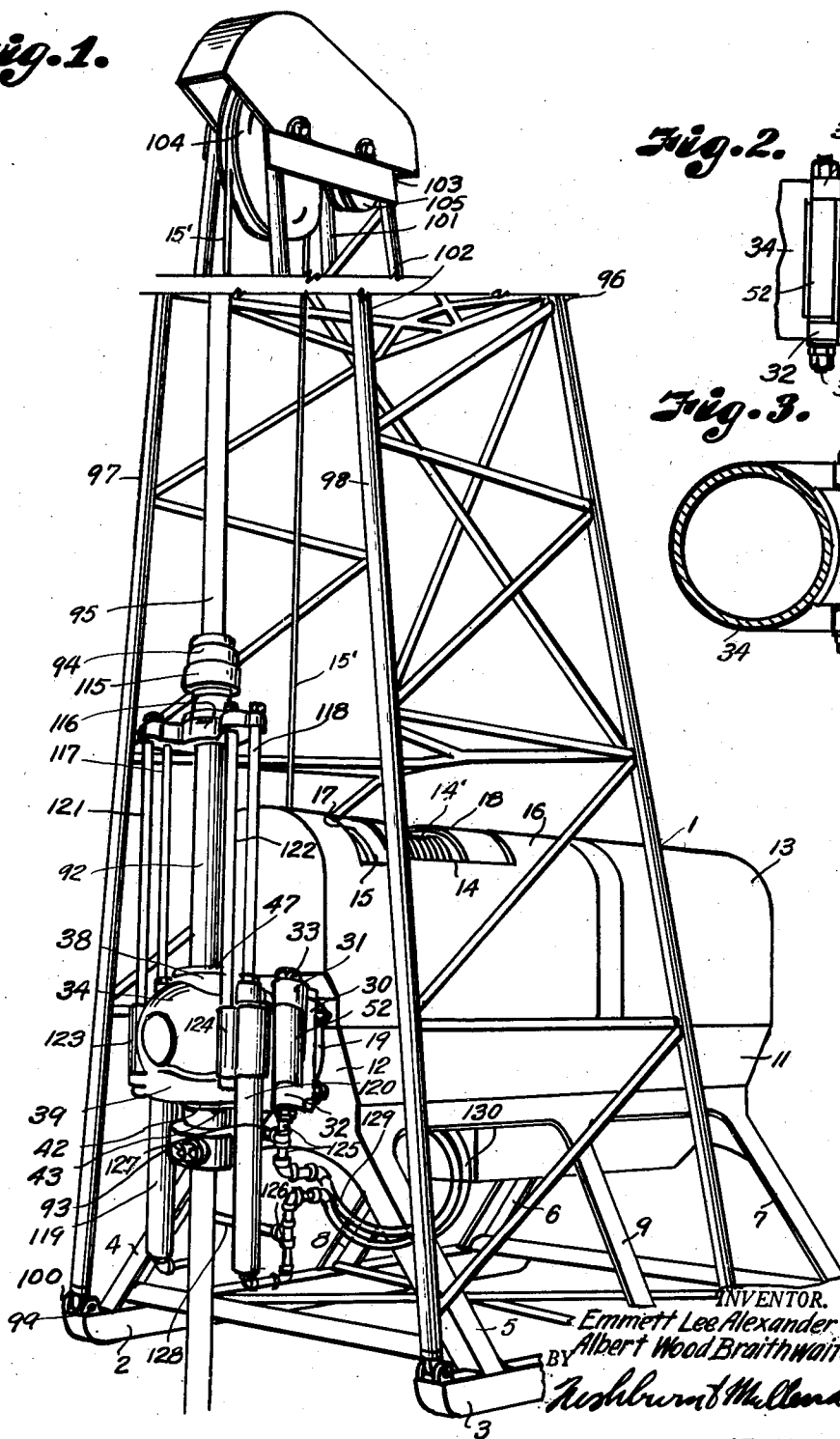


Fig. 2.

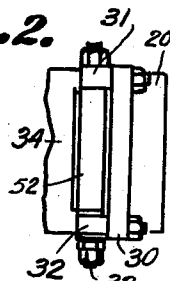
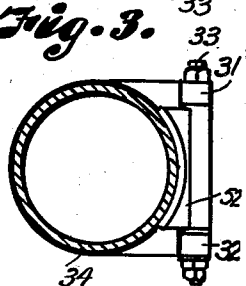


Fig. 3.



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3 Sheets-Sheet 2

Fig. 4.

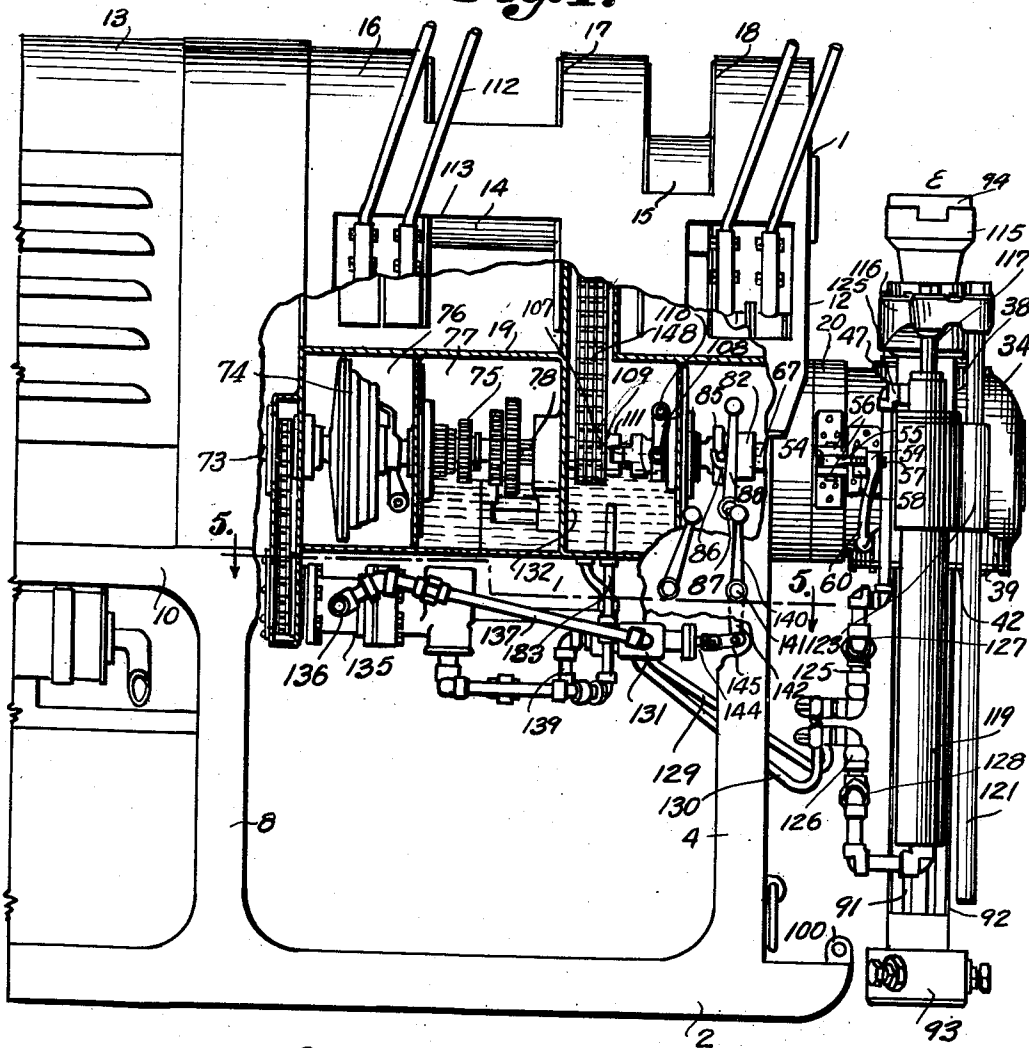
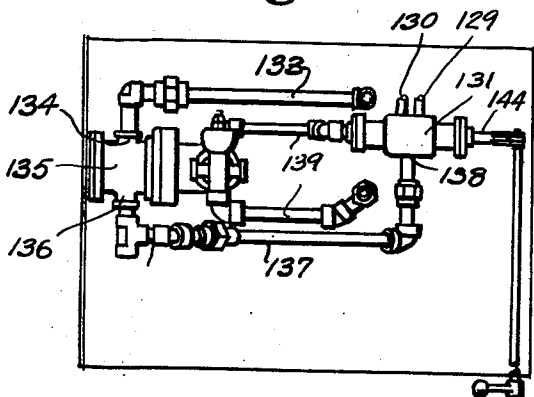


Fig. 5.



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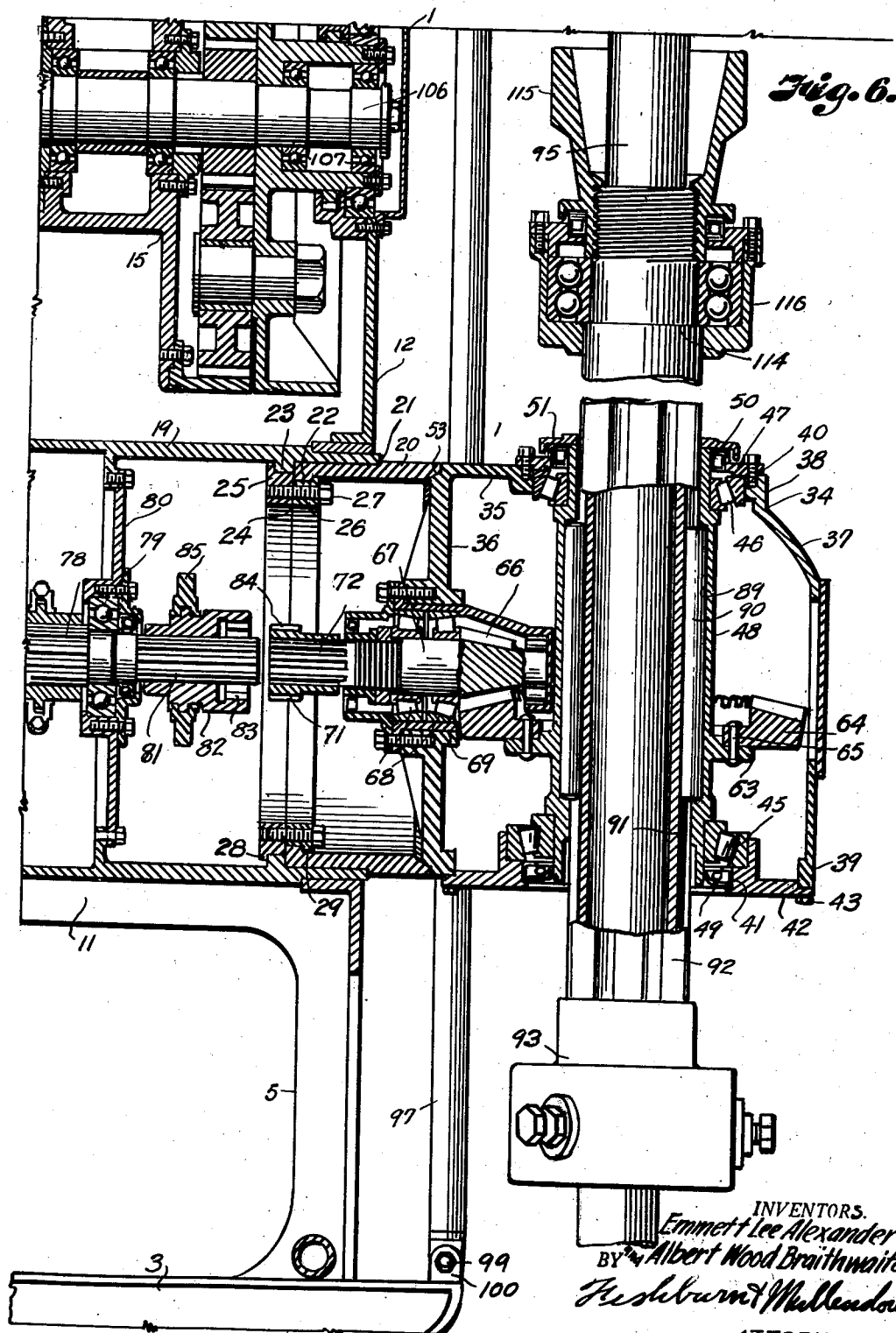
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

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PORTABLE DRILLING RIG

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4 Claims. (Cl. 255—22)

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The invention relates to drilling rigs of the type used in drilling bore holes in earth formations and has for its principal object to provide a relatively small, compact, light-weight skid-mounted drilling unit that is readily transported from one drilling site to another.

Other objects of the invention are to provide a skid mounting for the drilling apparatus wherein the skid frame forms a unitary part of the frame carrying the various mechanisms of the drilling unit; to provide a drilling unit equipped with a swivel mounted drill rotating mechanism for drilling bore holes at various angles with respect to the perpendicular; to provide a hinge support for the rotating mechanism on the swivel mounting whereby the drill rotating mechanism is adapted to be swung out of drilling position as when running in or pulling drill pipe casing or the like; to provide a hinging structure whereby the hinging axis, when extended, extends substantially tangentially with the periphery of the crown pulley on the drilling mast for retaining the axis of the rotating apparatus in alignment with the crown pulley, thereby facilitating movement of the drill rotating mechanism when carrying the drill rod; to provide a housing for the various driving mechanisms formed as a unitary part of the skid supported frame and which is adapted to contain the parts in a bath of lubricating oil, the oil also being used for the fluid supply in operating the hydraulic cylinders of the drill feeding mechanism which is used to control pressure on the drill bit when the drilling apparatus is in operation; and to provide a simplified piping system through which fluid is supplied to the hydraulic mechanism.

In accomplishing these and other objects of the invention, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawings wherein:

Fig. 1 is a perspective view of a drilling unit constructed in accordance with the present invention, a portion of the mast being broken away to shorten the drawing.

Fig. 2 is a fragmentary side view of the hinge connection for mounting the drill rotating and feed mechanisms.

Fig. 3 is a front view of the swivel ring and hinge mounting.

Fig. 4 is a side view of a portion of the drilling unit, part of which is broken away to better illustrate the various driving mechanisms and the piping system by which hydraulic fluid is supplied to operate the drill feeding mechanism.

Fig. 5 is a horizontal section on the line 5—5 of

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Fig. 4 particularly illustrating the pump and piping system.

Fig. 6 is an enlarged vertical section through the drilling unit, particularly illustrating the swivel mounting of the drill rotating and feed mechanisms and the clutch connection between the power unit shaft and the shaft of the drill rotating mechanism.

Referring more in detail to the drawings:

1 designates a drilling rig constructed in accordance with the present invention and which includes a pair of laterally spaced parallel skids 2 and 3 mounting upwardly and inwardly inclined legs 4—5 and 6—7 at the respective ends thereof, and intermediate legs 8—9 for carrying longitudinal side wall portions 10 and 11 formed as a part of the leg structure and which are connected at the ends by transverse end wall portions 12. The side wall portions carry a power unit indicated by the housing 13 at the forward ends thereof. The side wall portions also carry sand and hoisting reels 14 and 15 that are covered by a guard 16 having openings 17 and 18 registering with the respective reels for passing the sand 25 line 14' and hoisting cable 15' used in the operation of the drilling unit as in conventional drilling practice.

Extending longitudinally between the side portions 10 and 11 is a substantially cylindrical housing 19 for containing the drives for the various operating mechanisms later described. The housing 19 opens through the end wall portion 12 at the rear end of the frame and carries the drill rotating and control mechanisms. The drill rotating mechanism is connected by a swivel ring 20 sleeved within the open end of the housing 12 and having an annular shoulder 21 engaging the end of the housing and an inwardly extending flange 22 which abuts against an inwardly extending flange 23 of the housing 10. The swivel ring is retained in the housing by a keeper ring 24 including a pair of ring-like sections 25 and 26 secured together by bolts 27 passing through the openings in the ring 26 and engaged in threaded sockets in the ring 25 whereby the annular flanges 28 and 29 on the respective sections are held in engagement with inwardly extending flanges 22 and 23 respectively. Thus, the flanges are retained in abutting engagement; however, the ring 20 is adapted to turn about the axis of the housing for positioning the drill rotating mechanism at various angles later described.

Extending from one side of the swivel ring (Figs. 1, 2, and 3) is a laterally extending wing-

like plate 30 carrying ears 31 and 32 on the upper and lower portions thereof to carry hinge elements 33 on which the gear housing 34 is adapted to swing to and from axial registry with the axis of the housing 19. The gear housing is best illustrated in Fig. 6 and includes an annular wall 35 forming a continuation of the ring 20 and which is closed at the end adjacent the ring 20 by a plate-like portion 36 and at the opposite end by a rounded wall 37. Formed on the gear housing on an axis at right angles to the axis of the swivel ring are collar portions 38 and 39 encircling axial openings 40 and 41. The opening 41 at the bottom of the housing is closed by a plate 42 secured by fastening devices such as cap screws 43. The plate 42 and the annular wall 35 respectively support anti-friction bearings 45 and 46 which journal spaced portions of the drive sleeve 48. The bearings are provided with oil seal rings 49 and 50 on the outer sides of the anti-friction bearings 45 and 46 to retain lubricant within the gear housing and prevent entrance of drilling fluid. The top bearing is enclosed by a cap 51 fixed to the upper end of the sleeve and adapted to rotate therewith. Projecting from the side of the gear housing is a lug 52 engaged between the ears and secured thereto by the hinging elements 33, the hinging axis is set at an angle and when extended intersects the periphery of the crown pulley of the mast (later described) at the point from where the drill cable turns downwardly to connect with the drilling string.

The gear housing is retained in engagement with a bevel seat 53 in the end of the swivel ring by a clamp 54 including an eye bolt 55 pivotally mounted between a pair of ears 56 extending laterally from the side of the swivel ring opposite the hinge connection. The eye bolt has a threaded shank 57 adapted to be extended between a pair of laterally projecting ears 58 on the gear housing and the shank mounts a nut 59 that is adapted to be drawn into clamping engagement with the ears 58 by a hand lever 60. Upon release of the clamping engagement, the eye bolt of the clamp may be swung on the pivot connection out of engagement with the lugs whereupon the gear housing is free to move away from the swivel ring and to the side of the axis of the bore hole.

Extending circumferentially of the sleeve 48 within the gear housing is a flange 63 mounting a ring gear 64 that is secured thereto by fastening devices such as rivets 65. The ring gear is rotated by a pinion 66 that meshes therewith and which is carried on a stub shaft 67 rotatably mounted in anti-friction bearings 68 located within a bearing opening 69 of the plate portion 36 of the gear housing. The stub shaft extends into the coupling ring and carries a toothed clutch element 71 fixed thereto by splines 72. The power shaft 73 of the power unit is located coaxially with the housing 19 and is connected through a main clutch 74 with a variable speed transmission 75, both of which are located within compartments 76 and 77 formed in the housing 19. The power delivery shaft 78 of the transmission extends rearwardly within the housing and terminates adjacent the stub shaft 67, the shaft being suitably mounted in anti-friction bearings 79 carried by the partitions 80 extending transversely of the housing 19. The terminal end of the shaft 78 is splined as at 81 to slidably connect a coupling element 82 having internal teeth 83 adapted to mesh with the teeth 84 on the coupling element 71 previously described. The

coupling element 82 is operated by a collar 85 mounted thereon and which is connected by an arm 86 on an operating shaft 87 mounted in the housing 19 and which has one end extending through the side wall portion of the frame for mounting an operating lever 88 whereby the shaft may be rocked to move the clutch element 82 to and from clutch engagement with the clutch element 71 on the stub shaft 67. Therefore, when the main clutch is engaged and the clutch elements 82 and 71 are interconnected, the drive pinion 66 is rotated to rotate the ring gear 64 which rotates the sleeve 48 within the bearings of the gear case.

Formed in the inner face of the sleeve 48 are recesses 89 mounting roller-like keys 90 that engage in grooves 91 of a drive rod 92, which drive rod is projected through the sleeve and carries a gripping chuck 93 on the lower end thereof and a drive bushing 94 on the upper end, to engage a drill pipe or Kelly rod 95 that is projected through the drive rod as in customary drilling practice.

The drilling string is supported for movement through the drive rod by a mast 96 having legs 97 and 98 pivotally connected as at 99 with ears 100 on the rear ends of the skids 2 and 3. The mast also has legs 101 and 102 similarly connected with the skids. The legs converge inwardly and upwardly to connect with a pulley support 103 mounting a crown pulley 104 and a sand reel pulley 105 over which the cables from the sand reel and hoisting reel are respectively passed.

The reels previously mentioned are mounted on a shaft 106 having the ends journaled in bearings 107 carried in the ends 12. The reel shaft is operated by a chain 108 operating over a sprocket 109 on the shaft 78 and over an aligning sprocket (not shown) on the shaft 106. The sprocket 109 is normally loose on its supporting shaft but is adapted to be coupled thereto by a jaw clutch 107 movable into and out of position by an arm 103 engaged with a clutch ring 111 and which is operated by a rock shaft 110 oscillatively mounted in the frame and having a projecting end to which is connected a rock lever similar to the lever 88 previously described. The reels are under control of hand levers 112 that project through openings 113 in the side of the reel guard 16.

Connected with the upper end of the drive rod intermediate a shoulder 114 thereon and the drive bushing socket 115 is a transverse yoke 116 carrying depending piston rods 117 and 118 that are connected with pistons (not shown) operable in cylinders 119 and 120 carried by opposite sides of the gear housing. The yoke also carries guide rods 121 and 122 slidable in guides 123 and 124 projecting from the gear housing adjacent the cylinders.

Pressure fluid is supplied to the respective ends of the cylinders through pipes 125 and 126 that are connected with headers 127 and 128 having connection with hoses 129 and 130 leading to a control valve 131, the hose connections providing for swiveling and hinging movements of the drill rod rotating mechanism. The pressure fluid is contained within a compartment 132 of the housing 19 and also forms a lubricant for the drive mechanism contained therein. The pressure fluid is withdrawn from the lower portion of the housing through a pipe 133 having connection with the inlet 134 of a pump 135 that is suspended below the housing 19 and which has an outlet 136 with a pipe 137 leading to the inlet 138 of the control valve 131. The outlet of the con-

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trol valve 131 is connected by a pipe 139 through which the fluid is returned to the compartment 132. The control valve is operated to admit fluid alternately to the respective ends of the cylinders by a lever 140 located adjacent the lever 88 and which is mounted on a rock shaft 141 having a depending arm 142 connected with the valve stem 144 by links 145. The valve 131 may be of any ordinary construction and specifically forms no part of the present invention.

In operating the apparatus constructed and assembled as described, the drilling unit is transported to the site of drilling operation and the skids 2 and 3 are mounted on suitable sills if required to provide adequate support for the unit. The mast is erected and the drill cable is connected with the Kelly rod through a conventional swivel head (not shown) wherethrough drilling fluid is circulated through the drill rod and returned by way of the bore hole to be drilled as in regular practice. The Kelly rod is mounted within the drive rod and the bit (not shown) is connected with the lower end thereof to start the drilling operation. In drilling position the gear housing is latched in position so that it is directly over the axis of the hole to be drilled. Upon starting of the prime mover and engagement of the clutch 74 and the clutch element 82 with the clutch element 71, the pinion gear 66 drives the ring gear 64 to rotate the sleeve 48 which in turn rotates the drive rod 92 by reason of the keyed connection therewith. When the chuck 93 is engaged with the Kelly rod or drill pipe, the bit is rotated. Simultaneously the pump 135 is being operated to withdraw fluid from the compartment 132 and discharge the fluid under pressure through the valve 131 to the hose connection leading to the manifold which is connected to the upper end of the cylinders so that the pressure fluid acts on the tops of the pistons to move the pistons downwardly.

When the drive bushing 94 is engaged with the Kelly rod or drill pipe, pressure is exerted on the bit to enhance the drilling operation thereof. Pressure fluid is continued to be admitted to the upper end of the cylinders until the yoke 116 approaches the gear housing 34 wherein the setting of the valve 131 is changed to direct flow of pressure fluid to the lower end of the cylinders and to connect the upper end of the cylinders with the return pipe 139 leading to the compartment 132 in the housing 19. The drive bushing is disengaged and the drive rod is then lifted until the chuck 93 on the lower end thereof approaches the lower portion of the gear housing whereupon the drive bushing is again engaged with the Kelly rod or drill pipe as the case may be and the setting of the valve 131 is again changed. The setting of the valve is again changed to admit pressure fluid to the upper end of the cylinders and exhaust the fluid from the lower ends of the cylinders against establishing pressure on the bit.

These operations are continued until the upper end of the Kelly rod approaches the drive bushing whereupon the chuck and drive bushing are disengaged and the Kelly rod raised by the hoisting reel so that the lower joint thereof may be disconnected. After disconnection, the clamp is released and the gear housing carrying the pressure cylinders is swung laterally away from the bore hole on the hinge connection. Since the axial inclination of the hinge tilts the body as it is swung to an out-of-way position, the pull on the drill rod remains in alignment with the

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crown pulley to facilitate hinging movement of the drill unit. A section of the drill pipe is then connected to the drill bit and lowered into the bore hole by the sand reel, after which the rotating mechanism is again swung so that it seats upon the beveled edge of the swivel ring. In this position the clutch elements 71 and 82 are aligned so that they may be re-engaged. The Kelly rod is then connected to the upper end of the pipe section in the bore hole after which the chuck and drive bushing is engaged therewith and the clutch element having the internal teeth is moved into driving engagement with the clutch element having the external teeth, whereupon the drilling operation proceeds as above described.

From the foregoing it is obvious that we have provided a simple, light-weight drilling unit that is adapted to be readily transported from one drilling site to another and which is of strong, sturdy, and compact construction.

It is also obvious that the lubricant in the compartment 132 serves as the hydraulic fluid in operating the pressure mechanism associated with the drilling mechanism.

It is obvious that the drilling mechanism may be shifted so as to drill holes at various angles.

What we claim and desire to secure by Letters Patent is:

1. In a drilling apparatus, a supporting frame, a substantially cylindrical housing having ends supported on said frame and having an open end, a swivel ring carried in said open end of the housing and having a gear housing engaging seat, a drilling mechanism including a gear housing having a face engaging said seat, hinge means connecting the gear housing with the swivel ring, clamping means cooperating with said hinge means for retaining the gear housing in engagement with said seat when in drilling position, a driving shaft, means supporting the driving shaft in the housing coaxial with the swivel ring, a coupling element on said shaft, a driven shaft rotatably supported by the gear housing and bodily movable therewith, a coupling element on the driven shaft adapted to be carried into and out of alignment with the coupling element on the driving shaft when the gear housing is swung on the hinge means, and means for moving one of said coupling elements to engage with the other when the gear housing is in drilling position.

2. In a drilling apparatus of the character described, a supporting frame, an enclosure carried on the supporting frame including side and end wall portions and a cylindrical portion having one end supported in an opening of one of said end wall portions, a power unit carried on the supporting frame in alignment with said enclosure and having a power shaft rotatably supported in the opposite end of the cylindrical portion, transverse partitions in the cylindrical portion for forming clutch, transmission, and driving connection compartments, a transmission in the transmission compartment, a clutch in the clutch compartment connecting the power shaft with the transmission, a swivel ring, means rotatably supporting the swivel ring in said open end of the cylindrical portion, a drilling unit including a gear housing, hinge means for connecting the gear housing with the swivel ring, constant meshing ring and pinion gears in the gear housing a pinion gear shaft carrying the pinion gear and rotatably mounted in the gear housing coaxially of the swivel ring when the gear hous-

ing is in a drilling position, a shaft rotatably supported in the driving connection compartments and having one end connected with the transmission and the other end positioned in coaxial alignment with the pinion gear shaft, and means for coupling the last-named shaft with the pinion gear shaft.

3. In a drilling apparatus of the character described, a supporting frame, an enclosure carried on the supporting frame including side and end wall portions and an intermediate cylindrical portion having one end supported in an opening of one of said end walls, a power unit carried on the supporting frame in alignment with the other end of the cylindrical portion and having a power shaft, transverse partitions in the enclosure for dividing the enclosure into clutch, transmission, and driving connection compartments, a transmission in the transmission compartment, a clutch in the clutch compartment connecting the power shaft with the transmission, a swivel ring, means rotatably supporting the swivel ring in said open end of the enclosure, a drilling unit including a gear housing, means hingingly connecting the gear housing with the swivel ring, constant meshing pinion and ring gears in the gear housing, a pinion gear shaft carrying the pinion gear and rotatably mounted in the gear housing coaxially of the swivel ring when the gear housing is in a drilling position, a shaft rotatably supported in the driving connection compartments and having one end connected with the transmission and the other end positioned in coaxial alignment with the pinion gear shaft, means for coupling the last-named shaft with the pinion gear shaft, a hoisting unit carried on the supporting frame above said enclosure, a driving member in one of the driving connection compartments and having a driving connection with the hoisting unit, and means for selectively connecting the driving member with said last-named shaft.

4. In a drilling apparatus, a supporting frame including a pair of laterally spaced skids, legs supported on the skids, an elongated housing car-

ried on the legs at one end of the skids, a power unit carried on the legs on the opposite ends of the skids, partitions dividing the housing into a series of compartments, interconnected driving shafts connected with the power unit and extending through the compartments, a drilling means carried by the supporting frame adjacent the endmost compartment opposite the power unit, said drilling means including a drill rotating mechanism and a hydraulic mechanism for controlling pressure on a drill bit to be operated by said drilling unit, a pump carried by the supporting frame, a driving connection between the power unit and said pump, one of said compartments forming storage for a hydraulic fluid, a duct connecting said storage compartment with the inlet of said pump, a control valve, a duct connecting the discharge of the pump with said valve, ducts connecting the valve with the hydraulic mechanism, a hoisting unit supported above the housing, a driving connection in the storage compartment for connecting the driving shaft with the hoisting unit, means in said endmost compartment for connecting the driving shaft with the drilling unit, and a speed change gearing in another of said compartments having connection with the driving shafts.

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