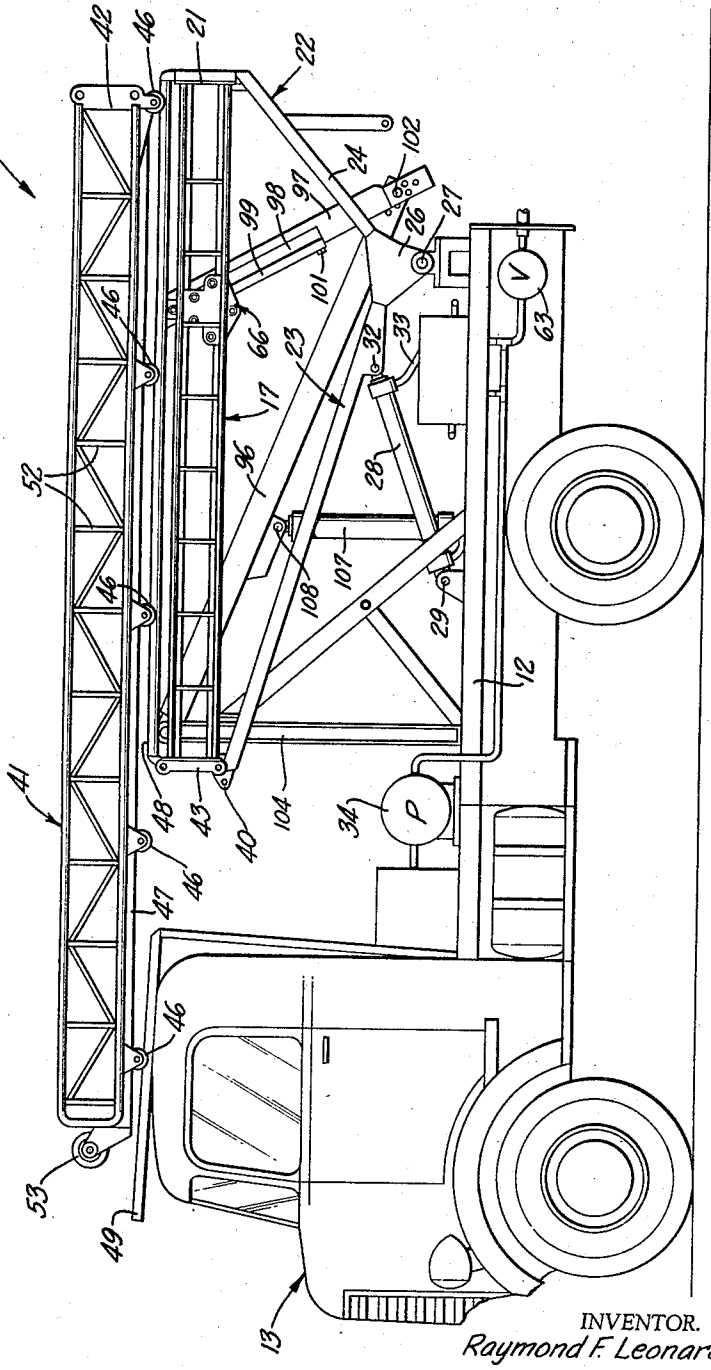
Sept. 15, 1959 R. F. LEONARD 2,904,310

PORTABLE HYDRAULIC DRILLING RIG

Filed Aug. 19, 1957 4 Sheets-Sheet 1

FIG. 1



INVENTOR.
Raymond F. Leonard

BY
William D. Hager
ATTORNEY

Sept. 15, 1959 R. F. LEONARD 2,904,310

PORTABLE HYDRAULIC DRILLING RIG

Filed Aug. 19, 1957

4 Sheets-Sheet 2

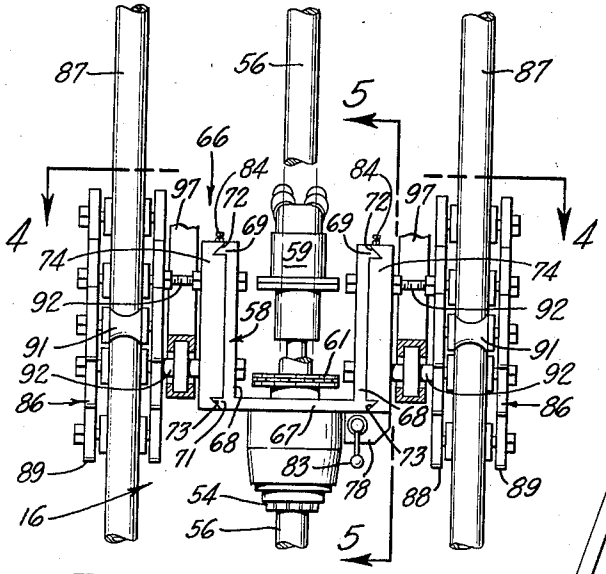


FIG. 3

FIG. 2

INVENTOR.
Raymond F. Leonard

BY
William D. Hager
ATTORNEY

Sept. 15, 1959 R. F. LEONARD 2,904,310

PORTABLE HYDRAULIC DRILLING RIG

Filed Aug. 19, 1957 4 Sheets-Sheet 3

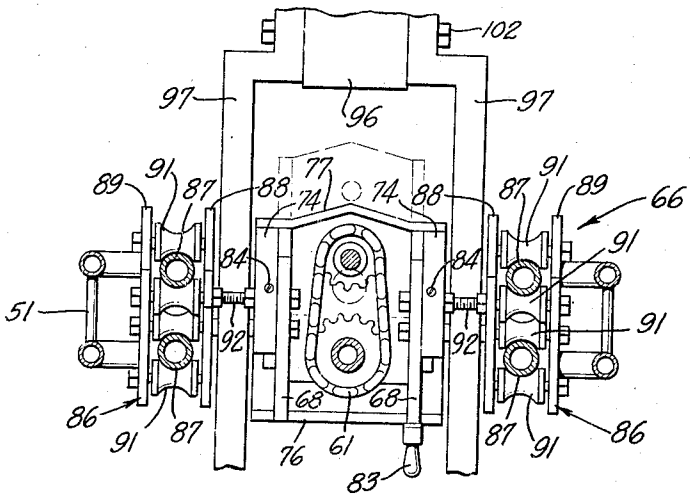


FIG. 4

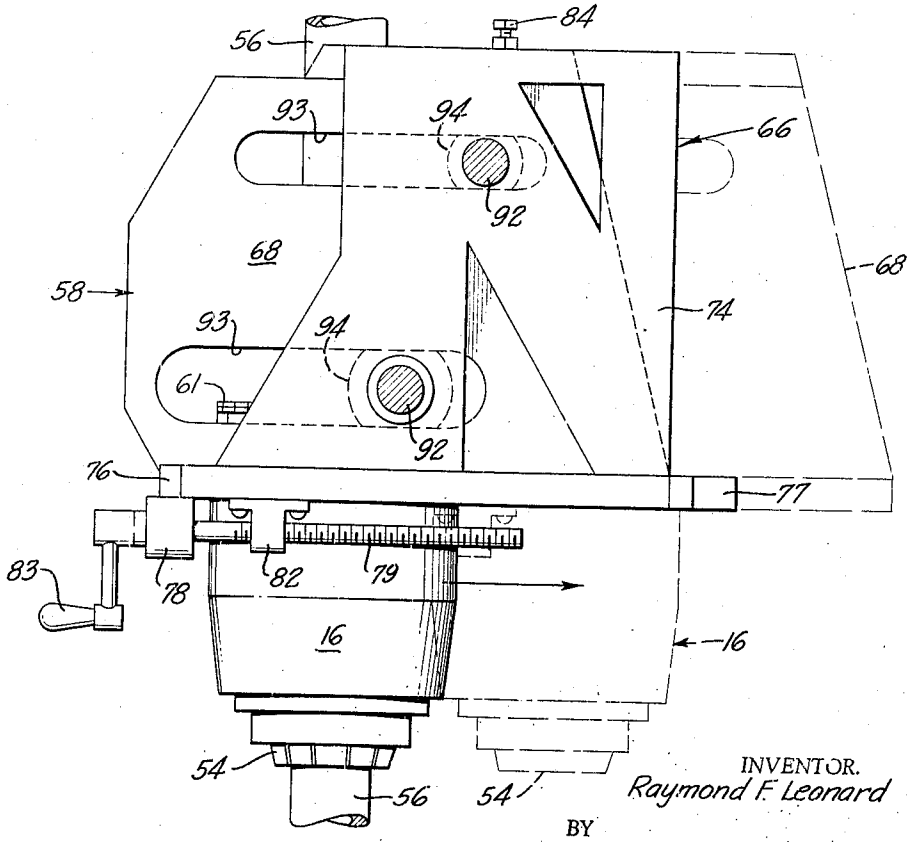


FIG. 5

INVENTOR.
Raymond F. Leonard
BY
William D. Hager
ATTORNEY

Sept. 15, 1959 R. F. LEONARD 2,904,310

PORTABLE HYDRAULIC DRILLING RIG

Filed Aug. 19, 1957

4 Sheets-Sheet 4

FIG. 7

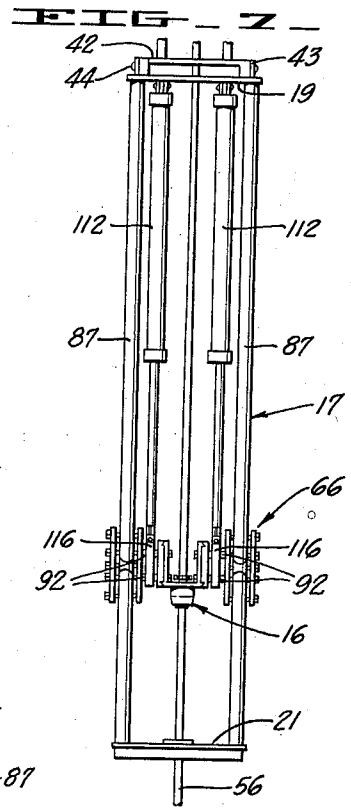


FIG. 8

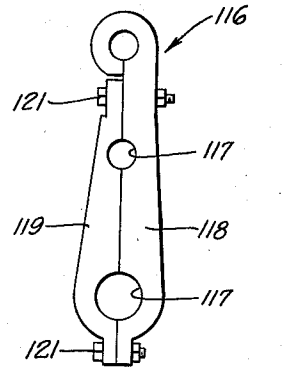


FIG. 6

INVENTOR.
Raymond F. Leonard

BY

William D. Hager

ATTORNEY

United States Patent Office 2,904,310 Patented Sept. 15, 1959

2,904,310

PORTABLE HYDRAULIC DRILLING RIG

Raymond F. Leonard, Redding, Calif.

Application August 19, 1957, Serial No. 679,038

5 Claims. (Cl. 255—22)

The present invention relates to portable drilling rigs and more particularly to a portable drilling rig wherein all functions are hydraulically controlled.

Apparatus for the drilling of holes in the earth for a variety of purposes, i.e., minerals exploration, blast holes, oil and water wells, footing test holes, general construction work in connection with hydro dams, shorings, and the like, are individually commonplace in the art. Known drilling rigs, which are capable of integrally performing all of the above, as well as other functions, and which are readily transportable into remote locations at substantial distances from the main base of supplies, are however variously disadvantageous. The portable drilling rig almost invariably includes many moving parts, e.g., drive shafts, gears, chains, and the like, in the apparatus employed to rotate and feed the drill into the earth. Such moving parts are subject to constant wear and attendant replacement and accordingly require extensive maintenance including thorough and time consuming lubrication to reduce the occurrence of breakdowns in the field which would seriously limit the available operating time. Moreover, excessive periods of time are frequently required to ready known drilling rigs for operation at the drilling site, as well as, upon completion of the drilling operation, to render the rig transportable for movement to another drilling site. It is therefore apparent that the attainment of an efficient and economical drilling operation is seriously hampered in the employment of conventional portable drilling apparatus.

The present invention greatly minimizes the difficulties noted above by providing a novel portable drilling rig which is particularly designed for mounting upon a truck or other suitable vehicle, and wherein substantially all functions are controlled hydraulically by means of a power take-off unit from the vehicle engine. Considerable advantage is gained as to the efficiency and economy of the drilling operation in that moving parts are virtually non-existent. The rotary drill motor is hydraulically driven thus eliminating drive shafts and attendant bearings with universals, bevel gears, and the like. Moreover, the spindle speed of the drill motor is continuously variable over an infinitely wide range by hydraulic flow control means without changing the truck engine speed or drive gears, thereby eliminating dead time and greatly reducing wear and tear on motive driving equipment. The drill spindle is mounted for up and down reciprocation upon a novel mast structure. Such reciprocation is effected hydraulically, thus providing smooth, almost vibrationless feed of the drill into the earth. Furthermore, the mast structure may be quickly swung hydraulically from a horizontal reclined transportable position to a drilling position at any desired angle between horizontal and vertical, thus minimizing the time required to ready the rig for operation.

It is therefore an object of this invention to provide improved apparatus for the drilling of holes in the earth with the utmost of efficiency and economy.

Another object of the invention is the provision of a

portable rotary drill rig wherein all drilling functions are performed hydraulically.

It is still another object of the invention to provide a portable drill rig which may be quickly converted from a transportable condition to an operable drilling condition.

Another object of this invention is the provision of a portable drilling rig which comprehends a minimum of maintenance and repair.

An important object of the invention is to provide drilling apparatus which may be quickly adjusted to any drilling angle between vertical and horizontal.

One other object of the present invention contemplates a hydraulically driven drill rig wherein substantially all drilling operations may be performed with the driving power plant at fast idle speed thus reducing fuel and repair costs to a minimum.

Another object of this invention is the provision of the character described wherein the drill has an infinitely variable rotational speed range and continuously adjustable thrust feed up and down into the earth.

A further object of the invention is the provision of a novel, hydraulically driven, foldable mast structure for employment in a portable drilling rig.

A still further object of this invention contemplates a novel hydraulically driven boom structure which may be employed to facilitate drill feed in a drilling rig.

Further and more specific objects, features, and advantages of the invention hereof will appear from the detailed description given below taken in conjunction with the accompanying drawings of which:

Figure 1 is a side elevational view of a portable drilling rig constructed in accordance with the present invention as mounted upon a truck in a folded horizontal transpotrable position.

Figure 2 is a fragmentary side elevation view of the drilling rig of Figure 1 erected in a vertical drilling position.

Figure 3 is an enlarged fragmentary rear elevational view taken along the line 3—3 of Figure 2.

Figure 4 is a plan sectional view taken along the line 4—4 of Figure 3.

Figure 5 is an enlarged sectional view taken along the line 5—5 of Figure 3.

Figure 6 is a fragmentary side elevation view of the drilling rig positioned in an inclined drilling position and illustrating a modified drill spindle feed structure.

Fgure 7 is a fragmentary front elevation view of the spindle feed structure of Figure 6.

Figure 8 is an enlarged detail view of a split hanger mount as employed for rapid installation of the modified spindle feed structure shown in Figures 6 and 7.

Considering now the invention in some detail and referring to the illustrated forms thereof in the drawing, there is provided a drilling rig **11** which is preferably mounted upon the bed **12** of a truck **13** so as to be readily transportable.

The drill rig proper includes generally a foldable mast structure **14** which is secured to truck bed **12** and adapted to be moved hydraulically between a horizontal transportable position and any desired drilling position between horizontal and vertical. A hydraulically driven rotary drill spindle **16** is mounted for hydraulically actuated reciprocating translation axially along the mast structure. A smooth, almost vibrationless, rotation and feed of any desired class of drill bit attached to the spindle is thus obtained at any drilling angle between vertical and horizontal depending upon the position of mast structure **14**.

More particularly, mast structure **14** preferably comprises a tower **17** formed for example from rectangular

framed side members 18 which are attached in parallel spaced relationship as by means of crown and base plates 19, 21 respectively secured to the top and bottom end extremities of the side members. Tower 17 is pivotally supported at the rear end of truck bed 12, as by means of a pair of pivot yokes 22. The yokes each include support arms 23, 24 respectively inclined from the ends of the side members 18 and intersecting in bearing plates 26 supported by spaced bearings 27 mounted upon the truck bed.

Tower 17 may be advantageously pivoted about bearings 27 between the horizontal transportable position (see Figure 1) and vertical drilling position (see Figure 2) thus facilitating erection of the rig by suitable hydraulic drive means such as a pair of hydraulic cylinders 28 operating on pivot yoke support arms 23 respectively. In order to facilitate efficient operation, the base extremities of cylinders 28 are pivotally secured to truck bed 12, as shown generally at 29, and the piston rods 31, translatable within the cylinders, are pivotally connected at their end extremities to support arms 23 near bearing plates 26, as shown generally at 32. Cylinders 28 may be operated by means of hydraulic fluid circulating through feed lines 33 communicably connected to the interior of each cylinder and supplied by a conventional hydraulic power take-off unit, e.g., a pump 34 driven by the engine of the truck 13. A suitable hydraulic flow control valve 36 inserted in feed lines 33 may consequently be employed to provide continuous regulation of the operating pressure of cylinders 28 over a wide range, thereby facilitating smooth adjustable control of the rotation of tower 17.

Tower 17 may be supported in the horizontal transportable position as well as inclined and vertical drilling positions by means of a pair of axially slotted elongated stabilizer bars 37 pivotally secured at one end to truck bed 12 as by means of detachable pivot bolts 38. Stabilizer bars 37 in addition slideably engage detachable lock nuts 39 attached to brackets 40 at the top end extremities of tower side members 18 respectively. Lock nuts 39 slide axially within the slots of the stabilizer bars 38 as tower 17 is rotated under appropriate control and direction of hydraulic cylinders 28. After the tower is rotated to any desired drilling position, the lock nuts 39 may be tightened to rigidly secure the stabilizer bars to the tower and thus support same. With tower 17 in the horizontal transportable position, however, it is preferable that stabilizer bars 37 be removed by detaching bolts 38, 39, in order to provide a more compact structure for transport (see Figure 1). Sufficient support is then provided in the horizontal position by piston rods 31 retracted into hydraulic cylinders 28 respectively.

In the event it is desired to extend the length of tower 17 for purposes which are subsequently described, such as to facilitate rapid pulling of a drill rod, mast structure 14 may advantageously include a tower extension member 41 which is adapted for rigid attachment to tower crown plate 19 and which may be conveniently supported atop the cab of truck 13 clear of tower 17 when not in use. Extension members 41 is best constructed as a rigid elongated framed structure and having a base plate 42 at its lower end extremity to facilitate mechanical attachment to spaced support brackets 43 projecting upwardly from crown plate 19. Attachment is best accomplished by means of bolts 44 or equivalent detachable fasteners threadably engaging the brackets and base plate.

Tower extension member 41 includes rollers 46 journalled at spaced intervals longitudinally along the bottom rail elements 47 thereof for engaging the top rail elements 48 of tower side members 18 when tower 17 is in the horizontal transportable position as shown in Figure 1. Rollers 46 also engage parallel spaced guide rails 49 which are mounted at a slight angle to the horizontal atop the truck cab. Accordingly, extension member 41 may be supported in a generally horizontal position upon the horizontally disposed tower 17 and guide rails 49 for transport between drilling sites. Rollers 46 engaging rail elements 48 and guide rails 49, however, render extension member 41 longitudinally slideable with reference to tower 17 whereby the extension member may be easily moved by hand to a position of extreme forward displacement entirely on top of the cab of truck 11 to facilitate unobstructed erection of the tower for various drilling operations where the extension member is not required. When the entire mast structure 14 is to be employed, extension member 41 is similarly urged to the above-noted displaced position to facilitate attachment of the extension member to tower 17 prior to erection. In this connection, it is to be noted that tower 17 may be slightly raised into axial alignment with the forwardly displaced extension member whereby support brackets 43 engage base plate 42. Bolts 44 may then be employed to secure the tower and extension member, after which the entire mast structure may be raised by means of hydraulic cylinders 28.

It will be appreciated that, due to the extreme length of the overall mast structure 14, it is desirable that means be employed to provide additional bracing of the mast when erected in the vertical position to facilitate a sturdy structure. The foregoing may be accomplished for example by detachable strut members 50 secured between tower stabilizer bars 37 and the upper extremity of extension member 41. It is to be further appreciated as regards the extreme length of mast structure 14, that ladders 51, 52 or equivalent means, are axially secured to tower 17 and extension member 41, respectively, to facilitate easy access to a pulley 53 journalled at the top of the mast for reasons which will become apparent hereinafter.

Considering now in more detail the hydraulically driven drill spindle 16 of previous mention which is mounted for slideable up and down translation axially of tower 17, and referring to Figures 3 and 4, it is to be noted that the spindle includes a conventional quick locking rotary chuck 54 adapted to releasably engage a drill 56, the chuck having a bore which accommodates any desired drill rod size, e.g., E, A, B, and N. Spindle 16 is preferably mounted upon a spindle yoke 58 and is rotated hydraulically as by means of a conventional hydraulic motor 59 carried by the yoke and driving the spindle, for example, through a gear and chain linkage 61. Motor 59 is connected through flexible feed lines 62 to power take-off pump 34 which drives the motor by means of hydraulic fluid circulated thereto through the feed lines 62. A suitable variable flow hydraulic control valve 63 may be employed to vary the rotational speed of spindle 16 continuously over a wide speed range without the usual changes in power plant speed or drive gear ratios necessitated by conventional rotary drill spindle driving equipment. It is therefore to be noted that the foregoing feature of the present invention eliminates dead time and greatly reduces wear and tear on the motive driving equipment inasmuch as the fluid or hydraulic drive of motor 59 does not include attendant drive shafts, gears, chains, and the like which are normally expendable.

As regards spindle yoke 58, it is to be noted that same is driven by a hydraulically driven feed assembly 64 which is adapted for up and down controlled reciprocation axially of mast tower 17 to provide means for feeding drill 56 into the earth. Moreover, the feed assembly preferably includes a carriage 66 upon which yoke 58 is mounted for adjustable translation from a normal drilling position to a rearwardly displaced retracted position (as indicated by the dotted lines of Figure 4) to facilitate pulling of oversized rods and casing other than through spindle chuck 54. For this purpose, yoke 58 is formed as a generally U-shaped bracket having a base section 67, to which spindle 16 and motor 59 are attached, and parallel spaced side sections 68 projecting up-

wardly from the base. Each side section 68 includes longitudinal chamfered shoulders 69, 71 projecting transversely from the top and bottom edges respectively of each section. Such shoulders 69, 71 slideably engage grooved guide ways 72, 73 respectively provided in the inner wall surfaces of each one of parallel spaced side members 74, of carriage 66, which are disposed outwardly from the sides of the yoke. Carriage side members 74 are rigidly attached at their base extremities as by means of front and rear stabilizer bars 76, 77. A dependent bracket 78, for journalling a feed screw 79, is attached at one side of front stabilizer bar 76. Feed screw 79 engages a threaded bore in a flange 82 projecting downwardly from the underside of yoke 58 whereby rotation of the feed screw, as by means of a hand crank 83 attached to the journalled end thereof, effects translation of the yoke with respect to the carriage from the normal drilling position to the retracted position or vice versa. Yoke 58 may be locked in either position as by means of set screws 84 extending downward through the top surfaces of carriage side members 74 and emerging from guide ways 72 to engage yoke shoulders 69.

As regards the up and down reciprocation of feed assembly 64 axially of mast tower 17, carriage 66 is preferably mounted for slideable translation axially of the tower by suitable roller bearings 86 rigidly attached to carriage side members 74. Bearings 86 engage pairs of spaced parallel guide rods 87 axially secured within framed side members 18 between crown and base plates 19, 21 respectively of the tower. Each bearing 86 comprises a pair of parallel support plates 88, 89 spaced on the inner and outer sides of guide rods 87 respectively and having a plurality of rollers 91 journalled between the plates and rolling upon the guide rods. Rollers 91 are, further, positioned in staggered relationship on opposite sides of each rod 87 to prevent transverse movement of the bearings with respect to the rod axis. The inner plate 88 of each bearing 86 is rigidly secured to the corresponding one of carriage side members 74 by a pair of heavy duty bolts 92 or equivalent means. Such bolts are attached at their end extremities to the plate and extend through the side member and through longitudinally extending slotted guide ways 93 provided in spindle yoke side sections 68. Bolts 92 threadably engage collar nuts 94, the collars of which are slideable within guide ways 93 to permit translation of yoke 58 within carriage 66.

Considering now in particular detail preferred means for hydraulically translating carriage 66 and spindle yoke 58 mounted thereon axially of mast tower 17 for purposes of feeding drill 56 into the earth, there is provided a boom 96 fastened at one end to the carriage and rotatably mounted at the other end upon truck bed 12. Boom 96 may be attached to carriage 66 by brackets 97 fastened to opposite sides of the boom and each having a slot 98 engaging the corresponding lower one of carriage support bolts 92 between bearing 86 and carriage 66. Slots 98 thus facilitate lateral movement of the boom with respect to the carriage. The top runner 99 of each slot 98 is detachably secured to the bracket base as by means of threaded fasteners 101 for purposes which are subsequently described. Brackets 97 are, in addition, made selectably pivotable with respect to boom 96 in their attachment thereto to permit the hereinbefore described rotation of mast structure 14 between vertical and horizontal positions. Such attachment may be made by means of a pivot bolt 102 freely engaging each bracket 97 and rigidly fastened to the boom, and a plurality of detachable machine bolts 103 threadably engaging the bracket and boom.

The rotational mounting of boom 96 upon truck bed 12 is made in any conventional manner for establishing an elevated pivot joint; for example, by means of an upright braced bearing post 104 rigidly attached centrally of the front end of the truck bed and pivotally secured to the boom by journal brackets 106. Rotation of the boom with respect to the bearing post consequently translates carriage 66 axially up and down within mast tower 17 when same is in the vertical drilling position.

Preferred means for rotating boom 96 hydraulically comprises a hydraulic cylinder 107 pivotally secured at its base extremity to truck bed 12 and having its piston rod pivotally secured to the boom at an intermediate point thereof as shown generally at 108. Cylinder 107 is driven by hydraulic fluid circulated thereto through feed lines 109 connected to power take-off pump 34. A flow control valve 111 inserted in the feed line facilitates controlled raising and lowering of boom 96 by rotation about bearing post 104. Carriage 66 is thereby axially translated up and down within mast tower 17 with an attendant extremely smooth hydraulically driven feeding of drill 56 into the earth.

Considering now a modified embodiment of a hydraulic drill feed structure, as shown in Figure 7, for employment in the drilling rig of the present invention for inclined hole drilling service, it is to be noted that for this purpose top runners 99 of brackets 97 and machine bolts 103 are removed to detach boom 96 from carriage 66 and permit the boom to hang free of mast tower 17. Hydraulic feed of carriage 66 may now be provided, for example, by a pair of hydraulic cylinders 112 detachably connected at their base extremities to the underside of mast tower crown plate 19 in closely spaced parallelism with framed side members 87. The piston rods of cylinders 112 are consequently detachably connected to carriage 66 to facilitate the hydraulic feeding of drill spindle 16, with the mast structure 14 at any desired drilling angle. The cylinders 112 are controllably driven in the manner hereinbefore described with respect to the various hydraulic cylinders of previous mention, i.e., by means of suitable feed lines 113 connected to pump 34 through a control valve 114.

Preferred structure for facilitating rapid connection and detachment of the piston rods of cylinders 112 to carriage 66 is illustrated in detail in Figure 8. As shown therein, split hanger mounts 116 are provided which are adapted for attachment between the piston rods and carriage bearing support bolts 92. More particularly, mounts 116 include axially spaced transverse bores 117 to accommodate bolts 92 and are axially split through the bores into a base element 118 which is adapted for end attachment to the piston rods of cylinders 112, and a flanged bracket element 119 detachably connected by means of fasteners 121 to the base element. Accordingly, the base and bracket elements 118, 119 may be detached to facilitate rapid engagement of bolts 92 in bores 117 and then secured by means of fasteners 121. Each base element 118 may then be attached to the piston rod of one of the hydraulic cylinders to ready the drilling rig for inclined hole drilling service.

Considering now, in summary, the overall operation of the drilling rig of the present invention, it is assumed that the rig is at a drilling site and initially in the folded horizontal transportable position illustrated in Figure 1. It is to be noted that several modes of operation are possible depending upon the particular type of drilling operation to be performed, namely vertical drilling or inclined drilling. In the event a deep vertical hole is to be drilled and it is desirable to use the entire mast structure 14 to facilitate rapid pulling of the drill, mast extension member 41 is first urged axially forward upon rail elements 48 and guide rails 49 to the displaced position atop the cab of truck 13 clear of mast tower 17. With the truck engine preferably operating at a fast idle to conserve fuel and driving hydraulic power take-off pump 34, flow control valve 36 is opened slightly to cause hydraulic cylinders 28 to act upon tower yoke 23. Tower 17 is thereby correspondingly raised slightly into axial alignment with extension member 41 with support brackets 43 engaging base plate 42. Bolts 44 are then inserted and fastened to secure mast extension member

41 to the top of tower 17. Control valve 36 is now opened further to effect raising of the entire mast structure 17 by hydraulic cylinders 28 to the vertical drilling position shown in Figure 2, with the mast being stopped and supported in such position by the slotted stabilizer bars 37. Additional bracing of mast structure 17 is effected by installing strut members 50 between the top of the mast and stabilizer bars 37.

In order to ready boom 96 for operation, brackets 97 are rigidly attached thereto by engaging machine bolts 103. Control valve 111 is then actuated to raise the boom to its upper limit of rotational travel by hydraulic cylinder 107. Carriage 66 and rotary spindle 16 carried thereby are thus lifted to the top of tower 17. Spindle yoke 58 is translated to the normal drilling position by rotating feed screw crank 83 and a suitable drill 56 is engaged in spindle chuck 54. The drill is engaged in such a manner so as to extend upwardly through spindle chuck 54 whereby additional drill rods may be threadably secured to drill 56, as required in the conventional manner, to extend to the top of the overall mast structure 17. An operator may then climb to the top of the mast by means of ladders 51, 52 and attach the uppermost drill rod to a pull rope (not shown) fed over pully 53 to truck bed 12 for connection to suitable tractive means, such as a conventional hydraulic winch, to facilitate rapid pulling of the drill.

With drill 56 secured to spindle 16, control valve 63 is operated to actuate hydraulic motor 59 and thereby rotate the spindle. At the same time control valve 111 is operated to controllably lower boom 96 and thus feed spindle 16 axially downward within mast tower 11. Drill 56 is accordingly rotated and fed into the earth and under appropriate control and direction of valves 63 and 111, the speed and feed respectively of drill spindle 16 may be continuously adjusted to produce a smooth, almost vibrationless, efficient drilling operation.

When boom 96 is lowered to its lowermost limit of rotation and therefore spindle 16 is at its lower limit of feed within mast tower 17, spindle chuck 54 may be disengaged from drill 56 and boom control valve 111 operated to quickly raise the spindle to the top of tower 17. With chuck 54 disengaged, spindle 16 is freely displaced upwardly along drill 56, or the associated drill rods, to the upper feed limit of the spindle at the top of tower 17. Chuck 54 is then engaged with the drill and another length of same is fed into the earth in the manner described above.

Spindle chuck 54 may be similarly disengaged from drill 56 at any time it is desired to rapidly pull the drill from the earth through the chuck, as by means of the pull rope and winch hereinbefore described. In pulling oversized drill rod and casings, however, it is desirable that same be pulled other than through the center of spindle 16, and the foregoing is facilitated in the present invention by first removing all lengths of drill rod which are attached above the spindle. Chuck 54 is disengaged from the length of drill rod immersed in the earth and spindle 16 is raised upward in tower 17 to a position which clears the drill rod. Feed screw hand crank 83 is then rotated to displace spindle yoke 58 rearwardly with respect to carriage 66 to the retracted position hereinbefore described. The pull rope may accordingly be now attached to the drill rod to pull same unobstructedly through the center of carriage 66.

In order to lower mast structure 17 to the folded horizontal transportable position upon completion of the drilling operation, the erection operation is carried out in reversed sequence. Machine bolts 103 are detached from brackets 97 to permit same to pivot freely about pivot bolts 102 in boom 96, and support struts 50 are removed. Hydraulic cylinders 28 effect lowering of mast structure 17 by appropriate operation of control valve 36 to force piston rods 31 into cylinders 28. With rollers 46 of mast extension member 41 engaging guide rails 49 on top of the truck cab, fasteners 44 are removed to disengage the extension member from tower 17. Such tower is then lowered the remainder of the way and extension member 41 is rolled rearwardly upon tower rail elements 48 into the transportable position.

In the event drilling rig 11 is to be employed for inclined hole drilling operations, mast extension member 41 is displaced forward atop the cab of truck 13 as hereinbefore described. Mast tower 17 is then unobstructedly raised by means of hydraulic cylinders 28 to any desired inclined drilling angle, as shown in Figure 6. The top runners 99 of brackets 97 are removed to detach same from carriage 66 and permit the brackets to hang free. Hydraulic cylinders 112 are then suspended from mast tower crown plate 19 and attached to carriage 66 by means of split hanger mounts 116. The cylinders are connected to power take off pump 34 through feed lines 113 and control valve 114 as previously described to ready the rig for operation. Upon opening valve 114, cylinders 112 drive carriage 66 and spindle 16 carried thereby axially of mast tower 17 regardless of the angle of same. The inclined drilling operation is accordingly controlled in a manner similar to that hereinbefore described in regard to vertical drilling, with the feed and rotation of drill 56 as engaged by spindle 16 being readily controlled by valves 114 and 63 respectively.

Thus, while the invention has been disclosed with respect to but a single embodiment of a novel combination of individually novel elements it will be apparent to those skilled in the art that any portion of the combination may be incorporated with the elements of other known drilling rigs and that numerous variations and modifications may be made within the spirit and scope of the invention and thus it is not intended to limit the invention except as defined in the following claims.

What is claimed is:

1. In a portable drilling rig adapted for mounting upon the bed of a truck and including at least a mast structure mounted for rotation at the rear end of the truck bed, a hydraulic cylinder carried by said truck bed and acting upon said mast structure to rotatably raise and lower same, and means for securing said mast structure in any position of rotation between a horizontal transportable position and a vertical drilling position, the combination comprising a peripherally framed carriage having a pair of parallel spaced side members, bearing means secured to said side members and engaging said mast structure for slideable translation of said side members axially parallel to the mast structure, a yoke slideably engaging said side members for translation therebetween in a direction transverse to the axis of said mast structure, a rotary drill spindle for engaging a drill rigidly secured to said yoke and having an axis of rotation parallel to the axis of said mast structure, drive means carried by said yoke for rotating said spindle, means secured to said yoke and said carriage for controllably effecting transverse translation of the former relative to the latter between a normal drilling position of said spindle and a retracted position wherein material may be pulled through the open central region circumscribed by said peripherally framed carriage, and hydraulic feed means acting upon said carriage for controllably translating same axially of said mast structure to feed a drill engaged by said spindle into the earth.

2. A portable drilling rig comprising a truck, said truck having an elevated cab disposed forward of a truck bed, an elongated mast tower pivotally secured at the rear end of said truck bed to be rotatable between a horizontal transportable position and a vertical drilling position wherein a portion of the tower overhangs the rear end extremity of said truck bed, an elongated mast extension member slidably supported upon the truck cab and said mast tower in the horizontal position and translatable axially thereof to a forward position of support entirely atop said cab and clear of said tower, said extension

member adapted for axially aligned end attachment to said tower, hydraulic means carried by said truck bed for controllably rotating said mast tower between the horizontal and vertical positions when said extension member is in said forward position clear of the tower, said tower stoppable in any position of rotation between said horizontal and vertical positions whereby said tower may be stopped in a position of axial alignment with said extension member and attached thereto, a carriage slideably mounted upon said mast tower and translatable parallel to the axis thereof, a hydraulically driven drill spindle carried by said carriage and having an axis of rotation parallel to the axis of said mast tower, an elongated boom pivotally secured at one end to said truck bed, at least one bracket secured to the other end of said boom and connected to said carriage while being slideably therewith in a direction transverse to the axis of said mast tower, said bracket selectively pivotal with respect to said boom whereby the bracket may be rigidly attached to the boom when the tower is in the vertical position and may be rendered pivotal while the tower is being rotated, and a hydraulic cylinder secured to said truck bed and acting on said boom to controllably rotate same about the pivoted end thereof, said boom thereby translating said carriage axially of said mast tower to feed said drill spindle in a drilling direction.

3. In a portable drilling rig for mounting upon a truck of a type having an elevated cab disposed forward of a truck bed, the combination comprising an elongated framed mast tower, a pair of pivot yokes secured between the end extremities of said tower at opposite sides thereof, bearing means mounted upon the rear end of said truck bed and pivotally secured to said pivot yokes, said mast tower rotatable with respect to said bearing means between a horizontal transportable position and a vertical drilling position wherein the lower portion of said mast tower extends below the rear end of said truck bed, at least one axially slotted stabilizer bar pivotally secured to said truck bed, a lock nut secured to the top of said mast tower and slideably engaging the slot of said stabilizer bar for locking the mast tower in any position of rotation between horizontal and vertical, a pair of parallel spaced axially extending rail elements secured to the upper axial side of said mast tower with reference to the horizontal transportable position, a pair of parallel spaced guide rails attached to the top of said truck cab and axially aligned with said rail elements when the tower is in the horizontal transportable position, an elongated framed mast extension member, a plurality of axially spaced rollers journaled to the underside of said extension member and engaging said guide rails and rail elements when the tower is horizontal, said extension member axially slideable with respect to said tower between a transportable position atop the mast tower and truck cab and a retracted position entirely atop said truck cab and clear of said mast tower to permit unobstructed rotation of same, said extension member in the retracted position being adapted for axially aligned rigid end attachment to said tower member, a pulley journaled to the top of said mast extension member for engaging a pull rope, a pair of hydraulic cylinders pivotally secured to said truck bed and having their piston rods pivotally secured to said pivot yokes respectively for rotating said mast tower between the horizontal and vertical positions, a hydraulic power take-off pump carried by said truck bed, hydraulic fluid feed lines connected to said pump and commonly connected to said hydraulic cylinders, a flow control valve inserted in said feed lines for controlling rotation of said mast tower including stoppage of the rotation of same in a position of axial alignment with said extension member in the retracted position for rigid end connection of the tower and extension member, a pair of parallel guide rails axially attached to each one of transversely opposed sides of said mast tower, a peripherally framed carriage circumscribing an enlarged central opening and having a pair of spaced-apart side members respectively in inward parallel juxtaposition with respect to said pairs of guide rails, a pair of roller bearings respectively slideably engaging said pairs of guide rails, fasteners rigidly attaching said bearings to the side members of said carriage, a spindle yoke disposed in partial closing relationship with the opening of said carriage and slideably engaging said carriage side members for translation therebetween in a direction transverse to the axis of said mast tower, a rotary drill spindle adapted to releasably engage a drill mounted upon said spindle yoke and having an axis of rotation parallel to the axis of said mast tower, a dependent bracket projecting from the underside of said carriage, a dependent flange projecting from the underside of said spindle yoke and having a threaded bore in axial alignment with said bracket, a feed screw journaled in said bracket and threadably engaging the bore in said flange to transversely translate the yoke and spindle mounted thereon relative to the carriage in response to rotation of said feed screw, said yoke being thereby translatable between a normal drilling position of said spindle and a retracted position wherein material may be pulled through the central opening of said carriage, a hydraulic motor mounted on said spindle yoke, a gear and chain drive connecting said motor to said spindle for rotating same, flexible feed lines connecting said motor to said take-off pump, a feed control valve inserted in said feed lines for controlling the rotational speed of said spindle, an upright bearing post mounted on said truck bed, an elongated boom having an end pivotally secured to said bearing post, a pair of slotted brackets secured to opposite sides of said boom with the slots of said brackets slideably engaging said fasteners connected to said carriage, said brackets selectively pivotal with respect to the boom to permit rigid attachment of the boom to the carriage when the tower is in the vertical positon and pivotal attachment therebetween during rotation of said mast tower, a hydraulic cylinder having its base extremity pivotally secured to said truck bed and the piston rod thereof pivotally secured to said boom for rotating same with respect to said bearing post, feed lines connecting said last named cylinder to said take-off pump, and a flow control valve inserted in said feed lines for controlling rotation of said boom about the pivot point thereof to thereby translate said carriage axially up and down in said mast tower and feed a drill engaged by said spindle into the earth.

4. A collapsible mast structure for a truck mounted drilling rig comprising a truck having an elevated cab disposed forward of a truck bed, an elongated framed mast tower pivotally mounted at the rear end of said truck bed and rotatable between a horizontal transportable position and a vertical drilling position wherein the lower portion of the tower extends below the rear end of said truck bed, at least one axially slotted stabilizer bar pivotally secured to said truck bed, lock nut means secured to the top of said mast tower and slideably engaging the slot of said stabilizer bar for manually locking the mast tower in any position of rotation between horizontal and vertical, a pair of parallel spaced axially extending rail elements secured to the upper axial side of said mast tower with reference to the horizontal transportable position, a pair of parallel spaced guide rails secured to the top of said truck cab and aligned with said rail elements when the tower is in the horizontal transportable position, said guide rail slightly inclined to the horizontal, an elongated framed mast extension member, a plurality of axially spaced rollers journalled to the underside of said extension member and engaging said guide rails and rail elements when the tower is horizontal, said extension member being thereby axially slideable with respect to said tower between a transportable position of support atop the mast tower and truck cab and a retracted position of support entirely atop said truck cab and

clear of said mast tower, said extension member in the retracted position being slightly inclined with respect to the horizontal, hydraulic cylinder means carried by said truck bed and acting upon said mast tower to controllably rotate same to positions of rotation between said horizontal and vertical positions for locking therein by said lock nut means, said extension member being translated to the retracted position clear of the tower prior to rotation of same, said tower being rotatable to a position of axial alignment with said extension member when same is in the retracted position, and means for detachably connecting said extension member to said tower when the latter is in said position of axial alignment with the former whereby said extension member and tower may be thereafter integrally raised to said vertical position by said hydraulic cylinder means.

5. Drill spindle feed structure for feeding a drill axially of a drilling rig mast tower and moving the drill in a direction transverse to the tower axis comprising a pair of parallel spaced guide rails axially attached to each of two opposite sides of said mast tower, a peripherally framed carriage circumscribing an enlarged central opening in alignment with the axis of said mast tower and having a pair of spaced-apart side members respectively in inward parallel juxtaposition with respect to said pairs of guide rails, a pair of roller bearings respectively secured to the side members of said carriage and spaced outwardly therefrom to slideably engage said pairs of guide rails, a spindle yoke disposed transversely to the central opening of said carriage and slideably engaging the side members thereof for translation therebetween in a direction transverse to the axis of said mast tower, a rotary drill spindle adapted to releasably engage a drill, said spindle mounted upon said yoke and having an axis of rotation parallel to the axis of said mast tower, a bracket depending from the underside of said carriage, a flange depending from the underside of said yoke and having a threaded bore in the direction of transverse translation of the yoke and aligned with said bracket, a feed screw journalled in said bracket and threadably engaging the bore of said flange to transversely translate the yoke and spindle mounted thereon relative to the carriage in response to rotation of said feed screw, said yoke being thereby translatable between a drilling position of said spindle in alignment with the axis of said mast tower and a retracted position wherein material may be pulled through the central opening of said carriage, drive means carried by said yoke and connected to said spindle for effecting rotation of same, and means acting upon said carriage to controllably feed same axially up and down said guide rails and thereby feed a drill engaged by said spindle axially of said mast tower.

References Cited in the file of this patent

UNITED STATES PATENTS

1,681,502	Sheldon	Aug. 21, 1928
1,895,901	Smith	Jan. 31, 1933
2,210,407	Henry	Aug. 6, 1940
2,364,851	Johansen	Dec. 12, 1944
2,516,182	Bury	July 25, 1950
2,657,908	Failing	Nov. 3, 1953
2,665,116	Brink et al.	Jan. 5, 1954

FOREIGN PATENTS

628,266	Great Britain	July 25, 1949