Sept. 22, 1970 S. LEVEN 3,529,679

DRILLING APPARATUS

Filed Nov. 29, 1968

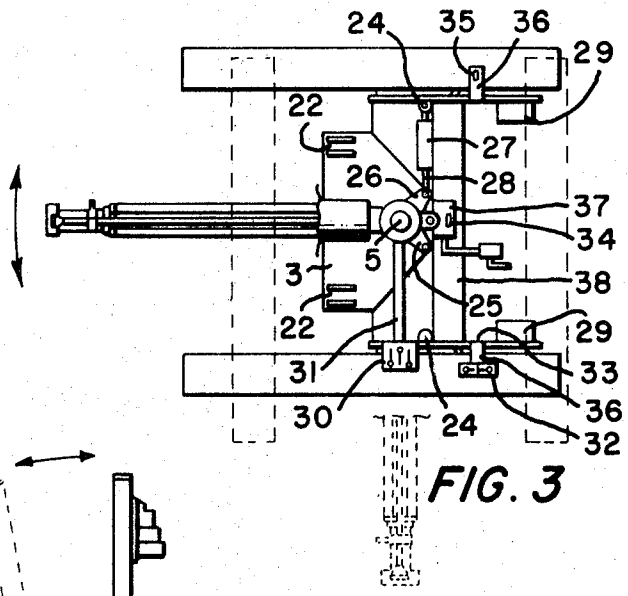


FIG. 3

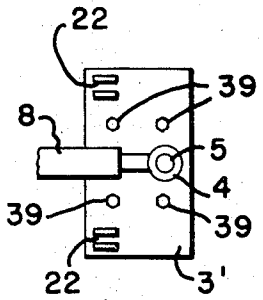


FIG. 4

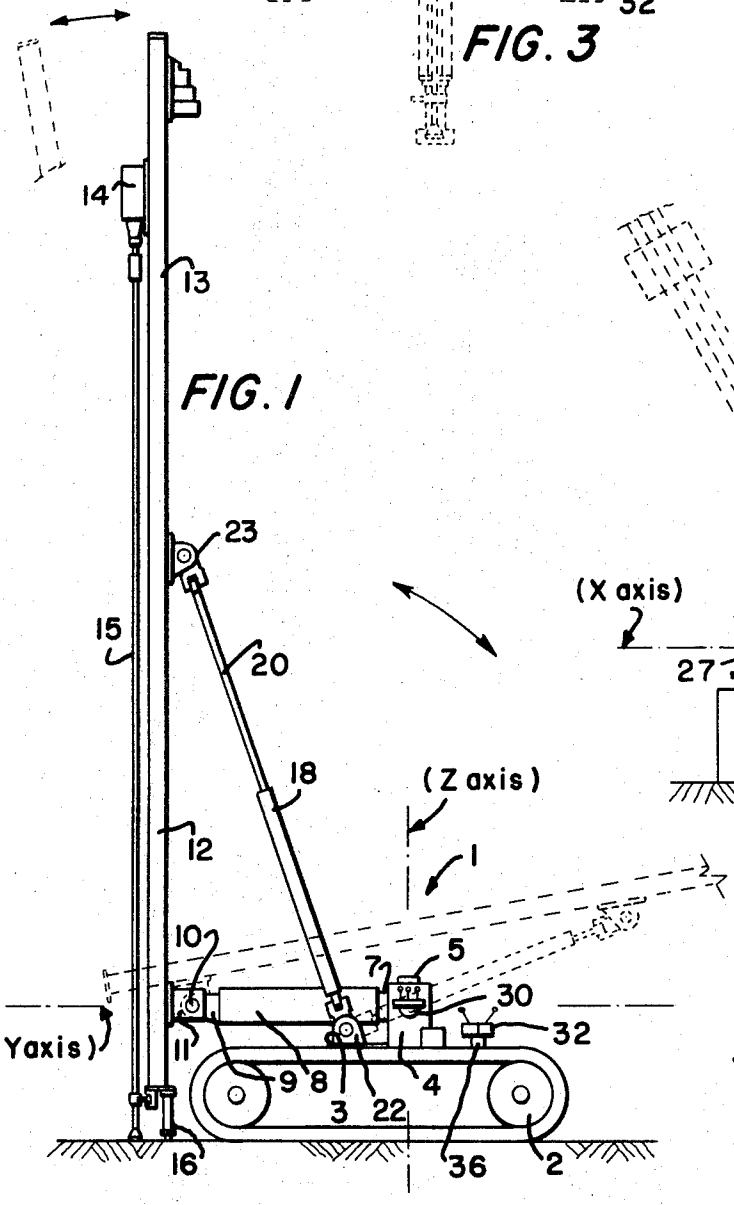


FIG. 1

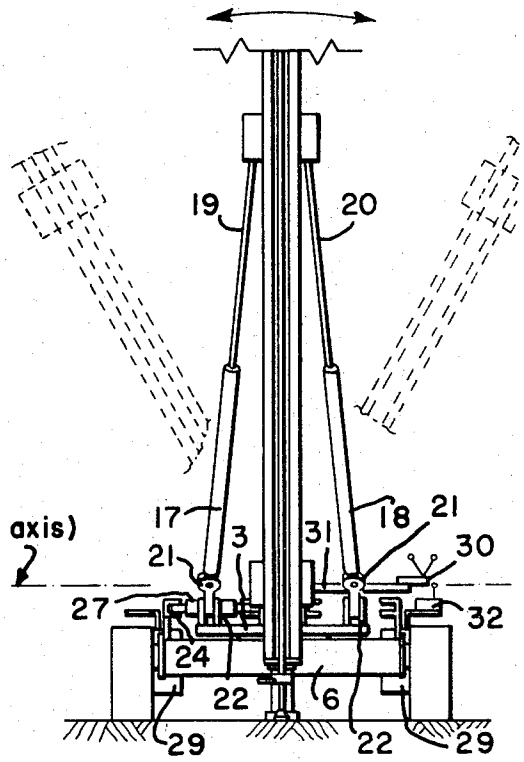


FIG. 2

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DRILLING APPARATUS

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ABSTRACT OF THE DISCLOSURE

A mobile drilling apparatus with a base-mounted tower movable about X, Y, and Z axes relative said base and having a tramming control console removable to a plurality of spaced-apart operating positions. The tower is mounted on a rotatable platform; this provides for movement of the tower about a vertical Z axis. A pair of extensible legs are coupled between the tower and the platform to provide for tower movement about a horizontal X axis, and the tower is also coupled to the platform by means of a rotatable shaft which accommodates movement of the tower about a further horizontal axis Y to facilitate a lateral tilting of the tower.

This invention pertains to drilling apparatus, and in particular to a drilling apparatus comprising a drill tower carried on a mobile base having means for universal articulation whereby said tower can be moved about X, Y, and Z axes relative said base.

Drilling apparatuses having a wide articulation of a drilling tower are known. That is, it is already taught by prior art how to slue a tower about a Z axis perpendicular to the horizontal, to bring into range laterally extending work areas in which drilling might be undertaken. Also, prior patents disclose means for the movement of a drill tower about a Y axis which is parallel to the horizontal and in line with the tramming path, thereby to "tilt" the tower to effect a true perpendicularity thereof relative the horizontal, and as a consequence to effect a simulated leveling of an otherwise non-level base. And of course, means for effecting a pivoting movement of a drilling tower about an X axis, parellel to the horizontal and transverse to the tramming path, whereby the tower might be elevated for working thereof and lowered for tramming, are notorious in the art. However, it is not taught in known prior art how to provide for tower movement about all three axes, in a mobile drilling apparatus. Nor has it been taught heretofore to provide for the removal of tramming controls to a plurality of spaced-apart operating positions, to facilitate an unencumbered manipulation of said controls regardles of the displacement of the tower about the Z axis. What is more, the prior art teaches no mobile drilling apparatus structure which provides for simulated leveling of the base whereby drilling perpendicular to the horizontal can be practiced at any point about a circular perimeter defined by the sweep of the tower about a Z axis. Heretofore, it has been necessary to reorient the positioning of the mobile base if vertical drilling was required at points along an arc transverse to the tramming path. It having been possible only to perform vertical drilling at a point in-line with the tramming path, a mobile base has had to be turned or otherwise repositioned, effectively to place the desired drilling area frontally, inline with the base.

It is an object of this invention therefore to provide a mobile drilling apparatus having means for effecting tower movement about all said three axes. Another object of this invention is to provide a drilling apparatus on a mobile base having means for effecting tower movement about all three axes, including means for disposing

said tower on a line perpendicular to the horizontal at any point about a circular perimeter defined by the sweep of the tower, in a Z axis, about a pivot mounting from which the tower is extendedly supported. It is another object of this invention to provide a drilling apparatus on a mobile base having means for disposing the tower perpendicular to the horizontal at any point about said circular perimeter, and at angles in X and Y planes with respect to said perpendicular.

A feature of this invention comprises the mounting of the tower, and mounting the means for effecting axial movements of said tower, on a platform which is rotatably carried on a mobile base. Another feature of this invention comprises having a control console which is removable to a plurality of spaced-apart operating positions about the mobile base. Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying figures in which:

FIG. 1 is a side elevation of a drilling apparatus according to the invention.

FIG. 2 is a front elevation of the drilling apparatus according to the invention;

FIG. 3 is plan view of the mobile base, and tower mounting for the rotatable platform, with the elevating cylinders omitted therefrom for purposes of clarity; and

FIG. 4 is a top view of an alternate embodiment of the rotatable platform.

As shown in FIGS. 1 and 2 the drilling apparatus **1** according to the invention comprises a mobile base **2** which carries a rotatable platform **3** thereon. The rotatable platform **3** has integral therewith an upstanding trunnion shaft **5** which extends from a cross member **6** which comprises a portion of the frame for the mobile base **2**. A shaft **7** extends perpendicularly from the sleeve **4** to which it is rigidly fixed, and receives thereabout a rotatable cylinder **8**, said shaft and cylinder having disposed therebetween appropriate bearing means (not shown.) Rotatable cylinder **8** mounts a clevis **9** at the forward or tower end thereof, which clevis receives a pivot pin **10** for mounting thereat a tower pivot mounting adapter **11**. The drilling tower **12** has a vertical guide member **13** for directing the vertical track the drilling tool **14**. A drill steel **15** extends from the drilling tool to address the ground level. A "stinger" **16** is carried on the lower end of vertical guide member **13** and is deployed there, according to a practice well known in the art, to provide for stability of the tower during drilling operations.

A pair of power cylinders **17** and **18** are mounted to the platform **3**, each having a extensible leg **19** and **20**, respectively, projecting therefrom. Pivot couplings **21** receive the lower end of cylinders **17** and **18** and are rotatably joined in clevises **22** secured to the platform **3**. The other end of extensible legs **19** and **20** are pivotably coupled to pivot couplings **23** at a point approximately midway along the tower **12**.

As seen in FIG. 3, the mobile base **2** carries a pair of pivot couplings **24** at each side thereof. Further, platform **3** has extending therefrom left-hand actuator lug **25** and right-hand actuator lug **26**. A power cylinder **27** is shown connected between right-hand actuator lug **26** and pivot coupling **24**, the extensible actuator rod **28** thereof being joined to lug **26**. Finally, tramming motors **29** are shown disposed adjacent the tracks of the drilling apparatus at the rear of the machine. Controls for effecting the axial motions of the tower **12** are commonly mounted in a console **30**, FIG. 3, which is carried on a hollow strut or tube **31** extending from sleeve **4**, tube **31** being integral with sleeve **4**. Within tube **31** are confined hoses or piping through which pass pressured fluid for actuation of

cylinders 17 and 18, and cylinder 27. The controls in console 30 are interposed between such hoses or piping which introduce the fluid from an external source (not shown) and such hoses or piping which supply the fluid to, or evacuate the fluid from, cylinders 17, 18, and 27. This confinement of the supply and venting or dumping hoses or lines, in tube 31, avoids the necessity—practiced in the prior art—of provisioning excessively lengthy and exposed lines, so as to be able to follow the excursions of the tower about the Z or "turntable" axis. However, tramming controls are packaged in a console 32 which is disengageable from and removable to a plurality of spaced-apart operating positions: positions 33, 34, and 35. Positions 33 and 35 comprise square apertures formed in conduits 36 carried on, and fixed to base 2. Conduits 36 are throughconnected with a pressured-fluid reservoir 37 by means of a base-transversing fluid-lines pipe 38. Accordingly, lines of pressured-fluid for operation of tramming motors 29 are supplied by reservoir 37, confined within pipe 38, and joined to appropriate engageable valving in positions 33 and 35, and to such valving at reservoir-located position 34. Console 32 carries therebelow an extending, hollow square member in which are disposed valving-engaging linkages, the latter being effective to operate said engageable valving in response to manipulation of the externally-disposed controls of console 32. Thus, console 32 can be removed to positions 34 and 35 to operate the tramming motors 29. This novel arrangement provides for free, unencumbered access to the tramming controls for operation thereof regardless of the disposition of platform 3 and tower 12 about the Z axis.

In operation, the tower 12 can be carried in a tramming, or parking position, as simulated in dashed-line representation in FIG. 1, for movement to and from a working site. The tower "parks" in a substantially horizontal position, being elevated approximately some 10 degrees of arc from horizontal. By actuation of both power cylinders 17 and 18 the tower 12 can be erected to a vertical, working position, as shown in FIGS. 1 and 2, the cylinders moving the tower about an X axis defined along pivot pin 10. Additionally, by further actuation of both power cylinders 17 and 18, the tower 12 can be inclined forwardly, from the vertical, approximately 26 degrees of arc. Also, as suggested by FIG. 2, by extending leg 19 and foreshortening leg 20, or vice versa, the drill tower can be caused to "tilt" to the right or left as simulated in dashed-line representations in FIG. 2. The "tilting" is facilitated by the rotation of cylinder 8 about shaft 7; the longitudinal axis of shaft 7 defines the priorly noted Y axis of motion. Accordingly, if the working area does not provide a level ground support, it is only necessary to extend either leg 19 or leg 20 and foreshorten the other leg (20 or 19) to place tower 12 in true perpendicularity relative the horizontal, thereby to simulate a leveling of the drilling apparatus.

In that the tower 12 and the power cylinders 17 and 18 are carried on rotatable platform 3, the same being a kind of turntable, the tower can be rotated to left-hand and right-hand, lateral, working positions. By means of the arrangement shown in FIG. 3, actuation of power cylinder 27 will extend rod 28 and cause platform 3 to turn on trunnion shaft 5, the longitudinal axis of shaft 5 defining the priorly noted Z axis. Accordingly, the tower 12 will slue to the right (i.e., toward console position 35). Thus, drilling can be undertaken at any point across an arc extending between a centerline along the forward tramming path and a line not less than 90° of arc therefrom to the right. Should it be required to slue the tower to the left, it is only necessary to disconnect power cylinder 27 from coupling 24 and lug 25, and reconnect it in the alternate coupling, i.e., between lugs 24 and 25. Then, by actuation of the power cylinder 27 in this alternate arrangement, the tower 12 can be slued toward the left (as shown in dashed-line representation) across a complementary arc, of not less than 90°.

It is to be noted that the tower can be turned on the Z axis, while maintained in a vertical disposition, to the left and right across an arc of not less than 180 degrees, which arc transverses the forward path along which the drilling apparatus can be made to travel. Also, as the power cylinders 17 and 18 are rotated therewith, said cylinders provide a means for simulating a leveling of the drilling apparatus, and for disposing the tower 12 in true perpendicularity with the horizontal, at any point along said tramming path transversing arc. In this, cylinders 17 and 18 turn tower 12 on the Y axis by extending one leg 19 or 20 and foreshortening the other. So, also, then, while the tower can be slued on the Z axis, across an arc of 180 degrees, it can be adjusted about either or both of the Y and X axes, at any point along said arc, to accomplish true vertical or slant drilling, as desired, at said any point. This is simply done, as noted previously, by extending one leg 19 or 20 and foreshortening the other, by moving said legs in a common direction at the common rate, or by executing one of these operations after the other.

Thus, my invention teaches a mobile drilling apparatus having a tower movable about X, Y and Z axes relative the base of the apparatus, and movable in X and Y planes, relative the vertical, at any point along an arc transversing the tramming path of the apparatus.

In an alernate embodiment of my invention, as represented in FIG. 4, I teach a means of effecting tower 12 movement about axis Z in all 360 degrees. In FIG. 4, where index numbers which are the same as, or similar to same or similar numbers in FIGS. 1–3 denote same or similar elements, my novel Z axis mounting is modified from that shown in FIGS. 1–3. A platform 3′ is rotatable about the same trunnion shaft 5, and shaft 5 carries the same shaft 7 and sleeve 8. However, in this embodiment, four bolts 39 are provided to secure platform 3′ to base 2 in any one of four, equidistant positions—said positions each being located 90 degrees of arc, from those most adjacent thereto, to either sides thereof. Simply by removing bolts 39, and manually slueing the platform 3′ about shaft 5, tower 12 can be disposed perpendicular to the horizontal at any point about a circular perimeter defined by the sweep of the tower, in the Z axis, about the shaft 5. Additionally, of course, bolts 39 can be reinserted and fastened to lock the platform 3′ in any one of the aforenoted 90 degree-spaced positions.

I say that the tower can be disposed perpendicularly at any point about the circular perimeter. Well, that is not wholly accurate. At locations which are midway between the 90 degree-spaced positions, the mobile track of the base intrudes on the perimeter. Accordingly, to allow the slue of tower 12 past these midway locations, it is necessary to retract legs 19 and 20—to dispose tower 12 in a near-tramming position—and to reextend legs 19 and 20 when the midway locations have been cleared.

What is claimed is:

1. A drilling apparatus, comprising:

a mobile base;

said base having a platform mounted thereon, said platform being rotatable in an arc, relative to said base, about a vertical Z axis;

a drill tower for operative mounting of drilling tool and a drill steel thereon;

shaft means intercoupling said tower and said platform to effect rotation of said tower coincident with platform rotation, said shaft means including means facilitating movement of said tower, relative to said base, about a first horizontal Y axis and a second horizontal X axis;

a pair of juxtaposed, extensible legs intercoupling said tower and said platform wholly effective for substantially paralleling said tower with the horizontal

into a tramming position, disposing said tower in surmounting and proximate relationship to said platform, with such a tool and steel in operative mounting thereon, and for movement of said tower about said X and Y axes at substantially any point about a circular perimeter defined by the movement of said tower about said Z axis.

2. A drilling apparatus, according to claim 1, wherein: said arc comprises a sweep of 360 degrees.

3. A drilling apparatus, according to claim 1, further comprising:

a tramming-control console detachably mounted to said base in one of a plurality of spaced-apart operational mounting locations.

4. A drilling apparatus, according to claim 1, further comprising:

means for locking said tower in any one of a plurality of angularly displaced positions about said Z axis.

5. A drilling apparatus, according to claim 1, further comprising:

means, carried by said platform, for controlling said power means, said controlling means being movable with said tower about said Z axis.

6. A drill apparatus, according to claim 1, further including:

an actuator intercoupling said platform and said base for moving said platform about said Z axis.

7. A drilling apparatus, according to claim 6, further comprising:

means, carried by said platform, for controlling operation of said actuator, said controlling means being movable with said tower about said Z axis.

8. A drilling apparatus, according to claim 7, wherein: said controlling means comprises hollow tubes, fixed to said platform, confining control lines therewithin, and mounting controls thereon with which to effect axial motions of said tower.

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