

Oct. 18, 1960

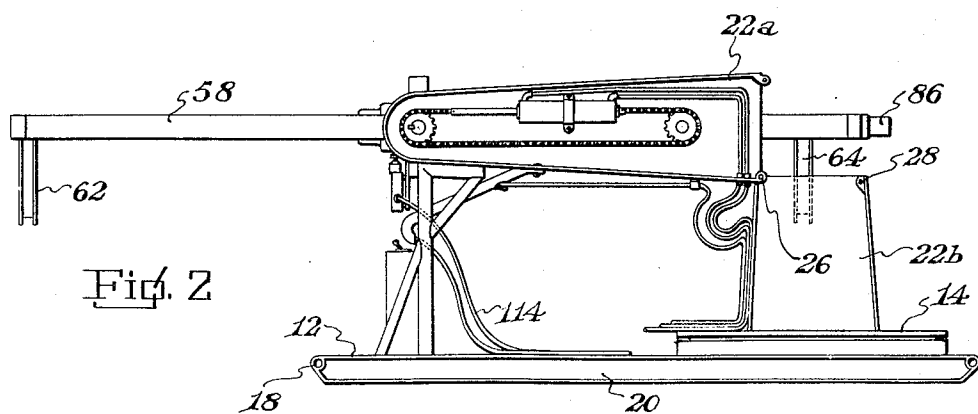
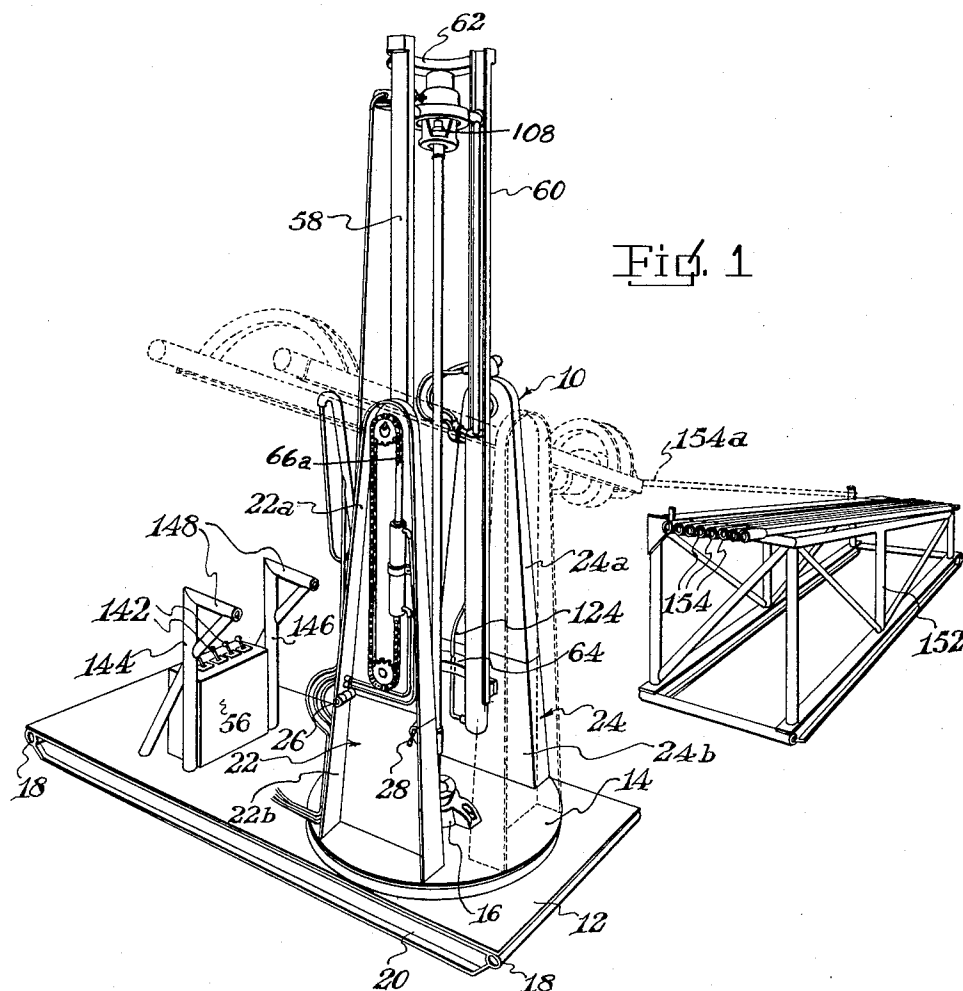
D. D. MISTROT

2,956,782

WELL DRILLING MACHINE

Filed Oct. 28, 1955

3 Sheets-Sheet 1



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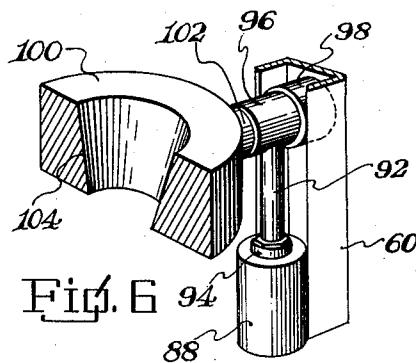
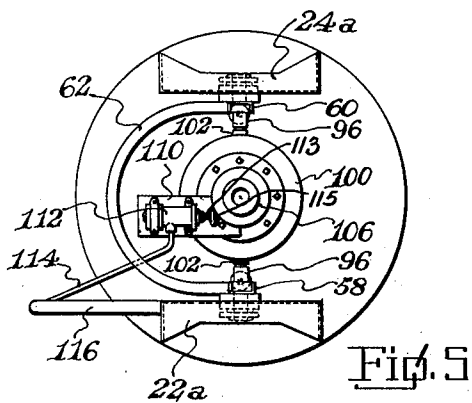
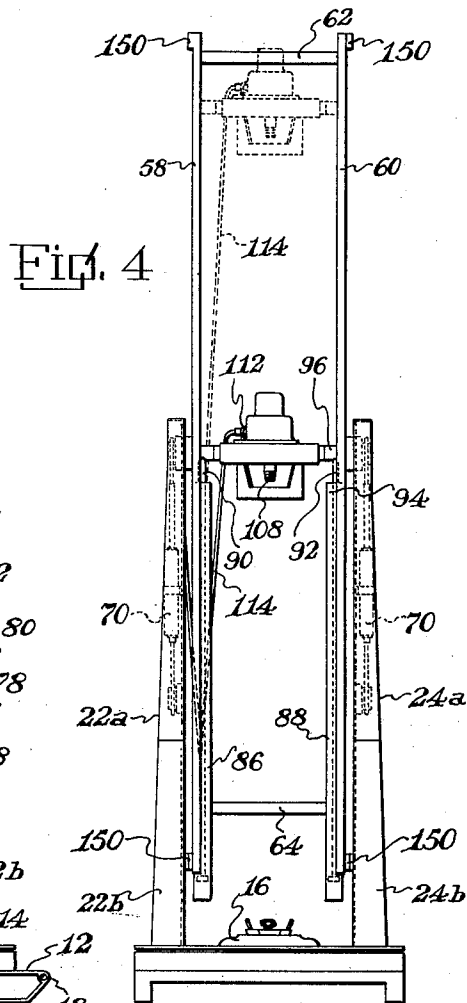
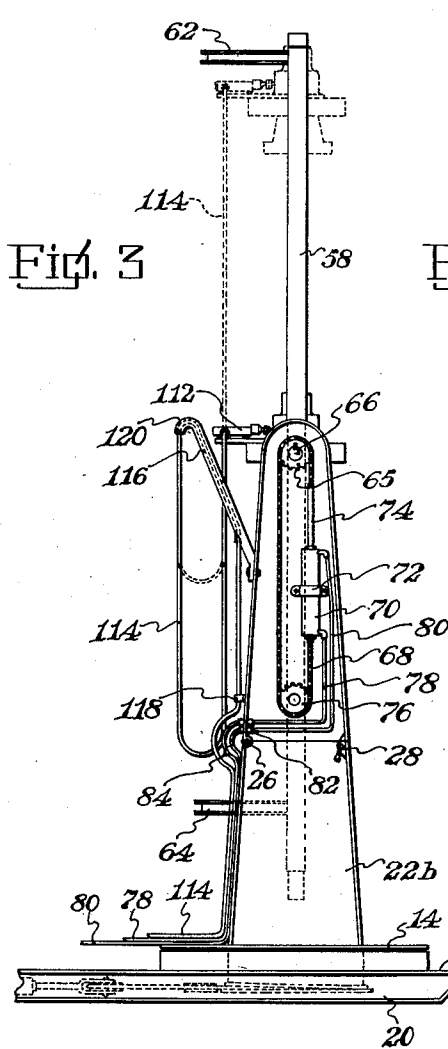
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3 Sheets-Sheet 3

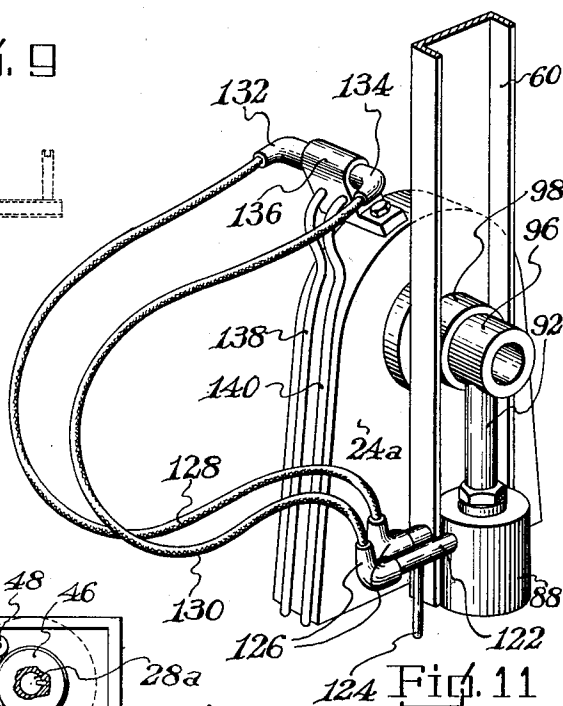
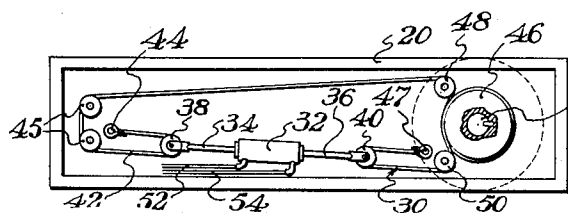
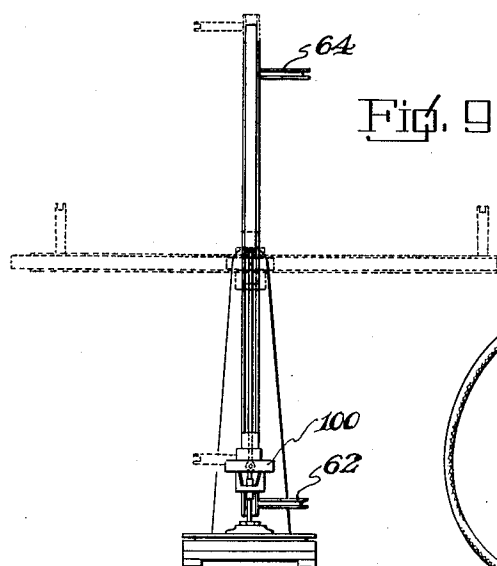
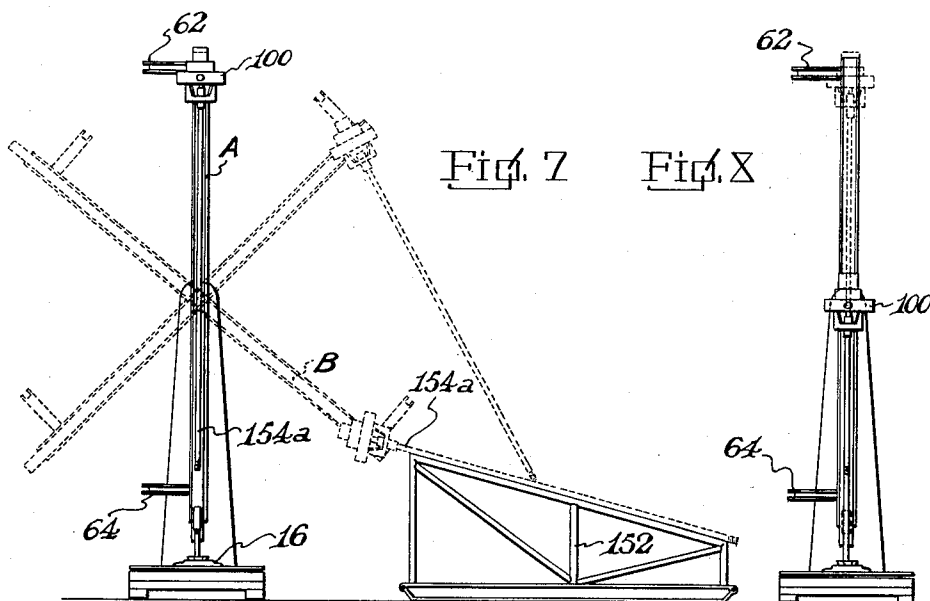


Fig. 10

Fig. 11

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WELL DRILLING MACHINE

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8 Claims. (Cl. 255—22)

This invention relates to improvements in well drilling apparatus and is particularly directed to a novel well drilling machine adaptable for drilling into the formation of the earth for the purpose or purposes of exploring, discovering and producing water, oil, gas, uranium and other similar or dissimilar minerals or substances.

Orthodox well drilling equipment in present use generally requires the provision of a derrick of expensive construction and which presents a transportation problem and is hazardous. Also, the required draw works with brakes, clutches and cables are hazardous as well as constituting a major breakdown problem. The necessary crown block and traveling block also present an intricate assembly and installation problem, which involves expense and risk to workmen. Such equipment requires the provision of a rotary table, swivel and a kelly, which involves the raising of the entire drill string for the full length of the kelly before another drill stem can be added.

It is a primary object of this invention to provide a well drilling machine, which is capable of performing satisfactory and efficient drilling operations without the use of so many intricate and disintegrated components employed by prior art machines, thereby reducing the weight of the machine, eliminating many troublesome and expensive parts and providing a machine of more simple, integrated and economical construction which can be operated more efficiently and with a greater degree of safety.

Another important object of this invention is to provide a well drilling machine which has a greater scope of operation and in which all of the parts and sub-assemblies are integrated into a compact and complete mechanism.

A further important object of this invention is to provide a well drilling machine which has a hydraulically actuated, vertically traveling means, which directly rotates the drill stem and thereby eliminates the need for a kelly.

A still further object of this invention is to provide a guide track means, which is rotatable 180° on an upstanding support about an axis transverse to the vertical and on which track means the vertically traveling means is mounted.

Generally stated, the present invention comprehends the provision of an upstanding rotatable support on which a track means is mounted for rotation about an axis transverse to the support so that the ends of the track means can be reversed. A hydraulically driven rotary head is vertically movable on the track means by hydraulic cylinders which reverse positions along with the track means to exert first a downward pull and then a downward push on the rotary head, the rotary head thereby rotating a drill stem completely down into the well.

The foregoing and ancillary objects are attained by this invention, the preferred form of which is set forth in the following description and illustrated in the accompanying drawings, wherein;

Fig. 1 is a perspective view of the well drilling machine showing the machine in a drilling position (full lines) and in a position for picking up a drill stem from a rack (dotted line position);

Fig. 2 is a side elevational view of the machine in a "broken over" or folded position for transportation;

Fig. 3 is a side elevational view of the machine;

Fig. 4 is a front elevational view thereof;

Fig. 5 is a top plan view thereof;

Fig. 6 is a perspective fragmentary sectional view through the rotary head assembly;

Figs. 7 to 9 are diagrammatic showings of the sequence of operation of the machine in (1) picking up a drill stem from the rack and positioning it vertically over a prior drill stem, which has been previously run and to which it is then coupled, (2) moving the drill stem down into the well on the retractive strokes of the piston rods of the "down" cylinders, and (3) reversing the guide track unit to bring the cylinders to an "up" position for the completion of the movement of the stem into the well by the extended movement of the piston rods;

Fig. 10 is a bottom plan view showing the means for rotating the frame base, and,

Fig. 11 is a perspective showing of the hydraulic connections to the cylinders which effect movement of the drilling head along the track means.

Referring now more particularly to the accompanying drawings, the well drilling machine, generally designated by the numeral 10, includes a platform 12 on which a frame base 14 is rotatably mounted. The base 14 carries a spider 16 of conventional construction and which overlies the boring or well hole to hold the suspended drill string. The spider, as is well known in the oil drilling rig art, is simply a collar that is disposed in the hole in the ground and is constructed to receive wedges which are inserted and removed as the need may be. The wedges are inserted to hold the drill string while another joint is being made for the addition of a section of the stem or the joint is being unmade for the removal of a section.

The platform 12 is provided at its ends with stiffening transverse tubes 18 and has ground engaging runners 20 extending longitudinally below its opposing side edges for transportation of the well drilling machine.

Frame uprights 22 and 24 extend upwardly, in spaced apart confronting relation from the base 14 and are channel shaped in cross-section for rigidity purposes. The uprights consist of hinged upper and lower sections 22a and 22b and 24a and 24b. The upper sections 22a and 24a are hinged, as at 26, to the lower sections for movement into lowered positions at right angles to the lower, fixed sections, the sections swinging about axes transverse to the longitudinal axis of the platform into positions horizontally overlying the platform, as shown in Fig. 2. Locks 28 of any suitable construction are provided to rigidly hold the upper sections in vertical positions of alignment with the lower sections, when the drilling machine is in operation.

The frame base is rotatably mounted on the platform and has a journal shaft 28a which extends vertically below the platform and which is hollow so that the drilling stems move therethrough as is conventional in this art and will be well understood by those skilled in this art as will the construction and arrangement of the frame base so that it rotates. The journal shaft 28a is a portion of the mechanism for rotation of the entire machine to different positions of hoisting or pick-up operation, as will be described, and the shaft is of sufficient size and hollow construction to permit the passage of the drill pipe and room for the spider. Means 30 for rotating the base is provided and is mounted on the underside of the platform, as shown in Fig. 10. Such means is hy-

draulically actuated and includes a double acting hydraulic cylinder 32 which is suitably supported by the underside of the platform. Piston rods 34 and 36 slidably and sealingly extend from the opposing ends of the cylinder and carry pulleys 38 and 40 on their outer ends. A cable 42 is anchored, at one end, to a pin 44 on the underside of the platform and is sheaved around the pulley 38 and passed over guide pulleys 45. The other end of the cable is anchored, as at 47, to the underside of the platform and is sheaved over the pulley 40. The cable is wrapped around a drum 46, which is suitably keyed on the shaft 28a. The cable passes from the drum around guide pulleys 48 and 50, which are disposed in proximity to the drum and spaced apart from each other to guide the cable. Fluid lines 52 and 54 extend from the cylinder 32, adjacent the ends thereof, and are connected to a hydraulic control housing 56 mounted on the platform.

The base is rotated by reciprocal movement of the piston (not shown) in the cylinder 32 to move the piston rods and thereby move the reaches of the cable. By such means, the base can be revolved to any position the operator may select for the desired operation, such as the picking up or laying down of drill pipe, the hoisting and placing of other materials and other operations.

The inner confronting faces of the uprights are planar and the edge flanges outstand from the uprights to laterally enclose the sides and top of the outer faces on which operating components are mounted, as will be described.

Elongated tracks 58 and 60 are mounted in laterally spaced, parallel relationship for rotation between the uprights, the tracks rotating about an axis transverse to the axes of the uprights or about a horizontal axis. The tracks are channel shaped in cross-section and face inwardly toward each other. Yokes 62 and 64 connect the tracks adjacent their ends and retain the tracks in transversely spaced relation, while strengthening them against turning stress and connecting them for simultaneous movement.

Each of the tracks is pivoted, intermediate its ends, by a trunnion 66 which fixedly extend laterally from the webs of the tracks. The trunnions are in alignment, transversely of the tracks, and are rotatably mounted transversely in the upper ends of the upper sections 22a and 24a of the frame uprights.

Both of the trunnions have a sprocket 65 keyed on its outstanding end and a chain 68 is trained over the sprocket to rotate it and produce the swinging movement of the tracks, which movement may be termed a "Ferris-wheel" movement. Hydraulic double-acting cylinders 70, which constitute the power means to rotate the tracks, are fixed by straps 72 on the outer faces of the upright sections 22a and 24a and are disposed parallel with the upright sections. The ends 68a of the chains are anchored to the outer extremities of the piston rods 74 of the cylinders, the chains passing over an idler sprocket 76, which is disposed below and in vertical alignment with sprocket 65. The piston rods 74 of the cylinder are in alignment with and connected to the ends 68a of the chain and move the chain in a clockwise or counter-clockwise direction responsive to action of the hydraulic fluid on the piston in the cylinder, the fluid flowing through the lines 78 and 80 that are connected to the cylinder at its upper and lower ends. The lines 78 and 80 suitably extend from each cylinder and are passed through guide sleeves 82 in the flange of the upper section and are outwardly looped, as at 84, so as to accommodate themselves to the hinged movement of the frame section 22a. The lines are suitably attached to the hydraulic control housing 56.

Elongated, double-acting cylinders 86 and 88 (see Figures 4 and 6) are fixedly mounted in the lower ends of the tracks and extend in axial parallelism with the tracks. The cylinders occupy approximately one-half the

length of the track so that the combined length of the cylinders and their piston rods approximately equals the length of the tracks, which are, of course, coextensive in length. The piston rods 90 and 92 slidably and sealingly extend from what are normally the upper ends 94 of the cylinders and terminate in transversely arranged journal sleeves 96 which extend into the tracks and are provided with circumposed rotatable guide rollers 98. The guide rollers engage the side walls of the tracks, as shown in Fig. 6.

A rotary head housing 100 is formed with radially outstanding and diametrically opposed journal pins 102 which are rotatably mounted in the journal sleeves 96 so as to swivelly suspend the rotary head housing transversely between the outer ends of the piston rods and to mount the rotary head housing to the piston rods for travel therewith, along the axes of the tracks.

The rotary head housing 100 is annular and has a tapered bore 104, as shown in Fig. 6. A hydraulically actuated rotary head 106 is rotatably seated in the bore 104 and is positioned and mounted so that its rotatable hollow shank 108, as shown in Fig. 1, depends from the housing for operative attachment to a drill joint of a drill stem section. A support 110 is horizontally mounted on the housing 100 and supports a hydraulic reversible motor 112. The motor has a shaft 113 which is operatively connected by a suitable drive transmission means, such as the gearing 115, to the rotary head for rotating the head and its associated drill stem sections. The motor is supplied with fluid pressure by a flexible hose 114, which is slidably carried by a tubular arm 116 that outstands upwardly and outwardly from the upper frame section. The flexible hose is held by a clamp 118 to the lower frame section and extends through a side opening into the arm 116, which terminates in a downwardly curved outer end 120. The hose is suspended from the arm in a loop fashion, in order that it may be played out to accommodate the travel of the head in the tracks.

Each of the cylinders 86 and 88 are in the preferred form of the invention provided with means for directly actuating their associated pistons. Obviously, for the operation of the device this is not necessary. However, both cylinders are identically constructed and are provided with connections for hydraulic fluid as shown, for example, in Fig. 11, the cylinder 88 is provided with fluid carrying pipes 122 and 124 which are attached to such cylinder at its upper and lower ends. The pipes have elbows 126 which connect with flexible hoses 128 and 130. The hoses are attached to elbows 132 and 134, which are swivelly attached to a fluid distributing block 136. The block is bolted on the upper end of the upper sections and is communicated by fluid lines 138 and 140 with the control housing 56.

The control housing 56 contains suitable valves controlling the flow of hydraulic fluid under pressure from a pump unit mounted therein to the various hydraulic cylinders and hydraulic motor. The housing has valve controllers 142 which control the selective operation of the hydraulic operating means for the various movable structures.

Supports 144 and 146 upstand from the platform and are spaced transversely apart a distance approximately equal to the lateral spacing of the uprights 22 and 24. The supports terminate, at their upper ends, in longitudinally extending rests 148 on which the upper sections 22a and 24a of the frame uprights are adapted to seat when they are hinged downwardly into collapsed positions, as shown in Fig. 2.

Friction catch or lock means 150 of a conventional structure and operation such that it is automatic in engaging and releasing operation, is provided on the inner faces of the lower frame upright sections 22b and 24b and on the outer web faces of the upper and lower ends of the tracks to lock the tracks in perpendicular positions.

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A portable rack 152 is provided for use in conjunction with the well drilling machine and has a downwardly and rearwardly sloped upper deck on which a plurality of drill stems 154 are rested.

The operation of the machine is believed to be easily apparent from a consideration of Figs. 7 to 9. As shown in Fig. 7, the tracks 58 and 60 are swung from their full line position A down to an inclined and outwardly extending position B. The movement is accomplished by the operation of the cylinders 70 which actuate the chains 68 and rotate the trunnions 66. The locking means is released by the power actuation of the tracks. The rotary head housing is held at the upper ends of the track by the piston rods 90 and 92 which are in fully extended positions from the cylinders 86 and 88. The rotary head housing is swung to a position to align the shank 108 of the rotary head with a selected drill stem 154a and the rotary head is rotated by its hydraulic motor to connect onto the threads of the drill stem joint. The tracks are then swung counterclockwise to the dotted line position with the rotary head housing swiveling about its journal sleeves 96 and with the rotary head dragging and lifting the selected drill stem from the rack.

The tracks are returned to their full line position A and lock automatically in such position. The drill stem 154a is suspended vertically from the rotary head and the head is lowered by retracting the piston rods 90 and 92 until the drill stem 154a may be screwed into the collar (drill-joint) of the preceding drill stem, which is suspended from the spider 16.

After the two drill stems are connected, the rotary head housing is raised slightly to relieve and remove the slips from the spider and the rotating, drilling operation is commenced. Such operation entails an actuation of the hydraulic motor 112 to rotate the rotary head and a downward retraction of the piston rods 90 and 92 to move the rotary head housing downwardly in the tracks.

Such operation continues until the rotary head housing 100 is in the position shown in Fig. 8 with the piston rods fully retracted. In such position, the pins or pintles 102 of the housing 100 are in perfect alignment with the trunnions 66.

At this point, power is supplied to the upper end of the cylinder 70 through fluid line 80, with fluid line 78 carrying the return flow from the lower end of the cylinder. The chain 68 is rotated clockwise and the sprocket 65 is rotated to rotate the trunnions. The tracks will then be swung, as shown in dotted lines in Fig. 9, end to end and the lower ends will become uppermost with the upper ends lowermost, as the tracks lock into a perpendicular inverted position, shown in full lines in Fig. 9. In such position, the cylinders 86 and 88 will be inverted and will be uppermost.

By applying reverse power in the cylinders 86 and 88, the piston rods 90 and 92 will be extended downwardly and this action with the rotating of the head 106 will cause the drill stem 154a to travel further into the well until the rotary head nears the spider. The slips are then set to lock the stem 154a to the spider 16 and the rotation of the head is reversed to unscrew the head from the stem joint. The tracks are then swung to the starting position so as to repeat the operation with the first step being the picking up of another section of drill pipe.

To pull the drill string out of the hole, stem by stem, the complete operation is reversed. The drill stems can be removed from and replaced on the rack or on a truck or any other drill stem carrier.

As used in the appended claims, the term guide means encompasses the parts of the track that perform a guiding function and the term track means is descriptive of the portion of the track which serves the purpose of controlling the movement of the drill head housing.

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Since other uses and environments for the machine will be obvious to those skilled in the art and since only the preferred embodiment has been shown, it is to be understood that such other uses and environments and other forms are within the scope of this invention, as defined by the appended claims.

I claim:

1. An earth drilling machine comprising a support, guide means vertically carried by the support and rotatably mounted thereon for bodily swinging movement in a vertical plane and through an arc of 180° about an axis transverse to the vertical, a rotary drill head carried by the guide means for movement along the axis thereof from one end to the other end, a double acting hydraulic cylinder fixed on one end of the guide means and disposed parallel with the guide means and having a piston rod connected to the drill head for drawing it down along the guide means in the one vertical position of the guide means and for pushing it down along the guide means in the inverted vertical position of the guide means.

2. An earth drilling machine as claimed in claim 1, wherein means is provided for rotatably mounting the guide means on the support and hydraulically actuated means is connected to said mounting means for rotating it.

3. An earth drilling machine as claimed in claim 1, a ground engaging mobile platform on which the support is rotatably mounted and from which it upstands and means for rotating the support about a vertical axis.

4. An earth drilling machine as claimed in claim 3, wherein said last means includes a drum attached to the support, a hydraulic double acting cylinder and a flexible element connected to the piston rod of the cylinder and wrapped around the drum to translate the reciprocation of the piston rod into rotary movement of the drum.

5. An earth drilling machine comprising a mobile platform, a support upstanding from the platform and rotatably mounted thereon, means for rotating the support about a vertical axis, an elongated track means vertically carried by the support, means mounting the track means on the support for vertical swinging movement of the track means about a transverse axis through an arc of 180° so that the track means can be inverted end to end, a rotary drilling head housing slidably carried by the track means for movement along the axis thereof from one end to the other end of the track means, means mounting the housing on the track means and including means supporting the housing for swivel movement to maintain the housing in proper horizontal drilling position when the track means swings relative thereto, a rotary drill head carried by the housing, motor means associated with the drill head for rotating it, means carried by the support and connected to the means mounting the track means on the support for rotating the track means, a hydraulic double acting cylinder fixed to one end of the track means and disposed parallel therewith and having a piston rod slidingly and sealingly extending from its inner end and means connecting the piston rod to the means supporting the housing so that the housing and drill head are pulled downwardly on the track means by the retractive action of the piston rod with the said cylinder at the lower end of the track means and so that, when the track means is vertically swung 180°, the housing and drill head are pushed downwardly by the extension action of the piston rod with the cylinder at the then upper end of the track means.

6. An earth drilling machine as claimed in claim 5, wherein locking means is provided between the frame and the track means for automatically locking the track means in a vertical position.

7. An earth drilling machine as claimed in claim 5, wherein said means mounting the housing on the track means includes rotatable guides on the track means and

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radially outstanding journal pins on the housing and rotatably attached to the guides.

8. An earth drilling machine as claimed in claim 7, wherein said means connecting the piston rod to the means supporting the housing includes a transverse journal sleeve on the outer extremity of the piston rod, said sleeve fitting in the guide and having the journal pins rotatably socketed therein.

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