

Dec. 6, 1960

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2,963,274

DRIVE FOR EARTH BORING TOOLS

Filed March 15, 1957

3 Sheets-Sheet 1

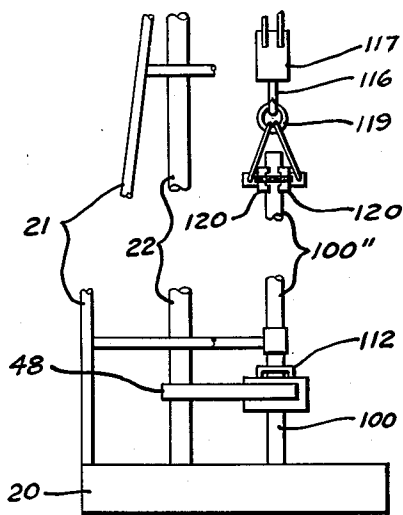


Fig. 8

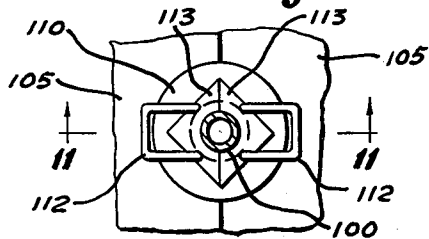


Fig. 10

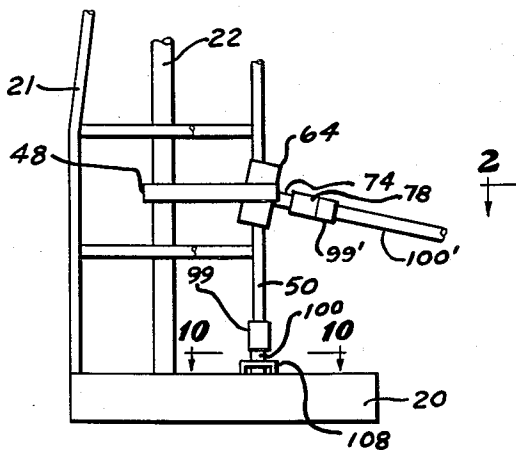


Fig. 9

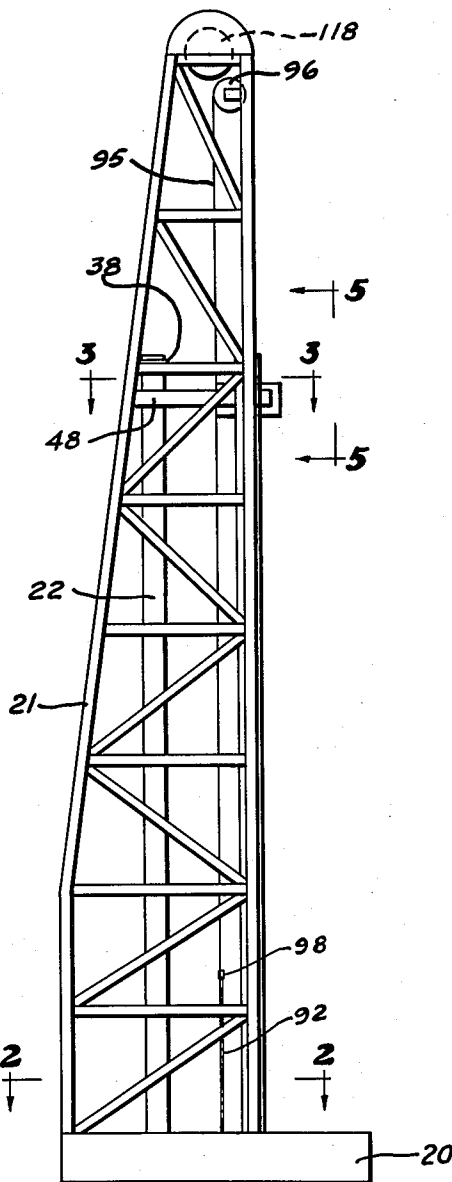


Fig. 1

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Fig. 3

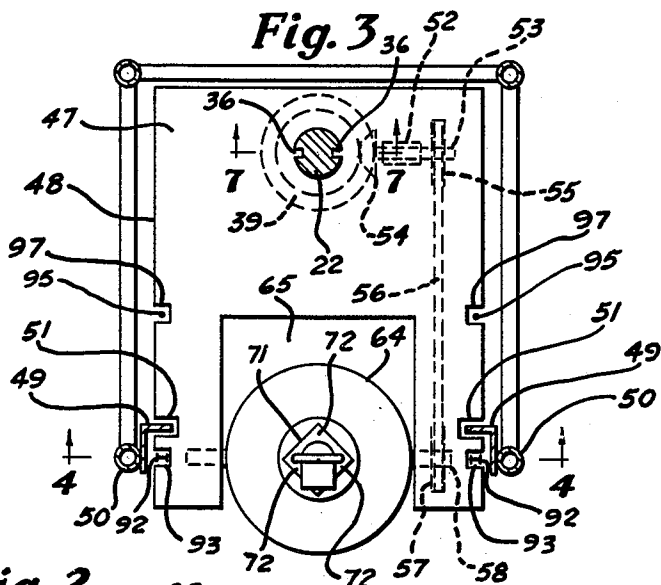


Fig. 2

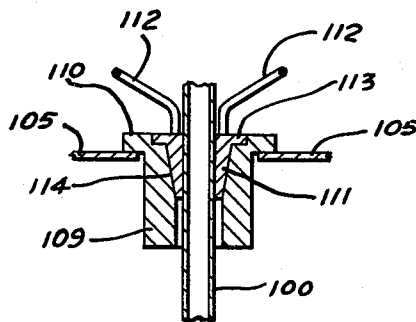
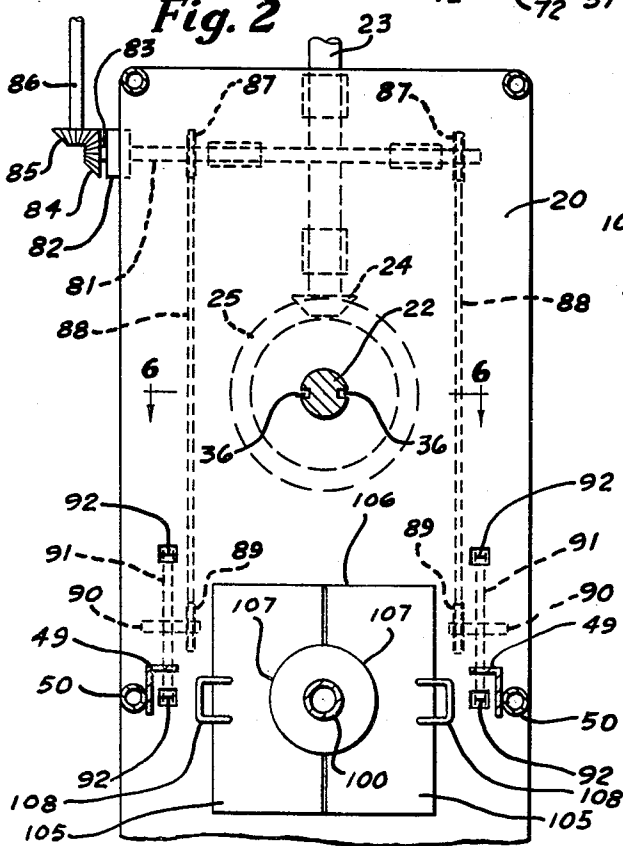


Fig. 11

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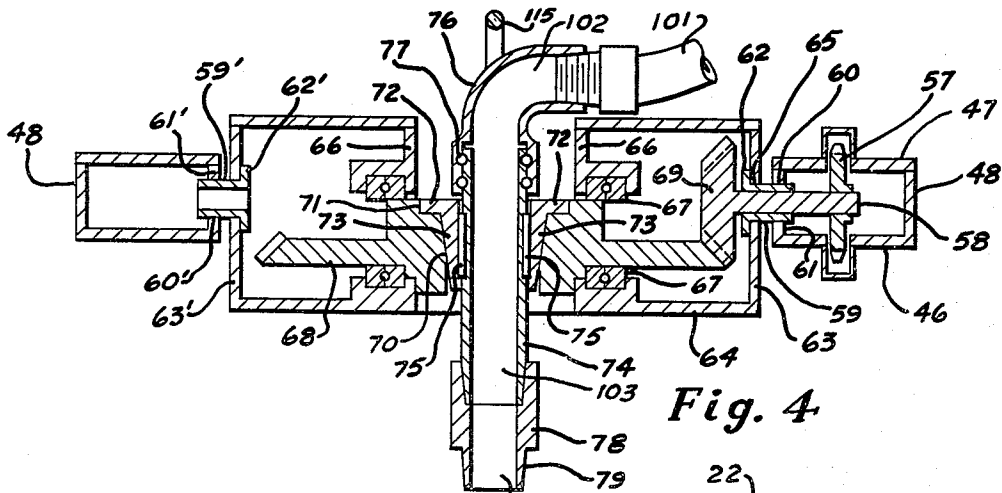


Fig. 4

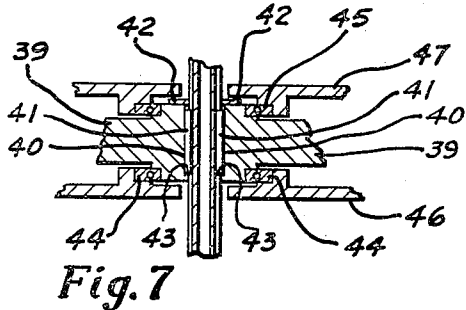


Fig. 7

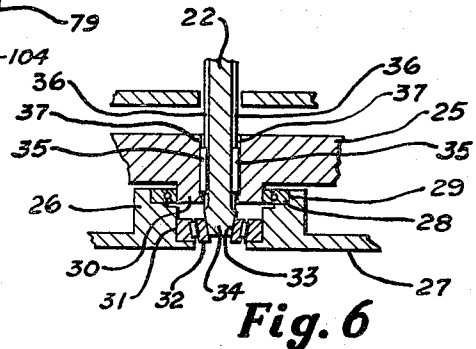


Fig. 6

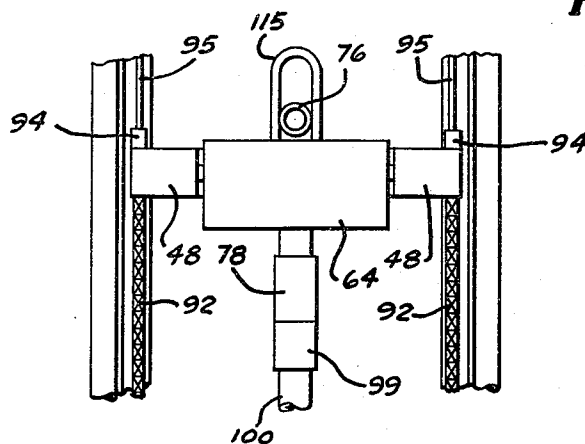


Fig. 5

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DRIVE FOR EARTH BORING TOOLS

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5 Claims. (Cl. 175-127)

My invention relates to earth boring apparatus, and more particularly to a power drilling apparatus that is provided with a drive shaft, ordinarily referred to as a kelly, that is held against endwise movement during its operation of rotating the drill.

In conventional drilling apparatus for drilling well bores, or carrying out other earth boring operations, it is necessary, every time a joint of drill pipe is added to the drill stem, to raise the drive shaft or kelly from its lowered position, lower it into a supplemental hole, commonly referred to as a rat hole, add the joint of drill pipe, and again remove the kelly from the rat hole and connect it with the upper end of the added joint of drill pipe. It is one of the important purposes of my invention to eliminate the use of such a rat hole and the raising and lowering of a drive shaft such as the above referred to kelly.

Also, in conventional drilling, it is necessary to raise the drill pipe up the length of the kelly or drive shaft each time that a joint of drill pipe is added. This is also avoided by my new and improved apparatus. The drill bit being adjacent or on the bottom of the hole, when adding a joint of drill pipe, this accomplishes continuous drilling. This is of considerable advantage, in that frequently in withdrawing the drill upwardly the distance above referred to, caving results below the temporary location of the drill bit while a new joint of drill pipe is being added, which increases the difficulty of proceeding with the drilling after the addition of such a length of drill pipe. By retaining the drill bit at or closely adjacent the lowest point reached in the drilling operation at the time a new joint of drill pipe is added, such caving is substantially entirely eliminated.

Other advantages of my invention are that the size of the hole drilled is not restricted to the inside diameter of a rotary table, ordinarily used, as the rotary table is eliminated; and longer life of the drive shaft or kelly is obtained because of the fact that the kelly drive used in my improved apparatus is not exposed to the drilling fluid or mud elements, such as sand, which cause undue abrasive wear on the conventional kelly.

In order to obtain the above advantages, it is a purpose of my invention to provide means for rotating a drill pipe or stem, comprising a drive shaft or kelly that is held against endwise movement, but which is rotated about its axis, and to provide rotary means, such as a drive sleeve, for connection with the drill pipe or stem, that has a driving connection interposed between it and the drive shaft or kelly, that includes a rotatable driving member, such as a gear, longitudinally slidably mounted on the kelly or drive shaft for rotation therewith. Thus the assembly, which may be referred to as a drive head, comprising the drive means that is longitudinally movable along the kelly, provides great flexibility in the vertical location at which the lengths of drill pipe are added to the string or removed therefrom, as this can be done anywhere along the length of travel of the traveling driving

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means, which length of travel is substantially the length of the drive shaft or kelly.

More specifically my improved drilling apparatus comprises a mast, in which the kelly is mounted to extend longitudinally for rotation about its axis, but is held against endwise movement relative thereto, and driving means for connection with a drill pipe, comprising a drive sleeve with which a water swivel is removably connected and which is driven from the kelly or drive shaft by a driving connection that includes a driving member, such as a gear, mounted on the kelly to slide longitudinally thereon, but which has a driving connection therewith so as to rotate with the kelly, the driving connection including a mounting for the drive sleeve whereby it is adapted to swing about a horizontal axis so that said drive sleeve can be swung about said axis out of a vertical position into any desired angular, or even a horizontal position, for attachment of drill pipe thereto. With the water swivel removed, the driving means for the drive sleeve can be used as a spin-out table when the string of drill pipe is being removed from the hole.

It is a further purpose of my invention to provide positive feeding means for feeding the drill pipe downwardly, which is connected with the mounting for the drive sleeve and the driving connection between the same and the kelly so as to move the entire driving apparatus, which may be referred to as a drive head, downwardly at a desired rate by said feeding means, with the drive member that is mounted on the kelly traveling downwardly along the kelly as this takes place.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined by the claims.

In the drawings:

Fig. 1 is a side elevational view of my improved drilling apparatus.

Fig. 2 is a section taken on the line 2-2 of Fig. 1, on an enlarged scale.

Fig. 3 is a similar view taken on the line 3-3 of Fig. 1.

Fig. 4 is an enlarged vertical sectional view through the mounting for the drive sleeve, the drive sleeve and associated parts, taken on the line 4-4 of Fig. 3.

Fig. 5 is a fragmentary elevational view taken on the line 5-5 of Fig. 1, on an enlarged scale.

Fig. 6 is a fragmentary section taken on the line 6-6 of Fig. 2.

Fig. 7 is a fragmentary section taken on the line 7-7 of Fig. 3.

Fig. 8 is a fragmentary side elevation of the drilling apparatus, showing the parts in position for the spinning out or removal of a section of drill pipe.

Fig. 9 is a fragmentary elevational view showing the position of the parts for the connection of a section of drill pipe to the drive head.

Fig. 10 is a sectional view taken on the line 10-10 of Fig. 9 on a slightly enlarged scale, and

Fig. 11 is a fragmentary section taken on the line 11-11 of Fig. 10.

Referring in detail to the drawings, my improved drilling apparatus is shown as being provided with a base 20, which may be either mounted in fixed position or portable, upon which a framework in the form of a mast 21 is mounted. Extending longitudinally of the mast 21 is a drive shaft or kelly 22. The drive shaft or kelly 22 is mounted for rotation about its axis and against movement longitudinally of its axis in a suitable manner. Any suitable means may be provided for rotating the shaft 22.

In Fig. 2 a shaft 23 is shown, which is driven in a suitable manner, and which is provided with a bevel pinion

24 that meshes with the bevel gear 25, which is mounted in suitable bearings on an upstanding boss 26 provided on the bottom wall 27 of the base member 20. Ball bearing means 28 is shown as being mounted in a recess 29 in the boss 26 and between the wall of said recess and a downwardly extending hub 30 on the gear 25. Below the gear 25 mounted in a socket 31 provided in the base member 20 is a thrust bearing 32 of any suitable character, which is shown as being provided with a tapered socket portion 33, in which the tapered end 34 of the shaft 22 is mounted. Said shaft 22 is provided with keys 35 that are seated in longitudinal grooves 36 in the shaft 22 and in aligning grooves 37 in the gear 25 to secure the gear 25 to the shaft 22 to rotate therewith. While this particular means for keying the gear to the shaft is shown in the drawings, any other suitable means for securing the gear 25 to the shaft 22 to rotate therewith may be provided.

The upper end of the shaft 22 is rotatably mounted in a bearing 38 which is mounted in any suitable manner upon the framework of the mast 21. Mounted on the shaft 22 between the bearing 38 and the base member 20 is a bevel gear 39. The bevel gear 39 is provided with a pair of grooves 40 in the hub portion thereof and keys 41 are mounted in said grooves 40 and in the grooves 36 in the shaft 22. Any suitable means, such as the members 42, may be provided for confining the keys 41 between the same and the inturned flange 43 on the gear 39 to retain the key members 41 in proper assembled relation with the gear 39. The gear 39 is mounted between suitable bearings 44 and 45 provided in the bottom wall 46 and top plate 47, respectively, of a movable platform 48, which is mounted for movement up and down in the mast 21. The platform 48 serves as mounting means for the gear 39, as well as for other driving means, to be described below. Said platform 48 is guided in its movements by means of suitable guiding means 49 mounted on longitudinal frame members 50 of the mast 21. While said guides 49 are shown as being angle members, welded or secured in any other suitable manner to said frame members 50, engaging in recesses 51 in the platform 48, any other suitable guiding means for the platform may be provided, as long as said guiding means prevents any twisting motion of the platform with respect to the mast.

Mounted in suitable bearing means 52 on the platform 48 is a shaft 53, which has a bevel pinion 54 thereon meshing with the bevel gear 39. Said shaft 53 has keyed thereto a sprocket wheel 55, over which a sprocket chain 56 operates. The sprocket chain 56 also operates over a sprocket wheel 57 that is keyed to the shaft 58, which is mounted in a suitable sleeve 59 serving as a bearing for said shaft 58. The sleeve 59 is rotatably mounted in an opening 60 in an upstanding wall portion 61 on the platform 48 and is provided with a flange 62, which bears against a vertical wall 63 of a housing 64 and extends also through an opening 65 in said wall 63. Preferably the flange 62 is secured to the wall 63, and thus said sleeve 59 serves as a bearing for the shaft 58 and as a tubular pivot member for the housing 64, for swinging the same about a transverse or horizontal axis. A similar sleeve-like member 59' having a flange 62' and rotatably mounted in an opening 60' in a wall 61' extending upwardly from the bottom of the platform 48 is provided in axial alignment with the sleeve 59 on the opposite side of the housing 64, the flange 62' being preferably in engagement with and secured to the upstanding wall 63' on said housing 64. The housing 64 is thus mounted on trunnions for a swinging movement about a horizontal axis. The housing 64 is mounted in an opening 65 in the platform 48 and has an inner wall portion 66 that is provided with suitable bearings 67 for a large bevel ring gear 68, that meshes with a bevel pinion 69 keyed on the shaft 58.

It will accordingly be seen that as the shaft 22 is ro-

tated the gear 68 will be rotated through the driving means comprising the bevel gear 54, the sprocket 55, the sprocket chain 56, the sprocket 57 and the bevel gear 69. It will also be noted that the gear 39 is rotatable with the shaft 22, but is slidable longitudinally thereof between the bearing 38 at the upper end of the kelly or drive shaft 22 and the base member 20. The gear 68 is provided with a central tapered opening 70 therein leading from a top rectangular opening 71, in which the flanges 72 of the slips 73, having tapering outer walls engaging the tapering wall 70 of the gear 68 are mounted. A drive sleeve 74 is fixed to rotate with the slips 73 and thus with the gear 68 by means of keys 75. The drive sleeve 74 has a water swivel 76 mounted thereon for relative rotation with respect to the drive sleeve 74 by suitable means, such as ball bearings 77. Said drive sleeve 74 is also provided with suitable coupling means 78 thereon, provided with threaded means 79 for connection with suitable coupling means on a drill pipe, as will be described below.

Mounted on the base 20 is a transverse shaft 81, which is provided with clutch means 82 for connecting the same with a shaft 83 extending from a bevel gear 84, that meshes with the bevel gear 85 mounted on a shaft 86 that is driven independently of the shaft 23. Thus by throwing in the clutch 82 in a well known manner, the shaft 81 can be rotated through the bevel gears 84 and 85 from the shaft 86. The shaft 81 has a pair of sprockets 87 mounted thereon, over which sprocket chains 88 operate, that also operate over sprockets 89 provided on stub shafts 90 mounted on the base member 20. Sprockets 91 are also fixed on the shafts 90 to rotate therewith and a sprocket chain 92 extends over each of the sprockets 91. Each of the sprocket chains 92 extends through an opening 93 in the platform 48, and has coupling sleeves 94 connecting it with the cables 95, the coupling sleeves 94 engaging the top wall 47 of the platform adjacent the openings 93 to limit downward movement of the cables and sprocket chains with respect to the platform 48. The cables 95 extend over sheaves 96 mounted on the mast in a suitable manner, and extend downwardly through openings 97 in the margins of the platform 48, and have their other ends connected with the ends of the sprocket chains that are opposite those that have the couplings 94 thereon, by means of similar couplings 98. The direction of rotation of the shafts 86 and 81 is such that the sprocket wheels 91 are rotated in a direction that the platform 48 will be fed downwardly by a pull of the chains 92 thereon whenever the clutch 82 is thrown in to rotate the shaft 81 by means of the shaft 86. The drill pipe is connected with the drive sleeve 74 by connecting the threads on the threaded portion 79 of the coupling member 78 with threads on a coupling 99 provided on the drill pipe 100. It is, of course, to be understood that a number of lengths of drill pipe 100 are coupled together in a similar manner to form a string of drill pipe that constitutes the drill stem of the apparatus, and which has a suitable drill at the lower end thereof that is operating in the ground to bore downwardly therein. While it is not always necessary to provide power feeding means for the drill stem, it is necessary under conditions in which the weight of the collective lengths of drill pipe is insufficient to feed the drill bit through the strata that may be encountered. When such power feeding is necessary, the clutch 82 is thrown in and the platform 48 is pulled downwardly, causing the drive sleeve 74 and the drill pipe connected therewith to be moved downwardly as desired. When such downward movement of the platform 48 occurs, whether due to the power feeding means or to the weight of the connected series of drill pipe that form the drill stem, the gear 39 will slide downwardly on the shaft 22, but will be constantly driven thereby to rotate the drive sleeve 74 and the drill pipe and drill connected therewith.

The drilling fluid is supplied from any suitable source of supply through a flexible conduit 101, which is connected with the water swivel 76, passing through the

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passages 102 and 103 in the water swivel and drive sleeve to the passage 104 in the coupling means to the passage inside the drill pipe. When a length of drill pipe has been fed downwardly so that it reaches the position shown in Fig. 9 for the same, with the coupling 99 on the end thereof adjacent the base 20 of my drilling apparatus, the drive sleeve 74 is disconnected therefrom after suitable gripping means has been engaged with the drill pipe, so as to prevent its dropping down into the hole beyond reach. While the drill is ordinarily resting on the bottom of the hole that is being drilled, it depends on the formation with which the drill is in engagement as to whether the weight of the drill pipe exerted thereon might cause it to sink down further into the formation through which drilling is being done, which might cause the drill pipe, at its upper end, to become inaccessible if it is not held from further downward movement. Any suitable or well known means for holding such a string of drill pipe from moving downwardly in the hole may be provided. In the drawings the base member 20 is shown as being provided with removable plate-like members 105, that close an opening 106 therein, and which are cut away at 107 to provide a circular opening between the same and are provided with handles 108 by means of which said plate-like members 105 can be removed and replaced. Referring to Figs. 10 and 11, a sleeve 109 is shown as being mounted in the circular opening provided between the plate-like members 105, which has a flange 110 thereon resting on top of the plate-like members, and slips 111 of a well known character are shown as being mounted in the sleeve-like member 109, having handles 112 thereon for manipulating the same, and being provided with a flange 113 on each thereof, which seat in a rectangular recess in the sleeve 109. The slips are tapered as shown in Fig. 11 and engage a tapering portion 114 of the bore in the sleeve 109, and have suitable gripping means on the inner sides thereof that engage with the drill pipe 100 in the usual manner. The holding means for the drill pipe is put in position as shown in Figs. 10 and 11, and after this has been done, the uncoupling of the drive sleeve 74 from the drill pipe, takes place.

After the drill pipe has been uncoupled from the drive sleeve, a new section of drill pipe is added by proceeding as shown in Fig. 9. With the platform 48 near the base member 20, the housing 64 and along with it, the drive sleeve 74, are swung about the axis of the trunnions 59 and 59' to an angular position approaching the horizontal, or to a substantially horizontal position, which makes it easy to screw the coupling 99' on the next section of drill pipe 100' to be attached to the string, to the coupling means on the drive sleeve. The clutch 82 is next moved to uncoupling position so as to disconnect the shaft 81 from the shaft 86, which makes it possible to move the platform 48 and the apparatus carried thereby upwardly by suitable elevating means. Preferably a bail 115 is provided on the housing 64 for attachment of the elevating means. Means for connection with the bail 115 may comprise a hook 116 mounted on a block 117, which is mounted on cables that operate over the crown sheave 118, in the usual manner. In Fig. 8 the hook 116 is shown as being attached to an elevator 119 having gripping jaws 120 that are in engagement with a drill pipe section 100'' that is to be removed from the next lower drill pipe section 100 during the operation of withdrawing the drill pipe from the hole. In order to break the joint between the drill pipe section 100'' and the drill pipe section 100, my improved new driving means for the drill stem is utilized as a spin-out table. In order to use the driving means in this manner, the platform 48 is positioned near the base member 20, as shown in Fig. 8, the water swivel is removed along with the drive sleeve 74 and the slips 73, and slips similar to the slips 111 shown in Fig. 11 are interposed between the drill pipe section 100 and the hub of the gear 68. By applying a suitable wrench or tongs for holding the drill pipe section 100'', and rotation

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of the driving means, including the gear 68, by means of the drive through the kelly 22, the gear 39 and the sprockets 87 and 89, the lower drill pipe section 100 is rotated in the proper direction to unscrew the same from the upper drill pipe section 100''. Thereupon the drill pipe section 100'' can be elevated by the means provided on the mast, including the gripping means 120, block 117 and the crown sheave 118, and stored in any desired place. This procedure can be repeated with each of the drill pipe sections as it is moved upwardly by the elevating means to such a position that the next lower section can be engaged with the drive that I have provided in the manner above described, until all of the drill pipe sections have been removed from the hole.

15 What I claim is:

1. In earth boring equipment, a framework, a drive shaft extending longitudinally of said framework and mounted for rotation thereon, means for holding said shaft against endwise movement relative to said framework, means for rotating said shaft, a platform mounted on said framework for movement longitudinally thereof, guiding means for said platform on said framework, a gear mounted on said platform for rotation with said drive shaft, said gear being longitudinally slidably mounted on said drive shaft, a housing connected with said platform to freely pivot thereon about a horizontal axis spaced transversely of said framework from a plane parallel to said horizontal axis and containing the axis of said drive shaft, a drive sleeve extending through said housing, a drive sleeve gear mounted in said housing on said drive sleeve in fixed position, said drive sleeve and drive sleeve gear being mounted for rotation in said housing about an axis perpendicular to said horizontal axis and held against movement relative to said housing in the direction of said axis of rotation of said sleeve and gear, and a driving connection between said gears comprising a gear in said housing mounted to rotate about said horizontal axis and meshing with said drive sleeve gear.

2. In earth boring equipment, a framework, a drive shaft extending longitudinally of said framework and mounted for rotation thereon, means for holding said shaft against endwise movement relative to said framework, means for rotating said shaft, a platform mounted on said framework for movement longitudinally thereof, guiding means for said platform on said framework, feeding means for moving said platform longitudinally of said framework, a housing mounted on said platform to swing freely thereon about a horizontal axis spaced transversely of said framework from a plane parallel to said horizontal axis and containing the axis of said drive shaft, a drive sleeve gear mounted in said housing to rotate about an axis perpendicular to said horizontal axis and held against axial movement in said housing, a drive sleeve extending axially through said gear and fixed thereto and extending from said housing, a shaft mounted on said platform to rotate about said horizontal axis and extending into said housing, a gear fixed on said shaft in said housing and meshing with said drive sleeve gear, and a driving connection between said first mentioned gear and said last mentioned shaft.

3. In earth boring equipment, a framework, a drive shaft extending longitudinally of said framework and mounted for rotation thereon, means for holding said shaft against endwise movement relative to said framework, means for rotating said shaft, a platform mounted on said framework for movement longitudinally thereof, guiding means for said platform on said framework, feeding means for moving said platform longitudinally of said framework, a housing mounted on said platform to swing freely thereon about a horizontal axis spaced transversely of said framework from a plane parallel to said horizontal axis and containing the axis of said drive shaft, a drive sleeve gear mounted in said housing to rotate about an axis perpendicular to said horizontal

axis and held against axial movement in said housing, a drive sleeve extending axially through said gear and fixed thereto, the axis of said drive sleeve and the axis of said drive shaft being in a common plane in all positions of said drive sleeve, a shaft mounted on said platform to rotate about said horizontal axis and extending into said housing, a gear fixed on said shaft in said housing and meshing with said drive sleeve gear, and a driving connection between said first mentioned gear and said last mentioned shaft.

4. In a drilling apparatus, a mast, a drive shaft extending longitudinally of said mast and mounted thereon for rotation about its axis, means for holding said shaft against endwise movement, means for rotating said shaft, a platform mounted on said mast for movement longitudinally thereof, a drive sleeve, a mounting for said drive sleeve comprising a housing mounted on said platform for swinging movement about a pivotal axis extending transversely to the axis of said sleeve, said pivotal axis being spaced transversely of said mast from a plane parallel to said pivotal axis and containing the axis of said drive shaft, means in said housing mounting said drive sleeve thereon for rotation about the axis of said sleeve, and means for rotating said sleeve about its axis comprising a drive sleeve gear in said housing through which said drive sleeve extends fixed to said drive sleeve and a driving connection between said gear and said drive shaft including a driving member mounted on said drive shaft to slide longitudinally thereon and rotate therewith, a member driven thereby and means for rotating said gear by means of said driven member including a stub shaft mounted on said platform to rotate about said pivotal axis and extending into said housing and a gear in said housing mounted on said stub shaft to rotate therewith and meshing with said drive sleeve gear.

5. In drilling apparatus, a base, a mast extending upwardly from said base, an upstanding drive shaft

mounted on said mast for rotation about its axis, means on said base for rotating said drive shaft including means for holding said shaft against endwise movement, a platform mounted for movement up and down in said mast, a housing mounted on said platform for pivotal movement about a horizontal axis, said pivotal axis being spaced transversely of said mast from a plane parallel to said pivotal axis and containing the axis of said drive shaft, feeding means for moving said member downwardly in said mast, a gear mounted on said platform and slidably mounted on said drive shaft to rotate therewith, a gear mounted in said housing to rotate about an axis perpendicular to said horizontal axis and held against axial movement in said housing, a drive sleeve fixed to said gear, and means interposed between said gears to drive said gear fixed on said sleeve from said drive shaft gear comprising a shaft on said pivotal axis having a gear mounted thereon in said housing to rotate therewith and meshing with said drive sleeve gear, and means for driving said last mentioned shaft comprising a shaft mounted on said platform to rotate about an axis parallel to said pivotal axis, and a gear mounted on said last mentioned shaft to rotate therewith and meshing with said first mentioned gear and a driving connection between said shaft on said pivotal axis and said shaft rotating about said axis parallel to said pivotal axis.

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