

Aug. 20, 1957

G. HEINISH

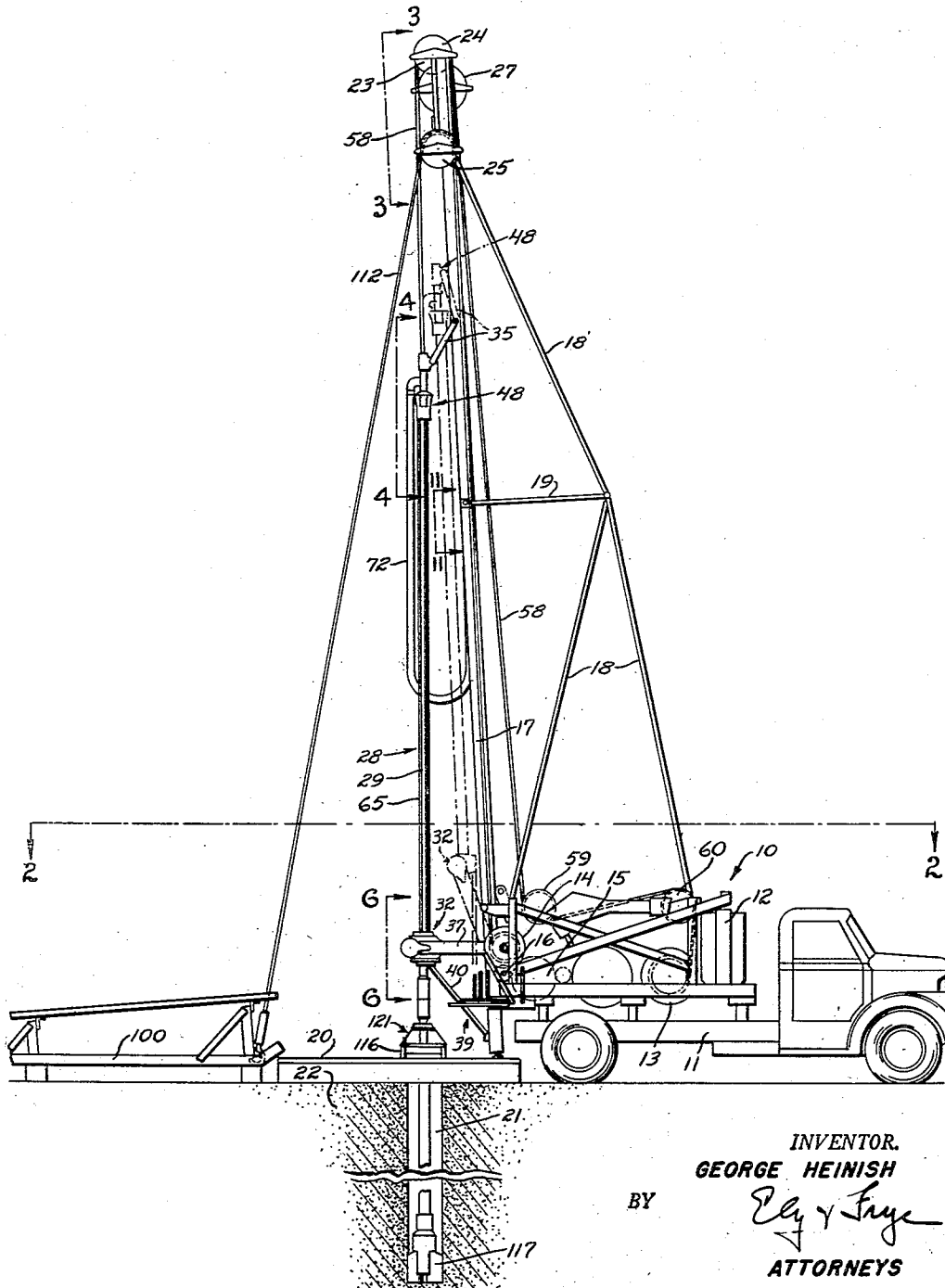
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ROTARY WELL DRILLING MACHINE

Filed March 20, 1951

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FIG. 1



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G. HEINISH

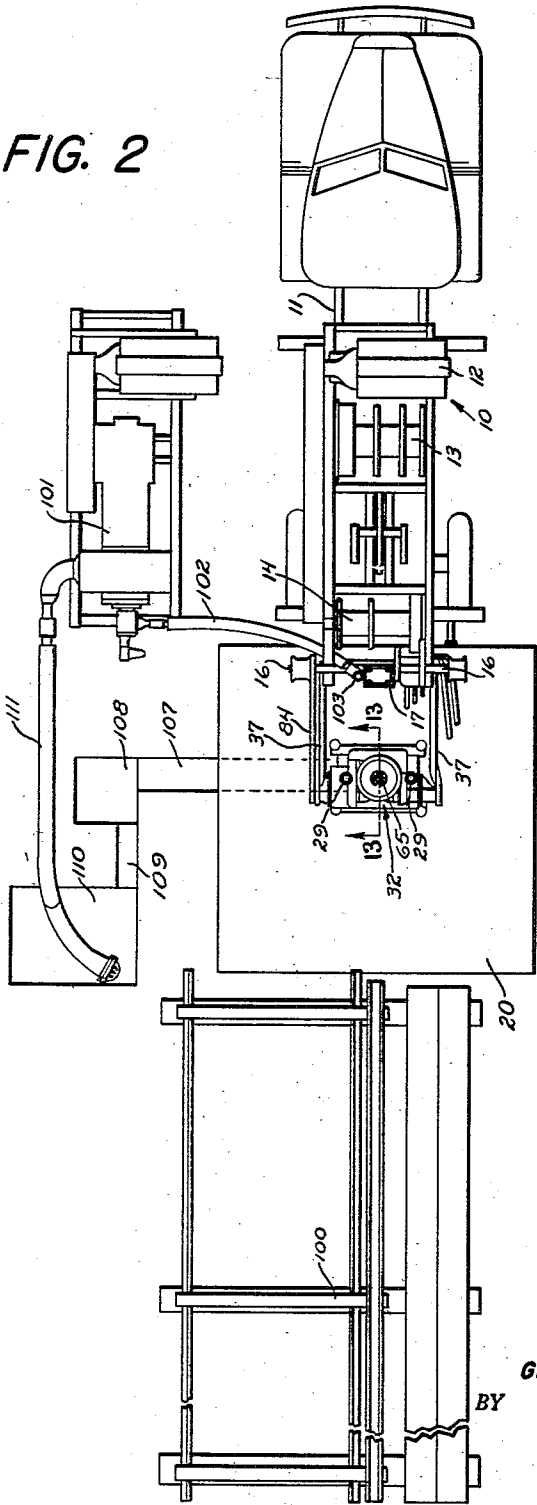
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ROTARY WELL DRILLING MACHINE

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FIG. 2



INVENTOR.
GEORGE HEINISH

BY

Ely & Faye
ATTORNEYS

Aug. 20, 1957

G. HEINISH

2,803,434

ROTARY WELL DRILLING MACHINE

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FIG. 3

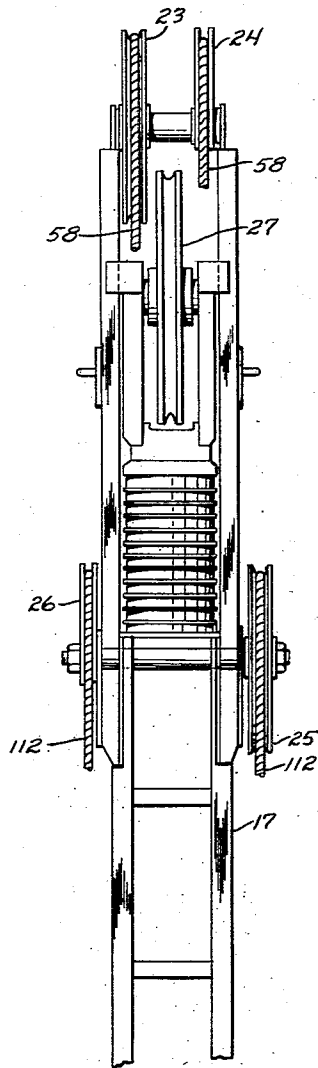


FIG. 5

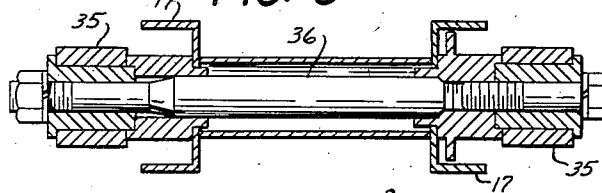
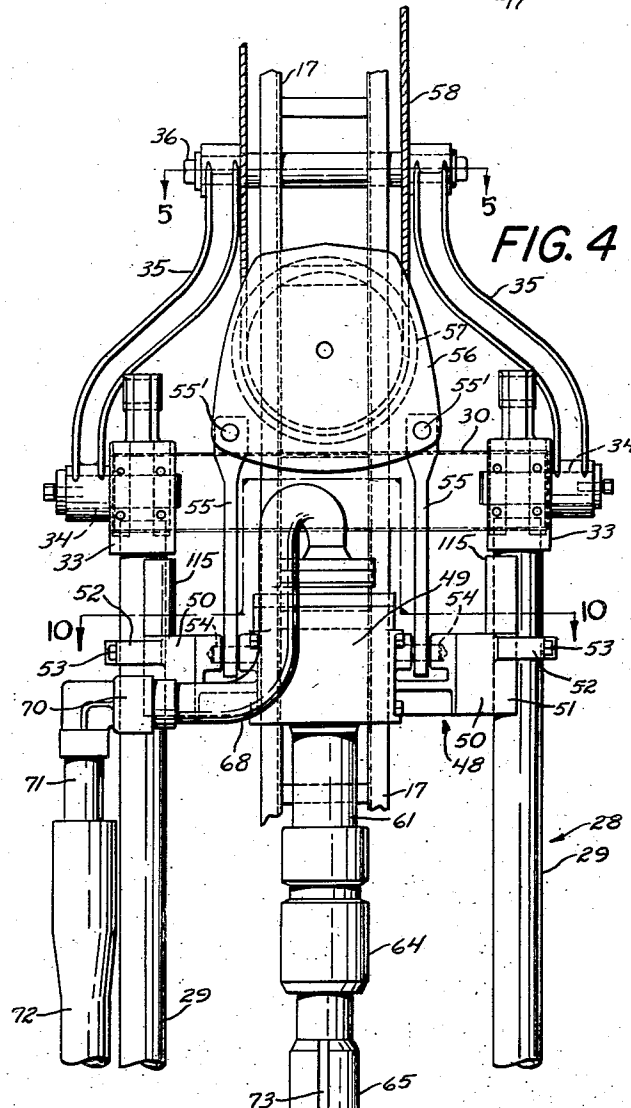


FIG. 4



INVENTOR.
GEORGE HEINISH

BY

Ely J. Frye
ATTORNEYS

Aug. 20, 1957

G. HEINISH

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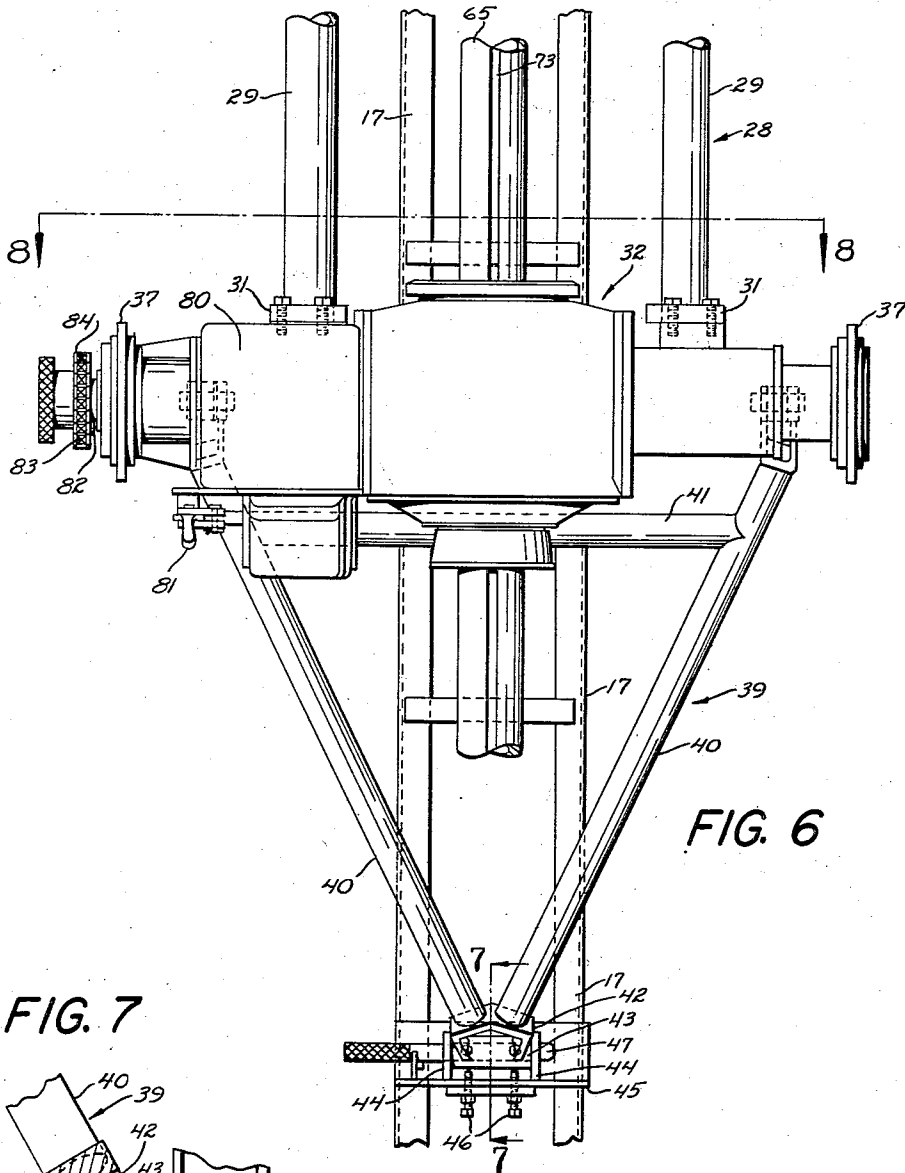
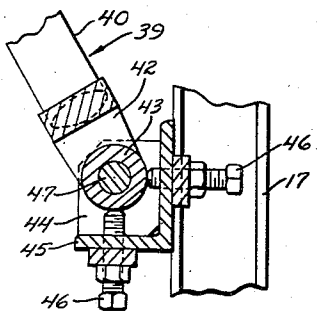


FIG. 7



INVENTOR.
GEORGE HEINISH
BY *Ely & Faye*
ATTORNEYS

Aug. 20, 1957

G. HEINISH

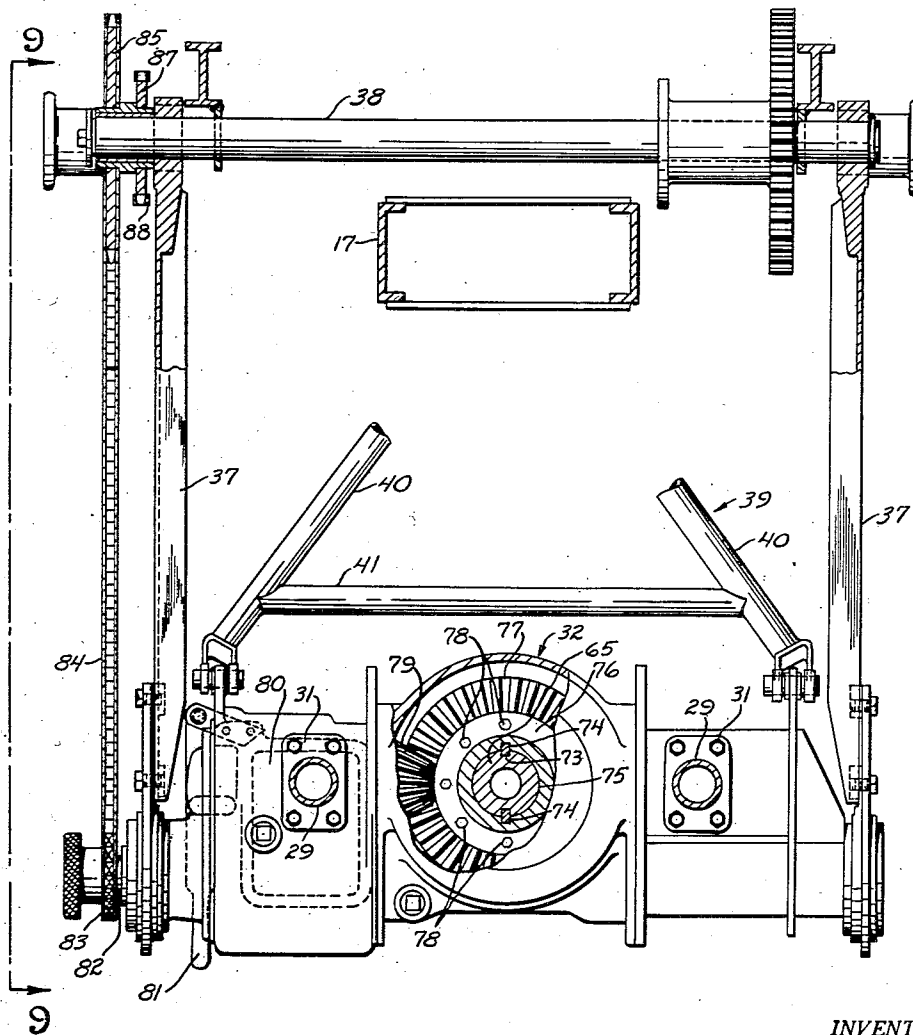
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FIG. 8



INVENTOR.
GEORGE HEINISH
BY *Ely & Faye*
ATTORNEYS

Aug. 20, 1957

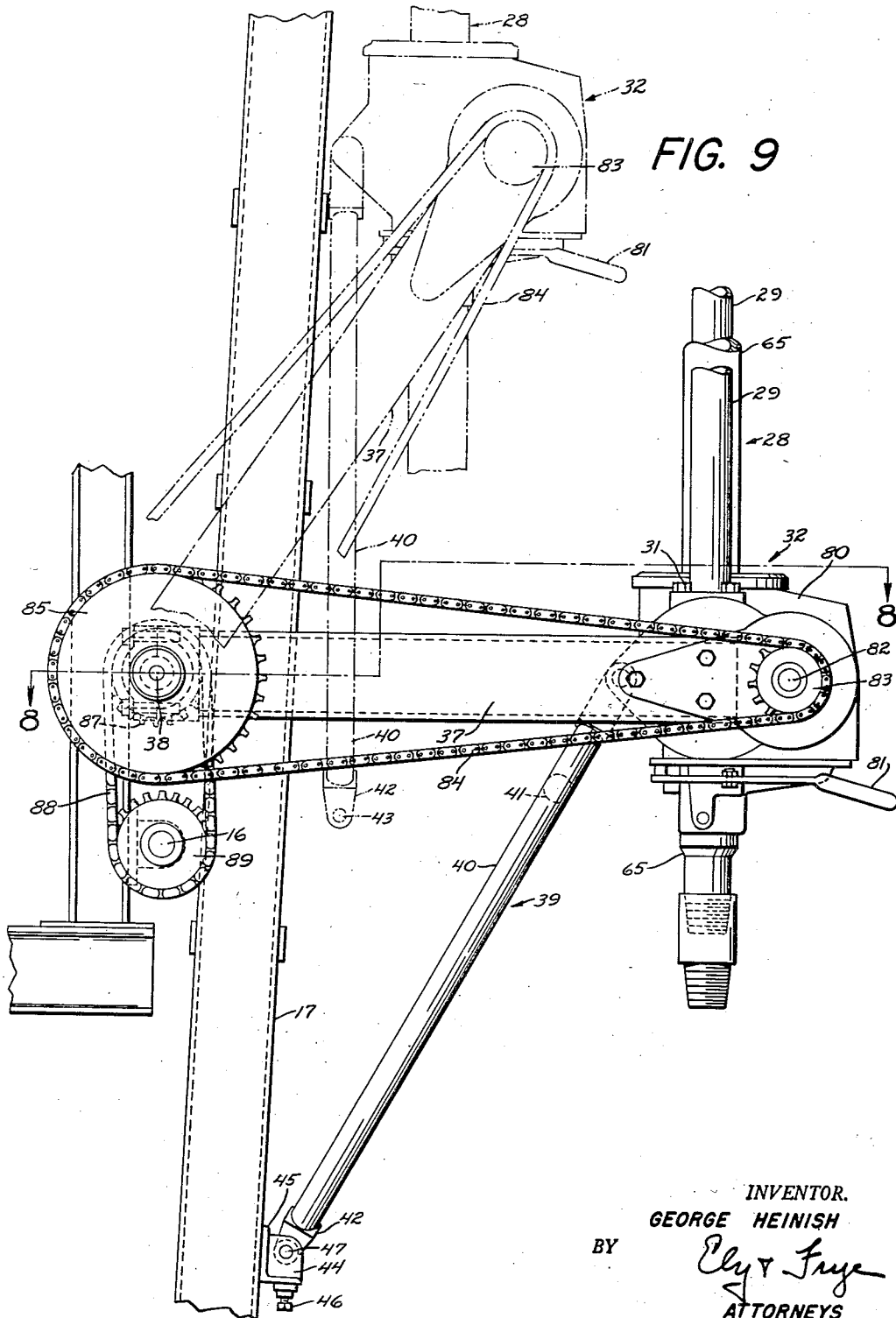
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G. HEINISH

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FIG. 10

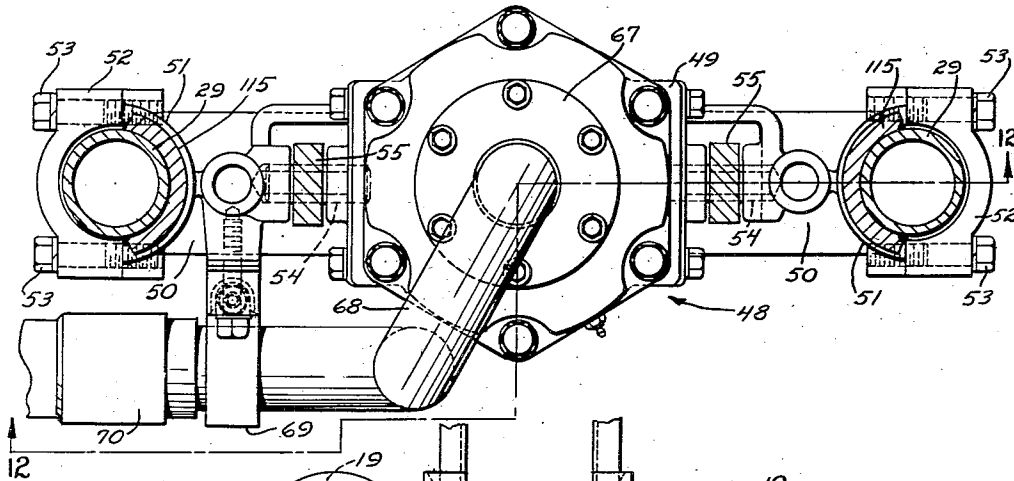
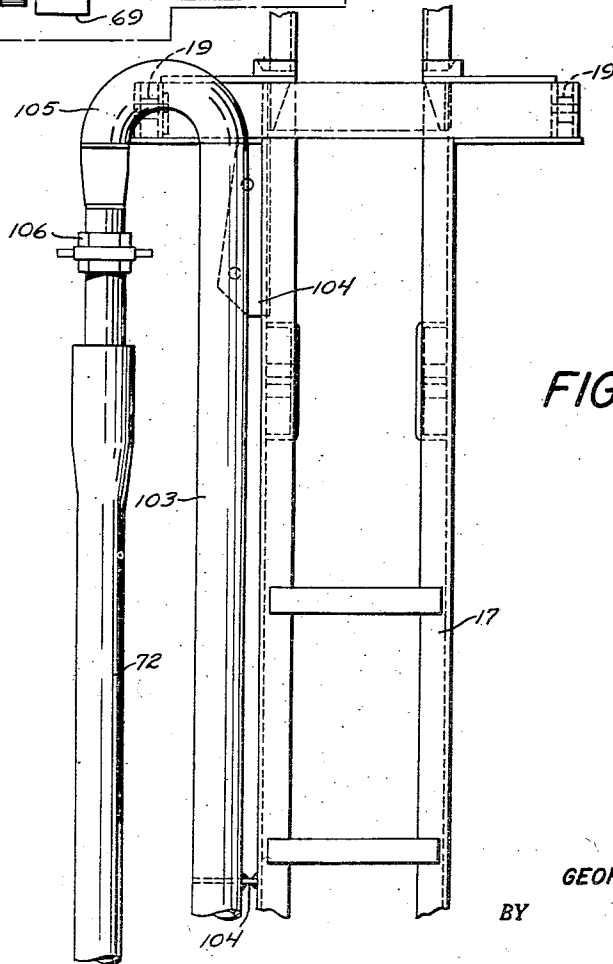


FIG. 11



INVENTOR.
GEORGE HEINISH

BY

ATTORNEYS

Aug. 20, 1957

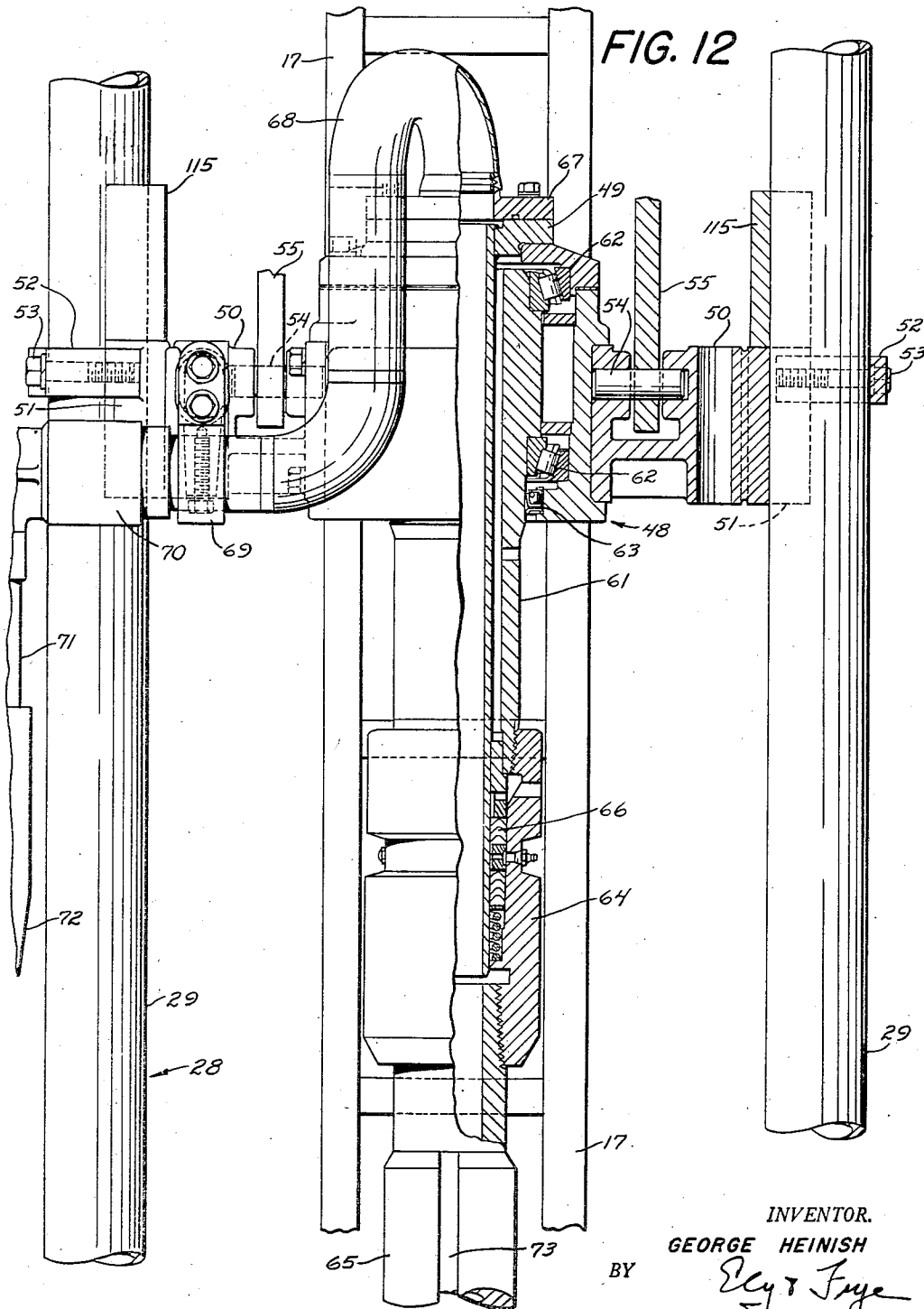
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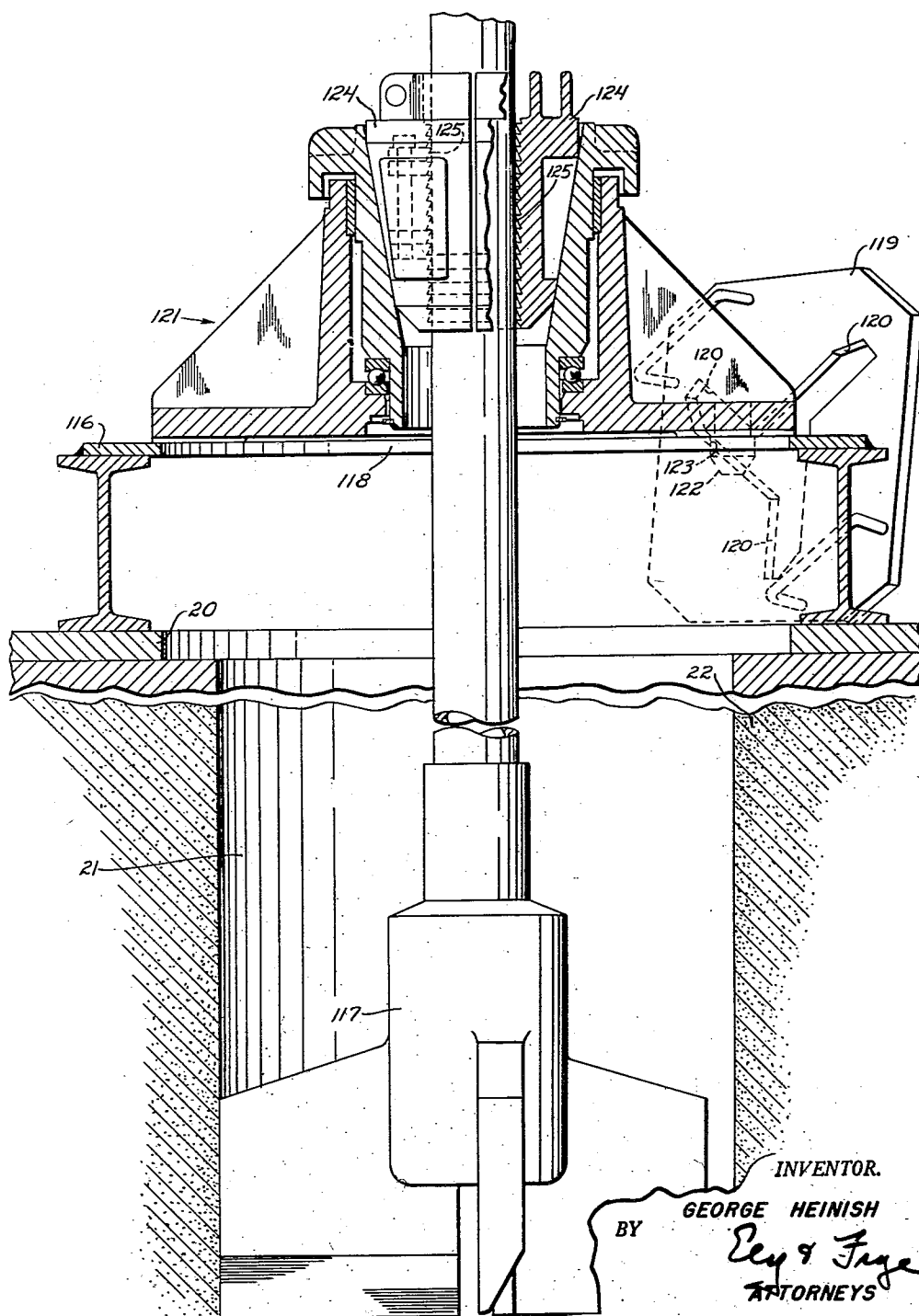
G. HEINISH
ROTARY WELL DRILLING MACHINE

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FIG. 13



INVENTOR.

GEORGE HEINISH

BY

E. J. Fager
ATTORNEYS

1

2,803,434

ROTARY WELL DRILLING MACHINE

George Heinisch, Akron, Ohio

Application March 20, 1951, Serial No. 216,569

6 Claims. (Cl. 255—19)

This invention relates to improvements in rotary well drilling machines per se, as well as to the combination of rotary well drilling equipment with a cable tool drilling machine.

Heretofore, in rotary well drilling machines, when it became necessary to disconnect the kelly from the string of drill pipe in the well in order to add another length of drill pipe to the string, it has been customary first to withdraw the kelly completely out of the rotary table or head, and then either to move the table or head in some manner out of the path of the new length of drill pipe which is to be secured to the string and lowered into proper position in the hole, or to pass the new length of drill pipe, after it has been connected to the string, through the table or head and into the hole. Thereafter the lower end of the kelly is connected to the new length of drill pipe, and the kelly is again passed through the table or head so that drilling may be continued. This manner of manipulating the kelly and rotary table or head is both time consuming and inefficient.

One of the objects of the present invention is to eliminate the necessity for withdrawing the kelly out of the rotary head when the time arrives to add a new length of drill pipe to the string.

Another object is to provide mechanism for pivotally attaching the kelly and the rotary driving head to a mast or the like, whereby when it becomes necessary to add a length of drill pipe to the string, or to permit access to the well for other reasons, the kelly and rotary driving head may be swung as a unit, while still connected together, upwardly and rearwardly a substantial distance out of the vertical plane in which the drill string is operating, thereby permitting ready access to the well and the drill string therein.

A further feature of pivotally mounting the kelly and rotary driving head for movement as a connected unit is that when drilling operations are to be resumed, the kelly and rotary driving head may be quickly swung to operating position over the well where the kelly may be readily connected to the drill string and drilling continued.

A further object is to provide suitable means for properly supporting the mechanism including the kelly and rotary driving head in both its operating and retracted positions.

On many drilling jobs it is desirable and sometimes necessary to use both rotary drilling equipment and cable tool drilling equipment. Heretofore under such circumstances it has been necessary to provide two completely equipped drilling machines, one of the rotary type and one of the cable tool type. A further object of the present invention is to provide a combination rotary and cable tool drilling machine wherein a standard cable tool drilling machine is provided for use in customary manner, together with rotary equipment which may be removably attached to the cable tool machine and operated with substantially the same mechanism used to operate the

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latter machine, thereby obviating the need for two complete drilling machines.

A further object is to provide a small size, light weight rotary driving head for driving the kelly and drill string in order to obtain maximum portability and easy transportation for the rotary equipment.

A further object is to separate the function of driving the kelly and drill string for the rotary drilling motion from the function of running the drill string and drill bit into the well and pulling them out, thus permitting the rotary driving head to be only large enough to provide the necessary strength for driving the kelly.

A further object is to provide means for adequately guiding the swivel head and kelly when the rotary driving head is in drilling position, which means also serves simultaneously to control the swivel head so as to prevent entanglement of the water hose which furnishes water to wash away the cuttings from the drill bit.

A further object is to provide a unit assembly of the rotary driving head, the kelly, and the swivel head, together with its drive mechanism and guides, which can be readily detached from the mast and body of the machine for separate transportation.

A further object is to provide a construction wherein the means used to guide and control the swivel head and kelly so as to get a correct stroke, will also serve as part of the mechanism for controlling the guiding and retraction of the rotary driving head.

A further object is to provide means for handling the drill string in and out of the well, which means will also serve with auxiliary equipment for handling the making and breaking of drill bits on the end of the drill string.

A further object is to provide rotary drilling mechanism wherein the rotary driving head, the kelly, the swivel and its guiding and controlling means, remain assembled at all times, either for performing drilling operations or for transportation purposes.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings.

In the drawings:

Fig. 1 is a side elevation of my rotary well drilling equipment attached to a standard cable tool drilling machine,

Fig. 2 is an enlarged partial plan view of the lower portion of the equipment shown in Fig. 1, taken substantially on line 2—2 of Fig. 1, with some parts being shown in section,

Fig. 3 is an enlarged front elevation of the upper end portion of the mast taken in the direction indicated by line 3—3 of Fig. 1,

Fig. 4 is a similar elevation of the upper end portion of the rotary drilling equipment taken in the direction indicated by line 4—4 of Fig. 1,

Fig. 5 is an enlarged section taken substantially on line 5—5 of Fig. 4,

Fig. 6 is an enlarged front elevation of the lower end portion of the rotary drilling equipment taken in the direction indicated by line 6—6 of Fig. 1,

Fig. 7 is an enlarged section taken substantially on line 7—7 of Fig. 6,

Fig. 8 is a similar section taken substantially on line 8—8 of Fig. 6, with some parts broken away and shown in elevation,

Fig. 9 is an enlarged side elevation of the portion of the equipment shown in Fig. 8, taken in the direction indicated by line 9—9 of Fig. 8,

Fig. 10 is an enlarged section taken substantially on line 10—10 of Fig. 4,

Fig. 11 is an enlarged front elevation of a portion of the mast showing the water stand pipe secured thereto, taken in the direction indicated by line 11—11 of Fig. 1,

Fig. 12 is an enlarged fragmentary view, partly in section and partly in elevation, taken substantially as indicated by line 12—12 of Fig. 10, and

Fig. 13 is a similar view taken substantially as indicated by line 13—13 of Fig. 2.

Referring to the drawings, the numeral 10 designates as a whole, a well known type of portable cable tool drilling machine that embodies all of the equipment necessary to drill a well with such machine, as will be understood. Included in this machine is the customary motor driven truck chassis 11 that carries a separate internal combustion engine 12 for operating the well drilling equipment through suitable driving connections including a friction clutch, a bull reel 13, a casing reel 14, a sand reel 15, a cathead shaft 16, and a mast 17. The mast is supported in raised position by the usual diagonal braces 18 and horizontal braces 19. The drilling machine 10 is shown in position adjacent a platform 20 which has been erected over an area in which it is desired to drill a well 21 in the ground 22.

As more clearly seen in Fig. 3, the upper end of mast 17 supports an upper rotatable sheave 23 and cable receiving bracket 24, and a lower rotatable sheave 25 and cable receiving bracket 26, as well as the usual crown sheave 27, which is normally used in cable tool drilling.

Referring more particularly to Figs. 1, 4, 6 and 12, the numeral 28 indicates as a whole, a generally rectangular frame consisting of tubular side frame members or guides 29, suitably connected at their upper ends to a cross frame member 30, while their lower ends are connected as at 31 to the housing of a rotary driving head, indicated as a whole by the numeral 32. As will be more clearly noted in Fig. 4, the cross frame member 30 has a casting 33 secured adjacent each end thereof, each of which carries a fixed stub shaft 34. Shafts 34 pivotally receive the outer ends of a pair of curved swing arms 35, the inner ends of which are pivotally carried on the ends of a fixed shaft 36 suitably mounted in the mast 17 at a predetermined location below the top of the mast.

The housing for the rotary head 32 is pivotally connected to the outer ends of a pair of lower swing arms 37 (see Figs. 8 and 9), while the inner ends of these arms are pivotally mounted adjacent the ends of the casing reel shaft 38. Pivoted to the side of housing 32 is a V-shaped supporting strut 39 having converging side arms 40 connected intermediate their ends by a cross arm 41 (Figs. 6 and 9). The lower ends of arms 40 are permanently secured in a socket member 42 that has a transverse opening 43 therein, and this socket member is adapted to be received between a pair of apertured ears 44 formed integral with an L-shaped plate 45 that is welded to the mast adjacent the lower end thereof. The position of socket member 42 between ears 44 may be adjusted by means of bolts 46 so that opening 43 will properly align with the apertures in ears 44 and permit a securing pin 47 to be passed therethrough. When frame 28, upper arms 35 and lower arms 37 are in the full line position shown in Fig. 1, strut 39 is secured to the mast with pin 47, but when it is desired to swing the frame and arms to the broken line position in Fig. 1, this pin must first be removed.

Mounted for sliding movement in the frame 28 and guided in such movement by side frame members 29 is a swivel head, indicated as a whole by the numeral 48 (Figs. 4, 10 and 12). This swivel head comprises a housing 49 having lateral extensions 50 that terminate in a semi-annular collar arrangement 51 partially surrounding the guides 29. A semi-annular yoke 52 is secured by bolts 53 to each collar 51 so as to properly mount the swivel head for sliding movement on guides 29. On each side of housing 49 a pivot pin 54 is suitably mounted and each pin pivotally receives the lower end of an arm 55, the upper ends of which are pivoted as at 55' to a hoisting block 56 which carries a rotatable sheave 57 around which

passes a hoisting cable 58. This arrangement provides a load equalizing connection between the hoisting cable 58 and swivel head 48. Cable 58 also passes around sheave 23 and bracket 24, has one end anchored near the lower end of the mast, while the other end is secured to the bull reel 13 after passing under sheave 59 and over sheave 60. Thus, the hoisting mechanism may be operated from the bull reel with the power already available in the cable tool drilling machine.

In the swivel head housing 49, a tubular spindle 61 is mounted for rotation on roller bearings 62 and has a suitable grease seal 63 at the lower end of the housing. Spindle 61 is reduced in diameter in its lower portion and is fixedly connected to the upper end of a tubular coupling 64, the lower end of which receives the threaded upper end of a tubular kelly 65. Suitable packing 66 is provided in the coupling member. With this arrangement, the spindle 61 will rotate smoothly with the kelly 65 on the bearings 62 provided therefor, supporting the weight of the kelly and the string of drill pipe, and providing a through passage for water to the drill bit.

The top of the housing 49 is closed by a cover 67 which has one end of a curved water pipe 68 welded or otherwise suitably secured thereto so that water may pass under pressure through the spindle and kelly (and any drill pipe that may be connected to the kelly) to the drill bit. Pipe 68 is curved as indicated in Figs. 4 and 12, and is supported adjacent its lower end in a bracket 69 carried by one of the housing extensions 50. The lower end of pipe 68 is connected by a suitable swivel joint 70 with a short piece of pipe 71 to which is connected one end of a flexible hose 72.

In its body portion, the kelly 65 is provided with oppositely disposed longitudinal keyways 73 that receive keys 74 (Fig. 8) to provide a driving engagement with an annular driving member 75 mounted in the rotary driving head housing 32. Member 75 has a lateral flange 76 that overlaps a similar flange (not shown) on a bevel gear 77, said flanges being bolted together by bolts 78 so that member 75 will rotate with the bevel gear 77. Meshing with gear 77 is a beveled pinion 79 carried on a shaft (not shown) that extends into a conventional two speed transmission unit 80. The transmission unit is of the type having a neutral position with a different speed on each side thereof so that the gears may be readily shifted to either speed by means of a gear shift lever 81.

Leading from the transmission unit 80 is a drive shaft 82 having a sprocket 83 fixed thereon, which receives a drive chain 84 that also passes around a larger sprocket 85 that is fixed on a rotatable sleeve 86 mounted on one end of the casing reel shaft 38 (Fig. 8). Also fixed on sleeve 86 is a small sprocket 87 that receives a chain 88 that also passes around similar sized sprocket 89 fixed on the driven cathead shaft 16 (Fig. 9). It is not believed to be necessary to describe the drive from the engine 12 to the cathead shaft 16 since it is a conventional drive found in cable tool drilling machines, and it will be understood that with the addition of the elements described I am enabled to drive the kelly from the engine 12.

Referring again to Figs. 1 and 2, I have shown a pipe rack 100 in front of the platform 20, which may be utilized to hold lengths of drill pipe to be used in the drilling operations. At one side of the platform and machine (Fig. 2) I provide means to supply water under pressure to the drill bit while it is operating. This means includes a mud pump unit 101 having connected thereto a discharge hose 102 which is also connected to the lower end of a stand pipe 103 that is secured to mast 17 by brackets 104 or the like (Fig. 11). Stand pipe 103 extends upwardly to a position opposite the horizontal braces 19 and is curved at its upper end, as indicated at 105, to extend downwardly, after which it is joined by a suitable coupling member 106 to the other end of the flexible hose 72. After washing the cuttings from the

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drill bit, the water will overflow the hole being drilled, bringing the cuttings to the surface, and will pass into a return ditch 107 which leads to a settling pit 108, from which the water passes through an overflow ditch 109 into a mud pit 110. A suction hose 111 then returns the water to the pump 101 for further circulation. Also shown in Fig. 1 is a second cable 112 which passes over the lower sheave 25 and bracket 26 on the mast for use with the casing reel in hoisting lengths of drill pipe in position over the hole to be joined to the drill string.

Assuming that drilling operations are to be started with the rotary drilling equipment, the frame 28 will occupy its full line position in Fig. 1, the supporting strut 39 will be secured to the mast near its lower end, and the swivel head 48 will be raised by the hoisting mechanism to its uppermost position (Fig. 4) at which time the extensions 50 on housing 49 will engage stop members 115 welded to frame members 29 near the upper end thereof. In this position the lower end of the kelly 65 will be far enough above the slip table base 116 (Figs. 1 and 13) to permit a drill bit, such as the bit 117, to be coupled with the lower end of the kelly. Since the lower end of the kelly is below the rotary driving head 32 at all times, relatively large drill bits may be readily used. The drill bit, kelly and swivel head are now lowered by using the brake control of the bull reel, sufficiently to permit the bit to pass through the opening 118 into engagement with the surface of the ground. The engine 12 is then started and the kelly is rotated through the rotary driving head in the manner previously described. As the bit drills into the earth the swivel head 48 with the kelly attached to it will move downwardly by gravity for the operable length of the kelly, which will produce with the equipment tested, a hole about 21½ feet in depth. During its vertical movement, the swivel head is guided by and prevented from turning by the guides 29, and the swivel joint 71 permits limited turning movement of the flexible hose 72 during movement of the swivel head.

The hoisting mechanism is now employed to raise the swivel head and kelly to their uppermost position again which will bring the drill bit above the slip table base 116. A bit breaker, indicated at 119 in Fig. 13, is now placed over the opening 118 in the slip table base, and slots 120 in the breaker receive the teeth of the bit in the customary manner and support the bit so that it may be disconnected from the kelly. After the bit has been disconnected from the kelly, the pin 47 is removed to disconnect the supporting strut 39 from the mast. Now the hoisting mechanism is operated again from the bull reel and the frame 28 is swung on arms 35 and 37 upwardly and inwardly from the full line position to the broken line position in Fig. 1. As the frame moves, the kelly and rotary driving head will swing as a unit with the frame, thus clearing the space above the well so that a length of drill pipe may be added to the string. This movement of the kelly and rotary driving head as a unit makes it unnecessary to disconnect these members from each other at any time.

With the frame 28 in its broken line position in Fig. 1, the cable 112, operated from the casing reel, is utilized to hoist a length of drill pipe (about 20 feet in length) in position over the bit so that its lower end may be coupled to the bit. Before coupling the drill pipe to the bit, a slip table, indicated as a whole by the numeral 121 (Figs. 1 and 13), is placed over the shank of the bit. Still using the cable 112, the drill pipe, bit and slip table are now raised enough to permit the bit breaker to be removed from over the hole and the bit and drill pipe are lowered into the hole. As soon as the slip table contacts the base 116 it will rest thereon while the drill pipe passes on through, and dowels 122 on the lower surface of the table extend through suitable openings 123 in the base to prevent turning of the table on the base. Table 121 receives a plurality of removable conventional tapered slip sections 124 having teeth 125 on their inner surfaces which

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grip the drill pipe and prevent it from dropping downwardly into the hole. After the slip sections are in proper position, cable 112 may be disconnected from the upper end of the drill pipe and returned to its Fig. 1 position.

The hoisting mechanism which includes cable 58 is now operated to return the frame 28, the kelly 65 and the rotary driving head 32 to their full line positions in Fig. 1, the supporting strut 39 is again connected to the mast, and the lower end of the kelly is coupled with the upper end of the length of drill pipe. After the slip sections 124 are removed from the slip table, the kelly is rotated as before and drilling continues until the kelly again reaches the lower end of its stroke.

As subsequent lengths of drill pipe are added to the line, the swivel head and kelly are again raised to their uppermost position, and it is necessary to employ the slip sections 124 to grip the pipe extending into the hole before the kelly is disconnected from the drill pipe. Each time a length of drill pipe is to be added, the kelly and rotary driving head are swung, as a unit and while still connected together, out of the way so as to permit ready access to the area above the well.

After drilling operations have been completed with the rotary equipment and the drill string removed from the well, the rotary assembly may be readily disconnected as a unit from the mast and body of the machine for transportation purposes. This removal is accomplished with the kelly, rotary driving head, swivel head and guide frame all in assembled position, simply by disconnecting the upper swing arms 35 from the mast, the lower swing arms 37 from the casing reel shaft, the strut 39 from the mast, and the drive chain 84 from sprocket 85. Or sleeve 86 with its sprockets 85 and 87 may be removed from the casing reel shaft, making it necessary only to remove chain 88 from sprocket 89 on the cathead shaft. Then by operating cable 58 from the bull reel the entire unit may be lowered, ready for transportation. If now desired, drilling may be continued in the usual manner with the cable tool drilling machine.

Due to the fact that the rotary driving head is used only to drive the kelly and drill string, and that it is not necessary to pass any drill pipe or drill bits through the driving head (as was customary in some prior constructions), the driving head need be only large enough and strong enough to perform its driving function. Also, since it is not necessary to pass the drill bits through the rotary driving head, relatively large drill bits may be used with a relatively small rotary head.

I have illustrated and described my rotary well drilling equipment as it would be employed with a cable tool drilling machine, but it is obvious that this equipment is suitable for use as a rotary drilling machine per se, and that it does not necessarily have to be used in combination with a cable tool drilling machine.

While I have shown and described a preferred embodiment of my invention, it will be understood that the invention is not limited to such embodiment, and that modifications and changes may be made therein without departing from the spirit of the invention or from the scope of the subjoined claims.

What is claimed is:

1. In a rotary drilling machine including a kelly and a rotary driving head operatively connected to said kelly for driving a drill string adapted to be connected to said kelly, a mast, sheave means carried by the mast and adapted to be positioned by the mast substantially over the hole to be drilled, mechanism for swinging said kelly and rotary driving head as a unit and while connected together to and from the mast and into and out of a vertical plane in which said drill string is operating, said mechanism comprising a frame in which said kelly is vertically movable and to the lower end of which said rotary driving head is secured, and means extending between the frame and the mast near the top and bottom

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of the frame for guiding the frame in its movement into and out of said vertical plane.

2. A rotary well drilling machine comprising a rotary driving head, a kelly operatively connected with said rotary driving head, a vertically movable swivel head in which the upper end of said kelly is journaled for rotation, a frame, means slidably carried in the frame and supporting the swivel head, said means also serving to prevent rotation of said swivel head during rotation of said kelly, and means for driving said rotary head and kelly, said frame being of a length to guide the swivel head throughout the full distance of vertical movement of the kelly.

3. The combination with a cable tool drilling machine having a mast and a body supporting said mast in upright position, of rotary drilling equipment comprising a frame, a swivel head mounted for vertical movement in and being guided by said frame, a kelly having one end journaled for rotation in said swivel head, a rotary driving head connected to the lower end of said frame and operatively connected to said kelly, an upper pair of swing arms pivotally secured between said mast and the upper end of said frame, a lower pair of swing arms pivotally secured between said body and said rotary driving head, and means operable from said cable tool drilling machine for swinging said arms, frame, swivel head, kelly and driving head as a unit with said kelly and driving head connected together into and out of well drilling position.

4. A combination of the character defined in claim 3 wherein said cable tool drilling machine carries a bull reel and an engine for operating said bull reel, and said means comprises hoisting mechanism operable from said bull reel.

5. A rotary drilling machine comprising a body and a mast extending upwardly therefrom, a vertical frame, a rotary driving head carried by the lower end of the frame, a kelly slidably received in driving relation by the

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head, a swivel on the top of the kelly, a pair of swing arms pivoted between the mast and the upper end of the frame, a second pair of swing arms pivoted between the rotary driving head and said body, and hoisting equipment operatively connected to the swivel and adapted to move the frame, driving head, kelly and swivel as a unit and relative to the body and mast to an operative, well drilling position or to an inoperative, out of the way position.

6. Rotary drilling equipment comprising a body, a mast on the body, a frame, a swivel head mounted for vertical movement in and being guided by said frame, a kelly having one end journaled for rotation in said swivel head, a rotary driving head connected to the lower end of said frame and operatively connected to said kelly, an upper pair of swing arms pivotally secured between said mast and the upper end of said frame, a lower pair of swing arms pivotally secured between said body and said rotary driving head, and means operable from said mast for swinging said arms, frame, swivel head, kelly and driving head as a unit with said kelly and driving head connected together into and out of well drilling position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,470,838	Holmes	Oct. 16, 1923
1,883,070	Stone	Oct. 18, 1932
2,049,971	Muegge	Aug. 4, 1936
2,081,200	Hollingsworth	May 25, 1937
2,169,678	Caldwell	Aug. 15, 1939
2,179,316	Anderson	Nov. 7, 1939
2,194,066	Caldwell	Mar. 19, 1940
2,200,075	Caldwell	May 7, 1940
2,223,600	Carleton	Dec. 3, 1940
2,565,224	Gibbens	Aug. 21, 1951
2,631,013	Darin	Mar. 10, 1953