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APPARATUS FOR SIMULTANEOUSLY DRILLING AND CASING A WELL HOLE

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3 Sheets-Sheet 1

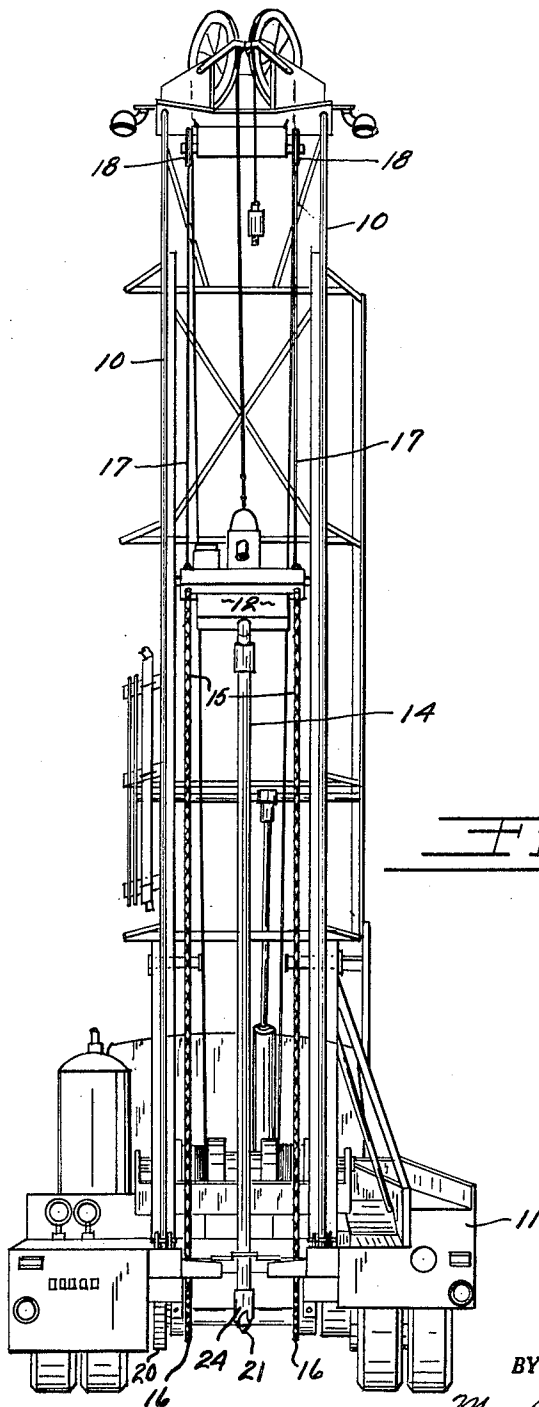


FIG. 1

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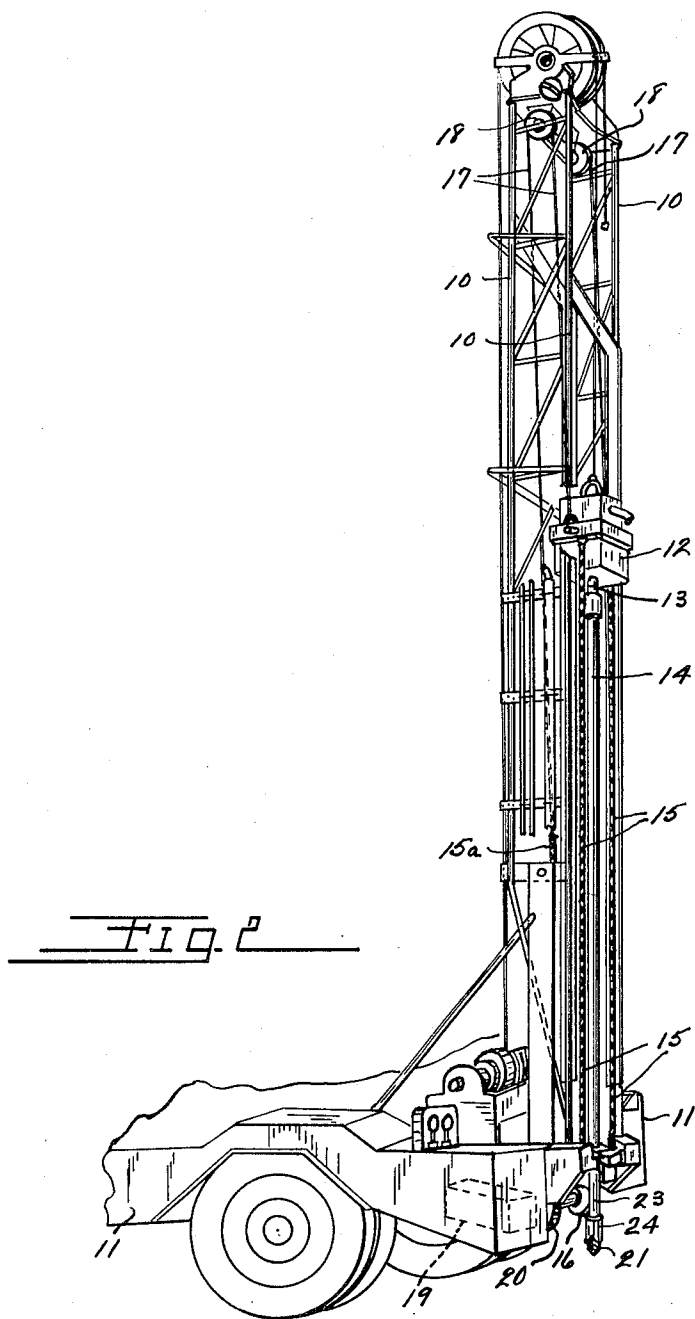
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3 Sheets-Sheet 2



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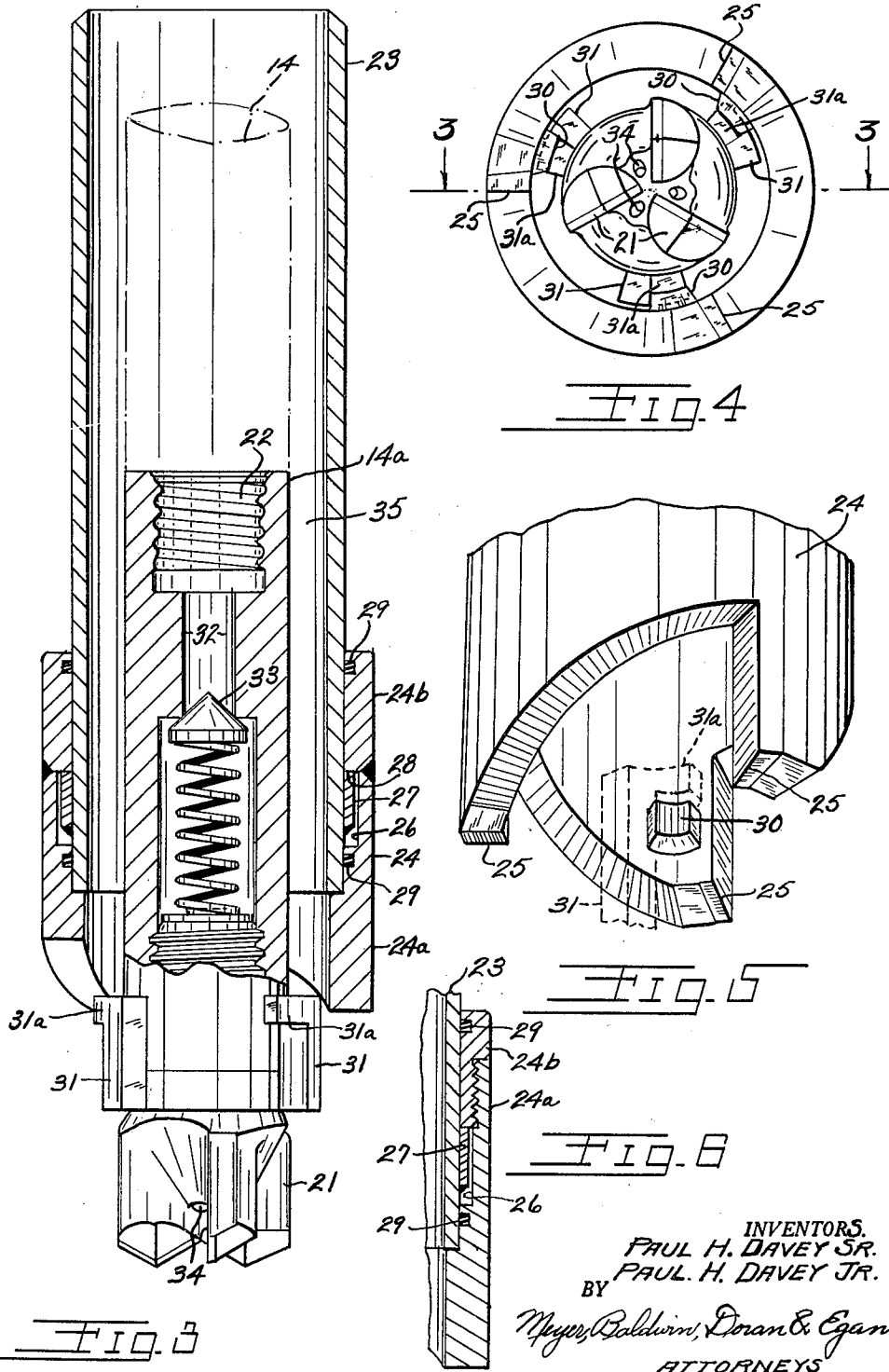
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3 Sheets-Sheet 3



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APPARATUS FOR SIMULTANEOUSLY DRILLING AND CASING A WELL HOLE

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4 Claims. (Cl. 175-257)

This invention relates to apparatus for simultaneously drilling and casing a well hole and more particularly for drilling a hole by rotating and forcing downward a drill rod having a drill bit at its lower end, and simultaneously pulling a casing into the ground at a predetermined location relative to the bit by coupling the casing to the drill rod.

This invention contemplates the provision of a length of well casing, a hollow shoe concentric with and rotatably mounted on the lower end of the casing, a drill rod centrally of the casing having a drill bit at its lower end, power means for urging said drill rod downwardly, and inter-engaging projections on the drill rod and the hollow shoe effective when the drill bit is a predetermined distance relative to the shoe so that the shoe and casing are always compelled to follow the drill bit downwardly at this predetermined distance.

Another object of the present invention is to provide a shoe with downwardly directed cutting means on its lower end and the shoe having inwardly directed projections that are adapted to engage with pull-down means carried on an associated drill rod, the pull down means engaging the projections on the shoe so that rotation of the drill rod causes rotation of the shoe in a direction to cause effective action of the cutting means on the shoe.

Another object of the present invention is to provide novel pull down projections as hereinafter described and claimed.

A still further object of the invention is to provide a novel cutting shoe adapted for coaction with a casing and a drill rod in the combination mentioned hereinabove.

Other objects and advantages of the present invention will appear from the accompanying drawings and description and the essential features will be set forth in the appended claims.

In the drawings:

FIG. 1 is a front elevational view of a drill rig adapted to carry out the present invention;

FIG. 2 is a perspective view of the same presenting mostly a side view;

FIG. 3 is an enlarged view of the lower end of a well casing and drill rod adapted to carry out this invention and partly broken away in central section to more clearly show the construction of L-shape projections provided on the drill rod for coupling with lugs provided on a hollow shoe rotatably attached to the casing;

FIG. 4 is a bottom plan view of the structure shown in FIG. 3;

FIG. 5 is a fragmental perspective view, enlarged, to illustrate the coaction of L-shape pull down members fastened to the drill rod as they engage projections which extend radially inward from a rotatable hollow shoe; while

FIG. 6 is a fragmental view showing a modification of a portion of the structure shown in FIGURE 3.

When rotary drilling well holes, particularly in loose

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soil, it is customary to drill a length of hole, then withdraw the drill string, and then place the casing. It often occurs that this is an inefficient manner of operating because material from the drill hole falls in before the casing can be inserted and the hole must be drilled out again. One of the features of the present invention provides the simultaneous casing of the hole along with the rotary drilling thereof so as to prevent any loose material falling into the drill hole before it can be cased.

In the accompanying drawings, FIGS. 1 and 2 show a more or less conventional drill rig for drilling well holes using rotary drills. Only the parts essential to understanding the present invention will be described. A mast 10 is mounted on a truck 11 for easy transportation from place to place. Mounted for vertical sliding movement in two parallel vertical side members of the mast 10 is a cross head 12. This cross head carries an hydraulic motor for rotatably driving a drive quill 13 which projects from the lower end of the cross head. Suitable hydraulic lines and a pump are provided for driving this hydraulic motor but further description of the same is deemed unnecessary here. Power means is provided for moving the cross head and connected drill string 14 downwardly during the drilling operation. In the present form this comprises two drive chains 15 attached to opposite sides of the cross head and extending downwardly on the forward side of the mast as viewed in FIG. 1, then around drive sprockets 16 at the bottom of the mast and then partly up the rearward side of the mast as indicated at 15a where each of the chains is connected to a length of cable 17 extending to the top of the mast, over an associated pulley 18 and downwardly on the front side of the mast where the cable is attached to the cross head. Thus, each chain 15 and associated cable 17 makes a continuous tension member passing around sprockets 16 at the foot of the mast and around pulleys 18 at the top of the mast. Power means is provided for rotating sprockets 16 in a direction to cause downward movement of chains 15 at the front side of the mast. This comprises a motor 19 mounted on the truck 11 and connected by suitable gearing 20 to drive the sprockets 16.

As is well understood by those skilled in this art, in using this kind of rig in a well drilling operation, a length of drill rod 14 is attached to the drive quill 13, usually by a threaded connection, then the hydraulic motor in the cross head 12 is operated to rotate the drill rod while at the same time a downward pressure is exerted by the chains 15 from the power source 19. A drill bit 21 is attached at the lower end of the drill rod as more clearly seen in FIGS. 3 and 4. To the lowest end of the drill rod structure 14 is attached a short length of rod 14a which carries the drill bit 21. This connection is customarily made by means of the threads 22.

In carrying out the present invention, a length of casing 23 is supported in the drill rig in any suitable fashion concentric and outside of the drill rod 14 which, when composed of a number of lengths of drill rod, is usually referred to as a drill string. In carrying out the present invention, a hollow, generally cylindrical shoe 24 is rotatably mounted on the lower end of the lowest portion of casing 23 by means preventing substantial axial movement between the shoe 24 and the casing 23. As best seen in FIG. 3, the shoe 24 is composed of a lower part 24a on the bottom edge of which are formed three cutting teeth 25 which are inclined downwardly and in one arcuate di-

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rection so that rotation of the drill rod in its usual drilling direction will cause rotation of the shoe 24 in a direction to cause cutting action of the teeth 25. The portion 24a also has an inwardly opening annular recess 26 adapted to receive an annular ring 27 which is welded to the casing 23. An upper portion of the shoe 24 indicated at 24b is then secured to the lower portion 24a either by welding as indicated in FIG. 3 or by the use of threaded connection as indicated in FIG. 6. One of the portions 24a or 24b has an annular horizontally positioned shoulder 28 adapted to ride on the ring 27 so as to give a bearing there for rotation of the shoe 24 relative to the casing 23. At the same time, substantial axial movement of the shoe 24 relative to the casing 23 is prevented by the embracing of the ring 27 by the annular opening 26, because the relative radial clearance between the shoe 24 and the outside diameter of casing 23 is very slight. Annular dirt seals 29 may be provided between the casing and the shoe 24 as shown in FIG. 3, if desired.

Means is provided for causing the lowest length of casing 23 to follow downwardly a predetermined distance behind the drill bit 21. This comprises radially inwardly directed projection means on the shoe 24 here shown as three inwardly directed projections 30 evenly spaced around the shoe 24 arcuately. Pull-down means is then provided on the drill rod end 14a to coact with the projections 30 in carrying out this invention. In the form shown, this comprises three L-shape members 31 spaced 120° apart and welded to the drill rod member 14a. Each of the vertical legs of the L-shape members 31 rests against one vertical face of one of the projections 30 so that rotation of the drill rod and bit 21 in the direction of the arrow of FIG. 4 will cause rotation of the shoe 24 in the direction toward which the horizontal legs of the L-shape members are pointing as seen in FIGS. 3 and 5. The horizontal legs 31a of each L-shape projection, as seen in FIGS. 4 and 5, rests upon the flat horizontal top of one of the projections 30.

The operation of this improved device should now be clear. With drill rod 14 carrying rod member 14a and drill bit 21 at its lower end, properly connected to the drive quill 13, and with a length of casing 23 having the shoe 24 connected to its lower end as described supported in the drill rig concentric with the drill string, the hydraulic motor in the cross head 12 is operated to rotate the drill rod while at the same time pressure downwardly is exerted on the cross head through the drive chains 15. The drill bit 21 will then enter the ground and the L-shape pull-down members 31 will engage against the projections 30 to draw the casing 23 down simultaneously with the drill rod whenever the horizontal legs 31a of the pull-down members 31 engage on the top of the projections 30 which are attached to the shoe 24. At the same time, the vertical legs of the L-shape members 31 will push against the sides of the projections 30 to cause rotation of the shoe 24 relative to the casing 23 causing a cutting action of the teeth 25 and thus more easily causing the downward movement of the casing into the ground a predetermined distance back of the bit 21. In one form of this invention using a drill bit approximately three inches in diameter, the teeth 25 of the shoe 24 follow downwardly at a distance approximately three inches above the bottom of the drill bit.

It will be understood by those skilled in this art that a flushing of the drill hole is provided in the usual manner. This comprises a central bore 32 extending downwardly in the drill string from the cross head 12 and provided with spring pressed check valve 33 at the bottom which permits flow of the flushing fluid downwardly through the bore 32 from the cross head 12 then outwardly through openings 34 in the bottom of the drill bit and then upwardly through the space 35 between the drill string and the casing 23 and thus out openings at the top of the casing not here indicated. The flushing fluid is introduced through a hose at the cross head 12 in the usual manner.

Referring to FIGS. 3, 4 and 5 of the drawings, it will be noted that the section line 3—3 of FIG. 4 cuts through

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the shoe 24 at positions well above the teeth 25. These teeth actually lie near the bottom of the vertical portions of the L-shape projections 31 leaving a small distance between the cutting teeth 25 and the drill 21. As mentioned hereinabove, the teeth 25 follow downwardly at a distance approximately three inches above the bottom of the drill bit 21. In actual use, the vertical portions of the projections 31 engage the projections 30 on the shoe 24 along the entire length of the vertical legs 31 so that the shoe 24 is rotated during several inches of vertical travel of the drill string with the vertical legs of the projections 31 engaging the members 30 long before the horizontal portion 31a reaches the position shown in FIG. 5. Actually, any small amount of material lying radially between the bit 21 and shoe 24 is engaged and removed by the bottoms of the L-shape members 31.

One of the advantages of the present method and apparatus is that it eliminates the need for coordination of casing and drill rod lengths as progressive lengths are added to each of these as the hole is driven deeper into the ground. It will be understood by those skilled in the art that consecutive lengths of casing 23 are aligned and usually joined to each other by means of a weld or by screw joints as the casing is extended into the ground.

It will be noted that there is no obstruction below the horizontal legs 31a of the pull-down projections so that at the end of a drilling operation, the drill string 23 can be pulled upwardly with the pull-down members 31 clearing the projections 30, thus leaving the shoe 24 in the ground. The savings accomplished in speed of drilling by the use of this invention makes it economical to use the shoe 24 even though the same is left in the hole afterwards.

If, during drilling, for any reason it is desirable to proceed with drilling using only the drill bit 21 without reference to the position of the lower end of the casing, it is always possible to disengage the horizontal legs 31a of the L-shape members 31 so that they vertically clear the projections or lugs 30 and thereafter the drill bit may be fed downwardly independently of the casing.

What is claimed is:

1. In combination, a length of well casing, a hollow shoe concentric with and rotatably mounted on the lower end of said casing, the shoe having cutting means for drilling downwardly, a drill rod located centrally of the casing having a drill bit at its lower end, inwardly projecting means rigid with the shoe, and outwardly directed pull-down members on said drill rod having horizontal portions effective to engage above said projecting means when the drill bit is a predetermined distance below the shoe and to pull said shoe and said casing downwardly after the bit, said pull-down members also having vertical portions effective to engage the projecting means so that a rotation of the drill rod causes rotation of the shoe in a direction effective to operate the cutting means.

2. The combination defined in claim 1 in which the hollow shoe has on its lower edge teeth directed downwardly and in one arcuate direction; and the drill rod and pull-down members are free of parts lying below the projecting means whereby after a drilling operation the drill rod may be pulled upward leaving the casing and shoe in the ground.

3. In combination, a length of well casing, a hollow shoe concentric with and rotatably mounted on the lower end of said casing, means compelling said casing and shoe to move downwardly together including a drill rod centrally of said casing having a drill bit at its lower end, said shoe having on its lower edge teeth directed downwardly and cutting in one arcuate direction, inwardly directed projection means rigid with the shoe and including lugs, each lug having a generally horizontal top and a generally vertical side, and outwardly directed pull-down members on said rod comprising a plurality of L-shaped members rigidly connected to the rod, one leg of each L-shaped member being generally horizontal and engageable over the top of its associated lug, the other leg of

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each L-shaped member being generally vertical and engaging said generally vertical side of its associated lug whereby rotation of the drill rod causes rotation of the shoe, the L-shaped member being effective to drive the shoe in said one arcuate direction, said drill rod and pull-down members being free of parts lying below the projection means whereby after a drilling operation said rod may be pulled upward leaving said casing and shoe in the ground.

4. A cutting shoe for attachment to a predetermined well casing and comprising a pair of attachable rings, each ring having an internal diameter slightly greater than the outside diameter of the selected casing, one of said rings having a recess and the other of said rings having a bearing surface to co-operate with a projection on the casing to permit axial movement and rotative move-

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ment between the shoe and the casing, said shoe having inwardly extending projections for engagement with pull-down means on a drill rod, and having on its lower edge teeth directed downwardly and in one arcuate direction.

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