

Aug. 14, 1951

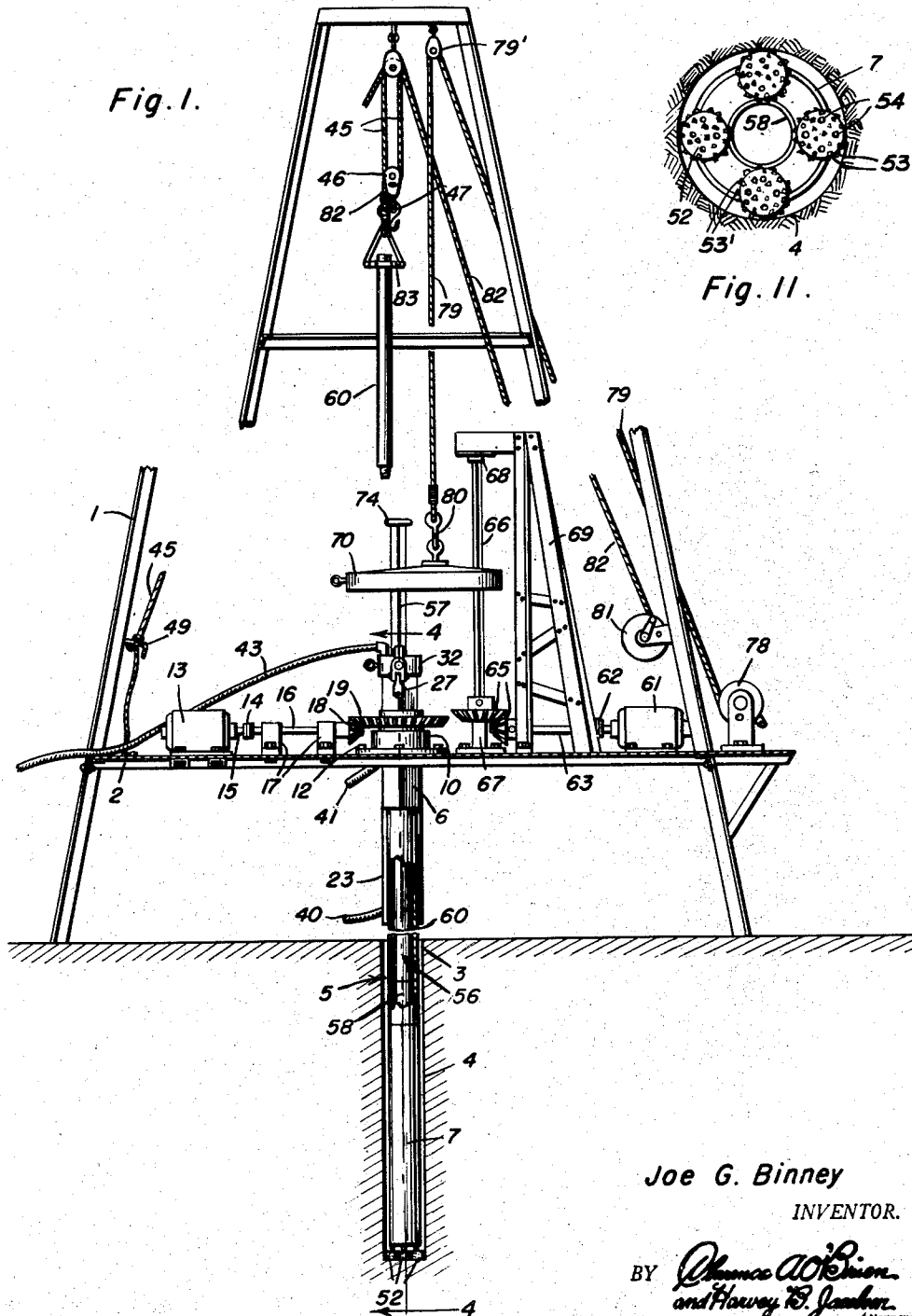
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2,563,913

GANG BIT CORE DRILLING APPARATUS

Filed Feb. 27, 1948

4 Sheets-Sheet 1



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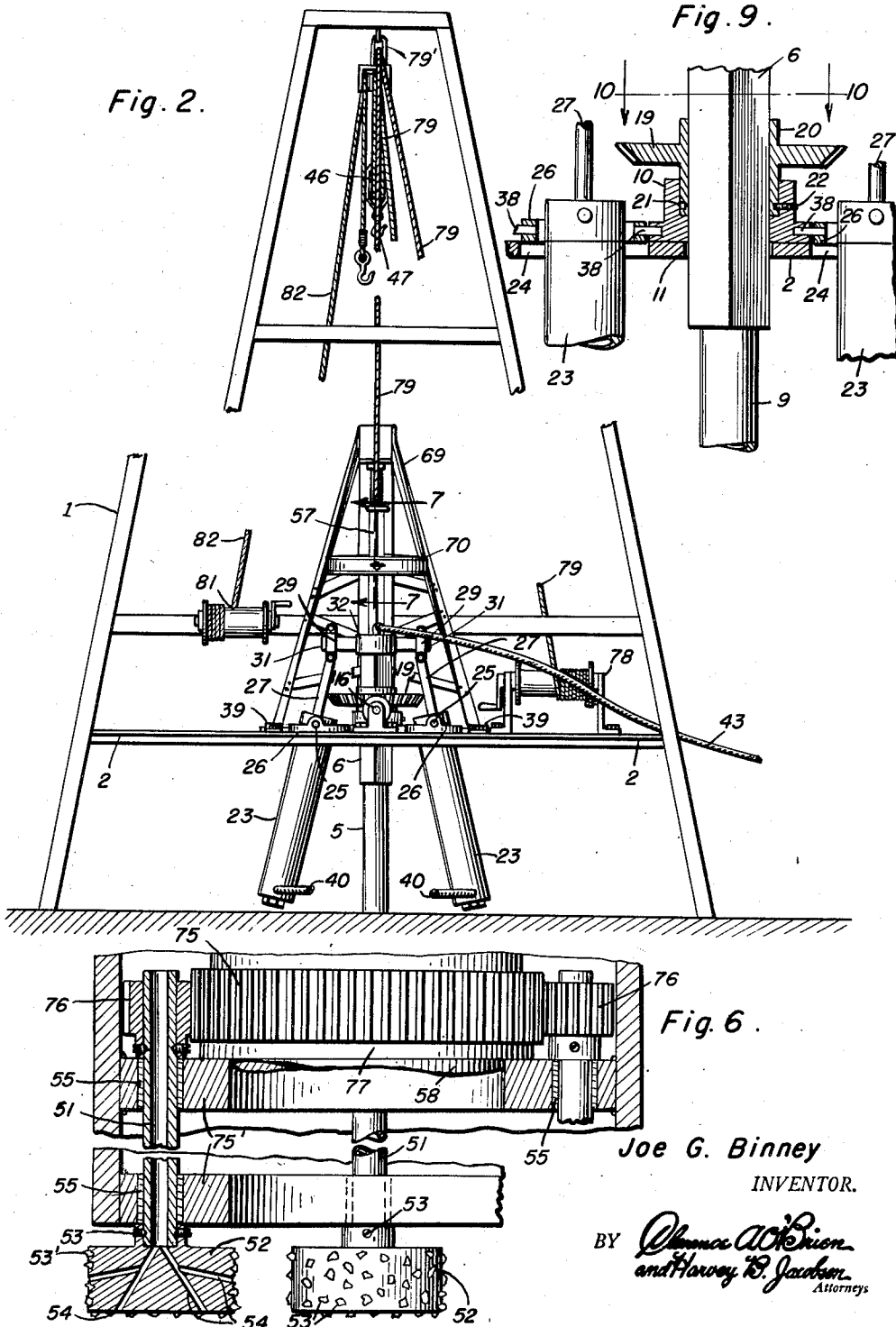
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Fig. 2.

Fig. 9.



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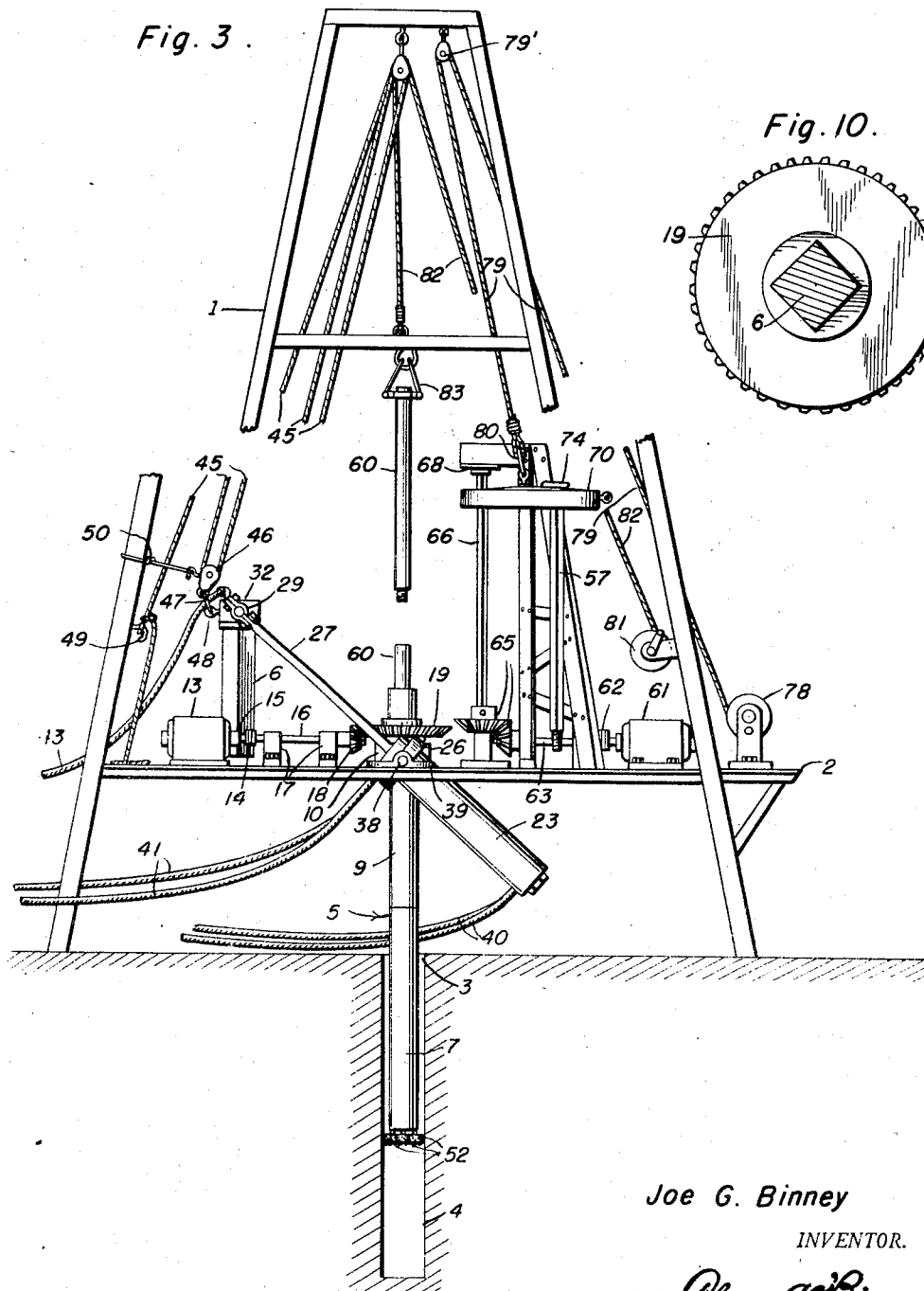
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GANG BIT CORE DRILLING APPARATUS

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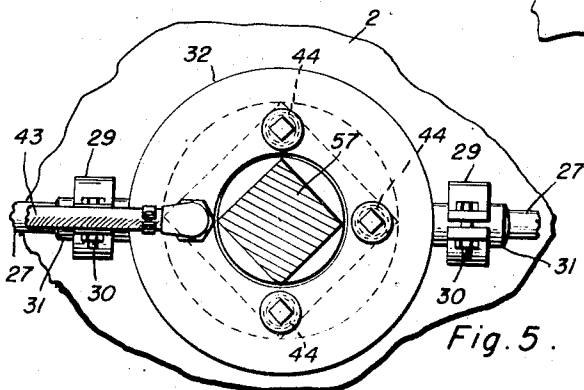
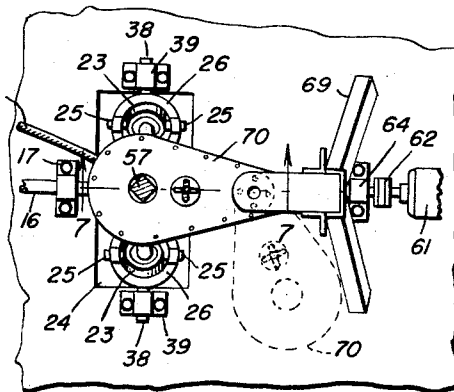
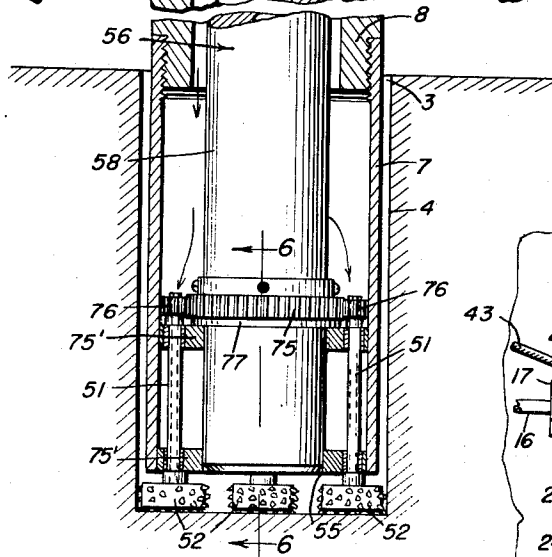
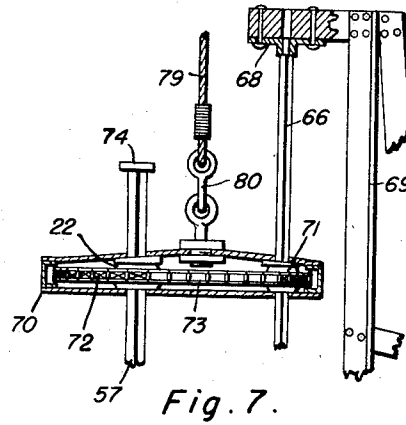
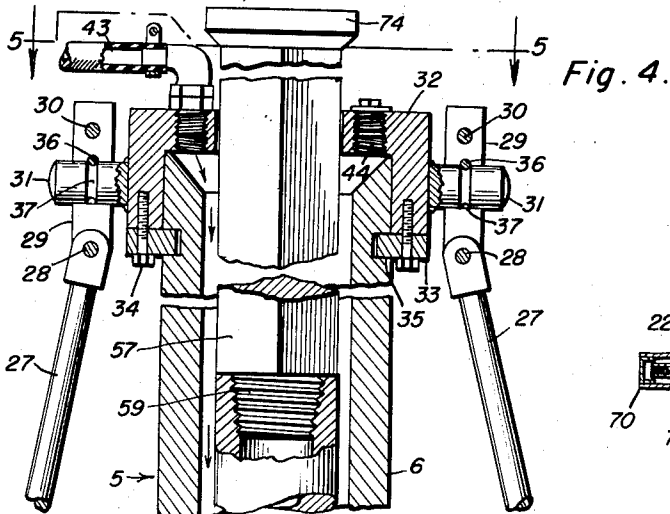
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GANG BIT CORE DRILLING APPARATUS

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,563,913

## GANG BIT CORE DRILLING APPARATUS

Joe G. Binney, New Douglas, Ill.

Application February 27, 1948, Serial No. 11,398

9 Claims. (Cl. 255—19)

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My invention relates to improvements in gang bit core drilling apparatus for use in drilling oil wells.

The primary object of my invention is to provide gang bit drilling apparatus of the class described whereby, as compared with present-day core drilling apparatus, cores can be drilled to a greater depth and with a greater thickness through all types of rock formations, hard or soft, quickly and comparatively inexpensively.

Other important objects, together with the precise nature of my improvements, will be readily understood when the succeeding description and claims are read with reference to the drawings, accompanying and forming part of the specification.

In said drawings:

Figure 1 is a view in side elevation, partly broken away and shown in section, of my improved gang bit core drilling apparatus in a preferred embodiment thereof;

Figure 2 is a similar view with the apparatus turned through an angle of 90 degrees;

Figure 3 is a view similar to Figure 1 but illustrating the driving head section for the core barrel swung out of the line of connection of the remaining casing and core barrel sections;

Figure 4 is a fragmentary view in vertical longitudinal section, partly broken away, and taken on the line 4—4 of Figure 1 with the parts drawn to a larger scale;

Figure 5 is a view in horizontal section taken on the line 5—5 of Figure 4;

Figure 6 is a fragmentary view in vertical section partly broken away and taken on the line 6—6 of Figure 4 with the parts drawn to a larger scale;

Figure 7 is a fragmentary view in vertical section taken on the line 7—7 of Figure 8 and drawn to a larger scale.

Figure 8 is a fragmentary view in plan of the sprocket drive casing, the tripod and other parts of the power drive for the driving head section of the core barrel, with parts subjacent thereto;

Figure 9 is a fragmentary view in vertical section taken on the same line of Figure 1 as Figure 4 and drawn to a larger scale;

Figure 10 is a detail view in transverse section taken on the line 10—10 of Figure 9;

Figure 11 is a view in bottom plan of the core barrel casing, the core barrel, and the gang bits.

Referring to the drawings by numerals, the apparatus of my invention, as illustrated, comprises a derrick 1 which may be of any usual construc-

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tion with a raised deck 2 above the mouth 3 of the well 4 to be drilled.

A sectional core barrel casing 5 is provided comprising a tubular driving head section 6 of polygonal form in cross section, and a leading drill carrying section 7 adapted to be threaded at its upper end onto a reduced, threaded, lower end 8 of the driving head section 6, at the start of the drilling operation, or, similarly attached to the lowermost one of casing sections, one of which is shown at 9, for extending the length of the core barrel casing 5 and which are adapted to be attached to said end 8 and connected together in the usual manner as will be understood.

The driving head section 6 is rotatable to rotate the core barrel casing 5 in an annular bearing 10 and a center opening 11 in the deck 2. The bearing 10 is bolted, as at 12, to said deck 2 to surround said opening 11 and said head section 6 is vertically slidable in said bearing 10 to pull the same out of said bearing so that the core barrel casing 5 may be pulled upwardly to attach sections 9 thereto, or detach such sections as may be required.

A power drive is provided for rotating the driving head section 6 of the core barrel casing 5 comprising an electric motor 13 suitably secured on the deck 2 with a suitable clutch connection 14 between the armature shaft 15 thereof and a horizontal driven shaft 16 rotatable in bearings 17 on said deck 2 and provided with a bevel driving gear 18 thereon. The driving gear 18 meshes with a bevel king gear 19 having a polygonal hub 20 in which said head section 6 is slidable in splined connection therewith and which is journaled in the bearing 10 with a circumferential groove 21 in which a bolt 22 in said bearing 10 extends to retain said hub 20 in the bearing.

Hydraulic means is provided for lifting the driving head section 6 out of the bearing 10 and king gear 19 clear of the same. The hydraulic means comprises a pair of upright, hydraulic cylinders 23 upon opposite sides of the bearing 10 and the head driving section 6 suspended at upper ends thereof to depend through openings 24 in the deck 2 and be swung on said deck by means of diametrically opposite, lateral trunnions 25 journaled horizontally in annular bearings 26 on the deck 2.

Piston rods 27 extend out of the upper ends of the hydraulic cylinders 23 with upper ends pivoted, by bolts 28, in sectional bearing yokes 29, the sections of which are secured together by said bolts 28 and other bolts 30 around a pair of lateral trunnions 31 on diametrically opposite

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sides of a cap member 32 for the upper end of the head driving section 6 in which said section 6 is rotatably secured by a bottom ring 33 bolted to said member, as at 34, and rotatable in a circumferential groove 35 in said section 6.

Cross pins 36 in the bearing yokes 29 seating in circumferential grooves 37 in the trunnions 31 retain said yokes on said trunnions. The annular bearings 26 are provided with diametrically opposite trunnions 38 at a right angle to the trunnions 25 and journaled horizontally in the bearing 10 and in bearings 39 on said deck 2.

The trunnions 25 in the annular bearings 26 provide for compensating swinging of the hydraulic cylinders 23 and pistons 27 about a horizontal axis as the head driving section 6 is lifted, or lowered, whereas, the trunnions 38 and the described bearings therefor provide for vertical swinging of said cylinders 23 and pistons 27 about a horizontal axis at a right angle to the first-mentioned axis to swing the lifted head driving section 6 in vertically suspended position to one side of the derrick 1 in an out-of-the-way position so that the core barrel casing 5 may be pulled as regards the other sections thereof.

Flexible, liquid pressure and discharge lines 40, 41 are connected to the opposite ends of the hydraulic cylinders 23 for connection to any suitable source of pressure supply, not shown, and with suitable control valves, not shown, interposed in said lines.

A water inlet pressure line 43 is tapped into the cap member 32 for introducing the usual water for drilling purposes into the core barrel casing 5, and plugged extra tap holes 44 are also provided in said cap member 32 for extra pressure lines if desired.

A block and tackle designated 45 is suspended from the top of the derrick 1 for lifting and lowering the driving head section 6 and with a lower pulley block 46 having a hook 47 thereon for coupling to an eye bolt 48 on the cap member 32. A hook 49 in the derrick 1 provides for attachment of the block and tackle 45 for holding the driving head section 6 suspended off the deck 2. A tie cable 50 is provided for connection to the derrick 1 and to the lower pulley block 46 for holding the block and tackle 45 swung toward one side of the derrick 1 to hold the suspended driving head section 6 to one side in a position such that the other sections of the core barrel casing 5 may be pulled.

The drill carrying section 7 of the core barrel casing 5 carries in the lower end thereof a gang of longitudinally extending, rotary, drill driving shafts 51 grouped around said end in equidistantly spaced relation and which are hollow to pass water therethrough to a gang of cylindrical, flat, drill heads 52 secured to the lower ends of said shafts 51 by set screws 53 with the side working faces of said heads projecting outwardly beyond said section 7 below the same. The drill heads 52 are adapted to be diamond studded as represented at 53', in the usual manner, and are ported, as at 54, to pass water to the working side and bottom faces thereof, for the usual purpose. The drill driving shafts 51 are journaled in vertically spaced bearings 55 in said section 7 for rotation in said bearings by means to be described.

The core barrel, designated generally 56 comprises a polygonal driving head section 57 extending into the driving head section 6 through the cap member 32 and rotatable in said section 6, and a lower, tubular drill driving section 58

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adapted to be threaded onto a reduced lower end 59 of said section 57, at the start of the drilling operation, or threaded onto one of intermediate core barrel sections, one of which is shown at 60, and which are provided for the usual purpose of extending the length of said core barrel 56 in a manner which will be understood.

A power drive is provided for rotating the head driving section 57 of the core barrel 56, as follows. An electric motor 61 of the reversible type on the deck 2 is operatively connected by a suitable clutch 62 to a horizontal power transmitting shaft 63 journaled in suitable bearings 64 on said deck 2.

Bevel gearing 65 operatively connects said shaft 63 to the lower end of a vertical, squared, driven shaft 66 offset to one side of the center of the deck 2 with its lower end journaled in a bearing 67 on said deck and its upper end journaled in a bearing 68 on a tripod frame 69 upstanding from said deck 2 and of any suitable type.

The driven shaft 66 rotates in and is extended through one end of an elongated, flat, sprocket drive casing 70 above the driving head section 57 and vertically slidable on said shaft 66, said casing 70 having a sprocket wheel 71 in said end vertically slidable on said shaft 66 and splined thereon by the squared contour of the shaft.

The driving head section 57 for the core barrel 56 is rotatably and slidably extended through the other end of said casing 70 with a sprocket wheel 72 thereon and to which the sprocket wheel 71 is operatively connected by a sprocket chain 73. The driving head section 57 is polygonal in cross section and slidably fitted in the sprocket wheel 72 to provide a spline connection between said head section 57 and the sprocket wheel 72.

An upper end flange 74 on the driving head section 57 prevents the same from slipping downwardly out of said casing 70. As will be seen, the sprocket casing 70 is adapted to be swung around the driven shaft 66, the purpose of which will presently be seen.

The drill driving section 58 is operatively connected to the drill driving shafts 51 by means of a ring gear 75 fast on said section 58 and meshing with smaller gears 76 fast on the upper ends of said shafts 51. Vertically spaced rings 75' in the lower end of the drill carrying section 7 and in which the lower end of the drill driving section 58 is rotatably fitted with a collar 77 therein resting on the upper ring 75' provide a water seal at the lower ends of said sections. The bearings 55 are fitted in said rings 75'.

The sprocket drive casing 70 is vertically slidable on the driven shaft 66 to lift and pull the driving head section 57 out of the driving head section 6 of the core barrel casing 5 and to hold said section 57 lifted clear of said section 6.

Means are provided for lifting the sprocket drive casing 70 to pull the driving head section 57 comprising a suitable reel 78 on the derrick 1 for winding up a pull cable 79 suspended from a pulley 79' at the top of said derrick with one end connected by a swivel 80 to the top of said casing 70. As will be understood, when said casing is slid vertically, the sprocket wheel 71 slides on the driven shaft 66 and the driving head section 57 is slidable in said casing 70 until the flange 74 is picked up by said casing 70.

A reel 81 on the derrick 1 is provided for winding up a block and tackle 82 for pulling casing sections and core barrel sections with the aid of the usual grips 83, for instance, as illustrated in Figures 1 and 3 wherein one core barrel sec-

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tion 60 of the intermediate sections has been shown as pulled.

Referring now to the operation of the described apparatus, the core barrel casing 5 is rotated by the motor 13, driven shaft 16, driving gear 18, king gear 19, and driving head section 6, and the core barrel 56 is rotated oppositely, relative to the core barrel casing 5, by the motor 61, power transmitting shaft 63, bevel gearing 65, driven shaft 66, sprocket and chain drive 71, 72, 73, and the head section 57 of said core barrel. Thus, the drill heads 52 are revolved in one direction by the drill carrying section 7 and rotated at high speed by the drill driving section 58. Water is supplied to the lower end of the core barrel casing 5 and the core barrel 56 by the line 43, such water passing downwardly through the space provided between said casing and barrel.

In pulling the core barrel casing 5, and the core barrel 56, the hydraulic means described is used to lift said casing 5 with the core barrel 56 until the driving head section 6 of the core barrel casing 5 is pulled out of the gear 20. In this operation, the driving head section 57 slides upwardly in the sprocket drive casing 70. The core barrel casing 5 may then be clamped in a lifted position, by the usual grips, not shown, and commonly used in well drilling. The driving head section 57 of the core barrel 56 may then be unscrewed from the subjacent core barrel section and lifted clear of the driving head section 6 by lifting the sprocket drive casing 70 through the medium of the cable 79 and reel 78, after which said section 57 may be swung about the driven shaft 66 to dispose the same to one side of the core barrel casing 5 out of the way. Unscrewing of the driving head section 57 may be accomplished by reversely operating the motor 61 to reversely operate the bevel gearing 65, driven shaft 66, and the sprocket and chain drive 71, 72, 73. In this position, the sprocket drive casing 70 may be tied by suitable means, not shown, to maintain the driving head section 57 swung out of the way and out of the line of connection of the remaining core barrel sections. Now, by grasping the driving head section 6, it may be unscrewed and detached from the subjacent core barrel casing section and pushed to one side of the line of connection of the remaining core barrel casing sections with the hydraulic cylinders 23 pivoting in the bearings 39.

The block and tackle 45 provide for suspending said driving section 6 at one side of the derrick 1 in which position it may be secured by the tie cable 50 in the manner already described. With the driving head section 57 and the driving head section 6 out of the way, as described, the remaining sections of the core barrel 56 may be pulled in the usual manner by means of the block and tackle 82, as shown for instance in Figures 1 and 3 in connection with one of the core barrel sections, and then the remaining sections of the core barrel casing 5 may be likewise pulled as desired. The manner in which the core barrel casing 5 and the core barrel 56 may be connected in sections and lowered will, it is believed, be clear from the foregoing description of the pulling operations.

The foregoing will, it is believed, suffice to impart a clear understanding of my invention, without further explanation.

Manifestly, the invention, as described, is susceptible of modification, without departing from the inventive concept, and right is herein reserved

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to such modifications as fall within the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. Well drilling apparatus of the class described comprising a sectional core barrel casing including a tubular detachable casing head section, a core barrel in said casing including a detachable barrel head section in the casing head section, means slidably mounting the barrel head section in the casing head section for lifting out of the same, means for lifting the barrel head section when detached out of the casing head section and moving the same laterally to one side of the casing in offset position relative thereto and parallel therewith, and means for subsequently moving the casing head section laterally when detached to the opposite side of the remaining sections of said casing.

2. Well drilling apparatus of the class described comprising a sectional core barrel casing including a tubular detachable casing head section, a rotary core barrel in said casing including a driving detachable barrel head section in the casing head section, means slidably mounting the barrel head section in the casing head section for lifting out of the same, means for lifting the barrel head section when detached out of the casing head section including a swingably mounted drive for said barrel head section for subsequently swinging the same laterally about a vertical axis to one side of the casing in offset parallel relation thereto, and means for subsequently moving the casing head section laterally when detached to the opposite side of the remaining sections of said casing.

3. In well drilling apparatus of the class described, a sectional casing of well tubing including a detachable head section, means for raising and lowering said casing comprising a pair of upright hydraulic cylinders upon opposite sides of said head section, piston rods extending upwardly out of said cylinders, means swingably suspending said section between said rods, and means pivotally suspending said cylinders by the upper ends thereof for lateral swinging movement to swing said head section when detached to one side of the remaining sections of the casing.

4. In well drilling apparatus of the class described, a sectional rotary casing of well tubing including a detachable head section, means for raising and lowering said casing comprising a pair of upright hydraulic cylinders upon opposite sides of said section, piston rods extending upwardly out of said cylinders, a cap member in which said section is rotatably suspended, said member being pivotally mounted between said rods to swing about an horizontal axis, and means pivotally suspending said cylinders by the upper ends thereof for lateral swinging movement to swing said head section when detached to one side of the remaining sections of the casing.

5. In well drilling apparatus of the class described, a sectional rotary barrel including a detachable driven head section, means for raising and lowering said barrel, power means for driving said section while said barrel is being lowered including a drive unit in which said section is splined, and means to mount said unit for swinging about a vertical axis to swing said section when detached to one side of the remaining sections of said barrel.

6. In well drilling apparatus of the class described, a sectional rotary barrel including a de-

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tachable driven head section, means for raising and lowering said barrel, and power means for driving said section while said barrel is being lowered including a drive unit in which said section is splined, means to mount said unit for vertical sliding movement and lateral swinging movement about a vertical axis to lift said section when detached and then swing the same about said axis to one side of the remaining sections of said barrel, and a hoist for lifting said unit.

7. In well drilling apparatus of the class described, a sectional rotary barrel including a detachable driven head section, means for raising and lowering said barrel, and power means for driving said section while said barrel is being lowered including a vertical power transmitting shaft, a sprocket and chain drive operatively connecting said shaft to said section with a sprocket splined on said section, and manipulative means for swinging said sprocket and the chain about said shaft to swing said section when detached to one side of the remaining sections of the barrel.

8. In well drilling apparatus of the class described, a sectional rotary barrel including a detachable driven head section, means for raising and lowering said barrel, and power means for driving said section while the barrel is being lowered comprising a vertical power transmitting shaft, a sprocket and chain drive unit operatively connecting said shaft to said section with sprocket wheels splined on said shaft and section whereby said unit is vertically slidable to lift said section when detached, a pickup connection between said section and the sprocket splined on the section for lifting of said section by said sprocket, and

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manipulative means for lifting said unit to lift said section.

9. In apparatus of the class described, a rotary core barrel casing, a rotary core barrel in said casing spaced therefrom to permit water to pass between the same and said casing, means to rotate said casing and barrel oppositely relatively, vertically spaced sealing rings in the lower end of said casing in which the lower end of said barrel is rotatably fitted with a sealing collar thereon resting on the upper sealing ring to form an additional seal, hollow water passing shafts journaled in said rings and grouped around said core with upper ends in communication with the space between said casing and barrel, a gear drive between said core barrel and shafts above said rings, and ported tool heads on the lower ends of said shafts with the ports thereof in communication with the interior of said shafts.

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