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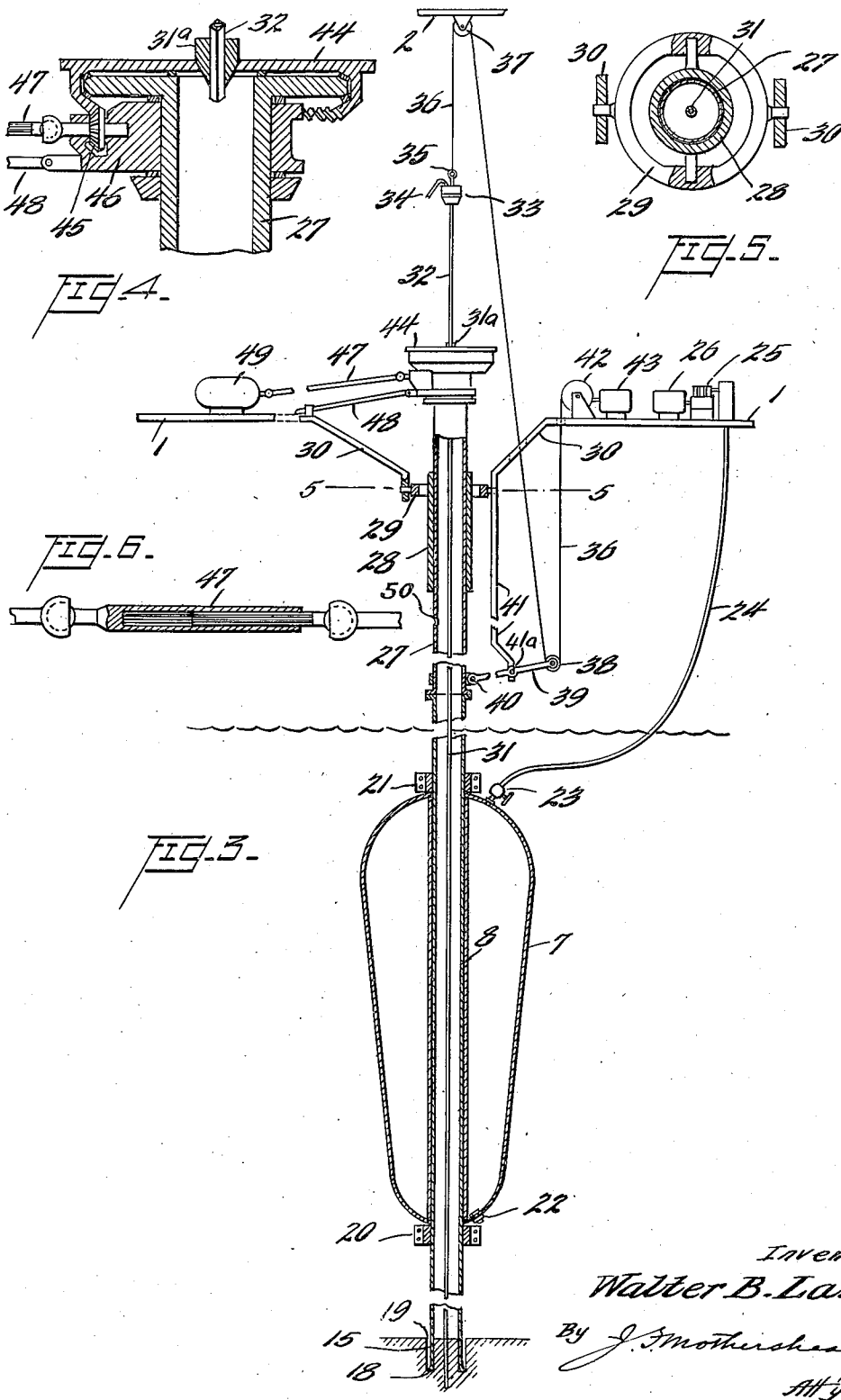
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APPARATUS FOR SUBAQUEOUS GEOLOGIC PROSPECTING

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APPARATUS FOR SUBAQUEOUS GEOLOGIC PROSPECTING

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9 Claims. (Cl. 255—1.4)

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The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (Ch. 460, 45 Stat. L. 467).

My invention relates to apparatus for subaqueous geologic prospecting by means of a drill or a core-drill, and particularly to prospecting for and the subsequent production of, oil and gas beneath bodies of water such as in the coastal continental shelves, inland lakes and rivers.

My invention provides means for prospecting from a platform anchored in deep water and therefore beyond the shallow waters in which the bed of the ocean can conveniently be used to support core-drilling apparatus. My prospecting apparatus may be used where the ocean is three hundred to three thousand feet or more deep. My invention provides a means for prospecting in the beds of rivers and inland lakes, as well as practically all of the areas of the subaqueous continental shelves, more particularly those areas where deep oil seeps are known to exist, such as off the California coast.

In the accompanying drawings:

Figure 1 is an elevation of my apparatus, diagrammatically indicating the essential elements in operative position.

Figure 2 is a plan view.

Figure 3 is an enlarged detail elevation, partly in section.

Figure 4 is an enlarged vertical section showing my driving gears.

Figure 5 is a cross-section on the line 5—5 of Figure 3.

Figure 6 is a detail, partly in section, showing my splined universal driving shaft.

In these drawings:

On a working platform 1 there is mounted a drill tower 2, an enclosed drill operating unit diagrammatically indicated at 3, suitable living quarters for an operating crew indicated at 4, and loading cranes for supplies indicated at 5. The platform is supported by a plurality of floats 6. A casing buoy 7 is fastened to a well casing 8 below the elevation of low tide, so that the buoy will always be submerged and constantly exert lifting force on the well casing.

A plurality of anchors 9 provided with suitable anchor cables 10 serve to maintain my platform over a selected site and for each anchor there is a warning buoy 11 attached to the anchor by a cable 12. For the purpose of enabling uncoupling of the floating structure from the well casing

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8 when it is desired to move the floating structure to a new location, or a safe location in case of threatened storm, the uppermost casing section 27 is detachably connected to the casing 8 just above the high water mark as shown in Fig. 3 and hereinafter described, and the floating structure, as indicated in Figs. 1 and 2, is arranged to provide a clear tunnel 13 extending from one face of the structure to a position underlying the drill tower 2. This clear tunnel 13 is provided by appropriate location of the floats 6 and strut-work of the structure to enable the structure to be withdrawn from superposition above the projecting end of casing 8 and the supporting float 7. Suitable cable windlasses 14 provide means for maintaining my device in position against wave and current action, as well as against the torque due to my core boring drill.

An embedded length of well casing 8 is indicated by 15, the length of the embedded portion depending largely upon the character of the ocean bed. The drilled hole is indicated at 16 and a plurality of torque-lines or cables 17 each secured to an anchor 9 may be paid out or shortened by gyro-controlled windlass operating means not shown.

The bottom of the casing 8 is provided with a suitable annular bit 18 which is rotated to cut into the rock by a standard drilling machine (not shown) which is temporarily mounted for that purpose on the platform to permit embedding the part 15. By any suitable and well-known process, a cement grout is introduced through the casing and forced outwardly to form a permanent seal at 19 between the portion 15 of the well casing and the surrounding rock of the ocean floor. A bolted pipe clamp 20 provides a supporting stop for my float 7 which has an axial tunnel through which the successive sections of casing are passed, while a similar clamp 21 transmits lifting force from my float 7 to my casing 8 after the latter is sealed in the rock. My float 7 is provided near the bottom with a differential check valve 22 through which water may be expelled by admitting compressed air through a valve 23 and a pipe 24 from an air compressor 25 operated by a suitable motor 26, both of which are mounted on the working platform 1.

A section 27 of the casing 8 forms a guide for an internally-machined sleeve 28 having a concentric gimbal 29. Depending from the platform 1, as shown in Fig. 3, there are bracket elements 30 which provide bearings for the trunnions of the Cardan joint 29, which trunnions, as shown in Fig. 5, extend at right angles to the trunnions pivotally

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connecting the Cardan ring 29 to the sleeve 28. By this arrangement provision is made for a sliding and giral connection between the casing 8-27 and the platform 1, thus providing a preferred form of means to accommodate movement of the platform relative to the casing due to ground swell or other wave action, wind, and tide drift. A hollow drill stem 31 has an upper section or "griefstem" 32 of non-circular section which terminates in a swivel 33 provided with goose-neck 34 through which flushing water is supplied to the hollow drill stem 31. The casing section 27 is provided with a suitable overflow opening or port 50 for the discharge of flushing water carrying the cuttings from the drill 18. The swivel is provided with an eye 35 to which a drill-hoisting cable 36 is attached. The cable 36 is passed over a pulley of a crown block 37 mounted on the drill tower 2. The cable is passed downwardly over a pulley 38 on the free end of a lever 39 which is pivotally attached at 40 to the casing 8. The lever 39 is also pivotally attached intermediate of its ends to a strut 41 attached to the working platform 1. The strut 41 in the form shown is attached to one of the brackets 30 which provides a bearing for the Cardan joint 29. The cable 36 is passed from the pulley 38 around a windlass 42 operated by a suitable motor indicated at 43.

A core drill is rotated by the grief-stem 32, freely slidable in the chuck 31a driven by a turntable 44 which is thus free to rise and fall relative to the grief-stem 32. The turntable 44 is driven by a bevel gear 45 mounted in a collar 46 on the upper casing 27. The turntable 44 is operatively connected by a splined universal driving shaft 47 having a torque rod 48, which keeps the gear 45, Fig. 4, aligned with the shaft 47, to a suitable motor 49 mounted on the working platform 1.

Preferably, my floats 6 are submerged to a depth at which wave action is very slight—for example, at 100 feet below the normal water line of my float which is preferably designed to offer a minimum of resistance to current and wave action, so that the rise and fall of my working platform 1 and my drill tower 2 is less than that of surface floating craft, while the fluctuations due to the tide may also be reduced by varying the volume of water in my ballast tanks 6. The well casing 8 and 27, float 7, and turntable 44 do not rise or fall with the waves or tide, while my working platform with everything supported thereby, including my drill tower 2, are subject to fluctuations with respect to the ocean bottom and the casing attached thereto. For this reason it is necessary to provide a flexible turntable drive and means for automatically taking up slack in my cable 36, which are provided for by the splined universal driving shaft 47 and by the arcuate movement of the pulley 38 which moves downwardly as my drill tower 2 moves down and vice versa. As the entire floating structure including strut 41 moves relative to the swivel 33 by the same amount that it moves relative to pivot point 40 it is clear that one unit of such motion in a downward direction produces one unit of slack in cable 36 which must be compensated for by movement of the pulley 38 downwardly by one-half unit of motion relative to the floating structure and hence to the pivot 41a carried thereby. Accordingly, it is apparent that the lever arm 40-38 is related to the lever arm 40-41a as 3 is to 2 so that as point 41a moves downwardly one unit, the pulley 38 will move downwardly half as much again, the same relation holding good during upward movement of the floating parts.

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My invention makes possible subaqueous geologic prospecting under depths of water which heretofore have been too great with available apparatus. Should my drill tap a supply of oil or gas, storage and oil refining equipment may be mounted on my working platform. Then either crude or refined oil may be delivered directly to ships which may stop for supplies.

Whenever it is desired to move my apparatus, it is only necessary to remove the drill rods to close the air valve 23 to my float 7, disconnect the air pipe between this valve and my compressor 25; then uncouple the upper section 27 of my well casing from the lower section 8 and cap the latter; then move my apparatus until the pipe 8 has emerged from the opening 13. After an oil and/or gas supply has been tapped, should it be desired to convey it ashore, suitable piping, such as is already known in this art, may be coupled to my well casing 8. Whenever it is decided to abandon a well which fails to produce oil in sufficient quantity to warrant development, the hole may be sealed as by plugging and cementing, and a blasting charge be then use to cut the casing loose from the ocean bed. Submarine television apparatus may be utilized to inspect the progressive stages of the work.

The size and shape of my floating structure may be varied in accordance with local conditions and the type of prospecting to be undertaken. Means are indicated for maintaining my structure in place without injury to a string of pipe and the attached float serves to relieve the lower portion of a string of pipe from excessive strains. This also makes it possible to remove all weight of the pipe from the platform and makes it independent of my floating equipment.

My mounting of the driving turntable on the string of pipe with yielding connections between the pipe and my floating structure provides for necessary freedom of relative movement, and serves to eliminate fluctuations of pressure on the core cutting bit, or raising it off the bottom during drilling with the risk of destroying the core. For unusually long strings of pipe a trussed brace may be added to give it rigidity.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications, among others being the making of my buoy 7 in axially-divided sections each provided with a venting check valve 22 and a supply pipe 24, as well as any suitable means for coupling these sections about the well casing 8 after the latter is cemented in place. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims, in which it is my intention to claim all novelty inherent in my invention as broadly as possible in view of the prior art.

What I claim is:

1. In a system of submarine drilling employing a drilling rig carried by a floating platform, a drill casing and a drill stem operable through the casing; the method which consists in (a) locating the floating platform in a position overlying the site at which it is desired to conduct the drilling; (b) anchoring the floating platform at said location to limit its lateral movement under tide, wind, wave and ground swell effects; (c) making up, in suspension, a string of casing adapted to reach the site from the floating platform and terminating in a drilling shoe at its lower end; (d) drilling in said string of casing and cementing

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the drilled in casing in place so as to secure a firm hold on the subterranean site; (e) supporting said casing to maintain it substantially erect above the site of operations; (f) connecting the so supported casing to said floating platform in a manner providing for vertical and gyral movement of the platform relative to the site; (g) lowering a drilling means through the casing into drilling relation with the site, and connecting said drilling means to the cable of the rig; and (h) drilling with said drilling means while compensating positively and continuously for tendency of the rig cable to become too slack or too short due to rising and falling motion of the platform relative to the site.

2. A method according to claim 1, in which said last-named compensating step includes the step of continuously and positively slacking off and picking up the cable as said platform rises and falls relative to the site.

3. A method according to claim 1, in which said last-named compensating step includes the step of slacking off and picking up the cable as said platform rises and falls relative to the site, and in which compensation for tidal and other relatively slow changes of elevation of the water surface relative to the site is effected by varying the buoyancy of said floating platform.

4. Flexible drilling apparatus for drilling at deep water submarine sites, comprising a floating platform adapted to be located in a position overlying the site at which it is desired to conduct the drilling, means for anchoring said platform so that its lateral movement under wind, wave and tide effects is limited to a relatively small percentage of the depth of water at the site; a drill casing having its lower end secured at the site and its upper end connected to the floating platform in a manner providing for vertical and gyral movement of the platform relative to the site; drilling means within the casing; a cable secured to said drilling means; a cable drum on said platform to which said cable is attached; and means for compensating continuously and positively for tendency of the cable to become too slack or too short due to rising and falling motion of the platform relative to the site.

5. Flexible deep water drilling apparatus according to claim 4, in which the upper end of the casing is slidable through a sleeve which in turn is mounted for gyral movement relative to said floating platform.

6. Flexible deep water drilling apparatus according to claim 4, in which the upper end of the casing is slidable through a sleeve which is mounted in a Cardan joint attached to said floating platform.

7. Flexible deep water drilling apparatus according to claim 4, in which said compensating means comprises a linkage movable by movement of said platform relative to said casing, said link-

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age having a movable arm carrying an idler pulley engaging a bight in said cable and arranged to positively and continuously increase and decrease the length of said bight to compensate for falling and rising motion of said platform relative to said casing.

8. In a flexible deep water drilling apparatus a drill casing secured at its bottom end at the subterranean site at which it is desired to conduct the drilling, means for maintaining said casing substantially erect above the site, said casing at its upper end terminating above the high water mark; a floating platform adapted to be located in a position overlying the upper end of said casing, strut-work and buoyancy chambers supporting said platform; a drilling tower carried by said platform; a section of drill casing secured to said platform in underlying relation to said tower and adapted to be detachably secured to the upper end of the first-named casing; flexible means for anchoring said floating casing in position; said strut-work and buoyancy chambers being positioned to provide a tunnel from the edge of said platform to said casing section, whereby said floating structure may be disconnected from said first-named casing and moved to and from the site of operations without disturbance of said first-named casing.

9. In a drilling apparatus for drilling at deep submarine sites, a drill casing having an annular bit at its bottom end drilled into the submarine site and sealed thereto, said casing being of such length as to be incapable of sustaining itself erect under the conditions existing at the site, and a buoyancy chamber secured to the upper part of said drill casing, said buoyancy chamber constantly exerting lifting force at the upper part of said casing and applying pulling tension to the underlying part of the casing preventing buckling of said casing and maintaining it substantially erect above the site.

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