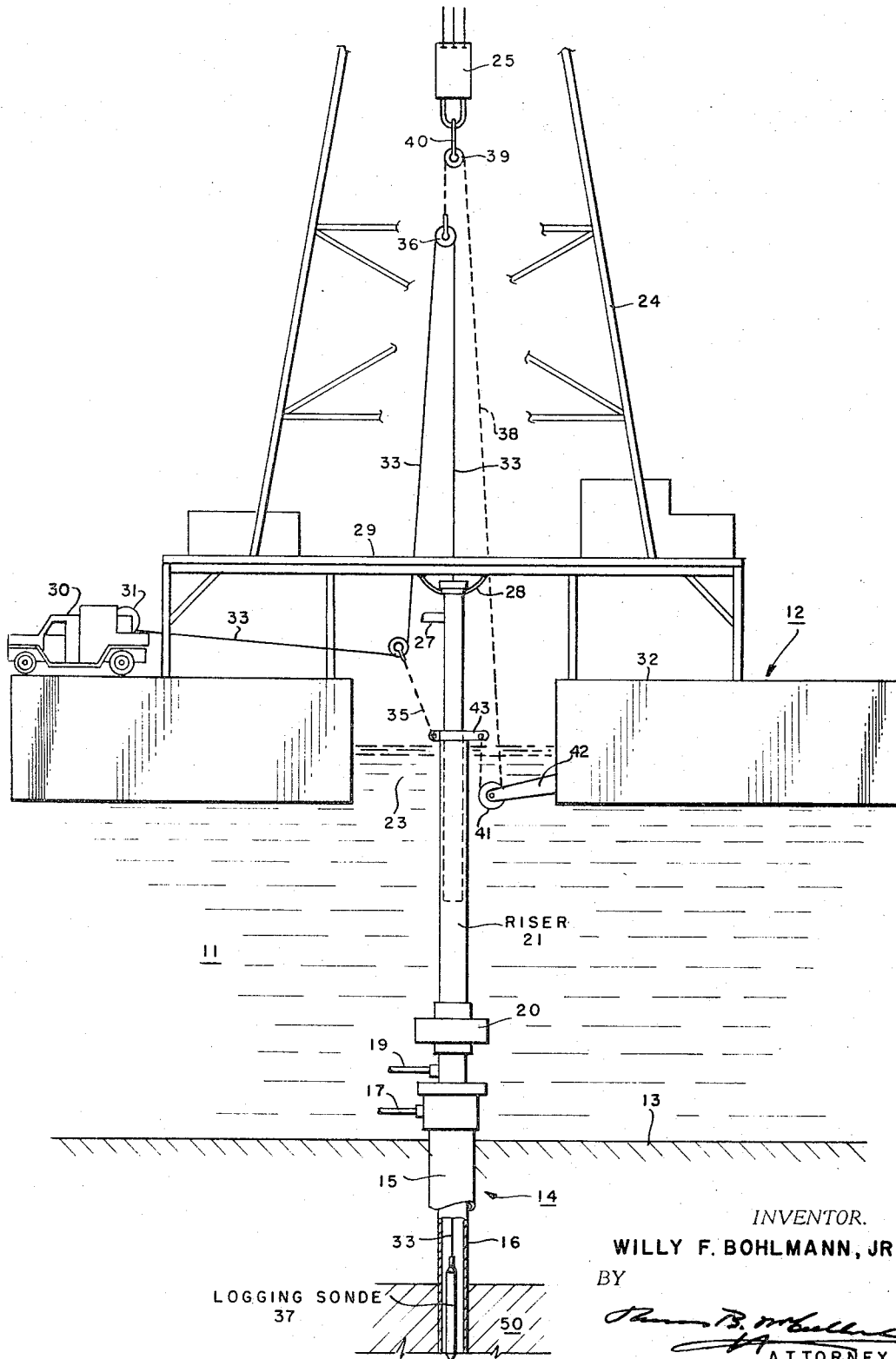


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OFFSHORE OPERATIONS IN WELLS

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OFFSHORE OPERATIONS IN WELLS

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ABSTRACT OF THE DISCLOSURE

In use of well tools from a floating vessel, the well tools are maintained at a selected point in the well by interconnecting the supporting system to the vessel and to the wellhead such that the supporting system moves corresponding to vertical movement of the vessel, the supporting system being connected to the vessel below the point of interconnection to the wellhead and the supporting system has a substantially vertical run.

The present invention is directed to method and apparatus for conducting operations in a well drilled in a body of water. More particularly, the invention is directed to conducting operations from a floating vessel in a well drilled in a body of water. In its more specific aspects, the invention is directed to maintenance of a well tool at a selected point in a well while suspended from a floating vessel in a body of water.

The present invention may be briefly described and summarized as a method and apparatus for conducting an operation in a well from a floating vessel in a body of water in which a well tool is suspended from the vessel by a first elongated member such that the well tool is maintained at a selected point in the well. In maintaining the tool at the selected point in the well, the first elongated member is supported above the vessel by the first end of a second elongated member of fixed length having a substantially vertical run, the second end of the second elongated member being attached to a fixed point on the well and to the vessel intermediate the first and second ends of the second elongated member below the fixed point for movement of the vessel relative to the fixed point and to the second elongated member. Thus, movement of the vessel relative to the fixed point varies the distance between the first and second elongated members corresponding to the relative movement to maintain the tool at the selected point in the well.

The tool which is maintained at a selected point in the well may be a perforator such as, but not limited to a bullet gun perforator, a shaped charge perforator, a mechanically operated perforator or one which perforates well pipe such as tubing or casing by directing a stream containing an abrasive material against the well pipe. Whatever type the perforator is, it is operated at the selected point to allow connection between the interior of the well and an earth formation penetrated by the well. The well tool may also include a well logging device which may be any of several well logging devices well known to the art, such as, but not limited to, electrical log, laterolog 7, conductivity laterolog, induction/electrical log, sonic/cement bond log, sonic BHC/cement bond log, gamma ray, gamma ray/neutron, formation density log, formation density log compensator, microlog/caliper, microlaterolog/caliper, continuous dipmeter and directional tools, cement bond tool, thermometer, caliper, side wall coring, lost circulation tool, bridge plug setting tool, free point indicator, high resolution thermometer, continuous flowmeter, through-tubing caliper, fluid sampler, formation tester and the like. Likewise, the well tool may be a surveying device which, like the perforator and the logging device, may be operated at the selected point in the well. The surveying device may

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include, by way of illustration, devices such as, but not limited to, those listed immediately above.

The first elongated member is suitably a flexible member such as a wireline or a cable, but the first elongated member may also include a drill string or a tubing string or other well pipe. Thus, the first elongated member may be a tubular member. When it is a tubular member, it may suitably be a continuous length of well pipe which may be reeled into and out of the well from a drum or spool.

The fixed point to which the second elongated member is attached may suitably be a drilling riser which is attached to a submerged wellhead. It is considered that the fixed point on the well may be at any point on the wellhead or any point on the equipment attached to the wellhead so long as the point is fixed relative to the floating vessel.

The invention also includes apparatus for use in a well from a floating vessel in a body of water in which a well tool is suspended from a vessel by a first elongated member. The apparatus in combination comprises a second elongated, flexible member attached at one end to a fixed point on the well and at a second end to a first elongated member and is connected to the vessel intermediate the first and second ends below the fixed point for movement of the vessel relative to the fixed point and the second elongated member. Means are provided for supporting the second elongated member at a point above the first elongated member a variable distance between the first and second elongated members. Thus, movement of the vessel relative to the fixed point varies the distance between the first and second elongated members corresponding to the relative movement to maintain the tool at the selected point in the well.

The present invention will be further illustrated by reference to the drawing in which the sole figure represents a best mode and embodiment contemplated.

Referring now to the drawing, numeral 11 designates a body of water in which a drilling vessel, such as a barge 12, is floating. Drilled in water bottom 13 is a well 14 provided with a casing 15 in which a drill string or other well pipe 16 is arranged. The casing 15 has a flow pipe 17 communicating with the annulus between the well pipe 16 and the casing 15 and a second flow pipe 19 communicating with the pipe 16. A wellhead and blowout assembly 20 is connected to the casing 15 and well pipe 16 by a suitable means. Attached to the wellhead and blowout assembly 20 is a drilling riser 21 which extends up to a point at least adjacent water level 22 and extends into a slot or opening 23 in the drilling barge 12. The drilling barge 12 is provided with a drilling derrick 24 from which there is suspended by usual suspension means, such as wire lines, an elevator or block 25. Arranged in the drilling riser 21 is a slip or telescopic joint 26, provided with a flow pipe 27, which is attached by means 28 to the derrick 24, and particularly to the derrick floor 29.

In accordance with the present invention, it is desired to conduct certain operations such as perforating, logging, surveying or any wireline operation from the drilling barge 12 in the well 14. To this end, a well servicing unit 30, provided with a reel or drum 31 on which a wireline or cable is reeled, is arranged on the drilling barge 12 particularly on the main deck 32.

A wireline 33 runs from the reel 31 around a sheave 34 which is supported by means 35 attached to the riser 21. The wireline or cable 33 runs over a second sheave 36 and thence into the well through the drilling riser 21 and wellhead and blowout assembly 20. A well tool 37 which may be a logging sonde, a perforator, a surveying unit or any other well tool or device is shown suspended

in the well by the wireline or cable 33. It is desired that this well tool 37 be arranged opposite a subsurface earth formation penetrated by the well 14 such as a formation 50 which is to be tested for the presence of hydrocarbons and the like. Since the vessel 12 is floating in the body of water, wind and wave action will cause the vessel 12 to rise and fall relative to water bottom 13 which in turn will cause the well tool 37 to be displaced upwardly and downwardly corresponding to movement of the vessel 12. Techniques are available for maintaining the vessel 12 at a fixed location relative to a given point on water bottom but heretofore it was not possible to compensate for upward and downward movement with respect to maintaining a well tool at a selected point in the well. In accordance with the present invention, this is now possible. Therefore, the sheave 36 is suspended above the vessel by a second elongated member such as a cable 38 which is arranged over a sheave 39 which in turn is supported by means 40 from the block 25. The second elongated member 38 runs over a sheave 41 which is attached to the vessel 12 by means 42 and as shown in the drawing runs over the sheaves 41 and 39 substantially vertically. The second elongated member 38 is of fixed length and is attached at its fixed end to the riser 21 by means 43. It may be considered that the riser 21 is part of the well 14 and the wellhead and blowout preventer 20 as shown in the drawings, the sheave 41 is below attaching means 43. In any event, the second elongated member must be of fixed length and must be attached to a fixed point on the well. The second elongated member is a flexible elongated member such as a wireline or a cable and is of fixed length. Thus, in accordance with the present invention, the well tool 37 may be maintained at a selected point opposite the formation 50. Thus, the invention operates as follows. Upward movement of the drilling vessel 12 causes the vertical distance between the drilling riser 21 and the sheave 41 to become less and the distance between the sheave 39 and the sheave 36 to increase the same amount which would result in insignificant, if any, movement of the well tool 37. Likewise, downward movement of the drilling vessel 12 causes the distance between the drilling riser 21 and the sheave 41 to become greater and the distance between the sheave 39 and the sheave 36 to become less by the same amount resulting again in only insignificant, if any movement of the tool 37.

The present invention has been demonstrated and operated satisfactorily in twenty-six logging operations, five perforation operations and packer settings in a maximum of 12 to 14 ft. seas and 50 m.p.h. winds. The rise and fall of the drilling unit did not affect the position of the well tool such as a logging tool and gun perforator which was maintained at a selected point in the well. These selected points were in a 12¼" and 8½" hole and 9⅝" casing at 2000 to 8700 ft. depths below water bottom.

Thus, the present invention is quite important and useful, since a very inexpensive and relatively simplified method and apparatus for accomplishing jobs where weather is a very influential factor is provided. The cost of the drilling or service unit in offshore waters is costly compared to the service being rendered, but in offshore operations, the results of such service are vital to continued development. The present invention allows this to be accomplished.

The nature and objects of the present invention having been completely described and illustrated, and the best mode and embodiment contemplated set forth, what I wish to claim as new and useful and secure by Letters Patent is:

1. In an operation conducted in a well from a floating vessel in a body of water in which a well tool is suspended from said vessel by a first elongated member, the method

of maintaining said tool at a selected point in said well which comprises:

- supporting said first elongated member above said vessel by the first end of a second elongated flexible member of fixed length, the second end of said second elongated member being attached to a fixed point on said well and to said vessel intermediate the first and second ends of said second elongated member below said fixed point for vertical movement of said vessel relative to said fixed point and said second elongated member; and
- supporting said second elongated flexible member at a point above said first elongated member a variable distance between said first and second elongated members;
- said attachments to said fixed point and to said vessel, and supporting said second elongated member above said first elongated member providing a substantially vertical run of said second elongated member;
- whereby vertical movement of said vessel relative to said fixed point varies the supporting distance between said first and second elongated members corresponding to said relative movement to maintain said tool at said selected point in said well.
2. A method in accordance with claim 1 in which the tool is a perforator which is operated at least at said selected point.
3. A method in accordance with claim 1 in which the tool is a logging device which is operated at least at said selected point.
4. A method in accordance with claim 1 in which the tool is a surveying device which is operated at least at said selected point.
5. A method in accordance with claim 1 in which the first elongated member is a flexible member.
6. A method in accordance with claim 1 in which the first elongated member is a tubular member.
7. A method in accordance with claim 1 in which the second elongated member is attached to a wellhead on said well.
8. For use in a well from a floating vessel in a body of water in which a well tool is suspended from said vessel by a first elongated member, apparatus for maintaining said tool at a selected point in said well which comprises in combination:
 - a second elongated flexible member attached at one end to a fixed point on said well and at a second end to said first elongated member and connected to said vessel intermediate said first and second ends below said fixed point for vertical movement of said vessel relative to said fixed point and said second elongated member;
 - means supporting said second elongated member at a point above said first elongated member a variable distance between said first and second elongated members;
 - said attachments to said fixed point and to said vessel, and said means supporting said second elongated member above said first elongated member providing a substantially vertical run of said second elongated member;
 - whereby vertical movement of said vessel relative to said fixed point varies the supporting distance between said first and second elongated members corresponding to said relative movement to maintain said tool at said selected point in said well.
9. Apparatus in accordance with claim 8 in which the second elongated member is movably connected to said vessel by contact of said second elongated member with a sheave attached to said vessel over which said second elongated member is run.
10. Apparatus in accordance with claim 8 in which the means supporting said second elongated member is a sheave and the second end of said second elongated mem-

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ber is attached to said first elongated member by a sheave over which said first elongated member is run.

11. A method for maintaining a well tool at a selected point in a well suspended from a floating vessel in a body of water which comprises:

interconnecting a flexible elongated member to the suspended well tool and to the vessel and the well for vertical movement of the vessel relative to the well and the elongated member;

the elongated member being connected to the well tool above the vessel and to the vessel intermediate its ends below the point it is connected to the well and being connected to the well tool, the vessel, and well such that the elongated member has a substantially vertical run;

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whereby vertical movement of the vessel relative to the connecting point to the well varies the run of said elongated member above the vessel corresponding to said vertical movement of the vessel.

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