April 30, 1968 L. R. MARTIN 3,380,714

CORRECTION SYSTEM FOR USE IN CARRYING OUT LINE-OPERATIONS IN AN UNDERWATER BOREHOLE

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FIG. 1.

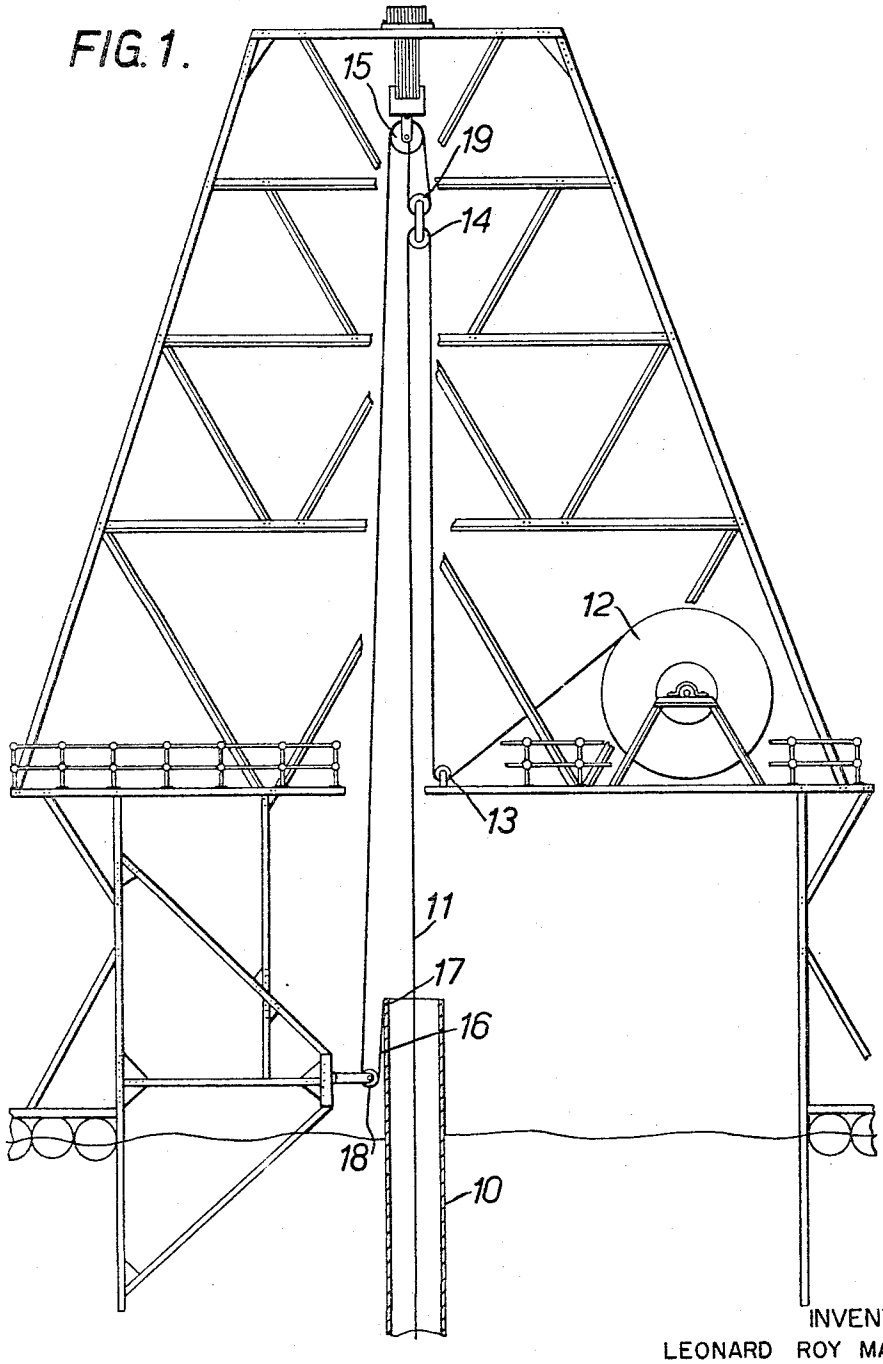

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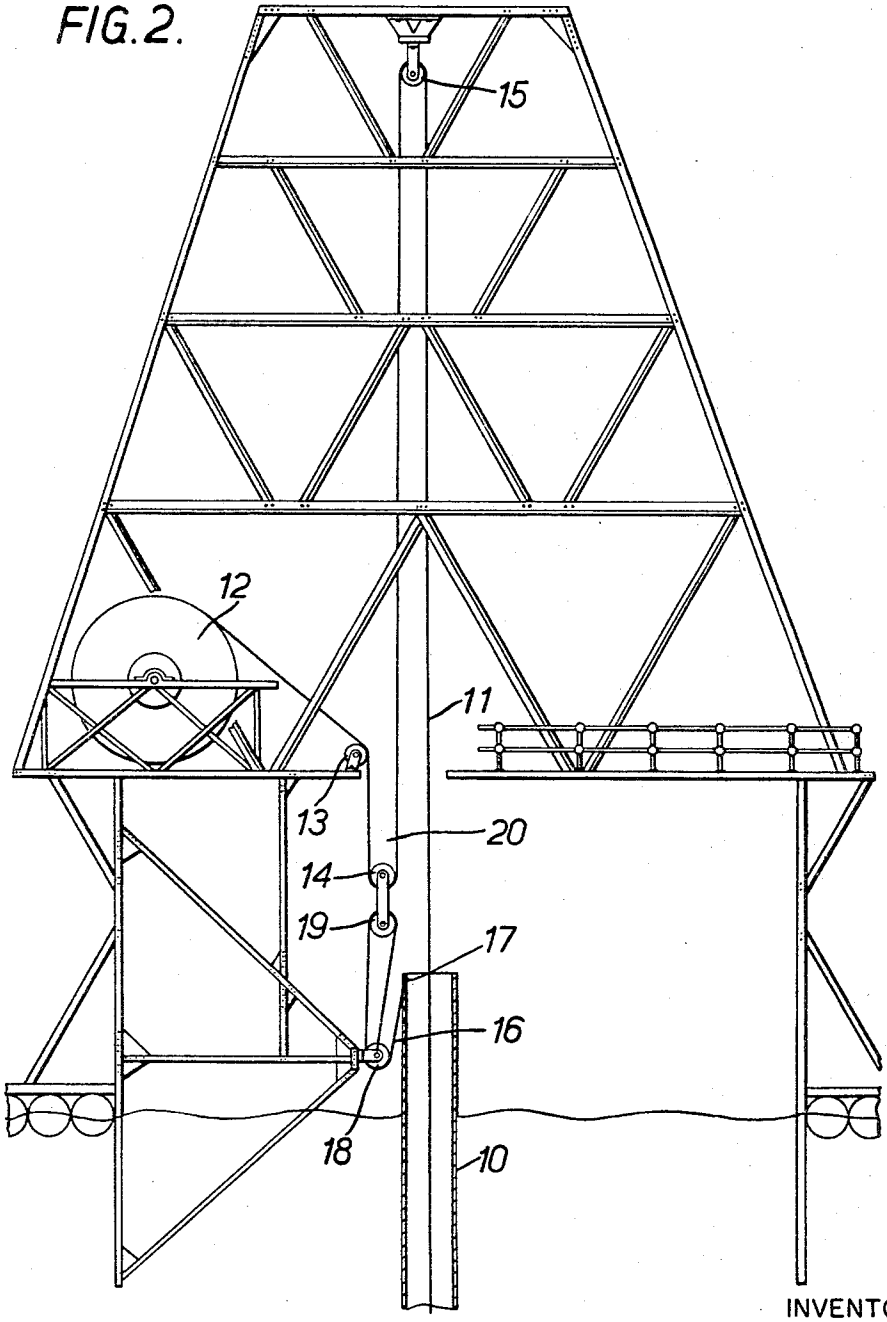
FIG. 2.



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CORRECTION SYSTEM FOR USE IN CARRYING OUT LINE-OPERATIONS IN AN UNDERWATER BOREHOLE

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1 Claim. (Cl. 254—172)

ABSTRACT OF THE DISCLOSURE

A floatable rig for carrying out line-operations in an underwater borehole, the rig being provided with a correction system for the borehole-line, the system having a correction line connected to a point fixed relative to the earth and to a correction pulley in engagement with the borehole-line, by which the length of borehole cable payed out in response to the rise and fall of the tide and wave action, is adjusted to correct for the vertical motion of the floating rig.

This invention relates to a correction system for use in carrying out line-operations in an underwater borehole.

In recent years the search for petroleum has extended to underwater rock formations and this has necessitated drilling underwater boreholes and the carrying out of well surveying and servicing operations in underwater boreholes.

In shallow water, e.g., about 5 fathoms, the work can be carried out from a platform equipped with retractable legs. The legs stand on the sea bed and hold the platform clear of the surface of the water and this enables drilling operations to be carried out in a similar manner to land operations. In deeper water, e.g., 20 fathoms, it becomes necessary to carry out operations from a vessel which is floating on the water and which is therefore subject to the rise and fall of tide and wave action.

From time to time it may be necessary to carry out an operation in which a tool is lowered into the borehole by means of a flexible cable which is unwound from a winch. In this specification these operations will be called line-operations and as an example of such a line-operation we quote the lowering of a sonde into a borehole to collect information about the composition and nature of the surrounding strata. In carrying out a line-operation it is necessary to maintain a predetermined rate of descent or ascent of the tool in the borehole and accurately to known the depth position of the tool relative to a fixed datum. It is an object of the present invention to achieve these conditions in line-operations from a floating vessel irrespective of the vertical motion of the vessel.

According to the invention a correction system for use during line-operations carried out from a floating vessel which has a winch for unwinding borehole-line and a series of one or more pulleys for directing the borehole-line into a borehole, comprises a correction line connected to a point fixed relative to the earth and to a correction pulley in engagement with the borehole line, the connection to the fixed point being such that a downward motion of the vessel tightens, and an upward motion slackens, the correction line and the connection to the correction pulley being such that the tightening of the correction line is transferred to the borehole line so as to take it in, and the slackening so as to pay it out, whereby the length of borehole cable payed out is adjusted to correct for the vertical motion of the floating vessel.

In most underwater drilling operations a conductor pipe passes from the surface and is rigidly attached to well head equipment situated at the sea bed so as to provide a return for the mud circulation. The top of this conductor pipe is fixed relative to the earth thereby forming a suitable reference point for a correction system according to the invention. In a convenient arrangement the correction line is secured to the top of the conductor pipe and is passed to the floating vessel via a pulley (hereinafter called the adjustment pulley) secured to the vessel at a point which is always below the level at which the correction line is secured to the conductor pipe whereby a downward motion of the vessel and hence the pulley tightens, and an upward motion slackens, the correction line.

Conveniently the correction line is secured to the floating vessel after passing around a secondary correction pulley which is attached to the correction pulley.

In a conventional arrangement for carrying out line-operations from a floating vessel, the borehole line is unwound from a winch at deck level, passed from a deck pulley over a travelling block which can be lowered to the bottom of the drilling mast to rig the system and then hauled to the top to guide the borehole line into the borehole. With this arrangement a correction system according to the invention may be rigged so that the correction passes line over the travelling block followed by the secondary correction pulley after which it is secured to the travelling block; the borehole line is passed over the deck pulley and then over the correction pulley which is attached the secondary correction pulley.

The invention will now be further described by way of example with reference to the drawings which accompanying the instant specification and in which:

FIGURE 1 illustrates a correction system according to the invention, and

FIGURE 2 illustrates a modification in which the correction is applied at an alternative position in the borehole line.

Both figures illustrate a correction system according to the invention arranged for use in the carrying out of a line-operation in a borehole which is being drilled in the sea bed and a conductor pipe runs from this equipment to the surface. The conductor pipe is secured to the sea bed and therefore it forms a convenient reference point fixed relative to earth.

For reasons of scale most of the items mentioned above were omitted from the drawings and only the upper portion of the conductor pipe, designated by the numeral **10**, will be shown.

In the arrangement shown in FIGURE 1 a borehole line **11** is unwound from a winch **12** passes around deck pulley **13** and over correction pulley **14** which guides the borehole line **11** into the conductor pipe and therefore into the borehole.

The correction system comprises the correction line **16** which is made fast to the fixed point **17** situated near the top of the conductor pipe **10**. The correction line **16** passes around the adjustment pulley **18** over travelling block **15** (which is positioned near the top of the drilling mast during the operation), is looped around secondary correction pulley **19** and is passed back to the mounting of travelling block **15** where it is secured. The secondary correction pulley **19** is connected to the correction pulley **14** so that tension in the borehole line **11** is applied to the correction line **16**.

When a vessel at sea is engaged in line-operations the whole of FIGURE 1 rises and falls under the influence of tide and wave action except the conductor pipe **10**. The operation of the correction system to eliminate this

motion from the borehole line **11** will be explained by considering a downward motion of the vessel. This downward motion is equivalent to an upward motion of the point **17** while all other points remain stationary and the mode of operation will be explained from this point of view since this is easier to follow.

An upward motion of the point **17** through a distance $2x$ pulls this quantity of the correction line **16** out of the loop **21** so that the secondary correction pulley **19** is pulled upwards through a distance x. The upward motion of the secondary correction pulley **19** is transferred to the upper borehole line pulley **14**, that is, a correction pulley, and this has the effect of increasing the size of the loop **20** to take in a quantity $2x$ of the borehole line **11**. The borehole line is restrained from paying out by the winch and therefore a quantity 2x of borehole line is taken in on the borehole side of loop **20**. Thus the borehole line **11** on the borehole side of loop **20** shares the motion of the point **17**.

We will now consider a downward motion of the point **17** (actually an upward motion of the vessel) through a distance of $2x$. The tension in the borehole line **11** due to the weight of the tool in the borehole maintains the tension in correction line **16** so that the amount of correct ion line paid into the correction system is taken into loop **21**: this allows pulleys **19** and **14** to fall through a distance x, thus paying out a quantity $2x$ on the borehole side of loop **20**. Again the borehole line **11** shares the motion of the point **17**.

Reverting to the more conventional view point (in which the point **17** is fixed and all other points move) it can be seen that the correction system has the effect of correcting the borehole line **11** for the motion of the floating vessel.

FIGURE 2 shows a modification in which the borehole line **11** passes over the deck pulley **13** and around correction pulley **14** and then over the travelling block which guides the borehole line **11** into the conductor pipe **10** and therefore into the borehole.

The correction system comprises the correction line **16** which is made fast to fixed point **17** on conductor pipe **10**. The correction line **16** passes around the adjustment pulley **18**, is looped round the secondary correction pulley **19** and passed back to the mounting of the adjustment pulley **18** where it is secured. The secondary correction pulley **19** is connected to correction pulley **14** so that the tension in the borehole line **11** is applied to the correction line **16**. With this arrangement the correction pulley **14** is situated below deck and functions in the same way as the upper logging pulley in the prior art arrangement. It will be apparent that this arrangement functions in the same way as that described in FIGURE 1.

I claim:

1. In a floatable rig for carrying out line-operations in an underwater borehole, said rig comprising a borehole-line, a winch for unwinding the borehole-line and at least one pulley for directing the borehole-line into the borehole, a correction system which comprises a correction line connected to a point fixed relative to said rig and to a point fixed relative to earth, a correction pulley which engages with the borehole-line, and a secondary correction pulley which is connected to said correction pulley and engages with said correction line between said points such that a downward motion of the floatable rig tightens, and an upward motion slackens, the correction line and said tightening and slackening are transferred to the borehole-line by the correction pulley so as to take it in and pay it out whereby the length of borehole-line payed out is adjusted to correct for the vertical motion of the floatable rig said correction system includes a conductor pipe which provides the point fixed relative to the earth to which said correction line is connected and wherein an adjustment pulley is secured to the rig at a point which is always below the level at which the correction line is secured to the conductor pipe, said correction system includes a traveling block connected to said rig and providing the point fixed relative to said rig to which said correction line is connected, the correction line passing, in sequence from the conductor pipe, over the adjustment pulley, the traveling block and the secondary correction pulley before being connected to the traveling block, whereby a downward motion of the rig and hence the pulley tightens, and an upward motion slackens, the correction line.

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