DEVICE FOR MEASURING THE RATE OF PENETRATION OF THE DRILL BIT DURING DRILLING OPERATIONS PERFORMED FROM A FLOATING INSTALLATION

Inventor: Philippe Joubert, Meudon La Foret, France
Assignee: Institut Francais du Petrole, des Carburants et Lubrifiants, Rueil-Malmaison, France
Filed: Nov. 7, 1972
Appl. No.: 304,414

Foreign Application Priority Data
Nov. 8, 1971 France .................................. 71.40041

U.S. Cl. .................. 254/172; 73/151.5; 173/11; 175/5; 175/40; 235/151.11
Int. Cl. .................. B66D 1/48
Field of Search .......... 254/172; 175/5, 27, 40; 73/151.5; 235/151.11; 173/11

ABSTRACT
This device comprises means for detecting the instantaneous position of the drill pipe relative to the floating installation, said means generating a first signal representative of this position. The first signal is transmitted to a circuit which generates a second signal representative of the average position of the drill pipe relative to the floating installation, this second signal being applied to a derivating circuit which delivers a signal representing the drilling speed.

11 Claims, 3 Drawing Figures
DEVELOPMENT FOR MEASURING THE RATE OF PENETRATION OF THE DRILL BIT DURING DRILLING OPERATIONS PERFORMED FROM A FLOATING INSTALLATION

The present invention relates to a device for measuring the rate of penetration of the drill bit during drilling operations performed from a floating installation and more particularly from a floating installation equipped with an apparatus preventing the drill pipe from being subjected to the vertical movements due to the action of the swell.

The floating drilling installation are at sea subjected to vertical pounding movements which make the drilling operations difficult.

Apparatuses for equipping the floating installations have already been proposed with a view to preserve the drill pipe from such vertical movements.

It results therefrom a relative movement of the floating installation with respect to the drill pipe, which makes difficult a direct measuring of the rate of penetration of the drill bit into the ground, this rate being one of the parameters which is important for conducting the drilling operations under the best conditions.

Such apparatuses generally comprise a support member for the drill pipe, permitting its downward displacement as the drilling progresses, and means for compensating the vertical movements of the floating installation, connecting this installation to the support member.

An object of the invention is accordingly to provide a device permitting the measurement of the drill speed during drilling operations performed from a floating installation equipped with an apparatus of the above-indicated type, this device making it possible to preserve the drill pipe from the vertical movements to which the floating installation is subjected.

The device according to the invention comprises, in combination with said apparatus, means for detecting the instantaneous relative position of the drill pipe and of the floating installation, said detecting means generating a first signal representative of said instantaneous position, means for processing said first signal, connected to said detecting means and adapted to generate a second signal, representative of the average relative position of said drill pipe with respect to said floating installation, means for processing said second signal, connected to said means for processing said first signal and adapted to generate a third signal representative of the average speed of displacement of the drill pipe with respect to the floating installation and means for displaying the value of said drilling speed, connected to said means for processing said second signal.

The invention will be readily understood from the following description of a particular, non-limitative embodiment, illustrated by the accompanying drawings wherein:

FIG. 1 illustrates an apparatus suitable for compensating the vertical movements of a floating installation,

FIG. 2 shows curves representing the relative movements of the drill pipe and of the floating installation,

FIG. 3 diagrammatically illustrates a particular embodiment of the device according to the invention, used in combination with the apparatus of FIG. 1.

For the above indicated reasons, the floating drilling installations are provided with apparatuses whereby the drill string can be preserved from the vertical movements due to the action of the swell.

Such apparatuses are described for example in U.S. Pat. No. 3,285,574 and in U.S. Pat. No. 3,788,073 and U.S. Pat. No. 3,778,074.

These apparatuses generally comprise a support member for the drill pipe allowing the displacement thereof as the drilling progresses and means for compensating the vertical movements of the floating installation, connecting the support member to this installation.

The support member may, for example, be constituted by one or more pulleys or blocks from which the drill pipe is suspended and by a "pseudo-stationary" crown block connected to the floating installation.

The means for compensating the vertical movements comprise a jack inclined with respect to the path followed by the support member, this jack being articulated at one end on the floating installation and being articulated at its other end either directly to the support member or to an element including a lever which itself is articulated to the support member on the one hand and to the floating installation on the other hand.

The jack is supplied with a fluid under pressure through an air-oil accumulator or through a pneumatic accumulator.

These compensation means may also be constituted by a device connected to an accumulator which supplied a fluid under a variable pressure, this device providing a determined pressure to a jack supporting the support member of the drill pipe.

All these devices comprise at least one element (jack or lever) which is articulated and subjected to a rotating motion determining the instantaneous position of the support member of the drill pipe.

FIG. 1 illustrates a non-limitative embodiment of such an apparatus for compensating the vertical movements of the floating installation.

In this figure, reference numeral 1 designates the drill pipe suspended from the hook of a travelling block which is connected through a cable 3 to a pseudo-stationary crown block 4.

One end of the cable 3 is connected to the floating installation (not shown), the other end being wound on a handling winch which permits the displacement of the travelling block 2. The axis 5 of the travelling block 4 is moveable along a vertical guideway 6 carried by a derrick 7 which is integral with the floating installation. The travelling block 4 is carried by two arms 8 and 9, each having one end articulated to the axis 5 of the travelling block 4 and the other end displaceable within slots 10 and 11 respectively integral with the derrick 7. Each articulated arm 8 and 9 is subjected to the action of a jack (jacks 12 and 13 respectively) articulated both to the derrick 7 (articulations 14 and 15) and to one of the arms 8 and 9 (articulations 16 and 17). The jacks are supplied with fluid under pressure through at least one air-oil accumulator, such as the accumulators 18 and 19.

The device operates as indicated hereunder. When, under the action of swell, the floating installation moves vertically and upwardly, the tension in the cable 3 connecting the blocks 2 and 4 tends to increase, thereby producing an inward displacement of the piston rods of the jacks 12 and 13 into their respective cylinders which rotate about their respective articulations 14 and 15. The axis 5 of the block 4 is then moved...
downwardly relative to the slot 6 along a distance which corresponds to the vertical displacement of the ship. When the floating installation is displaced downwardly the reverse phenomenon occurs and the axis 5 moves upwardly. As the drilling progresses, and as long as the cable 3 is not handled through the winch, an identical process occurs resulting in a downward displacement of the average position of the axis 5 of the block 4.

In FIG. 2, the curve I in solid line shows as a function of time, the instantaneous position of the axis 5 in the guide slot 6 whose length L is limited by points A and B.

The first derivative of the curve M (in dotted lines) which represents the average position of the axis 5, is representative of the drilling speed, the ondulations of the curve I having a peak-to-peak amplitude P representative of the alternating vertical movements of the axis 5 generated by the vertical movements of the floating installation.

The length L has obviously been so selected that L > P. The curves I and M also represent the instantaneous angle θ and average angle θm of inclination of a jack (such as jack 13) with respect to a horizontal line.

The instantaneous position of the axis 5 in the slot 6 can be determined through detection means either directly associated to the axis 5 or associated to one of the jacks 12 or 13 or alternatively associated to one of the arms 8 and 9, this arrangement being however not limitative.

This circuit comprises comparators 34 and 35 which receive through a conductor 36 the signal representing the instantaneous position of the block 4. At a second input 37, the comparator 34 receives an order signal representative of the lowermost position of the block 4. At a second input 38, the comparator 35 receives an order signal representative of the uppermost position of the block 4.

When the signal representative of the instantaneous position of the block 4 has a value outside the interval defined by the order-values applied to the comparators 34 and 35, the corresponding comparator delivers at its output terminal a safety signal which, through conductors 39, 40 or 41 and 42, can be transmitted to warning lamps 43 and 44 and to an acoustic warning device 45 so as to warn the operator that the block 4 is at its uppermost or lowermost position.

The signals delivered by the comparators 34 and 35 are transmitted through the conductors 46 and 47 respectively for controlling the operation of the winch on which is wound the cable 3, so as to provide for an automatic operation as indicated hereinafter.

Since the slot 6 has a length L greater than the amplitude of the vertical movements of the floating installation, the block 4 is placed in the position C shown by FIG. 2, such that the length of the portion CA of the slot be at least equal to the amplitude P/2 of the vertical movements of the floating installation.

During the drilling operation, the slider of the potentiometer is driven in rotation through the axis 15 of the jack 13 and a first signal is obtained, which represents the instantaneous position of the block 4, the curve representing the variations of this signal having the shape of the curve I of FIG. 2.

This signal is applied to a filter 27 which cut off the sinuosities of the curve and delivers a signal representative of the average position of the block 4, whose variations are shown by a curve having the shape of the curve M (FIG. 2).

This signal is applied to a deriving circuit which delivers a signal representative of the value of the drilling speed, this value being recorded and/or displayed at 33.

The signal representing the instantaneous position is applied to the comparators 34 and 35.

When the value of this signal is equal to the order value displayed at 38, which has been selected for representing the selected uppermost position of the block in the slot 6, the comparator 35 generates a warning signal energizing the warning lamps 44 and/or the acoustic warning device 45. The operator can then actuate the winch so as to unwind the cable 3, thereby causing the rising of the block 4 until the signal representative of the instantaneous position causes the activation of the comparator 34 which, in turn, generates a signal indicating to the operator that the winch must be stopped.

The same operation can be made automatic, the control of the winch being then achieved through the signals issued from the comparators 34 and 35 and transmitted through the conductors 46 and 47.

Changes may be made in the above-described device without departing from the scope of the present invention.

For example, the potentiometer 20 can be controlled by the rotation of the articulated arms 8 or 9. It will also be possible to select another type of detection means such as, for example, a potentiometer whose slider has
5 a rectilinear displacement controlled by the movements of the block 4. The generator 21 may be an oscillator whose frequency is modified through the detection element 21, an analogical circuit being then substituted for the filter 27, this circuit generating a signal which is a function of the frequency of the signal issuing from the generator etc.

What we claim is:

1. A device for measuring drilling speeds of a drill pipe subject to relative movement with respect to a drilling installation, said device comprising:
   first signal means for generating a first signal representative of the position of a drill pipe with respect to the drilling installation;
   second signal means connected to said first signal means for deriving from said first signal a second signal representative of drilling speeds of said drill pipe, said second signal being a first derivative of said first signal; and
   display means connected to said second signal means for displaying said second signal such that said drilling speeds are obtained.

2. A device according to claim 1, wherein said first signal represents a relative position between said drill pipe and said drilling installation.

3. A device for measuring drilling speeds of a drill pipe subject to relative movement with respect to a drilling installation, said device comprising:
   first signal means for generating a first signal representative of the position of a drill pipe with respect to a drilling installation;
   second signal means for deriving from said first signal a second signal representative of drilling speeds of said drill pipe; and
   display means for displaying said second signal such that said drilling speeds are obtained.

4. A device according to claim 3, wherein said first signal means includes correcting means for eliminating the effects of oscillatory movements of said drill pipe with respect to said drilling installation, said oscillatory movements being superimposed upon direct movement between said drill pipe and said drilling installation.

5. A device according to claim 4, wherein said second signal means includes deriving means for generating a first derivative of said output signal to obtain an output signal representative of a relative position of said drill pipe with respect to said drilling installment.

6. A device according to claim 5, further comprising safety means for indicating predetermined limits of said oscillatory movements, said predetermined limits defining a given interval of oscillatory movements.

7. A device according to claim 6, wherein said safety means comprise at least first and second comparator means, each of said comparator means being supplied with respective signals representative of said predetermined limits, said comparator means comparing said respective signals with said intermediate signal, and indicating means for indicating a value of said intermediate signal, said value representing a position of said drill pipe with respect to said drilling installation outside of said predetermined limits.

8. A device for measuring drilling speeds of drill pipe from a floating drilling installation of the type including an apparatus for preventing drill pipe from vertical movements, said apparatus including a support member for supporting drill pipe, control means for controlling displacement of said drill pipe relative to said floating installation, and compensating means for compensating vertical movements of the drill pipe with respect to the floating installation, said device comprising:
   detecting means for detecting an instantaneous relative position of drill pipe with respect to a floating installation, said detecting means generating a first signal representative of said instantaneous position, first processing means for processing said first signal, said first processing means being connected to said detecting means and generating a second signal representative of a relative position of said drill pipe with respect to said floating installation, said relative position being a function of said instantaneous position,
   second processing means for processing said second signal, said second processing means being connected to said first processing means and generating a third signal representative of a relative speed of advancement of said drill pipe with respect to said floating installation, and
   display means for displaying values of drilling speed, said display means being connected to said second processing means.

9. A device according to claim 8, wherein said second processing means are constituted by a derivating circuit, said derivating circuit generating a signal representative of the first derivative of a signal applied thereto.

10. A device according to claim 8, wherein said compensating means comprise at least one element subjected to an oscillatory motion having a rotary component, wherein said detecting means are constituted by a revolving potentiometer supplied by an electric generator, said revolving potentiometer having a slider in rotation with said at least one element, and said revolving potentiometer delivering a first oscillatory electric signal representative of an instantaneous position of said at least one element, and wherein said first processing means is constituted by an electric circuit for filtering the variations of said first oscillatory electric signal, said filtering circuit delivering a second electric signal representative of a relative position of said at least one element, and said second processing means are constituted by a derivating electric circuit.

11. A device according to claim 8, wherein first safety means are connected to said control means for delivering to said control means a first safety signal exclusively when a support member for supporting said drill pipe reaches an upper limit position, said first safety means being directly connected to said detecting means and receiving therefrom said first signal representative of said instantaneous position, and wherein second safety means are connected to said control means for delivering to said control means a second safety signal exclusively when said support member reaches a lower limit position, said second safety means being directly connected to said detecting means and receiving therefrom said first signal representative of said instantaneous position, said second safety means being actuated at the reception of said first safety signal and interrupting its operation at the reception of said second safety signal.