

[54] **METHOD AND APPARATUSES FOR TRANSMISSION OF DATA FROM THE BOTTOM OF A DRILL STRING DURING DRILLING OF A WELL**

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[22] Filed: **Aug. 11, 1972**

[21] Appl. No.: **279,899**

[52] U.S. Cl. **73/151**

[51] Int. Cl. **E21b 47/12**

[58] Field of Search 73/151, 152, 136 R; 175/40, 175/50, 230, 269

[56]

References Cited

UNITED STATES PATENTS

3,123,162	3/1964	Rowley	175/269 X
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Primary Examiner—**Jerry W. Myracle**

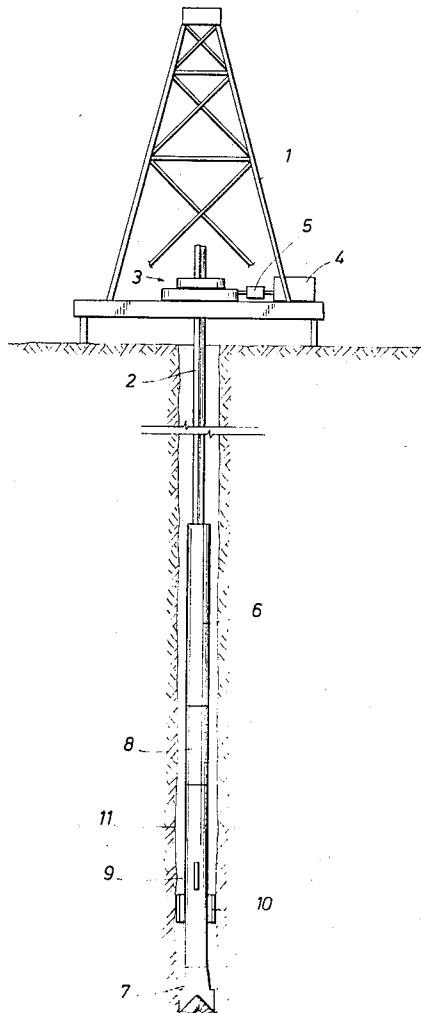
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[57]

ABSTRACT

Disclosed are a data transmission method and several devices for carrying out the method for transmitting logging or other measurements made downhole during a drilling operation to the surface of the earth, either in real time without interruption of the drilling operation, or during brief interruptions of the drilling operation but without the necessity of removing the drill string from the borehole. The system employs means for momentarily engaging the borehole while rotating the drill string, and recording the torque being applied to the rotating drill string by means of a surface positioned dynamic torque meter. Measurements made downhole are converted to pulse time electrical signals, and these electrical pulses are employed to activate the borehole engaging means so that torque pulses are generated which travel up the drill string and are sensed on the surface by the torque meter. By measuring the time between torque pulses as recorded by the surface torque meter the intelligence becomes readily available on the surface without the necessity of pulling the drill string.

21 Claims, 8 Drawing Figures



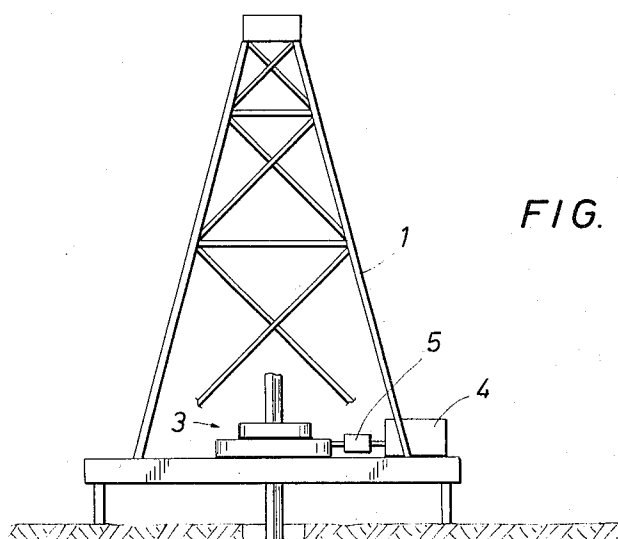


FIG. 1

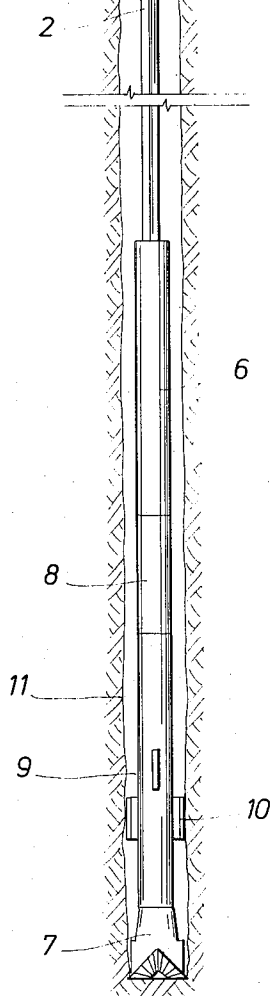


FIG. 2

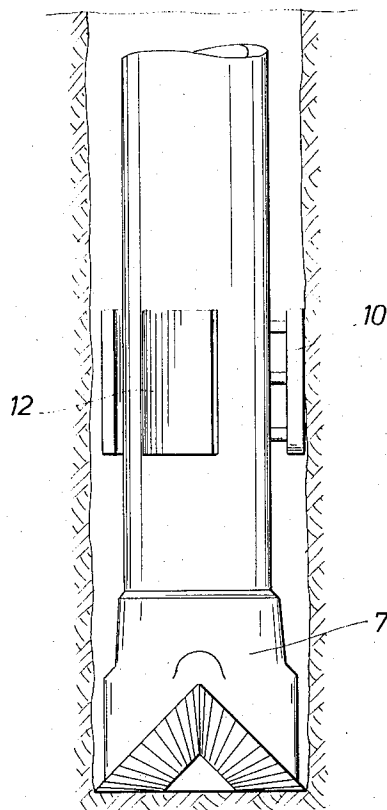


FIG. 3

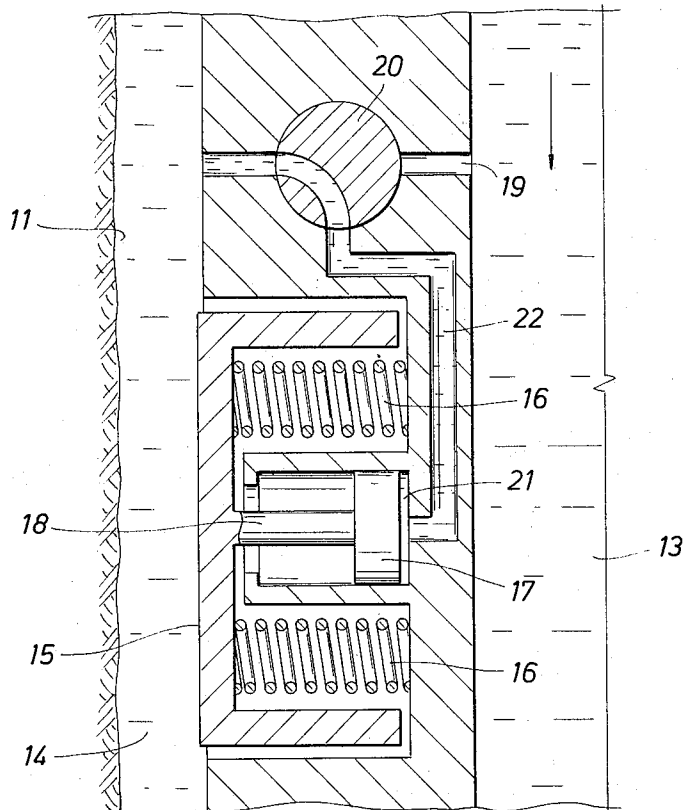


FIG. 4

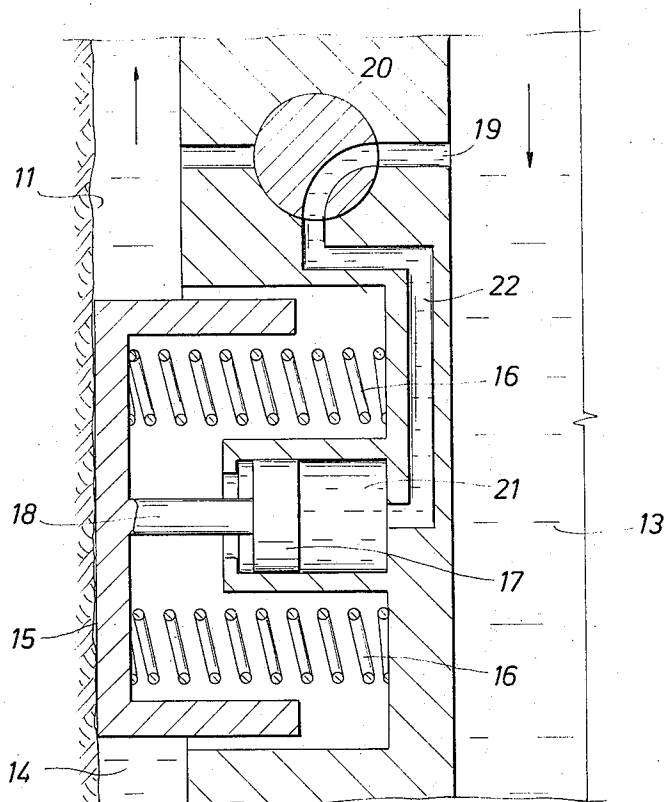


FIG. 5

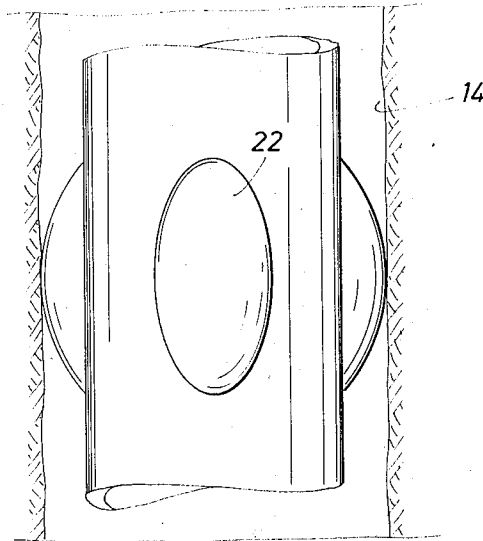


FIG. 6

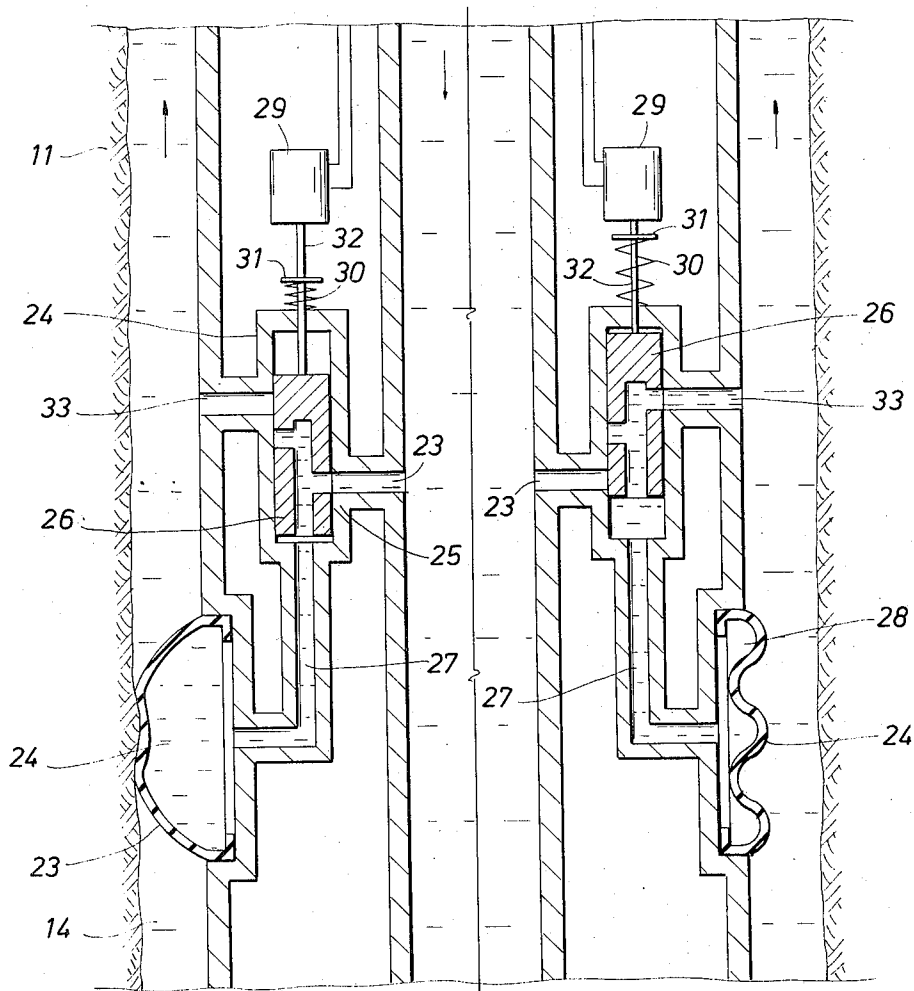


FIG. 7

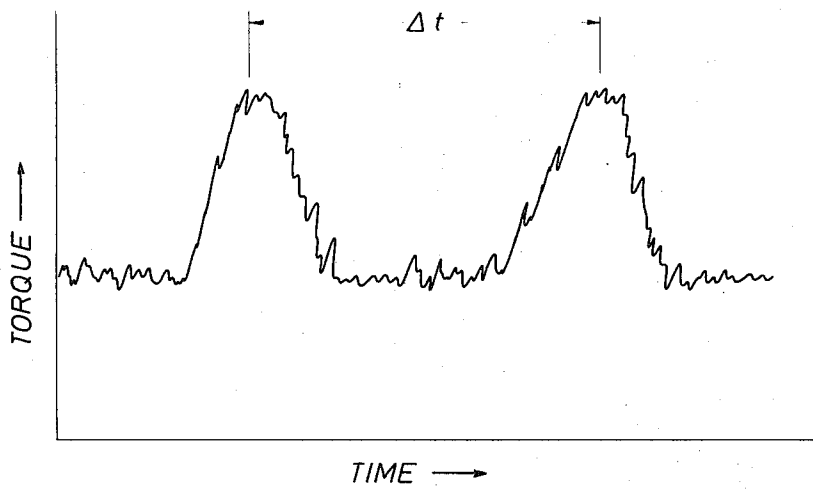
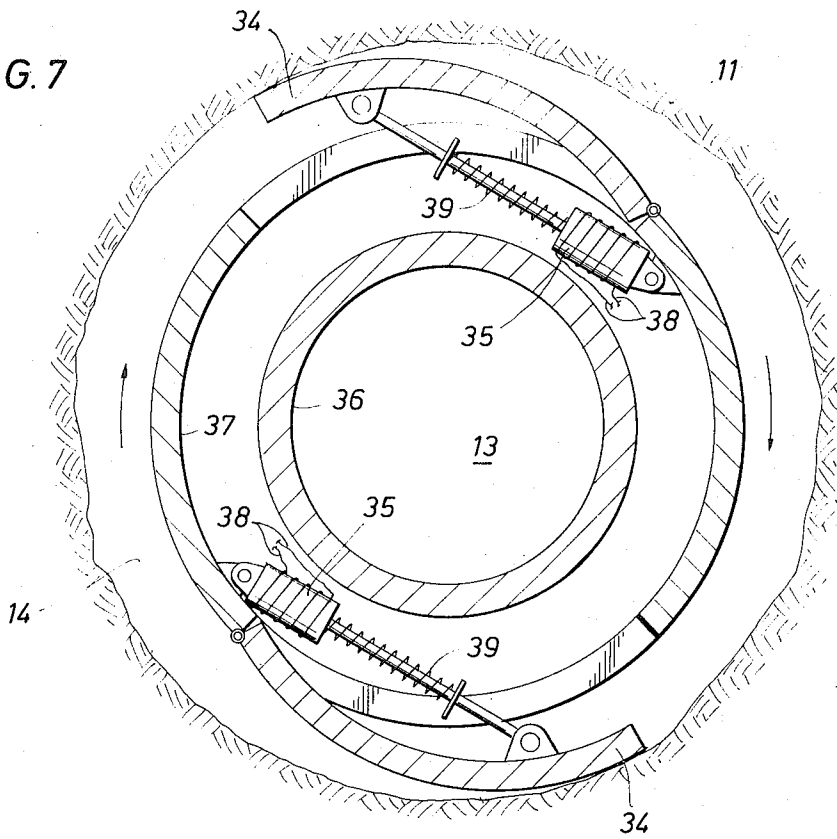


FIG. 8

METHOD AND APPARATUSES FOR TRANSMISSION OF DATA FROM THE BOTTOM OF A DRILL STRING DURING DRILLING OF A WELL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a drilling system, and more particularly to a system for making downhole measurements in the vicinity immediately adjacent to the drill bit, and for transmitting the measurements to the surface without the necessity of removing the drill string from the borehole. This operation may be accomplished during the drilling operation without any interruption thereof, or the drilling operation may be briefly interrupted periodically for the purpose of transmitting data to the surface, but in any event the drill string need not be removed from the borehole.

2. Prior Art

During the drilling of wells, such as wells drilled for the purpose of recovering petroleum from subsurface petroleum containing formations, there are numerous measurements which are of interest to the persons directing the drilling operation for the purpose of determining how well the operation is proceeding and also for the purpose of determining the lithology being encountered as the borehole progresses deeper and deeper into the earth. It is common practice today in the drilling of oil and gas wells to interrupt the drilling operation periodically and pull the entire drill string from the borehole, to permit the running of logging tools into the borehole to determine the types of formations which have been penetrated by the well, and to determine the characteristics of such formation layers indicative of the presence of petroleum deposits. As the well gets deeper and deeper, the time required for the removal and rerunning of this drill string, known in the industry as a trip, becomes greater and greater. In some deep wells as much as 24 hours can be required for a trip, and numerous additional hours are required for the running of a logging tool into the formation. The time required to perform the logging operation also increases with depth of the well, and in deep wells it is common practice to log only preselected zones of the wellbore.

It has long been realized that it would be highly desirable to perform certain basic logging operations during the course of the drilling operation, and to transmit such information back to the surface either periodically or in real time. This would permit a complete record of the subsurface lithology to be accumulated as the drilling proceeds, and would not necessitate the delay of drilling operations for the running of logs. Also, it is known that some interaction occurs between the drilling fluid and the formation, so a more accurate log could be obtained if it is run shortly after the formation has been penetrated. Equipment for making the subsurface measurements has been within the available state of the art and current technology for several years, but a satisfactory data transmission system has not yet been developed.

Some of the earlier data transmission systems involved attempts to develop a plurality of mutually insulated electrical conductors permanently positioned within the drill pipe, with provisions for establishing electrical connections between the various connectors

as the drill string is made up by screwing the large number of joints of drill pipe together. Since the drill pipe is generally high grade steel and hence a relatively good electrical conductor, and most wells are drilled employing a water base drilling fluid which is also a relatively good conductor, the problem of maintaining electrical continuity and insulation proved to be virtually insurmountable, and no operational system has ever been made available for this reason.

Another approach to the transmission of data from subsurface logging or measuring instrumentation units has been proposed utilizing the drilling fluid which is almost universally used during the drilling operation. By providing means for temporarily interrupting or restricting the flow of drilling fluid through the subsurface conductor, pressure pulses could be generated and recorded on the surface by sensitive pressure measuring devices in fluid communication with the drilling fluid stream. These systems, while quite ingenious, have never been completely satisfactory because of the problems associated with abrasion of the fluid flow restriction means by the drilling fluid itself, and because of the potential hazards of plugging of these valves with formation solids or other solids normally present in the drilling fluid.

The desire to make and obtain the information from measurements downhole during the drilling operations has been so great that recording systems have been proposed and designed to permit the recording of information on magnetic tape for subsequent retrieval of the information during the next regularly schedule trip, such as when the drill string is removed to permit replacement of the drill bit with a new bit. While the information is not transmitted to the surface in real time or indeed until the drill pipe is removed from the borehole, it does permit the recording of measurements during the drilling operation itself, which is highly desirable for a number of reasons. Logging information, for example, may be obtained in very freshly drilled formations, so that its characteristics may be determined before any changes may be brought about by contact with the drilling fluid, which in many instances are highly chemicalized and so are prone to distort the subsequently made logging measurements. Additionally, numerous measurements made during the drilling operation such as fluid pressures, vibrational studies, hole deviation, etc., cannot be made except when the drilling operation is in progress. Finally, although the use of a downhole recorder does not eliminate the waiting time to obtain the information, it does eliminate the lost time while making a conventional logging operation. An example of a suitable downhole tape recorder system is found, for example, in U. S. Pat. No. 3,566,597.

SUMMARY OF THE INVENTION

A method is disclosed for transmitting data from a subsurface logging or measuring unit to the surface of the earth during the drilling of a well in the earth without the necessity of removing the drill string from the well. Various types of measurements may be made, such as conventional logging measurements including SP or Self Potential, Resistivity, etc., or measurements such as hole direction or deviation, fluid pressure, temperature, or any other parameter desired to be measured during the drilling operation. The intelligence obtained by the measuring systems is encoded into a pulse

time modulation format by conventional electronic means, and the electrical signal is used to activate a downhole device to increase momentarily the torque required to turn the drill string to produce torque pulses measurable on the surface by a wide range high sensitivity dynamic torque meter. U. S. Pat. Nos. 3,295,367 and 3,599,482 describe such surface torque measuring devices which are quite suitable for use in recording the transmitted torque pulses in the implementation of the subject invention.

The torque pulses for the practice of this invention may be generated by activating devices in the drill string, generally located relatively near the bottom of the string and immediately above the drill bit itself, such devices being transversely extendable outward from the drill string a sufficient distance to engage the formation wellbore. When these protrusions are extended transversely to contact the wellbore, the torque required to rotate the drill string is increased, and the increase is measurable on the surface by means of the torque meter mentioned previously. The increase in torque continues for so long a time as the wellbore engaging protruding devices are maintained in this transversely extended condition, and stops abruptly as the devices are retracted back into the drill string. In transmitting data from the subsurface unit, a series of pulses will be utilized, and the intelligence corresponding to the measurements made in the subsurface measuring units is contained in the time between the torque pulses. Although a relatively sharp torque pulse measurement on the surface is most desirable, it is necessary to maintain the wellbore engaging apparatus in the engaging configuration for a number of seconds, depending on the depth of the transmitting tool, in order to have an observable spike on the surface because of the mechanical damping characteristics of the drill string.

The wellbore engaging apparatus may be activated by electrical, pneumatic, or hydraulic means. One especially attractive method of activating the wellbore engaging apparatus is to utilize the drilling fluid as a hydraulic fluid, since a considerable pressure differential ordinarily exists between the drilling fluid in the inner flow passages of the drill string and that in the annular return path between the drill string and the formation. This reduces the complexity of the downhole equipment since the power fluid is already available, and only sufficient power to activate the valve mechanism necessary to direct this drilling fluid is needed.

The wellbore engaging device may be one or a plurality of metallic elements which can be forced outward from the drill string to press against the formation, or a flexible material may be formed into a series of inflatable expandable units which can be distended from the drill string a sufficient distance to contact and rub against the wellbore.

The present invention, including its function and objects, will be better understood from the foregoing description and the description to follow when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the entire drilling system including the data transmission apparatus useful in the practice of this invention.

FIG. 2 illustrates in greater detail one type of wellbore engaging means of the data transmission system

located in close proximity to the drill bit useful in the practice of this invention.

FIG. 3 shows a half-section of one version of the wellbore engaging means in a non-extended condition such as is experienced during the drilling operation.

FIG. 4 illustrates a half-section view of the same wellbore engaging means as FIG. 3 but in a distended condition such as is employed for engaging the wellbore to transmit torque pulses.

FIG. 5 illustrates another embodiment for the practice of this invention wherein the wellbore engaging device comprises an inflatable flexible device for contacting the wellbore.

FIG. 6 illustrates a cross-sectional view of the wellbore engaging device of FIG. 5 showing both the drilling and engaging positions.

FIG. 7 illustrates a cross-sectional view of still another wellbore engaging means useful in the practice of this invention employing a hinged element activated by an electrical solenoid which can be caused to swing outward and contact the wellbore.

FIG. 8 illustrates the signal received at the surface torque meter during the data transmission phase.

DESCRIPTION OF THE PREFERRED METHOD

In the practice of my invention, the logging instrument or other measuring device performs the desired measurement and the data are converted into electrical analog signals with the measurements represented by the elapsed time between peaks of the signal. This is a common form of modulation, referred to as pulse time modulation, frequently employed in transmitting scientific data. Power for operation of the measurement devices and electronics is supplied by conventional batteries (not shown). If desired, the measurement and data transmission operation may continue more or less continually during the drilling operation, with the periodic torque pulses being generated to indicate the desired parameters being monitored. In some instances it is desirable to interrupt the normal drilling operation and activate the subsurface equipment to have it make measurements and transmit the measurements back to the surface by the torque pulses. One very satisfactory method of accomplishing this is to include a centrifugal switch in the measurement and electronics assembly, which senses the cessation of rotation of the drill string. When a measurement is desired, the pumps are stopped and the drill bit rotation is stopped. The centrifugal switch will close when the drill string rotation is stopped, and the measurement devices are activated thereby. Thereafter the measurement is encoded into pulsed analog electrical signals which are used to activate the wellbore engaging apparatus as is described hereinabove. Rotation of the drill string must be resumed for transmission of the signal back to the surface, but during this operation it may be desirable to lift the entire drill string several feet so that the drill bit does not contact the bottom of the well. This will reduce the magnitude of the torque being transmitted and will also eliminate some of the variations and noise normally received in monitoring the torque being supplied to the drill string. In the instance of those wellbore engaging apparatuses employing the pressure differential between the drilling fluid in the inner flow passage 13 and the annular space 14, the drilling fluid pumps must be operating during the data transmission cycle.

Still another method of activating the measurement and data transmission systems, where it is not desired to transmit data continually during the drilling cycle, involves the use of conventional strain gauges applied to a section of the drill collar to sense the amount of weight being applied to the bit, which are activated when the drill string is raised a sufficient distance so that the bit no longer contacts the bottom of the wellbore. Either type of switch or both may be used to activate the measurement and data transmission functions.

DESCRIPTION OF THE PREFERRED DEVICES

Turning now to FIG. 1, there is illustrated a drilling system for carrying out the above method including a drilling rig 1 and the drill pipe 2 rotated by the rotary table 3 which is itself rotated by means of engine 4. A wide range dynamic sensitive torque meter 5 is provided for measuring and recording the torque being applied to the system for rotating the drill pipe 2. The drill string includes the drill pipe 2 and drill collars 6 which are generally located above the drill bit 7 and the drill pipe, and serve to increase the total amount of mass near the bottom of the hole so that the drill pipe 2 is maintained in a condition of tension, which tends to cause the drilling of a straighter hole. The measurement and instrumentation sections are contained in a module 8 which comprises a special sub approximately the same size as a conventional drill collar but which has the logging and/or measurement and electronics equipment located inside. Measurements are made through special transducer openings contained in the outer shell of module 8. The torque pulse generating module 9 includes wellbore engaging means 10 which can be caused to move outward from the outer shell of sufficient distance to engage and press against the formation 11. As the drill string is rotated the contact between wellbore engaging means 10 and formation 11 increases the torque required to turn the drill string, and this increased torque is measured by torque meter 5.

FIG. 2 illustrates in greater detail the wellbore engaging means 10 positioned immediately above the drill bit 7. One wellbore engaging means 10 is shown in its extended configuration, contacting the wellbore and thereby increasing the torque required to rotate the drill string and drill bit, whereas the wellbore engaging means 12 is shown in the retracted configuration as would normally be the case during the drilling operations. While retracted, the wellbore engaging means offer little or no additional resistance to the rotation of the drill pipe, and do not interfere with the normal drilling operation. Ordinarily all of the wellbore engaging means would be in the same configuration, that is, they would all either be all extended or all retracted at any particular moment. The different configurations are shown in FIG. 2 merely for the purpose of illustrating the two configurations in which they may function.

FIG. 3 illustrates a half-sectional view of the mechanism for engaging the wellbore. It should be noted that an interior fluid passage 13 is provided so that drilling fluid may be pumped down the center of the assembly in a relatively unrestricted fashion so that it may be made available to the drilling bit to perform its normal functions in the drilling operation. Additionally, the entire assembly has a diameter approximately the same as a conventional drill collar so that an annular space 14

is maintained between the assembly and the wellbore for the passage of drilling fluid and formation cuttings in a generally upward direction to the surface.

The wellbore engaging means of this particular embodiment illustrated in FIG. 3 employs an outer shell 15 for contacting the wellbore which is normally held in a retracted position so as to offer little resistance to the rotation of the drill string by tension springs 16. A hydraulic piston 17 is provided and connected with outer assembly 15 by rod 18, so that movement of piston 17 causes the contacting assembly to move outward generally in the direction of the adjacent wellbore. Fluid passage 19 is provided between the inner flow space 13 and a valve mechanism 20 which permits establishing fluid communication between passage 19 and the cylinder space 21 via hydraulic passage 22. Rotary valve 20 may be rotated so that drilling fluid from the inner flow space 13 passes through valve body 20 and passage 22 to fill the hydraulic cylinder 21, forcing hydraulic piston 17 to move outward, overcoming the tension of springs 16 thereby forcing the wellbore contacting assembly 15 into direct contact with wellbore 11. The pressure in inner flow space 13 is generally in the range of 1,500 pounds above the hydrostatic pressure attributable to the column of drilling fluid inside inner flow space 13, hydrostatic pressure being a function of the specific gravity of the drilling fluid and the length of the column of fluid in inner flow space 13. Since a significant pressure drop occurs across the jets in drill bit 7, the pressure differential between the drilling fluid of inner flow space 13 and annular space 14 is usually in the range of from about 500 to about 600 pounds per square inch. This pressure differential is quite sufficient to provide a sizeable force for moving wellbore contacting assembly 15 outward, providing contact with the formation 11. Rotary valve 20 may be rotated by a small electric motor (not shown) or a relay ratchet arrangement, or by any other means, and it functions in response to the electrical signal received from the logging or instrumentation module located immediately above. When the wellbore engaging means has been maintained in the engaged position for a sufficient length of time to permit the torque pulse to be received on the surface, rotary valve 20 is rotated to the exhaust position as is shown in FIG. 3, wherein the drilling fluid is allowed to flow from cylinder space 21 to the lower pressure present in annular space 14. The fluid pressure in cylinder space 21 is no longer sufficient to overcome the force of tension springs 16; therefore, the wellbore contacting assembly 15 moves back into the cavity provided therefor, and the torque required to rotate the drill string is reduced.

FIG. 4 illustrates the same apparatus as FIG. 3 except the position of wellbore contacting element 15 is shown in its extended configuration in contact with wellbore 11. Note that valve 20 is rotated 90 degrees counterclockwise to establish fluid communication between the inner flow passage 13 and hydraulic cylinder space 21, causing the hydraulic piston 17 to be forced outward. Springs 16 have been extended because the force generated by hydraulic piston 17 is greater than the restoring force of springs 16. Only a very small amount of energy is required to rotate valve 20, which can be supplied by conventional batteries (not shown) contained in the measuring and electronic module 8.

Another embodiment of the wellbore engaging means as shown in FIG. 5, is comprised of a plurality

of assemblies constructed from a flexible material, capable of being inflated and distended a sufficient distance to contact the wellbore. These flexible wellbore contacting devices 22 may be formed in any desired geometrical arrangement, and any desired number of such devices may be used. It is preferable to have more than a single device and it is desirable to have such devices located somewhat evenly around the periphery of the assembly so that the retarding or braking action will be uniformly distributed around the lower section of the drill string. A single continuous device which extends completely around the periphery of the assembly should not be used since this would obstruct the return passage of drilling fluid in annular space 14.

The flexible inflatable wellbore contacting devices of FIG. 5 are shown in cross-sectional view in FIG. 6. Flexible inflatable wellbore contacting device 22 of FIG. 5 is shown in the extended position 23 of FIG. 6 wherein it is in contact with wellbore 11, and in numeral 24, the device is shown in its collapsed position as is normally used during the drilling operation when it is not desired to increase the amount of torque required to rotate the drill string. Ordinarily these devices would not be in mixed configuration; that is, they would either be all extended or all collapsed, but they are shown in the different configurations in FIG. 6 to illustrate the two possible configurations. As in previous assemblies, an inner flow passage 13 is provided for the downward flow of drilling fluid to the drill bit, and a passage 23 is provided for fluid communication between inner flow passage 13 and a two-position slideable hydraulic valve 24. Illustration 25 shows interior valve body 26 in position for inflating the flexible expandable wellbore contacting device 26. When in this position, drilling fluid from inner flow passage 13 passes through passage 23, through valve body 26 and then through flow channel 27 into the interior 28 of the expandable wellbore contacting device 23. Since the pressure in the drilling fluid in space 28 is considerably greater than the pressure of the drilling fluid in annular space 14, the inflatable device inflates and distends from the assembly until it contacts and pushes against the wellbore 11. The urging of this device against the wellbore increases the torque required to rotate the drill string, and this increased torque is maintained so long as the sliding valve assembly is maintained in this position. The slideable valve is actuated by any convenient means, in this instance a solenoid 29 is utilized to actuate the valve into the inflated position. Compression spring 30 maintains the valve in the upper position when the solenoid is not actuated, as is illustrated by the right hand portion of the cross-sectional view in FIG. 6. With the solenoid 29 deactivated, compression spring 30 urging against the element 31 which is attached to rod 32, biases valve body 26 in an upward position, permitting drilling fluid to pass from the interior chamber 28 through passage 27 and out through passage 33 into the annular space 14. This causes the inflatable wellbore contacting device 22 to withdraw to the condition illustrated by numeral 24.

In FIG. 7 there is illustrated in cross-sectional view still another embodiment of the wellbore contacting apparatus useful for generating torque pulse signals for the practice of this invention. In this embodiment, one or several sections of the outer casing of the assembly is formed into a flap or door 34 which is hinged on one side so that it may be rotated outward to press against

the formation 11. Movement of formation contacting flap 34 is supplied by solenoid 35 attached to the inner conductor 36 as well as the outer shell 37, and is activated by passage of a current through wires 38. The flap may of course be energized by a hydraulic cylinder as well, although in this instance it is shown utilizing an electrical solenoid device. The assembly must still be provided with an inner flow passage 13 for the passage of drilling fluid in a downward direction from the surface to the drill bit, and the overall dimensions must be approximately the same as the drill collars so as to maintain annular space 14 through which drilling fluid and formation cuttings pass to the surface. Solenoid 35 is attached to outer shell 37, so actuation thereof causes wellbore contacting device 34 to swing outward until it rubs against formation 11. Tension spring 39 maintains wellbore contacting flap 34 in a closed position when solenoid 35 is not energized, for normal drilling operation.

FIG. 8 illustrates an example of the surface measured torque recorded as a function of time, illustrating two torque pulses resulting from two separate downhole cycles of one of the wellbore engaging wall devices described herein. The time t between these two pulses corresponds to the value of the subsurface measurement.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modification may be made without departing from this invention in its broader aspects; and, therefore the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A method for transmitting data from the bottom of a drill string in a wellbore being drilled in the earth comprising:

- a. generating data by making desired measurements near the bottom of the wellbore;
- b. generating torque pulses in the drill string near the lower end thereof, said torque pulses being responsive to said data;
- c. monitoring at the surface of the earth the torque pulses transmitted up the drill string.

2. A method as recited in claim 1 wherein the second step comprises:

- a. engaging and disengaging the wellbore wall near the lower end of the rotating drill string to increase the torque required to rotate the drill string for generating the torque pulses in the drill string.

3. A method as recited in claim 1 wherein the second step comprises:

- a. engaging and disengaging the wellbore wall near the lower end of the drill string, and
- b. controlling the engaging and disengaging of the wellbore wall by the lower end of the drill string for generating the torque pulses in the drill string.

4. A method as recited in claim 3 wherein the second step comprises:

- a. time modulating the engaging and disengaging of the wellbore wall at a time rate corresponding to the data being transmitted.

5. A method as recited in claim 1 wherein the third step comprises:

- a. monitoring the time modulation of the torque pulses in the drill string at the surface.

6. A method as recited in claim 1 further comprising the initial step of:

- a. raising the drill bit above the bottom of the wellbore to initiate the data transmission function.

7. A method for transmitting data from the bottom of a drill string during the drilling thereof in the earth to the surface of the earth comprising the steps of

- a. measuring preselected parameters to generate data near the bottom of the drill string;
- b. momentarily increasing the resistance to rotation of the drill string in the wellbore, said step of increasing the resistance being responsive to said data;
- c. monitoring on the surface of the earth the torque required to rotate the drill string.

8. A method as recited in claim 7 wherein the second step comprises:

- a. engaging the wellbore wall at the lower end of the drill string to increase the resistance to rotation of the drill string in the wellbore.

9. A method as recited in claim 7 wherein the second step comprises:

- a. controlling the time intervals between the momentary increases in resistance to rotation of the drill string to correspond to the data being transmitted to the surface.

10. A system for transmitting data from the lower end of a drill string in a wellbore to the surface of the earth comprising

- a. a drill string;
- b. means located on the lower end of said drill string for making preselected measurements to generate data;
- c. drill string torque generating means controllable from the lower end of the drill string for generating torque pulses in said drill string said torque pulses being responsive to said data; and
- d. monitoring means on the surface of the earth for monitoring said drill string torque pulses.

11. A system as recited in claim 10 wherein the drill string torque pulse generating means comprises:

- a. controllable means for increasing and decreasing the resistance to rotation of the drill string in the wellbore,
- b. control means for controlling said controllable means for increasing and decreasing the resistance to rotation of the drill string in the wellbore, and
- c. said controllable means for increasing resistance to rotation of the drill bit being responsive to said control means for controlled increasing and decreasing of the resistance to rotation of the drill string in the wellbore.

12. A system as recited in claim 11 wherein said controllable means for increasing and decreasing the resistance to rotation of the drill string comprises:

- a. an element mounted in a cavity in a lower section of the drill string and extendable transversely to the wellbore wall,
- b. means for transversely extending said element to the wellbore wall, and
- c. means for retracting said element into the lower section of the drill string.

13. A system as recited in claim 12 wherein said transversely extendable element comprises:

- a. a piston, the outer surface of said piston conforming generally to the outer surface of said lower section of said drill string, and being transversely ex-

tendable a sufficient distance to contact the wellbore wall.

14. A system as recited in claim 12 wherein said transversely extendable element comprises:

- a. a flexible inflatable enclosure positioned on the outer surface of said lower section of the drill string, covering the cavity in the lower section of the drill string, and being of sufficient size that it contacts and rubs against the wellbore wall when inflated, and
- b. means for filling the flexible inflatable enclosure with a fluid to inflate said enclosure when it is desired to increase the resistance to rotation of the drill string.

15. A system as recited in claim 12 wherein the transversely extendable element comprises:

- a. a flap element pivotally connected to one side of the cavity in the lower section of the drill string, and being of sufficient width to contact the wellbore wall when extended outward from the drill string.

16. A system as recited in claim 12 wherein the means for transversely extending the transversely extendable element comprises:

- a. a controllable hydraulic piston positioned in the cavity in the lower section of the drill string, and being extendable a sufficient distance to force the transversely extendable element into contact with the wellbore wall, said piston being connected on its outer side to the transversely extendable element.

17. A system as recited in claim 16 wherein the hydraulic piston is actuated by drilling fluid.

18. A system as described in claim 12 wherein the means for transversely extending the transversely extendable element comprises:

- a. an electrically actuated solenoid positioned within the lower section of the drill string and attached thereto, said solenoid having a reciprocating plunger, the outer end of said plunger being attached to the transversely extendable element.

19. A system as recited in claim 12 wherein the means for retracting the transversely extendable element comprises:

- a. a tension spring attached on one end to the means for extending the transversely extendable element and on the other end to the transversely extendable element.

20. A data transmission system for transmitting data from a subsurface measuring device located in the lower part of a drill string in a wellbore being drilled in the earth and for sensing said data at the surface of the earth comprising:

- a. a drill string for extending into the wellbore,
- b. a drill bit attached to the end of the drill string,
- c. surface located means for rotating the drill string,
- d. measuring means located above the drill bit for measuring a preselected subsurface parameter,
- e. electrical signal producing means positioned in the lower part of the drill string, said electrical signal producing means being responsive to the data being measured, said electrical signal producing means producing an electrical signal having a plurality of time modulated pulses, with the time between pulses being proportional to the data being transmitted,

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f. means responsive to the electrical signal producing means for momentarily increasing the torque required at the surface to rotate the drill string, said means being positioned in the lower section of the drill string, and

g. means located at the surface of the earth for monitoring the momentary increases in the amount of torque required at the surface for rotating the drill

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string.

21. A system as recited in claim 20 wherein the means for momentarily increasing the torque required to rotate the drill string comprises:

a. wellbore wall contacting means attached to the lower section of the drill string.

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