Dec. 21, 1943. R. G. PIETY 2,337,269

MARKING DEVICE

Filed Aug. 14, 1941

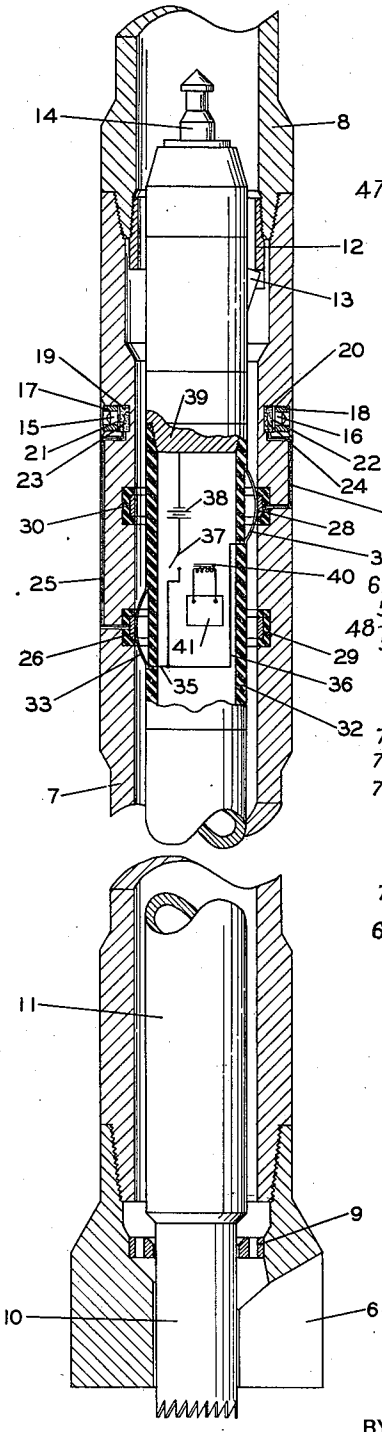

FIG. 1

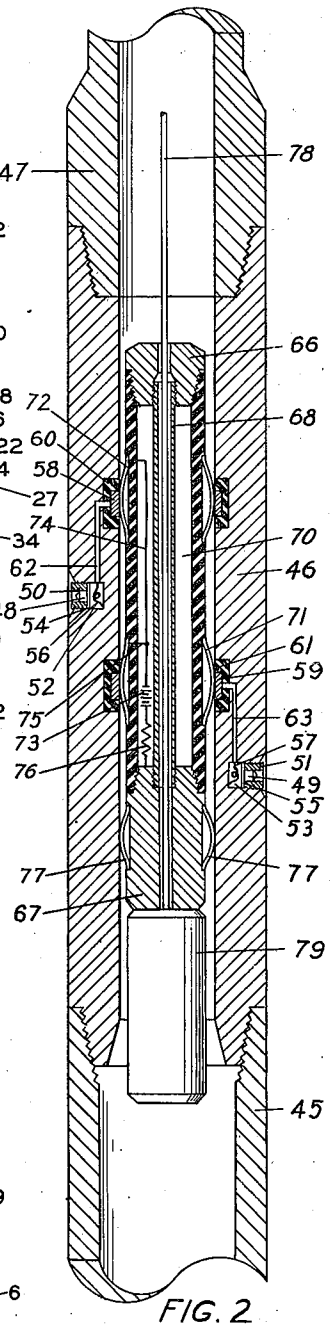

FIG. 2

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MARKING DEVICE

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7 Claims. (Cl. 255—1.8)

This invention relates to apparatus for placing markers in subsurface strata during the drilling of a bore hole.

The desirability of designating certain formations penetrated by a well bore or establishing reference points along the well bore is becoming increasingly evident as the depth of drilling increases. Demands for precision in selective completion of wells have stimulated development of means for locating the precise section of the well bore from which production is desired. The successful completion of a well by perforation of a casing, for example, often depends upon the ability of the operators to locate the perforating instrument exactly opposite the desired formation after the well has been cased. The applicant's copending application, Serial No. 329,810, filed April 15, 1940, discloses a method of and apparatus for placing markers in and along the wall of a bore hole. The markers of the copending application are such that they may be readily located as desired by use of the proper detective instrument. A specific embodiment of the markers takes the form of bullets or projectiles containing radioactive material. The bullets are placed in the wall of the well bore by means of a perforating gun. Such markers may be used as reference points for distance measurements or for designating formation boundaries and may be located after the well is cased.

The present invention provides apparatus for placing markers along the bore hole during the drilling thereof. Projectiles containing radioactive material or other detectable substances are placed in the wall of the bore hole during the drilling operations. The projectiles are fixed from apparatus associated with the drilling equipment which eliminates the necessity of suspending drilling operations or removing the drill bit from the hole as required by previous devices. An advantage of the invention is that the marker may be definitely established relative to the position of the drill bit at the time of marking which may be at the operator's convenience. For example, regions in which cores are taken or the points at which changes in the formations pierced by the drill are evidenced may be marked. Depth measurements from the top of the hole are not required in placing the markers or subsequently locating markers to aid in completion of the well.

An object of this invention is to provide apparatus for placing markers along the wall of a bore hole.

Another object of this invention is to provide such apparatus for incorporation with the drill assembly.

Still another object of this invention is to provide a marking device by which markers may be selectively placed in the wall of the bore hole.

A further object of this invention is to provide apparatus for placing markers along a bore hole during the drilling thereof, which markers may be located after the bore hole is cased.

Figure 1 of the drawing is a cross-sectional view, partly in elevation, of one embodiment of the present invention.

Figure 2 of the drawing is a cross-sectional view of a modification of this invention.

With reference to Figure 1 of the drawing, the numeral 6 designates a drill bit of a conventional type for use with a wire line core barrel. The drill bit 6 is attached to a drill collar 7 which, in turn, is attached to the drill pipe 8. Shown in operative position in the drill bit are the slush ring 9 and the core cutter 10 of conventional design. The core barrel 11 serves as a receptacle for cores cut by the core cutter 10. The core barrel and the core cutter are held in position and driven by the driving ring 12 and the driving dog 13. The pull bar 14 serves to release the driving dog 13 to allow removal of the core barrel from the drill collar. In accordance with the present invention, projectiles 15 and 16 containing radioactive material are contained in the barrels 17 and 18. The barrels 17 and 18 are screw threaded into the drill collar 9. The projectiles are propelled by explosive charges in the chambers 19 and 20 in the drill collar. Seals 21 and 22 prevent ingress of well fluid to the chambers prior to placing of the markers. The charges of propellant are ignited by electric heating elements 23 and 24 in the respective chambers 19 and 20. The heating element 23 is connected by an insulated electrical conductor 25 to a contact ring 26 in the interior of the drill collar. Similarly, the heating element 24 is connected by the insulated conductor 27 to the contact ring 28. Contact rings 26 and 28 are insulated from the drill stem by the bands of electrical insulation 29 and 30, respectively.

Incorporated in the core barrel assembly above the core barrel proper is the hollow insulated section 32 containing the control mechanism for placing of the markers in the formation at the desired points. The section 32 may be made of Bakelite or other suitable electrical insulation, or may be otherwise electrically insulated from the remainder of the core barrel assembly. Springs contacts 33 and 34, carried by the section

32, are electrically insulated from one another and from the remainder of the core barrel assembly. Insulated electrical conductors 35 and 36 make connection between the contacts 33 and 34 and a switch 37. One pole of the battery 38 is connected to the metallic subsection 39 of the core barrel; the opposite pole is connected to switch 37. The switch is actuated by a solenoid which is energized by a timing mechanism 41 containing a source of electric current. The timing mechanism may be set to energize the solenoid 40 to thereby close the switch 37 at any desired time. When the switch 37 is closed, current from the battery flows through the conductors 35 and 36 to the contacts 33 and 34, respectively. From contact 33 the current flows through the contact ring 26 and conductor 25 to the heating element 23, igniting the propellant in the chamber 19. Ignition of the propellant drives the projectile 15 out of the barrel 17 and into the wall of the well bore adjacent the drill collar. Similarly, the projectile 16 is placed by the ignition of propellant resulting from flow of current from the contact 34 through the contact ring 28, conductor 27 and heating element 22. The electrical circuits are completed through the drill collar 7, the driving ring 12 and driving dog 13, and the core barrel sub-section 39 to the battery.

In operation, the marker bullets or projectiles 16 and 17 are placed in or near the formation from which a core is taken by operation of the apparatus of the present invention. Whenever marking of the formation is desirable, the timing mechanism 41 is adjusted prior to introduction of the core barrel into the well bore. The core barrel is then run in the well through the drill tubing 8 into the position in the drill collar as indicated in Figure 1 of the drawing. After the lapse of a predetermined time interval, the solenoid 40 is energized, closing the switch 37 which in turn fires the marker bullets from the barrels as previously described. The bullets are deposited in or near the formation from which the core is taken and in definite relation thereto. The markers may be located at any time thereafter by a suitable detective instrument, for example, an instrument of the type disclosed in the applicant's copending patent application previously referred to. The markers may be placed simultaneously, as described, or consecutively with a time interval between the placing of each marker.

With reference to Figure 2 of the drawing, the numeral 45 designates the drill collar of rotary drilling equipment. A sub-section 46 of the drill collar makes connection between the drill collar and the drill pipe 47. Markers in the form of bullets 48 and 49 having radioactive properties are contained in barrels 50 and 51 in a sub-section 46. Explosive for propelling the bullets are contained in the firing chambers 52 and 53 which are sealed by seals 54 and 55 and are provided with ignition filaments 56 and 57. Contact rings 58 and 59 are spaced along the interior of the sub-section and insulated therefrom by the electrical insulation 60 and 61. The electrically insulated conductors 62 and 63 establish communication between the contact rings and the ignition filaments. The marker bullets are placed at will by means of a firing mechanism contained in a go-devil adapted to pass through the interior of the drill pipe and drill collar assembly. The body of the go-devil comprises a tubular member 65 of Bakelite or other suitable electrical insulation, metallic end plugs 66 and 67 and a central insulated pipe 68. The annular space between the pipe 68 and the tubular member 65 defines a fluid tight compartment 70 closed at each end by the plugs 66 and 67. Spring contacts 71 and 72 are carried by the insulated tubular member 65 and are connected to one terminal of the battery 73 by insulated conductors 74 and 75. The opposite terminal of the battery is connected to the plug 67. A resistance element 76 between the battery and the plug prevents damage to the battery from the short circuit established during running of the go-devil into position. Spring contacts 77 on the plug 67 makes contact with the drill collar and act as guides for the go-devil. The go-devil is supported and positioned in the drill collar by the wire line 78 and attached weight 79.

In operation, the drill collar sub-section is provided with the marker bullets before being run into the well bore. Drilling is carried on in the conventional manner, the drill bit, not shown in the figure, being attached to the drill collar and driven by the drill stem. As the drilling progresses, the operator may place the markers at will. For example, it is often desirable to place a marker in the formation from which a core is taken, as previously described, or at the point where changes in the formation occur. Such changes may be indicated by the rate of drilling, by an electric log, or by showings in the cuttings in the well stream. To place the markers, the weight 79 is lowered on the wire line 78 into the drill collar 45 through the drill stem. The go-devil is then run in through the drill stem on the wire line as shown in the figure until it rests on the weight 79. By slowly raising the wire line, the contacts 71 and 72 are made to coincide with the contact rings 58 and 59. Current from the battery 73 flows through the insulated electrical conductor 74 through the contact 72 and contact ring 58 and through the insulated electrical conductor 62 to the igniting filament 56. The electrical circuit is completed through the drill collar sub assembly 46, the spring contacts 77, plug 67 and the resistance 76 to the battery. The flow of current through the ignition filament ignites the propellant in chamber 52 and propels the projectile 48 into the earth formation adjacent the drill collar. Similarly, the connection between the contact 71 and the contact ring 59 allows current from the battery to flow through the filament 57, firing the marker bullet 49. With the go-devil in the position shown in the figure, both markers, 48 and 49, are placed simultaneously. It will be evident, however, that the markers may be placed selectively, if desired. For example, the marker 49 may be placed independently by placing the weight 79 and the go-devil in such a position that the contact 72 establishes connection with the contact ring 59.

Having thus described my invention, I claim:

1. Apparatus for placing geophysical markers in the wall of a bore hole during rotary drilling operations with a drill bit and drill stem, a drill collar associated with the drill stem and having the marker bullets loaded therein, means for discharging the marker bullets comprising an electrical contact on the inner surface of the drill collar, said contact being electrically insulated from the drill collar and electrically connected to the marker bullets for firing the same, a firing mechanism adapted to be lowered into and withdrawn from the drill collar through the drill stem, a source of electric current in the firing

mechanism, and contact means associated with the firing mechanism for cooperation with said electrical contact in the drill collar when the firing mechanism is lowered a predetermined distance in the drill collar.

2. Apparatus for placing geophysical markers in the wall of a bore hole during rotary drilling operations with a drill bit and drill stem, a drill collar associated with the drill stem and having the marker bullets loaded therein, means for discharging the marker bullets comprising an ignition device in the drill collar responsive to electric current to fire the bullets, a firing mechanism adapted to be lowered into and withdrawn from the drill collar through the drill stem, a source of electric current associated with the firing mechanism, means for electrically connecting the firing mechanism with the ignition device when the firing device is lowered a predetermined distance in the drill collar, and means for establishing an electric current through said connection after a predetermined time interval.

3. Apparatus for placing geophysical markers in the wall of a bore hole during rotary drilling operations with a drill bit and drill stem, the combination comprising a drill collar associated with the drill stem, marker bullets contained in said drill collar, propellant in the drill collar for placing the marker bullets, an electric element for discharging propellant, an electrical contact on the interior of the drill collar, said contact being electricaly insulated from the drill collar and electrically connected to the electric element, a firing mechanism adapted to be lowered into and withdrawn from the drill collar through the drill stem, a source of electric current associated with the firing mechanism, and an electrical contact on the firing mechanism for cooperation with the contact on the drill collar when the firing mechanism is lowered a predetermined distance in the drill collar to discharge the propellant and thereby place the marker bullets.

4. In apparatus for placing a geophysical marker in the wall of a bore hole while drilling by means of a rotary conduit having a drill bit secured to its lower end and rotatable therewith: a marker bullet carried by the conduit and adapted to be propelled into the wall of the bore hole upon being electrically discharged, an electrical contact element secured to the interior of the conduit and electrically insulated therefrom, an electrical conductor insulated from the conduit and forming electrical connection between the bullet and the contact element, a device adapted to be lowered into the conduit and including a chamber therein, a source of electric energy in the chamber, and means for establishing electrical connection between the source of electric energy and the contact element when the device is in a predetermined position in the conduit to permit the transmission of electric energy from the source to the marker bullet, whereby the bullet is discharged and propelled into the wall of the bore hole.

5. In apparatus for placing a geophysical marker in the wall of a bore hole while drilling by means of a rotary conduit having a drill bit secured to its lower end and rotatable therewith: a marker bullet carried by the conduit and adapted to be propelled into the wall of the bore hole upon being electrically discharged, an electrical contact element secured to the interior of the conduit and electrically insulated therefrom, an electrical conductor insulated from the conduit and forming electrical connection between the bullet and the contact element, a device adapted to be lowered into the conduit and including a chamber therein, a source of electric energy in the chamber, and means including a timing mechanism for establishing electrical connection between the source of electric energy and the contact element when the device is in a predetermined position in the conduit and upon the lapse of a predetermined time interval to permit the transmission of electric energy from the source to the marker bullet, whereby the bullet is discharged and propelled into the wall of the bore hole.

6. In apparatus for placing a geophysical marker in the wall of a bore hole while drilling by means of a rotary conduit having a drill bit secured to its lower end and rotatable therewith: a marker bullet carried by the conduit and adapted to be propelled into the wall of the bore hole upon being electrically discharged, an electrical contact element secured to the interior of the conduit and electrically insulated therefrom, an electrical conductor insulated from the conduit and forming electrical connection between the bullet and the contact element, a device adapted to be lowered into the conduit and including a top wall, a bottom wall, and a tubular side wall of electrical insulating material disposed therebetween, a source of electric energy in the device, and means extending through the side wall for affecting electrical connection between the source of electric supply and the contact element when the device is in a predetermined position in the conduit to permit the transmission of electric energy from the source to the marker bullet to thereby discharge the bullet and propel the same into the wall of the bore hole.

7. In apparatus for placing a geophysical marker in the wall of a bore hole while drilling by means of a rotary conduit having a drill bit secured to its lower end and rotatable therewith: a marker bullet carried by the conduit and adapted to be propelled into the wall of the bore hole upon being electrically discharged, an electrical contact element secured to the interior of the conduit and electrically insulated therefrom, an electrical conductor insulated from the conduit and forming electrical connection between the bullet and the contact element, a device adapted to be lowered into the conduit and including a top wall, a bottom wall, and a tubular side wall of electrical insulating material disposed therebetween, a source of electric energy in the device, and means extending through the side wall and including a timing mechanism for affecting electrical connection between the source of electric supply and the contact element upon the lapse of a predetermined time interval and when the device is in a predetermined position in the conduit to permit the transmission of electric energy from the source to the marker bullet to thereby discharge the bullet and propel the same into the wall of the bore hole.

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