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ELECTRICAL CONNECTING MEANS FOR WELL BORE APPARATUS

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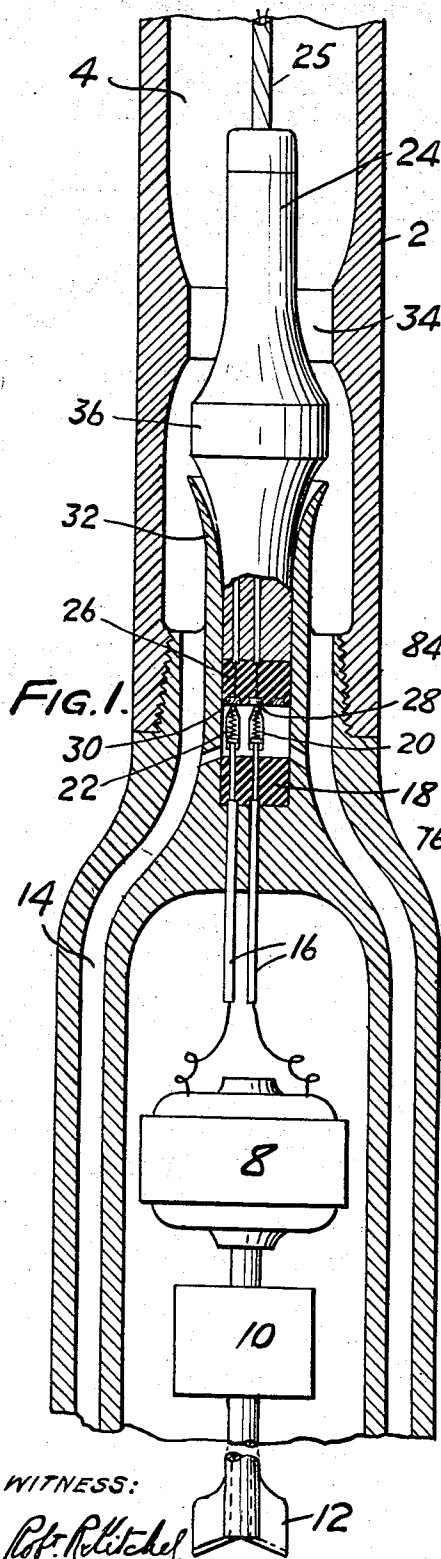


FIG. 1.

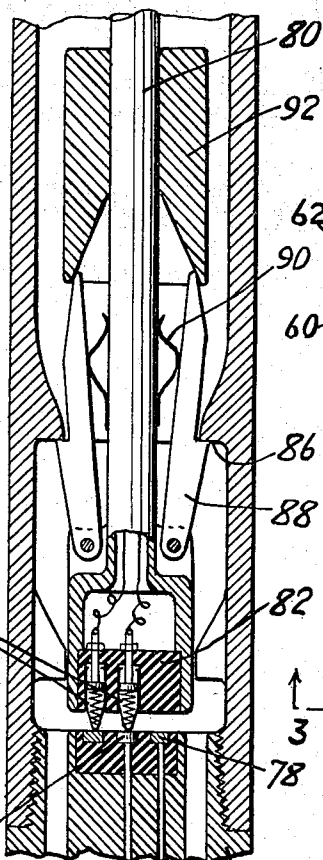


FIG. 4.

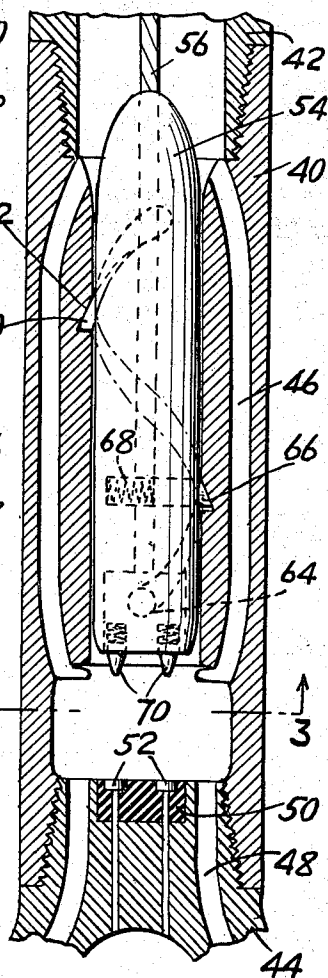


FIG. 2.

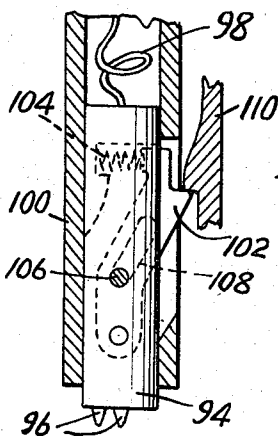


FIG. 5.

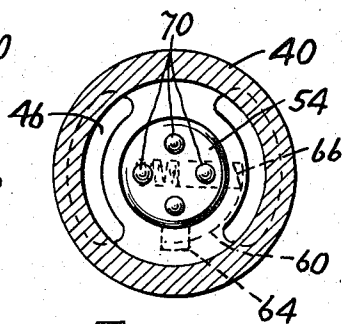


FIG. 3.

WITNESS:

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ELECTRICAL CONNECTING MEANS FOR
WELL BORE APPARATUS

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4 Claims. (Cl. 255—28)

This invention relates to means for effecting electrical connection with apparatus within a bore hole supported by a drill stem.

At the present time, it is necessary to operate within bore holes various types of apparatus requiring or desirably having electrical connection with the surface of the ground. In some cases, such apparatus may be supported by conducting cables, which, however, are quite expensive, since they must be armored to withstand friction with the walls of the bore hole. Otherwise, they will be rapidly destroyed. The use of conducting cables may in some instances be avoided by providing power supplies to be lowered in the bore hole with the apparatus to be operated therein, or if the apparatus is of the type requiring recording to be effected, recording mechanism may be lowered therewith, the lowering being either by cable or through the use of a drill stem.

It sometimes happens, however, that the electrical apparatus must be lowered within the bore hole by means of a drill stem and that electrical connection should be made with the surface. Bearing in mind, however, the mode of making up a drill stem, it will be evident that electrical connection with the surface presents a difficult problem, which has heretofore been solved only by providing special drill stem sections having conductors built into them and arranged so that an electrically continuous surface connection is provided when the sections are assembled.

In accordance with the present invention, there are provided means for effecting electrical connections comprising specifically, engageable elements, one carried by the drill stem adjacent the apparatus requiring the connection, and the other arranged to be lowered by a cable through the drill stem. The cable in such case, being protected by the smooth walls of the drill stem bore, need not be so strongly armored as cable designed to pass through an open hole, and in accordance with the present invention, rapid connection and disconnection may be effected. At the same time, provision is made for maintaining circulation of mud and for rotation of the drill stem without affecting the electrical connection.

The above and other objects of the invention will be best appreciated from the following description, read in conjunction with the accompanying drawing, in which:

Figure 1 is a fragmentary sectional view, partly diagrammatic in form, illustrating electrical connecting means for supplying current to a motor arranged to drive a bit;

Figure 2 is a similar view showing an alter-

native arrangement whereby electrical connections to more than two wires may be effected;

Figure 3 is a transverse section taken on the plane indicated at 3—3 in Figure 2;

Figure 4 is a further view similar to Figure 1 showing another modification of the invention; and

Figure 5 is a fragmentary sectional view showing still another modification of the invention.

Referring first to Figure 1, there is illustrated therein a lower drill stem section 2 provided with a bore 4 and adapted to be threaded in the usual fashion to other drill stem sections arranged to support it and provided with bores for the circulation of mud. The section 2 carries at its lower end a sub indicated at 6. This is illustrated in diagrammatic form as incorporating an electrical motor and reduction gearing 10. Through this reduction gearing the motor is arranged to drive a bit 12 illustrated diagrammatically on a much smaller scale than the remainder of the apparatus. This bit, if designed for drilling the main hole, will have a diameter substantially greater than the sub 6, and the drill stem, and will be mounted coaxially with the drill stem in suitable bearings therein. As will be evident hereafter, a motor such as 8 may be used to drive a coring bit or other suitable apparatus and the illustration of the bit 12 is to be regarded as merely illustrative. If drilling of any type is to be accomplished, however, or even if logging electrodes or the like are carried by the drill stem, it is desirable to maintain mud circulation to the bottom of the hole and this may be effected through channels 14 provided in the sub 6, and extending to suitable distributing means below the sub.

Within a cylindrical socket in the sub 6 there is located a cylinder of insulating material 18 through which there extend insulated conductors 16 from the motor. At the upper ends of these may be located yielding contact members 20 and 22, the former being concentric with the apparatus and the latter eccentric, as illustrated.

Arranged to be lowered through the drill stem and the section 2 upon an insulated conducting cable 25 is a contact member 24, desirably of heavy construction and adapted to enter at its lower end within the guide member 32 forming a continuation of the bore which houses the insulating cylinder 18. At its lower end the contact member 24 carries an insulating end 26 in which are located a central contact button 28 and an annular contact ring 30 designed to engage respectively the elements 20 and 22. The

button and ring are connected to the conductors within the cable 25.

The section 2 of the drill stem is preferably provided with a constriction indicated at 34 and the member 24 is provided with an enlargement 36 arranged to pass through the constriction 34, but with comparatively little clearance.

In the use of the apparatus so far described, the sub 6 carrying the bit 12, which is rotatable relatively to it in bearings as mentioned above, and housing the motor and reduction gearing 10, is lowered into the drill stem by the assembly of drill stem sections in the usual fashion. When the position at which the bit is to operate is reached, there is lowered within the drill stem a member 24 by means of the cable 25. After the cable is located within the drill stem, it may be surrounded by a suitable stuffing box so that mud circulation may be maintained under pressure while the cable is within the drill stem. When the member 24 enters the guide 32, the contacts 20 and 22 will engage the button and annular ring, respectively, completing electrical connection to the motor. In order to insure that the connection remains tight, there are preferably provided the constriction 34 and enlargement 36. These, by somewhat restricting the flow of mud, will cause the exertion of a high pressure on the member 24, forcing it downwardly to insure good contact.

In connection with this modification, reference may be made to an improved method of drilling which it makes possible. At the present time, a very great amount of power is required to rotate the entire drill stem which, at the present time may be more than a mile long. With the arrangement just described, it is possible to have rotating for drilling purposes only a bit rotating relatively to the drill stem and operated by means of a motor housed within a sub such as 6. At the same time, to prevent collapse of the walls, the drill stem may be quite slowly rotated, but it will be obvious that the rotation may be far more readily effected, particularly if the drill stem is caused to rotate in a direction opposite the direction of rotation of the bit. By having the cable pass through a suitable stuffing box, the conventional mud circulation may be maintained. The cable may be mounted upon a reel carried by the rotary table so that the supply rotates with the drill stem; or, alternatively, the reel may be rotated somewhat remote from the upper end of the drill stem by means synchronized with the rotation of the stem. Whenever it is necessary to add a fourth to the drill stem, the member 24 may be rapidly raised and then relowered to renew contact.

If it is desired to make a connection through two conductors only, the arrangement described will suffice, though it will be obvious that it would be possible to provide a plurality of concentric contact rings in place of the single ring 30. In order to provide a larger number of contacts, however, an arrangement such as illustrated in Figure 2 may be adopted. This comprises a member forming part of the drill stem 42 located so as to support a sub 44, which may be similar to the sub 6 previously described. Mud circulation may be provided through passages 46 and 48. At the upper end of the sub 44 there may be provided an insulating block 50 carrying a plurality of buttons of any suitable number indicated at 52, for example four of them.

Arranged to be lowered on a supporting multiple cable 56 is a member 54 designed to enter a

bore 58 in the member 40. The interior of this bore is provided with a spiral slot indicated at 60, which has at least one complete turn, as illustrated. This slot is preferably of the cross-section illustrated, having a sloping upper surface 62 designed for releasing purposes, as indicated below.

The member 54 carries a latch indicated at 66 pressed outwardly by a spring 68. The lower end of the slot 60 is provided with a hole 64 somewhat deeper than the slot designed to latch the member 54 in a predetermined angular position.

The member 54 carries a plurality of spring pressed contact elements 70 connected to the various conductors of the cable 56 and arranged to correspond to the contact buttons 52.

In the operation of this modification, the member 54 is lowered into the bore 58. As the latch 66 moves downwardly in engagement with the bore wall, it will eventually snap into the groove 60. As further lowering takes place, the latch pin 66 will snap into the hole 64. Thus the member 54 is brought into a predetermined angular position with respect to the sub 44 and proper contacts are made between the elements 70 and corresponding buttons 52. The sub 44 is, of course, lined up in predetermined position with respect to the section 40.

When the latch pin 66 enters the hole 64, it will tend to resist any turning action, and consequently, the angular alignment will be maintained. The member 54 may be released readily, however, by exerting sufficient upward force on the cable 56, the sloping end of the latch being arranged to engage the inner edge of the hole 64 so that the latch may be cammed inwardly. It will also be free to pass upwardly out of the groove 60, by reason of the sloping top surface of the groove.

While mud pressure or the weight of the contacting member may serve to maintain good electrical contact, it may be desirable at times to insure that vibration, as, for example, in a drilling operation, cannot cause a chattering contact. In such case, recourse may be had to the type of arrangement illustrated in Figure 4. In this arrangement the section 72 of the drill stem carries the sub 74, which may be of the same type as the sub 6 of Figure 1. A button and ring 76 and 78, respectively, are electrically connected to the devices within or below the sub. The device which is carried by the cable in this case takes the form of a tubular member 80 provided with a head 82 in which are located the insulated contact points 84 joined to the wires of the supporting cable. A shoulder 86 formed in the section 72 of the drill stem is adapted to be engaged by shoulder latch members 88 pivoted to the member 80 and spring pressed outwardly by springs conventionally illustrated at 90. It will be evident that once this device reaches its contacting position, the latches 88 will snap under the shoulder 86, preventing upward movement. This latching should occur when the springs pressing the contact points downwardly are compressed so as to insure good contact. When it is desired to release the member 80, a sleeve 92 may be dropped over the cable and end of the member 80 to engage and cam inwardly the upper ends of the latches 88. Thus release is effected and the entire assembly may be raised to the surface.

Latching and release of a device of this type may be effected in various ways. For example, as indicated in Figure 5, while the apparatus may

be latched against vibration, it may be arranged to be readily released by an upward pull on a cable. In Figure 5, for example, the member 94 carries contact points 96, which may be of the type heretofore described, and connection to these may be made to a cable supporting an outer sleeve member 100 by means of one or more flexible wires 98. The sleeve 100 carries a transverse pin 106, which engages within a slot 108 in a latch member 102 urged outwardly by a spring 104. At 110 there is illustrated a shoulder engageable by this latch and corresponding to the shoulder 86 of Figure 4.

It will be evident that when a device of the nature of Figure 5 is lowered within the drill stem, the weight of the outer sleeve after the member 94 reaches its lowermost position will permit the latch 102 to move outwardly to engage the shoulder 110. An upward pull on the cable carrying the sleeve 100, however, will raise the pin 106, causing the latch 102 to move inwardly and thereby be released from the shoulder 110, so that the assembled members may be lifted.

It will be evident that the connecting means illustrated may be used for various purposes. Its use for driving drilling bits and coring apparatus has been indicated above. It may be used to drive said wall coring apparatus of the type illustrated in Williston Patent 1,932,612, though by the use of the connecting device, the side wall cutters may be driven by a motor carried by the drill stem rather than by rotation of the drill stem. The invention is also adapted to transmit signals of various types to the surface. For example, it is obviously applicable to the type of orienting apparatus described in Palmer et al. Patent 2,012,138. Signals from the surface may also be transmitted, for example, for the purpose of controlling the liberating of a charge of cement at a predetermined position in a hole.

The invention is also applicable to provide the electrical connections necessary for electrical well logging or control of cameras or the like. Currents may be transmitted for well logging purposes either of direct current or alternating current types, and even high frequencies may be readily transmitted by the use of coaxial type of cable. Logging may be carried out while the drill stem is rotating by having suitable brush connections at the surface.

What I claim and desire to protect by Letters Patent is:

1. In combination, a drill stem, an electrical

contact element located in the interior of the lower portion of the drill stem, an electrically conductive cable, a member supported by the cable and having a contact element engageable with the contact element in the drill stem, and mechanical means for releasably holding said contact elements in engagement with each other, said mechanical means being operative to latch said elements in such engagement when the contact element on the cable reaches engaging position, by reason of the weight of said member, with respect to the contact element in the drill stem.

2. In combination, a drill stem, an electrical contact element located in the interior of the lower portion of the drill stem, an electrically conductive cable, a member supported by the cable and having a contact element engageable with the contact element in the drill stem, and latch means for holding said elements in engagement with each other, said latch means being operative to latch said elements in such engagement when the contact element on the cable reaches engaging position, by reason of the weight of said member, with respect to the contact element in the drill stem.

3. In combination, a drill stem, an electrical contact element located in the interior of the lower portion of the drill stem, an electrically conductive cable, a member supported by the cable and having a contact element engageable with the contact element in the drill stem, and releasable latch means for holding said contact elements in engagement with each other, said latch means being operative to latch said elements in such engagement when the contact element on the cable reaches engaging position, by reason of the weight of said member, with respect to the contact element in the drill stem.

4. In combination, a drill stem, an electrical contact element located in the interior of the lower portion of the drill stem, an electrically conductive cable, a member supported by the cable and having a contact element engageable with the contact element in the drill stem, and latch means releasable by upward tension upon the cable for holding said contact elements in engagement with each other, said latch means being operative to latch said elements in such engagement when the contact element on the cable reaches engaging position, by reason of the weight of said member, with respect to the contact element in the drill stem.

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