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CONTACT MEANS FOR ELECTRICALLY OPERATED WELL TOOLS

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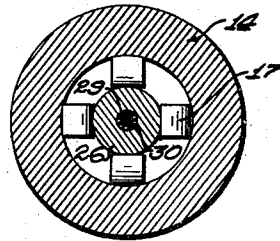
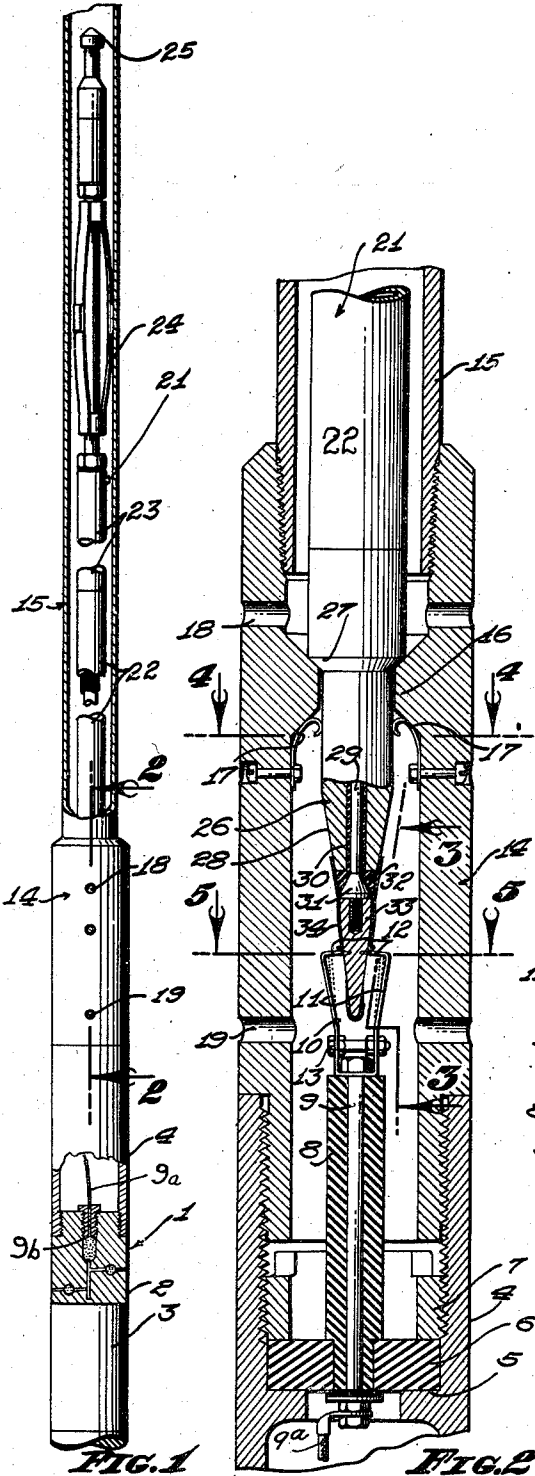


FIG. 4

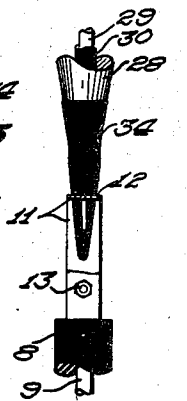


FIG. 3

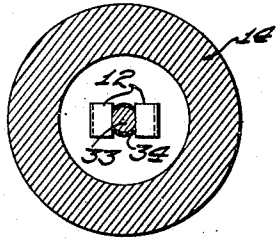


FIG. 5

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CONTACT MEANS FOR ELECTRICALLY  
OPERATED WELL TOOLS

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9 Claims. (Cl. 166—1)

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My invention relates to electrically operated well tools; more particularly to contact means between an electrically operated well tool and a source of electrical energy. Among the objects of my invention are:

First, to provide a contact means which is particularly adapted to form the electrical connection between an electrically operated well tool, such as a gun perforator, suspended from a tubing string and a battery-containing go-devil dropped into the tubing string;

Second, to provide a contact means wherein the contact element carried by the go-devil is completely insulated from surrounding fluids until actual contact is made with the terminal element of the well tool, so that no loss of energy occurs during descent of the go-devil through conductive fluids such as salt water;

Third, to provide a contact means of this character which insures a positive, complete contact even though immersed in conductive fluid; and

Fourth, to provide a contact means of this character which is an improvement on the Anderson Patent No. 2,058,287 for Bore hole device and method of its use.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings, in which:

Figure 1 is a fragmentary elevational view of a well device (in this case a gun perforator) suspended from a tubing string, the tubing string being broken away and in section to show a go-devil in electrical connection with the gun perforator;

Figure 2 is an enlarged fragmentary, longitudinal sectional view through 2—2 of Figure 1, showing particularly the contact means;

Figure 3 is a fragmentary elevational view taken from 3—3 of Figure 2, with one of the contact slips shown in section; and

Figures 4 and 5 are transverse sectional views through 4—4 and 5—5, respectively, of Figure 2.

While my contact means is adaptable to any type of well tool which requires connection to a source of electrical energy for a nominal period, it is shown in connection with a gun perforator 1. The particular type of gun perforator illustrated is the type shown in my copending application, Serial No. 422,088, filed December 8, 1941, now Patent No. 2,326,114, granted August 10, 1943. The several gun units 2 are connected by couplings 3, the upper unit being provided with an end coupling 4.

The end coupling 4 is internally threaded at

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its upper end and is provided with an internal shoulder 5, upon which rests a partition 6 which is sealed against the partition by a ring nut 7. The partition 6 receives a post 8 of insulating material through which extends a tie bar 9 forming a conductor to the interior of the gun perforator below the partition 6. The lower end of the tie bar 9 has attached thereto an insulated wire 9a which leads to the ignition means 9b in the firing chamber of the gun 1. The upper end of the tie bar secures a terminal 10 which comprises leaf spring elements 11 extending upwardly from the upper end of the post 8. The upper extremity of each spring element is provided with an intumed finger 12 which is adapted to make a scraping contact, the intumed extremity of each finger being sharpened. A cross bolt 13 connects the two spring elements 11 near their lower ends so that the fingers 12 are initially held at the desired relative spaces indicated by dotted lines in Figure 2.

The upper end of the end coupling 4 receives a connecting sub 14 which in turn is screw-threaded into the lower end of a tubing string 15. Near its upper end the connecting sub 14 is provided with a constriction 16 substantially smaller than the bore of the tubing. The upper and lower sides of the constriction form downwardly and upwardly beveled shoulders. Immediately below the constriction 16 there are secured to the interior of the connecting sub 14 several contact clips 17 of spring material which curl upwardly and inwardly, so as to be engaged by a member projected through the constriction. Bleeder ports 18 and 19 are provided through the sub above and below the constriction 16.

The go-devil, designated generally by 21, comprises a battery case 22 in which are resiliently mounted the requisite batteries, a weight bar 23 attached to the upper end of the battery case, a spring cage 24 secured to the upper end of the weight bar and having leaf springs which bear against the tubing 15 to control the descent of the go-devil. The upper extremity of the go-devil is provided with a suitable retrieving member 25 shaped so that it may be grasped by a conventional fishing tool, so that the go-devil may be withdrawn after it has served its purpose.

Secured to the lower end of the battery case 22 is a terminal base 26. The lower portion of the terminal base is reduced in diameter, forming a beveled shoulder 27 adapted to rest upon the shoulder formed by the upper side of the constriction 16. The lower end of the terminal base 26 forms a tapered portion 28 which serves to

guide the terminal base into the constriction 16. A conductor 29 extends upwardly through the center of the terminal base and is electrically isolated therefrom by an insulation sleeve 30. The lower portion of the conductor 29 is provided with an enlargement 31, and between this enlargement and the lower end of the terminal base is positioned an insulation ring 32. Below the enlargement 31 the conductor 29 is threaded to receive a terminal member 33. The terminal member is in the form of a cone and sufficiently pointed to pass between the fingers 12 of the terminal 10.

The terminal element 33, insulation ring 32 and the lower portion of the tapered end 23 are provided with an insulating coating 34 which may be in the nature of a thin rupturable rubber sleeve, or may be a coating of paint or lacquer, or any of the various synthetic materials, preferably those capable of withstanding the elevated temperatures encountered in the well bore and which are insoluble in fluid.

Operation of my contact means is as follows: The well tool is lowered to position on the tubing and the go-devil dropped. During descent of the go-devil the batteries are protected against the shorting action of conductive fluids by reason of the coating 34. The terminal element 33 is guided by the tapered end 23 and the constriction 16 into substantially centered relation with the fingers 12. As the terminal element 33 passes downwardly between these fingers they scrape off the insulation or tear the insulation, if rubber or analogous material is used, to make electrical contact with the terminal element. The material comprising the terminal element may be relatively soft so that the scraping fingers dig into the metal slightly. This contact is maintained until the go-devil is withdrawn.

It is desirable, particularly when the go-devil is used in conjunction with explosive well tools, that the go-devil become electrically inert after a short period of time, so that there is no danger after, say, a period of half an hour or an hour, that the go-devil can operate the explosive well tool. This is accomplished by using small size batteries which, in the event of being shorted by electrical contact or through a conductive fluid, quickly dissipate their energy. However, it is desirable that the full potentialities of the batteries be utilized at the time electrical connection is made, and not be dissipated into a conductive fluid as the go-devil is dropping or being lowered to position.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention.

I claim:

1. Electrical connector apparatus adapted to be operated in the presence of electrically conductive fluid comprising: an electrical contact element; an electrical terminal member; means to guide said terminal member into engagement with said contact element; a rupturable insulation layer entirely covering the exposed surface of said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact element to rupture said insulation layer and make electrical contact with said underlying terminal member upon effecting said engagement.

2. Electrical connector apparatus adapted to be operated in the presence of electrically con-

ductive fluid comprising: an electrical contact element; an electrical terminal member; a housing associated with said contact element; means associated with said housing slidably to contain and to guide said terminal member into engagement with said contact element; a rupturable insulation layer entirely covering the exposed surface of said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact element to rupture said insulation layer and make electrical contact with said underlying terminal member upon effecting said engagement.

3. Electrical connector apparatus adapted to be operated in the presence of electrically conductive fluid comprising: a pair of oppositely positioned electrical contact elements; an electrical terminal member; means to guide said terminal member between and into engagement with said contact elements; a rupturable insulation layer entirely covering the exposed surface of said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact elements to rupture said insulation layer and make electrical contact with said underlying terminal member upon effecting said engagement.

4. Electrical connector apparatus adapted to be operated in the presence of electrically conductive fluid comprising: a pair of oppositely positioned electrical contact elements; an electrical terminal member; a housing associated with said contact elements; means associated with said housing slidably to contain and to guide said terminal member between and into engagement with said contact elements; a rupturable insulation layer on said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact element to rupture said insulation layer and make electrical contact with said underlying terminal member upon effecting said engagement.

5. Electrical connector apparatus adapted to be operated in the presence of electrically conductive fluid comprising: a pair of oppositely positioned electrical contact elements; a tapered electrical terminal member; means to guide said tapered terminal member between and into engagement with said contact elements; a rupturable insulation layer on said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact elements to rupture said insulation layer and make electrical contact with said underlying tapered terminal member upon effecting said engagement.

6. Electrical connector apparatus adapted to be operated in the presence of electrically conductive fluid comprising: a pair of oppositely positioned electrical contact elements; a tapered electrical terminal member; a housing associated with said contact elements; means associated with said housing slidably to contain and to guide said terminal member between and into engagement with said contact elements; a rupturable insulation layer on said terminal member and adapted initially to seal said member from electrical contact with surrounding conductive fluid; and means associated with said contact elements to rupture said insulation layer and make electrical contact with said underlying tapered ter-

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5 minal member upon effecting said engagement.

7. The combination with an electrically operated well tool adapted to be suspended in a well bore containing an electrically conductive fluid, a go-devil adapted to be lowered into the well bore to a prescribed position adjacent said well tool, guide means associated with said well tool for guiding said go-devil into said prescribed position, an electrical contact element associated with said well tool and an electrical terminal element on said go-devil arranged to make electrical contact with said contact element when said go-devil is in said prescribed position, of a rupturable layer of insulation covering said terminal element for initially sealing the same from contact with surrounding electrically conductive fluid and means associated with said contact element for rupturing said layer of insulation as said go-devil moves into said prescribed position adjacent said well tool.

8. In a perforating gun of the character described having a gun body provided with a bore and a chamber for an explosive charge, an adapter connected to said body providing for the connection of a tubular string thereto, a contact member within said adapter, an electrical conductor connected to said contact member and having ignition means in the chamber, a unit adapted to be lowered through the string and including a guide for positioning the unit relative to the adapter, said unit also including a

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source of electrical energy and means for contacting said contact member to electrically connect said source with the contact member to complete an electrical circuit through said conductor.

9. In a perforating gun of the character described having a gun body provided with a bore and a chamber for an explosive charge, a tubular string from which the body is suspended, a contact member associated with said body, an electrical conductor connected to said contact member and having ignition means in the chamber, a unit adapted to be lowered through the string and including a guide for positioning the unit relative to the contact member, said unit also including a source of electrical energy and means for contacting said contact member to electrically connect said source with the contact member to complete an electrical circuit through said conductor.

ARTHUR J. ZSCHOKKE.

#### REFERENCES CITED

The following references are of record in the file of this patent:

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