Dec. 2, 1952 G. F. TURECHEK ET AL 2,620,029

ELECTRICAL CONNECTOR FOR WELL TOOLS

Filed Dec. 21, 1948

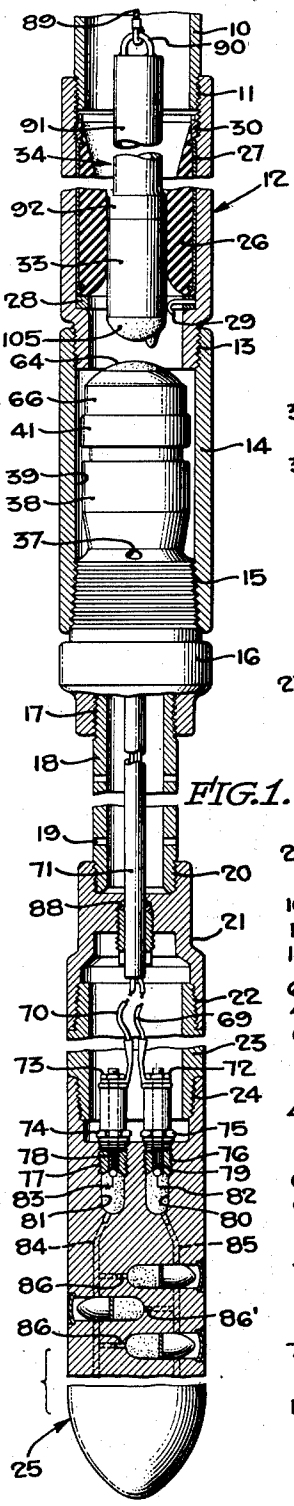


FIG. 1.

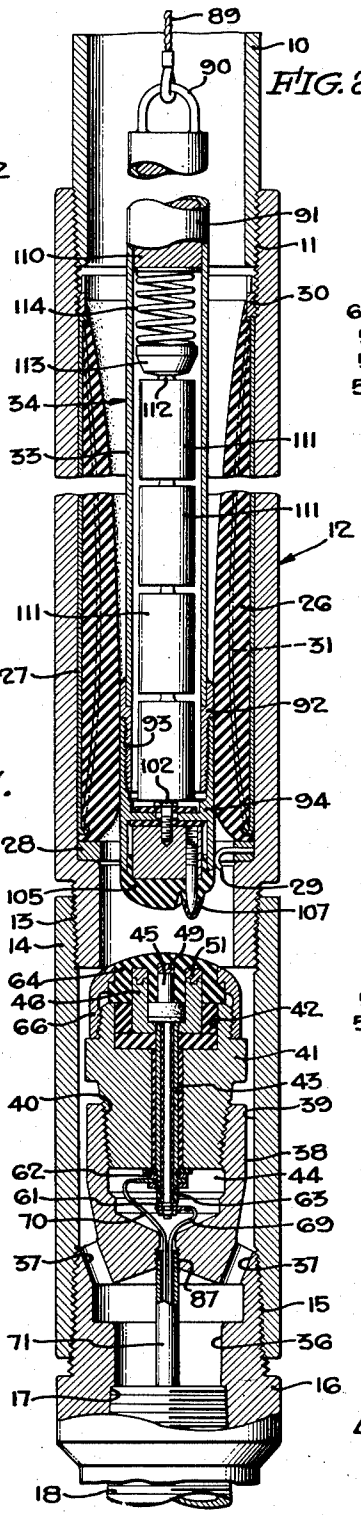


FIG. 2.

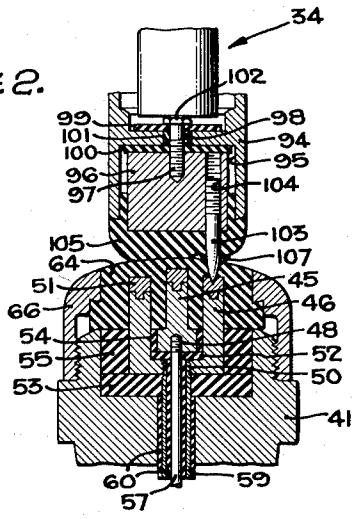


FIG. 3.

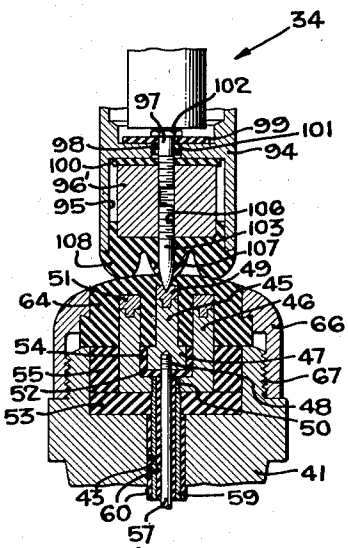


FIG. 4.

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Patented Dec. 2, 1952

2,620,029

UNITED STATES PATENT OFFICE

2,620,029

ELECTRICAL CONNECTOR FOR WELL TOOLS

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Application December 21, 1948, Serial No. 66,442

8 Claims. (Cl. 164—0.5)

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This invention relates, in general, to submergible electric connectors and more particularly to coupling devices for making electrical connections with electrically actuated or operated devices or tools submerged in conductive fluid within well boreholes.

The apparatus of this invention finds its principal utility in connection with the so-called go-devil types of electrical connectors adapted to be lowered or dropped down a well borehole through tubing, drill-pipe, casing or the like into connection, at the lower end thereof, with a well tool to be operated electrically, such as for example, an electrically fired, casing perforating gun. When the so-called go-devil is dropped or is lowered on an ordinary wire line the go-devil device may carry its own supply of electric current in the form of a battery of dry cells, storage batteries or the like, or the go-devil may be lowered on a conductor cable, in which case the current source may be located at the ground surface at the top of the well borehole and the current conducted through the conductor in the cable to the lowered go-devil and to the contactor mechanism associated therewith. In either case, suitable remotely operable means is required for making an efficient electrical coupling between the go-devil and the electrically actuated device deep within the well borehole and while submerged in the well fluid. In either case, but particularly where a go-devil connector device is employed which contains its own current source of supply, it is important to eliminate or at least minimize the occurrence of short circuiting current which may flow between the several connector elements thereof through the fluid within the well through which the device is lowered. Usually the well fluid through which such a device is lowered and in which it must operate is in the form of drilling mud which contains sufficient electrolytic materials to render it highly conductive.

In the Zschokke Patent No. 2,427,377 a connector device is disclosed which provides for maintaining the contact elements of the go-devil portion of the apparatus completely insulated from surrounding fluids until contact is established with the terminal elements of the well tool, so that no loss of current will occur by reason of short-circuiting through the surrounding conductive fluid between the contact elements during descent. The present invention is an improvement over that of the beforementioned Zschokke patent in that it not only maintains the go-devil contacting element or elements insulated

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from the well fluid during its descent in the well but it also maintains the well tool terminal elements with which it is to be coupled, insulated from the well fluid prior to the establishment of the connection, and furthermore maintains both the go-devil contactor elements and the well tool terminal elements insulated from the well fluid during the time the electrical connection coupling is maintained between the go-devil and the well tool.

The improvements of the present invention also include a coupling arrangement between go-devil contact elements and well tool terminal elements whereby any one of two or more electrical circuits within the well tool can be selectively and separately energized by manipulation of the go-devil from the top of the well.

It is accordingly an object of this invention to furnish an improved submergible electrical coupling.

It is another object to provide a submergible electrical connector coupling which maintains all of the interconnecting contactor and terminal elements thereof insulated from surrounding conductive fluid prior to establishment and during maintenance of the coupling connection.

It is still another object of this invention to provide a multiple element coupling device by means of which an electrical current source or supply may be coupled to any one or more of a number of separate electrical circuits within a well tool or device located at a remote position within a well borehole.

These and other objects, advantages and features of novelty will be evident hereinafter.

In the drawings, which illustrate a preferred embodiment and mode of operation of the invention and in which like characters designate the same or similar parts throughout the several views:

Figure 1 is a longitudinal sectional view of the general assembly of the apparatus of the invention as it would appear when suspended in a well borehole in readiness for operation.

Figure 2 is an enlarged longitudinal sectional view of a portion of the apparatus of Figure 1.

Figure 3 is an enlarged longitudinal sectional, detailed view of a fragmentary portion of the apparatus of Figure 2 illustrating its appearance at the completion of an initial stage of the operation of the invention.

Figure 4 is an enlarged longitudinal sectional, detailed view of a fragmentary portion of the apparatus corresponding to that of Figure 3, illus-

trating its arrangement and appearance at another stage in the operation of the invention.

The apparatus is as follows:

Referring first primarily to the several longitudinally interconnected housing components of the general assembly as best shown in Figure 1, 10 is the lower end of a string of drill pipe or tubing upon which the apparatus may be lowered and suspended in a well borehole and through which fluid produced from the well may be caused to flow under production as hereinafter more fully described. The lower threaded end of the tubing or drill pipe 10 makes threaded connection at 11 with the upper end of a cylindrical bumper guide housing 12 which in turn makes threaded connection at 13 into the upper threaded end of a terminal housing collar 14 which surrounds a tool terminal assembly hereinafter described. The lower threaded end of the terminal housing collar 14 makes threaded connection at 15 with the shouldered intermediate section of a bypass sub 16 which in turn makes threaded connection at 17 with the upper end of a length of perforated strainer tubing 18. The strainer tubing 18 is provided with a plurality of radial perforations through its walls as shown at 19 to permit entrance of well fluid into the strainer tubing from which it may flow upward through the bypass sub as hereinafter more fully described.

The lower, threaded end of the perforated strainer tubing 18 makes threaded connection at 20 with the upper threaded end of a gun head sub 21. The gun head sub 21 makes threaded connection at threads 22 with the upper end of a cylindrical gun terminal connector housing 23 which in turn makes threaded connection at 24 with the upper threaded end of a gun perforator body 25.

Referring again, in more detail, to the upper portion of the apparatus assembly, the beforementioned bumper guide housing 12 contains or houses an elongated bumper guide sleeve 26 which has an outer cylindrical surface sheathed in a suitable metal covering 27 of such a diameter as to make a snug sliding fit within the inside diameter of the bumper guide housing. The inner passage through the bumper guide 26 is divergent from either end thereof toward a lower intermediate section of reduced diameter which gives it the appearance of a venturi shaped passage as viewed in cross-section of Figures 1 and 2.

An inwardly projecting, annular shoulder formed near the lower end of the bumper guide housing 12, serves as a support for an annular shaped grounding ring 28 which carries a number of inwardly projecting contactor spring fingers 29.

The lower end of the bumper guide sleeve 26 rests upon the upper surface of the annular grounding ring 28 and is secured thereon within the bumper guide housing 12 by means of an annular gland 30, which is adjustably threaded into threads 11 in the upper end of the bumper guide housing 12. The bumper guide sleeve 26 may be made of any one of a number of suitable resilient materials such as natural or synthetic rubber and preferably is molded around suitable reinforcing wires or rods as shown at 31.

The inside diameter of the bumper guide sleeve 26 at its throat or section of minimum diameter is preferably of a diameter equal to or very slightly less than the maximum outside diameter of the go-devil head member 33 of the go-devil assembly 34, hereinafter more fully described.

The hereinbefore mentioned by-pass sub 16, which is located below and coupled to the lower end of the bumper guide housing 12 by means of the intermediately located terminal housing collar 14, is formed with a lower, central bore or entrance passage 36 which leads, at its upper end, into a plurality of outwardly directed by-pass ducts, as shown at 37. The upper end portion of the by-pass sub, extending above the ducts 37, is cup-shaped as viewed in cross-section at 38 and serves as a terminal supporting pedestal. The terminal supporting pedestal 38 is enclosed within an intermediate portion of the terminal housing collar 14. Sufficient clearance is provided between the outside diameter of the terminal supporting pedestal 38 and the adjacent inside wall surface of the surrounding contact housing collar 14 to form an annular passageway as shown at 39, through which fluid passing through the by-pass ducts 37 may flow.

The terminal supporting pedestal member 38 is provided with internal threads at 40, into which is screwed a terminal head member 41. The top of the terminal head member 41 is provided with a cylindrical depression or terminal socket 42. A drilled passage or bore 43 coaxially interconnects the bottom of the terminal socket 42 with the cavity 44 formed within the pedestal 38 at the lower end of the terminal head member 41.

Contained coaxially within the terminal socket 42 are a pair of spaced, concentric terminal members 45 and 46. The inner terminal member 45 is substantially cylindrical in shape having an outwardly flanged lower end as shown at 47 and internally threaded as shown at 48. The upper end portion of the central terminal member is tipped with a layer of lead or the like soft metal as shown at 49.

The outer concentric terminal member 46 is of a substantially annular or cup-shaped form having an internally threaded portion 50 at its lower end and an upper end surface also carrying an annular covering of soft metal as shown at 51.

The terminals 45 and 46 are held in concentrically and vertically spaced positions with respect to one another by means of a number of insulating bodies comprising a pair of insulating discs 52 and 53, and insulating annular spacer members 54 and 55. The inner terminal 45 is clamped downward in position against the insulating discs 52 by means of a central conductor rod 57 threaded at 48 into the lower end of terminal 45. These insulating bodies may be composed of Bakelite, Formica, Micarta or the like material.

The outer, annular terminal member 46 is clamped down against the insulating disc 53 by means of a conductor tube 59 threaded at 50 into the lower end of the said outer terminal member. The conductor rod 57 and surrounding conductor tube 59 are spaced apart within the bore 43 in concentric relation to one another by means of a pair of insulating tubular spacers 60. The downward clamping force is applied through the conductor rod 57 and the conductor tubing 59 by means of suitable clamping nuts as shown at 61 and 62, respectively, which bear upward against suitable insulating washers 63, which insulate them from the lower end of the terminal head member 41.

The upper end portion of the concentric terminal members 45 and 46 are filled in between and covered over by means of a body of soft insulating material as shown at 64 which is clamped downward in close fitting fluid tight

engagement over the ends of the terminals 45 and 46 and against the upper end surfaces of the insulating annuli 54 and 55 by means of a threaded retainer cap 66. The retainer cap 66 makes screwed connection with the upper end of the contact head member at threads 67.

A pair of insulated conductors 69 and 70 make bolted connection with the lower end of the inner rod conductor 57 and the outer tubular conductor 58, respectively, in the cavity 44 formed below the lower end of the terminal head member 41. Conductors 69 and 70 lead down through a tubular conduit 71 which passes through the gun head sub 21 and into the interior of the gun terminal connector housing 23 and there makes bolted connection respectively with terminal posts 72 and 73, respectively, of a pair of igniter plugs 74 and 75, screwed at 76 and 77 into the upper end of the gun body 25. Insulated conductor rods 78 and 79 extend down through the igniter plugs 74 and 75 into igniter cartridge chambers 80 and 81, where they are grounded to the gun body 25 through fusible ignition filaments 82 and 83.

Suitable fire train or ignition ducts, as shown at 84 and 85, lead from the ignition cartridge chambers 80 and 81 down through the gun body 25, each making connection with a separate group of a plurality of lateral branch ignition passages 86 and 86' leading into the powder or cartridge chambers of a plurality of laterally directed perforating gun units.

The beforementioned tubular conduit 71, through which the conductors 69 and 70 pass from the lower end of the terminal head member 41 to the terminals 72 and 73 at the upper end of the gun body 25, makes fluid tight screwed connection at 87 into a central passage extending down through the lower end of the terminal supporting pedestal 38 from the cavity 44, and this conduit extends downward coaxially through the perforated strainer tubing 18 and centrally through a packing gland 88 into the space within the connector housing 23.

The go-devil assembly 34 which is adapted to be lowered down through the drill pipe or tubing 10 by means of a suitable line or cable 89 and retrieved therefrom by the same means comprises a bail 90, attached to the upper end of a cylindrical sinker and battery containing case 91 which in turn carries attached to its lower end the beforementioned go-devil head assembly 33. The go-devil head assembly 33 comprises a head connector sub 92 which makes threaded connection at 93 into the upper end of a head collar 94. The head collar 94 is formed with a downwardly directed cylindrical recess or opening 95 containing an inner cylindrical shaped contact block 96. The cylindrical contactor block 96 is retained and coaxially spacially positioned within the recess 95 by means of a bolt 97 which passes through a central opening 98 in the bottom of the recess 95 and is insulated therefrom by means of insulation washers 99, 100 and a short length of insulation tubing 101 surrounding the shank of the bolt 97. The upper headed end 102 of the bolt 97 serves as a battery contactor point as hereinafter described.

A pointed contactor member 103 extends downward from a threaded opening 104 formed at one edge portion of the contactor block 96 as shown in Figure 3.

The lower end of the head collar 94 and the contactor block 96 are covered over with a resilient insulating body 105 which may be composed of rubber, neoprene or other suitable rubber-like or soft insulating material. The insulating body 105 is preferably rounded outwardly or convex in general form and serves both to exclude well fluid from the spaces within the recess 95 surrounding the contactor block 96 and as a supporting bumper upon which the force and weight of the go-devil 34 may be absorbed and supported when the go-devil is lowered into contact with the contact head assembly from the position as illustrated in Figure 2 to that illustrated in either Figure 3 or Figure 4.

The lower pointed end of the contactor member 103 which protrudes beyond the outer surface of the insulating body 105 is normally covered over prior to being lowered against the terminal head assembly as illustrated in Figure 2, with a conical insulating sheath as shown at 107. This insulating sheath 107 is preferably composed of rubber, neoprene or the like insulating material and cemented or otherwise bonded to the adjacent covering material 105 surrounding the contactor 103 to prevent the entrance of any fluid at that point.

In Figure 4 a lower end portion of another form of go-devil head assembly is shown which is similar to and interchangeable with that illustrated in Figures 2 and 3, except that the pointed contactor member 103 is centrally located and extends downward coaxially from a threaded opening 106 in the contactor block 96'. The lower ends of the head collar 94 and the contactor block 96' are covered over with a resilient insulating body 108 which is similar to that shown at 105 in Figure 3, except for a suitable modification in form to accommodate the centrally located contactor point 103.

The upper end portion of the sinker and battery container case 90, of the go-devil 34, may be filled with a body of weighting material such as, for example, lead, as illustrated at 110 in Figure 2. The lower portion of the go-devil case 91 normally contains a plurality of dry cell batteries stacked end to end in series electrical connection as shown at 111.

The bottom of the case of the lowermost dry cell is supported by, and makes electrical contact with, the beforementioned battery contactor 102 formed by the head of bolt 97. The central top terminal 112 of the uppermost battery of the series makes electrical contact with a contact button 113 acting under downward compression through a helical spring 114. The batteries 111 are thus connected in series in conventional manner and form a series circuit one pole thereof terminating at the bottom of the go-devil assembly 34 in the pointed contactor point 103 and the other pole terminating at an intermediate portion of the go-devil in a ground connection comprising the button 113, helical spring 114 and the case 90. As illustrated in Figure 2, the positive pole of the series of batteries is connected to the grounded button 113 and the negative pole thereof connected to contactor point 103. The polarity may obviously be reversed by inverting the stack of batteries within the case 90, and in some cases this reversal of polarity may be desirable.

When the go-devil 34 is lowered into the position illustrated in Figure 2, contactor fingers 29 make mechanical and electrical contact with the outside surface of the go-devil head collar 94 and thus serve to ground the go-devil case 90 to the bumper guide housing 12 and to the parts of the apparatus associated therewith, including the fluid, if any, within the well borehole.

The operation of the apparatus is as follows:

The apparatus assembled and having the appearance shown in Figure 1, except the go-devil assembly 34 is omitted, is first lowered into the well borehole to a position where perforation operations are to be conducted. The go-devil assembly 34 is next lowered down through the tubing or casing 10 upon the line 89 to a position within the bumper guide 26 approximating that illustrated in Figure 2. The go-devil 34 is then dropped or lowered with sufficient velocity, from the position illustrated in Figure 2, into supporting contact with the terminal head assembly 41 within the contact housing collar 14 where it assumes the position and appearance illustrated in Figure 3. By this downward motion and in this position, the protruding pointed contactor member 103 is thrust through its covering insulating sheath 107 to a position penetrating the insulating body 64 and into contact with the soft metal 51 on the upper end of the outer annular terminal member 46, as shown in Figure 3. By this operation, an electrical circuit is completed from the batteries 111, through bolt 97, contactor block 96, pointed contactor member 103, annular terminal member 46, conductor tubing 59, conductor 70, conductor rod 78 of the igniter plug 74, and thence through the ignition fuse wire 83, in ignition cartridge chamber 81, to the grounded body 25 of the gun and in return therefrom through the conductive metal portion of the apparatus to the contactor fingers 29, to the metal case of the go-devil 34 and from there through helical spring 114 and contactor button 113 to the batteries.

The ignition cartridge 81 is thus fired, causing in turn, all of the gun units to be fired which are connected thereto through the longitudinal ignition duct 84 and lateral branch ignition ducts 86.

Following this, the go-devil 34 may be withdrawn from the well through the tubing or drill pipe 10, by means of the line 89 and the contactor assembly including the head collar 94 of the form shown in Figure 3 removed from the go-devil case and replaced by a head collar having centralized contactor mechanism associated therewith having the form shown in Figure 4. The go-devil 34 may then be again lowered through the tubing or drill pipe 10 to a position within the apparatus as illustrated in Figure 4. In this position the protruding, pointed contactor member 103 penetrates the sheath 107 and the insulating body 64 into contact with the soft metal covering 49 of the central terminal member 45. Electrical contact is thus made from the batteries 111 through the central electrode member 45, conductor rod 57, conductor 69 and through conductor rods 79 in the igniter plug 75 to the ignition filament 82 within the ignition cartridge chamber 80. The ignition cartridge chamber 80 is thus fired causing all of the gun units to be fired which are connected thereto through the longitudinal ignition duct 85 and lateral branch ignition ducts 86'.

From the foregoing, it is apparent that two or more separate groups of perforating gun units can be separately and selectively fired by employing a suitable arrangement of two or more concentric terminal members of the type illustrated at 45 and 46 in Figures 2, 3 and 4, together with different go-devils or with a go-devil of the type illustrated at 34 having changeable, correspondingly suitable contactor head arrangements of the type illustrated at 94 in Figures 3 and 4.

While, by way of illustration, only two concentric terminal members 45 and 46 have been shown in the construction of the terminal assembly in the terminal head member 41, any desired number of such concentric terminal members may be employed therein in similar arrangement, within the practical limits set by the space available and size and spacing of terminal members required. The pointed contactor members 103 may be suitably positioned in the go-devil head at any desired point on the diameter of the face of the contactor block 96, to accommodate any such modification of the arrangement and number of terminal members.

The number of gun units or separate groups of gun units which may be separately fired may thus be increased from that shown in the drawings to a greater number, corresponding to the increased number of separate terminal members employed.

The perforator gun illustrated herein may be of any suitable type adapted to be ignited electrically and capable of perforating a casing or the surrounding formations within a well borehole, such as, for example, the bullet type gun perforator shown in the Zschokke Patent No. 2,326,114. Or, instead of employing a bullet type of gun perforator, a perforator gun may be employed utilizing the so-called "shaped charge" principal, accomplishing its perforating by the penetrating effect of a high velocity jet of gases projected from the concave or conically formed end of a high explosive body.

After the perforating operations have been completed, as hereinbefore described, any production of well fluid which results therefrom may flow from the well borehole through the perforations 19 into the strainer tubing 18 and thence up through the lateral passages 37 in the by-pass sub 16 into the annular space 39 between the contact supporting pedestal 38 and the surrounding contact housing collar 14, and thence upward through the bumper guide or pad member 26 into the tubing or drill pipe 10 (the go-devil 34 having been previously retrieved by means of the line or cable 89 or forced upward out of the bumper guide pad 26 by the pressure of the produced fluid) and from there upward through the tubing or drill pipe 10 to the usual casing head and production connections at the surface of the well. The apparatus of this invention may thus be employed to perforate the well or casing at the point from which it is desired to obtain production and then the well may immediately thereafter be put on production and permitted to produce through the tubing or drill pipe 10 without the necessity of removing the perforating apparatus from the well. Any detrimental effects of killing the well during the time interval while the gun is removed and suitable production tubing is installed, is thus obviated.

The apparatus of this invention, in addition to the operation hereinbefore described, is also well suited to use in combination with a formation tester or production packer for the purpose of testing a formation or producing a well.

It is to be understood that the foregoing is illustrative only, and that the invention is not limited thereby but includes all modifications thereof within the scope of definition of the appended claims.

What is claimed is:

1. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate concentric terminal members insulated from one another and

surrounded by sufficient protective insulation initially to exclude said terminal members from contact with surrounding fluids, said insulation including a soft insulating layer initially forming a fluid tight covering over one end of said terminal assembly; a go-devil body; an outwardly pointed, axially directed contactor member fixed to and extending from the end of said go-devil body, the axis of said contactor member being parallel but positioned laterally with respect to the axis of said go-devil body to penetrate said insulating layer and selectively contact one only of said concentric terminals when said go-devil body is moved coaxially into forceful end-to-end abutment with the end of said terminal assembly; and guide means associated with said electrode assembly to guide said go-devil body into such end-to-end abutment with said terminal assembly.

2. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate, concentric terminal members insulated from one another and surrounded by sufficient protective insulation initially to exclude said terminal members from contact with surrounding fluids, said insulation including a resilient convex-shaped bumper body initially forming a fluid tight covering over at least a portion of one end of said terminal assembly; a go-devil body; an outwardly pointed axially directed contactor member fixed to and extending from the end of said go-devil body, the axis of said contactor member being parallel but positioned laterally with respect to the axis of said go-devil body to penetrate said convex-shaped bumper body and selectively contact one of said concentric terminal members when the said end of said go-devil body is moved coaxially to forceful end-to-end abutment with the said convex-shaped bumper body on the end of said terminal assembly; and guide means associated with said electrode assembly to guide said go-devil body into such end-to-end abutment with said terminal assembly.

3. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate, concentric terminal members insulated from one another and surrounded by sufficient protective insulation initially to exclude said terminal members from contact with surrounding fluids, said insulation including a resilient convex-shaped bumper body initially forming a fluid tight covering over at least a portion of one end of said terminal assembly; a go-devil body; an outwardly pointed axially directed contactor member attached to and extending from the end of said go-devil body, the axis of said contactor member being parallel but positioned laterally with respect to the axis of said go-devil body; a layer of insulation in the form of a resilient convex-shaped bumper body positioned on the end of said go-devil body and of sufficient extent initially to cover and to exclude said contactor member from contact with surrounding fluids, said contactor member being adapted to penetrate said first mentioned convex-shaped bumper body and said convex-shaped bumper body on the end of said go-devil body and selectively contact one of said concentric terminal members when said bumper bodies are moved coaxially into forceful and compressive end-to-end abutment with one another; and guide means associated with said terminal assembly to guide said go-devil body into such end-to-end abutment of said bumper bodies with one another.

4. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate, concentric terminal members insulated from one another and surrounded by sufficient protective insulation initially to exclude said terminal members from contact with surrounding fluid, said insulation including a soft insulating layer initially forming a fluid tight covering over one end of said terminal assembly; a go-devil body; a source of electrical current in said go-devil body; an outwardly pointed axially directed contactor member fixed to and extending from the end of said go-devil, the axis of said contactor member being parallel but positioned laterally with respect to the axis of said go-devil body to penetrate said insulating layer and selectively contact one only of said concentric terminal members when said end of said go-devil body and said end of said terminal assembly are moved coaxially into end-to-end abutment with one another; means electrically insulating said contactor member from said go-devil body; conductors connecting one terminal of said source with said contactor member and another terminal thereof to said go-devil body; and guide means associated with said terminal assembly to guide said go-devil body and said terminal assembly into such end-to-end abutment.

5. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate, concentric terminal members insulated from one another and surrounded by sufficient protective insulation initially to exclude said terminal members from contact with surrounding fluid, said insulation including a resilient convex-shaped bumper body initially forming a fluid tight covering over one end of said terminal assembly; a go-devil body; a source of electrical current in said go-devil body; an outwardly pointed, axially directed contactor member attached to and extending from the end of said go-devil body, the axis of said contactor member being parallel but positioned laterally with respect to the axis of said go-devil body, to penetrate the said convex-shaped bumper body and selectively contact one of said concentric terminal members when said end of said go-devil body and said bumper body are moved coaxially into forceful and compressive end-to-end abutment with one another; means electrically insulating said contactor member from said go-devil body; conductors connecting one terminal of said source with said contactor member and another terminal thereof to said body; and guide means associated with said terminal assembly to guide said go-devil body and said terminal assembly into such end-to-end abutment.

6. Electrical connector apparatus adapted to be operated while immersed in electrically conductive fluid comprising: a terminal assembly including a plurality of separate concentric terminal members insulated from one another; a resilient, convex-shaped bumper body covering at least a portion of the end of said terminal assembly; a go-devil body; an outwardly pointed axially directed contactor member extending from the end of said go-devil body; a resilient, convex-shaped bumper body on said end of said go-devil body and having a portion thereof initially covering said contactor member, said contactor mem-

ber being adapted to penetrate said convex-shaped bumper bodies and selectively contact one of said concentric terminal members when said bumper body on said end of said go-devil body and the bumper body on said end of said terminal assembly are moved coaxially into forceful and compressive end-to-end abutment with one another; and guide means associated with said terminal assembly to guide said go-devil body and said terminal assembly into such end-to-end abutment.

7. In well production apparatus having an electrically actuated perforating gun employing an explosive charge and lowered into a well borehole on a tubular suspension member through which fluid produced from the well may flow, the combination comprising: a tubular coupling between said gun and said tubular suspension member; a fluid inlet to said coupling located above said gun, said inlet and said coupling thereby forming a fluid flow passage from the exterior to the interior of said tubular suspension member; a terminal assembly fixed within said coupling above said inlet and defining in part the fluid flow passage therethrough from said inlet; an electric terminal member in said assembly and having a surface adjacent the upper end thereof; a fluid tight covering of insulation on said terminal assembly initially excluding said terminal member therein from contact with any fluid within said coupling; a tubular guide member comprised of said coupling located above said terminal assembly and adapted to guide the lower end of a go-devil body passed down said tubular suspension member into abutment with the upper insulation-covered end of said terminal assembly; and an insulated conductor extending through said coupling from said terminal member to ignition actuating means within said gun.

8. In well production apparatus having an electrically actuated perforating gun employing an explosive charge and lowered into a well borehole on a tubular suspension member through which fluid produced from the well may flow, the combination comprising: a tubular coupling between said gun and said tubular suspension member; a fluid inlet to said coupling located above said gun, said inlet and said coupling thereby forming a fluid flow passage from the exterior

to the interior of said tubular suspension member; a terminal assembly fixed within said coupling above said inlet and defining in part the fluid flow passage therethrough from said inlet; an electric terminal member in said assembly and having a surface adjacent the upper end thereof; a fluid-tight covering of insulation on said terminal assembly initially excluding said terminal member therein from contact with any fluid within said coupling; a resilient guide member located within said coupling above said terminal assembly and adapted to guide the lower end of a go-devil body passed down said tubular suspension member into abutment with the upper insulated covering end of said terminal assembly; a fluid-tight conduit extending through the interior of said coupling from within said terminal assembly to within said gun; an insulated conductor extending through said conduit from said terminal member to ignition actuating means within said gun; an elongated go-devil body adapted to be passed down said tubular suspension member; an outwardly pointed, axially directed contactor member extending from the lower end of said go-devil body; a resilient, convex-shaped bumper body of insulating material on said lower end of said go-devil body and having a portion thereof initially covering said contactor member, said contactor member being adapted to penetrate said convex-shaped bumper body and said fluid tight covering of insulation on said terminal assembly into contact with said terminal member when said go-devil body is lowered through said tubular suspension member and through said guide member into abutment with the upper end of said terminal assembly.

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