Sept. 16, 1941. C. E. WELLS 2,255,838

ELECTRICAL CONNECTOR

Filed Oct. 16, 1939

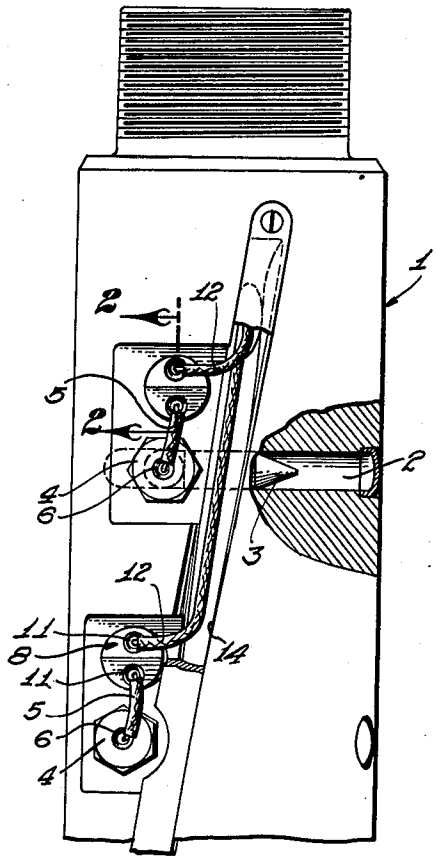


FIG. 1

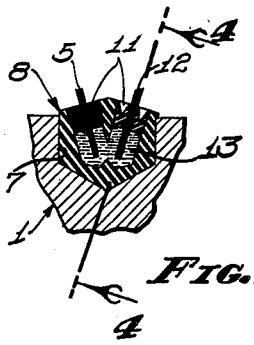


FIG. 2

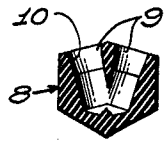


FIG. 3

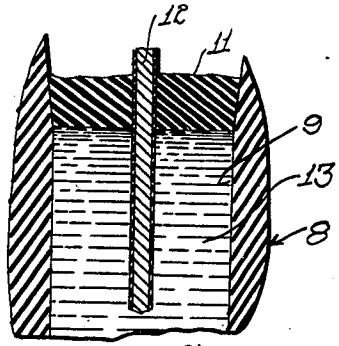


FIG. 4

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ELECTRICAL CONNECTOR

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3 Claims. (Cl. 173—324)

My invention relates to electrical connectors, particularly to electrical connectors between parts of an electrically operated tool designed to operate within a well bore. Among the objects of my invention are:

First, to provide an electrical connector for oil well tools which may be submerged to great depths in liquid and subjected to hundreds of pounds of hydrostatic pressure;

Second, to provide an electrical connector of this character which is particularly designed for use in conjunction with a gun perforator of the multiple gun unit type, so that each gun unit may be connected through an external wiring system to the source of electrical energy without shortage or leakage by or through the connector to the surrounding fluid;

Third, to provide a connector of this character which in no manner interferes with the loading or cleaning of the gun perforator with which it may be incorporated, but which materially facilitates connection of each of the gun units to its respective lead wire; and

Fourth, to provide an electrical connector which is particularly simple and economical of manufacture.

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

Figure 1 is a fragmentary elevational view of a gun perforator incorporating my novel electrical connector, parts and portions of the gun being shown in section;

Figure 2 is a fragmentary transverse sectional view through 2—2 of Figure 1, illustrating my electrical connector with the lead wires and sealing gaskets in place;

Figure 3 is a transverse sectional view through the body member of my electrical connector, with the remaining parts removed; and

Figure 4 is an enlarged sectional view through 4—4 of Figure 2.

As indicated hereinbefore, my electrical connector is particularly designed for use in conjunction with gun perforators. Gun perforators are lowered often to depths in excess of 10,000 feet into liquid-filled well holes for the purpose of firing projectiles through a surrounding casing into the formation to establish points of entry of the well fluid. It is desirable that gun perforators be controlled electrically and that the several gun units comprising the gun perforator be fired in sequence; this necessitates lead wires to each of the gun units, which may be twenty-five or more. To facilitate servicing and for other reasons, it is desirable to have the wiring along the outside of the gun. However, it is equally desirable that there be little or no leakage of current from the connecting or lead wires into the surrounding liquid or to the return side of the circuit, namely, the body of the gun.

One type of gun perforator is illustrated in Figure 1, and comprises a gun body 1 having a plurality of laterally directed gun bores 2, each of which receive a bullet 3. The gun bores 2 are intersected by other right angularly disposed, laterally directed bores which form additional cartridge chambers and which are sealed by plugs 4. These plugs serve the added function of supplying electrical energy to filaments contained within the cartridges for the purpose of discharging the gun. This is accomplished by means of a small bore through each plug 4, which bore receives a lead wire 5. Around the lead wire, at the outer end of the plug, a suitable sealing gasket 6 is provided. The lead wire is preferably enamel-covered, insulated from well fluid, and may be provided with additional insulation, as desired.

Adjacent each plug 4 the gun body 1 is provided with a socket 7 which receives a block 8 formed of insulating material which constitutes the body of my connector. The block 8 is provided with two converging and intersecting sockets 9 which have slightly tapered outer ends 10. Each tapered outer portion is adapted to receive a gasket 11 in the nature of a rubber cork or plug. Each plug is provided with a small bore therethrough. One plug receives a lead wire 5 while the other receives the end of a conductor 12 connected to a source of electrical energy, as will be explained hereinafter. Each cork or plug 11 is provided with a V-shaped annular groove which forms pressure lips adapted to bear against the walls of the corresponding socket 9 and around the corresponding lead wire 5 or 12.

Commercial enameled wire without additional insulation has proven, in actual operation, to fully insulate the wire even when subjected to extreme well pressure and temperature. Any additional insulation, therefore, serves principally to protect the lead wires against abrasion. Furthermore, by reason of the fact that the lead wires dip into mercury and the severed extremities of the lead wires are necessarily without enamel, it has been found unnecessary to clean the enamel from the lead wires—this is best illustrated in Figure 4.

The space within the connecting sockets 9 is completely filled with mercury 13 and inasmuch as the sockets 9 intersect, an electrical link is

formed between the two lead wires 5 and 12.

Each of the lead wires or conductors 12 extend from their respective electrical connectors into channels 14 provided along the sides of the gun and pass in a bundle through the upper end of the gun into a suitable controller (not shown) adapted to connect each of the conductors 12 in sequence with their respective gun units.

In operation it sometimes happens that the lead wires 5 will blow out of their corresponding plugs 6. The electrical connector holds these wires with only sufficient tension by reason of the resilient gripping action of the corks 11 to withstand the normal handling. Thus, in the event that one of the lead wires should blow out and thereby be pulled from the connector, the connector itself is in no manner damaged. As a matter of fact, it has been found that the holes through the plugs or corks 11, which accommodate the wires, may be so small that even the mercury contained within the socket 9 has little or no tendency to leak, so that the connectors may be used repeatedly without the necessity of refilling the pockets with mercury.

In reloading it is merely necessary to screw in the plug 4 with the short lead wire 5, bend the lead wire over and thrust it into the plug 8.

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 as broadly as the prior art permits.

I claim:

1. In an electrical connector adapted to withstand extreme hydrostatic pressure: a body of insulating material having a pair of intersecting sockets therein; mercury filling said sockets; sealing plugs closing said sockets and sealing the mercury therein; and conductor wires sealed in and extending through said plugs into said mercury, said plugs having external annular V-shaped channels therein forming pressure lips adapted to bear against said conductor wires and against the surrounding sockets to form fluid-tight pressure responsive seal, said plugs resting directly upon and supported by the mercury.

2. In an electrical connector adapted to withstand extreme hydrostatic pressure: an insulated body member having a cavity therein; a conducting liquid filling said cavity; a removable plug for closing said cavity; and a conductor extending through said plug into said cavity, said plug having an annular V-shaped groove surrounding said conductor forming pressure responsive lips adapted to bear against said conductor and against the surrounding socket to form a pressure responsive sealing means, said plug resting directly upon and supported by said liquid.

3. In an electrical connector adapted to withstand extreme hydrostatic pressure: an insulated body member having a cavity, and a pair of openings to said cavity; removable plugs adapted to fit the openings and close said cavity; a conductor extending through each plug into said cavity; and a conductive liquid completely filling said cavity for making electrical contact between said conductors; each of said plugs having an annular V-shaped groove surrounding its conductor forming pressure-responsive lips adapted to bear against said conductor and against the surrounding body to form a pressure responsive sealing means, said plugs resting directly upon and supported by the conductive liquid.

CHARLES E. WELLS.