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2,681,701

ELECTRICAL IGNITER

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FIG.2.

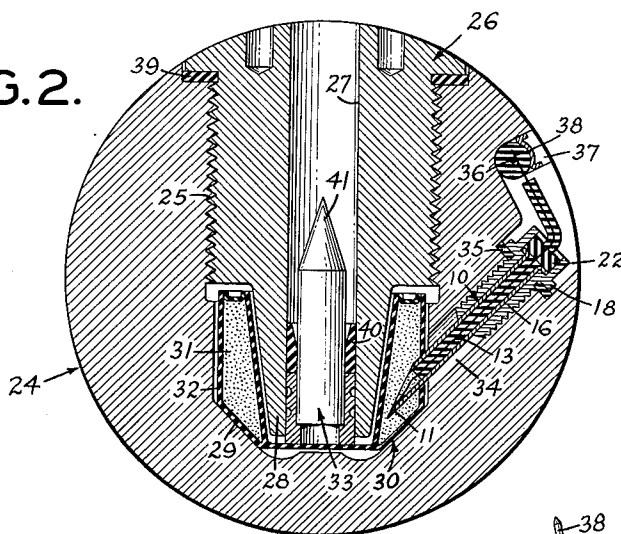


FIG.1.

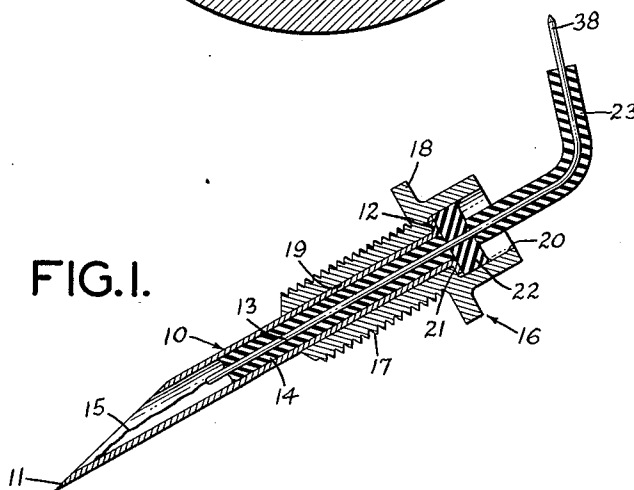


FIG.3.

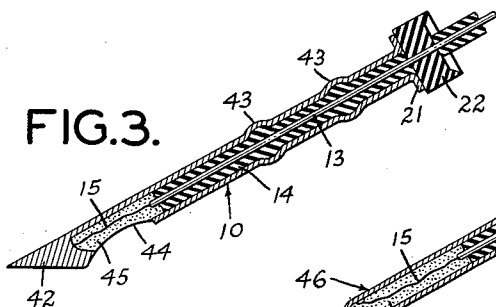
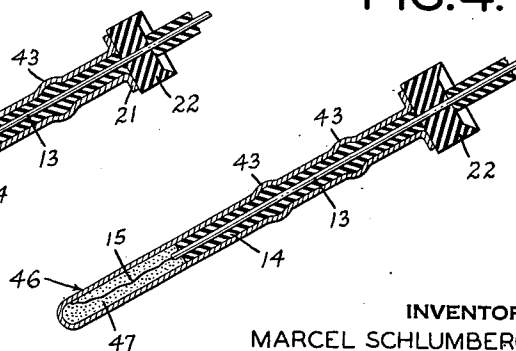


FIG.4.



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ELECTRICAL IGNITER

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8 Claims. (Cl. 164—0.5)

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This invention relates to devices for setting off explosive charges. More specifically, it has to do with new and improved electrical igniters which are particularly well adapted for firing explosive charges in bore hole equipment or the like, although they are not limited to such uses.

The several types of electrical igniters employed heretofore for setting off explosive charges in bore hole equipment such as formation sample takers, gun perforators or the like have not been particularly satisfactory. Filament type igniters, for example, are usually placed in the corresponding explosive chambers and connected in the firing circuit before the explosive charges are put in place. This has proved to be a tedious and time consuming operation that cannot readily be accomplished in the field. Further, the delicate igniter filaments may be damaged or broken in loading or in handling prior to use so that improper operation may result. Also, the presence of the igniters in the loaded piece of equipment increases the likelihood of a dangerous premature explosion.

In an effort to overcome the above-noted disadvantages, it has been proposed to make either the charge or a detonator disposed in proximity thereto out of explosive material containing conductive particles, and to connect the detonator or charge to the firing circuit after completion of the loading operation by means of a needle inserted thereinto through a port in the bore hole equipment. Such charges, however, are non-standard and difficult to manufacture in large quantities and are, therefore, expensive. Further, the igniter resistance is not constant as required for proper operation of the better igniter networks.

One object of the invention, accordingly, is to provide new and improved electrical igniters for setting off explosive charges in bore hole equipment or the like that can be put in place after the explosive charges have been loaded into the equipment.

Another object of the invention is to provide new and improved electrical igniters of the above character that can be readily assembled in the bore hole equipment, even under field conditions.

A further object of the invention is to provide new and improved electrical igniters of the above character which include in a unitary assembly all of the elements necessary for proper ignition of an explosive charge.

Still another object of the invention is to provide a new and improved electrical igniter of the above character having a given resistance which

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remains constant even after the igniter has been inserted in an explosive charge.

In accordance with the invention, electrical igniter means is provided which comprises an igniter element either partly or wholly enclosed in an envelope of sufficient strength to enable it to be forced into an explosive charge without damage to the igniter element. Preferably, the envelope is made of electrically conducting material to which one end of the igniter element is connected, its other end being connected to a conductor extending through the envelope and insulated therefrom. The envelope may be inserted into an explosive charge in bore hole apparatus through a port therein, suitable packing material being employed to insure watertightness.

The invention may be better understood from the following detailed description of several representative embodiments thereof, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a view in longitudinal section of electrically operated igniter means constructed according to the invention;

Fig. 2 is a view in transverse section of gun perforator apparatus equipped with electrical igniter means of the type shown in Fig. 1; and

Figs. 3 and 4 illustrate two other modified forms of electrical igniters constructed according to the invention, respectively.

In the exemplary embodiment shown in Fig. 1, the igniter comprises a thin hollow tube 10, preferably made of strong conductive material such as aluminum, for example. The tube 10 is provided with a sharp pointed tip 11 at one end thereof and a laterally extending flange 12 at its other end. The tube 10 is preferably cut slantwise at the tip 11 to enable it to be forced through sturdy materials with ease. Mounted in the tube 10 and insulated therefrom by suitable insulating material 14 is a conductor 13. A filament wire 15, preferably of known resistance, is connected between the tip 11 of the tube 10 and the conductor 13. By passing electric current of proper intensity between the conductor 13 and the tube 10, the filament 15 can be heated sufficiently to ignite an explosive charge in the immediate vicinity thereof, as is well known in the art.

The igniter may be adapted to be mounted in an adapter 16 having external threads 17 and a laterally extending flange 18. The adapter 16 also has a bore 19 of sufficient diameter to accommodate the tube 10, which communicates with a bore 20 of larger diameter, a shoulder 21

being formed therebetween. The tube 10 is adapted to be inserted through the bores 23 and 19 until the flange 12 is seated on the shoulder 21. The tube 10 should preferably be crimped in several places to insure good electrical contact with the adapter 16. A washer 22 of nonconductive material such as rubber, for example, may be inserted around the conductor 13 and tightly fitted into the bore 20 in the head of the adapter 16. The conductor 13 may be further covered with insulating material 23, if necessary.

By way of example, a transverse section of a gun perforator equipped with an electric igniter according to the invention is shown in Fig. 2. For a more detailed description of the perforator, reference is made to the applicant's copending application Serial No. 128,386, filed November 19, 1949, for "Electrical Firing System for Explosively Operated Bore Hole Tools."

Referring now to Fig. 2, the perforator comprises a long cylindrical housing 24 which is preferably fashioned from steel, containing a threaded cavity 25 into which a gun barrel 26 is adapted to be fitted. The gun barrel 26 has a gun bore 27 therein and its rear portion 28 cooperates with a cavity 29 in the housing 24 to form a chamber 30. The chamber 30 is adapted to receive an explosive charge 31 encased in a plastic container 32. The gun bore 27 is adapted to receive a bullet assembly 33. Formed in the housing 24 is a laterally extending bore 34 into which is threaded an adapter 16, gasket means 35 being inserted under the flange 13 to insure a watertight joint. Electrical energy is adapted to be supplied to the igniter by an insulated conductor 36 mounted in a groove 37 formed in the outer wall of the housing 24.

The perforator is loaded by removing the gun barrel 26, inserting an explosive charge 31 into the chamber 30, and replacing the gun barrel 26. An igniter assembly of the type shown in Fig. 1 is then inserted through the bores 20 and 19 in the adapter 16 until the pointed tip 11 of the tube 10 pierces the explosive charge container 32 and the igniting filament 15 lies well within the explosive charge 31. The washer 22 is forced tightly into the bore 20 in the adapter 16. The end 38 of the conductor 13 is preferably pointed and inserted through the insulation on the conductor 36 to bring it into electrical contact with the conductor 36. Since the source connectable to the conductor 36 has a grounded terminal, the conductive housing 24 also being grounded, it will be understood that a firing circuit to the filament 15 is now prepared. The bullet assembly 33 may now be inserted in the gun bore 27 whereupon the entire device is ready to be lowered into a bore hole.

The washer 22 in the adapter 16 and the gasket 35 prevent the bore hole fluid from entering the chamber 30 through the port 34. A gasket 39 between the gun barrel 26 and the housing 24, and a stopper 40 which forms part of the bullet assembly 33 prevent fluid from entering the chamber 30 through the main gun opening.

When the housing 24 has been lowered to the proper level in a bore hole (not shown), a current source is applied between the conductor 36 and ground. This causes the igniter filament 15 to heat up sufficiently to set off the explosive charge 31, thereby discharging the

projectile 41 in the bullet assembly 33 at a high velocity from the gun bore 27.

It is assumed, of course, that part of the explosive charge 31 was forced up into the tube 10 around the filament 15 when the tube 10 was forced into the charge 31, so that heating of the filament 15 resulted in ignition of the charge 31. It may be desirable, however, to coat the igniter filament 15 with a varnish or other suitable material containing particles of finely divided explosive material which will ignite when the wire 15 is heated, thus insuring more uniform and effective ignition of the charge.

If the container 32 is very thick or if the charge 31 is firmly packed, it may be desirable to employ the embodiment shown in Fig. 3, which offers more protection for the igniting filament 15. In Fig. 3, the hollow, conductive tube 10 has a broad, sharp tip 42 fashioned thereon, which prevents any external pressure from being exerted on the filament 15 as the tube 10 is forced into an explosive charge. The tube 10 may be provided with small ridges 43 or the like to insure good electrical contact with the adapter 16. Also, an opening 44 may be formed in the tube 10 to provide communication between the explosive charge and the filament 15, so that when the latter becomes heated sufficiently, the charge will be set off.

Where the explosive charge is firmly packed, the tip 42 of the tube 10 may leave a hollow therein as it is forced into the charge, so that the igniter 15 may not come into contact with the charge at all. For this reason, it is preferred, in the embodiment of Fig. 3, to pack a suitable explosive material 45 around the filament 15 before the tube 10 is forced into the charge. Thus, when filament 15 becomes heated, the material 45 will be ignited and will in turn set off the explosive charge, regardless of how firmly the latter may be packed.

In the embodiment shown in Fig. 4, the filament 15 is wholly enclosed by a tube 46 and is surrounded by explosive material 47. Thus, when the tube 46 is inserted in an explosive charge and current is passed through the igniter 15, the explosive material 47 will be ignited, destroying the tube 46 and setting off the main explosive charge. It will be observed that the filament wire 15 in Fig. 4 is well protected from exterior forces which might tend to break it. If desired, particles of conductive material which becomes heated when current is passed therethrough may be incorporated in the explosive material 47 in Fig. 4. In such case, the filament 15 can be eliminated since the passage of current from the conductor 13 to the tube 46 ignites the charge 47 which, in turn, sets off the main explosive charge in which the tube 46 has been placed.

From the foregoing, it will be understood that the invention provides novel and highly effective electrical igniters for setting off explosive charges in bore hole equipment, for example. By virtue of the construction outlined above, the igniters may be put in place after the explosive charges have been loaded into the equipment. Further, this can be done easily even under field conditions without damaging the igniters in any way.

It will be understood that the several illustrative embodiments disclosed herein are susceptible of numerous modifications in form and detail within the scope of the invention. The embodiments described and shown in the drawings, therefore, are not to be regarded as limiting the scope of the following claims.

I claim:

1. Electrical igniter apparatus comprising a relatively rigid housing having a pointed end, electrical igniter means or the like disposed wholly within the housing and adapted to be protected thereby, means forming an opening in said housing providing communication between said igniter means and the exterior of said housing, and electrical connections to said igniter means.

2. Electrical igniter apparatus comprising a relatively rigid, conducting housing having a pointed end, an electrical conductor in said housing and insulated therefrom, electrical igniter means or the like in the housing and adapted to be protected thereby, said igniter means having one terminal connected to said housing and another terminal connected to said conductor, and explosive material in said housing and adapted to be ignited by said igniting means.

3. Electrical igniter apparatus comprising a hollow conducting tube adapted to be inserted in an explosive charge or the like and having a pointed end, an electrical conductor in said tube and insulated therefrom, electrical igniter means in said tube having one terminal connected to said tube and another terminal connected to said conductor, and means forming an aperture in said tube providing communication between said igniter means and the exterior of said tube.

4. Electrical igniter apparatus comprising a hollow conducting tube cut slantwise at one end to form a sharp point enabling said tube to be inserted into an explosive charge, an electrical conductor in said tube and insulated therefrom, and an igniting filament in said tube having one terminal connected to the tube near said one end and another terminal connected to said conductor.

5. Electrical igniter apparatus comprising a hollow conducting tube having a sharply pointed portion at one end thereof, an electrical conductor in said tube and insulated therefrom, an igniting filament in said tube having one terminal connected to the tube and another terminal connected to said conductor, means forming an opening in the side of said tube to provide communication between said igniting means and the exterior of the tube, and a body of explosive material in said tube and adapted to be ignited by said igniting means.

6. In bore hole apparatus comprising a body adapted to be lowered into a bore hole and having an explosive charge therein, the combination of means forming a bore in said body extending from said charge to the outer wall of the body, a hollow tubular housing mounted in said bore, said tubular housing having a tip portion the cross sectional area of which is forwardly diminishing to a point to facilitate insertion into said

charge, electrical igniter means confined wholly within said housing in the portion thereof penetrating the charge, and an electrical connection extending from said igniter means to the outside of said body.

7. In bore hole apparatus comprising a body adapted to be lowered into a bore hole and having an explosive charge therein, the combination of means forming a bore in said body extending from said charge to the outer wall of the body, a hollow conducting tube mounted in said bore and having a shaped end for facilitating insertion into said charge, an electrical conductor in said tube and insulated therefrom, electrical igniter means in said tube in the portion thereof penetrating the charge, said igniter means having one terminal connected to said conductor and another terminal connected to the tube, and means forming an aperture in said tube providing communication between said igniter means and the explosive charge.

8. In bore hole apparatus comprising a body adapted to be lowered into a bore hole and having an explosive charge therein, the combination of means forming a bore in said body extending from said charge to the outer wall of the body, a hollow tubular adapter secured in said bore, gasket means providing a watertight joint between said adapter and the bore, a hollow, conducting tube snugly fitted in said adapter and having a pointed end penetrating said explosive charge, packing means providing a watertight joint between the adapter and said tube, an insulated conductor in said tube and extending to the outside of the body, electrical igniter means in said tube in the portion thereof penetrating the charge, said igniter means having one terminal connected to said conductor and another terminal connected to the tube, and means forming an aperture providing communication between said igniting means and the explosive charge.

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