DIELECTRIC PLUG FOR ELECTRICAL INITIATION OF EXPLOSIVES

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INVENTORS.
H. CHESSIN
R. A. SEYBERT

BY
W. A. Duesenberg
O. R. Hodges
R. B. Sherer
ATTYS.
This invention relates to an improved plug for use in electric initiation of explosives. More particularly, it is concerned with an electric primer in which the energy to ignite the main explosive charge is supplied by an electrical breakdown across a dielectric.

The application is a divisional application of my co-pending parent application Serial No. 668,822, filed June 28, 1957, which has matured into Patent No. 2,996,944.

Electric primers in general utilize a Joule type heating element which may take the form of a hot wire bridge, for example. These primers are designed so that the wire which initiates the explosion operates rather efficiently as a heating element when a current flows through it. It has recently been determined that the detonation caused by these electrical primers is due mainly to their inherent tendency to spark or arc as the wire is severed and only secondarily to the heating action of the hot wire.

Accordingly, it is an object of the present invention to provide a new and improved electric primer that is designed to operate as a sparking detonator to more efficiently utilize the input energy.

Another object is to provide a method of making a non-reusable dielectric plug for the electrical initiation of explosives in which the operating characteristics of the plug may be accurately determined to suit the intended use by varying certain steps in the production process.

A still further object is to provide a new and improved electric primer useful in detonating an explosive bomb or weapon which primer may be produced inexpensively on a large scale.

Yet another object is to provide a frangible capacitor having a dielectric formed integral with one of the conducting leads of the capacitor and adapted to physically breakdown to produce a sparking spark upon application of a predetermined voltage.

An even further object is to provide a method of manufacturing a capacitor having a rupturable conducting portion and adapted to physically breakdown to produce an initiation spark upon electrical breakdown of the dielectric.

These and many other objects will become apparent when the following specification is considered in conjunction with the attendant drawing in which like numerals designate like parts throughout the various views and in which:

FIG. 1 is a perspective view of the primer of this invention during an intermediate step in the process of manufacturing the primer according to a preferred embodiment thereof;

FIG. 2 is a view of the completed primer partly in section; and

FIG. 3 is a greatly magnified fragmentary view of the firing portion of FIG. 2.

Referring now particularly to FIGS. 1 and 2, numeral 10 generally designates the dielectric plug or primer which includes a wire or rod 11 encased at one end portion thereof in a suitable insulating sleeve or cylinder 12 which adheres tenaciously to the rod. As shown more clearly in FIG. 3, the end of wire 11 terminates at one face of the insulator 12 so that it is coplanar with this face. A layer of dielectric 13 is deposited on this end of the wire 11 and a thin coating of metal 14 lies upon the dielectric layer so that the end of wire 11, dielectric 13 and the metal coating 14, form a rupturable capacitor. When sufficient voltage is applied across this capacitor, the dielectric 13 will break down causing a spark or arc discharge between the end of wire curve 11 and coating 14 of sufficient energy to rupture the thin coating 14. This spark in turn detonates a conventional detonator explosive 16 which is advantageously placed contiguous with the metal foil 14 of the dielectric plug to initiate the main explosive. It is to be understood that the dielectric 13 and metal coating 14, as shown in the drawing, are greatly exaggerated and out of proportion so as to more clearly illustrate the interrelational disposition thereof. In actual practice both the dielectric 13 and the coating 14 are extremely thin and the dielectric overlying the end of wire 11 extends beyond the diameter of this wire a distance greater than the thickness of the dielectric to assure that electrical breakdown takes place across the thickness of the dielectric rather than across the surface 15. The associated electronic circuitry for applying the firing voltage across the dielectric between lead 11 and the conducting film 14 forms no part of this invention and may be of any conventional design. For this reason, it is not herein more completely described or shown in the drawing.

The dielectric plug is fabricated by molding a plastic, glass or other rigid insulator suitable for the purpose around a portion of a conducting wire 11 so that one end of the wire is completely encased in the insulating material 12. The insulating material is now ground to form a face perpendicular to the wire 11. By continuing to grind this face a surface 15 is formed coplanar with the end of wire 11. At this stage in the process the primer has the appearance shown in FIG. 1.

The face 15 of the plug is now treated chemically or electrochemically to form a dielectric layer 13 which covers this face and the end of wire 11, FIG. 3. This step may consist of the chemical deposition of a suitable compound or salt, or it may consist of the chemical or electrochemical reaction of the end of the metal wire with an appropriate reactant. For example, the end of wire 11 may react with a sulfide or polysulfide to form a layer of the metal sulfide or the end of the wire may be phosphated or anodized. In short, any process which forms a layer of dielectric bonded to the end of wire 11 may be used.

The thin electrically conductive layer 14 is now deposited over this dielectric 13. This may be done in several ways as by pressing on a thin metal foil or evaporating or painting a metal film on face 15 and the dielectric 13. Evaporating the metal film is the preferable manner of accomplishing this however because it forms an extremely thin conducting film which allows good physical and thermal contact between the spark and the detonator explosive indicated at 16 when the film 14 is ruptured by the spark or arc as the dielectric 13 breaks down.

It is apparent that by altering the thickness of the dielectric 13, it is possible to obtain breakdown of the dielectric at any desired voltage level. Since the voltage at which the dielectric breaks down controls the intensity of the spark it is possible, merely by varying the thickness of the dielectric, to alter the firing energy of the plug 10 to suit the particular detonator explosive.

The following example is given by way of illustration only and is not to be construed as limiting this invention in any manner.

Example

One end portion of an inch length of B and S 24 gauge
soft aluminum wire was molded into a thermosetting plastic 3/8” slug so that the wire is perpendicular to one face of the slug. This face is ground with progressively finer emery paper then polished with buffing compound. This exposed end of the wire is anodized to form the dielectric layer indicated at 13 in the drawing. The piece is now washed in water and air dried. Finally, a layer of aluminum metal is deposited on the face of the slug by evaporation from a coated hot tungsten filament at a pressure of less than one micron of mercury.

The slug face is buttered with detonator explosive in a binder and upon application of a firing voltage to the other end of the aluminum wire 11, the dielectric 13 breaks down; the resulting spark ruptures film 14 and initiates the detonator explosive.

Although only one embodiment of this invention has been described, it is obvious to one skilled in the art that it is susceptible of many modifications and variations. It is therefore to be understood that this invention is not to be limited to the modification specifically described but is to be limited only by the scope of the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

A device for the electrical initiation of explosives which comprises an electrically insulating plug having a planar face, a lead wire having a portion of its length disposed within said plug and substantially perpendicular to said planar face, said lead wire having an end terminating in and co-planar with said planar face, a thin dielectric layer covering said exposed end and extending laterally beyond the periphery of said wire and over said planar face a distance greater than the thickness of said dielectric layer, and an electrically conducting coating disposed on said dielectric layer and separated from said exposed end of said lead wire by said dielectric layer.

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