Feb. 4, 1964 H. CHESSIN ETAL 3,120,182

DIELECTRIC PLUG FOR ELECTRICAL INITIATION OF EXPLOSIVES

Original Filed June 28, 1957

FIG.1.

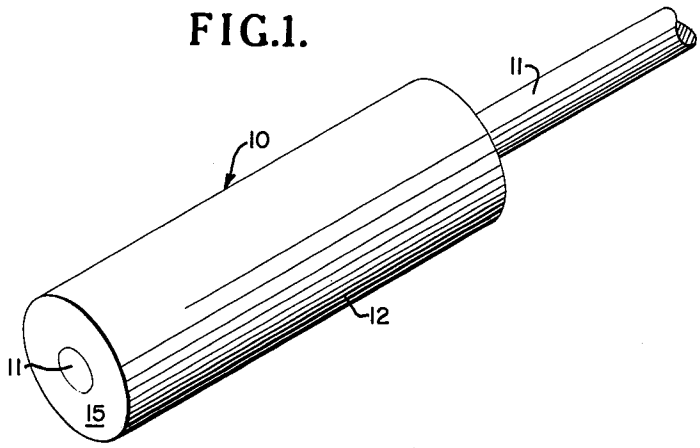


FIG.2.

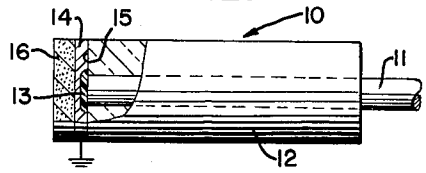
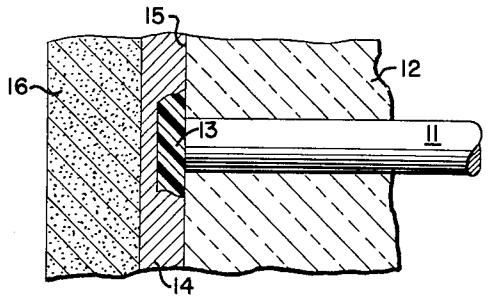


FIG.3.



INVENTORS.
H. CHESSIN
R. A. SEYBERT

BY
W. O. Quesenberry
O. L. Hodges
R. B. Sherer
ATTYS.

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DIELECTRIC PLUG FOR ELECTRICAL INITIATION OF EXPLOSIVES

Hyman Chessin, Olean, N.Y., and Robert A. Seybert, Sherman, Tex., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Original application June 28, 1957, Ser. No. 668,822, now Patent No. 2,996,944, dated Aug. 22, 1961. Divided and this application Dec. 21, 1960, Ser. No. 77,481

1 Claim. (Cl. 102—28)

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.

This application is a divisional application of my copending 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 detonating 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 more 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 co-

planar 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 phosphatized 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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