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Kaszupski

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[54] **ELECTRIC IGNITION ELEMENT WITH SECONDARY IGNITION CAPABILITY**

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[52] **U.S. Cl.** ..... **102/46,** 102/70.2 A

[51] **Int. Cl.** **F42b 5/08,** F42b 9/08

[58] **Field of Search** ..... 102/46, 28 R, 70.2 A

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[57] **ABSTRACT**

An electric ignition element having primary and secondary ignition circuits. If the primary ignition circuit fails, the secondary ignition circuit is activated.

9 Claims, 2 Drawing Figures

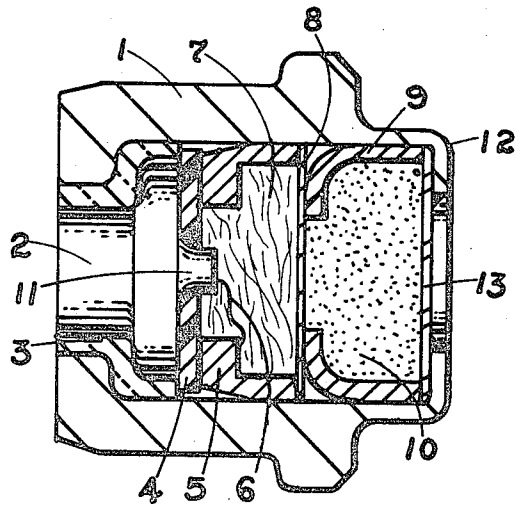


FIG.1

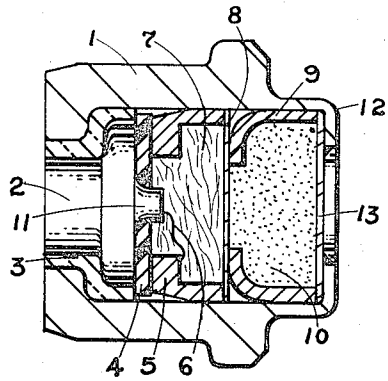
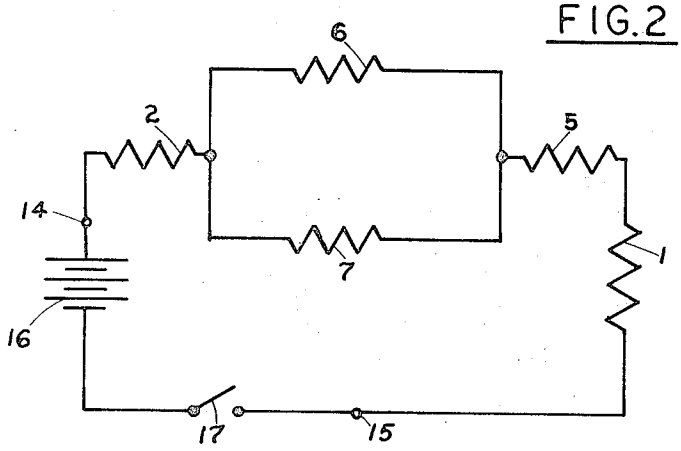


FIG.2



ELECTRIC IGNITION ELEMENT WITH SECONDARY IGNITION CAPABILITY

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

This invention relates generally to ignition elements and specifically to electric ignition elements for activating another device. While not limited thereto, the invention finds special application for igniting the propellant charge in a cartridge for ejecting a rocket or bomb from an aircraft.

There are several common types of electric ignition elements. These include the resistance and exploding wire types and the conductive mix, carbon bridge, and spark gap types. The resistance wire and the exploding wire types are characterized by usually good ignition response and good stability to electrical environments but are susceptible to mechanical environments that might break the wire and cause failure. The conductive mix, carbon bridge, and spark gap types are not susceptible to mechanical environments because no wire is used. However, these electric ignition element designs generally have poor stability to electrical environments. Because of these weaknesses, electric ignition elements are generally considered to have poor reliability.

When higher degrees of reliability are required in electric ignition element applications, redundancy is designed into the ignition system. This is accomplished by designing the ignition element with two wires (in the exploding wire and resistance wire designs) or by employing two ignition elements, either one of which can cause successful functioning of the system. These redundancies serve to increase the reliability of electric ignition element systems.

Increased reliability through the introduction of redundancy, however, introduces other problems. First, redundancy usually introduces increased costs and/or size. Second, because the redundancy usually incorporates two elements of the same type, both can be damaged by the same environments. Third, some redundant systems that use two ignition elements with individual ballistic trains, require ignition of both elements as well as synchronised ignition of both elements to obtain the optimum functioning of the system, requirements often difficult to fulfill. Because of these problems, the concept of redundancy does not always satisfy reliability requirements.

SUMMARY OF THE INVENTION

An object of the invention is to provide an electric ignition element with increased reliability.

Another object of the invention is to provide an electric ignition element with good ignition response.

A further object of the invention is to provide a low-cost ignition element of simple design.

A further, more specific object of the invention is to provide an improved electric ignition element for explosive cartridges.

In accordance with the above objects and considered first in one of its broader aspects, an electric ignition element according to the invention may comprise a housing, an electrically conductive explosive primer powder mix supported by the housing and effective to ignite upon receiving an energizing current, a nonexplosive impedance element in contact with the primer powder mix and effective when energized to ignite the primer powder mix prior to its ignition by an energizing current, and an electric circuit connected for supplying, when activated, energizing current to the primer powder mix and the impedance element.

The invention will be more clearly understood when the following detailed description of the preferred embodiment thereof is read in conjunction with the accompanying drawing which is described below.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of an electric ignition element constructed in accordance with the invention.

FIG. 2 is a schematic diagram of parts of the electric ignition element of FIG. 1, and illustrates the manner of their connection in the circuit of an associated weapon or other apparatus in which the ignition element may be used.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The electric ignition element illustrated in FIG. 1 comprises a housing or sleeve 1 and a center contact 2 which is permanently sealed to the sleeve 1 by means of a solid insulator 3 which, for example, might be formed of glass. An insulating washer 4, which may be Teflon, for example, separates the center contact 2 from a ground ring 5 which makes contact with the sleeve 1. An impedance element, preferably in the form of a resistance wire 6, has its ends connected, as by welding, for example, to the ground ring 5 and to a short extension 11 of the center contact 2 which project through an axial opening in the insulating washer 4 and is in contact with an electrically conductive explosive primer powder mix 7.

The primer powder mix 7 is consolidated in the interior of and in contact with the ground ring 5 and is supported axially by an ignition disc 8 and a support cup 9. The support cup 9 is filled with igniter powder 10, and the entire assembly is sealed by crimping the end portion 12 of the sleeve 1 over a second ignition disc 13.

When the electric ignition element of FIG. 1 is mounted in the apparatus in which it is to be used, such as a weapon, for example, it is connected electrically, as shown in FIG. 2, to input terminals 14 and 15 of an electric circuit associated with the apparatus, the electric circuit comprising a source of energy such as a battery 16 and switch or trigger 17.

The electric ignition element is operated to perform its function in the associated apparatus by closing the switch 17 so as to energize the circuit. This causes the resistance wire 6 to get hot and ignite the primer powder mix 7. Ignition of the primer powder mix 7 causes the discs 8 and 13 to blow and the powder 10 to ignite. If the particular application of the ignition element is in an aircraft which uses a cartridge for ejecting a rocket or bomb, then, in that case, ignition of the powder 10 is used for igniting the propellant charge in the cartridge.

If the resistance wire **6** should initially be broken prior to or upon closing of switch **17**, the primer powder mix **7** will get hot to the point of ignition, however, the resistance wire **6** will still conduct to some extent due to a portion of the primer powder mix **7** closing the gap at the break in the resistance wire **6.**

By controlling the ratio of resistances of the resistance wire **6** and primer powder mix **7**, the conductive mix **7** is shielded from all electrical environments including the ignition pulse. This results in a threefold effect.

First, in an electrically sound ignition element, the primary ignition mode is always the resistance wire. Second, the mechanical weakness of the resistance wire is compensated for and negated by, the ignition capability of the conductive mix circuit when the wire is broken. Third, the susceptibility of the conductive mix circuit to electrical environments is reduced by the protective shunting effect of a good resistance wire. The resultant ignition element has characteristics of electrical stability and good ignition response common to the resistance wire type of ignition element without the loss of reliability normally attributed to the mechanical weakness of resistance wire systems.

In an exemplary electrical ignition element which was constructed in accordance with the invention, the impedance element or resistance wire **6** had a 1.5 mils diameter and a resistance of **1** ohm, and the primer powder mix **7** had a resistance of 20 ohms. The primer powder mix **7** was composed of 71.5 percent Barium nitrate 23 percent Stabilized Red Phosphorus, and 5.5 percent Graphite.

I claim:

1. An electric ignition element comprising a housing,

an electrically conductive explosive primer powder mix supported by said housing and effective to ignite upon receiving an energizing current,

a nonexplosive impedance element in contact with said primer powder mix and effective when energized to ignite said primer powder mix prior to ignition of the primer powder mix by an energizing current, and

an electric circuit having input terminals coupled to the primer powder mix and the impedance element for supplying energizing current thereto.

2. An electric ignition element according to claim **1** wherein said housing is electrically conductive and connected to one of said input terminals and to said primer powder mix and said impedance element.

3. An electric ignition element according to claim **2** wherein said primer powder mix and said impedance element are connected in parallel.

4. An electric ignition element according to claim **3** wherein the parallel combination of said primer powder mix and said impedance element is connected in series with said housing.

5. An electric ignition element according to claim **4** wherein said impedance element is a resistance wire.

6. An electric ignition element comprising an electrically conductive sleeve,

an electrically conductive tubular ground ring supported in the interior of and in contact with said sleeve,

an electrically conductive explosive primer powder mix supported in the interior of and in contact with said ground ring and effective to ignite upon receiving an energizing current,

an electrically conductive contact member supported in the interior of said sleeve and having a portion in contact with said primer powder mix,

a nonexplosive impedance element connected to said ground ring and said contact member and effective when energized to ignite said primer powder mix prior to ignition of the primer powder mix by an energizing current, and

an electric circuit for providing energizing current to said primer powder mix and said impedance element, one input terminal of said electric circuit connected to said contact member and another input terminal of said electric circuit connected to said sleeve.

7. An electric ignition element according to claim **6** wherein said impedance element is a resistance wire and is embedded in said primer powder mix.

8. An electric ignition element according to claim **6** wherein said impedance element and said primer powder mix are connected in parallel.

9. An electric ignition element according to claim **6** wherein said impedance element and said primer powder mix are connected in parallel and the parallel combination connected in series with the contact member, the ground ring, and the sleeve.

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