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3,306,202

ELECTRIC INITIATOR

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Fig. 1

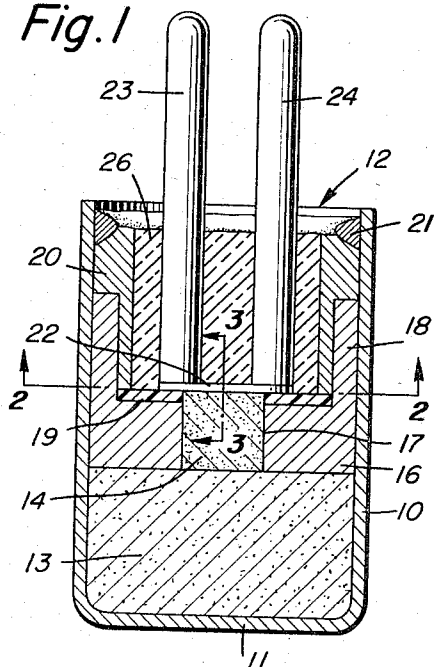


Fig. 2

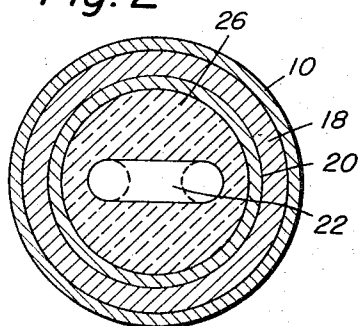
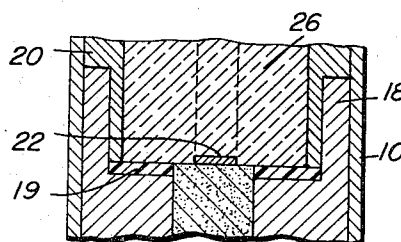


Fig. 3



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ELECTRIC INITIATOR

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2 Claims. (Cl. 102—28)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to electric initiators for explosives, and more particularly, to an improved electric initiator for explosives which is relatively insensitive to spurious signals and radiated electrical fields.

The purpose of the present invention is to provide an electrically initiated timer, detonator, squib, or igniter which is insensitive to the application of electrical energy at powers below a predetermined level which is above the level usually required to fire such devices. Requirements of the equipment in which the present initiator was intended to be used dictated that the device be completely safe upon the application of currents below 1 ampere or 1 watt of electrical power, whichever happens to be greater, and will always function when currents of 5 amperes or a power of 5 watts of electrical energy and above are applied, whichever is smaller. These limits are illustrative only and are not to be read in a limiting sense. As will be more apparent from the detailed description to follow, the limits may be varied by changing the functional relationships between certain parts of the device. In addition to the above, the desired result had to be accomplished without using external heat dissipating electrical media such as the bypass or shunt circuits sometimes employed in the prior art.

Conventional methods of overcoming the problem of premature ignition of electrical initiators have not been satisfactory. Often these systems are complicated and expensive, and in many instances safety is achieved at the expense of reliability. Early electrical initiators of the present character utilized a resistance heating element in combination with a charge of heat sensitive explosive material such as mercury fulminate, lead azide or diazodinitrophenol which in turn initiated a main charge. Initiators of this type are highly susceptible to inadvertent initiation, and many attempts have been made to render them safe. One of the more important solutions which has found wide acceptance in the art involves the use of an insensitive high explosive charge, with a so-called exploding bridgewire as the initiator. The bridgewire will carry relatively high currents which are inadvertently applied to the device but when a high voltage sharp pulse of electrical energy is applied, the wire explodes and ignites the charge. This solution is ordinarily satisfactory, but would not meet the requirements set forth above. Often it is found that inadvertently applied low voltages have heated the bridgewire to its fusing temperature without initiating the explosive, but still rendering the device inoperative from that time on. This is, of course, only one example of devices known to the prior art, but it can be said that no device has been available heretofore which can perform in the required manner as outlined above.

Accordingly, it is an object of the present invention to provide an electrically initiating explosive device which will operate as set forth above and in which conventional explosives are employed.

Another object of the invention is to provide an electrical initiator in which the rate of transmission of heat to a heat sensitive explosive can be more accurately controlled than has been possible heretofore.

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The device according to the invention utilizes conventional explosives, of the heat sensitive type for example, but with specific structure of the electrical elements to provide the desired safety. In particular, the heater element is made of a flat strip of alloy. Lead-in conductors are provided, which contact the heater strip and act as heat sinks. No external heat dissipating mediums are employed.

Other objects and advantages of the invention will occur to those skilled in the art from a reading of the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a cross-sectional view through the device of the invention;

FIG. 2 is a section on line 2—2 of FIG. 1; and
FIG. 3 is a partial section on line 3—3 of FIG. 1.

Referring now to FIG. 1, the electric initiator according to the invention is there shown as comprising a housing or receptacle 10 of conventional type having a closed end 11 and an open end 12. A main charge 13 is contained within the lower portion of the receptacle 10.

The electrically actuated means for initiating the explosion in main charge 13 operates generally in the conventional manner by heating a heat sensitive explosive material by means of an electrical resistance element. The structure of the heating system is different from prior art structures, however, in ways which will largely be obvious from the following description.

A heat sensitive initiator charge 14 of conventional material such as lead azide, for example, is supported in contiguous relationship to main charge 13 in a cup-shaped charge holder 16 which fits within the cylindrical wall of receptacle 10. Charge holder 16 is provided with a central bore 17 and an upwardly extending cylindrical wall 18. An insulating disc 19 is provided to insure electrical insulation between charge holder 16 and the electrical parts of the device.

The resistance heating element of the invented device is indicated at 22. As shown, this resistance element is a flat rectangular strip of suitable metal. In the preferred embodiment, strip 22 is of cupron alloy, although it will be understood that other suitable materials may be employed as desired. In order to supply electrical energy to resistance heating element 22, a pair of lead-in conductors 23 and 24 are provided. These elements contact resistance element 22 at their lower ends. In this manner, heat is transmitted from resistance heating element 22 to the lead-in conductors 23 and 24 so that the lead-in conductors themselves act as heat sinks. Completing the assembly is a body 26 of glass or other material which serves to support the conductors 23 and 24. A metallic sleeve 20 surrounds body 26, permitting the parts to be joined together and sealed by a solder joint 21. Body 26 may also be of material capable of conducting heat away from strip 22, but this is not essential to the invention. The presence of conductors 23 and 24 as heat sinks, provides the desired safety in the device at low values of input current. At such low values, the resistance element 22 will heat up somewhat, but the heat will be conducted away through the lead-in conductors so that the heat sensitive charge 14 is not heated to its detonation point. By making the resistance element flat, the relation between the conduction between the resistance element and the lead-in conductors and between the resistance element and the explosive is variable as hereinafter described. Upon the application of a higher value of current or wattage, the relationship of the lead-in conductors and the heating element is such that the lead-in conductors cannot carry away sufficient heat to prevent actuation of the lead azide initiator charge. Under these conditions, of course, the device detonates.

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As stated above, the use of a flat ribbon or strip as the heating element makes it possible to vary the relationship between the heat loss from the strip to the heat sinks and the heat loss to the explosive. The amount of heat lost to the heat sinks is a function of the cross-sectional area of the strip, since heat cannot leave the central portion of the strip except by conduction through the area of the strip which is effectively in contact with the heat sinks and the effective contact area is the cross-sectional area. The loss to the explosive is a function of the amount of surface area of the strip in contact with the explosive. Thus, for a given cross-sectional area and length of strip, the loss to the heat sinks is constant, and the loss to the explosive can be varied by varying the shape of the cross-section, by varying the thickness and width of the strip, to place more or less area in contact with the explosive as desired. It should also be noted that the rate of heating of strip 22 is a function of the cross-sectional area. It follows that the rate of heating of the strip is fixed for a given cross-sectional area and the relative rate of heating of the explosive can be varied by varying the shape of the strip. By the simple expedient of using a ribbon or strip instead of the conventional cylindrical wire, a high degree of control over the current sensitivity and response time of the device is achieved.

Thus, a device has been described which uses conventional explosives and generally conventional plug structure but which is safe in that it will not initiate upon the application of relatively low current or power but will initiate reliably upon the application of higher values of current or power. This is accomplished without using external heat dissipating electrical media.

Obviously certain modifications and variations of the present invention will occur to those skilled in the art in the light of the above teachings. It is therefore to be understood within the scope of the appended claims the invention may be practiced otherwise than as herein specifically described.

What is claimed is:

1. An electric initiator for explosives which is insensitive to the application of electrical currents or electrical power below a predetermined level which is above the level usually required to fire such devices and which will reliably function when electrical currents or electrical power above another predetermined level is applied, comprising

- a metallic receptacle having a closed end and an open end,
- a main charge of explosive in said receptacle adjacent said closed end,

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- a cup-shaped metallic charge holder having its base in contiguous relation to said main charge and its sidewall contacting said receptacle, said charge holder having a bore through its base,
 - a heat sensitive explosive charge disposed in said bore and in contact with said main charge,
 - an insulating disk in the bottom of said charge holder, said disk having a bore therethrough in axial alignment with the bore in said holder,
 - a resistance heating element spanning the bore in said disk and in contact with said heat sensitive explosive charge, said element comprising a flat strip of conductive metal,
 - a pair of lead-in conductors in contact with said resistance heating element and extending out of said open end of said receptacle for connection to a source of electric power, said lead-in conductors having a predetermined heat capacity and acting as heat sinks,
 - a block of insulating material in which said conductors are embedded, and
 - a metallic sleeve surrounding said block of insulating material and soldered to the inside wall of said receptacle,
- whereby for low values of applied electrical current or electrical power heat will be conducted away from said resistance heating element through said lead-in conductors so that said heat sensitive explosive charge is not prematurely heated to its detonation point.
2. An electric initiator as recited in claim 1 wherein said resistance heating element is made of cupron alloy.

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