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W. B. SMITS

2,708,877

LOW TENSION IGNITER FOR EXPLOSIVES

Filed June 23, 1948

2 Sheets-Sheet 1

Fig. 1.

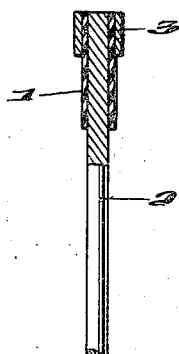


Fig. 2.

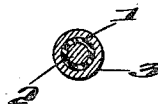


Fig. 3.

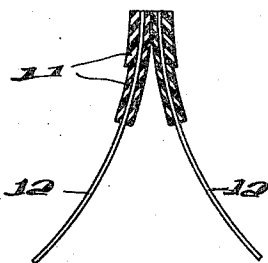


Fig. 4.



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Fig. 5.

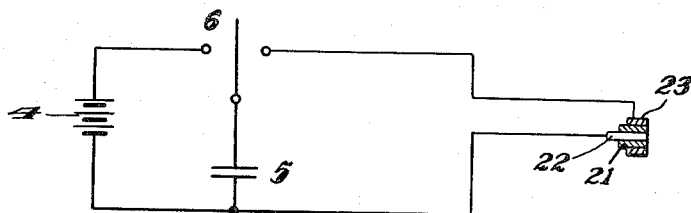


Fig. 6.

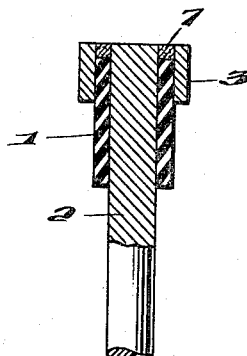
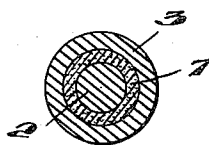


Fig. 7.



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LOW TENSION IGNITER FOR EXPLOSIVES

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4 Claims. (Cl. 102-28)

It is known to ignite explosives by means of a spark or by means of ohmic heat, that is, heat developed by an electric current on passing through a resistor. Furthermore, among others, ignition by means of a striking pin and percussion cap is extensively used for firing guns and the like.

The application of resistance ignition based on the development of ohmic heat requires a certain time for sufficient temperature rise to achieve ignition, which means that always a certain time lag must be reckoned with.

The ignition by means of a spark requires relatively high tensions whereas the ignition by means of a striking pin and percussion cap cannot be used for all purposes and a rather complicated mechanism is needed for its operation.

The object of the present invention is to provide an ignition device working in all circumstances practically without any time lag, and which is very inexpensive and of limited dimensions, enabling its use even where the available space is very limited. Moreover the electric currents necessary to operate this ignition device are of considerably lower tension than those required for ordinary spark ignition.

The ignition device according to the present invention consists in an electric igniter composed of two electrodes with a solid insulating intermediate layer positioned in the spark gap between the electrodes to form a continuous spark supporting surface, said electrodes being adapted to be connected to a condenser to obtain a non-inductive creep discharge thereof between the electrodes across said spark supporting surface. One object of the invention is to provide such a device.

It is of advantage, in order to reduce the electric time lag to a minimum, to keep the self-inductance of the electric circuit as low as possible. The creep discharge of the condenser across the spark supporting surface between the electrodes thus follows practically without any delay upon the establishment of the electric connection between the loaded condenser and the igniter. Another object of the invention is to provide an ignition device which operates substantially without delay.

A creep discharge across the creep supporting spark gap requires lower voltages than an ordinary spark. Moreover a creep spark discharge of a condenser liberates the available electric energy in almost an explosive manner, having thereby an extremely high ignition effect on the explosive charge. This enables use of relatively short spark lengths so that the working tension of such a sparking device can be considerably lower than the tension at which ordinary spark igniters are operated. The working at lower tensions is another object of the invention.

The tensions required to operate the creep spark igniter according to the present invention are of the magnitude of 500-1000 volts when the electrodes are in normal contact with the intermediate layer.

By making the connection still closer, e. g. by sintering or similar processes, it is possible to strongly reduce the necessary ignition tension e. g. to 200 volts or even less, which can be of advantage in many cases. In order, however, to liberate sufficient energy at such low tensions, it is obviously necessary to use condensers of a greater capacity.

The device according to the invention for obtaining

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a creep discharge for igniting explosives is of very simple construction. It comprises two electrodes of a conductive material, preferably a metal, separated by a thin layer of an insulating material. The spacing of the electrodes depends upon the nature of the insulating characteristics of the intermediate layer and the tension used.

In order to enhance the creep conducting qualities of the intermediate layer, a thin layer of semi-conductive material can be applied to its spark supporting surface. The provision of an igniter having such a layer is an object of the invention.

Semi-conductive layers are well-known in low tension sparking arrangements and the manner of forming such layers is also known to those skilled in the art. Reference may be had, for example, to British Patent No. 645,403.

The choice of materials of the igniter depends upon the nature of the explosive to be ignited. In many cases it can be of advantage to make one or both of the electrodes and/or the intermediate layer of combustible or explosive material in order to liberate additional energy.

Thus the electrodes may, for example, consist of magnesium and the insulating material composing the intermediate layer, of paper, Celluloid, gun cotton, or generally of a non-conductive solid combustible or explosive material. The electrode material may also be combined with a substance, with which at adequately high temperature it is capable of forming a compound, viz. potassium chlorate, potassium nitrate, hypochlorites, etc. The provision of such igniters represents another object of the invention.

In the case of ignition by means of a non-explosive electric creep spark igniter, the ignition of the explosive is facilitated by bringing it in direct contact with the active surface of the igniter.

In the case of explosives which are difficult to ignite a small amount of a priming composition, such as fulminate of mercury, lead azide or the like may be used to initiate the explosion. It is of advantage to locate said primers in direct contact with the active surface of the igniter. This, however, becomes unnecessary if the igniter is explosive as set forth above.

The electric creep spark igniters according to the invention present the advantage of being perfectly moisture resistant. Neither are they affected by oil or other impurities. They have a very high working security which is achieved in a very simple and inexpensive way. Another object of the invention is to provide such highly dependable igniters.

As set out already above the igniters according to the present invention work practically without any time lag. Measurements have shown that this time lag is of the magnitude of 10^{-6} second.

The drawings show examples of embodiments of an electric creep spark igniter according to the present invention, and the manner in which it may be connected with the condenser.

In the drawings Figure 1 represents a longitudinal section of an igniter constructed in accordance with the invention.

Figure 2 gives a top view of the apparatus according to Figure 1, showing the surface at which the creep discharge occurs. The reference numerals 2 and 3 indicate the electrodes, and 1 is the insulating material.

Figure 3 represents a longitudinal section of another embodiment of the invention.

Figure 4 shows a top view of the article shown in Figure 3. The numeral 11 represents the insulating material and 12 the electrodes.

Fig. 5 illustrates a wiring diagram of a typical arrangement of the igniter circuit.

Fig. 6 represents an enlarged longitudinal section of another embodiment of the invention. This figure resem-

bles Fig. 1 but is different in that a special layer of a chemically active substance 7 is shown located atop the solid insulator portion 1.

Fig. 7 shows a top view of the apparatus according to Fig. 6, showing the special layer of the chemical substance across which the creeping spark occurs.

Referring now to Fig. 1, the numeral 1 denotes an insulator of a cylindrical configuration which surrounds a central electrode 2. Concentric with the insulator is the outer electrode 3, an end of which is flush with an end of the central electrode 2 as well as the insulator 1. In this manner these three units form a concentric arrangement, terminating so as to form a coplanar, flat tip.

Because the ignition ends of the electrodes are coplanar and the cylindrical insulator therebetween is flush with the ends of the electrodes, the insulator forms a surface across which a spark may easily creep, for the insulation connects the two electrodes mechanically, and no intervening air space is left between the electrodes. It is obvious that there is an infinite number of paths between the two electrodes across which the spark may occur. Since the flush surface of the insulator forms a semi-conductive layer, a path is readily provided so as to support the spark that occurs between the electrodes.

Referring now to Fig. 5, this figure shows one manner of connecting an igniter made according to the invention, there being no novelty in the particular connections used, this system being shown in order to make the working of the device easily understood. The electrodes 22 and 23 of the igniter, separated by the insulating layer 21, are connected with a condenser 5 and a change over switch 6, respectively. When the switch is in the condenser loading position, the condenser 5 is charged from the source 4 of direct or pulsating direct current. By changing over the switch 6, the loading connection is cut and the condenser connected with the igniter discharges itself across the spark supporting surface 21 with a creep spark discharge.

The embodiment shown in Fig. 6 illustrates a modification of the igniter. I have found that when different explosives are to be ignited it may be desirable to vary the composition of the insulator portion 1. I have found, therefore, that if the insulator has on its end surface adjacent the explosive to be ignited and between the electrodes, a special layer 7, a more desirable type of creeping spark may be obtained. During the manufacture of the igniter, layer 7 can be bonded to the surface of the insulator. Such a layer which can be semi-conductive, may be formed from carbon or carbon producing materials. Organic substances could be used which split off carbon as they decompose. Alternatively or in addition, the electrode material may be combined with a substance which at a raised temperature and under high energy development is capable of forming a compound, viz. potassium chlorate, potassium nitrate, hypochlorites, etc. The poles themselves may also be made from an electrically conducting explosive.

As to the electrodes of Figs. 1 and 6, in the case of an ignition by means of a non-burning electrode it is desirable that the explosives are in direct contact with the places at which the surface creepage occurs.

In the case of substances which are difficult to explode, a small amount of an easily exploding substance, such as fulminating mercury, lead azide and the like, may induce the explosion. Said substance, such as percussion mercury, is disposed advantageously in the surface creep path, or pressed against the igniter, respectively.

This is not necessary when the ignition is effected by means of electrodes composed of rapidly burning or exploding substances.

The device according to the invention may be used to advantage in exploding charges for making tunnels, or other works where it is essential to use igniters of high working security and resistant to moisture and impurities.

The perfect working security is especially important for making seismographic observations, for example in order to establish the presence of oil, where the drilling holes may be flooded.

In apparatus for releasing bombs from airplanes, the igniter according to the invention presents great advantages allowing a much better moisture protection of the releasing charge and consequently ensuring a perfect working security, as well as greater accuracy due to the reduction in the time delay introduced by conventional igniters.

The igniter according to the invention may also be used to advantage in firing torpedoes, rockets and rocket propelled units. In torpedoes and rocket propelled units, the ignition of the propulsion charge may be effected with complete working security by means of the creep spark igniter.

A very important application of the invention is the firing of guns, machine guns and the like. In guns the striking pin and percussion cap mechanism are replaced by a creep spark igniter in the cartridge, in which it can be mounted in a simple manner, the poles making contact with the terminals of the condenser circuit when the breech mechanism is closed. The conductors to one of the poles can be advantageously formed by the mass of the gun and of the cartridge. Particularly in warships with central fire control said device presents the advantage of a rapid transmission of the electrical impulse controlling the firing of the guns, as in this case a direct contact is used in which salt water has no influence and mechanical operations are eliminated.

In remote controlled mines the ignition mechanism according to the invention may likewise be used to advantage and as the device is shock and heatproof, ammunition and the like fitted with it may be handled and stored with great safety.

I claim:

1. A low tension igniter for explosives and for operation by discharge of an electrical condenser, said igniter comprising two concentric electrodes and a solid cylindrically shaped insulator positioned between said concentric electrodes and connecting them mechanically and having one surface flush with the spark generating ends of said electrodes to provide a supported spark gap, the flush surface of said insulator being formed as a semi-conductive layer providing a continuous spark supporting surface positioned between said electrodes.

2. A low tension igniter for explosives and for operation by discharge of an electrical condenser, said igniter comprising two concentric electrodes and a solid cylindrically shaped insulator positioned between said electrodes and connecting them mechanically and having one surface substantially flush with the spark generating ends of said electrodes to provide a supported spark gap, and a semi-conductive layer disposed on said surface and providing a continuous spark supporting surface positioned between said electrodes and flush with the spark generating ends of said electrodes.

3. In an igniter as defined in claim 1, at least one of the constituent parts thereof consisting of combustible material.

4. In an igniter as defined in claim 1, at least one of the constituent parts thereof consisting of explosive material.

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