

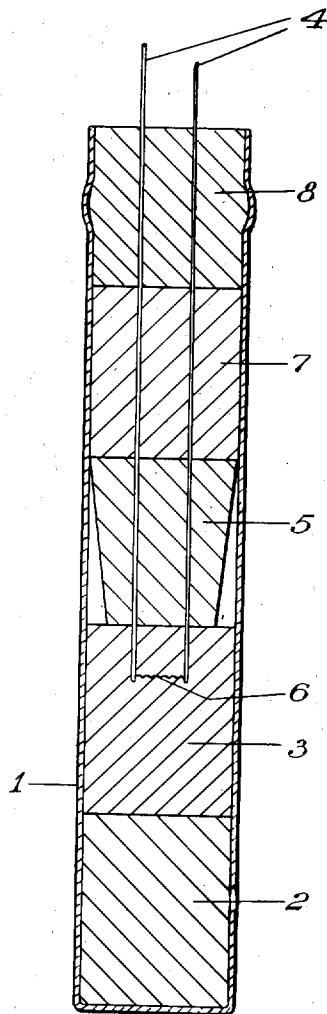
Jan. 14, 1941.

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2,228,339

ELECTRIC SQUIB

Filed Nov. 19, 1936



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UNITED STATES PATENT OFFICE

2,228,339

ELECTRIC SQUIB

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Application November 19, 1936, Serial No. 111,581

7 Claims. (Cl. 102—10)

The present invention relates to electric squibs and to improved ignition compositions for the same. It has particular application to means for the prevention of misfires when squibs are fired in series.

As is well known, electric squibs are employed in igniting deflagrating explosive compositions, for example black powder, where the nature of the explosive is such that it is desirable to effect initiation by means of a flame rather than by a detonator, as is the case with dynamites and other high explosives. It is common to employ electric current for firing the squibs.

The electric squibs known to the art generally consist of a shell or tube of metal or other material, a deflagrating explosive charge enclosed therein, and an electrical firing element. The latter element is desirably formed by passing two leg wires through a mass of insulating material which closes the shell, and joining the ends of these wires within the shell. The joiner is effected by means of a highly resistant connecting wire which is heated to incandescence with the passage of electric current therethrough. This bridge wire is imbedded in the ignition charge so that the passage of current through the circuit causes the charge to deflagrate. When the squib is fired thus, the flame plays upon the explosive charge to be ignited.

Delay electric squibs differ from the ordinary electric squibs in that the firing element is separated from the chief deflagrating charge by a column of material having a uniform rate of combustion, and serving as a delay element.

Electric squibs and delay electric squibs may be either vented to provide an escape for gases, or ventless to keep out moisture.

The ignition composition for electric squibs should possess low and uniform firing current properties, and the ability to develop, on combustion, a hot flame of considerable duration, especially when wet working conditions prevail. While many ignition compositions possess one or the other of these necessary properties, it is a fact well recognized in the art that a few are available which have both of these characteristics to the desired degree. In addition, the ignition compositions in present use, which even approximate the type desired, exhibit properties which lead to further difficulty. It is generally true that compositions which furnish the desirable hot flame of considerable duration are relatively slow in initiation. This property results in numerous misfires, when squibs charged with such compositions are fired in series.

The object of the present invention is a new and improved electric squib. An additional object is a new and improved electric squib such that difficulties in series firing are obviated. A further object is an electric squib containing a slow ignition charge, which may be satisfactorily fired in series. Another object is an electric squib containing an improved bridge wire such that misfires in series are prevented. Further objects will be apparent as the invention is hereinafter described.

We have discovered that misfires in series may be practically eliminated by selecting a bridge wire so characterized that the time required for fusion thereof is sufficiently greater than the period of initiation of the charge that certainty of firing in series is assured.

A possible explanation of the mechanism causing misfires when squibs are shot in series, is that the circuit is broken before all the ignition charges therein have been initiated. On first consideration it might appear that if a squib would fire alone it would likewise fire in series. However, this is not the case. Certain irregularities invariably occur in the large scale manufacture of squibs. It is impossible to maintain an absolute uniformity in the compositions and amounts of materials employed. As a result certain very minute variations occur in the composition and structure of the bridge wire, and likewise in the composition of the ignition charge. Due to such variations, some bridge wires, supposedly uniform, will fuse after a shorter period of application of the current than the average wire. Some of the ignition charges will require longer than the average time to initiate, due to variation or segregation of the components therein. If such a defective wire happens to be introduced into the same squib with such an irregular charge, the squib might misfire even if shot alone. But if such a wire occurs in one squib of a group connected in series, and such a charge be present in one or more squibs in the series, misfires may occur in the squibs having the irregular charges, whether or not any misfire occurs in the squib having the defective wire. The effect of firing in series is to combine the effect of an imperfect bridge wire with that of the irregular charge. As soon as the fastest bridge wire of the series burns through, the circuit is broken, and any charge in the series, which has not had time to be initiated, will result in a misfire. Naturally such a difficulty will be present chiefly in squibs which employ igni-

tion mixtures which are inherently slow in initiation.

We have discovered that, by selecting a bridge wire which is slow to fuse, slow ignition charges 5 desirable for their other qualities may be satisfactorily fired in series without the usual misfires. We prefer to employ for this purpose a wire made from an alloy of nickel and chromium, and having a diameter of approximately 0.00225 10 inch. Although this type of wire is satisfactory for any squib, it solves the specific problem of the squib which contains an ignition charge capable of initiation by electrical means but which undergoes initiation so slowly that misfires 15 occur when such charges are fired in series. We prefer to employ the bridge wire of our invention in conjunction with what we shall designate as the "slow ignition charge." In order to avoid repetition and preserve clarity, the term 20 "slow ignition charge," as used in the specification and claims of this application, is hereby defined to mean, "an ignition charge capable of initiation by means of a standard 80% platinum, 20% iridium bridge wire having a diam- 25 eter of 0.0015 inch, but which undergoes initiation so slowly that misfires occur when such charges are fired in series by means of such wire."

We have found that the use of a bridge wire 30 which is slow to fuse is particularly advantageous when employed in a squib having our preferred ignition charge comprising a loose blend of ground smokeless powder and black powder. We make no claim to the use of this charge in squibs generally herein, but such is claimed in the copending application, Serial No. 111,583, filed November 19, 1936, which application has now matured 35 into Patent 2,118,533. A blend of approximately 40% black powder and 60% ground smokeless powder may be used to illustrate the properties of the improved ignition composition. Such a 40 composition is desirable in view of its standardized firing current of about 0.330 ampere, high rate of deflagration once it has been initiated, 45 and its hot flame of long duration. When combined with the bridge wire of the present invention, charges of this composition may be fired satisfactorily in series. In addition to the foregoing, it has been found advantageous to employ 50 said bridge wire in squibs containing any suitable slow ignition mixture, and especially desirable with such loose charges as blends of ground smokeless powder and an oxidizing agent, or ground smokeless powder, an oxidizing agent and 55 at least one finely divided metal. As examples of metals, the following are suitable: aluminum, tellurium, selenium, zirconium, magnesium and the like. Sulfur or calcium silicide may be substituted for the metals in the foregoing, if desired. Any 60 suitable oxidizing agent may be employed, such as potassium chlorate, potassium nitrate, barium nitrate, and barium peroxide. No claim is made herein to the use of the foregoing compositions as ignition agents in squibs generally, but such 65 is claimed in copending application, Serial No. 111,582 filed November 19, 1936.

In order to describe our invention more clearly, we shall refer to the attached drawing, which 70 is a view in vertical cross section of an electric

squib. The numeral 1 represents a shell of any suitable material such as metal, for example, copper, aluminum or the like. At the bottom of the shell is placed a base charge 2 of black powder, suitably pressed into the shell. This is covered 5 by a loose slow ignition charge 3. The leg wires 4 are held in position by the plug 5, and are joined by the bridge wire 6, comprising an alloy of 80% nickel and 20% chromium, having a diameter of 0.00225 inch. The squib is closed by 10 means of a waterproofing composition 7, and a sulfur seal 8.

It is to be understood that the foregoing embodiment is cited by way of illustration only, and is not to be construed as limiting our invention in 15 any way. While we prefer to employ a squib of the ventless type, the principles of the invention apply equally well to the vented type. Although the ordinary electric squib is depicted, our invention is satisfactorily applied to the delay 20 electric squibs, as described in the foregoing.

As many widely different embodiments of this invention may be made, we intend to be limited only by the following claims.

We claim:

1. An electric squib comprising a metal shell, a slow ignition charge selected from the group consisting of charges comprising smokeless powder and an oxidizing agent, charges comprising 30 smokeless powder, an oxidizing agent, and a metal, and charges comprising ground smokeless powder and a black powder, and a bridge wire comprising an alloy of nickel and chromium having a diameter of at least approximately 0.00225 inch, whereby certainty of firing is assured under 35 conditions prevailing in series firing.
2. An electric squib especially adapted for series firing comprising a bridge wire and a slow ignition charge, said bridge wire being selected for its cooperation with said ignition 40 charge, said ignition charge being characterized by a period of initiation at least equal to that of a standard blend of 40% black powder and 60% ground smokeless powder when the latter is fired with a current of 0.330 ampere through a standard 45 80% platinum, 20% iridium bridge wire having a diameter of 0.0015 inch, and said selected bridge wire being characterized by a rupture time substantially in excess of the aforesaid period of initiation of said charge. 50
3. The electric squib of claim 2 wherein said selected bridge wire comprises an alloy of approximately 80% nickel and 20% chromium having a diameter of 0.00225 inch.
4. The electric squib of claim 2, wherein the 55 loose ignition charge comprises a solid aliphatic nitric ester.
5. The electric squib of claim 2, wherein the loose ignition charge comprises ground smokeless powder and black powder. 60
6. The electric squib of claim 2, wherein the loose ignition charge comprises ground smokeless powder and an oxidizing agent.
7. The electric squib of claim 2, wherein the 65 loose ignition charge comprises ground smokeless powder, an oxidizing agent, and a metal.

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