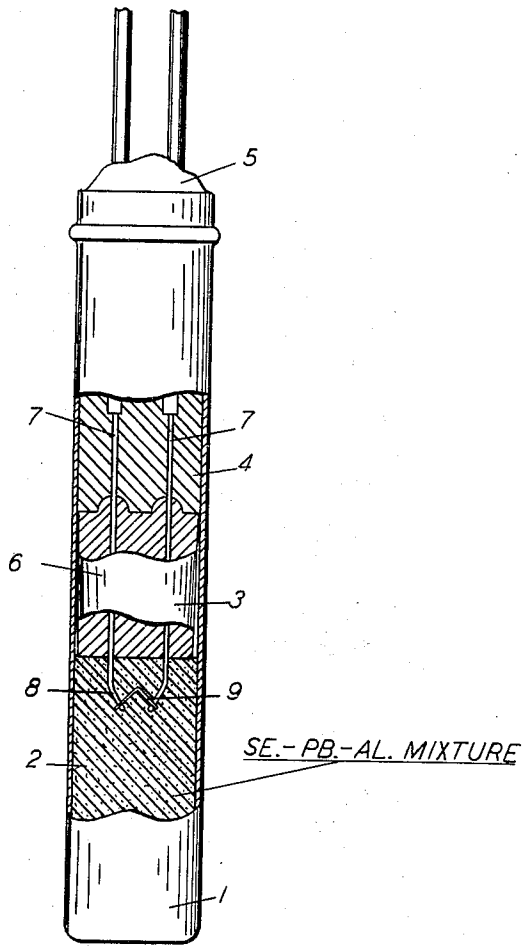
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ELECTRIC SQUIB

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ELECTRIC SQUIB

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This invention relates to improvements in electric squibs and more particularly to squibs containing an improved flame producing mixture.

Electric squibs are useful in igniting deflagrating explosive compositions, where initiation of the explosive is brought about by means of a flame. The use of an electric current for firing these squibs displays obvious advantages over the older fused methods. The electric squibs known to the art generally will comprise a metallic shell of the vented or ventless type with an explosive igniting charge therein, a firing assembly including a bridge plug positioned to initiate the charge, a water-proofing material, such as asphalt, tar, or the like above the bridge plug and a sealing compound usually sulphur above the water-proofing material.

The prior art squibs may comprise a charge made up of three components, a base charge, an ignition charge and a sensitive explosive charge. Initiation of the base charge is affected through the ignition charge which in turn is initiated by the sensitive explosive contained either in a concave portion in the base of the bridge plug or as embodied in a match head construction familiar to those in the art. Thus, it may be seen that before the electric squib functions in its intended manner, a sensitive explosive usually mercury fulminate, diazo or lead azide is initiated by means of a heated bridge wire, which in turn initiates an ignition charge, which in turn initiates the base charge. The base charge in the case of ventless squibs ruptures the shell in some manner or another thereby permitting the squib to eject a flame which then initiates the deflagrating explosive composition. In the case of vented squibs, the explosive charge of which is entirely contained either in a concave portion in the base of the bridge plug or in a match head form, the initiated charge produces flames which are ejected out of the shell through the vented portions thereof. Moisture is a problem in the case of the vented squib and many attempts have been made to remedy this moisture defect as, for example, by using a base charge and a closed metal shell, the base charge operating upon initiation to rupture the shell in some manner as by splitting or melting. However, base charges of this type are normally initiated by a series of more sensitive explosives as hereinbefore described.

It is an object of this invention to provide a ventless electric squib having a flame-producing charge directly ignitable by means of a bridge wire.

Another object is to provide a ventless electric squib having a flame producing mixture comprising an admixture of selenium and lead or tin and a flame producing ingredient present in an amount sufficient to produce a squib having firing characteristics superior to prior art devices and sufficient to permit rupture of the shell.

A still further object is to provide an electric squib having a directly ignitable single charge which operates to prevent failure under firing conditions, to permit use of a ventless type shell, and to provide a deflagrating explosive ignition flame.

Generally described, the present invention comprises a metallic shell closed at one end and opened at the other and containing a single charge disposed in the closed end thereof. The charge comprises a mixture of selenium and tin or lead and a flame producing ingredient as, for example, aluminum present in an amount in about 5% of the total weight of the charge. A firing plug including a pair of leg wires embedded in an insulating material and connected by means of a bridge wire is inserted in the open end of the shell and positioned so that the bridge wire is embedded in the charge. The open end of the shell is then provided with a water-proofing compound and a sulfur seal to complete the assembly of the device.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawing forming a part of the specification, wherein is illustrated a longitudinal view partly in cross section showing the relationship of the firing plug to the single squib charge.

The present invention is embodied in the ventless electric squib of the type shown in the figure which consists essentially of a ventless metal shell 1, a flame producing mixture 2, and an electric firing means indicated generally at 3, which is sealed in the shell 1, by means of a water-proofing compound 4, and sulfur seal 5.

The flame producing charge 2 is positioned in the base of the shell 1 as shown and comprises an admixture of finely divided selenium, lead, and aluminum. The flame producing charge 2 is made up of a two component system, one component of which comprises the lead and selenium admixed and the second component of which may be aluminum.

It has been discovered that the aluminum component or flame producing ingredient of the flame producing charge 2 must be present in an amount from between about 1% and about 7%

by weight of the charge in order to produce a squib which will operate at maximum efficiency. Where less than 1% of aluminum is used, there is a tendency for the charge to function improperly by failing to burst the shell. Where more than 7% of the aluminum is used, the desired results of firing the squibs at a low current consistent with this invention are not obtained. It is preferred to use between about 3% to about 6% of aluminum powder or other suitable flame producing ingredients with the first component of the flame producing charge.

The lead-selenium component of the flame producing charge 2 are combined in chemically equivalent amounts. Thus, a lead-selenium composition may include selenium about 27.6% and lead about 72.4%. Tin may also be used in place of lead and may be present together with the selenium in a quantity equal to the chemical equivalent of the components. Thus, for example, a selenium-tin composition may include selenium about 40% and tin about 60%.

In preparing the components of this flame producing charge, the ingredients will be reduced to a finely divided form and will be intimately admixed by any suitable procedure.

The second component of the flame producing charge 2 consists preferably of powdered aluminum. However, other suitable flame producing ingredients may be used as, for example, such powdered metals as magnesium, zirconium, zinc, or non-metallic ingredients as, for example, nitrostarch, smokeless powder, and black powder.

The firing assembly indicated generally at 3 includes a bridge plug 6, usually made of sulfur and containing a binder such as tar, or the plug may be made of a synthetic resin or rubber through which extends a pair of leg wires 7 in dielectric or insulated relationship with each other. The terminal ends 8 of the leg wires 7 are electrically connected by means of a bridge wire 9 made of platinum or any other suitable high resistant material. The firing assembly is inserted in the open end of the shell 1 and positioned therein so that the bridge wire 9 is disposed or embedded in the charge 2 as shown. The device is then sealed against the entrance of moisture by means of a water-proofing compound 4 and a sulfur seal 5.

The following examples show the advantages of the present flame producing charge over a regular flame producing charge of a prior art squib.

Example	Ignition mixture	Bridge wire resistance	Leg wire terminal centers	Minimum firing current (M. F. C.)	Critical firing current (C. F. C.)
		Ohm/yd.	*Inches*	*Amperes*	*Amperes*
1	Regular [1]	450	0.142	0.50	0.90
2	Pb-Se/Al	450	0.142	0.50	0.50
3	Pb-Se/Al	870	0.100	.35	0.40

[1] Applies to a regular flame producing charge of a prior art squib.

The squibs of Examples 2 and 3 consisted of a 0.267 caliber ventless aluminum squib shell. The flame producing or ignition mixture consisted of a mixture comprising an admixture of lead-selenium in a 72.4/27.6 ratio respectively and powdered aluminum present in 5% of the total weight of the charge. The lead-selenium component of the charge was mixed with the aluminum component by rolling the ingredients on paper. The plug was provided with a platinum alloy bridge wire.

A comparison of Examples 1 and 2 shows a reduction in the critical firing current from 0.90 to 0.50 amperes without changing the value of the minimum firing current. This is important, since it means that more squibs may be shot in series under adverse current conditions than may be shot under similar conditions using the regular ignition mixture of a prior art squib. Tests made on a series of 30 squibs of the type disclosed in Example 3 for failure to fire showed that none failed. This is explained on the fact that the ignition mixture of this invention is relatively slow burning, and hence many more devices in series have an opportunity to become ignited before one fires to break the circuit and furthermore, on the fact that the residue of the burned mixture is electrically conductive. This feature of electrical conductivity permits the device to continue to carry current even after the bridge wire has been burned.

The use of the charge of this invention eliminates the use of the sensitive explosive mercury fulminate, diazodinitrophenol, or lead azide and permits a safer method of manufacturing the squibs of this invention.

From the foregoing description, it is apparent that the objects of this invention have been accomplished by providing a squib having a flame producing charge comprising a 2 component system, used in loose form one component of which consists of an admixture of chemically equivalent amounts of selenium and lead or tin and the other component of which consists of powdered aluminum or other suitable flame-producing ingredients mixed in an amount sufficient to permit firing of the squib under adverse current conditions and to permit bursting of the shell.

What I claim and desire to protect by Letters Patent is:

1. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, and flame producing ingredient, said ingredient being present in an amount between about 1% and about 7% by weight of the total weight of the said mixture.

2. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, and a metallic flame producing ingredient, said ingredient being present in an amount between about 1% and about 7% by weight of the total weight of the said mixture.

3. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, the elements of said mixture being present in substantially chemically equivalent amounts, and aluminum being present in an amount between about 1% and about 7% by weight of the total weight of the said mixture.

4. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, the elements of said mix-

ture being present in substantially chemically equivalent amounts, and aluminum being present in an amount between about 3% and about 6% by weight of the total weight of the said mixture.

5. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, the elements of said mixture being present in substantially chemically equivalent amounts, and aluminum being present in an amount of about 5% by weight of the total weight of the said mixture.

6. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and a metal from the group consisting of lead and tin, the elements of said mixture being present in substantially chemically equivalent amounts, and powdered aluminum being present in an amount of about 5% by weight of the total weight of the said mixture.

7. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and lead present in substantially chemically equivalent amounts, and a metallic flame producing ingredient, said ingredient being present in an amount between about 1% and about 7% by weight of the total weight of the said mixture.

8. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and lead present in substantially chemically equivalent amounts, and aluminum being present in an amount between about 3% and about 6% by weight of the total weight of the said mixture.

9. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and lead present in substantially chemically equivalent amounts, and aluminum being present in an amout of about 5% by weight of the total weight of said mixture.

10. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and tin present in substantially chemically equivalent amounts, and aluminum being present in an amount between about 1% and about 7% by weight of the total weight of said mixture.

11. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and tin present in substantially chemically equivalent amounts, and aluminum being present in an amount between about 3% and about 6% by weight of the total weight of the said mixture.

12. An electric squib comprising a shell, a firing assembly, a flame producing mixture in operating position with said assembly, said mixture comprising an ignition composition consisting of selenium and tin present in substantially chemically equivalent amounts, and aluminum being present in an amount of about 5% by weight of the total weight of said mixture.

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