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IGNITION MEANS FOR AMMUNITION PRIMER OR THE LIKE

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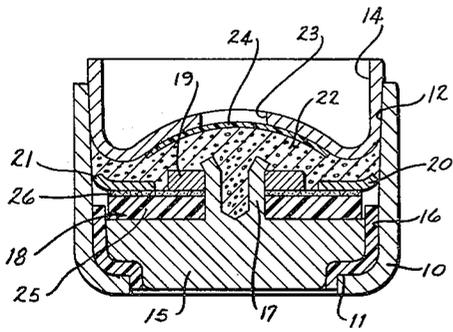


FIG. 1

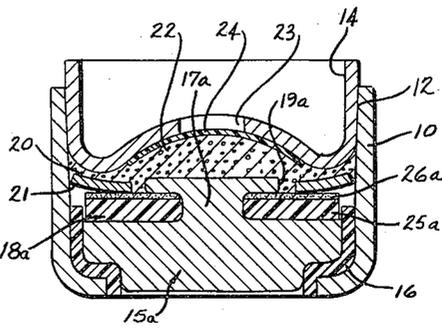


FIG. 3

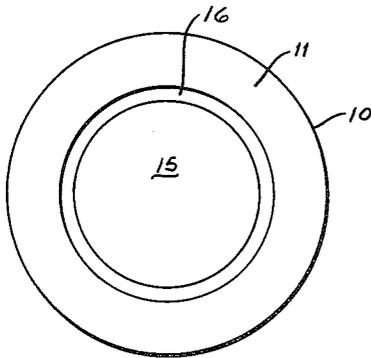


FIG. 2

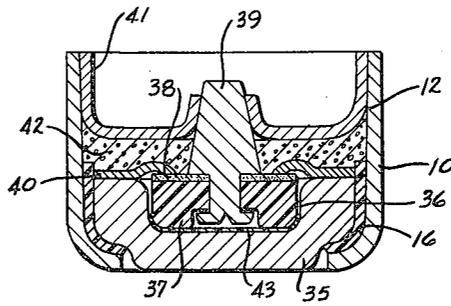


FIG. 4

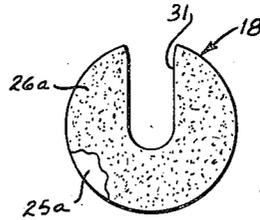


FIG. 6

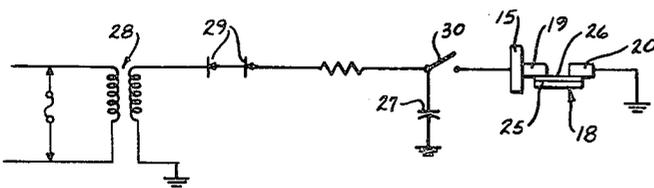


FIG. 5

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**IGNITION MEANS FOR AMMUNITION
PRIMER OR THE LIKE**

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This invention relates to ammunition and more particularly to primer means adapted for use, among others, in igniting a propelling charge, such as for a shell or other type of missile.

One of the objects of the present invention is to provide novel means for electrically igniting a charge of solid or granular materials, such as gun powder.

Another object of the invention is to provide a novel electrically energizable device for igniting a charge of powder or the like which is of simple construction and reliable in operation.

Another object is to provide a novel ammunition primer which may be subjected to testing before installation therein of any explosive or powder to establish the ultimate firing characteristics thereof without danger of damage which might otherwise occur from an explosion during testing.

Still another object is to provide a novelly constructed spark gap device which is useful in electrically energized ammunition primers and other ignition apparatus.

A further object of the invention is to provide a novel ammunition primer or the like which is both dependable and safe.

A still further object is to provide a device of the above character which may be designed to fire without fail upon the application of a predetermined small voltage and yet be safe against firing by static or other electrical charges of sizable energy content capable of firing similar devices heretofore known.

Another object is to provide a novel device of the above character which may be tested for determining the operating characteristics thereof without utilizing specialized measuring instruments.

Another and important object of the invention is to provide a novel ammunition primer which lends itself to being made in small sizes and which may be made in large quantities and in bulk without loss of control over the firing characteristics.

A further object is to provide an ammunition primer or the like which embodies pure powder unmixed with other ingredients, and which is constructed in a novel manner to insure uniform control of the range of applied electrical energy in which the same will fire.

Another object is to provide novel semi-conductive means adapted for use in bridging the gap of a so-called shunted surface type of spark or igniter gap.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

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FIG. 1 is a vertical sectional view, on an enlarged scale, taken along the diameter of a primer adapted for use in 20 mm. case ammunition;

FIG. 2 is a bottom view of the primer of FIG. 1;

FIGS. 3 and 4 are views like FIG. 1 of modified forms of primers embodying the invention;

FIG. 5 is a simplified diagram of one form of electrical circuit adapted for energizing the devices of FIGS. 1, 3 and 4; and

FIG. 6 is a plan view, on a reduced scale and with a surface portion broken away, of the semi-conductor of the device of FIG. 3.

The three embodiments of the invention illustrated in the drawing, by way of example, are in the form of primers of the type adapted to be electrically energized and adapted for use in shells and the like for igniting a larger missile propelling charge of powder. The devices illustrated and the inventive features and parts thereof may, of course, be used in other environments and for other purposes.

In the form shown in FIG. 1, the invention comprises a cylindrical case or shell 10 which is open at both ends but provided at the lower or outer end with an internal flange or shoulder 11. The shell 10 is made of electrically conductive material, such as brass, and the internal diameter of the end portion opposite flange 11 is preferably tapered at 12 for receiving a cover 14. In a primer for 20 mm. case ammunition the diameter of shell 10 may be on the order of about one-third inch.

A primer button or input contact 15 is supported in shell 10 by flange 11 and is electrically insulated therefrom in a known manner by a ring 16 of insulating material which may be flexible to facilitate assembly. Projecting inwardly and axially from the inner face of button 15 is a cylindrical shank or electrode centering post 17. Surrounding the latter and centered thereby are a semi-conductive disc or washer 18, the detail composition and structure of which are hereinafter described, and an electrode disc or washer 19. The elements 15, 18 and 19 are secured together in any suitable manner, such as by rolling or spinning outwardly the outer end of hollow post 17, and may be referred to as the center electrode assembly.

The above described assembly and insulation 16 may be secured in shell 10 in a novel manner which simplifies the manufacturing process and reduces the cost. In the form shown, an outer or ground electrode ring 20 functions as the securing means. Electrode 20 has an inner diameter somewhat greater than the outside diameter of center electrode 19 thereby forming an annular spark gap, the desired width of which will be determined by the available voltage, the nature of the medium in the gap between the electrodes, the properties of the semi-conductor 18 and other factors. The outer diameter of electrode 20 is somewhat greater than the inside diameter of shell 10 so that when the electrode is pressed into the shell, the outer edge of the electrode curls slightly as indicated in FIG. 1. Electrode 20 is then held in firm electrically conductive contact with the surface of semi-conductor 18 by the engagement of the corner 21 of the electrode with the inner wall of the shell. In a primer adapted for a 20 mm. shell, electrode 20, 21 is pressed into position with a pressure of approximately 300 pounds and the radial width of the

gap between electrodes 19 and 20 may be of the order of a few thousandths of an inch. For example, some suitable embodiments may have gaps which are in the vicinity of about .010 inch in width.

The primer construction is completed by pressing a mass 22 of readily ignitable powder between the spark gap assembly and a cover comprising the centrally apertured metallic cap 14 and a sheet 24 of fish paper or the like across the aperture 23. The cover cap 14 has a press fit in the internally tapered portion 12 of shell 10 and may be assembled with a pressure of about 500 pounds. The powder is thus firmly packed and fills the gap space between the outer and inner peripheries of electrodes 19 and 20, respectively. For safety, among other reasons, the powder 22, which is pure and substantially non-conductive electrically, may be wet when it is installed.

Although the semi-conductor 18 may be made in various ways and of a variety of materials known to the art of so-called "shunted surface type" gaps, the present invention contemplates a novel semi-conductor which is especially adapted for primers that must be capable of being consistently fired at relatively low voltage and yet be safe against firing by likely or probable charges of static electricity. In one commercial embodiment which is required to fire without fail when subjected to a voltage of about 190 volts applied to a 4 microfarad condenser, but which must be safe against firing when the same is subjected to a static charge of as much as 200,000 ergs applied energy, the novel semi-conductor used comprises a non-conductive base 25 of glass melamine and a novel semi-conductive or high resistance coating 26 on the surface engaged by electrodes 19 and 20. Said coating may consist of a mixture of fine powdered graphite and a high temperature resistant vehicle, such as silicone varnish. A suitable mixture may comprise microfine graphite as a conductor and silicone varnish as a binder. If it is desired to apply the mixture by means of a spray gun, it may be desirable to add a thinner, such as toluene. One mixture which has proved successful comprises 35% by weight of graphite, 45% SR 32 silicone varnish and 20% toluene. These proportions may be varied for different applications and different gaps. The mixture is applied to the base sheet 25 to a thickness which when dried will provide a uniform coating approximately .004" to .005" thick. The coating 26 may be stepwise cured and baked in an oven at temperatures from 150° C. to 200° C. At the lower temperature the solvent is driven from the mixture and the final drying of the varnish is effected at the higher temperature. The thickness of the base sheet 25 may be of the order of .018" in small units but may vary widely. This type of semi-conductive surface 26 may, with reasonable care in manufacture, be consistently uniformly applied so that the range of applied energy which will result in firing any one of a large quantity of primers can be maintained reasonably constant.

When it is desired to energize or fire a primer constructed in the manner and with the parts above described, a suitable voltage is applied across the electrodes 19 and 20, preferably connecting a charged condenser across the same. Although the voltage normally used may be insufficient to spark across the gap between electrodes 19 and 20 in the absence of the semi-conductive bridge 26 or even in the presence of such bridge the effect of the application of the voltage, such as from a condenser of suitable capacity, is to ignite the powder between the electrodes. This result is presumed to result from the generation of heat and perhaps ionization in the area of the gap. In the case of primers, it is important that the primer will not ignite when subjected to any likely static charge during the handling or use thereof. It is believed that accidental firing by static electricity is best avoided by keeping the resistance of bridge 26 between the electrodes 19 and 20 as low as

possible consistent with attaining the desired result by application of the available energy for firing the primer in a gun. Static electricity applied at high voltage with only small capacity will be rapidly dissipated without creating sufficient heat to ignite the powder 22. Static electricity of the character and in excess of the maximum intensity usually encountered may be simulated by a 20 kilovolt charge across a 400 micro-microfarad condenser capable of applying about 800,000 ergs electrical energy. With the novel construction herein disclosed the resistance across the gap 19, 20 may in large quantity production be consistently kept at a constant or uniform value as low as two or three ohms or even less. Accordingly, such a primer will not be set off by any static charge to which it might normally be subjected and may yet be safely and surely ignited when subjected to the discharge of a four microfarad condenser at a voltage of 190 volts or less. Ignition of the powder in the gap 19, 20 will cause the burning of the entire mass 22. The resulting flame and pressure puncture cover member 24 and ignite an adjacent mass of powder in the casing of a shell or the like which may serve as the propelling charge for the missile or bullet of the shell in which the primer is mounted.

A simplified circuit for energizing a primer of the above type is illustrated in FIG. 5. A condenser 27 of about 4 microfarad capacity may be charged from any suitable source, such as from a source of alternating current through a transformer 28 and rectifiers 29. When a switch 30 is closed to connect the condenser across the electrodes of the primer spark gap, the condenser discharges across the gap through primer button 15, electrode 19, semi-conductive coating 26, electrode 20, and shell 10 to ground. A high energy discharge at a relatively low voltage of less than 190 volts will effectively ignite a sensitive form of gun powder 22. In a gun, the switch 30 usually consists of a retractable pin which engages the primer button 15 only when the breach is closed, ready for firing.

In the modified construction shown in FIG. 3 the center electrode assembly comprises a primer button 15a having a reduced portion 17a and an integral annular electrode 19a. The disc 18a comprising glass melamine layer 25a and a semi-conductive coating 26a, corresponding with the disc 18 of FIG. 1, is provided with a single radial slot 31 having a width equal to the diameter of neck portion 17a. This disc may thus be slid into position under electrode 19a and the latter may be pressed down into firm engagement therewith. The remaining elements of the assembly are substantially the same as corresponding elements in FIG. 1 and bear the same numerals. If desired, the ground electrode washer 20 may be somewhat dish-shaped as seen in FIG. 3.

In the embodiment illustrated in FIG. 4 the ground electrode is in the center and in this respect differs from FIGS. 1 and 3. A primer button 35 is mounted in shell 10 and insulated therefrom by insulator 16. A center electrode assembly is seated in a recess 36 in member 35, the same comprising a ceramic or similar insulating member 37 having a coating 38 of carbon or the like on the upper surface thereof. A center electrode 39 is riveted or otherwise suitably secured in a central opening in insulator 37. A metallic washer 40 is rested on the surface of button 35 and contacts the surface coating 38 in spark gap relation with center electrode 39. Electrode washer 40 is preferably secured to member 35, such as by spot welding, and is made of spring metal to yieldably but firmly engage coating 38. A cover 41 fits into shell 10 and around electrode 39 to retain the powder or other suitable combustible 42. Energy for igniting the powder is derived from current flow from source 27 through button 35, outer electrode 40, carbon coating 38, center electrode 39, cover 41 and shell 10 to ground. The coating may be applied to ceramic member 37 by subjecting the same to the fumes of a burning

hydrocarbon. All surfaces except the top, as viewed in the drawing are then cleaned. To insure against electrical contact between member 37 and contact button 35, a thin layer of insulation 43 may be interposed therebetween.

Although only a limited number of embodiments of the invention have been illustrated in the drawings and described in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. For example, the semi-conductive disc 18 or 18a may be of semi-conductive material throughout or the surface thereof rendered semi-conductive in any other manner known to the art. If desired, the electrode member 40 of FIG. 4 may be secured in position by providing an upstanding peripheral flange on contact button 35 and rolling the flange inwardly over the edge of said member. Various other changes may also be made in the specific design and arrangement of the parts illustrated as well as in the specific materials suggested without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. An ammunition primer or the like comprising a casing, an electrically non-conductive combustible charge in said casing, and a shunted-surface gap assembly in said casing, whereby said charge may be ignited by impressing a sufficient voltage across the electrodes of said gap, at least a substantial portion of the entire space between said electrodes being spanned by means having a substantially flat electrically semi-conductive surface connecting the electrodes and being substantially co-extensive with the cross-sectional area of said space in a plane parallel to and adjacent said surface, and the space between said electrodes being filled solely by said charge.

2. A primer or the like as defined in claim 1 wherein one electrode of said gap is connected to said casing and the other electrode is insulated from the casing.

3. A primer or the like as defined in claim 1 wherein the gap is substantially annular and the inner electrode is insulated from the casing.

4. An ammunition primer or the like comprising a casing, a shunted surface gap including spaced electrodes and a semi-conductive bridge connecting said electrodes, at least a substantial portion of the entire space between said electrodes being spanned by a substantially flat electrically semi-conductive surface of the bridge, said spanning surface connecting the electrodes and having an area substantially co-extensive with the cross-sectional area of said space in a plane parallel to and adjacent said surface, and an electrically non-conductive combustible charge in the casing filling the space between the electrodes and contacting the semi-conductive surface of said bridge.

5. A primer or the like as defined in claim 4 wherein the electrical resistance across said gap in the absence of said charge is of the order of only a few ohms.

6. A primer or the like as defined in claim 5 wherein said resistance is of the order of about 3 or 4 ohms.

7. A primer or the like as defined in claim 4 wherein the casing comprises a shell portion and a cover for said shell portion to retain said charge therein.

8. A primer or the like as defined in claim 7 wherein said cover serves as a conductor connecting one of said electrodes to the shell portion.

9. An ammunition primer or the like comprising a casing, an electrically non-conductive combustible charge in said casing, and a shunted surface electrical spark gap in the casing adjacent said charge, said gap being formed by spaced electrodes and a semi-conductive bridge connecting said electrodes, said bridge comprising a substantially flat semi-conductive surface substantially co-extensive with the cross-sectional area of the entire space between said electrodes in a plane parallel to and adjacent said surface.

10. A primer or the like as defined in claim 9 which will ignite when a four microfarad condenser charged to 190 volts is applied and which will fail to be ignited by a static charge capable of applying over 200,000 ergs of electrical energy at the gap.

11. A primer or the like as defined in claim 9 which will ignite when electrical energy is applied at the gap in an amount equivalent to that applied by a four microfarad condenser charged to a voltage of 190 volts but which will not ignite when subjected to a static charge of electricity of a magnitude which would apply as much as 200,000 ergs energy at the gap.

12. A primer or the like as defined in claim 9 wherein the bridge comprises a disc of insulating material having a semi-conductive coating covering the entire area of the surface thereof bridging said electrodes.

13. A primer or the like as defined in claim 12 wherein said coating comprises powdered graphite.

14. A primer or the like as defined in claim 9 wherein one electrode is in the form of a flat washer retained in the casing by biting engagement between the outer periphery of the washer and said casing.

15. A primer or the like as defined in claim 9 comprising a center electrode assembly which includes a contact button, one of said electrodes and a neck portion joining said button and said one electrode and surrounded by said bridge.

16. An ammunition primer or the like comprising a casing, an electrically non-conductive combustible charge in said casing, a shunted surface electrical spark gap in the casing adjacent said charge, said gap being formed by spaced electrodes and a semi-conductive bridge connecting said electrodes, said bridge comprising a semi-conductive surface connecting said electrodes and spanning substantially the entire space between said electrodes, and a center electrode assembly which includes a contact button, one of said electrodes and a neck portion joining said button and said one electrode, said semi-conductive bridge being a radially slotted disk astraddle said neck portion between the button and electrode of said assembly.

17. An ammunition primer or the like comprising a casing, a shunted surface gap including spaced electrodes and a semi-conductive bridge connecting said electrodes, at least a substantial portion of the entire space between said electrodes being spanned by a substantially flat electrically semi-conductive surface of the bridge, said spanning surface connecting the electrodes and having an area substantially co-extensive with the cross-sectional area of said space in a plane parallel to and adjacent said surface, and an electrically non-conductive combustible charge in the casing filling the space between the electrodes and contacting the semi-conductive surface of said bridge, said casing comprising a shell portion and a cover for said charge therein and said cover comprising a part having a central opening and an auxiliary combustible cover across said opening.

18. An ammunition primer or the like comprising a casing, a shunted surface gap including spaced electrodes and a semi-conductive bridge connecting said electrodes, at least a substantial portion of the entire space between said electrodes being spanned by a substantially flat electrically semi-conductive surface of the bridge, said spanning surface connecting the electrodes and having an area substantially co-extensive with the cross-sectional area of said space in a plane parallel to and adjacent said surface, and an electrically non-conductive combustible charge in the casing filling the space between the electrodes and contacting the semi-conductive surface of said bridge, said casing comprising a shell portion and a cover for said charge therein and said cover serving as a conductor connecting one of said electrodes to the shell portion and having a central opening closed by said one electrode.

19. An ammunition primer or the like comprising a

casing, an electrically non-conductive combustible charge in said casing, an annular shunted surface electrical spark gap in the casing adjacent said charge, said gap being formed by spaced electrodes and a semi-conductive bridge connecting said electrodes, said bridge comprising a substantially flat semi-conductive surface substantially co-extensive with the cross-sectional area of the entire space between said electrodes in a plane parallel to and adjacent said surface, and a center electrode assembly comprising a contact button having a hollow neck portion and a metallic washer around said neck portion constituting one of said electrodes, said bridge being partially interposed between said button and washer and said neck portion being peened outwardly to secure the parts of said assembly together.

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References Cited in the file of this patent

UNITED STATES PATENTS

39,542	Beardslee	Aug. 18, 1863
319,628	Russell	June 9, 1885
372,046	Stuart	Oct. 25, 1887
374,640	Sundstrom	Dec. 13, 1887
1,084,745	Lindsay	Jan. 20, 1914

FOREIGN PATENTS

914,022	France	June 11, 1946
578,300	Great Britain	June 24, 1946
982,837	France	Jan. 31, 1951