

UNITED STATES PATENT OFFICE

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PRIMING MIXTURE

No Drawing.

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This invention relates to ammunition and has for its object the production of ammunition which shall leave no corrosive residues in the bore of a gun in which it is fired, but on the contrary, will protect the bore from corrosion.

When a few loads of ordinary ammunition are fired through a gun barrel, and the barrel is cleaned and oiled in the usual way and laid aside, in the course of a few days the surface of the barrel becomes corroded by substances which form underneath the oil and the formation of which cannot be prevented by an oil film. It is at the present time well understood that such "after corrosion" is caused by the combustion residues of a single universally used ingredient of the ammunition priming mixture.

With the advent of modern smokeless and semi-smokeless powders, it became necessary to greatly increase the heat and pressure generated upon the explosion of the priming mixture, thus necessitating a very powerful and dependable oxidizing agent. Potassium chlorate has been quite universally used for this purpose. The combustion of this substance, however, leaves a residue of very hygroscopic potassium chloride, which substance solidifies at a comparatively high temperature, and is driven by the high pressures prevailing within the gun barrel into microscopic fissures and indentations in the surface from which it cannot be removed by mechanical swabbing, or by the universally used non-aqueous gun cleaning compositions. Due to its hygroscopic character, the potassium chloride subsequently absorbs moisture and corrodes the gun barrel, even after it has been cleaned and oiled with great care.

Another very harmful effect which results from the use of ordinary ammunition, particularly ammunition which contains potassium chlorate either in the propellant powder or in the priming mixture, is the effect which for the purpose of this specification will be termed "chemical erosion" as distinguished from the "mechanical erosion", or wear due to friction between the barrel surface and the metallic bullets which pass through the barrel. Such chemical erosion consists of the

removal of particles of the barrel steel, probably by chemical combination with combustion residues of powder and priming mixture, and its occurrence in confined chiefly to an area adjacent to and extending a short distance rearwardly and a somewhat greater distance forwardly from the cartridge shell mouth. It is at this point that the steel of the barrel and cartridge containing chamber is exposed to the action of the combustion residues under the highest pressure at the highest temperature, under which conditions the combustion residues are extraordinarily chemically active. Barrels in which a large number of ordinary cartridges have been fired show a distinct enlargement of the barrel and the chamber adjacent to the shell mouth. Such enlargement not only produces an open gap in which the departing bullet is entirely free and unsupported and which it must cross before engaging rifling of the barrel, but likewise leave the forward end of the shell or powder case unsupported so that said shell expands into contact with the enlarged chamber on the firing of the cartridge, and its extraction from the chamber is rendered extremely difficult.

While in general any acid residues probably produce both chemical erosion and after corrosion, the residue of potassium chlorate is chiefly responsible for chemical erosion just as it is for after corrosion. This residue, potassium chloride, at the high temperature prevailing in the gun barrel is probably partly dissociated and in a very chemically active state. The free chlorine attacks and combines with the steel of the barrel removing a small quantity of the steel with each shot fired. The accuracy of the gun is soon greatly impaired and the roughened surface remaining is particularly susceptible to rusting when the gun is not in use.

For these reasons, the need for a priming composition which does not include potassium or other chlorates has long been felt, and many other oxidizing agents have been proposed and tried.

The preparation of a priming composition, however, is a delicate and difficult

undertaking, involving many problems beside the yielding of a non-corrosive residue. While the ingredients must be capable of reacting with extreme rapidity when struck a sharp blow, they must also remain uncombined in an intimate mixture for an indefinite time. They must also be incapable of reacting with the surface metal of their containers. They must likewise remain stable and active for an indefinite time under extreme conditions of temperature and humidity.

The difficulty of securing satisfactory priming mixtures is further augmented by differences in the character of the powder used for different styles of cartridges. A powder which is difficult to ignite requires a primer acting with a force and intensity which is very undesirable for powder which is more easily ignited. Priming mixtures have not possessed the flexibility necessary to readily adapt them to different powders. The performance of a mixture comprising certain ingredients has been practically invariable, and in order to vary the intensity and duration of the flame or other characteristics of the action, it has been necessary to completely reorganize the mixture.

The present invention contemplates a priming mixture which is not only positive and certain in action, stable and entirely non-corrosive, but is likewise susceptible of simple and ready control of its combustion characteristics.

Generally stated, priming mixtures include three classes of ingredients—a fuel to be burned with heat and flame, an oxidizer to furnish oxygen for the combustion of the fuel, and a material which is exploded by the impact of the firing pin with sufficient heat and flame to start the reaction between the oxidizer and the fuel. Said explosive ingredient will be called the “initial explosive” or “combustion initiator”. Prior to the present invention the most widely used combustion initiator was mercury fulminate, and this invention comprises the discovery of combustion initiators which may wholly or in part replace mercury fulminate. All of the ingredients of the mixture however must be such that no residues remain which will react to corrode the bore of a gun barrel. For an igniter or initial explosive the normal lead salt of trinitroresorcine has been found to be desirable. This salt may be advantageously used in conjunction with mercury fulminate, a non-corrosive oxidizer such as barium nitrate, and a fuel, such as antimony sulphide. The resulting mixture is entirely non-corrosive, and different samples show very unusually uniform powder igniting qualities.

The lead trinitroresorcinate appears to act as a combustion accelerator, or more generally stated, as a combustion regulator. While

in the main, mixtures of this type containing lead trinitroresorcinate burn more rapidly and are more forceful in action than those which do not contain lead trinitroresorcinate, the uncertain and erratic action of the latter mixture with its occasional instances of extraordinary and unaccountably forceful action entirely disappears. Different portions of the mixture show very marked uniformity in functioning, thus furnishing the quality of perfect dependability which is so desirable in these compositions. Moreover, the rate of combustion and the heat and forcefulness of the action are susceptible of ready control by simple variations in the proportions of the ingredients, and thus the mixture is adaptable to the ignition of different types of propellant powder. For this purpose the proportions of the ingredients may be varied substantially as follows:

Mercury fulminate	10% to 40%
Antimony sulphide	20% to 45%
Barium nitrate	10% to 60%
Lead trinitroresorcinate	5% to 35%

As above stated the replacement by lead trinitroresorcinate of a part of the mercury fulminate of a mixture containing say 40% of mercury fulminate, the combined mercury fulminate and lead trinitroresorcinate content remaining 40%, results in a mixture which burns and ignites powder much more promptly, rapidly and regularly than the mixture containing mercury fulminate only. This effect is exactly the reverse of that which would be expected from the known properties of mercury fulminate and lead trinitroresorcinate. The accepted rate of detonation of mercury fulminate is 3920 meters per second while the rate of detonation of lead trinitroresorcinate is 2153 meters per second. Further, lead trinitroresorcinate is about $\frac{1}{12}$ th as sensitive to friction and percussion as mercury fulminate. Hence it would seem that the replacement of a part of the mercury fulminate of a general mixture by lead trinitroresorcinate would both reduce the sensitiveness of the mixture and decrease its rate of combustion; yet exactly the reverse condition was found.

A possible explanation of the extraordinary effect of the presence of lead trinitroresorcinate in mercury fulminate priming mixture is as follows:

It has been found that when a quantity of mercury fulminate less than $\frac{1}{10}$ th gram is exploded alone it does not acquire the velocity of detonation which is acquired when a larger quantity is exploded. The ignition of $\frac{1}{10}$ th of a gram of mercury fulminate on a glass plate results in a puff and a flame without damage to the plate, whereas the ignition of a larger quantity shatters the plate. Similar ignition of $\frac{1}{10}$ th gram of

more rapidly detonating explosive perforates the plate without shattering it. Now the quantity of mercury fulminate in an individual priming charge is substantially less than $\frac{1}{10}$ th gram. Hence when ignited alone its rate of detonation or combustion would be far less than that of a larger quantity. It is believed that when lead trinitroresorcinate is present the flame produced when the mercury fulminate begins to burn rapidly ignites the lead trinitroresorcinate and under the heat and pressure thus generated the detonation rate of the mercury fulminate is very greatly increased. Thus something approaching the normal detonation rate of mercury fulminate is utilized and the powder igniting action of the primer thereby greatly accelerated. The foregoing constitutes applicant's best theoretical explanation of the extraordinary inter-action of mercury fulminate and lead trinitroresorcinate in priming compositions.

Other non-corrosive oxidizing salts, such as lead chromate, lead nitrate, and potassium nitrate and other fuels such as lead or copper sulphocyanate may wholly or in part replace barium nitrate and antimony sulphide. However, these and other details of the invention as herein described, are to be regarded as illustrative rather than restrictive, the invention being susceptible of embodiment in many different compositions all falling within a broad interpretation of the appended claims:

In said claims the term "oxidizing ingredient" is to be understood as defining that part of a priming mixture having an oxidizing function, whether comprising one material or more than one. Similarly the terms "fuel" and "fuel ingredient" are to be understood as embracing that part of a mixture primarily intended to be burned by the oxygen of the oxidizing ingredient, whether or not more than one distinct material is included therein.

What is claimed is:

1. A priming mixture for ammunition, comprising normal lead trinitroresorcinate, mercury fulminate and a non-corrosive oxidizing ingredient.

2. A priming mixture for ammunition, comprising normal lead trinitroresorcinate, mercury fulminate and a fuel.

3. A priming mixture for ammunition comprising normal lead trinitroresorcinate, mercury fulminate, barium nitrate and an antimony sulphide.

4. A priming mixture for ammunition comprising normal lead trinitroresorcinate, mercury fulminate, a non-corrosive oxidizing ingredient, and an antimony sulphide.

5. A priming mixture for ammunition comprising normal lead trinitroresorcinate, mercury fulminate and a non-corrosive oxidizing ingredient comprising at least one salt

of the group consisting of barium nitrate, lead nitrate and lead chromate.

6. A priming mixture for ammunition comprising normal lead trinitroresorcinate, mercury fulminate, a non-corrosive oxidizing ingredient including at least one salt of the group consisting of barium nitrate, lead nitrate and lead chromate, and a fuel ingredient comprising at least one material from the group consisting of antimony sulphide, lead sulphocyanate and copper sulphocyanate.

7. A priming mixture for ammunition, comprising normal lead trinitroresorcinate, mercury fulminate, barium nitrate, a second non-corrosive oxidizer and a fuel ingredient.

8. A priming mixture for ammunition comprising normal lead trinitroresorcinate, mercury fulminate, a non-corrosive oxidizing ingredient including a lead salt, and a suitable fuel ingredient.

9. A priming mixture substantially as follows:

Mercury fulminate-----	10% to 40%
Antimony sulphide-----	20% to 45%
Barium nitrate-----	10% to 60%
Lead trinitroresorcinate-----	5% to 35%

In witness whereof I have signed my name hereto this 17th day of March, 1927.

JAMES E. BURNS.