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AMMUNITION

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This invention relates to primers for ammunition, and contemplates a priming mixture of superior quality and improved characteristics, as well as a novel method in the preparation of priming mixtures.

Ammunition priming mixtures ordinarily comprise an oxidizer, a fuel, and a percussion sensitive ingredient adapted when ignited by percussion to initiate the combustion of the fuel by the oxidizer. Frequently an abrasive or frictionating medium is added to insure ignition of the priming composition upon impact. The "fuel" is any oxygen deficient substance, and certain substances having explosive properties are of themselves fuels so that the addition of an inexplosive material acting solely as a fuel becomes unnecessary. Normal lead styphnate is a material of this class, it does not contain sufficient oxygen for the complete combustion of its own constituents and it possesses properties which render it desirable as a priming mixture explosive ingredient. Usually, however, it requires the addition of a small quantity of a substance which is more sensitive to percussion, such as tetrazene (guanylnitrosaminoguanyltetrazene), lead nitrato-hypophosphite, and the like. Normal lead styphnate has in recent years been used extensively in this manner as a priming mixture explosive. However, like most other priming mixture components, particularly explosive components, it has been separately manufactured and admixed with other ingredients in the same form in which it performs its intended function.

The present invention comprises the discovery of a novel method of preparing a priming composition containing normal lead styphnate. It has been found that this normal salt is produced when equimolecular proportions of monobasic lead styphnate and styphnic acid are mixed together in a moist condition. As a result of this discovery, it becomes possible to make lead styphnate priming mixtures by the admixture of reacting quantities of basic lead styphnate, styphnic acid, and other priming composition ingredients, such as a sensitizer, an oxidizer, and an abrasive. As a sensitizer, tetrazene or lead nitrato-hypophosphite is preferred, although other sensitizers may be used. The most common abrasive, or frictionator, is glass; but instead of glass there may be used other inert or active substances of requisite hardness, such as calcium silicide, ferro silicon, or a pyrophoric alloy. As an oxidizer, barium nitrate is preferred, although other of the well-known oxidizing nitrates, chlorates, perchlorates, and oxides, may be used, either singly or in combination, subject only to the limitation that oxidizers, such as lead peroxide, which tend to react with styphnic acid should be added after the completion of the styphnic acid-basic lead styphnate reaction. A fuel may be added if desired, the same precaution being observed if the fuel tends to react with styphnic acid.

It is desirable to follow the usual practice of preparing a dry pre-mix of the inert ingredients, for example, barium nitrate and glass, and to add to this pre-mix the requisite quantities of the explosive and sensitizing ingredients; that is, tetrazene, basic lead styphnate and styphnic acid. The basic lead styphnate may be in the usual yellow amorphous or semi-amorphous form or any one of the crystalline forms disclosed in the present applicant's prior patents. With the explosive and sensitizing ingredients there is added a quantity of water sufficient to give the composition the consistency desired for mixing and to effect the reaction between basic lead styphnate and styphnic acid. This may be done either by using one or more of such ingredients in a wet condition or by adding the desired quantity of water alone, the explosive and sensitizing ingredients being dry. That a reaction takes place is definitely shown by several different phenomena. The composition, which in the initial stages of mixing is relatively dry, during the mixing process becomes distinctly wetter, showing the ejection of water as the result of a chemical reaction. The subsequent appearance and properties of the mixture differ from those of a mixture of the same ingredients which has been prepared dry so that no reaction between the styphnic acid and the basic lead styphnate is permitted to take place. X-ray photographs of the mixture show the distinctive pattern of normal lead styphnate, a pattern which is not found in a dry mixture of the same ingredients.

Preferably an excess of basic lead styphnate is used, chiefly for the purpose of insuring that no free styphnic acid remains in the mixture. A free acid may react with other ingredients, with undesirable results; while free basic lead styphnate may be actually useful as a sensitizer and explosive. The molecular weight of mono-basic lead styphnate being 689 and the molecular weight of styphnic acid being 245, reacting quantities would be in the proportions of about 2.81 parts of mono-basic lead styphnate to 1 part of syphnic acid. In practice, not less than 3 parts of mono-basic lead styphnate are used

to 1 part of styphnic acid. In mixtures in which lead nitrato-hypophosphite is made in situ from lead nitrate and lead hypophosphite, as described in Patent No. 2,160,469, it is desirable that these ingredients be not added until the reaction between styphnic acid and basic lead styphnate is substantially complete, it having been found that the presence of free styphnic acid is detrimental to the reaction between lead nitrate and lead hypophosphite.

The mixture resulting from the practice of the process above outlined shows satisfactory stability and a high degree of sensitivity as compared with mixtures of the same ingredients in which the lead styphnate has been separately manufactured and added as lead styphnate. This may be due in part to a distinctive form and size of lead styphnate crystals secured through the formation of this compound in admixture with the other ingredients and its formation under the mixing agitation of the pasty but solid mass of the mixture, as distinguished from its formation in solution according to the usual methods. When normal lead styphnate is separately prepared, it is necessary to so control the process of its manufacture as to secure the compound in short dense crystals, as distinguished from elongated frangible needlelike crystals which may be broken in handling and upon breaking explode with undesirable results. Where the normal salt is made in situ in the mixture, the mixture remaining moist until it is separated into pellets and inserted in primers or shells, the presence of needle crystals is actually desirable, due to the fact that such crystals are more sensitive to percussion and shock than the short dense crystals. It is likewise probable that the superior properties of the mixture are due in part to a more uniform distribution of the normal lead styphnate throughout the other ingredients, such uniform distribution being due to the formation of the lead styphnate in situ and during the agitation of the mass of solid particles.

In the preparation of a preferred priming mixture including tetrazene and barium nitrate, the ingredients which are mixed are as follows:

Tetrazene	1 to 8% preferably 5%
Glass	18 to 30% preferably 25%
Barium nitrate	18 to 30% preferably 25%
Red or yellow mono-basic lead styphnate	28 to 38% preferably 34%
Styphnic acid	8 to 12% preferably 11%

A priming mixture comprising tetrazene and lead nitrate may be prepared from the following ingredients:

Tetrazene	.05	to 8% preferably 2%
Glass	15	to 25% preferably 20%
Lead nitrate	30	to 42% preferably 38%
Red or yellow mono-basic lead styphnate	25	to 35% preferably 31%
Styphnic acid	7	to 14% preferably 9%

A priming mixture comprising lead nitrato-hypophosphite is prepared from the following ingredients:

Lead hypophosphite	7 to 14% preferably 10%
Lead nitrate	8 to 15% preferably 12%
Glass	15 to 25% preferably 20%
Barium nitrate	20 to 30% preferably 25%
Red or yellow mono-basic lead styphnate	20 to 30% preferably 25%
Styphinic acid	7 to 14% preferably 8%

It will be understood, however, that these mixtures are typical and illustrative only, other sensitizers, abrasives and oxidizers may be used. The essence of the invention is the discovery that normal lead styphnate may be made in situ in admixture with other ingredients by the reaction of moist basic lead styphnate and styphnic acid, and the appended claims are to be broadly construed.

What is claimed is:

1. In the preparation of priming mixtures, the method which comprises the admixing of solid ingredients comprising an oxidizing ingredient, an abrasive, moist styphnic acid and moist basic lead styphnate, the mixture being maintained in a moistened condition whereby normal lead styphnate is formed by the reaction of said moist styphnic acid and moist basic lead styphnate.

2. In the preparation of ammunition priming mixtures comprising normal lead styphnate, an oxidizing ingredient, and an abrasive, the method which comprises preparing a dry pre-mix of said oxidizing ingredient and said abrasive, adding to said dry pre-mix substantially equimolecular proportions of mono-basic lead styphnate and styphnic acid, moistening and thereafter mixing said ingredients in a moistened condition while said mono-basic lead styphnate and styphnic acid react to form normal lead styphnate.

3. In the preparation of ammunition priming mixtures comprising lead nitrato-hypophosphite, normal lead styphnate, an oxidizing ingredient, and an abrasive, tne method which comprises preparing a dry pre-mix of said oxidizing ingredient and abrasive, adding to said dry pre-mix reacting quantities of mono-basic lead styphnate and styphnic acid, moistening and mixing said ingredients in a moistened condition while said mono-basic lead styphnate and styphnic acid react to form normal lead styphnate, thereafter adding to said mixture reacting quantities of lead nitrate and lead hypophosphite, and thereafter mixing said ingredients in a moistened condition while said lead nitrate and said lead hypophosphite react to form lead nitrato-hypophosphite.

4. In the preparation of ammunition priming mixtures comprising lead nitrato-hypophosphite, normal lead styphnate, an oxidizing ingredient, and an abrasive, the method which comprises preparing a dry pre-mix of said oxidizing ingredient and abrasive with lead nitrate, adding to said dry pre-mix reacting quantities of mono-basic lead styphnate and styphnic acid, moistening and mixing said ingredients in a moistened condition while said mono-basic lead styphnate and styphnic acid react to form normal lead styphnate, thereafter adding to said mixture the reacting quantity of lead hypophosphite, and thereafter mixing said ingredients in a moistened condition while said lead nitrate and said lead hypophosphite react to form lead nitrato-hypophosphite.

5. In the preparation of ammunition priming mixtures, the method of securing an admixture of normal lead styphnate with other ingredients which comprises preparing a dry pre-mix of inert ingredients, adding to said dry pre-mix basic lead styphnate, styphnic acid and a quantity of water adequate to form a paste, and mixing said materials while moist to distribute said basic lead styphnate and styphnic acid throughout the other ingredients, thereby enabling said basic lead styphnate and styphnic acid to react to form

normal lead styphnate in situ in admixture with said other ingredients.

6. In the preparation of ammunition priming mixtures, the method of securing an admixture of normal lead styphnate with other ingredients comprising an oxidizer and an abrasive which comprises preparing a dry pre-mix of inert ingredients, adding to said dry pre-mix basic lead styphnate, styphnic acid, a combustion initiator, and a quantity of water adequate to form a paste, and mixing said materials while moist to distribute said basic lead styphnate and styphnic acid throughout the other ingredients, thereby enabling said basic lead styphnate and styphnic acid to react to form normal lead styphnate in situ in admixture with said other ingredients.

7. In the preparation of ammunition priming mixtures, the method of securing an admixture of normal lead styphnate with other ingredients comprising an oxidizer and an abrasive which comprises preparing a dry pre-mix of inert ingredients, adding to said dry pre-mix basic lead styphnate, styphnic acid, tetrazene, and a quantity of water adequate to form a paste, and mixing said materials while moist to distribute said basic lead styphnate and styphnic acid throughout the other ingredients, thereby enabling said basic lead styphnate and styphnic acid to react to form normal lead styphnate in situ in admixture with said other ingredients.

8. In the preparation of ammunition priming mixtures, the method of securing an admixture of normal lead styphnate, which comprises the bringing together and moistening of requisite quantities of an oxidizer, basic lead styphnate and styphnic acid, and the mixing of said ingredients in a moistened condition while said basic lead styphnate and styphnic acid react to form normal lead styphnate in admixture with said oxidizer.

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