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PRIMING COMPOSITION

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This invention relates generally to priming compositions and particularly to non-corrosive priming compositions for use in small arms ammunition.

Because of the corrosive effect of potassium chlorate, numerous efforts have been addressed toward the problem of finding a priming composition as sensitive and as stable, yet as free of manufacturing hazards, as was the potassium chlorate priming of old.

In the non-corrosive primers heretofore disclosed, it has been necessary to provide a highly sensitive primary explosive for initiating the priming mixture, as otherwise the sensitivity of the priming mixture was insufficient to be dependable. In some instances, it has been proposed to utilize non-corrosive oxidizing agents and fuels without the highly sensitive primary explosive, in order to reduce the hazard of manufacture, but in those cases where adequate sensitivity has been achieved, instability of the mixture has been encountered. Red phosphorous has been suggested by numerous workers in the art as a material utilizable with non-corrosive ingredients and without the primary explosive initiator, but the priming compositions resulting from these suggestions have proven unsatisfactory either from the standpoint of sensitivity or from the standpoint of stability, to an extent such that they have not superseded non-corrosive priming mixtures containing the primary explosive ingredient despite the greater hazard involved in handling the latter.

The object of the present invention, generally stated, is to provide a priming composition of the non-corrosive type, which is highly sensitive and satisfactorily stable, and which does not require the presence of a primary explosive.

Another object of the invention is to improve the sensitivity of non-corrosive priming mixtures which do contain primary explosive ingredients, but whose sensitivity is lower than that of mercury fulminate, lead azide, and the like.

A more specific object of the invention is to improve the stability and sensitivity of priming compositions containing red phosphorous.

The present invention is predicated upon the discovery that a non-corrosive priming composition having sensitivity, stability, and freedom-from-handling hazard on a parity with or better than potassium chlorate priming mixtures may be provided by the concurrent utilization of red phosphorous with a secondary explosive, such as pentaerythritol tetranitrate, trimethylenetrinitramine, and trinitrotoluene. When incorporated in a non-corrosive priming mixture with red phosphorous, pentaerythritol tetranitrate and trimethylenetrinitramine, in particular, and trinitrotoluene, to a lesser degree, do exhibit the property of radically increasing the sensitivity of the composition without adversely affecting its stability. Unlike other priming compositions, the sensitivity of the red phosphorous-secondary-explosive-containing priming composition is not adversely affected as the size of the pellet increases. Consequently, the weight of the pellet of priming for any

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given round of ammunition can be increased to insure ignition of the propellant and eliminate the possibility of dangerous "squibs" in small arms ammunition.

The invention is characterized by the concurrent use of red phosphorous and one of the three secondary explosives, to-wit: pentaerythritol tetranitrate, trimethylene-trinitramine, and trinitrotoluene, or mixtures thereof. While some other compounds having the characteristics of a secondary explosive may be utilized with red phosphorous to achieve an increased sensitivity, the three aforesaid are the only ones revealed by our investigation which exhibit the synergetic effect of increased sensitivity without adversely affecting stability. For example, trinitrophenylmethylnitramine, when incorporated with red phosphorous in a non-corrosive priming composition, results in a composition which is relatively unstable.

It is to be understood, of course, that the red phosphorous incorporated in the priming mixtures, in accordance with the present invention, must itself be as stable as possible, within practical limits. Consequently, it is contemplated that, prior to incorporation with the other components, the ordinary red phosphorous of commerce may be purified and have its stability improved by any known method, such for example as that published in Industrial and Engineering Chemistry 40, 301 (1948), in which the phosphorous is first subjected to an acid treatment, an elutriation, and a coating with aluminum hydroxide.

In the manufacture of non-corrosive primers in accordance with the present invention, any of the well known non-corrosive oxidizing agents, such as barium nitrate, potassium nitrate, lead nitrate, lead dioxide, basic lead nitrate, and barium nitrate-potassium nitrate double salt, may be utilized. Priming compositions of the present invention may be compounded with or without primary explosive ingredients. Since one of the objectives of all endeavors in this branch of the explosives art is to reduce the hazards of manufacture, it is desirable to make use of the less sensitive members of the primary explosive family, for example, lead trinitro resorcinate. In priming compositions which contain lead trinitro resorcinate as a primary explosive initiator, the sensitivity can be decidedly improved by the incorporation of the red phosphorous-secondary explosive sub-composition aforesaid.

In compounding the priming composition in accordance with the present invention, the several ingredients may be mixed and charged in the usual manner. In order to assure the maintenance of intimate contact between the red phosphorous and the secondary explosive, it is preferable to coat the red phosphorous with the secondary explosive. Such coating may be accomplished by dissolving the secondary explosive in any suitable solvent, mixing the phosphorous with the solution to form a homogeneous paste, then precipitating the secondary explosive from the solvent, then separating the solvent liquor and drying the solid residue. If acetone is used as the solvent for the secondary explosive, precipitation of the latter may be accomplished by the addition of water.

The proportions of the several ingredients of the composition are preferably within the ranges indicated in the following table:

	Percent
Primary explosive	0-30
Secondary explosive	5-10
Red phosphorous	15-25
Oxidizer	50-70

The secondary explosive indicated in the foregoing table is one selected from the group consisting of pentaerythritol tetranitrate trimethylenetrinitramine, and trinitrotoluene. The oxidizer is preferably a non-corrosive one.

As a specific example of a non-corrosive priming composition free of primary explosive initiator, the following formula may be followed:

	Percent
Red phosphorus -----	25
Pentaerythritol tetranitrate -----	5
Barium nitrate -----	70

As an example of a composition containing primary explosive initiator, whose sensitivity is improved in accordance with the present invention, the following formula is representative:

	Percent
Normal lead trinitro resorcinate -----	25
Red phosphorus -----	17
Pentaerythritol tetranitrate -----	5
Barium nitrate -----	53

Trimethylenetrinitramine may be substituted for pentaerythritol tetranitrate in each of the foregoing examples without substantial variation in proportions or results.

In sensitivity tests conducted to compare the priming compositions of the present invention with others, it has been ascertained that, of a test lot charged with non-corrosive priming composition containing both red phosphorus and a secondary explosive of the class aforesaid, 100% fired when a four-ounce ball was dropped thereon for a distance of 2½ inches thereon, while primers otherwise comparable in composition, but omitting either the red phosphorus or the secondary explosive, did not all fire even when the four-ounce ball was dropped thereon for a distance of 3¾ inches. When impacted by the four-ounce ball dropping 2¼ inches, 79% of the primers, constituted according to the first specific example above given, fired, but only 18% of the test lot, charged with 25% red phosphorus and 75% barium nitrate, fired at this distance.

From the foregoing disclosure, those skilled in the art will find that the invention accomplishes its objects and provides a priming composition having all the virtues of a potassium chlorate primer, but being non-corrosive and without requiring the use of hazardous materials. While two specific examples have been given and various alternatives suggested, it is to be distinctly understood that the invention is not limited to the particular ingredients, or the proportions thereof, indicated in the examples, but that various adjustments in the compositions may be made in order to fit the primer to the requirements of any given round or any given propellant. It will also be understood that the compositions of this invention are preferably loaded in caps having a surface of a compatible metal such as aluminum, lead, or zinc, which will not promote decomposition of the mixtures particularly under hot and moist storage conditions. Such modifications or adjustments may be made in accordance with the custom in the art, and without departing from the spirit of the present invention or the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. A priming mixture comprising substantial quantities of red phosphorus, a non-corrosive solid oxidizing agent therefor, and a secondary explosive selected from the group consisting of pentaerythritol tetranitrate, trimethylenetrinitramine, and trinitrotoluene, and mixtures thereof.

2. The priming mixture of claim 1 which includes a primary explosive initiator.

3. A non-corrosive priming mixture containing substantial quantities of red phosphorus, a solid oxidizing agent therefor, and pentaerythritol tetranitrate.

4. A non-corrosive priming mixture containing substantial quantities of red phosphorus, a solid oxidizing agent therefor, and trimethylenetrinitramine.

5. A non-corrosive priming mixture consisting essentially of:

	Percent
20 Solid oxidizer -----	50-70
Red phosphorus -----	15-25
Secondary explosive -----	5-10

in which the secondary explosive is selected from a group consisting of pentaerythritol tetranitrate, trimethylenetrinitramine, and trinitrotoluene, and mixtures thereof, and in which the oxidizer is capable of oxidizing red phosphorus.

6. The priming mixture of claim 1 wherein the secondary explosive is coated on the red phosphorus.

7. A non-corrosive priming mixture consisting essentially of:

	Percent
Oxidizer -----	50-70
35 Red phosphorus -----	15-25
Secondary explosive -----	5-10

in which the secondary explosive is selected from a group consisting of pentaerythritol tetranitrate, trimethylenetrinitramine, and trinitrotoluene, and mixtures thereof; and wherein the oxidizer is selected from a group consisting of barium nitrate, potassium nitrate, lead nitrate, lead dioxide, basic lead nitrate, and barium nitrate-potassium nitrate double salt.

8. In a non-corrosive priming mixture for ammunition, red phosphorus sensitized with a secondary explosive selected from a group consisting of pentaerythritol tetranitrate, trimethylenetrinitramine, and trinitrotoluene, and mixtures thereof.

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