Patented June 5, 1945

2,377,670

UNITED STATES PATENT OFFICE

2,377,670

AMMUNITION PRIMING MIXTURES

Philip H. Burdett, Bridgeport, and Matthew W. Maughan, Fairfield, Conn., assignors to Remington Arms Company, Inc., Bridgeport, Conn., a corporation of Delaware

No Drawing. Application August 26, 1943, Serial No. 500,138

6 Claims. (Cl. 52—21)

This invention relates to priming compositions for ammunition and particularly to means for improving the workability and homogeneity of said compositions when they are mixed in the presence of moisture.

The conventional ammunition priming mixture contains a reaction initiating explosive, a fuel, and an oxidizer. In some instances it is necessary, or desirable, to supplement the reaction initiating explosive by a sensitizer therefor, such as guanylnitrosaminoguanyltetrazene. A frictionator may be used also to assist in the ignition of the composition when it is struck by a blow. The use of a frictionator is normally desirable in rimfire priming mixtures and may be a material such as ground glass. Priming mixtures can be mixed and loaded into primer cups either wet or dry. The handling of dry mixtures is attended with considerable hazard and other obvious undesirable features. One method of loading priming mixtures into shells includes the use of a plate with a purality of holes therein filled with the priming mixture, the volume of a hole being selected so as to give the proper volume of priming mixture for the particular shell or primer cup to be charged. Empty shells or primer cups are placed under the filled holes and appropriate knock-out pins are passed through the holes to force the pellets formed in each hole out of the hole and into a shell thereunder, gravity being depended upon to complete the movement of the pellet into the empty shell or primer cup.

One of the properties causing difficulty in the loading and mixing of wet priming mixtures is an apparent stickiness of the mixture and tendency of the pellets of the priming mixture to stick to the knock-out pins just mentioned instead of falling freely into the empty shell. Another difficulty in the wet mixing of priming mixtures is the obtaining of homogeneity or a complete mixture of the ingredients so that when the reaction initiating explosive is set off, the effect thereof will be transmitted to the other ingredients of the mixture. It is also apparent that with better homogeneity and dispersion of the ingredients, the initial combustion or detonation will be more easily started.

The charger plate has the holes therein filled by rubbing the wet priming mixture into the holes while the plate is placed on a table or other similar surface. The excess priming mixture is rubbed or removed from the upper surface of the plate. Hitherto there has been a tendency for removal of some of the priming mixture from the holes in the plate by this operation, which is eliminated by the present invention. The plate is then removed from the table and placed over the shells or primer cups to be primed. As the charger plate is lifted from the table, the priming mixture may tend to stick to the table and thus cause removal of some of the mixture. One type of charger plate and a mechanical charging means is shown in the patent to Reynolds, No. 2,313,265. The invention is applicable to both rimfire and centerfire priming mixtures. It assists greatly in the priming of rimfire shells wherein the priming mixture is dropped into the shell and then placed in the rim of the shell by a spinner. In view of the relatively minute quantities of priming mixtures in a shell or primer cup, the removal of only a small part thereof may result in failure of the primer to function satisfactorily. There will be non-uniformity of the amount of priming charge in each shell or cup if the holes in the plate are not filled uniformly.

In the present invention, it has been found that the addition of a small quantity of a surface active agent will so reduce the interfacial tension of the liquid and/or moistened ingredients of the priming mixture as to result in better mixing and homogeneity of the mixture. The addition of the surface active agent also improves the workability of the mixture by preventing sticking of the mixture to the punches and to the charger plate. A further improvement occurs when the charger plate is wiped after the mixture is rubbed into the holes because the mixture will cut-off cleanly and leave a uniform amount in each of the charger plate holes.

One method of mixing the ingredients comprises pre-mixing the fuels and oxidizers and then bringing the explosive in a moistened condition into contact therewith. The ingredients are then placed in a mixing machine having a pair of paddles similar to the conventional bread dough mixer. This machine is run for a predetermined length of time in one direction and then a predetermined length of time in the opposite direction until the ingredients are mixed. The ingredients then are removed from the mixer and are ready for the charger plate operation above described.

For some types of priming mixtures, gum ara-

bic and/or gum tragacanth are dissolved in water and used in the mixture to serve as a binder, or for other reasons. Any surface active agent which materially reduces the interfacial tension of the moistened ingredients, or the water, will serve to improve the workability and/or homogeneity of the mixture. Certain of the agents are better than others because it is desirable to choose an agent which is compatible with the priming mixture materials. It is preferable that the particular wetting agent used not react with any of the priming mixture ingredients over a period of time so as to affect the stability and sensitivity of the mixture after storage. It is also desirable that the wetting agent itself be chemically stable. A surface active agent is one which modifies the properties of the surface layer of one phase in contact with another. In aqueous solutions this means the presence in the same molecule of one or more hydrophillic or water attracting groups and one or more hydrophobic or water repelling groups which serve as the water repelling portion of the molecule. It is also desirable that the molecule be properly balanced so that there is a sufficiently long hydrocarbon chain to give the proper surface activity. Some of the surface active agents comprise a single hydrocarbon chain and usually it is necessary that there be at least 8 carbon atoms for the agent to be effective. Some of the agents are of the branched chain type.

In general, the surface active agents may be classified in three groups:

1. Groups containing O or S, with or without H, which include such substances as, alcohols, ethers, thioalcohols, etc., such as "Triton NE," "Tween 20,"
2. Groups containing N, including the amines and amides such as, triethanolamine, "Triton K-60," "Arctic Syntex M Liquid,"
3. Groups containing S and O or P and O, such as the sulfated or sulphonated substances, "Duponol #80," "Arctic Syntex T," "Victor 35B."

The substances identified by trade names are well known and obtainable on the market.

The surface active agents may also be grouped as soaps, sulfated aliphatic esters, aliphatic sulphates, amide derivatives, aliphatic sulphonates, alkyl aryl sulphonates, esters and ethers, and cation active compounds. The esters and ethers in general are of the non-ionic type.

One of the surface active agents which has been found particularly good is that sold to the trade as "Triton NE." This is an aryl alkyl polyether alcohol and is a high molecular weight alcohol containing a number of ether groups. The molecular weight is about 700. "Triton NE" has a high boiling point and a reverse solubility curve. It is non-ionic in character which means that it does not ionize in the presence of water and therefore there is less probability of an attack on any of the primer ingredients.

One example of the use of the invention is in a priming mixture of approximately the following composition:

Example I

	Per cent
Tetrazene	2
Lead styphnate	38
Antimony sulphide	5
Calcium silicide	11
Barium nitrate	39
Lead peroxide	5

1½ cc. of "Triton NE" per 12½ pounds of priming composition was added to the ingredients and it was found that the workability and homogeneity were decidedly improved. In this mixture, the tetrazene is used in order to provide the proper sensitivity for the initiating explosive, lead styphnate.

A surface active agent was used also in a priming mixture approximately comprising:

Example II

	Per cent
Lead styphnate	30
Barium nitrate	20
Lead hypophosphite	8
Lead nitrate	12
Glass	30

Such a priming mixture is disclosed in the patent to Brun et al. No. 2,160,469. An alkyl sulphate surface active agent sold to the trade as "Duponol No. 80" was added to this mixture to the extent of about 5 cc. per 12½ pound batch and the charging properties were markedly improved. The mixture was homogeneous, was much smoother than conventional mixtures, and was not sticky.

Surface active agents were also tried with a priming mixture of the chlorate type. Such a mixture includes potassium chlorate, antimony sulphide and lead sulfocyanate with pentaerythritetetranitrate, (known at PETN). In this type of mixture, a wetting agent such as "Triton NE," "Duponol #80," or "Tergitol #7" (a sodium salt of a sulfonated fatty acid), can be added to the gum solution which is normally used therein. The antimony sulphide and lead sulfocyanate are premixed and then a portion or all of the gum solution added thereto in a mixing machine. The wet PETN is added to the gum, antimony sulphide and lead sulfocyanate. The remainder of the surface active agent can then be added, if it was not all put in at first. This is followed by the potassium chlorate. It was found that small quantities of surface active agents markedly improved the workability and homogeneity of the mixture and in fact, in some instances, increased the sensitivity after an extended storage test.

The gum mixture usually employed in a priming mixture is complex and difficult to mix so as to obtain uniformity. The gum mixture may contain gum tragacanth, gum arabic, flake glue, thymol, and alcohol. The addition of a wetting agent to the gum mixture improves the uniformity thereof and makes it easier to obtain the correct properties of viscosity, density and uniformity of dispersion. It has also been found that one of the ingredients, such as the flake glue, can be used as the binder. In such a case, 4 cc. of a wetting agent, such as "Triton NE," per 12½ pound batch of priming mixture can be used with a 5% solution of flake glue as the binder.

The aryl alkyl polyether alcohol was also found to markedly improve the workability and homogeneity of a mercury fulminate mixture of about the following composition:

Example III

	Per cent
Tetrazene	2
Lead styphnate	19.5
Antimony sulphide	12.5
Calcium silicide	8.8
Barium nitrate	37.7
Mercury fulminate	19.5

A test was run to determine the stability of a priming mixture, such as the type disclosed in

Example I, including the following surface active agents as well as a control sample without a surface active agent:

		Dilution	Drops used in water added to 100 grams of mixture
"Arctic Syntex T"	Sulfonated alcohol	1:50	5
"Arctic Syntex M Liquid."	Ammonium salt	1:25	4
"Triton K60"	Quartenary ammonium salt.	1:50	5
"Tween 20"	Polyoxyalkylene ether of partial lauric acid ester.	1:25	3
"Triton E40"	Oil-water soluble	1:25	5
"Victor 35B"	Phosphorated aclohol	1:50	5
"Triton NE"	Aryl alkyl polyether alcohol.	1.5	6
Triethanolamine		1:25	4

The samples showed a marked improvement in chargeability or workability upon being charged into primers and the stability was not much different than the control sample and in many instances was slightly better.

The surface active agent may of course be placed in the mixture at various points in the mixing process and in different manners. For example, the surface active agent may be added as a liquid, a paste or a solid.

As set forth previously, a small quantity of a surface active agent will be sufficient. It is not desirable to place too much of the agent in the mixture as it will become too wet. It is also possible in some cases, when a surface active agent is used, to have a higher moisture content in the mixture and still obtain good chargeability. By this means some mixtures can be made safer to handle.

The invention described herein can be used in rimfire as well as centerfire mixtures and provides a means for markedly improving the chargeability of a wet priming mixture.

What is claimed is:

1. In the manufacture of ammunition priming compositions by the water wet mixing of ingredients, the method of improving the workability of the water wet mixture which comprises adding a surface active agent thereto during mixing to change the interfacial tension of the moistening ingredients.

2. In the manufacture of ammunition priming compositions by the water wet mixing of ingredients, the method of improving the workability of the water wet mixture which comprises adding a non-ionic surface active agent during mixing to change the interfacial tension of the moistening ingredients.

3. In the manufacture of ammunition priming compositions by the water wet mixing of ingredients, the method of improving the workability of the water wet mixture which comprises adding an aryl alkyl polyether alcohol during mixing to change the interfacial tension of the moistening ingredients.

4. In the manufacture of ammunition priming compositions by the water wet mixing of ingredients, the method of improving the workability of the water wet mixture which comprises adding an alkyl sulphate during mixing.

5. In the manufacture of ammunition priming compositions by the water wet mixing of ingredients, the method of improving the workability and homogeneity of the water wet mixture which comprises adding a sodium salt of a sulphonated fatty acid during mixing.

6. In the manufacture of ammunition priming compositions containing a gum binder by the water wet mixing of ingredients, the method of improving the workability of the water wet mixture which comprises adding a surface active agent to the gum binder and then mixing the ingredients while water wet including the binder.

PHILIP H. BURDETT.
MATTHEW W. MAUGHAN.