United States Patent Office 3,267,035 Patented August 16, 1966

3,267,035

COMPOSITION FOR AND METHOD OF LUBRICATING BULLETS AND SHOT

Richard M. Tillman, Ponca City, Okla., assignor to Continental Oil Company, Ponca City, Okla., a corporation of Oklahoma

No Drawing. Filed May 22, 1964, Ser. No. 369,593
19 Claims. (Cl. 252—49.5)

This invention relates to a composition for, and method of, lubricating bullets and shot of the type which require lubrication in order to reduce fouling of the firing mechanism and barrel of firearms in which such bullets and shot are used. More particularly, but not by way of limitation, the present invention relates to a method for providing a dry film lubricant on lead bullets and shot which, without lubrication, foul the barrels of firearms by lead deposition thereon and which, with conventional lubricants, tend to foul the firing mechanism.

It has been recognized for many years that lead bullets or shot deposit lead within the barrels of pistols, rifles and shotguns in which such ammunition is used. Such lead deposition results in fouling which impairs the accuracy with which the firearm may be fired, and in extreme cases may impair the operation of the firearm. It has further been recognized that a substantial reduction in lead fouling of the type described can be achieved in the case of bullets by lubricating the bullets. A type of lubricant which has been widely employed for this purpose is a tacky wax or wax-grease mixture. Although this type of lubricant does substantially alleviate the problem of lead fouling, the lubricant itself gives rise to certain other problems which render its use a far less than fully satisfactory solution to the fouling problem. Thus, because of the tackiness or sticky consistency of these lubricants, there is a propensity for powder grains from the cartridge or shell to adhere to the lubricant and to remain unburned during the discharge of the cartridge. This unconsumed residue, consisting of the gummy lubricant and powder grains, accumulates in the operating mechanism of the firearm and contributes to operating difficulties. Moreover, sticky or tacky lubricants are especially objectionable when applied to externally lubricated bullets (as opposed to those lubricated internally within the case of the cartridge) as is the current practice in rimfire ammunition. Such external lubrication results in undesirable soiling of the hands of one handling the ammunition, and in the introduction of abrasive particles of dust and dirt into the firearm mechanism and bore by the propensity of the tacky lubricant surface to pick up and carry foreign materials with which it comes in contact.

In the case of lead shot of the type utilized in shotgun shells, it is not believed that any attempt has ever been made to individually lubricate the shot to counteract the problem of lead fouling. It seems probable that this solution to the problem of fouling in the case of small, spherical-type shot has not been proposed because of the effect that the use of a sticky lubricant would have upon a shot column and the resulting shot pattern. In other words, due to the tendency of the soft, tacky lubricant to stick individual pellets together, the shot charge so treated would tend to emerge from the barrel as a single agglomerate rather than in the usual spherical geometry associated with a shot pattern.

In an effort to overcome some of the described undesirable features which characterize the use of a tacky or

sticky wax, or wax-grease mixtures as bullet and shot lubricants, it has been proposed, in the case of both bullets and shot, to jacket or coat the projectiles with a copper alloy. This procedure has effectively minimized bore fouling resulting from the use of lead bullets and shot. The copper alloy coating, however, can be provided only by substantially increasing the cost of producing such ammunition. Moreover, the harder copper alloy coating or jacket results in more rapid wear of the barrel of the firearm in which such ammunition is used than is experienced when the softer lead bullets and shot are employed. For these reasons, lead bullets and shot continue to be used in large quantities, particularly in low velocity ammunition, such as rimfire cartridges and center-fire cartridges for pistols and older rifles. The use of uncoated lead shot in shotgun shells also continues to predominate.

The present invention provides a new technique for reducing the extent of lead fouling which is experienced when ammunition of the type using lead projectiles (either bullets or shot) is employed. The method of accomplishing such reduction of fouling is based upon the use of a lubricant composition which is dry to the touch and adheres well to a bullet or shot, providing a dry film or coating over the surface thereof. One of the primary advantages of the use of the dry film lubricant of this invention derives from its physical properties which permit a tough, adherent and non-tacky coating having a low coefficient of friction to be applied to the surface of the projectile. Thus, the problems of dirtying the hands of a person handling the cartridges, or the deposition of grease, abrasive particles and powder on the firing mechanism and in the bore of the firearm are obviated or substantially reduced.

The lubricant composition which is utilized in the practice of this invention may be broadly described as a mixture of a wax and a wax extendible, synthetic resin copolymer. Although, as will later be explained, a wide variety of waxes may be employed in the lubricant mixture used in the invention, the use of petroleum-derived paraffin and microcrystalline waxes is preferred. The wax extendible copolymers which may be employed are defined as copolymers which are mutually miscible in all proportions with the wax utilized. The preferred copolymers for use with the preferred paraffin and microcrystalline waxes are ethylene-vinyl acetate and ethylene-ethyl acrylate, each of which imparts to the waxes a degree of toughness and adherence not characteristic of the waxes alone. Although wax-copolymer compositions of the described type have been heretofore utilized for several purposes, it is believed that the use of this general type of mixture as a lubricant for ammunition constitutes a novel utilization of the compositions which is not suggested by any of the adaptations or uses of the compositions previously known.

In the practice of the method of the invention, it is preferable to apply the wax-copolymer blend or mixture in the form of a water emulsion, or from a volatile organic solvent solution. This is due to the high viscosity of the wax-copolymer blend which makes it quite difficult to apply the pure blend directly to bullets and shot. It should be understood, however, that direct application of the pure wax-copolymer blend to certain types of bullets, such as those used in internally lubricated, center-fire ammunition, can be utilized if this technique of application should be desirable for any reason.

From the foregoing general description of the invention, it will have become apparent that it is a major object of

the present invention to provide a dry film lubricant for lead bullets and lead shot which reduces the extent of fouling of firearms in which ammunition of this type is used.

A more specific object of the present invention is to provide a lubricant which can be applied quickly and easily to lead bullets and shot, and which is a cleaner, less tacky lubricant than the types which have previously been utilized for this purpose.

An additional object of the present invention is to provide a dry film lubricant for lead bullets and shot which, while reducing fouling of firearms by lead projectiles of this type, does not affect the accuracy with which such firearms may be discharged.

Another object of the present invention is to provide a new and highly desirable use for mixtures of a wax and a wax extendible copolymer, and particularly, for compositions which include a petroleum-derived wax and a copolymer such as ethylene-vinyl acetate.

Yet another object of the present invention is to provide a lubricant composition for providing a film or coating on lead bullets and shot, which lubricant composition can be more effectively used than previously employed wax-type lubricants or blends of waxes and greases utilized for this purpose.

In addition to the foregoing described objects and advantages of the invention, additional objects and advantages will become apparent as the following detailed description of the invention is read.

The lubricant composition used in the present invention has been hereinbefore described as a mixture of wax and a wax-extendible, synthetic resin copolymer which is miscible in all proportions with the wax which is used. These two components of the lubricant composition will initially be described in greater detail.

The type of wax which is used in the lubricant composition of the invention is subject to considerable variation in its chemical and physical requirements, and the main criterion of its selection is that it meets certain functional demands. These demands are that the wax impart to the lubricant a relatively low coefficient of friction, a sufficiently high melting point to prevent blocking in storage and to perform as an adherent coating to the ammunition upon which it is used. A number of waxes or waxy materials meet the above described requirements, and may be utilized in the lubricant composition of the present invention. Suitable waxes may be of either animal, vegetable or mineral origin and may, in appropriate instances, be either natural or refined. Synthetic waxes are also suitable and can be employed. The waxy materials which, in addition to meeting the above described functional requirements, are otherwise operable in the invention, may be defined broadly as opaque or translucent organic thermoplastics having a melting point between about 40° C. and 90° C. with such thermoplastics melting to relatively low viscosity liquids and not exhibiting thread spinning phenomena, forming pastes or gels with organic non-polar solvents, and having water resistant properties.

The waxes derived from petroleum are preferred for use in the invention, and of these, paraffin waxes are most preferred. Paraffin waxes are the waxy constituents occurring in various fractions of most crude petroleum. Since they derive from the fractionated cuts obtained upon distillation of the crude petroleum, they are frequently referred to as petroleum distillate waxes to distinguish them from the so-called microcrystalline waxes which are derived from certain tarry or more viscous residues remaining from certain fractionations occurring in the petroleum refining processes. The paraffin waxes manifest melting points in the range of from about 40° C. to 65° C. and Saybolt viscosities in the range of from about 35–45 S.S.U. at 210° F., and are further physically characterized by crystallizing into large, well-formed distinct crystals of the plate and needle types. The physical characteristics of a paraffin wax may vary and depend upon the crude petroleum source, the portion of the crude which is used for wax production and differences in refining techniques. Additionally, as hereinbefore indicated, waxes of animal, vegetable or synthetic origin can be employed in combination or mixture with the paraffin wax. Also, microcrystalline waxes derived from petroleum residues may be used and are, in fact, the second most preferred type of wax for use in combination with the wax-extendible copolymers used in the lubricants of the invention. Generally, microcrystalline waxes having dropping points in the range of from about 150° F. to about 190° F. are suitable.

The second constituent of the dry lubricant blends used in the present invention is a wax-extendible, synthetic resin copolymer. By the term wax-extendible is meant a copolymer which is miscible in all proportions with the wax which is employed. Several materials are suitable for use as this ingredient of the dry film lubricant used in this invention, but the preferred materials are copolymers of vinyl acetate and ethylene, and copolymers of ethylene and ethyl acrylate. Both of these materials impart to the compositions which include the wax and copolymer, a tough, adherent quality which prevents the lubricant from being unintentionally removed or spalled off during normal handling or carrying of the ammunition as would be the case if a hard non-tacky wax was used alone. The copolymer constituent also reduces or eliminates the tacky quality attributable to soft wax constituents if they are used in the lubricant. The most suitable results in ammunition lubrication have been obtained using blends of a petroleum-derived wax, such as paraffin wax, microcrystalline wax or blends of the two with ethylene-vinyl acetate copolymers of the type hereinafter described in detail.

The ethylene-vinyl acetate copolymers which are preferably blended with petroleum-derived wax in forming the dry film composition used in practicing the invention are characterized in having a polymerized vinyl acetate content of from about 5 to about 40 percent by weight, and, preferably, from about 25 to 35 percent by weight. These copolymers can conveniently be prepared by copolymerizing a mixture of ethylene and vinyl acetate in the presence of a free-radical catalyst, e.g., tertiary butyl hydroperoxide, in a suitable reactor at a pressure of from about 15,000 to about 30,000 p.s.i. and a temperature of from about 150° C. to about 250° C. By varying one or several of the reaction conditions, various molecular weight copolymers can be obtained. Ordinarily in this art, the molecular weight of the resultant copolymer is generally not expressed as such because of the difficulty and uncertainty of reliably ascertaining this property. Accordingly, an alternate and preferred manner of specifying the molecular weight characteristic of such copolymers is in terms of the cooplymer's melt index as determined by ASTM D–1238–57T. Briefly stated, this test consists of determining the amount in grams (melt index value) of the copolymer that can be pressed through a standard orifice in ten minutes at 190° F. with a piston weighing 2,160 grams. The ethylene-vinyl acetate copolymers especially useful herein exhibit melt indices ranging from about 3 to about 300 and preferably from about 3 to about 30. The most preferred ethylene-vinyl acetate copolymers have a tensile strength exceeding about 1000 p.s.i. as determined by ASTM D–882–56T using a crosshead speed of ½ inch per minute and a sample length of 1 inch.

The described ethylene-vinyl acetate copolymers are available commercially under the trademark "Elvax." Several types of the Elvax copolymers are marketed, with the several types varying in the ratio of ethylene to vinyl acetate contained in each. The known properties of four

of the ethylene-vinyl acetate cooplymers are more specifically characterized as follows:

Copolymer	Elvax 150	Elvax 220	Elvax 240	Elvax 250
Comonomer Ratio, Wt. percent (ethylene:vinyl acetate)	66:34 to 68:32	73:27 to 71:29	73:27 to 71:29	73:27 to 71:29
Melt Index (ASTM D-1238-57T)	22 to 28	125 to 175	22 to 28	12 to 18
Refractive Index, N_D^{25}	1.485	1.485	1.485	1.482
Density at 30° C., grams/cc	0.95	0.95	0.95	0.95
Softening Point (Ring and Ball), ° F	243	192	307	276
Inherent Viscosity, cp. at 30° C.[1]	0.77	0.63	0.78	0.85
Molecular Weight	300,000	150,000	225,000	400,000
Tensile Strength, p.s.i.[2]	1,000	460	2,000	2,000
Elongation at Break, percent [2]	700	650	850	750

[1] Determined using a solution of 0.25 weight percent copolymer in toluene.
[2] Crosshead speed of ½ inch per minute and a sample length of 1-inch (ASTM D-882-56T).

Of the foregoing materials, the use of the Elvax 240 in preparing the composition of the present invention is preferred, although the other Elvax materials can also be used.

A highly effective dry lubricant composition which may be utilized for eliminating or greatly reducing the fouling problem associated with lead ammunition comprises between about 60 percent by weight and about 95 percent by weight paraffin or microcrystalline wax, and from about 5 percent by weight to about 40 percent by weight ethylene-vinyl acetate copolymer. A blend containing from 15 to 30 percent by weight of the copolymer is preferred. Small amounts of commonly used wax additives such as oxidation inhibitors can also be included in the compositions.

Blends of the wax and copolymer can suitably be prepared by first heating about one-half of the total wax content of the first blend to a temperature of from about 250° F. to 300° F. in a suitable mixer. The wax may then be stabilized by adding a small amount of a suitable oxidation inhibitor to the wax in the mixture. All of the copolymer resin is then blended into the hot wax to form a resin-wax concentrate in which no discrete particles of the copolymer can be discerned. The balance of the wax is next added to the blend concentrate and the total mixture is agitated to a uniform consistency. Alternatively all of the wax may be added before addition of the copolymer if desired. The composition is then ready for application to ammunition by one of the techniques hereinafter described.

Another copolymer which can be utilized in the preparation of the dry film lubricant used in the practice of the present invention is a copolymer of ethylene and ethyl acrylate. This material is blended with the wax in substantially the same weight ratio as is used in the blends of petroleum-derived wax with ethylene-ethyl acetate copolymers. Of the ethylene-ethyl acrylate copolymers which may be employed, the preferred species are characterized by the typical following properties:

Melt index [1]	2.5 to 20.1
Ethyl acrylate, wt. percent	15 to 20
Tensile strength, p.s.i.[2]	1100 to 2000
Elongation at break, percent [2]	670 to 810
Density @ 30° C., grams/cc.	0.924 to 0.944
Brittle point, ° C.	−70°
Hardness, short "D" [3]	30 to 40

[1] ASTM D-1238-57T.
[2] ASTM D-412-57T at 2" per minute crosshead speed.
[3] ASTM D-1706-57T.

An especially suitable ethylene-ethyl acrylate copolymer for use in preparing the dry lubricant used in the practice of the invention is that which is sold under the trademark

"Zetafin 70A1." Zetafin 70A1 has the following properties:

Ethyl acrylate content, wt. percent	15 to 20
Melt index	18 to 19
Density @ 30° C., grams/cc.	0.927 to 0.929
Hardness, shore "D"	30 to 35
Hardness, shore "A"	88

The dry lubricant blends of wax and wax extendible copolymer can be applied to bullets and shot by several different techniques. The blend may be applied in a "dry state" in which the blend is constituted only by the two components hereinbefore described, or predominantly of the two components with minor quantities of oxidation inhibitor and/or other usual additive compounds. However, it is preferred to prepare either an aqueous emulsion, or a volatile solvent solution of the wax-copolymer compositions for the purpose of applying the composition to bullets and shot. This is because the relatively high viscosity of the lubricant in its undiluted melted state or its relative hardness and resistance to cold flow in the solid state makes application of the blend difficult in most existing bullet and shot coating equipment.

Where the wax-copolymer composition is made up as a water emulsion, it is preferred to use from 50 to 95 percent by weight water in the emulsion. The use of deionized water is preferred in order to prevent the development of undesirable precipitates or residues in the emulsion. An emulsifying agent, such as triethanol amine stearate, sodium lignosulfonate, or morpholine stearate, is also included in the mixture to promote the emulsification of the wax and copolymer in the water. The emulsifying agent may be formed in situ if desired, such as by the addition of triethanol amine and stearic acid to the emulsion mixture. The total amount of emulsifying agent utilized will vary considerably, depending upon the particular wax and copolymer utilized, but in general will range from about 1 percent by weight to about 10 percent by weight of the total emulsion.

Where the dry film lubricant composition of the invention is applied to ammunition in the form of an emulsion, the bullets may be dipped into the lubricant emulsion, and the excess lubricant spun off by rotating the bullets rapidly around their longitudinal axis. The water in the remaining emulsion is removed by drying the bullets with warm air. As a final step in the coating procedure, the bullets are heated to a temperature sufficiently high to fuse the coating. With most compositions which include paraffin wax, the temperature utilized for fusing the blend will range from about 120° F. to 150° F. In substantially all instances, a temperature at, or slightly above, the melting point of the wax component of the composition will suffice for fusion.

As an alternative procedure to application of the compositions of the invention in the form of water emulsions, the wax-copolymer blends can be dissolved in a suitable solvent for the composition. Volatile petroleum derived hydrocarbons may be utilized as may chlorinated solvents. Among the solvents which are suitable are carbon tetrachloride, perchloroethylene, tri- and tetrachloroethylenes, tetracholorethane and chlorobenzene. These materials have been found to give good coatings of the dry film lubricant on shot and bullets. Since the use of solvent cutbacks for application of the dry film lubricant has the disadvantages of flammability and toxicity, the water emulsion technique for application of the wax-copolymer blends constitutes the preferred method of application.

Perhaps the most feasible method of coating shot with the dry film lubricant is to tumble the shot in the presence of a quantity of powdered lubricant.

The invention will be better understood from the following examples which illustrate certain particular embodiments of the invention, and set forth the results obtained when bullets coated with the dry film lubricant of the invention were fired in several types of firearms.

Example 1

Two lubricant compositions were prepared and respectively contained (a) 60 percent by weight recrystallized microwax (melting point 150–175° F., dropping point 150–190° F.) and 40 percent by weight Elvax 240 (properties hereinbefore defined), and (b) 60 percent by weight refined 350 paraffin wax (melting point 143–150° F.) and 40 percent by weight Elvax 240.

These lubricant compositions were applied to Hensley and Gibbs No. 50 (152 grains) .38 caliber Special bullets sized to 0.3565 inch, and also to Hensley and Gibbs No. 130BB (198 grains) .45 caliber bullets sized to .452 inch. The bullets were lubricated by standing them in a container, pouring in the molten lubricant, and then removing the bullets from the solidified cake with an appropriately sized cork borer. The bullets were sized to the proper dimensions and the excess lubricant removed by the sizing die.

The .38 caliber bullets were fired in a .38 Special Colt Officer's Model revolver ahead of 4.5 grains of Du Pont Pistol Powder No. 5066. 100 rounds were fired using bullets coated with the recrystallized microwax-copolymer composition, followed by the firing of 100 rounds using bullets coated with the refined paraffin wax-copolymer composition. After the firing of each of the 100 rounds, the firearm was inspected. In each case, the bore, forcing cone and chambers were clear and free of lead. The inside surface of the barrel appeared dry instead of oily.

The .45 caliber bullets were fired in a .45 Colt Automatic ahead of 5.5 grains of Du Pont Pistol Powder No. 5066. The firing was carried out at a rapid rate to permit the barrel to heat up. 100 rounds were fired using bullets coated with the recrystallized microwax-copolymer composition followed by the firing of 100 rounds using bullets coated with the refined paraffin wax-copolymer composition. Upon inspection of the firearm after the firing of the first 100 rounds, the barrel was free of lead.

No deposition of gummy material or powder grains was noticed in the case of the tests of bullets fired in either the .38 caliber pistol or in the .45 caliber pistol.

Example 2

A water emulsion of the following composition was prepared:

Component:	Weight percent
Elvax 240	4.6
Paraffin wax	11.46
Triethanol amine	2.3
Stearic acid	5.16
Deionized water	76.48

The aqueous emulsion of wax and copolymer was applied to fifty .22 caliber rimfire long rifle cartridges which had been thoroughly cleaned with solvent to remove their existing lubricant. The aqueous emulsion was applied by dipping the cartridges in the emulsion, drying the excess emulsion using a heat gun and then bringing the temperature of the cartridges up to the melting point of the coating. The fifty coated cartridges were then fired in a K–22 Smith & Wesson .22 caliber revolver. After completion of the firing, the firearm was examined. No leading was perceptible in the revolver cylinders, on the forcing cone or in the barrel.

Example 3

A composition containing 60 percent by weight 100 paraffin wax and 40 percent by weight Elvax 220 was applied as a thin coating to fifty Hensley & Gibbs No. 50 (152 grains) .38 caliber bullets. The lubricant coating adhered very tenaciously to the bullets and demonstrated good flexibility or plasticity. Upon firing the bullets in a .38 Special Officer's Model revolver ahead of 4.5 grains of Du Pont Pistol Powder No. 5066, no lead fouling of the revolver was perceived to occur.

Example 4

A composition containing 40 percent by weight Zetafin 70A1 (properties hereinbefore described) and 60 percent by weight of 100 paraffin wax was applied to fifty .38 caliber bullets of the type described in Example 3. The coating adhered well to the bullets and was flexible in response to bending stresses. Firing of the bullets in a .38 Special Officer's Model revolver did not result in any lead or lubricant deposition in the firearm.

Example 5

The aqueous emulsion utilized in Example 2 was tested on a pilot scale by a large manufacturer of cartridges. In the pilot test, .38 caliber bullets were dipped into the lubricant and then the excess emulsion was spun off the bullets by centrifugal force. The bullets were then dried with hot air and the compositions were finally fused by heating to the melting point of the wax component. The lubricated bullets were then machine-loaded in the cartridges in conventional loading equipment. No problems were encountered either in the lubricating procedure or in loading. Moreover, it was observed that the lubricant did not scrape off or build up in the cartridge loading machines as the conventional, previously used wax-grease lubricating material did. It was also observed that when the bullets were fired in .38 caliber pistols, powder grains did not stick to the base of the bullets, as had been usually observed when conventional tacky lubricants were employed.

Example 6

One type of bullet lubricant which has previously been proposed involves the deposition of a wax coating on the bullet using a water base emulsion. The wax is applied either with or without a very small amount of a natural or synthetic resin which is considered to act as a film forming material. One of the types of resin which has been proposed for forming the film is an acrylate resin. Using a bullet lubricant of the type described, some tackiness and adherence of powder grains and dirt is still experienced. The present invention does not rely upon a separate film forming technique, since the wax constitutes a continuous phase when applied to the bullets and shot, and the copolymer is present in the wax as a compatible, completely miscible disperse phase.

In order to compare the results obtained when using the dry film lubricant of the present invention with the results obtained using the wax emulsions and the acrylate resin film-forming type wax lubricants described, bullets were lubricated with these materials and small arms firing tests were conducted.

Fifty Hensley & Gibbs No. 50 (152 grain) .38 caliber bullets were coated with a water emulsion containing 34.4 percent by weight paraffin wax, 3.3 percent by weight polyvinyl alcohol and 62.2 percent by weight water. Another fifty bullets of the same type were coated with a composition containing 22.5 percent by weight 100 paraffin wax, 3.0 percent by weight oleic acid, 4.5 percent by weight triethanol amine, 2.0 percent by weight borax, 1.5 percent by weight methyl methacrylate resin and 66.5 percent by weight water.

All one hundred bullets were then fired in a .38 Special Colt Officer's Model revolver ahead of 4.5 grains of Du Pont Pistol Powder No. 5066. The firearm was thoroughly cleaned after the fifty rounds of ammunition coated with the first described composition had been fired.

In the case of the fifty bullets coated with the first described composition, the coating was brittle and was easily fractured out of the lubricating grooves. Some slight streaks of lubricant were deposited in the bore of the revolver. No lead fouling of the gun was perceived to occur.

Leading was not observed following firing of the fifty cartridges coated with the methacrylate composition. However, adherence of this material to the bullets was poor and the coating was very brittle and fractured easily.

From the foregoing description of the invention, it will be perceived that the present invention provides an effective method for reducing the occurrence of lead fouling in firearms using lead bullets or shot. The dry film lubricant compositions which are proposed are relatively inexpensive and may be easily applied to the ammunition by any one of the several techniques hereinbefore discussed.

Although certain preferred embodiments of the invention have been hereinbefore described by way of example, it will be understood that some modification and variation may be made in the proportions indicated and in the materials to which reference has been specifically made without departure from the basic principles which underlie the invention. Insofar as such modifications continue to rely upon the fundamental principles which underlie the invention, they are deemed to be circumscribed by the spirit and scope of the invention except as the same may be necessarily limited by the appended claims or reasonable equivalents thereof.

What is claimed is:

1. A method of lubricating shot and bullets to reduce fouling of firearms in which they are used comprising applying as a coating to such shot and bullets, a composition comprising:

from about 60 percent by weight to about 95 percent by weight of wax; and

from about 5 percent by weight to about 40 percent by weight of a copolymer selected from the group consisting of ethylene-vinyl acetate copolymers and ethylene-ethyl acrylate copolymers.

2. A method as defined in claim **1** wherein said wax is a petroleum-derived wax.

3. A method as defined in claim **2** wherein said copolymer is an ethylene-vinyl acetate copolymer.

4. A method as defined in claim **3** wherein said ethylene-vinyl acetate copolymer has a vinyl acetate content of from about 10 percent by weight to about 40 percent by weight and a melt index of from about 3 to about 300.

5. A method as defined in claim **4** wherein said ethylene-vinyl acetate copolymer has a vinyl acetate content of from about 25 percent by weight to about 35 percent by weight and a melt index of from about 3 to about 30.

6. A method as defined in claim **5** wherein said petroleum-derived wax is a paraffin wax melting between about 40° and 65° C.

7. A method as defined in claim **5** wherein said petroleum-derived wax is a microcrystalline wax.

8. A method as defined in claim **2** wherein said copolymer is an ethylene-ethyl acrylate copolymer.

9. A method as defined in claim **2** wherein said composition contains from about 15 percent by weight to about 30 percent by weight of said copolymer.

10. A method as defined in claim **8** wherein said ethylene-ethyl acrylate copolymer contains from about 15 percent by weight to about 20 percent by weight ethyl acrylate and has a melt index of from about 2.5 to about 20.1.

11. A method as defined in claim **2** wherein said petroleum-derived wax is a paraffin wax melting between about 40° C. and about 65° C.

12. A method as defined in claim **2** wherein said composition is applied as a water emulsion of said wax and copolymer.

13. An aqueous emulsion composition for applying a dry lubricant coating to ammunition comprising:

(a) from about 60 percent by weight to about 95 percent by weight water;

(b) from about 3 percent by weight to about 38 percent by weight of a petroleum-derived wax;

(c) from about 0.25 percent by weight to about 16 percent by weight of a copolymer selected from the group consisting of ethylene-vinyl acetate and ethylene-ethyl acrylate; and

(d) a suitable emulsifying agent.

14. An aqueous emulsion composition as defined in claim **13** wherein said petroleum-derived wax is a paraffin wax melting between about 40° C. and about 65° C.

15. An aqueous emulsion composition as defined in claim **13** wherein said copolymer is ethylene-vinyl acetate having a vinyl acetate content of from about 10 percent by weight to about 40 percent by weight and a melt index of from about 3 to about 300.

16. An aqueous emulsion as defined in claim **13** wherein said petroleum-derived wax is a microcrystalline wax.

17. An aqueous emulsion composition as defined in claim **15** wherein said petroleum-derived wax is a paraffin wax melting between about 40° C. and about 65° C.

18. A method of lubricating bullets and shot comprising:

applying to the bullets and shot, an aqueous emulsion comprising

from about 60 percent by weight to about 95 percent by weight water;

from about 3 percent by weight to about 38 percent by weight of a petroleum-derived wax;

from about 0.25 percent by weight to about 16 percent by weight of a copolymer selected from the group consisting of ethylene-vinyl acetate and ethylene-ethyl acrylate;

removing excess aqueous emulsion from the bullets and shot to leave a uniform coating thereon; and

heating said coating to about the melting point of the wax in said emulsion.

19. A method of lubricating bullets and shot comprising:

dissolving in a volatile hydrocarbon solvent, a blend consisting essentially of from about 60 percent by weight to about 95 percent by weight of a petroleum-derived wax, and from about 5 percent by weight to about 40 percent by weight of a copolymer selected from the group consisting of ethylene-vinyl acetate copolymers and ethylene-ethyl acrylate copolymers; and

applying the volatile hydrocarbon solution of the blend to the bullets and shot to form a coating of the solution thereon;

removing the solvent from the bullets and shot to leave said blend thereon; and

fusing the blend on the bullets and shot.

References Cited by the Examiner

UNITED STATES PATENTS

1,953,904	4/1934	Bowyer et al.	252—37.2 X
2,346,124	4/1944	Dew	252—49.5
2,877,196	3/1959	Reding	260—28.5
2,919,647	5/1960	Dear et al.	102—92.5 X
3,010,899	11/1961	Boyer	252—56 X
3,048,553	8/1962	Moss	260—28.5

DANIEL E. WYMAN, *Primary Examiner.*

C. F. DEES, *Assistant Examiner.*