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MATERIAL FOR AND METHOD OF CLEANING METAL SURFACES.

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To all whom it may concern:

Be it known that we, PERCY H. WALKER and JOHN H. BOWER, citizens of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Materials for and Methods of Cleaning Metal Surfaces; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This application is made under the act of March 3, 1883, chapter 143 (22 Stat., 625) and the invention herein described and claimed may be used by the Government of the United States, or any of its officers or employees in the prosecution of work for the United States, or by any person in the United States, without the payment of any royalty thereon.

This invention relates to materials for and methods of cleaning metal surfaces such as iron or steel, and more particularly to the removal of metal fouling from fire arms and ordnance, such as rifle barrels, machine gun barrels, and rifled guns of all types.

A principal object of the invention is to produce an effective metal-cleaning liquid which will attack and remove undesirable deposits of a metallic nature from metal surfaces without detrimentally affecting the surface to be cleaned. Another important object of the invention is to provide the active chemical ingredients of the metal-cleaning solution in the form of solid substances which can be easily transported and easily handled, and which can be readily and accurately brought together with a necessary amount of a suitable solvent to produce an effective cleaning liquid or solution of the type desired.

While the invention in its broader aspects relates to the cleaning of metal surfaces in general, its greatest present utility is in connection with the removal of cupro-nickel fouling from rifle, machine gun and other gun barrels, as well as copper and nickel coatings from iron and steel generally.

It is well known that gun barrels after considerable use become fouled with copper or cupro-nickel deposits or coatings due to the action of the gun rifling on the bands or jackets with which the projectiles are provided. In order to maintain the gun in proper condition, it is necessary to remove this copper fouling or cupro-nickel fouling from time to time. Various methods have been proposed heretofore for doing this, and some of these methods have proved effective. The most satisfactory mixture heretofore used for this purpose was prepared by mixing ammonia water, ammonium persulfate, and ammonium carbonate. This solution apparently acts in the following manner: the ammonium persulfate oxidizes the copper and nickel, and the resulting oxids are dissolved in the mixture of ammonium hydroxid and ammonium carbonate, thus removing the metal fouling. Ammonium persulfate in neutral or acid solution would oxidize the steel of the rifle barrel; but the rather large excess of free ammonia keeps the solution strongly alkaline and prevents injurious corrosion of the steel.

The above mixture, while efficient, has several disadvantages. In the first place, the complete solution decomposes in a short time and hence must be freshly prepared for use. Again, one of the essential ingredients, ammonia water, must be transported in liquid form and is a substance which rapidly loses its strength unless kept carefully stoppered and in a cool place. Breakage of the ammonia water containers is also a serious difficulty. Furthermore, preparation from the separate ingredients involves weighing and measuring which is not only troublesome and wasteful of material, but in the hands of men unaccustomed to such operations, frequently results in mistakes. Improper proportions of the ingredients can easily produce a solution which may have little or no effect on metal fouling but which may have decidedly injurious effects on the guns.

The present invention therefore consists in obviating the foregoing difficulties and objections by using substances which are solid and easily kept and transported, but which, when properly mixed with water, react to give a liquid which removes cupro-nickel and similar deposits without injuring the steel of the gun barrel, or other metal object to be cleaned.

Stated generally, the invention involves the preparation and use of the necessary

chemical ingredients in the form of solid substances put up in separate measured units of some kind, these units most conveniently taking the form of compressed tablets containing predetermined quantities of the ingredients. For example, one unit may comprise a chemical containing oxygen in active condition and therefore adapted, upon addition of water, to oxidize the copper or cupro-nickel fouling in a gun barrel. This same unit most desirably embodies also what may be conveniently termed a latent or potential solvent for the metal oxids resulting from the attack on the fouling, such latent or potential solvent being a substance which, upon addition of water, or another reagent, develops the necessary solvent action. Broadly speaking, such potential solvent substance may be present either as an integral part of the compound containing active oxygen, or as another chemical compound admixed therewith, the latter being generally more desirable and convenient in actual practice. Another unit, to be used in conjunction with the first mentioned unit, should comprise in solid form, such as a tablet, an alkaline reagent which, upon reaction in aqueous solution with the constituents of the first unit, will aid in developing the potential solvent action before mentioned. Ordinarily, only the two units mentioned are necessary in practicing the invention. The chemical contents of the tablets or other forms constituting the two separate units being predetermined with the requisite accuracy, it is only necessary to bring together the separate units in proper predetermined proportions, in the presence of the necessary amount of water, to produce an effective cleaning liquid of the character described.

In order to afford a more complete understanding of the invention, a typical embodiment thereof will now be described in detail. It will be assumed that the completed cleaning solution when ready for use is to contain ammonium persulfate, ammonium sulfate, and ammonium hydroxid in proper proportions to rapidly attack and dissolve cupro-nickel gun fouling, and at the same time not to undesirably affect the steel of a gun barrel. Ammonium persulfate and numerous other ammonium salts are solids that can be easily kept and transported when dry. Furthermore, most ammonium salts, among which ammonium sulfate offers special advantages, do not react with ammonium persulfate when mixed therewith in dry condition. Accordingly, one of the separate units in the present instance, consists of a dry uniform mixture of ammonium persulfate and ammonium sulfate compressed into tablets. In order to ensure strength and coherence of these tablets, a small amount of a suitable binder such as sugar or dextrin may be incorporated with the salts; and a small amount of stearic acid or other lubricating agent may also form a part of the mixture in order to effect ready separation of the tablets from the forming dies. Such additions are, of course, common practice in the tablet-making art.

The other separate unit in the present instance comprises tablets of a caustic alkali, caustic soda (sodium hydroxid) being entirely suitable for this purpose. Caustic alkalies such as sodium hydroxid and potassium hydroxid, can be readily kept and transported without alteration if protected against moisture. The caustic soda tablets may of course also comprise binding and lubricating ingredients.

The proportions of the ingredients used in preparing the above described tablets may vary considerably in practice. In a typical embodiment of the invention found to be especially advantageous, the tablets of the first unit may each weigh about 2.25 grams, and may contain 0.75 gram of ammonium persulfate and 1.25 grams of ammonium sulfate, the balance consisting of binder and lubricant. That is, the proportion of persulfate to sulfate is about 3 to 5 in this instance, and in general it will be found best to have the sulfate constitute the greater part of the mixture. For best results, these tablets should not contain more than 3 per cent of matter insoluble in water, and not more than 0.1 per cent of matter insoluble in water after ignition. The tablets of the second unit may be of about the same weight and contain about 2 grams of caustic soda or sodium hydroxid. Most desirably, the caustic soda tablets should not contain more than 0.5 per cent of matter insoluble in water, and not more than 0.1 per cent of matter insoluble in water after ignition. In using tablets of this particular description to remove metal fouling from a rifle barrel, for example, a very effective solution is obtained by dissolving four of the ammonium-persulfate-ammonium-sulfate tablets and one caustic soda tablet in from 30 to 35 cubic centimeters of water. The material dissolves completely except for small quantities of binder and lubricant which may be disregarded. The fixed alkaline reagent, caustic soda in this instance, liberates ammonia from both the ammonium persulfate and the ammonium sulfate with formation of sodium sulfate, the resultant solution being strongly ammoniacal and highly oxidizing in character. The necessary amount of this solution is introduced into the gun barrel, the breech of which has been previously plugged, and is allowed to remain in the gun long enough to ensure the necessary cleansing action. As a rule this is effected in from 15 to 30 minutes. The ammonium hydroxid, together with any

excess ammonium sulfate, readily dissolves the cupro-nickel oxids formed by the oxidizing action of the ammonium persulfate on the metal fouling.

The tablets comprising the two units are of course kept in separate tightly closed containers, and can be readily issued in the field or elsewhere when it is necessary to clean the gun barrels. It is simply necessary to take the necessary number of tablets of each unit and add to them the specified amount of water in order to prepare the cleaning liquid; and hence no special skill is required and the liability of mistake in making up the liquid is practically eliminated. Furthermore, since all the chemical ingredients are in solid form, they are easily transported and handled without the danger of container breakage attending transportation of aqua-ammonia, and with a very great reduction in amount of cargo space required.

It is evident that the ammonium hydroxid required in the completed cleaning liquid could be generated from ammonium persulfate alone without the use of an ammonium salt admixed therewith; but as ammonium persulfate is an expensive chemical, marked economy can be effected by using either ammonium sulfate or some other ammonium salt in admixture therewith. For this purpose, ammonium nitrate or ammonium chlorid, for example, can replace ammonium sulfate in the formula above given, since neither of these salts reacts upon ammonium persulfate in dry mixture therewith; but in practice we find ammonium sulfate particularly efficient and desirable, and it is also relatively inexpensive. Ammonium carbonate is less desirable for this purpose than the sulfate, chlorid or nitrate, because it is not so stable. Instead of ammonium persulfate, it is also possible to use other soluble persulfates, such as sodium persulfate, or potassium persulfate, or mixtures of these with each other or with ammonium persulfate. When sodium or potassium persulfate is used, it is of course essential to employ with it an ammonium salt to furnish ammonium hydroxid by reaction with caustic alkali in the complete liquid mixture. Mixtures of two or more ammonium salts may replace the single ammonium salt; and, similarly, mixtures of caustic alkalies, such as sodium and potassium hydroxids may be used in place of a single caustic alkali.

It is to be noted that although ammonium hydroxid generated by mixture of the separate solid reagents with water as described, is the most convenient solvent to employ for copper and nickel oxids, the invention in its broader aspects is not restricted thereto. For example, salts of substituted ammonium compounds which will liberate solvent ammonium bases upon reaction with an alkali or an alkaline reagent, may be employed in conjunction with the persulfate or other persalt; but ordinarily there is no advantage in using such salts over the use of the more common ammonium compounds.

Persulfates are particularly efficient as oxidizers in metal cleaning liquids of the character here in question. Other oxidizing agents may be employed under some conditions, however, such as perselenates, for example, but persulfates, and especially ammonium persulfate, are distinctly preferable in practice.

What we claim is:

1. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising ammonium persulfate and ammonium sulfate, in proper proportions to give a suitable metal-cleaning solution upon treatment with water and a fixed alkaline reagent.

2. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising ammonium persulfate, and ammonium sulfate, the ammonium sulfate constituting the greater part of the mixture.

3. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising about 3 parts by weight of ammonium persulfate and about 5 parts by weight of ammonium sulfate.

4. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising a soluble persulfate and an ammonium salt, in proper proportions to give a suitable metal-cleaning solution upon treatment with water and a fixed alkaline reagent.

5. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising a per-salt and an ammonium salt substantially inert toward said per-salt, in proper proportions to give a suitable metal-cleaning solution upon treatment with water and a fixed alkaline reagent.

6. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising a metal-oxidizing agent and a potential solvent for metal oxid, substantially as set forth.

7. As a new composition of matter useful in cleaning gun barrels and other metal surfaces, a substantially dry mixture comprising an oxidizer for copper and nickel, and a potential solvent for copper and nickel oxids.

8. Material for use in cleaning gun barrels and other metal surfaces which comprises separate solid substances in the form of measured units adapted, when brought together with sufficient water or other ap-

propriate solvent, to give an ammoniacal oxidizing liquid of the desired character.

9. Material for use in cleaning gun barrels and other metal surfaces which consists of the necessary chemicals in solid condition put up in two separate units, such as tablets or other convenient form, adapted to be mixed in a predetermined manner with water to give an ammoniacal oxidizing liquid.

10. Material for use in cleaning gun barrels and other metal surfaces which consists of two separate solid substances prepared in convenient form such as tablets, one of which comprises a mixture of a soluble persulfate such as ammonium persulfate, with an ammonium salt such as ammonium sulfate; while the other of said substances comprises a caustic alkali such as sodium hydroxid.

11. Material for use in cleaning gun barrels and other metal surfaces which consists of two kinds of tablets; one kind containing about 0.75 gram of ammonium persulfate and 1.25 grams of ammonium sulfate; and the other kind containing about 2.00 grams of caustic soda.

12. The process of preparing a liquid for cleaning gun barrels and other metal surfaces which comprises reacting with a fixed alkaline reagent upon a per-salt and an ammonium compound in the presence of water.

13. The process of preparing a liquid for cleaning gun barrels and other metal surfaces which comprises mixing ammonium persulfate, ammonium sulfate, and a caustic alkali, with water.

14. A compound for removing fouling from gun barrels and the like, comprising ammonium per-sulphate, ammonium sulfate and sodium hydroxide in a reacting mixture at the time of introduction into the gun barrel.

In testimony whereof we hereunto affix our signatures.

PERCY H. WALKER.
JOHN H. BOWER.