June 28, 1932. W. H. WOODFORD 1,865,157

LUBRICANT

Filed Oct. 11, 1928

Fig. 1

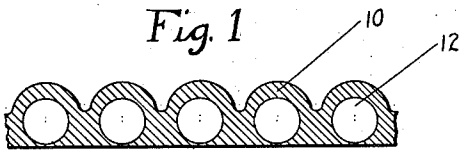


Fig. 2

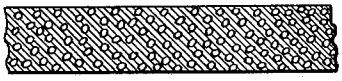


Fig. 3

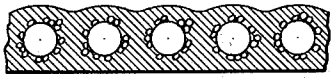


Fig. 4

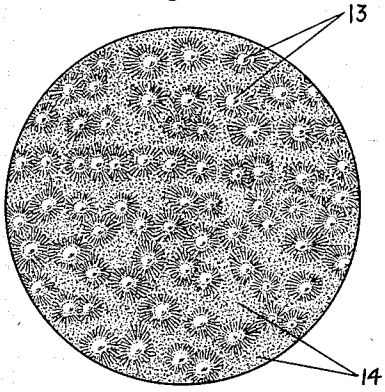


Fig. 5

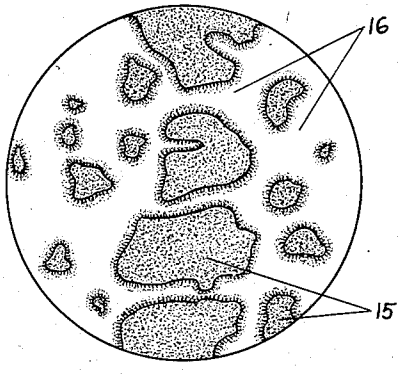


Fig. 6

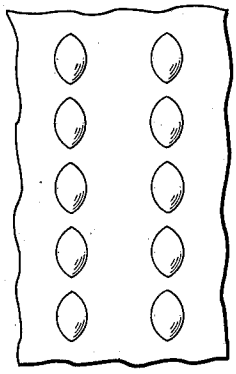
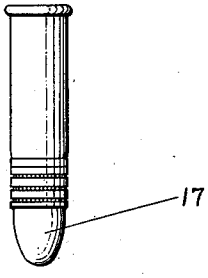


Fig. 7



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Patented June 28, 1932

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UNITED STATES PATENT OFFICE

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LUBRICANT

Application filed October 11, 1928. Serial No. 311,941.

This invention relates to lubricants and methods of applying lubricants to surfaces to be lubricated and will be discussed with special reference to the lubrication of bullets.

It is commonly recognized or assumed that lead bullets, for use in rifled fire arms, require the application of a lubricant for the securing of their best performance. In some bullets the lubricant is applied to grooves or cannelures which are placed within the powder case, the projecting point of the bullet being free from lubricant. Other bullets are lubricated by the application of lubricant to an exposed cannelure, or the application of lubricant to the entire exposed portion of the bullet. In the past the more popular bullet lubricants have comprised such substances as stearine, petrolatum and ozokerite in mixtures of varying compositions. The application of these and similar materials leaves a greasy surface which renders the bullets and cartridges containing them somewhat unpleasant to handle and causes foreign materials with which the bullets come in contact to readily adhere thereto. It also makes them undesirable to be carried in the clothing on account of the soiling of the clothing with the bullet grease.

It is an object of this invention to provide a lubricant which may be applied to bullets and other articles in such a way as to leave an entirely dry and hard surface, the lubricant however becoming available as and when it is needed.

It is a further object of the invention to construct a cartridge containing a lubricated bullet which presents a dry, hard, varnished surface, the lubricant however, becoming effective upon the passage of the bullet through a gun barrel.

It is a further object of the invention to effect the proper lubrication of bullets by means of a quantity of lubricant which is but a small fraction of the quantity heretofore considered to be necessary.

It is a further object of the invention to apply a lubricant to an article to be lubricated by the use of an emulsion of the lubricant and a volatile fluid.

It is a further object of the invention to secure a lubricant upon an article to be lubricated beneath an impervious lacquer film, which film is destroyed rendering the lubricant available by the pressure of the lubricated article against a hard surface.

As a part of this invention, it has been discovered that a thin film of a lubricant, sufficient to secure proper lubrication but far less in quantity than the amount of lubricant ordinarily applied, can be spread upon the surface of an article, such as a bullet, by preparing an emulsion of a lubricant such as a mineral oil in a volatile fluid such as ethyl acetate. Upon the evaporation of the fluid the oil remains as a thin and more or less continuous film. The film, however, may not be entirely continuous by reason of the tendency of the oil to collect in drops during the evaporation of the fluid. As seen under a microscope, the oil droplets in suspension in such a fluid are in constant motion, (the "Brownian" movement) and the coalescence of different droplets tends to form drops of increasing size. Advantage is taken of this tendency of the oil to collect in drops in another phase of the invention which will now be discussed.

It has been found that if a substance capable of forming a hard, impervious film, such as a suitable grade of pyroxylin, be dissolved in the volatile fluid and a suitable oil be then added the oil will collect in drops of a size which varies with the characteristics of the particular oil and the particular solvent and that these drops may be imprisoned beneath the pyroxylin film which is formed as the solvent evaporates. A thin film of pyroxylin is formed upon the surface of the metal and adheres thereto while a second film is formed over the surface of the oil drop and adjoins the film adhering to the metal in the space between the oil drops, as illustrated in the drawing. Lubricating films of varying thickness with varying distribution of the oil throughout the film may be thus secured.

In the drawing:

Figs. 1, 2 and 3 are cross sections through various forms of the film.

Figs. 4 and 5 are plan views of photomicrographs of different forms of the film.

Fig. 6 is a plan view of a form of the film containing elongated droplets of oil.

Fig. 7 shows an ordinary cartridge, the bullet of which is coated with the film.

If the oil collects in relatively large drops, the drops are arranged in a single layer, and the pyroxylin film is raised over the drops, forming encasing capsules having oil globules imprisoned therein. Such a film is shown in Fig. 1 of the drawing, which is a cross section through the film. The pyroxylin 10 constitutes about 60% and the oil 12 about 40% of the dried film.

If the composition used is such that the solvent evaporates before the Brownian movement has collected the oil into relatively large globules, the fine droplets will be distributed throughout the thickness of the film in the manner illustrated in the sectional view, Fig. 2. The exterior surface of the pyroxylin is in this case comparatively smooth. If the Brownian movement is only partially completed the oil is distributed as shown in the sectional view, Fig. 3, a central relatively large globule of oil being surrounded by a group of smaller drops, and the surface of the pyroxylin being somewhat depressed between the drops.

In practice any of the conditions illustrated in Figs. 1–3 may be secured. It has even been found feasible to regulate the number and distribution of the oil drops by the addition of a known quantity of a pulverized, insoluble material such as soapstone, the solid particles of soapstone forming nuclei about which the oil drops collect. The thickness of the film may be varied, say from .0001 inch to .0015 inch. For bullet lubrication a thickness of about .0003 has been found desirable.

Fig. 4 is a plan view drawn from a photomicrograph of a pyroxylin film having globules of a mineral oil imprisoned therein. The size of the globules and the condition of the surface are substantially that shown in Fig. 1. The globules 13 are of generally uniform size, each covered by an encasing capsule of pyroxylin, which is continuous with the coating of the areas 14 separating the capsules.

Fig. 5 is a plan view, also drawn from a photo-micrograph, of the same surface after it has been subjected to pressure, crushing the capsules and liberating the oil. Irregular patches of partially lubricant free surface 15 remain, but the major portion 16 of the surface is well lubricated.

When the lubricating composition is applied to articles such as bullets by dipping and subsequently allowing the excess composition to drain off, the oil drops are elongated in the direction of the drainage, and tend to be arranged in rows which form distinct ridges with continuous depressions between them. This condition is illustrated in the plan view, Fig. 6.

Fig. 7 shows a cartridge comprising a bullet 17 coated with a lubricant containing pyroxylin film. The bullet has a dry hard surface, is clean to handle, and lint and dirt do not adhere to it. Moreover coloring matter may be added to the lubricating composition to give the cartridge or other article an attractive and distinctive appearance. When such a cartridge is fired the pressure of the bullet on the wall of the barrel crushes the lubricant containing capsules and spreads the lubricant over the entire surface. The lubricant thus becomes available at the time it is required, and is inoffensive until required.

The quantity of lubricant used is much less than when it is applied in the usual way. In fact, perfect lubrication is secured with a surprisingly small quantity. Moreover, the absence of an excess of lubricant improves the operation of certain guns, particularly guns of the auto loading "blow back" action type. In these guns the breech is opened by the gas pressure in chamber and barrel, and the excess lubricant is to a large extent blown back into the action, where it congeals and may accumulate in such quantities as to cause sluggish operation and misfunctioning. With bullets lubricated according to the present invention little or no lubricant is blown into the action and greatly improved functioning after extended firing has been secured.

With some lubricants, careful manipulation is necessary in order to secure imprisoned drops in an adherent film with a dry, lubricant free surface. Thus for example, stearine yields the best results when evaporation of the solvent takes place at temperatures between about 110 and 120° Fahrenheit. At lower temperatures the stearine is precipitated in fine particles during the evaporation of the solvent and is distributed throughout the film rather than being encased within the film. At somewhat higher temperatures a different reaction takes place, which appears to adversely effect the lubricating qualities of the stearine.

The composition of the lubricant emulsion may be greatly varied. Numerous different oils may be used as well as different pyroxylin solvents and the amount of oil with any particular pyroxylin solution may also be varied. One formula which has given excellent results is as follows:

Lubricating oil 6.5%, ethyl acetate 74.8, dry pyroxylin 13.09, alcohol (in pyroxylin) 5.61.

With this solution the dried film comprises substantially 33% of the lubricating oil and 67% pyroxylin.

While the method and the composition have been discussed chiefly with reference to their application to bullets it will be understood that the invention is not limited to this particular field. Both the method of applying

the fluid lubricant by evaporation from a volatile fluid and the method of protecting a fluid lubricant by means of a frangible film or capsule being new with this applicant, the appended claims are to be broadly construed.

Claims:

1. A lubricating fluid comprising a fluid lubricant suspended in a volatile fluid.

2. A lubricating fluid comprising a fluid lubricant, a volatile solvent and material dissolved in said solvent adapted to form an impervious film when the solvent has evaporated therefrom.

3. A lubricating coating comprising an impervious film having drops of a fluid lubricating medium contained within said film.

4. A lubricating coating comprising a pyroxylin film having drops of a lubricating fluid contained therein.

5. A lubricating coating comprising a pyroxylin film having drops of a mineral oil contained in said film.

6. A lubricating coating comprising an impervious film having drops of a lubricating medium contained beneath its surface, the surface of the film being raised above such drops whereby said film may be broken and the lubricating medium released by the application of sufficient pressure thereto.

7. The lubricating fluid comprising a lubricating oil, pyroxylin and ethyl acetate.

8. A lubricating coating for projectiles comprising spaced drops of oil, each encased in an impervious, frangible capsule.

9. A lubricating coating for projectiles comprising a lacquer film having drops of a fluid lubricant enclosed therein.

10. A lubricating coating for projectiles comprising a pyroxylin film having drops of a mineral oil enclosed therein.

11. A lubricating coating for projectiles comprising a pyroxylin film containing drops of a fluid lubricant beneath its surface.

12. A lubricating coating having a dry non-lubricating frangible surface and containing beneath said dry surface drops of a fluid lubricant which becomes available when said frangible surface is broken by pressure.

13. A lubricating coating comprising spaced drops of a lubricating fluid contained within and separated by a solid frangible material adapted to be broken when subjected to pressure.

WATSON H. WOODFORD.