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[54] DETERRENT COATING FOR PROPELLENT GRAINS

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[51] **Int. Cl.** **F42b 1/00**

[58] **Field of Search** ..... 102/39, 49, 98; 60/35.6 RS; 149/10

[56] **References Cited**

UNITED STATES PATENTS

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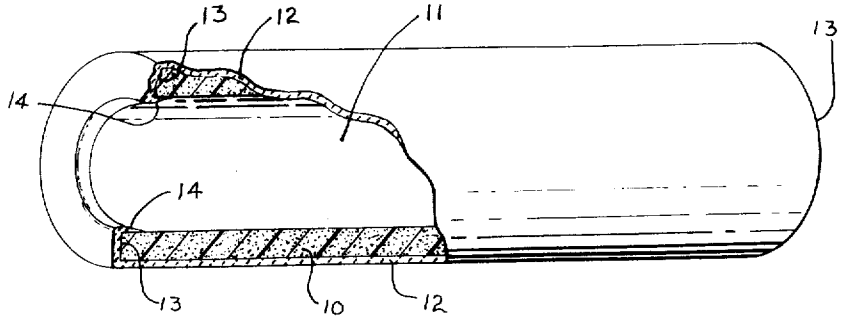
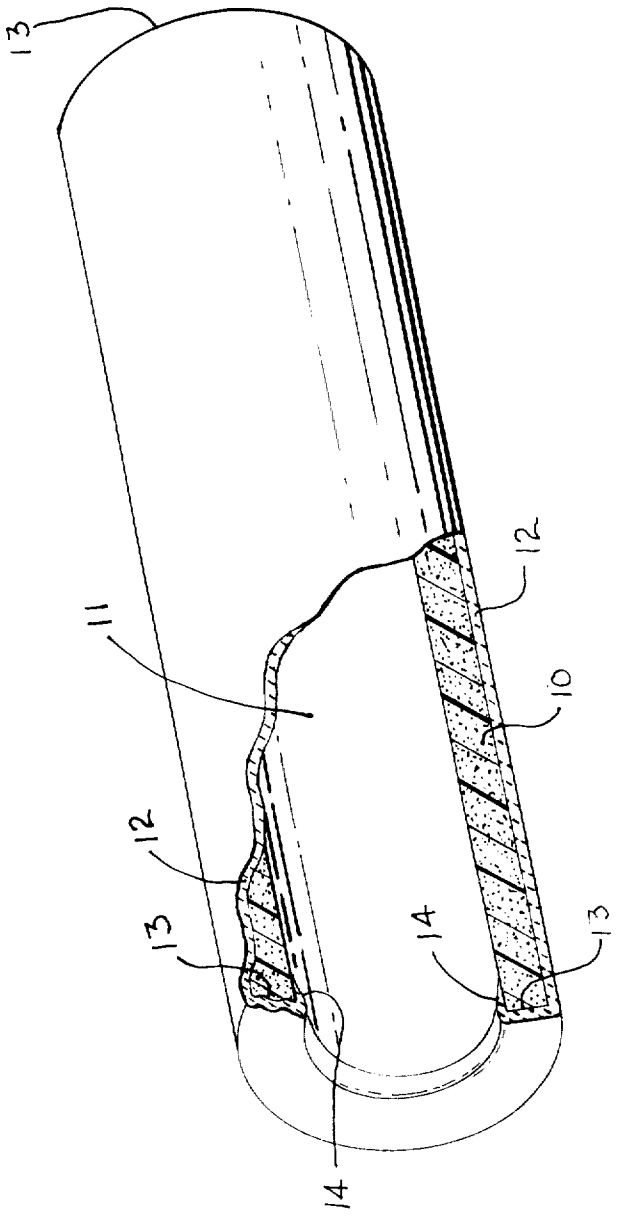
EXEMPLARY CLAIM

1. A method of preparing progressive-burning, multiple-base propellants comprising tumbling grains of propellant having a perforation through the length of the grain with a powder mixture consisting essentially of about 65 percent copper resinate and about 35 percent lead naphthenate by weight and then applying heat to said grains and powder mixture during tumbling to soften said powder mixture sufficiently to form a continuous, adherent coating on said grains.

4 Claims, 1 Drawing Figure





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DETERRENT COATING FOR PROPELLENT GRAINS

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to the deterrent coating of propellent grains, particularly those containing water-soluble or heat-sensitive components. It includes not only the chemical type of coating agent used but also a novel method for applying a coating to obtain progressive burning.

In the case of propellants for large caliber guns, the ballistics of the propellant can be varied over an appreciable range by altering the geometry of the propellent grains, i.e., by varying the web dimensions and consequently the burning surface. The small sizes of propellant grains for light artillery and particularly for small arms use do not permit much leeway in changing web dimensions and deterrent coatings are applied to these propellants to reduce their initial rate of burning. The usual methods used in producing such modified propellants yield grains which have a concentration gradient of the coating agent which decreases from the surface into the web of the grain. This produces a differential rate of burning: the rate increasing as the grain burns away, making for progressive burning.

According to usual practice, these progressive burning propellants are prepared by coating the propellant grains with organic materials which are gelatinizing agents for nitrocellulose by tumbling them together in a rotating sweetie barrel. The contents of the barrel are heated above the melting point of the coating agent which becomes sufficiently fluid to coat the grains. Even when liquid deterrents are used the coating is done appreciably above ambient temperature. During the coating operation, the mixture is usually wet with water which may be added directly or in the form of condensed steam during the heating period.

The above coating technique is unsatisfactory for use with propellants which contain water-soluble components, e.g., nitroguanidine, in addition to organic materials. When such propellants are coated in the presence of water or organic liquids, sufficient materials are leached out to affect the composition and hence the burning characteristics of the grains. Dry coating techniques, which involve tumbling the grains with nonliquid coating materials, are likewise unsatisfactory. Inorganic materials give discontinuous coatings and therefore fail to yield progressive burning propellants. Organic compounds, even those useful for coating purposes when below their melting points, readily diffuse throughout propellant grains at ambient temperatures. Such diffusion results in merely diluting the composition and does not produce the desired deterrent effect.

For propellant compositions which contain temperature-sensitive materials, e.g., nitroglycerine or diethyleneglycol-dinitrate, it is desirable that the coating agent be applied at as low a temperature as possible. It is generally desirable that deterrent coatings on propellant grains may be easily applied without agglomeration of the grains or tackiness of the deterrent material under storage conditions, even in the tropics. For practical purposes, what is desired is a coating agent whose softening point is so high that it will not develop tackiness at 71° C. and which can be applied below 100° C.

It is accordingly the primary object of this invention to provide a coating composition which will not leach out soluble propellant constituents; which can be applied to propellants containing temperature-sensitive constituents; which will not diffuse through propellant grains even upon storage at temperatures up to 71° C.; and which will be generally compatible with double- and triple-base propellants. It is a further object of this invention to provide a deterrent material which will give a continuous coating on propellant grains. It is an additional object of this invention to provide a deterrent coating which will not become tacky or cause clustering of propellant grains, even in the tropics.

These objects as well as others can be accomplished by means of a dry coating procedure applicable to small perforated grains. Preferred coating materials in carrying out this

procedure are metallic soaps and their mixtures having a softening point at about 80° C. These coatings are applied by tumbling in a sweetie barrel at their softening temperatures according to the usual method for applying deterrent coatings. The coatings thus produced are continuous films covering entire outside surfaces of the grains and a small portion of the perforation, near the ends. The uniformity of such coatings is of minor significance.

A fuller understanding of this invention will be gained by reference to the accompanying drawing in which the single FIGURE thereof, partly in cross section, illustrates a propellant grain **10** in cylindrical form having a central perforation **11** through its entire length. A deterrent coating **12** formed in accordance with the teachings of this invention covers the entire outer surface of the grain, extends over the end surfaces **13** and to a small extent within the perforation, as shown at **14**.

When such coated grains are ignited, combustion occurs first at the uncoated surfaces of the perforations and no burning at the outer surface will occur until most of the grain is consumed. This results in a progressively burning propellant by reason of a progressively increasing burning surface rather than by a differential rate of burning, as was the result of previous coating methods.

In the coating of propellant grains in order to obtain uniform ballistics, it is not only necessary that the coating be continuous over the outside of the grain, but it is desirable that the coating procedure yield a negligible amount of clustered grains. By using the organometallic compounds of this invention, the temperature of the coating material is raised to the point where it is sufficiently tacky to adhere to the grains. Then, upon cooling, the tacky grains can readily be separated from each other. Repeating this operation of heating to tackiness, breaking and cooling, two or three times, gives a firmly bonded continuous film of the coating agent on the propellant grains.

As an example of the invention, but not in restriction to the exact conditions stated, we may cite the following procedure which includes not only the use of organometallic coating composition, but also a method of application suitable for such a coating material.

Example I

A mixture of 65 percent copper resinate and 35 percent lead naphthenate, softening at approximately 80° C. is prepared and ground to pass through a U.S. No. 50 sieve. Approximately 50 pounds of small extruded propellant grains containing a perforation, are placed in a sweetie barrel and approximately 3½ percent of deterrant coating is added in three increments at 15-minute intervals. During the tumbling procedure, the sweetie barrel is rotated at the rate of approximately 30 r.p.m. It is heated by lowering it part way into a water bath, the temperature of which is maintained by the admission of steam or otherwise. The barrel is then raised from the bath and the loosely clustered grains mechanically separated from each other with the help of a small paddle. The barrel and its contents are then reheated and the clustering and breaking down repeated for two additional cycles to insure a continuous film of the coating agent on each grain. The mass is allowed to cool to room temperature while tumbling is continued. The cooled grains are then screened to remove fines and clustered grains, and the propellant immediately glazed with graphite in the usual manner.

What is claimed is:

1. A method of preparing progressive-burning, multiple-base propellants comprising tumbling grains of propellant having a perforation through the length of the grain with a powder mixture consisting essentially of about 65 percent copper resinate and about 35 percent lead naphthenate by weight and then applying heat to said grains and powder mixture during tumbling to soften said powder mixture sufficiently to form a continuous, adherent coating on said grains.

2. A method as in claim 1 which includes the step of tumbling said coated grains until they are cooled to room temperature.

3. A method of preparing progressive-burning, multiple-base propellants comprising selecting small, extruded grains of propellant having a perforation through the length of the grain and tumbling said grains at a temperature of about 80° C. with a mixture of organometallic compounds having a softening point at about 80° C. to form an organometallic coating thereon, said coating being composed of about 65 percent copper resinate and about 35 percent lead naphthenate by weight.

4. A method as in claim 3 wherein the copper resinate and lead naphthenate mixture is added in the amount of 3.5±0.5 percent by weight of propellant.

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