Jan. 9, 1968 D. KATZ 3,362,328

WEAR REDUCTION ADDITIVES

Filed Jan. 24, 1966

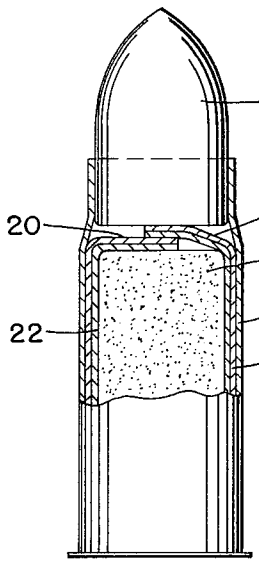


FIG. 1.

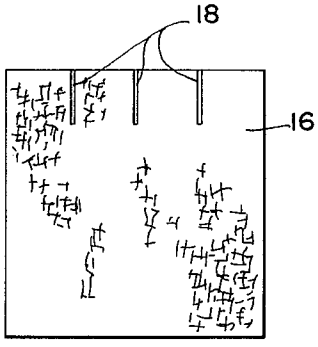


FIG. 2.

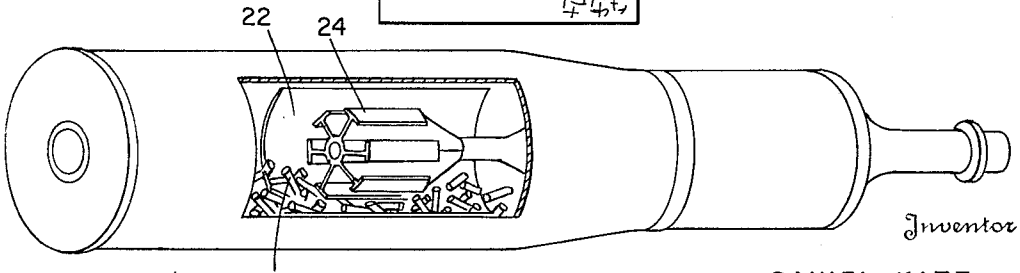


FIG. 3.

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WEAR REDUCTION ADDITIVES

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ABSTRACT OF THE DISCLOSURE

Fibers of polyester, acrylic, silk, wool, glass, and asbestos, when incorporated in a dispersion of wax containing an erosion-resistant-forming substance such as $CaSO_4$ or $CaCO_3$, or either combined with TiO_2, and applied to sheets in propellant systems, will improve brittleness and tackiness properties of the treated sheets approaching −40° F. and +145° F. respectively as well as to prevent damage to fins (of fin stabilized projectiles) when the fins contact the propellant.

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

This invention relates generally to ordnance items and more particularly concerns fiber additives for sheets which are incorporated into cartridges and shells for improving physical properties of the sheets when subjected to varying environmental conditions.

In U.S. Patent No. 3,148,620, Jacobson et al. deal with the problem of excessive gun barrel wear caused by ignition of propellant producing hot gases which pass through the barrel.

In U.S. Patent No. 3,282,215, issued to Milton Roth for "Additives for Reduction of Gun Wear," assigned to the same assignee hereof, various inexpensive and readily available additives are disclosed for efficiently reducing gun barrel erosion when the additives are incorporated or dispersed within a wax carrier to form a sheet for use in cartridges and shells.

In both of the aforementioned, the wax becomes undesirably brittle at low temperatures and excessively tacky at higher temperatures. When wax sheets are incorporated into ammunition and then subjected to standard simulated transportation tests at environmental extremes, the wax has a tendency to coat the propellant in contact therewith, particularly at elevated temperatures, and to cause degradation of ballistic performance. When fin stabilized rounds are employed where the fins are in the propellant, erratic flights have occurred due to propellant clumping causing fin damage.

In prior ammunition where the wax sheet is necessarily assembled at the firing site, the wax sheet comprising cloth, wax, and additive, I have found that at a temperature of −40° F., the resultant sheet was too brittle to be readily assembled. Further, housekeeping problems are posed in processing the wax sheet, and in ammunition plants where the sheets are inserted into cartridges of various types due to the brittleness of wax which yields accompanying debris.

Attempts were made to eliminate the aforementioned difficulties by replacing wax, either partially or wholly, with elastomeric materials such as polyethylene, polyurethane, and the like, but their incomplete combustibility or cost rendered the attempts generally abortive.

It is therefore a broad object of this invention to reduce erosion or wear in ordnance members subjected to hot gases of burning propellants.

Another object of the invention is to reduce erosion or wear in gun barrels of weapons wherein the propellant is partially surrounded by a wax carrying sheet.

A further object of the invention is to provide a fiber structure within a wax sheet surrounding ammunition propellant to permit the sheet and ammunition to successfully withstand environmental extremes.

The exact nature of the invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing wherein:

FIG. 1 is a front elevation view, partly broken away, of a cartridge embodying the preferred additive of the present invention,

FIG. 2 is a view of an unfolded sheet utilized in the cartridge of FIG. 1, and

FIG. 3 is a partially sectioned view of a cartridge having a finned projectile wherein fins contact propellant.

The erosion resistant forming substances comprises a salt such as $CaSO_4$ or $CaCO_3$ or either combined with TiO_2, all as described in the patent to Roth, supra, and dispersed in a carbonaceous carrier material such as paraffin or microcrystalline waxes or other hydrocarbons melting between about 70 to 200° F.

The part of the sheet comprising the chemical additive or additives dispersed in the wax which is impregnated in a textile adjacent the front part of the charge is more effective than the sheet adjacent the rear end of the charge. Determination of the minimum sheet thickness can be readily computed from the formula set forth in the patent to Jacobson et al. supra:

$$10\sqrt{C} \text{ mg./cm.}^2$$

where C is the calibre of the firearm in cms.; and cm.^{2} refers to the area of the sheet. By sheet, I refer to my fibers along with the additives incorporated or dispersed within the wax carrier, including the textile or fabric upon which it is coated or impregnated.

The formula given above may be expressed more generally so that it applies to all substances as follows:

$30\sqrt{C}$ gram calories per sq. cm. of sheet surface—that is the substance is such that in reacting with the propellant gases it absorbs $30\sqrt{C}$ gram calories per sq. cm. of the sheet surface.

I have obtained good results by dispersing my fibers along with a selected additive or additives, in fine particle size throughout the wax and applying the mixture on fabric covering the charge.

One form of my invention is illustrated in FIG. 1 wherein a cartridge is shown having a metal case **10**, propellant charge **12** comprised of a suitable propellant and a projectile **14**. Within case **10** and in contact with the inner surface thereof is a textile wrap **16** which may be of any suitable material such as rayon (preferred), cotton, silk or other conventional materials. The upper section of wrap **16** has a plurality of vertical slits **18** (FIG. 2) through part of its length which form flaps **20** as shown in FIG. 1.

Textile **16** is coated, or coated and impregnated with my fiber-additive layer **22** dispersed in the above-described wax. The fibers may be natural or synthetic in origin and organic or inorganic in composition. Fibers of organic origin such as Dacron, a polyester fiber, and Orlon, an acrylic fiber, both manufactured by E. I. du Pont de Nemours, or silk or wool fibers, and inorganic fibers such as glass fibers or asbestos fibers, have been found to work admirably well in helping achieve the objects of the present invention. Nylon fibers or cellulose fibers are not considered as satisfactory as they are known to break down upon exposure to oxides of nitrogen formed from propellant aging. The fibers will preferably be between ¼ and ½ inch long, of about 2 to 8 denier and will comprise about 0.5 to 3% by weight of the wax and chemical additive. Thus, layer 22 will comprise my fibers dispersed

within a wax carrier along with the chemical additive $CaSO_4$ or $CaCO_3$, or either combined with TiO_2, or any of the known chemical additives for reducing gun barrel erosion. It is preferred that the chemical additive be of a very fine particle size, such as that of talc, for example. Flaps 20 and the additive layer 22 are adapted to be folded in overlapping manner over the upper surface of the propellant charge 12.

The additive coating is prepared by melting the wax and thereafter mixing with my fibers and the additive in proportions hereinafter described. Next, the coating is applied to the fabric in the desired thickness and permitted to cool and thus forming my sheet.

Coated fabric 16 which is preferably one-half to five-sixths the length of the charge, may be wrapped around the propellant 12 or it may be held in position in the cartridge as the propellant material is poured in. If desired, fabric 16 may be secured to the inner wall of the case by glue or other suitable means so as to retain the coated fabric in position. Thereafter flaps 20 are folded over and projectile 14 is placed on top of the flaps as shown in FIG. 1.

My fibers are effective in shells of approximately 76 mm. size to the largest artillery ammunition and are intended to be used on fixed, semifixed, separated or separate-loading types of ammunition. The amount and thickness of my fiber-additive sheet will depend upon the size of ammunition with which it is employed and may readily be calculated from the aforementioned formula. In 105 mm. high explosive anti-tank shells, for example, my fibers will permit rougher handling of the shells without the wax sheet crumbling and physically deteriorating. In ammunition for a 175 mm. gun, for example, where sheets will be assembled at the firing site, my fibers provide for maximum flexibility of the sheet and ease of handling thereof under severe environmental conditions.

In the data presented below, the sheet was intended for use on 105 mm. high explosive anti-tank ammunition. Textile 16 was a piece of spun rayon cloth which was resin-treated in order to render the cloth resistant to water and to oxides of nitrogen degradation. The rayon was placed on a smooth surface and a mixture of my fibers with chemical additives poured thereon and spread evenly by scraping with a blade and resulted in a sheet slightly under 1/16 inch in thickness.

Of course it will be understood that other textiles may be used advantageously and my fiber and additives may be impregnated therewithin as well as produce a coating of specified thickness. The propellant used was triple-based.

ENVIRONMENTAL DATA

Additive	Proportion, Weight Percent	Physical properties		
		At −40° F.	At +145° F.	Fin Damage, Percent (Approx.)
TiO_2:Wax:Without Fibers	45:55	Brittle	Tacky	10.0
TiO_2:Wax:Dacron Fibers	45:54:1	Less brittle	Less tacky	0.9
TiO_2:Wax:Dacron Fibers	44:54:2	do	do	0.9
TiO_2:Wax:Orlon Fibers	45:54:1	do	do	1.0
TiO_2:Wax:Silk Fibers	45:54:1	do	do	1.1
TiO_2:Wax:Wool Fibers	45:54:1	do	do	1.1
TiO_2:Wax:Glass Fibers	45:54:1	do	do	1.3
TiO_2:Wax:Asbestos Fibers	45:54:1	do	do	1.3

In the data above, the sheets, consisting of fabric, wax, fiber and chemical additive, were subjected to a simulated 1000 mile truck transportation test over extremely rough roads, the sheets having been maintained at —40° F. and +145° F. The physical condition of the sheets was then immediately inspected for brittleness at lower temperatures and tackiness at higher temperatures. As can be seen from the data, the sheets without fiber were not sufficiently flexible and produced handling and assembling problems at both temperature extremes. Percentage fin damage was obtained by photographing shells coming out of the gun. No fins or broken fins comprised fin damage in the table above.

In FIG. 3 of the drawings, a 105 mm. high-explosive anti-tank shell is illustrated, wherein fins 24 are in direct contact with propellant 12. My fiber-additive sheet 22 is shown surrounding propellant 12. In actual firing tests, my sheets did not degrade ballistic performance, nor tend to clump the propellant to cause fin damage, nor present housekeeping problems formed by debris.

It will be understood, of course, that my fibers may be employed singly, or in any combination and yet achieving the objects of the invention, so long as the total fiber content remains substantially within the limits aforedescribed.

Reference is hereby made to patent application, Ser. No. 522,796, of Jean P. Picard, for "Erosion Reducer," filed Jan. 24, 1966, and to a continuation-in-part application thereof by Jean P. Picard, for "Erosion Reducer," filed Jan. 20, 1967, both applications being assigned to the same assignee of this patent application.

I claim:

1. In a propellant system including:
means for containing propellant, and
a sheet surrounding at least an upper half of said propellant, said sheet comprising a pervious material impregnated and coated with a dispersion of wax and a wear reducing chemical additive,
the combination therewith of the improvement for reducing brittleness at low temperatures, tackiness at high temperatures, and debris forming properties of said sheet when subjected to severe environmental conditions comprising:
fibers contained within said dispersion in an effective amount less than the weight of said wax and said additive.

2. The system of claim 1 wherein said fibers are selected from the group consisting of polyester fibers, acrylic fibers, silk fibers, wool fibers, glass fibers and asbestos fibers.

3. The system of claim 1 wherein said fibers are about 1/4 to 1/2 inch long and about 2 to 8 denier.

4. In a system comprising a projectile in association with a cartridge having a propellant, means for containing said propellant and a rayon sheet impregnated and coated with a dispersion of wax and a wear reducing chemical additive surrounding at least an upper half of said propellant, the combination therewith of the improvement for reducing brittleness at low temperatures, tackiness at high temperatures, and debris-forming properties of said sheet when subjected to severe environmental conditions comprising fibers contained within said dispersion.
said fibers constituting about 0.5 to 3.0% by weight of said wax and said additive.

5. The system of claim 4 wherein said fibers are selected from the group consisting of polyester fibers, acrylic fibers, wool fibers, silk fibers, glass fibers and asbestos fibers.

6. The system of claim 4 wherein said fibers are about ¼ to ½ inch long and about 2 to 8 denier.

7. The system of claim 4 wherein said projectile contains fins, said fins being in contact with said propellant, and said improvement reduces fin damage due to avoidance of propellant clumping.

8. The system of claim 1 wherein said low temperatures approximate −40° F. and said high temperatures approximate +145° F.

9. The system of claim 4 wherein said low temperatures approximate −40° F. and said high temperatures approximate +145° F.

References Cited

UNITED STATES PATENTS

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