ABSTRACT OF THE DISCLOSURE

An ammunition round wherein the propellant contained therewithin is surrounded by a combustible and consumable case comprising one of many cellulose derivatives. The combustable case is mounted around a sleeve which contains the propellant, the sleeve having one end fitted within a base plug, and a projectile is mounted within the other end. The consumable case will have a thickness approximately three times greater than that of the sleeve, and the nitrate, acetate, hydroxy and methoxy groups of the consumable case material are held within certain prescribed limits.

This invention relates to ordnance items and more particularly concerns novel and improved cartridge casing films which are combustible and consumable.

Prior art cartridges, in the main, employ a metallic casing, or felted nitrocellulose fiber type casings, or are caseless. Each possesses definite drawbacks in use. For example, metallic casings are heavy, expensive, must be extracted from the weapon and machined to within close tolerances. The nitrocellulose fiber type casing requires a time-consuming felt process necessitating the use of dangerous oxidizers in order to insure complete combustion of the cartridge case. Caseless type ammunition is susceptible to premature ignition if inadvertently exposed to sparks and is undesirably hygroscopic thus deleteriously affecting ballistic performance.

We have discovered that ammunition of any size may be readily wrapped with a cellulose-like film of desired thickness which substantially overcomes or at least minimizes the disadvantages aforementioned.

It is therefore a broad object of this invention to provide improved cartridges.

Another object of the invention is to provide combustible and consumable cartridges having an organic film functioning as a cartridge case.

Still another object of the invention is to provide cartridges wherein the organic film is a cellulose derivative, the film lending itself admirably to uniform application and is characterized by non-hygroscopic and good tensile strength properties.

A further object of the invention is to provide cartridges wherein the film composition is chemically controllable and adaptable to cartridges of varying sizes.

A still further object of the invention is to provide cartridges wherein the organic film is inexpensive, easily wrapped around the cartridge propellant to achieve desired film thicknesses and yet not adversely affecting the ballistics of the cartridge.

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

FIG. 1 is a longitudinal section of one embodiment of our invention; and

FIG. 2 is another embodiment of our invention as applied to mowed caseless ammunition.

Referring now to the drawings and more particularly to FIG. 1 thereof, which illustrates a typical small arms cartridge, the invention not being limited thereto, however, a standard base plug 10 having a primer 12 disposed therein has a suitable propellant 14 contained within a sleeve 16 and a projectile 18 inserted thereinto. The projectile, if desired, may be secured to sleeve 16 by means of a suitable solvent, such as acetone or ethylacetate, and the like. Sleeve 16 is open ended and will preferably be made of a cellulose derivative, such as cellulose nitrate, acetate, although other cellulose derivatives such as cellulose acetate-nitrile, cellulose nitrates and mixed cellulose esters of organic acids, mixed cellulose esters of organic and nitric acids as well as other cellulose derivatives like methyl cellulose nitrate and ethyl cellulose nitrate have also been found to work well as organic films.

Wrapped around sleeve 16 will be a film 20 of the same material as sleeve 16 and functioning as a cartridge case. For a .30 caliber small arms cartridge, a film thickness of about 0.03 inch has been found to work most satisfactorily, while sleeve the thickness is held to a minimum of about 0.01 inch, and yet sufficiently strong to contain the propellant 14 and projectile 18. The film 20, for a .30 caliber cartridge, may be a single wrapping of 0.03 inch film material or ten wrappings of 0.003 inch material, or any number of wrappings which will yield the desired thickness. Ballistic properties of cellulose nitrate are rather similar to those of the type which was used in the preparation of the film were determined and found to be about the same as those of cellulose nitrate of the military grade.

Our film may contain its own oxidizer in the nitrate group, the oxygen being evenly distributed throughout the film and thus substantially insuring complete combustion thereof, which, in addition to leaving no harmful residue, will provide added pressure and thus permitting the use of press propellant than metallic casing cartridges of like sizes. Further, the degree of substitution of the nitrate, acetate, methoxy, or ethoxy groups can easily be controlled in our improved films.

In the modified cartridge of FIG. 2, a molded propellant 30 has the usual projectile 32 adhesively secured in a recess thereof. The adhesive may be any well-known combustible type, such as "Ducoc" cement, for example, which is a nitrocellulose dissolving in methyl ethyl ketone, and having no deleterious effects upon the molded propellant. The projectile may partake of any suitable small arms type, that shown being a typical jacketed type for receiving the impressions of the lands and grooves to effect stabilization.

A primer 34 is received within an axial recess 36 of propellant 30, the primer igniting propellant 30 by means well known. Propellant 30 is wrapped with a cellulose derivative 38, similar to the film 20 of FIG. 1. In both illustrated embodiments, the outside diameter of the film should be essentially the same as the outside diameter of a metal case if one were used.

Although it is not intended that the invention be limited thereto, there is set forth hereinbelow for purposes of illustration, examples of how our films may be produced:

EXAMPLE I

25 g., cellulose nitrate acetate containing 2.4 ONO₂ and 0.5 CH₃COO groups per one glucose unit were dissolved in 400 ml. (range: 300—1000) of ethylacetate. To this solution was added 0.613 g. (range: 0.4—1.5) of a dioctyl phthalate plasticizer. The resultant solution was poured into a vessel having a flat glass bottom of 4.5 x 18 inches and the solution evaporated. After evaporation, a film 0.003 inch thick was obtained. The film was cut into 1 inch wide strips and wrapped around a sleeve of a .30 caliber cartridge. A substantially homogeneous and uniform cartridge case was obtained by softening the sides.
and edges of the strips with acetone and applying slight pressure. For a better understanding of the above, reference is made to a glucose unit, or a portion of an ordinary cellulose molecule:

\[
\begin{align*}
\text{Cellulose} & \xrightarrow{\text{HNO}_3} \text{Cellulose(NO}_3)_x \left(\text{OOCCH}_3\right)_y \\
\text{and } x+y+z &= 3.
\end{align*}
\]

It will be noticed that there are three replaceable \((\text{—OH})\) groups. Thus, cellulose acetate, if treated with HNO\(_3\) can produce the mixed ester:

\[
\text{Cellulose} \xrightarrow{\text{HNO}_3} (\text{OH})_x \left(\text{OOCCH}_3\right)_y
\]

In accordance with the above, we have found the following ranges to be satisfactory:

<table>
<thead>
<tr>
<th>Compound</th>
<th>(-\text{ON}_3)</th>
<th>(-\text{CH}_3\text{COO})</th>
<th>(-\text{OH})</th>
<th>Methoxy</th>
<th>Ethoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose nitrate acetate</td>
<td>7 to 24</td>
<td>6 to 24</td>
<td>0 to 6</td>
<td>0 to 6</td>
<td>1.7 to 2.5</td>
</tr>
<tr>
<td>Methyl cellulose nitrate</td>
<td>7 to 13</td>
<td>0 to 6</td>
<td>1.7 to 2.5</td>
<td>1.7 to 2.5</td>
<td></td>
</tr>
<tr>
<td>Ethyl cellulose nitrate</td>
<td>7 to 13</td>
<td>0 to 6</td>
<td>1.7 to 2.5</td>
<td>1.7 to 2.5</td>
<td></td>
</tr>
</tbody>
</table>

**EXAMPLE II**

50 g. cellulose nitrate acetate containing 12% nitrogen and about 0.1 free hydroxy groups per one glucose unit were dissolved in 1200 ml of ethylacetate and the solution thus formed was poured into a glass bottom container, the dimensions of the bottom being about 5 x 19 inches, the solution then being evaporated at room temperature. Distilled water was poured over the film formed at the bottom of the container to facilitate separation of the film from the glass. The film was then cut to produce a strip 3.5 inches wide. The two end edges of the strip were softened by the use of acetone and joined. After evaporation of the solvent a tube was obtained which was 3.75 inches in diameter. The tube was flexible and since the material which was used to make the film was water resistant and left no residue on burning, the tube was suitable for the manufacture of combustible cartridge cases.

The films formed by Example I and II are suitable for small arms ammunition. In larger ammunition, quite apparently, a lesser degree of substitution of nitrate is needed. In all cases, our films are uniform, have low moisture absorption, high tensile strength and leave no residue or burning.

We claim:

1. In a round of ammunition including a primer for igniting a propellant and a projectile associated therewith, the combination therewith of the improvement comprising a film surrounding said propellant, said film being selected from the group consisting of cellulose nitrate acetate, methyl cellulose nitrate, ethyl cellulose nitrate, cellulose acetate-urethane, cellulose esters, mixed cellulose esters of organic acids, and mixed cellulose esters of organic and nitric acids, said cellulose nitrate acetate containing between about 0.7 to 2.4 nitrate groups, 0.6 to 2.4 acetate groups and up to 0.6 hydroxy groups; said methyl cellulose nitrate containing between about 0.7 to 1.3 nitrate groups, 1.7 to 2.5 methoxy groups and up to 0.6 hydroxy groups; and said ethyl cellulose nitrate containing between about 0.7 to 1.3 nitrate groups, 1.7 to 2.5 ethoxy groups and up to 0.6 hydroxy groups.

2. The round as described in claim 1 further characterized by said primer being disposed in a base plug, a sleeve having a first open end fitted within said base plug, said projectile being adhesively mounted within a second open end of said sleeve.

**References Cited**

- UNITED STATES PATENTS
  - 2,405,104 7/1946 Mydans
  - 2,632,391 3/1953 Kintzinger
  - 3,345,945 10/1967 Quinlan et al.

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