United States Patent

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[72] Inventors **Jules J. Schwartz**
Wilmington;
Robert E. Black, Jr., Newark; Harry G. Jones, Newark, Del.; Kenneth D. Rubin, Dover, N.J.

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[73] Assignee **Thiokol Chemical Corporation**
Bristol, Pa.

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[54] **CARTRIDGE WITH FRAGMENTABLE CASE**
15 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** ..... **102/38,** 102/43 P
[51] **Int. Cl.** **F42b 5/30**
[50] **Field of Search** ..... 102/38, 43, 43 D; 89/1.817

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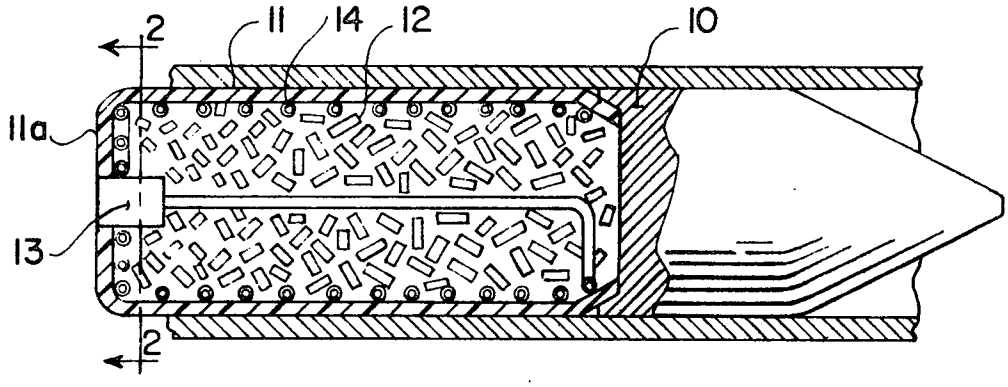
Primary Examiner—Robert F. Stahl
Attorney—William R. Wright, Jr.

ABSTRACT: A gun cartridge or round of ammunition and a method for its preparation is presented having a flexible case which is caused to be broken into fragments in the gun firing chamber by a linear train of explosive included in or adjacent to the case. The explosive train is arranged in a predetermined geometric pattern which will efficiently break up the case into small fragments upon firing of the projectile's cartridge initiator and will be discharged from the gun barrel by the force of the explosion and by the force generated by the bore evacuator if one is provided.



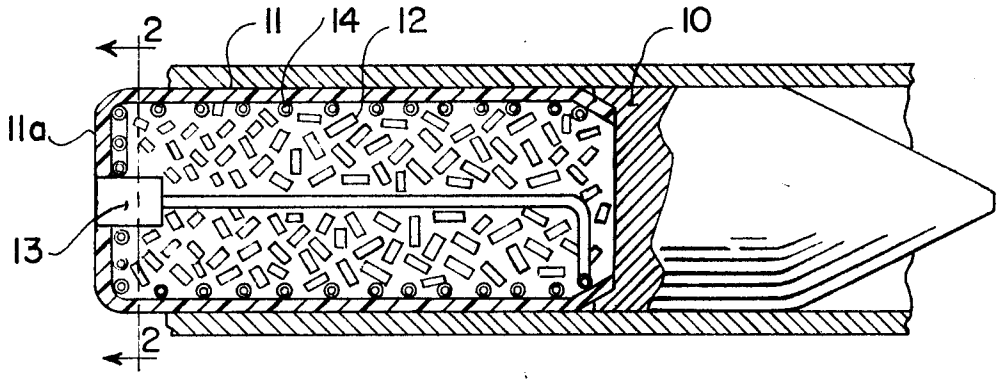


Fig.1

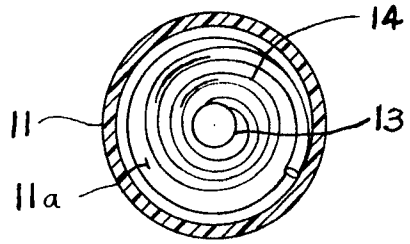


Fig.2

JULES J. SCHWARTZ
ROBERT E. BLACK, JR.
KENNETH D. RUBIN
HARRY G. JONES

INVENTORS

BY William R. Wright Jr.
AGENT

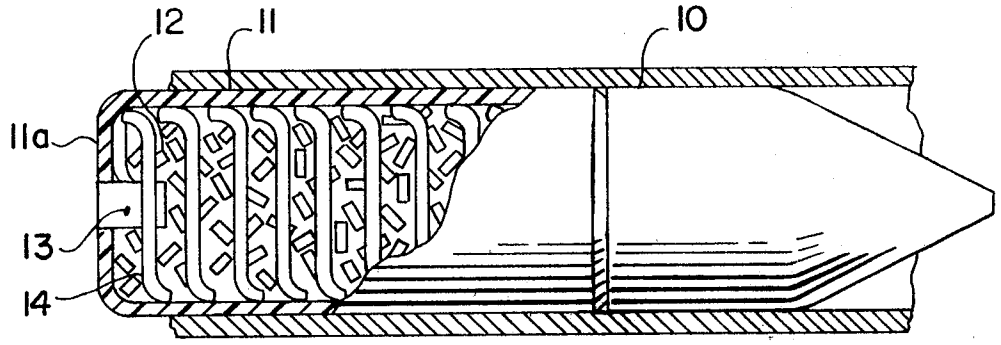


Fig.3

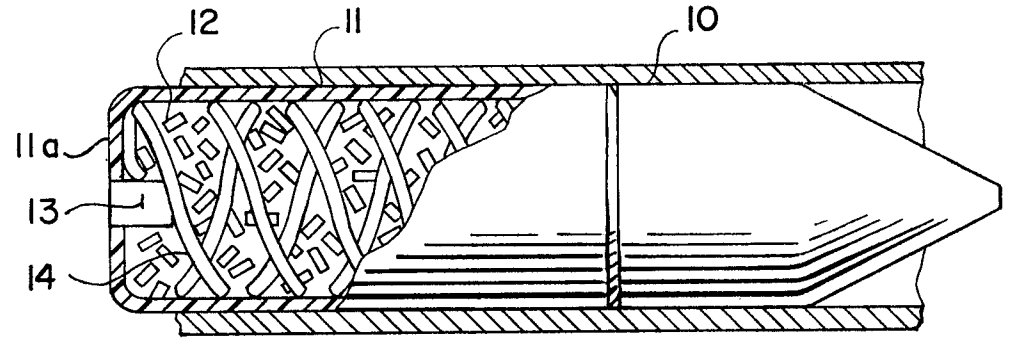


Fig.4

JULES J. SCHWARTZ
ROBERT E. BLACK, JR.
KENNETH D. RUBIN
HARRY G. JONES

INVENTORS

BY William R. Nigh, Jr.
AGENT

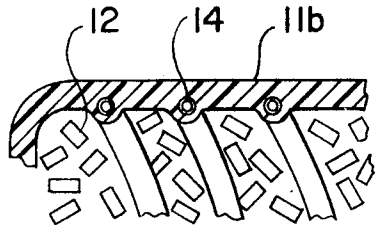


Fig.5

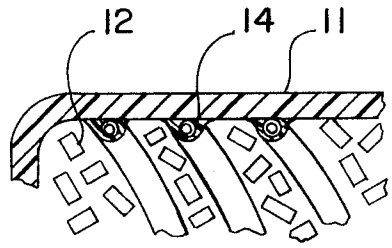


Fig.6

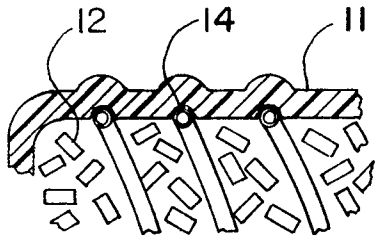


Fig.7

JULES J. SCHWARTZ
ROBERT E. BLACK, JR.
KENNETH D. RUBIN
HARRY G. JONES

INVENTORS

BY William R. Wright, Jr.
AGENT

CARTRIDGE WITH FRAGMENTABLE CASE

BACKGROUND OF THE INVENTION

The present invention relates generally to cartridges for projectiles fired from guns and relates more particularly to the type of cartridge in which it is intended that, upon firing, the cartridge case be broken into small fragments which are discharged from the gun muzzle before the next firing.

A problem of long standing in the art of gunnery is how to dispose of the cartridge case once the cartridge has been fired. One way is to simply remove the cartridge in one piece from the gun firing chamber by means of some ejection mechanism and then to discard it or collect it. There are, however, a number of disadvantages to such an arrangement such as the added complexity of the mechanism with resultant added weight, time consumed during its operation, the possibility of a malfunction, sticking of the cartridge in the gun and the disposal or retrieval of the cartridge after it has been removed in such a manner that it will not become available or useful to an enemy.

One solution to this problem is to provide a cartridge case which, at the time of firing, will be broken up into small fragments and completely discharged from the gun muzzle. This is not, however, entirely satisfactory because the fragments vary in size so greatly that the larger ones may not leave the gun muzzle but instead become jammed in the firing chamber or barrel where they could seriously interfere with the insertion or firing of the next round. The present invention makes it highly unlikely that fragments of such magnitude would be produced and thus from a practical standpoint solves this problem. This is accomplished by the inclusion of a linear explosive train in or adjacent to the wall of the cartridge case and arranged in a predetermined geometric pattern. As the train detonates, the case is divided up into fragments of such size that they will cause no particular problem of emission from the gun muzzle.

There is, however, another serious problem in the use of frangible cases. If the case is made of material which is fragile enough to break up into small fragments in the firing chamber of the gun, it also tends to be so fragile as to break easily outside of the gun, particularly if the cartridge should be dropped, rendering the cartridge useless as ammunition and highly dangerous as well. The present invention also solves this problem by providing a cartridge case of tough, flexible material which resists handling and dropping shocks to a high degree yet will be fragmented in an effective manner inside the gun's firing chamber as the explosive train detonates.

It is, therefore, an object of the present invention to provide a flexible cartridge case for an ammunition round wherein upon firing of the round in the firing chamber the case is fragmented into small pieces or fragments which are easily expelled from the gun muzzle.

It is also an object of the present invention to provide a device of the foregoing type which is simple, positive in action safe for the operator of the gun and not subject to breakage when being shipped or handled outside of the gun.

In the drawings:

FIG. 1 is a longitudinal cross-sectional view of an ammunition round showing the fragmentable case and the explosive train;

FIG. 2 is a transverse cross-sectional view of the round shown in FIG. 1 showing the spiral pattern of the train at the base of the cartridge case;

FIG. 3 is an external side view of the round with the case partially cut away to show the train in the geometric pattern of a helix;

FIG. 4 is an external side view of the round with the case partially cut away to show the train in the geometric pattern of a crisscross helix;

FIG. 5 is a longitudinal cross-sectional partial view of the round showing the explosive train embedded in the wall of the case;

FIG. 6 is a view similar to that shown in FIG. 5 with the explosive train on the inner wall of the case and covered by an abrasion-resistant coating.

FIG. 7 is a longitudinal cross-sectional partial view of the round showing the explosive train located in a channel formed in the wall of the case and partially surrounding the train.

A preferred embodiment of the present invention is shown in FIG. 1 in which a projectile **10** is fitted to cartridge case **11** which is filled with a propellant **12** such as grains of gun propellant, the rear end of case **11** being closed by a wall **11***a* which is preferably integral with wall **11** although not necessarily so. In the center of end wall **11***a* is a firing or ignition initiator **13** of the usual type which comprises an igniter including a firing initiator and a relatively small charge of fast burning powder which in turn ignites the cartridge's main propellant charge **12**. Connected to initiator **13** is a linear explosive train **14** which is adapted to become ignited from the burning of the initiator **13** and which itself burns rapidly with explosive force to cause the case **11** to break through where it is in contact with case **11**. This force and heat combined with the force and heat of the burning of the propellant charge **12** is sufficient to cause the case **11** to break up into relatively small fragments which either burn completely or are ejected from the gun muzzle by the explosive force and the force of the gun's bore evacuator if one is provided leaving little or no residue to interfere with the next round as it is inserted into the firing chamber.

The case **11** is made of thermoplastic material such as a polyethylene or a poly-acetal of as thin a cross section as will withstand mechanical shocks due to dropping and handling and yet not be too thick to be cut through by the action of the explosive train. With thicker sections, additional explosive is used.

As will be seen from the drawings, particularly in FIGS. **1**, **2** and **3**, the explosive train **14** extends from the initiator **13** around the inside (or outside if desired) of the case **11** in a helical pattern and touches the case substantially throughout its length. Also train **14** is wound in a continuous spiral pattern on the cartridge's end wall **11***a* in the manner shown in FIG. **2** with the spiral portion of the train **14** in FIG. **2** either continuous with the helically coiled portion or separate from it. In any event, both ends should be connected to the initiator so that ignition of the train will start at each end and progress toward the center in order to lessen the chance of a break or gap in the train interrupting the continuity of the detonation with resultant erratic functioning of the train and possibly less complete fragmentation of the case **11**.

The explosive train **14** is ordinarily a mild detonating cord made up of a continuous length of high explosive such as cyclotrimethylenetrinitrimine ($C_3H_6N_6O_6$), commonly known as RDX, or pentaerythrityltetrainitrate ($C_5H_8N_4O_{12}$), commonly known as PETN, or another suitable explosive, encased in a continuous metallic or plastic sheath. The train, however, may be any other suitable explosive whether sheathed or not since the sheathing serves only as a protection to the explosive and is not essential to proper operation of the present invention.

Mild detonating cords of the foregoing nature are readily available in the market such as, for example, X-CORD mild detonating cord sold under that trade mark by the Products Division of Explosive Technology, a subsidiary of Ducommun Incorporated, Fairfield, California or PYROCORE mild detonating cord sold under that trademark by E. I. DuPont de Nemours and Company, Wilmington, Delaware.

In addition to the simple helical arrangement of detonating cord on the sidewall of case **11**, other patterns such as multiple or varying pitch helices can be used or the crisscross pattern shown in FIG. **4** may also be used. This particular crisscross pattern has the advantage that diamond, square or rectangular pieces will be cut from the case wall thus reducing the likelihood that long strips of case material will remain in the gun barrel or firing chamber after the firing of the cartridge. Also it has the advantage that the end burning detonating cord

may be expected to propagate ignition at the various points of crossing thus ensuring rapid and effective burning of the entire pattern of the explosive train even in the event that there should be inadvertent discontinuities in the train, the detonation taking the path of least resistance and thus circumventing them.

The explosive train, or detonating cord, **14**, may either be wound on the surface of the wall of case **11** in the manner shown in FIG. **1** and held in place by an adhesive such as an epoxy cement, may be embedded in the wall itself as shown in FIG. **5** or may be covered over by a plastic material such as polypropylene or other semiresilient plastic material as shown in FIG. **6**. The train can also be applied to the outer surface of the case if desired as mentioned earlier in this specification. Covering of the cord in this manner is desirable in that it affords additional protection for the cord during handling of the cartridge both during manufacture and under field conditions, supplementing the protection afforded by its own shield. The case **11** may also be formed into helical depressions or channels as indicated in FIG. **7** to receive the train **14** and partially surround it thus increasing the effective force of the detonation.

In operation, the igniter **13** is operated by the firing mechanism of the gun and it, in turn, ignites the end, or ends, of the mild detonating cord **14**. The explosive in the cord **14** then burns quickly, the detonation propagating down the length of the cord vary rapidly. The force of this linear type of explosion is directed outwardly from the cord in a radial direction and impinges, in part, upon the inner wall of case **11** where it causes local heating and eroding of the wall and to all practical purposes breaks through the wall. At substantially the same time, the main propellant **12** is also ignited by igniter **13** and its burning takes place with its generated high pressure causing propulsion of the projectile through the gun barrel and expulsion therefrom. As these events occur, the wall **11** is essentially cut up into fragments which are of sufficiently small size and weight that they will either be ejected from the gun barrel by the force of the burning propellant **12** or can easily be blown out therefrom by the operation of a bore evacuator. A bore evacuator is a scavenging device which is fundamentally a means of releasing compressed air or an inert gas into a gun to sweep the firing chamber and barrel after the gun has been fired. When the fragments and any other debris resulting from the explosion are out of the gun, it is ready for another cartridge to be loaded and for the cycle to be repeated.

In addition to the circular cross section type of mild detonating cord shown in the various figures of the drawings, trains of other cross sections may be used if desired such as a cord with a vee-shaped notch with its open end at the case wall so that upon detonation a shaped charge or Monroe effect of concentrated explosive force will be realized. Also one or both of the trains may be flattened where they cross one another to enhance the propagation of the detonation at such locations.

What we claim is:

1. A round of ammunition including a fragmentable case having sidewalls and a base, a projectile, a propellant contained in said case, an ignition initiator, and a linear explosive train connected thereto and disposed against the sidewalls and base of said case, whereby upon firing of the round in a gun the ignition initiator ignites both the propellant and the explosive train and the case becomes fragmented by the detonation of the train.

2. The invention set forth in claim **1** with the linear explosive train arranged in a helical pattern on the sidewalls of the case.

3. The invention set forth in claim **1** with the linear explosive train arranged in a helical pattern of varying pitch on the sidewalls of the case.

4. The invention set forth in claim **1** with the linear explosive train arranged in a helical crisscross pattern on the sidewall of the case.

5. The invention set forth in claim **4** with at least one of the trains flattened at the crossing.

6. The invention set forth in claim **1** with that portion of the explosive train on the base of the cartridge case arranged in a spiral pattern.

7. The invention set forth in claim **1** with the explosive train arranged in a helical pattern on the sidewalls of the case and in a spiral pattern on its base.

8. The invention set forth in claim **1** with the explosive train arranged in a crisscross pattern on the sidewalls of the case and in a spiral pattern on its base.

9. The invention set forth in claim **1** with the fragmentable case made of polyethylene.

10. The invention set forth in claim **1** with the fragmentable case made of polyacetal.

11. The invention set forth in claim **1** with the linear explosive train embedded in the wall of the case.

12. The invention set forth in claim **1** with the linear explosive train covered by a coating of abrasion resistant material.

13. The invention set forth in claim **1** with the linear explosive train connected at its ends to the ignition initiator.

14. The invention set forth in claim **1** with the fragmentable case having channels in its walls adapted to partially receive the explosive train.

15. The method of causing fragmentation of a cartridge casing containing a propellant including the steps of placing a linear explosive train against the surface of the casing walls and placing the cartridge in a gun firing chamber and igniting the explosive train and the propellant, whereby the propellant burns and the linear explosive train detonates and the detonation of the train causes fragmentation of the cartridge casing.