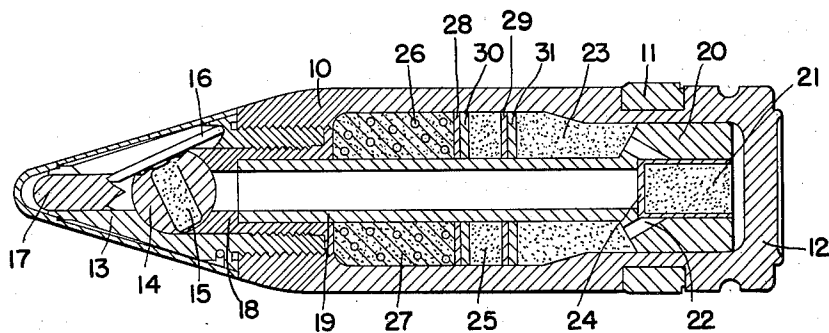


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COMBINATION FRAGMENTATION STRUCTURAL
INCENDIARY DAMAGE PROJECTILE
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3,101,053

COMBINATION FRAGMENTATION STRUCTURAL INCENDIARY DAMAGE PROJECTILE

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(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention relates to a projectile for use against aircraft and similar targets and has for an object to produce one capable of depth penetration with incendiary damage and at the same time providing controlled projectile body fragmentation damage to vulnerable parts.

High explosive (HE) shells are old for use against all manner of targets. They depended largely on the fragmentation effect of a shell body upon the target. Likewise high explosive incendiary (HEI) shells have been tried with a relatively long burning incendiary material carried for delivery against a target. For use against aircraft a projectile known as the structural incendiary damage (SID) type has been suggested and contemplated. An impact responsive nose fuse firing a booster and quantity of balls embedded therein is in such an incendiary explosive. This was found to fire the balls for penetration but there was little or no blast effect and fragmentation effect of the shell body upon an aircraft. The present invention was devised to inflict substantially the same kind of deeper structural damage but, in addition, is capable of achieving the desirable requirement of damage to an aircraft from fragments of the projectile body. Therefore, this invention combines all the desirable attributes described for the present standard HE type shell and the SID type shell in one design.

This has been achieved not, as often attempted in the ammunition field, by using a multi-piece projectile body with a separate base fuze mechanism, but by retaining a standard projectile body and incorporating a flash tube and base detonator within its internal confines; thus the base of the shell is not weakened and an efficient point-to-base detonating mechanism is realized. In other words, this invention achieves the necessary base detonation effects without the use of a base fuze mechanism.

The present standard 20 mm. explosive incendiary shell produces excellent fragmentation of the steel shell body and good incendiary effects, but the blast damage is essentially restricted to the surface of the aircraft while some of the body fragments produce a desired effect by penetrating deeper to strike personnel, fuel lines, instrumentation, etc. The effects achieved by body fragmentation are highly desirable and remain a military requirement.

Referring to the drawing, the single FIGURE is a longitudinal cross-section through a preferred embodiment of the present invention.

The illustrated projectile has a cylindrical body 10, a rotating band 11, and said body is provided with a closed base 12. A conical nose 13 has a sensitive impact responsive detonator 15 carried by a ball rotor 14 armed by centrifugal force to bring stab 17 into igniting contact with the nose detonator 15 upon impact. A spring 16 normally retains the stab 17 in a forward position where it will not set off detonator 15. A threaded sleeve 18 holds the rotor 14 in place on assembly and is in threaded engagement with the brass nose 13, which is threaded to a forward portion of the body as shown. The foregoing de-

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scribed elements are the normal parts of a standard M505 fuze.

An aluminum tube 19 has its forward end snugly fitting within sleeve 18 to axially position its front end. An enlarged rear end 20 of tube 19 fits within the projectile body base portion to accurately and axially hold this tube. A base detonator 21 in a metal cup 24 is located in the bottom of tube 19 for the purpose of enabling a flame or shock wave from the nose detonator 15 when the ball rotor is in its armed position, to travel longitudinally through tube 19 to ignite the base detonator and then detonate the body bursting charge 23. Several vents 22 extend forwardly and radially outward to a rear portion of this body bursting charge 23 in order that the latter may be ignited at its rear so that the shock wave and pressure flame front will propel the body fragments from shattered body 10, metal balls 26, and incendiary material 25 in a controlled forward direction after the nose 13 has been blown off. The balls or slugs 26 are of lead or other metal, these balls being of a diameter approximately .156 inch. For a 20 millimeter projectile these balls are approximately 23 in number having an appropriate inert material 27 between them. The inert material and separator washers of neoprene 28 and 29 absorb some of the shock of set-back on firing the projectile from a gun and are intended to prevent accidental prefring of either the incendiary material 25 or the charge 23. Additional support separators 30 and 31 of aluminum provide a backing for the more yieldable separators 28 and 29.

In the present invention it has been determined for a 20 millimeter projectile using a body bursting charge 23 of the material familiarly known as RDX, that between 40 and 60 grains of such explosive is to be used to achieve its mission and yet not have the balls too widely dispersed as will occur should too much of this charge 23 be used. A larger than this amount of explosive 23 also has the effect of increasing the angle of dispersion of the fragments over too wide an area thus giving only surface penetration. The incendiary material 25 in the present invention is preferably about 50% by weight zirconium having a particle size of 20 to 60 mesh in order to be long burning, with about 22½% of a 50-50 alloy of aluminum and magnesium, as an aid in initiating combustion of the zirconium particles, and with about 22½% of an oxidizing material such as potassium perchlorate and 5% trinitrotoluene as disclosed in the prior invention of Thomas Stevenson, Serial Number 736,932, filed May 21, 1958, for "Incendiary Composition" now Patent 2,951,752 dated September 6, 1960.

Among the advantages of the present invention may be mentioned that it gives much the same new results in depth of penetration of an aircraft as did the aforementioned invention of the SID type projectile and, in addition, provides a cone of dispersion for fragments of the projectile body that are somewhat akin to the fragment pattern from the standard high explosive incendiary projectile which contains no balls for deeper penetration. In other words, this invention partakes of the advantages of each of the foregoing prior projectiles without having the disadvantages of either in nonperformance of one need. The cones of dispersion for the balls and for the body fragments may be obtained by the use of other explosives than those mentioned and when other velocities compatible with the desired results are used. With the specific details herein disclosed a cone of dispersion of about 19° has been obtained for the balls and a cone of dispersion of about 90° obtained for the body fragments.

The detonator 15 in the ball rotor 14 is preferably

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known as the M47 and is composed of approximately the following proportions:

	Milligrams
RDX (cyclotrimethylene trinitramine)-----	34
Lead styphnate-----	3
Lead azide-----	3
Barium nitrate-----	3
Antimony sulfide-----	2.25
Tetracene-----	.75

The base detonator 21 includes 230 milligrams of lead azide and 80 milligrams of tetryl according to standardized practice. As shown in the drawing the bursting charge 23 extends for a greater axial distance than does the incendiary charge 25 and but for the inert material 27 would also extend for a greater axial distance than do the balls by themselves.

We claim:

1. In a projectile of the type for firing incendiary material and metal slugs in as narrow a cone of dispersion as about 19° and including a projectile body, an impact responsive nose and fuze in said projectile, an incendiary material, solid slugs to be fired with said incendiary material in said projectile body, said nose fuze firing said incendiary material after said nose fuze has been blown off, the combination therewith of the improvement for enhancing the probability of bringing down an enemy aircraft with body fragments having a narrowed cone of dispersion thereof while retaining the aforesaid slugs and incendiary material in a narrow cone of dispersion, said improvement including a base detonating charge, a body bursting charge in front of said base detonating charge and in back of said slugs and incendiary material, an axial imperforate hollow metal tube extending from adjacent said nose fuze through said slugs, incendiary material and said body bursting charge for firing said base detonating charge by a long flame from said nose fuze, said tube having an enlarged rear end fitting within said projectile body and enclosing said base detonating charge, the projectile body enclosing the enlarged rear end of said

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tube fitted therein and a substantial length of said projectile body being thicker than the portion of the body around said slugs, incendiary material and a substantial length of said body bursting charge whereby said enlarged rear end of said tube and the thick body wall portion reinforce said base detonator against radial outward rupture, flame passageways inclined radially outward and forward from said base detonator, through said enlarged rear end of said tube to a rear face of said body bursting charge, the projectile body thickness tapering gradually from an intermediate portion of said body bursting charge in front of said enlarged end of said tube to a substantially uniform reduced thickness throughout substantially all of said incendiary material, most of the length occupied by said slugs, and a substantial length of said body bursting charge, whereby on actuation of said nose fuze a flame passes through said tube to ignite said base detonator in advance of igniting said body bursting charge and incendiary material, the rear face of said body bursting charge being ignited and a shock wave and pressure flame front will propel said slugs, incendiary material, and body fragments in a controlled forward direction.

2. A combination according to claim 1 in which the body fragments from said projectile have a cone of dispersion of about 90°.

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