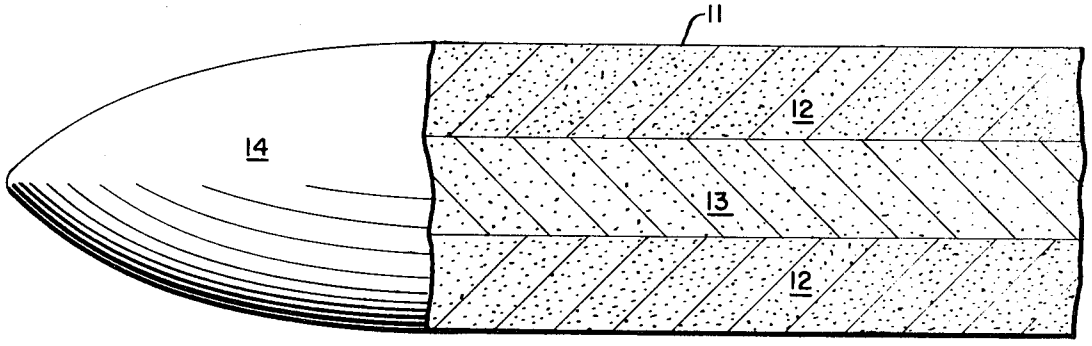
July 7, 1970 V. PHILIPCHUK 3,518,942

ANTIAIRCRAFT PROJECTILE

Filed Oct. 14, 1960

FIG. 1.



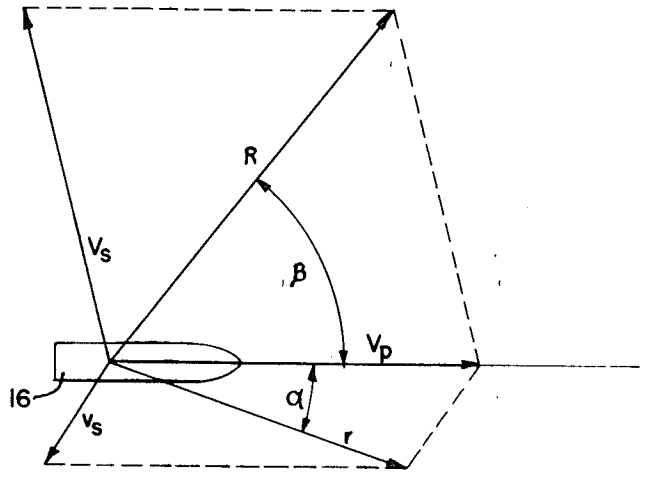


FIG. 2

INVENTOR.
V. PHILIPCHUK

BY W. E. Queenberry
O. E. Hodges
ATTORNEYS.

United States Patent Office

3,518,942

Patented July 7, 1970

3,518,942

ANTIAIRCRAFT PROJECTILE

Vasil Philipchuk, North Scituate, Mass., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Oct. 14, 1960, Ser. No. 62,815

Int. Cl. F42b *13/12, 13/14, 13/18*

U.S. Cl. 102—56 4 Claims

This invention relates to a new and improved antiaircraft projectile. More particularly, it is concerned with an explosive loading for a projectile which provides a controlled fragmentation pattern to obtain optimum results.

In the past, projectiles have been generally of two types, armor-piercing and high explosive rounds. The latter produced large holes at the impact point of the target while the former produced small holes which extended deep within the target. At high altitudes, the efficiency of the high explosive rounds was diminished to a great extent by the rarified atmosphere which has been known to produce a 50% reduction in blast damages caused by these high explosive rounds. On the other hand, the armor-piercing rounds have been known to pass completely through the target without effecting any damage other than a small hole in those surfaces of the target at the entry and exit points of the projectile.

It is one object of this invention, therefore, to provide a new type of explosive loading for an antiaircraft projectile which is not adversely affected to any great extent by altitude variations, that is to say, the structural damage caused by this projectile is about the same at high altitudes as it is at low altitudes.

Another object of this invention is to provide a method of loading a projectile warhead so that the direction of the fragment beam is controlled into a narrow forwardly directed cone or beam spray which produces extensive damage within a target.

Another object is the provision of a new and improved warhead for antiaircraft projectile which is incendiary as well as explosive in nature and which produces a deep hole within the target aircraft resulting in extensive interior damage.

These and many other objects will become more readily apparent when the following description is read and considered along with the following drawings wherein:

FIG. 1 is a view partly in section of an antiaircraft projectile made in accordance with the principles of this invention; and

FIG. 2 is a vector diagram of the projectile as it explodes showing the nature of the beam spray.

Basically this invention relates to a projectile and a method of making the same wherein the static fragmentation velocity of the warhead on detonation is reduced to produce a narrow in-flight cone of fragmentation. This results in a deep hole in the target aircraft causing intensive interior damage. As can be seen in FIG. 1, the warhead comprises generally a casing **11** which is filled with an inert material **12** composed of a powder of copper oxide or similar inert substances having a density roughly similar to copper oxide such, for example, as zinc oxide, calcium stearate, or sand. Mixed with the powdered inert is a powder of about 40 mesh titanium in a weight ratio of about 9 parts inert to one part titanium. The titanium provides the desired incendiary action upon detonation of the projectile. The particle size of the inert is not critical, it may be any commercially available powder. The mixture of inert powder and titanium may be termed an inert filler to distinguish it from the explosive mixture. The inert filler occupies the interior of the projectile except for a central core of explosive material **13** such as 97/3 RDX/wax.

It is essential that the charge to mass ratio of the projectile (i.e., ratio of weight of explosive to the total weight of the projectile) be controlled in the range .010–.020 to produce a narrow cone of fragments which will cause great damage within the aircraft target.

In a 20 mm. projectile the process for loading to produce a beam spray angle of about 40° is as follows: The mixture of copper oxide and titanium is pressed into the charge cavity of the shell, a .18 inch diameter hole is drilled centrally into this inert filler. The hole is filled with explosives totaling about 1 gram and the nose fuze **14** is assembled into the projectile. It should be obvious of course that for a larger projectile the hole to be drilled into the inert filler will be larger.

In the event that it is desired to produce a fragmentation beam angle which subtends a greater angle, it may be necessary to increase the charge to weight of the projectile simply by drilling a larger diameter hole into the filler and adding more exposive. A series of 20 mm. projectiles were made according to the principles of the invention and tested in the following manner. They were fired at a F8U aircraft which was on the ground so that the extent of interior damage could be readily ascertained by examining the structure of the aircraft.

Examination of the aircraft revealed extensive interior damage to the plane. This is believed to be due to the fact that the beam spray was confined to a rather narrow cone producing a deep hole, and to the fact that the titanium ignited forming sparks within the interior of the airplane which could ignite or detonate the fuel of an airplane in flight. Actual fuel cell tests were conducted at altitudes of up to 28,000 feet and this design created sustained fires even at 28,000 feet. The titanium particles of the appropriate size produce sparks upon detonation of the explosive material which persist for a time sufficient to ignite the fuel even at high altitudes. On the other hand, conventional high explosive ammunition failed to produce self sustaining fires in the fuel cells at altitudes exceeding 20,000 feet. It is therefore evident that the instant projectile is superior in this respect to conventional antiaircraft projectiles.

Although RDX was employed in these particular tests it should be obvious to those skilled in the art that any conventional primary explosives may be used in place of RDX. The important feature is a method of producing the central core of explosive material and maintaining the charge to weight ratio at the optimum level of .010–.020, preferably .018.

By maintaining the charge to weight ratio at a low level, the velocity of the fragments produced upon break up of the casing **11** may be maintained very low. For example, the static velocity of the fragments may be about 800 f.p.s. compared with a value of about 2500 f.p.s. for a high explosive antiaircraft projectile. While the static velocity could be reduced even further by decreasing the charge to mass ratio, it is generally not desirable to do this because the fragmentation of the casing may not be complete at those charge to mass ratios necessary to theoretically produce a static fragment velocity perceptibly less than 800.

The effect of the low static velocity of the fragments in producing a narrower, more lethal beam spray is best appreciated by referring to FIG. 2. The projectile **16** is assumed to be moving toward a target (not shown) with an in-flight velocity V_P of 2500 f.p.s. with respect to a target. Vector V_s indicates a typical static fragment velocity of 2500 f.p.s. for a high explosive antiaircraft round while vector v_s indicates a static velocity of 800 f.p.s. for a projectile constructed in accordance with the principles of this invention. The resultant velocity vectors R and *r* are about comparable in magnitude, however the

beam spray angle (2B) of the conventional explosive round is much greater than the beam spray angle (2α) of the instant projectile. Therefore, the fragments of casing **11** and the inert material and the persistent titanium sparks impact upon the target in a narrower cone and produce extensive damage within the target.

Although this invention has been described with reference to but a single embodiment, it is by no means so limited and is susceptible of many alterations and modifications without departing from the spirit and scope thereof. Accordingly, this invention is to be limited only by the scope of the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. an antiaircraft projectile comprising an outer generally cylindrical casing, an explosive charge disposed within said casing and coaxial therewith, and an annular inert filler comprised of a mixture of inert powder and a titanium powder disposed about said charge and substantially filling the casing, the charge to total projectile mass ratio being in the range of from .010 to .020.

2. An antiaircraft projectile comprising an outer casing, an explosive charge centrally disposed within said casing, an annular filler mixture disposed about said charge and comprising 90% inert material and 10% of 40 mesh titanium, the charge to mass ratio of said projectile being in the range from about .010 to about .020.

3. An antiaircraft projectile comprising an outer generally cylindrical casing, an explosive charge having a charge to total projectile mass ratio in the range of from .010 to .020 and disposed within said casing and coaxial therewith and an annular filler mixture comprised of 90% inert powder and 10% titanium powder disposed about said charge and substantially filling the casing whereby upon detonation of said charge the filler mixture is projected in a narrow cone path in the direction of travel of the projectile at a static velocity of approximately 800 feet per second thereby causing upon impact with the target persistent titanium sparks to effect a conflagration of the target.

4. An antiaircraft projectile comprising an outer generally cylindrical casing, an annular filler mixture composed of approximately 90% inert powder and 10% titanium powder placed within and in contact with said casing, and an explosive charge having a charge to projectile mass ratio in the range from about .010 to about .020 for projecting said filler mixture upon detonation of said charge in a narrow cone path in the direction of travel of the projectile and at a substantially low static velocity of approximately 800 feet per second thereby causing a persistent and complete ignition of the titanium powder upon contact with a target.

References Cited

UNITED STATES PATENTS

2,323,303	7/1943	Bluehdorn et al.	102—90
2,801,590	8/1957	Balke et al.	102—90
2,103,807	12/1937	Willing	102—65
2,669,182	2/1954	Weiss	102—66
1,153,513	9/1915	Nixon	102—66
1,277,311	8/1918	Hansen	102—67
2,276,110	3/1942	Snelling	102—56
2,056,098	9/1936	Gavlak	102—56
2,276,110	3/1942	Snelling	102—56
2,897,714	8/1959	Percoul	86—20
2,968,986	1/1961	Swift et al.	86—20

BENJAMIN A. BORCHELT, Primary Examiner

C. T. JORDAN, Assistant Examiner

U.S. Cl. X.R.

102—66, 67, 90