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TRANSLATION

ANTITANK PROJECTILES

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ANTITANK PROJECTILES

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For a long time there has been uninterrupted competition among the means of attack and the methods of defending people on the battlefield. It has always led to the appearance of qualitatively new forms of armament. In particular, at the time the tank and other armored targets appeared on the battlefield, ground artillery obtained armor-piercing projectiles as armament. As armor improved and became more durable, the penetrating power of the projectiles increased.

The Development of Armored Defense

The first tanks to appear on the battlefield in 1916 were very primitive: the armor (only 10-16 mm thick) provided protection only against bullets, and the tank travelled 7-9 km/hr. However, they fulfilled their role, and therefore the process of improving them began immediately.

Armor protection is one of the basic military properties of the tank. It must be able to withstand immense percussive impacts which arise when a projectile hits the tank, and must have a high degree of hardness and sufficient ductility so as not to be brittle. Alloyed steel has just such properties. Alloying additives (chromium, nickel, molybdenum, manganese, and others) increase the hardness of steel without lowering its ductility. For example, a 4% addition of nickel to iron doubles its hardness.

Armor with the best combination of hardness and ductility is obtained by heat treatment of the alloyed steel.

The second way to strengthen armor — increasing its thickness — has certain limitations since the weight of a tank can be increased only up to a certain point, otherwise it would lose its other important combat properties - maneuverability, passability over roadless terrain, and speed.

Armor-Piercing Projectiles

The increase in thickness and the improvement in the quality of armor rendered ineffective the use of ordinary artillery projectiles for tank warfare. For this reason, special artillery projectiles and antitank guns appeared even before World War II.

The energy reserve of the artillery projectile provides the destructive force when it meets the target. The energy reserve of the projectile, or its kinetic energy, is the product of one-half its mass and the square of its velocity at the target. This determines the first requirement which the projectile must fulfill: it must have high kinetic energy. The second requirement of the projectile is its stability on impact.

The first requirement is met by optimum selection of the projectile's characteristics and muzzle velocity. The second is met by the selection of material and suitable design of the projectile.

Artillery projectiles are divided into sharp- and blunt-nosed types, depending on the shape of the head. They may have a chamber for the bursting charge, or they may be filled (in the form of a solid block). The stability of a projectile with a bursting charge is significantly lower than that of a solid one, so projectiles of up to 37-mm caliber are usually made solid (monolithic).

The projectile consists of a body with a ballistic head. The body has a bourrelet and a rotating band stamped from soft metal. In the base there is a housing for screwing in the tracer.

There is an inertial fuse for setting off the bursting charges; the bursting charge is intended to increase the fragmentation of the projectile inside the tank. The body of the projectile is made of hardened steel.

The best results for armor piercing are obtained when the projectile meets the target at 90°. If the angle of incidence is less, the piercing is less; at certain angles the projectile ricochets off the tank.

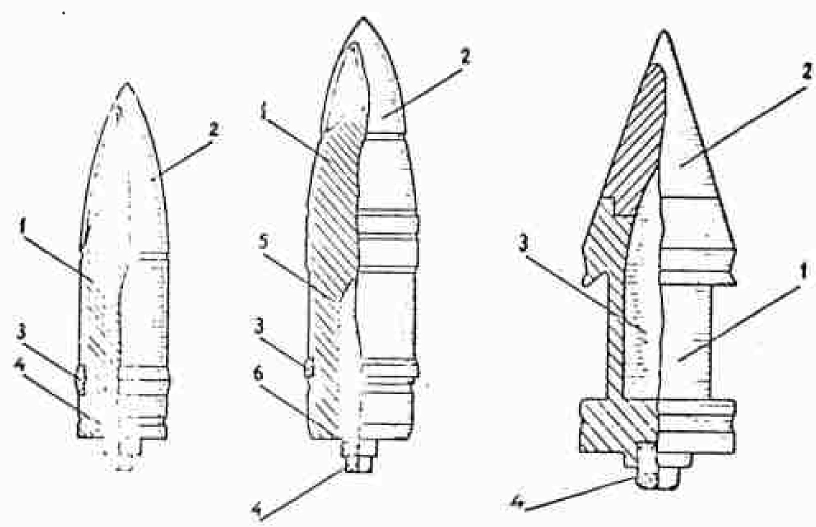
The projectile not only pierces the armor, but its shrapnel destroy the equipment and crew inside the tank.

Subcaliber Projectiles

A subcaliber projectile consists of an aluminum or light steel body (base plate), a ballistic head, an armor-piercing central part, and a tracer. To decrease the weight, it is often made in the shape of a spool. The central part is made of hard alloys. The weight of a subcaliber projectile is 1-2 times less than that of the usual armor-piercing variety, while the velocity reaches 1000-1400 meters per second.

Light projectiles quite rapidly lose speed in flights, which is particularly noticeable during long-range firing. Since the range of fire against tanks is short, this drawback is not substantial.

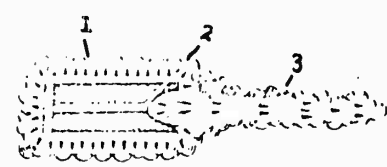
The high velocity of the projectile when it meets the tank and the hardness of its central portion assure good armor-piercing ability. The armor-piercing action is increased since the energy of the impact is concentrated in a small area: at the moment the projectile meets the tank, its light body shatters and its central portion pierces the armor. A large number of fragments form, which are heated to a temperature of 900-1000°; these destroy the crew, put the equipment out of commission, and start a fire inside the tank.



Types of antitank projectiles. Left - filled, pointed, armor-piercing projectiles: Center-blunt projectile with explosive charge: 1) projectile body; 2) ballistic head; 3) driving band; 4) tracer; 5) charge; 6) fuse: Right-subcaliber projectile: 1) base; 2) ballistic head; 3) armor-piercing central portion; 4) tracer.

Cumulative Projectiles

Before the beginning of World War II, it was believed that weapons with calibers up to 40 mm were sufficient for any type of tank combat. The increased thickness and improved quality of tank armor made necessary a 2-2.5-fold increase in the caliber of antitank weapons. As a result, armament weight increased significantly, and maneuverability was reduced. And still armor-piercing projectiles were insufficient for successful tank combat. A need for new weapons arose; thus cumulative projectiles began to appear.



Directional effect of the explosive wave when a cumulative projectile bursts: 1) projectile body; 2) funnel-shaped cavity in the charge; 3) direction of the gas jet.

The armor-piercing effect of the cumulative projectile does not depend on the velocity of its impact with the tank. This permits the firing of such projectiles from weapons with a relatively low muzzle velocity, from recoilless rifles, and from manually operated grenade launchers. There also exist cumulative antitank hand grenades.

There are two reasons for the high armor-piercing ability of cumulative projectiles: their bursting charge consists of powerful explosives, and the explosion is directional.

For concentration of the energy of the explosion in one direction, a cavity is made in the warhead and is covered with a metal [illegible]. During the explosion a monolithic metallic jet is driven into the side of the obstacle at a velocity greater than 10,000 meters per second. The pressure at the burst zone reaches hundreds of thousands of atmospheres. As a result of the great velocity and density, the energy of the explosion jet is able to penetrate the armor of any tank.

Cumulative projectiles were initially called "armor burners"; actually they do not burn through the armor, but disintegrate it with the directional explosion jet.

High-power explosives - a compacted mixture or fusion of hexogen and TNT in various proportions, and sometimes pure hexogen - are used as the bursting charge.

The shell of the cumulative projectile is usually made in sections (to facilitate assembly and outfitting). It consists of a body, a nose section, and a base. A bursting charge with a cumulative recess of different shape is placed inside the shell. The detonator or a primer detonator is placed in the lower part of the bursting charge.

Just as the projectile meets the target (tank armor), the instantaneous fuse is tripped. The impulse from the fuse is transmitted to the primer detonator in the lower part of the bursting charge. This explosion causes detonation of the bursting charge, directed toward the cumulative recess.

Cumulative projectiles have great armor-piercing ability along with relative simplicity of construction and inexpensiveness. This has been the reason for the wide use of cumulative warheads in anti-tank projectiles.

And so the competition between armor and the means of combatting armored targets continues.

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