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ARMOR PIERCING INCENDIARY PROJECTILE

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FIG.1.

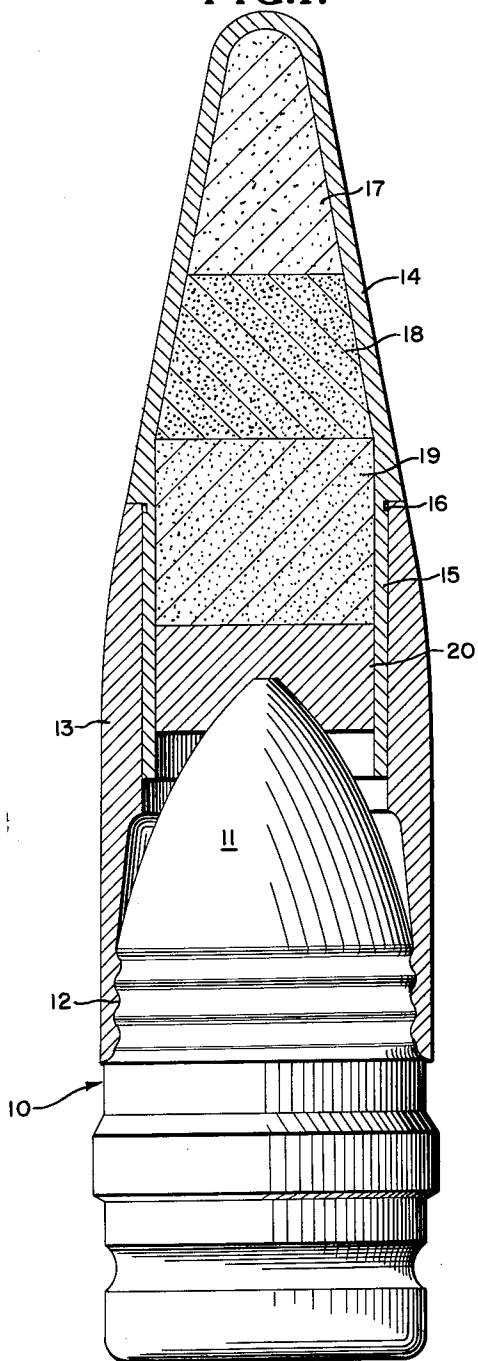
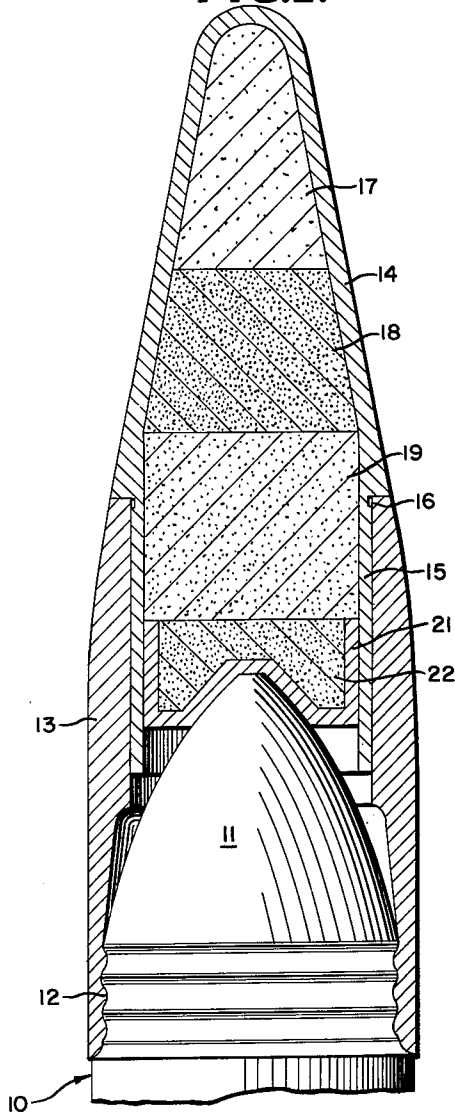


FIG.2.



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ARMOR PIERCING INCENDIARY PROJECTILE
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This invention relates to an incendiary nosepiece for small caliber armor piercing projectiles. More specifically the invention relates to an improved incendiary nosepiece for armor piercing projectiles which nosepiece does not contain a fuse, is relatively insensitive to in service handling and which will function on impact with a lightly armored target at gun firing velocities.

In modern warfare successful attacks on lightly armored targets such as aircraft have required that the target be penetrated by explosive armor piercing projectiles. In addition it has been found highly desirable to combine with the armor piercing explosive projectile an incendiary which will ignite the surrounding material such as the mixture of air and fuel escaping from tanks or pipes ruptured by the projectile. The only practical method which has been found of combining the armor piercing projectile with the incendiary composition is to provide the projectile with a hollow nosepiece which fits over the nose of the projectile and is filled with an incendiary composition.

The incendiaries employed in armor-piercing incendiary projectiles must, however, be sufficiently insensitive to withstand the jolts and vibrations of handling in service and the shock of firing in the gun. Prior art armor-piercing incendiary projectiles have, therefore, employed insensitive incendiary compositions and have inserted in the nosepiece of the projectile an impact fuze of one type or another. Such armor piercing incendiary projectiles are well known in the larger calibers. Prior attempts to construct a small caliber armor piercing incendiary projectile employing an impact fuze, however, have not been successful. The impact fuze required for a small caliber projectile, such as a 20 mm. projectile, must be insensitive to handling yet must be small enough to be inserted in the nosepiece and still leave sufficient room for an adequate amount of incendiary composition within the nosepiece. The problems involved in constructing, loading and controlling the sensitivity of an impact insensitive fuze of this small size make the use of such fuzes so difficult as to be impractical.

Incendiary compositions which will ignite on impact without the use of any special percussion mechanism are known and have been used in small caliber incendiary projectiles. These compositions are employed in hollow thin walled projectiles on the theory that distortion of the nose on impact will ignite the incendiary composition. The sensitivity of the composition is then adjusted by varying the ingredients in the composition as described in United States Patent No. 2,532,323 issued December 5, 1950 to G. A. Miller, Jr. Projectiles loaded in the manner described have, however, not been entirely satisfactory. Projectiles loaded with incendiary compositions which are sufficiently sensitive to withstand in-service handling are not sufficiently sensitive to impact and have been found to give erratic performance against targets having "skins" comparable to the .064 inch duraluminum used on modern aircraft.

Attempts to improve performance of this type of incendiary projectile by inserting an increment of more sensitive incendiary in the nose of the projectile have not been successful. The performance remained erratic as before unless the incendiary composition was made too sensitive for service use.

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Applicants have discovered that if the nosepiece of an armor-piercing incendiary projectile is provided at the larger open end thereof with a retaining disc which seals the incendiary mix in the nosepiece under pressure and if the nosepiece is loaded in the nose thereof with a properly designed starter mix, a greatly improved incendiary nosepiece for armor piercing projectiles is provided. Upon impact on the target the armor piercing projectile impinges on the retaining disc causing compression of the starter mix thus causing the starter mix to function. The nosepiece of the invention permits the use of relatively insensitive incendiary compositions which will withstand in-service handling while at the same time insuring that the incendiary nose will function on impact on the target at gun firing velocities.

It is, therefore, an object of the present invention to provide an incendiary nosepiece for small caliber armor piercing projectiles which does not require the use of a special percussion mechanism or fuze.

Another object is to provide an incendiary nosepiece of the type disclosed which is sufficiently insensitive to withstand in-service handling and which will function satisfactorily on impact with lightly armored targets at gun firing velocities.

Other objects will become apparent to those skilled in the art as the invention is more completely disclosed in the following detailed description considered in connection with the accompanying drawing in which like reference numerals designate like parts thereof and wherein:

FIG. 1 is a sectional view of one form of the nosepiece of the invention shown assembled on the nose of an armor piercing projectile; and

FIG. 2 is a view on which is shown a modified form of the retaining disc of the invention similarly assembled with a portion of the projectile cut away.

Referring now to the drawing there is shown in FIG. 1 thereof an armor piercing projectile 10 of the well known type having an ogival shaped armor piercing nose 11. Mounted over the nose 11 and fastened thereon by means of serrations 12 is an open ended cylindrically shaped steel adapter 13. The hollow thin walled conically shaped nosepiece 14 has a cylindrically shaped adapter sleeve 15 having an external diameter about the same as the internal diameter of the adapter 13. The nosepiece adapter sleeve 15 is inserted into the end of the adapter 13 opposite to the end into which the projectile is inserted. The nosepiece 14 is prevented from rotating by means of serrations on the interior surface of the adapter 13 and is held against sliding out of the adapter by a ring 16 on the interior surface of the adapter 13 which meshes with a complementary groove on the exterior surface of the nosepiece adapter sleeve 15. The junction between the nosepiece 14 and the projectile 10 with the adapter 13 are sealed with a suitable cement such as Pettman cement to seal the nose piece 14 against the entrance of moisture.

The nosepiece 14 is formed of a ductile metal sheet material, such as aluminum, of sufficient strength to prevent deformation in loading and handling. In the narrow or nose end of the nosepiece 14 is loaded an increment 17 of incendiary starter mix. In the center portion of the nosepiece 14 are two increments 18 and 19 of an incendiary base mix. Inserted in the adapter sleeve 15 of the nosepiece 14 is a retaining disc 20 which holds the incendiary mix increments 18 and 19 and the starter mix increment 17 in position. The retaining disc 20 is shaped so as to fit over the nose of the projectile 10 and abuts against the projectile when the nosepiece is assembled on the projectile. The diameter of the retaining disc 20 must be such that it fits closely within the adapter sleeve 15 to prevent breakup of the incendiary charge and leakage of the incendiary powder into the

space between the projectile 10 and retaining disc 20 within the adapter 13. The diameter of the retaining disc 20 is preferably such that an effective seal is formed between the nosepiece adapter sleeve 15 and the retaining disc 20 by the swaging action of assembly.

As shown in FIG. 1 the retaining disc 20 is a solid metal disc with a cone shaped impression on one side thereof adapted to fit over the nose of the projectile 19. A modified form of the retaining disc is shown in FIG. 2 wherein the retaining disc 21 is hollow so as to permit the loading within the retaining disc of an additional increment 22 of the starter mix to insure ignition of the incendiary mix upon the shearing off of the nosepiece upon impact with a target at a highly oblique angle.

The retaining disc 20 is important since when the projectile 10 with its nosepiece 14 impinges on a target at gun firing velocity the thin walled nosepiece 14 is deformed, the projectile 10 impinges on the retaining disc 20 which in turn exerts pressure on the incendiary and starter mixes and the resulting heat of compression ignites the starter mix which in turn ignites the incendiary mix. Thus it is possible in the nosepiece of the invention to use a starter mix and an incendiary mix which is insensitive to normal handling in service but which will function upon impact with a target at gun firing velocities.

A starter mix which has been found suitable for use in the nosepiece of the present invention is composed of $49.0 \pm 2.0\%$ 50/50 magnesium/aluminum alloy, $49.0 \pm 2.0\%$ ammonium perchlorate and $2.0 \pm 0.5\%$ calcium resinate.

A suitable incendiary base mix contains $48.0 \pm 2.0\%$ 50/50 magnesium/aluminum alloy, $48.0 \pm 2.0\%$ barium nitrate, $1.0 \pm 0.5\%$ asphaltum and $3.0 \pm 0.5\%$ calcium resinate.

Both the starter and incendiary base mixes are prepared in the same manner. The proper amounts of the various ingredients are weighed out and mixed for 20-30 minutes in a mechanical blender. After blending, suitable precautions should be taken against moisture absorption during storage before actual incendiary loadings.

Large numbers of 20 mm. armor piercing projectiles have been provided with nosepieces constructed in accordance with the invention and loaded with one increment of 1.6 gms. of the above starter mix and two increments of 2.1 gms. each of incendiary base mix. Hundreds of firings against single 0.064 in. duraluminum plate have shown that incendiary nosepieces so constructed and loaded functioned satisfactorily 100%. Numerous drop test trials show that the sensitivity of these nosepieces is not sufficient to cause functioning on free fall from a height of 40 ft.

Prepelleting of the incendiary charge is unnecessary. Positive and uniform consolidation of the charge is obtained by pressing loose incendiary composition in the nosepiece 14 itself. Thus the loading involves merely scooping, or weighing, the incendiary increments into the nosepiece and consolidation with a suitable punch and a rapid automatic press. Tolerances on the intrusion depth of the retaining disc 20 in the nosepiece 14 can easily be maintained by pressing the disc 20 and third incendiary powder increment 19 to a stop. In this manner, seating of the disc 20 on the projectile nose 11 can be insured. Assembly of the loaded nosepiece 14 with the adapter 13 is a simple, single pressing operation.

The flame propagating ability of the incendiary nosepiece of the invention may be enhanced and prolonged by substituting a coarse (20-60 mesh) titanium powder for the 50/50 magnesium/aluminum alloy up to about 20% of the incendiary base mix. The use of this coarse titanium powder in the incendiary base mix results not only in an increased flash size but in a notably increased duration of functioning because of the long burning titanium particles. In a 20 mm. projectile as above described this means the loading of incendiary base increments of 2.35 gms. where an incendiary base mix containing 20% titanium powder is used and resulted in an

increase in incendiary duration from about 1000 to about 570 milliseconds. No substantial increase in the sensitivity of the incendiary mix is noticeable. The coarse titanium particles maintain the igniting qualities of the incendiary mix long after the concentrated burst has disappeared. The white hot titanium particles serve to warm up the surrounding material to promote ignition and to insure oxidation and burning.

The impact of an armor piercing incendiary projectile constructed in accordance with the invention at a high oblique angle frequently resulting in the shearing off of the thin walled nosepiece 14 where it joins the steel adapter 13. The use of the modified hollow retaining disc 21 shown in FIG. 2, filled with an additional increment of starter mix, insures the ignition of the incendiary mix within the adapter 13 and results in improved incendiary performance even at a highly oblique angle of impact.

From the foregoing it will be seen that there has been provided an improved highly effective incendiary nosepiece for armor piercing projectiles, which nosepiece is simple in construction and does not require a special percussion mechanism or fuze. The nosepiece will ignite on impact with lightly armored or skinned targets but is sufficiently insensitive to safely withstand in-service handling. There has also been provided an improved nosepiece for an incendiary armor piercing projectile which will function effectively even at highly oblique target impact angles. In addition there has been provided an improved incendiary composition having increased flash and greatly increased incendiary duration.

Obviously many modifications and variations of the invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of appended claims, the invention may be practiced otherwise than as specifically described.

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

1. An incendiary nosepiece for an armor piercing projectile comprising a hollow cone-shaped nosepiece having a thin wall of ductile material and a cylindrical portion at the wide end thereof adapted to fit over the nose of a projectile having a tapered nose, a hollow retaining disc adapted to engage the nose of said projectile slideably mounted in and closing the said cylindrical portion of said nosepiece, said disc being filled with an incendiary starter material, a second increment of incendiary starter material disposed in the narrow end of said nosepiece, at least one increment of incendiary base material in said nosepiece, said increments of starter material being capable of ignition by compression between the wall of said nosepiece and said retaining disc upon impact of said nosepiece wall with a target, said incendiary base material being relatively insensitive to ignition by impact compared to said incendiary starter material and capable of ignition by the combustion of said starter material.

2. The incendiary nosepiece of claim 1 wherein the hollow retaining disc is shaped in the form of a hollow cylinder having one closed end adapted to engage the nose of the projectile and one open end facing the interior of said nosepiece.

3. The incendiary nosepiece recited in claim 2 wherein the said incendiary starter material comprises substantially 49% of 50/50 magnesium/aluminum alloy, 49% of ammonium perchlorate and 2% of calcium resinate.

4. The incendiary nosepiece recited in claim 3 wherein the said incendiary base material comprises substantially 48% of 50/50 magnesium/aluminum alloy, 48% of barium nitrate, 1% of asphaltum and 3% of calcium resinate.

5. The incendiary nosepiece recited in claim 4 wherein said incendiary base material comprises substantially 20% of titanium, 28% of 50/50 magnesium/aluminum alloy, 48% barium nitrate, 1% of asphaltum and 3% of calcium resinate.

6. The incendiary nosepiece recited in claim 5 where-

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in said incendiary base material contains 20-60 mesh titanium powder.

7. An incendiary nosepiece for an armor piercing projectile comprising a hollow cone-shaped nosepiece having a thin wall of ductile material and a cylindrical portion at the wide end thereof adapted to fit over the nose of a projectile having a tapered nose, a hollow retaining disc adapted to engage the nose of said projectile slideably mounted in and closing the said cylindrical portion of said nosepiece, said disc being filled with an incendiary starter material, a second increment of incendiary starter material disposed in the narrow end of said nosepiece, at least one increment of incendiary base material in said nosepiece, said increments of starter material being capable of ignition by compression between the wall of said nosepiece and said retaining disc upon impact of said nosepiece wall with a target, said incendiary base material being relatively insensitive to ignition by impact compared to said incendiary starter material and capable of ignition by the combustion of said starter material, the hollow retaining disc being shaped in the form of a hollow cylinder having one closed end adapted to engage the nose of the projectile and one open end facing the interior of said nosepiece and wherein the incendiary starter material is capable of ignition by compression between the wall of said nosepiece and said retaining disc upon impact of the nosepiece wall with a target.

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8. The incendiary nosepiece recited in claim 7 wherein the incendiary starter material comprises substantially 49% of 50/50 magnesium/aluminum alloy, 49% of ammonium perchlorate and, 2% of calcium resinate.

9. The incendiary nosepiece recited in claim 7 wherein the incendiary base material comprises substantially 48% of 50/50 magnesium/aluminum alloy, 48% of barium nitrate and 3% of calcium resinate.

10. The incendiary nosepiece recited in claim 7 wherein the incendiary base material comprises substantially 20% of titanium, 28% of 50/50 magnesium/aluminum alloy, 48% of barium nitrate, 1% of asphaltum and 3% of calcium resinate.

11. The incendiary nosepiece recited in claim 10 wherein the incendiary base material contains 20-60 mesh titanium powder.

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