Nov. 1, 1966 H. S. LIPINSKI 3,282,540

GUN LAUNCHED TERMINAL GUIDED PROJECTILE

Filed May 5, 1964

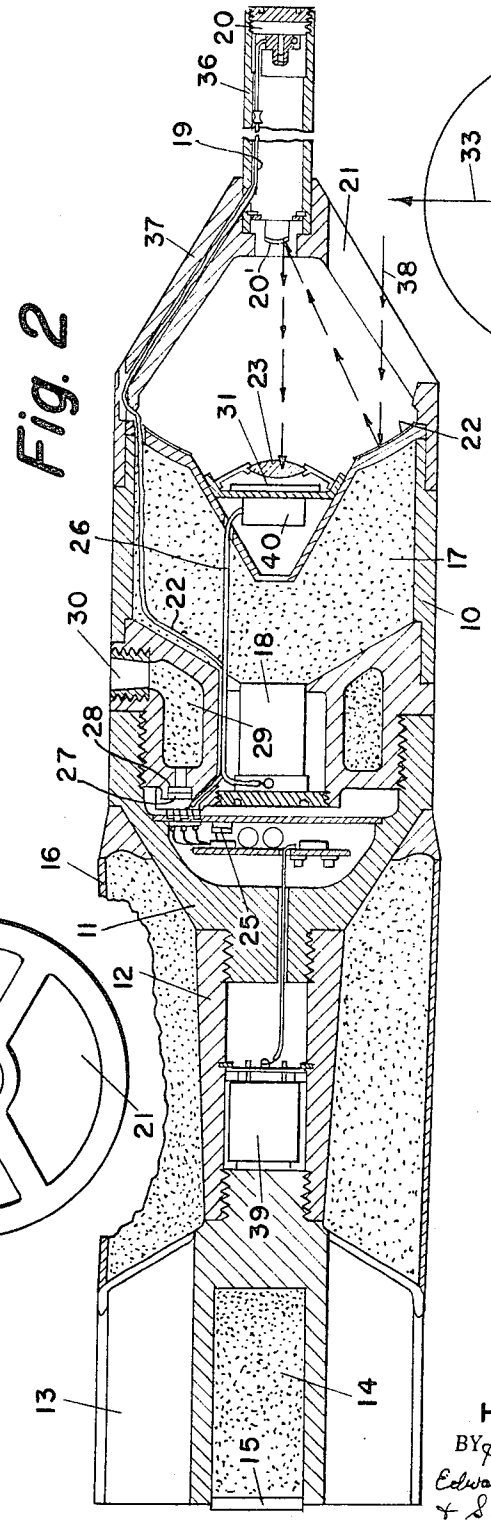


Fig. 2

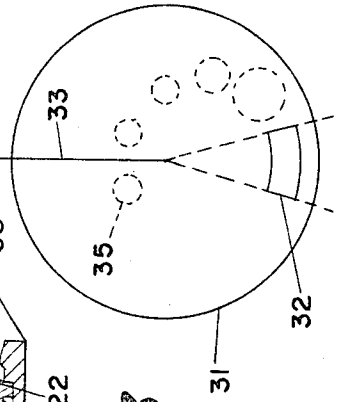


Fig. 3

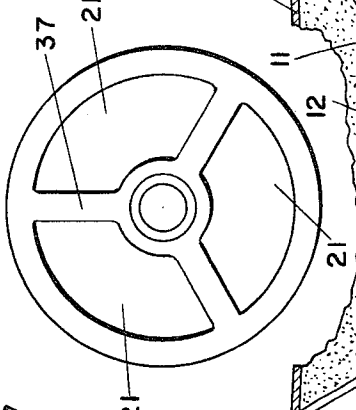


Fig. 1

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GUN LAUNCHED TERMINAL GUIDED PROJECTILE

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4 Claims. (Cl. 244—3.16)

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

This invention relates to an improvement upon the gun launched terminal guided projectile disclosed in the prior application of Sidney Ross, Serial No. 831,443, filed August 3, 1959, and now Patent No. 3,072,055, dated January 8, 1963. An object of this invention is to utilize the projectile hardware more effectively for its guidance system permitting a shortening of the length of such a projectile thereby making it more stable and accurate in flight.

Specifically this has been accomplished by this invention in recognizing the desirability of having the forward inner cone surface of a shaped charge perform a new function prior to the initiation of the warhead by combining it with curved reflecting surface against which reflected light rays from the target entering the projectile nose are reflected onto a forward reflecting surface and thence to a target sensing device for determining the effectiveness of the projectile trajectory. As a result the length of the projectile has been shortened very substantially by an amount equal to the linear distance in said Ross patent between the reflecting curved mirror **22** and the forward portion of the shaped charge **17**. This has been done by making the forward end portion of the shaped charge function as well as before but having such end portion curved in order that it may serve also as the curved mirror for reflecting the light rays entering through the nose.

Referring to the drawing:

FIG. 1 is a front end view of the projectile of this invention.

FIG. 2 is a longitudinal section through this projectile.

FIG. 3 illustrates a construction for the perforate mask described in the above mentioned Ross patent.

FIG. 2 shows an embodiment possessing the advantage of the Ross patent construction in an all electronic mechanism capable of quickly and automatically correcting an error in the direction of flight of a projectile in response to an image of the target seen and sensed by the projectile. In this drawing, the projectile parts are numbered using most of the numerals up to **31** to designate equivalent parts in both the Ross construction and the present. This projectile includes a head **10** forward of an adapter **11** and a boom **12** to which are connected stabilizing fins **13** whereby only a slow rotation of about 15 to 25 revolutions per second is needed according to custom with this type of fin stabilized projectile. Propellant **14** is usually provided in the boom **12** in the vicinity of the stabilizing fins. A primer **15** is frequently losated in a rear end portion of the projectile. Some known type of safety arming device is customary to preclude accidental firing of explosive charges in the gun or too close to the muzzle. The propellant is frequently surrounded by a consumable or frangible casing **16** for convenience and safety in shipment.

A shaped charge **17** is fired by a fuze or primer **18** by an electrical impulse through a conductor **19** leading thereto from a piezoelectric fuze or generator **20** in a forward portion of the projectile, which fuze **20** functions in response to impact on a target. This fuze **20** is mounted well forward of the nose cone in a stand-off support **36** to provide adequate stand-off distance of about 1 to 2 calibers for the fuze **20** in front of the front end or base of the shaped charge cone. Instead of the all transparent nose of Ross this construction contemplates three aluminum ribs **37** for mounting a reflecting surface **20'**. These ribs **37** are of an angular width of about **13** degrees at their rear and radial outer ends and provide three circular sections of arc in the nose **21** of approximately 107 degrees each and allow adequate light rays such as those shown by the arrows **38** to enter the nose or cover **21** and be reflected by the curved mirror **22** onto the reflecting surface **20'** and thence rearward in a generally axial direction through the lens **23** and into a detector or photocell **40** connected to a timed amplifier **25** through a conductor **26** to a fuze **27** for firing a primer **28** and explosive charge **29**. Firing charge **29** generates a gas which is discharged through the nozzle **30** whose axis passes through the gravitational center of the projectile and produces a thrust capable of changing the direction of projectile movement and therefore a change in its trajectory. The medium by means of which this result is obtained is a spot of light or other radiation emitted or reflected by a target hereafter described.

The radiations emitted or reflected by a target pass through transparent arc portions **21** of the nose and after being reflected by mirror **22** are again reflected by mirror **20'** through the lens **23** onto a mask **31** fixed with respect to the projectile for rotating with the projectile. The construction of the mask is shown in FIG. 3 as having an aperture **32** located 180° from the nozzle **30**; the central axis of the nozzle is through the center of gravity along the arrow **33** in FIG. 3, which indicates the direction of gas discharge. As the projectile rotates the image **35** of the target moves over the mask **31** and increases in size as the target is approached. Rotation of image **35** over the mask and near its center indicates a satisfactory direction for flight of the projectile and nothing happens until the target is hit. However when the image is displaced far enough for the center of the mask to pass over aperture **32**, the detector **40** senses the image and generates a signal to the fuze **27** which ignites the primer **28** firing charge **29** changing the direction of the projectile. The detector mask **31** and timed amplifier **25** may be electrically tuned to exclude fallacious targets or those lacking a characteristic radiation of a probable target or the probable target may reflect only a particular radiation from an illuminator from a displaced vantage point or gun site.

Among the advantages of this invention may be mentioned the savings in material and greater accuracy resulting from a reduction in the length of the projectile. The reduction in length is equivalent to a substantial portion of the head length of the Ross projectile. This reduction in length is measured from the front or radially outer edge of curved mirror **22** to the forward or outer edge of the shaped charge **17**. In the present invention these points are one and the same because the forward inner surface of the shaped charge is now the same as the forward edge of mirror **22** when the mirror **22** is contiguous to or abutting the shaped charge. Preferably the mirror **22** should be a foil or other lightweight reflecting surface so as to offer no substantial impediment to the usual hot particles issuing in a narrow stream from a shaped charge. Because a thrust from nozzle **30** is through the center of gravity of the projectile, and the center of pressure is in rear of the center of gravity a couple about a transverse axis provides a torque resulting in an angular displacement in the trajectory where nozzle **30** functions, although this is too rapid to be caught by the human eye. A battery or other electric generator **39** has been found desirable located in the boom, as shown. Likewise the elec-

tronic amplifying apparatus has been found to be desirably placed in the adapter portion of the projectile.

I claim:

1. In a gun fired, fin stabilized projectile having rotation, said projectile comprising a casing attached to a nose, a major portion of the cross-sectional area of said nose being transparent to radiations from a target, an explosive charge carried by said projectile and adapted to fire said charge through a nozzle to produce a thrust transversely of the longitudinal axis of said projectile, electronic means operable to fire said charge in response to radiations from a target received through said transparent area, said electronic means including a detector of target radiations operable to fire said charge in response to such received radiations, means including a mask located in front of said detector, and rotatable with said projectile and provided with an aperture radially displaced from said longitudinal axis but substantially opposite said nozzle, said aperture being located a sufficient distance from said longitudinal axis to admit target radiations to said detector when said longitudinal axis is at a definite angle with the line of sight from said projectile to said target, a mirror located to direct target radiations to said detector through said mask aperture after being reflected from a substantially axial reflecting surface, a shaped charge located forward of said explosive charge and provided with a piezoelectric impact fuze located at a forward end of said nose, and electrical connections from said fuze to said shaped charge for firing said shaped charge, the combination therewith of the improvement for shortening the overall length of said projectile and enhancing the stability and accuracy of said projectile, said improvement comprising said mirror being disposed adjacent a forward portion of said shaped charge, and said transparent portions of said nose constituting sectors bounded by radial supporting ribs having included equal obtuse angles.

2. A projectile according to claim 1 in which each of said included angles is about 107°.

3. A projectile according to claim 1 in which said piezoelectric fuze is carried by a standoff support extending in front of a forward end of said shaped charge for a distance of between about 1 to 2 calibers.

4. A projectile according to claim 1 in which said projectile has an adapter in rear of said explosive charge, a boom behind said adapter, and stabilizing fins behind said adapter, an electric battery located in said boom and a substantial portion of said electronic means being located within said adapter.

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