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A. S. CLARKE

3,140,661

GENERATOR-POWERED FUZE

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Fig. 1.

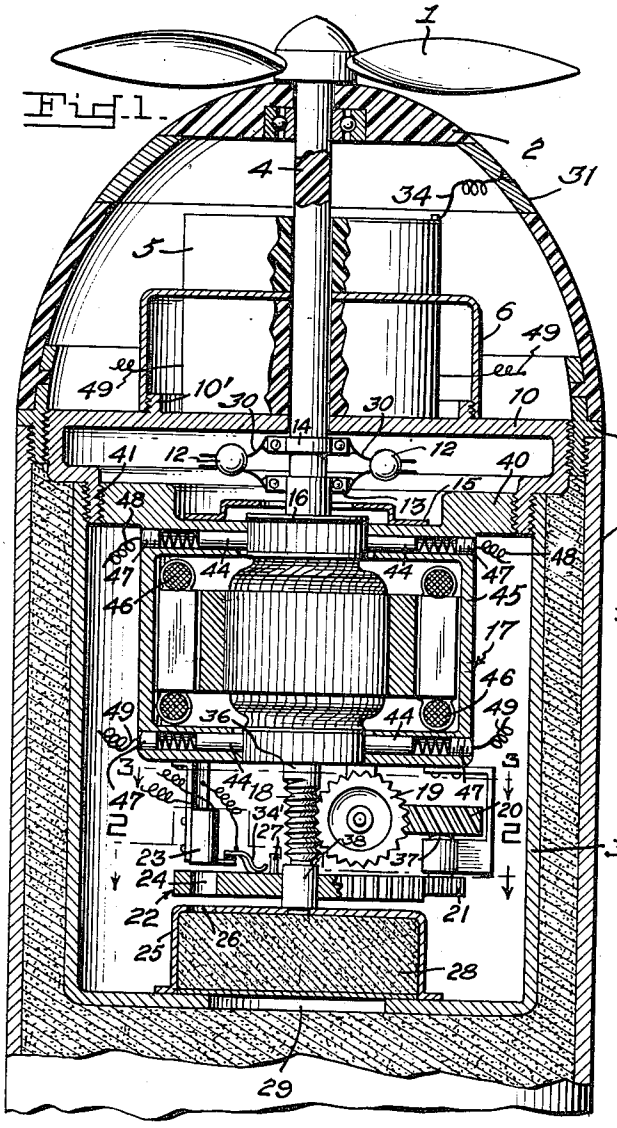


Fig. 3.

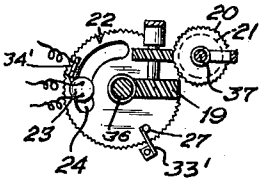
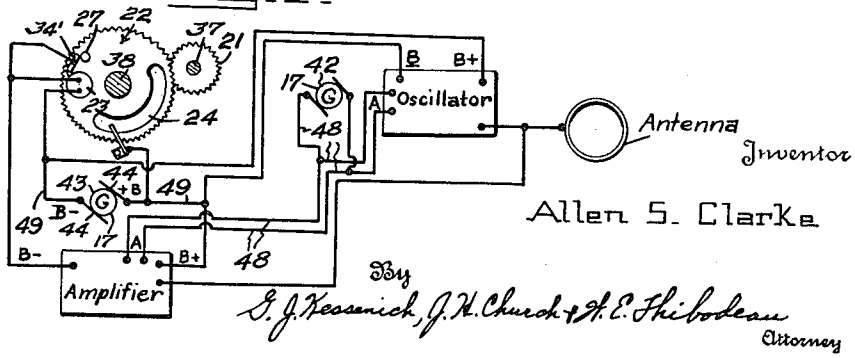


Fig. 2.



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GENERATOR-POWERED FUZE

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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 generator-powered fuzes for projectiles.

An object of this invention is to provide an electrically actuated fuze such as a proximity fuze or the like having an air driven generator for developing the necessary electrical energy for use in bombs, rockets or the like.

Another object is the provision in a fuze of the above type of speed governing means for a generator so that the generator will provide a substantially constant voltage output when the projectile velocity is varying.

A further object is to provide means for arming the fuze through the motion of the generator drive shaft so that the fuze will be in a condition for firing only after the projectile has moved a safe distance from the starting point.

Another object is the provision of novel self-destroying means so that in the event of a miss against an aerial target the projectile will be destroyed before reaching the ground, when over friendly territory.

Still another object is the provision of means whereby the generator will avoid electrical interference with the electrical apparatus of the fuze in its normal function.

A further object is a novel means for providing two separate voltage levels in a single power supply so as to supply filaments with suitably low voltage and anodes with suitably high voltage from a single source where an electronic circuit is employed in a fuze.

The disadvantages of the use of batteries to energize early forms of electrically controlled or operated fuzes has long been recognized because of objectionable bulk, weight, and peculiar risks, and it has been heretofore sought to overcome these by installing in projectiles air-operated generators operated by air currents incident to progress of the projectile when fired.

The effective adaptation of such generator construction to use with v.t. fuzes responsive to hertzian echo waves, has, however, been found impracticable due to impairments of functions of the fuze by parasitic effects in the rotor elements. It has been theretofore necessary to hamper projectiles with electrical batteries, to supply a dependable sustained current of the necessary potential to operate the receiver and amplifying device of such fuzes over the period required.

It is therefore an object of the present invention to enable the use of an air driven generator effectively in such fuzes as last mentioned.

Accordingly my invention provides such a projectile fuze having a fluid current motor driven generator or windmill as a source of electric power, but with such construction as to avoid impairment of the response of the exceedingly sensitive receiver and amplifier fuze control.

This attainment is of high importance because of the advantage inherent in such an apparatus, that no electrical energy is available to accidentally initiate a detonation of the fuze until the projectile is in flight, thereby insuring a greater degree of safety than is otherwise possible. I also obtain a relatively constant voltage output from such a fuze through the use of a speed governing

means, and provide two voltage levels from one generating source. An incidental advantage is that through the generator drive shaft a convenient power source is available to operate mechanically actuated elements such as a gear train for arming the fuze, and for preventing damage in friendly territory as will be apparent from the detailed description which follows.

Other objects and advantages and features of invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification in which like numerals are employed to designate like parts throughout the same:

FIGURE 1 represents a fragmentary side elevation of the fuze, embodying my invention, with the fuze and operating mechanism in longitudinal section,

FIGURE 2 represents a cross-sectional view taken on line 2—2 of FIGURE 1 showing the arming disc and associated self-destruction means, schematically, and

FIGURE 3 is a cross-section on the line 3—3 of FIGURE 1, at the instant of destructive firing by safety mechanism.

Referring to FIGURE 1, an airfoil rotor 1 is mounted before the nose 2 of a projectile 11. It may be of any suitable non-conducting material such as a plastic compound and is attached to a non-conducting shaft 4 of any suitable non-conducting material, which is supported by suitable bearings. The nose 2 or windbreak, is shown as plastic material molded on a keyed metal ring 33 which is threaded into the shell case 11, and around the supporting partition plate member 10, which forms the base on which the fuze is assembled. Shaft 4 passes concentrically through an insulating block 5 containing oscillator elements, and through a metal amplifier shield case 6 containing amplifier elements of the circuit, which are shielded by case 6 from the high frequency radiation from the oscillator above.

A metal wave radiator element or antenna may also be molded into the nose 2 as a ring, as shown at 31, and is connected to the oscillator in block 5 through wire 34. The use of a plastic airfoil 1 eliminates the possibility of electrical interference with the radiation from the antenna or reception of signals to be utilized in control and/or detonation of the fuze. Amplifier shield 6 is supported on plate 10 in any suitable manner, as, by its interior threads engaged on a boss 10' on the plate 10 as shown. Shaft 4 passes concentrically through plate member 10 and drives a generator 17 therebelow. A plastic shaft is used in order to avoid electrical interference with the operation of the oscillator due to the rotation of the shaft or parts carried thereby, and to avoid other electrical potential possibilities.

Attached to the shaft below the plate 10 there is a centrifugal ball governor, consisting of a sliding collar 13 on the shaft and an anchored collar 14 fixed to the shaft. To these collars weights 12 are attached by means of spring arms 30. A circular shoe plate 16 is carried by the sliding collar 13, and over this a brake plate 15 is carried on a head plate 40 which is peripherally threaded and screwed into a reduced diameter extension 41 of the plate 10 and secured appropriately.

It is notable that the airfoil 1 and its shaft 4 are rotatable on the longitudinal or flight axis of the shell or projectile device. The balls 12 are diametrically opposite to each other, and the arms 30 are fixed in the balls and curved divergently therefrom inwardly in a diametrical plane of the shaft. The arms 30 are so attached to the collars 13 and 14 as to hold the latter apart when the governor is at rest, and the shoe plate 16 is then clear of the brake plate 15.

At some pre-determined speed proper for normal operation of the generator, balls 12 move outward under

centrifugal force and draw plate 16 into contact with plate 15 to effect a braking action and prevent further increase in the rotational speed, thus holding the generator voltage approximately constant, independently of the speed of the vehicle.

The generator 17 is provided with two windings on the armature, one to deliver a relatively low voltage for heating the filaments in the amplifier and oscillator, and one to supply a relatively high voltage for the anode circuits.

Below the generator there is a system of gearing, for the purpose of providing safety and self-destruction provisions in a device of this nature. The action of the gearing is as follows: Worm 18 is cut integral with or attached to the lower end of a lower armature shaft 36, which may be of metal conventionally attached to the armature. When shaft 36 rotates it causes gear 19 to turn. On the same shaft with gear 19, FIGURE 3, there is another worm which engages gear 20, causing the latter to rotate. On shaft 37, to which gear 20 is attached, there is fastened a gear 21, which meshes with teeth cut in the periphery of a large gear disc 22 revolvable on a stud shaft 38 fixed on a booster can 25 thereunder. Disc 22 is an interrupter having an arc-shaped slot 24 (best seen in FIGURE 2) therein concentric with shaft 38, and of the same radius in relation to the shaft 38 as a flashport 26 formed in the booster can 25 thereunder. Before the airfoil starts rotating on the fuze the slot is at least 180° removed with respect to the detonator or squib shown at 23. The latter is permanently fixed in alignment with the flashport. The purpose of the arc-shaped slot is to provide a means for permitting the fuze to remain armed over an interval of time representing the normal firing interval, while the interrupter is in normal operating motion. The detonator 23 is conventionally connected to the B output of the amplifier contained in shield 6.

After the airfoil 1 has made a predetermined number of revolutions corresponding to safe air travel to beyond the minimum target range, slot 24 registers with detonator 23, whereby explosion of the latter is permitted to communicate a detonating wave to the booster 28 through the blast port 26 which is in line with detonator 23. The detonation of the charge 28 in turn sets off the major charge in the projectile through hole 29. In the safe position detonator 23 will not fire charge 28 because metal disc 22 is interposed between the two explosives, and provides for safety against accidental firing of the detonator. Attached ot disc 22 is a pin 27 which after movement of disc 22 makes contact with an insulated contact spring, which acts through a suitable electric circuit to activate detonator 23 causing self-destruction of the device when the same is used over friendly territory in the event of a miss against an aerial target. FIGURE 2 shows a schematic view of the self-destruction feature in which pin 27 rotates into contact with insulated contact 33 and fires the detnoator 23 through a suitable electrical circuit as in 34. When this device is used over hostile territary pin 27 will be omitted, and the fuze will then automatically operate on approach to the earth if an aerial target has been missed.

The generator armature 17 is fixed on the shaft 4 below the shoe plate 16 with a low potential commutator 42 at its upper end, and a high potential commutator 43 at its lower end. Leads 49 may be taken in multiple from the brushes 44 of the latter commutator to the B leads of the tubes of the amplifier and oscillator circuits, on the one hand, and to the insulated brush 33′ and one lead to the detonator, on the other hand. A wiper brush 34′ is shown bearing on the disc 22 and connected to the other lead of the detonator 23, to complete a circuit to the detonator at times.

The generator 17 is shown as including a case 45 of insulating material in which the field winding 46 is conventionally mounted, the case ends being thickened

and bored radially to receive the sliding brushes 44 and brush springs confined by metal screw plugs 47 to which the springs are respectively attached. The conductors 48 for the filament circuits are shown attached to the screws 47 adjacent the upper commutator brushes; and conductors 49 for the anode-cathode circuits and for the brush 33′ and one detonator lead are connected to the screws 47 of the lower commutator brushes.

The upper end of the generator case 17 is enlarged to form the plate 40 before referred to as engaged in the reduced downward extension of the plate 10. The latter extension is also externally threaded and has screwed thereon to the upper, open, interiorly threaded lip portion of a case 32 of drawn metal as shown. This encloses the generator, the gearing, detonator, and safety and destruction device before referred to. Its lower end has a large aperture 29 formed therethrough, to communicate the effect of the booster 28 to a main charge below, not shown. This opening 29 may be covered by a thin membrane of gilders, metal or the like.

The booster can 25 is in the form of an inverted cup flanged at its lip and secured to the bottom of the case 32 over the port opening 26.

The lower end of the shaft 36 may be stepped in the stud 38 as a thrust bearing for the generator and propeller assembly. The detonator 23 may be a conventional one commonly used for setting off boosters across a space, the lower end of the detonator cup being indented. The support for the detonator—not shown—may be a conventional one fixed in relation to the blast port 26.

It will be understood that the elements described above constitute an arming and self-destruction circuit only, and that normal fuze operation will be effective to, in any known manner, actuate detonator 23 in the event the projectile comes sufficiently close to the target subsequent to the arming operation and prior to the self-destruction operation described above.

In the location of the slot 24, and arranging for its first registry with the detonator and flash port of the booster can, the interrupting material of the disc should extend such distance from the detonator while the disc is in initial position that the slot will not extend across the path between the detonator and booster flash port until the projectile has moved over a distance from the launching or firing device sufficiently to insure that the control devices will not be affected by nearby objects or structures, and whereby, if the detonator is set off within the limit of safe flight required, it will not explode the bursting charge of the projectile. The slot 24 is of such length, in its arc that it will remain continuously in registry with the detonator and flash port until the projectile has moved well beyond the maximum practical range of a target at which the projectile will be fired.

I claim:

1. In a projectile, the combination of an electrically actuated fuze, an air driven generator for supplying electrical energy to said fuze, a gear train mechanically connected at one end to the rotor of said generator, a firing train comprising a detonator, and booster, rotatable means operatively related to the other end of said gear train and across said firing train, an arc shaped concentric slot formed in said rotatable means positioned to register with the firing train at a terminal position of said rotatable means, and intermediate positions, means to fire said detonator variable in time according to range of a target, and means responsive to movement of the said rotatable means to said terminal position to fire said detonator.

2. In a projectile having an electrically actuated fuze, electric generating means comprising an air driven motor, a generator, means mechanically interconnecting said motor and generator for generating electrical energy

when the projectile is in flight, said interconnecting means comprising a generator driving shaft, means driven from said driving shaft effective to arm the fuze beyond a given range and including means for timed self-destruction after the normal firing interval has elapsed while the projectile is still in flight.

3. In a projectile having an electrically actuated fuze, electric generating means, comprising an air driven motor, a generator, means mechanically interconnecting said motor and generator for generating electrical energy when the projectile is in flight, electronic circuit components located between the motor and generator, wherein the means for interconnection between the motor and generator comprises a shaft of non-conducting material passing through the locus of the electrical circuit components.

4. In an arming device for use in a projectile fuze having a firing train, the combination of an element normally interrupting the train, motive means, a gear train operated by said motive means to move said element to

an armed position, and a firing switch operable by said gear train after the normal firing interval for self-destruction of said fuze.

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