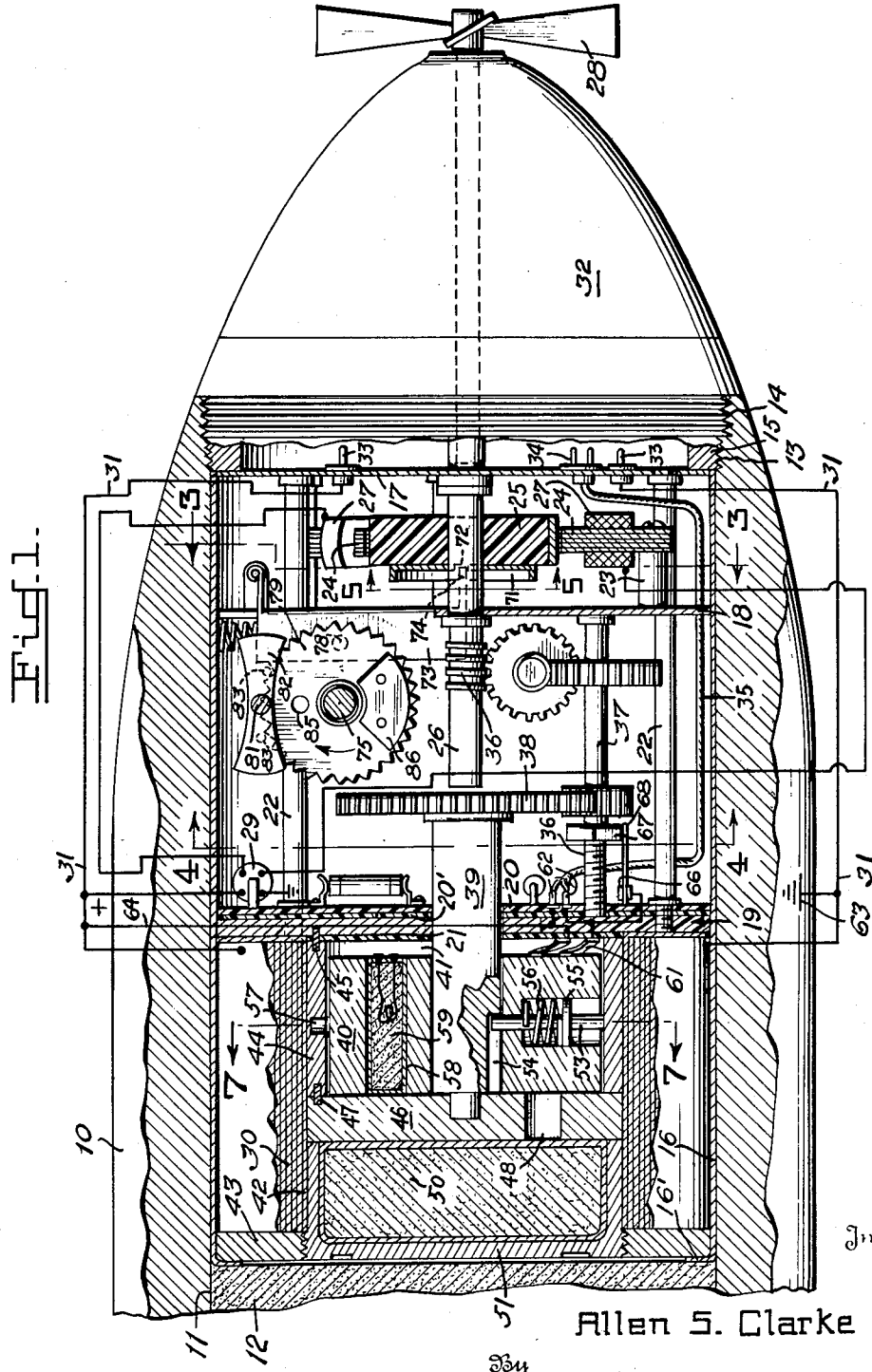
July 24, 1956 A. S. CLARKE 2,755,737

ROCKET GENERATOR POWER SUPPLY

Filed Nov. 25, 1947 3 Sheets-Sheet 1

Fig. 1.



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ROCKET GENERATOR POWER SUPPLY

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Fig. 2.

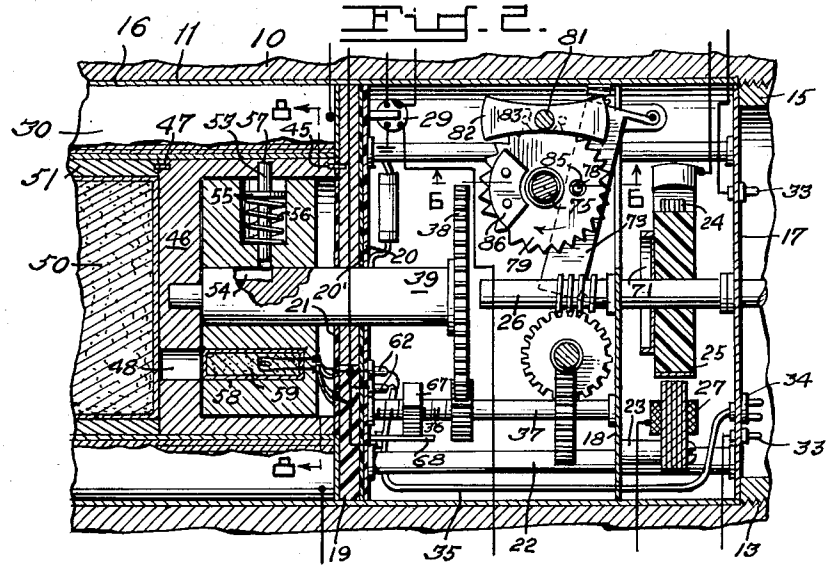


Fig. 3.

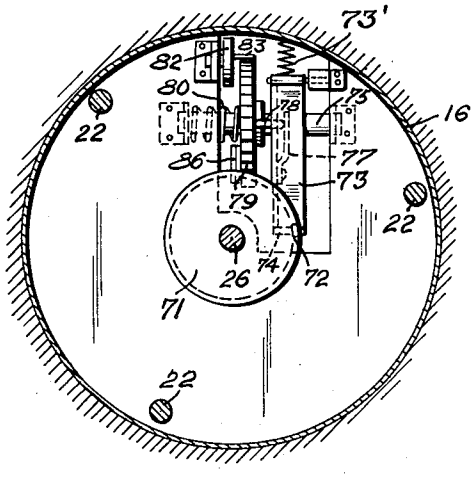
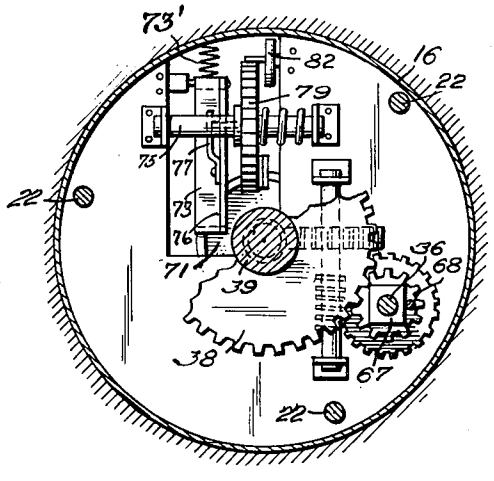


Fig. 4.



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Fig. 5.

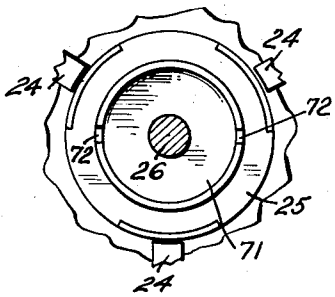


Fig. 7.

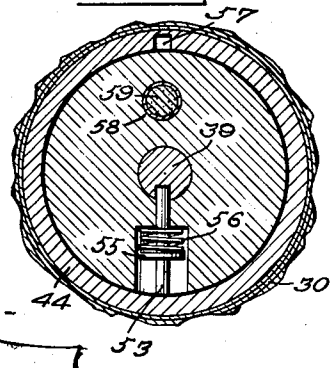


Fig. 6.

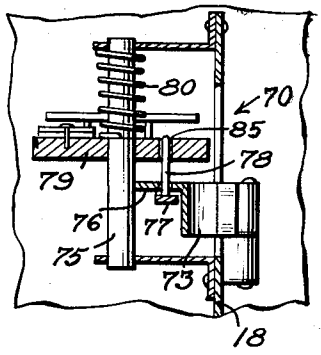
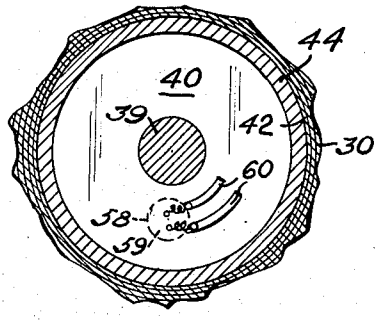


Fig. 8.



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ROCKET GENERATOR POWER SUPPLY

Allen S. Clarke, Washington, D. C., assignor to the United States of America as represented by the Secretary of War

Application November 25, 1947, Serial No. 788,074

7 Claims. (Cl. 102—70.2)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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

My invention relates to fuzes requiring electrical power, and was conceived in the perfection of means to enable transition from power to wind driven generator power supply for fuzes for projectiles used in anti-aircraft fire. It is also an aim to enable the production of a complete unit which is capable of installation within the limited space available in standard projectiles and bombs, which may be readily produced by punch press and screw machine for the major number of parts in the device (representing great economy in cost of production as well as enabling quantity production with a minimum capital investment, and facilitating assembly).

It is a particular aim of the invention to present a novel construction by which there may be embodied a generator, a safety means for preventing generation of electrical potential under casual conditions, and means to arm the fuze in the completion of an explosive train and electrical circuits only after establishment of effective flight conditions over a desired period.

A further aim is to devise a novel, simple and effective means to effect the self destruction of the fuze and attached explosive after a predetermined maximum flight period.

Additional objects, advantages and features of invention reside in the construction, arrangement and combination of parts involved in the embodiment of the invention, and otherwise, as will be understood from the following description and accompanying drawings, wherein:

Figure 1 is a fragmentary longitudinal section of a projectile in which my invention is embodied;

Figure 2 is a similar view showing the set-back in operation;

Figure 3 is a cross section on the line 3—3 of Fig. 1;

Figure 4 is a section on the line 4—4 of Fig. 1;

Figure 5 is a fragmentary section on the line 5—5 of Fig. 1;

Figure 6 is a section on the line 6—6 of Fig. 2;

Figure 7 is a section on the line 7—7 of Fig. 1;

Figure 8 is a top view of the arming rotor in place.

Referring more particularly to the drawings, there is illustrated a projectile having a conventional shell body 10 formed with a chamber 11 loaded with a bursting charge 12.

The upper end of the shell is truncated in a plane normal to the axis of the shell and interiorly threaded in two diameters, as at 13 and 14. The smaller thread receives a retainer ring 15 attached to a case 16 in the form of an open-end cylindrical can which is slidingly set in the shell 10, although in the event that the fuze is made smaller in diameter, the case may be spaced from the wall of the shell and part of the charge 12 will surround the case 16.

Within the case 16 there is set a unit structure comprising all operative parts of the fuze except the electronic

system or electrical time control or other special control of the detonation action of the fuze. This unit comprises a framing including a top circular plate 17, a middle one 18 and a lower composite one 19, which has two upper dielectric plates 20—20' thereon and a concentric smaller lower dielectric plate 21. This composite plate is spaced some distance from the rear extremity of the fuze unit. These several plates are connected by a number of rigid posts 22.

As a formal showing of the generator, on stud posts 23 a set of armature cores 24 are mounted on the plate 18 around a magneto rotor 25 which is fixed on a shaft 26 mounted revolubly in the top and middle plates 17, 18 on the longitudinal axis of the projectile, and on each core 24 an armature coil 27 is engaged, so that rotation of the rotor will develop alternating flux in the cores and corresponding A. C. potentials in the coils. The shaft 26 is driven conventionally from a wind vane 28 revolubly mounted on the nose of the projectile, although other forms of vanes or air turbines may be employed as found desirable. The rotor magnet arrangement and the forms of the armature elements may conform to approved practices, and may be assumed to be such that the alternations are identical in all coils and that they are connected in series to a rectifier 29 mounted on the dielectric cover of the lower plate 19, from which rectified current is passed by leads 31 to a capacitor 30, and to an electronic or other electrical detonation control unit 32, which is shown as a fuze cap, having a threaded tenon screwed into the larger threads 14 of the mouth of the shell. The details of the unit 32 are not illustrated since they comprise no novel part of the invention herein claimed. Two insulated stud electrode terminals 33 are shown mounted on the plate 17, with which jumper connections of conventional form may be made for the unit 32, and a two-prong plug 34 for the detonating leads of the unit 32 is also shown mounted on the plate 17, from which a cable 35 is extended to the detonator in the fuze, as will be further described.

The shaft 26 has on its lower end below the middle plate 18 a worm 36, which, through a reduction gearing including a low speed counter shaft 37, drives large terminal gear 38 fixed on a large diameter driven shaft 39, coaxial with the shaft 26, and operating an arming rotor 40 releasably keyed thereto normally and located in a chamber 41 formed below the lower plate 19. All of the gearing is located between the middle and lower plates 18 and 19, the counter shaft 37 being parallel to the axis of the shafts 26 and 39 and being mounted in bearings on the plates last mentioned. The shaft 39 extends a distance above the lower plate 19 close to the lower end of the shaft 26, and the gear 38 is on the upper end, for a purpose to be explained.

The chamber 41 is formed within the capacitor, which is constructed as a hollow cylinder fitted next to the case 16 and carried on a flanged tube 42 having its upper end pressed against the plate 19 by an internally threaded ring 43 set against or secured to the lower end of the tube and itself supported by the crimped-in lower edge 16' of the case 16, to which it may be welded. The opening through the ring 43 is not less in diameter than the interior of the tube 42. Set within the upper part of the tube 42 there is a thick tubular wall 44, forming the immediate wall of the chamber 41, and it may be pinned to the plate 19 as at 45. The bottom of the chamber is formed by a thick interrupter plate 46 fitted within the tube 42 and also pinned as at 47 to the tube wall 44, or otherwise keyed to the wall 44. This plate has a flash port or train port 48 therethrough, as a link in the explosive train to a booster charge 50 carried in a cup 51 fitted entirely within the tube 42 and threaded at its base in the ring 43 so as to press the plate 46 and wall 40 upward, clamping them

and the whole remaining assembly against the ring 15 forming the virtual top or shoulder of the case 16. The capacitor is thus free of mechanical stresses which might affect its operativeness.

Within the chamber 41 and fitted revolubly around the shaft 39 is the arming rotor 40, which is a cylindrical block of material close to but clearing the wall 44, and of slightly less altitude than the chamber 41. It is normally keyed to the shaft 39 by a plunger 53 radially slidable in the rotor and projecting inwardly into a longitudinal key slot 54 in the side of the shaft 39 and opening on the lower end of the latter. There is no sliding movement of the plunger longitudinally of the shaft 39 in operation of the device, but the slot permits convenient assembly of the parts of the arming and detonator device by introduction of the latter from below after the rotor 40 and plunger have been assembled in the wall part 44. The plunger has a collar 55 fixed midway of its length in an enlarged radial bore opening on the periphery of the rotor, the outer end of the plunger extending therethrough and bearing against the inner surface of the wall 44, against which it is pressed by a helical spring 56 confined between the collar and the inner end of the large bore. At one point in the wall 44, a socket 57 is formed into which the outer end of the plunger may move under pressure of the spring when the rotor has been turned to an armed position shown in Fig. 2, and the thickness of the wall 44 and depth of the socket are sufficient to permit movement of the plunger into the socket far enough to clear the opposite inner end of the plunger from the slot 54. In the present instance the socket 57 is shown as located diametrically opposite the position of the plunger as shown in Figure 1, which may be assumed to be the normal or initial position of the parts prior to firing, but this angular initial relation may be varied according to the time during which it is desired that the fuze shall remain unarmed after firing (and the positions of Figure 1, under an extreme time delay might represent a condition after the mechanism has been in operation for a time). However, the socket 57 is at the side of the chamber diametrically opposite the port 48. In the rotor 40 diametrically opposite the plunger there is formed a detonator hole 58 extending entirely through the rotor, in which there is set a primer or detonator 59, of the squib type, and it may be seen that when the plunger engages the socket 57, the detonator is aligned with the port 48 which is in communication with the booster 50. This constitutes the armed position of the rotor.

In the top of the rotor 40 near the hole 58 two radially spaced contacts 60 are fixed, to which respective wires from the squib are connected, as shown in Fig. 8. On the insulator plate 21 there are mounted two brushes 61 arranged to bear on the top of the rotor 40 and to engage the contacts 60 when the rotor has been moved to the armed position. Conventional leads are extended from these brushes to respective terminal posts 62 mounted on the upper insulating plate 20, to which the detonator circuit from the unit 32 may be connected by the wires of the cable 35. In practice the posts 62 would be extended with clearance through plate 19 and used to hold the brushes 61, this detail being omitted for convenience in illustration.

By the construction described, it may be seen that after a predetermined time from the moment of firing the detonating circuit from the control head 32 will be closed at the rotor 40, and thereafter when the unit 32 functions to transmit a detonating potential to the squib, the squib or primer will be set off, and through the port 48 function the booster 50, which will in turn detonate the main bursting charge 12.

In order to cause the self destruction of the projectile after a time which is greater than that required for the flight of the projectile to a target within a range which has been predetermined as practicable for normal attack or defense against aerial target, means has been provided for closing a circuit between the capacitor and the squib 59 independently of the unit 32, one form of which will now be described. A permanent connection 64 between one electrode of the capacitor and one brush 61 is made, and an open circuit from the other electrode of the capacitor and the other brush, arranged to be closed at 66 by a slow movement member operated by the gear train. Other circuit forms may be employed, and it may be preferable to use an insulated lead from both sides of the condenser, the equivalence and execution of which will be obvious to those concerned in the art. For illustration only one terminal of the capacitor is indicated as grounded at 63 while the other is connected by an insulated lead 64 to one brush 61. From the other brush an insulated lead is extended to a stationary insulated contact 66 on the dielectric plate 20 near the counter shaft 37 and exposed upward so as to be engaged by a travelling nut 67 engaged on the lower end portion of the shaft 37 threaded for the purpose. A vertical bar 68 is fixed beside the nut parallel to the shaft, so as to wipe against the nut to prevent rotation of the latter, and the contact 66 is located close to the bottom of this bar, in position to be engaged by the nut at the lower limit of nut travel. The threads on the shaft 37 are in such direction that in operation of the gearing from the shaft 26, the nut will move downward, and will engage the contact a considerable time after the rotor 40 has been moved to its armed position of Fig. 2. If desired the apparatus may be so designed that the gear 38 may be located at a greater height in the space available between the plates 18 and 19, in which event a greater length of threaded shaft will be available for movement of the nut.

It will be seen from the immediately preceding description that after a predetermined excessive flight of a projectile equipped with my invention the nut 67 will have travelled into contact with the contact 66, and the shaft 26 being journalled in the plates 18 and 19, the circuit through ground is completed and the capacitor permitted to discharge through the squib causing detonation of the bursting charge in the usual sequence.

It is one of the great safety features of such fuzes that there is no possibility of electrical detonation of the bursting charge until after the projectile has been in flight a certain time, because not until it is in flight is the electrical potential generated, and the arming device shown assures the movement of the projectile to a safe distance from the point of discharge of the projectile before there is any possibility of the detonating circuit being closed to the squib, by the unit 32.

However, the generator does tend to operate during such safety period, and supplies a potential which is useful in heating filaments in case such are involved in the unit 32.

If the projectile should be dropped so as to strike materials which would cause rotation of the generator rotor and accidental closing of the detonation circuits a serious explosion might occur, and if the projectile were dropped accidentally from a plane an explosion in an undesired area would probably occur, by the functioning of the vane if no provision were made to forestall such occurrences.

In order to prevent such casual operation of the generator and to prevent the functioning thereof and the control devices unless the projectile is actually fired from a gun or other launching device, a generator latch 70 is provided preventing rotation of rotor 25, but which is responsive to conditions incident to firing to permit continued operation of the rotor after a predetermined time.

The generator lock device comprises an inverted dished circular plate 71 having a peripheral flange thereon notched at 72 at one point at least (two notches being shown), and below this a latch or lock lever 73 is pivoted on the plate 18 outwardly of the generator so as to swing upwardly beneath the flange. It has a tongue 74 arranged to engage in the notch 72, being urged to this elevated position by a compression spring 73' acting on a heel portion of the lever extending downward from the lever pivot. In this instance the lever swings in a plane approxi-

mately tangent to the periphery of the notched plate **71** which is of a diameter somewhat less than that of the rotor **25**. Below the lever a sufficient distance to permit it to drop from engagement with the notch **72**, there is a shaft **75** revoluble in brackets extended from the plate **18**, its axis being normal to the plane of operation of the lever. The lever has a longitudinal flange **76** dependent at one side, and on the inner side of this flange there is secured a leaf spring **77** having an extreme part normally spaced from the flange and carrying a pin **78** thereon extended at right angles to and through the flange and beyond.

On the shaft **75** close to the lever there is slidable and freely revoluble an escapement star wheel **79** against the side of which the end of the pin **78** bears, the wheel being urged along the shaft and against the pin by a compression helical spring **80** engaged loosely around the shaft seated against one of the shaft-supporting brackets. On a rock shaft **81** parallel to the shaft **75** a rocker **82** is fixed to oscillate in a plane close beside the wheel **79**, and having pallet pins **83** extended therefrom so as to wipe upon the periphery of the star wheel, one engaging at the apex of a tooth while the other pin engages in the space between two teeth, whereby rotation of the wheel rocks the rocker, and the wheel is delayed in its movement. At a point which is initially at a distant part of the wheel from the lever **73** a transverse opening **85** is formed through the wheel of a size and location suitable to receive the pin **78** therethrough if the lever is at the rearward or lower part of its movement away from the notch **72**. The shaft **75** may serve as a stop for the lever **73** at this position. With the star wheel set at a predetermined initial position of the aperture with relation to the lever, a weight **86** fastened to the side of the wheel opposite the lever is at a position in the direction of the nose of the projectile, but off center with relation to force acting thereon rearwardly parallel to the axis of the device. The distance of the aperture **85** from the engaging axis of the pin **78** should be less than 178 degrees, so that under firing, set-back force acting on the weight will rotate the wheel, rocking the rocker, and moving the aperture to alinement with the position which the pin **78** will then have due to similar forces acting on the lever. When this condition is established, the spring **80**, as well as, in some cases, inertia of the wheel due to rotation of the projectile by the rifling of a gun, will move the wheel slidingly along the shaft **75** so that the pin **78** is fully received in the aperture **85**, permanently holding the lever **73** retracted from engagement with the notch **72** on the generator rotor, and permitting the latter to operate as long as the projectile continues in flight.

If the projectile should be accidentally dropped so as to strike upon a floor, the lever **73** might become disengaged, and possibly a momentary partial turn of the vane **28** occur, but the lever would be quickly returned to its engagement with the flange on the generator rotor, and would engage the notch or one of the notches therein after only slight movement of the rotor **25**.

If the projectile were accidentally dropped in space over the earth there would be no sufficient force of set-back manifest to operate the lever **73** or the weight **86**, so that no releasing of the rotor would occur and no current would begenerated to cause the self-destruction action or permit functioning of the unit **32**.

While I have disclosed the details of my invention in the best embodiment in which I have produced it, nevertheless this is purely exemplary, and it will be understood that modifications of construction arrangement and combination of parts, substitution of materials and equivalents mechanical or otherwise, may be made without departing from the spirit of the invention as set forth in the appended claims.

It may be noted that the shaft **26** is extended at its lower part to, or nearly to, the upper end of the shaft **39**, so that shaft **26** will serve as a stop for the shaft **39** to prevent forward slippage of the latter, without requiring other special structural forms for the purpose.

I claim:

1. In a fuze of the character described, a generator rotor having a notched element, a lever pivoted in the fuze extending transversely of the flight axis positioned and spring urged to engage said notch, and having its principal mass located to move the lever from said engagement under set-back force, an escapement device thereadjacent including an escapement wheel in a plane coincident with the direction of the flight axis of the device weighted at a forward part so as to be rotated by set-back under firing, and means operatively connected with the wheel normally tending to move to lock said lever at a rearward position of the wheel and lever and responsive to such positioning of the wheel and lever to move to locking relation to said lever.

2. In a device of the character described, a generator having a rotor rotative on a fore-and-aft axis of the device, a latch movable in a fore-and-aft path having a forward position in locking engagement with the rotor, and movable rearwardly to clear the same, a weighted rotary locking member beside the latch also movable in a fore-and-aft path having a part movable therewith at an angle to the movement of the latch, a spring urged locking pin normally in slidable engagement with said rotary locking member carried by said latch and laterally movable to locking engagement with said weighted rotary locking member, the said weighted rotary locking member having an aperture to receive said pin when said latch is at full released position and said weighted rotary member is at its rear limit, and a motion retarding means operatively connected with the locking member.

3. The structure of claim 2 in which the weighted locking member includes a shaft in a plane normal to the axis of the rotor, a star wheel slidable longitudinally of the shaft, a spring confined between the shaft and wheel to urge the latter toward one limit of its sliding movement, said latch being in the path of movement of the wheel by the spring.

4. In a fuze of the character described, a framing having a wind-operated generator including a rotor on a fore-and-aft axis of the fuze, a counter shaft and a driven shaft, a reduction gearing connected between the rotor and said shafts, an arming rotor carried by the driven shaft and an interrupter therebeside having a blast-communicating port at one point, said arming rotor having a detonator normally distant from said port but alined therewith at an armed position of the arming rotor, electrical means for firing said detonator including an electrical source, a circuit including the same and two contacts on the rotor and respective wiper contacts on the framing and a circuit closer in said electrical means including a threaded part on said counter shaft, a travelling nut engaged on said threaded part, means to hold the nut against rotation and a contact member on the frame in the path of the nut near one limit of its travel operative to close said circuit to the detonator.

5. The structure of claim 4 in which said circuit includes a tubular capacitor at the rear of the fuze concentric with said axis, said framing including a transverse plate forwardly of said capacitor having said driven shaft revoluble therein, a hollow cylindrical wall device set within the capacitor behind the plate to form a chamber, said arming rotor revoluble therein, said driven shaft releasably keyed to the arming rotor at initial position, means responsive to rotation of the arming rotor to a predetermined armed position to unlock the driven shaft and arming rotor, an interrupter plate rearwardly of said wall in fixed relation to the latter, and a booster charge behind the interrupter with the capacitor.

6. The structure of claim 5 in which the capacitor includes a mounting tube set against said plate, and an internally threaded ring against the tube, a case for the fuze connected with the ring and framing, said booster including a cup inserted through said ring and having threaded

engagement therewith in compressing engagement with the interrupter and cylindrical wall.

7. The structure of claim 6 in which said driven shaft has a slot therein within the length of the arming rotor, a radially reciprocable plunger in the arming rotor having one end in the slot normally and the other slidingly abutting said cylindrical wall device, spring means urging the plunger radially outwardly to clear the slot, said cylindrical wall device having a recess therein at a position alined with the plunger when the arming rotor is in armed position, to receive the outer end of the plunger in clearing relation to said slot and in locking relation between the arming rotor and said cylindrical wall.

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