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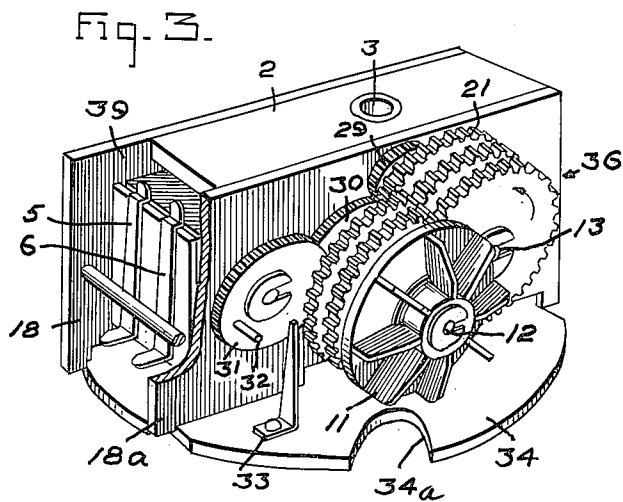
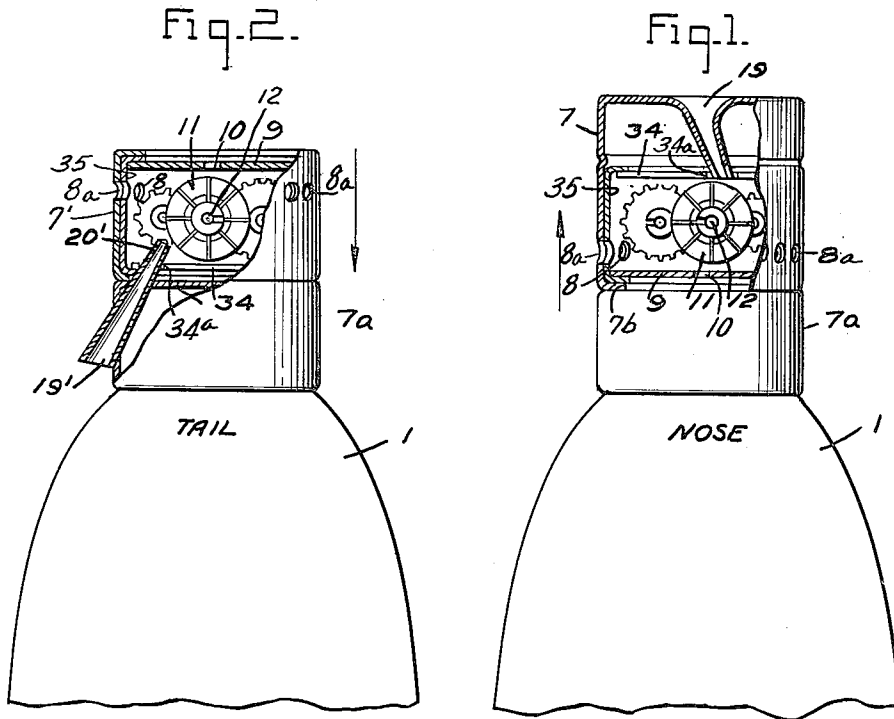
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WIND-OPERATED DELAYED ARMING FUZE

Filed May 27, 1947

2 Sheets-Sheet 1



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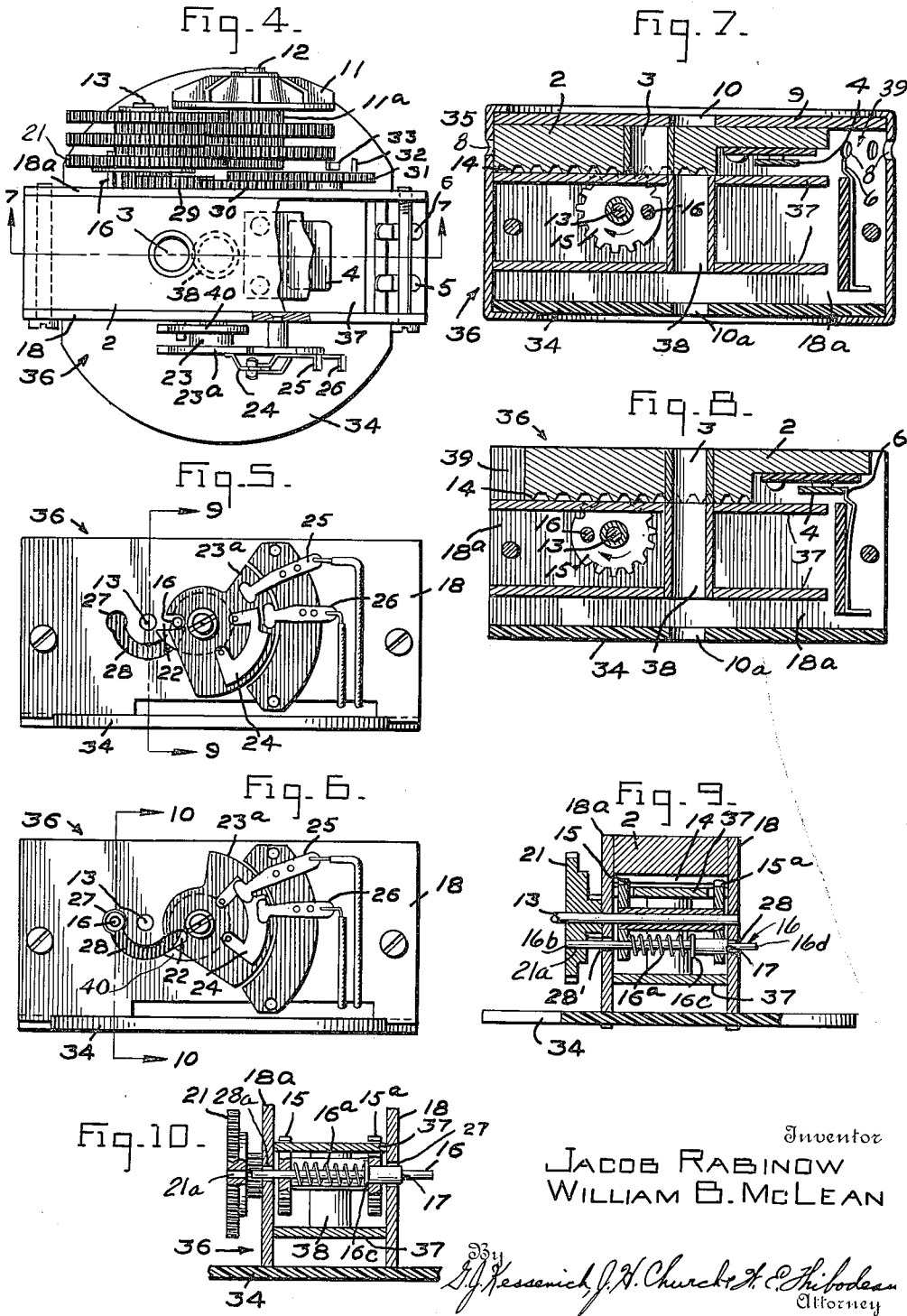
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WIND-OPERATED DELAYED ARMING FUZE

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2 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 of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Our invention relates to a turbine-operated arming device for ordnance fuzes of a kind used with ordnance missiles, such as bombs, rockets and shells, and particularly to electrically actuated fuzes such as condenser fuzes, which include a source of electrical power.

Fuzed military missiles of certain types usually employ an arming mechanism which arms the fuze subsequent to release or firing of the missile so as to minimize the possibility of an early explosion occurring close enough to the launching point to be dangerous to personnel employing the weapon.

Heretofore, in fuzes of this type, energy for powering the arming device has come from either an inertia member acted upon by set-back force when the projectile is launched or fired; or a windmill has been mounted in the projectile to furnish power for the arming mechanism.

A primary object of our invention is to provide for projectiles of the above type a fuze arming device which eliminates the dangers of prior art devices. Specifically, the prior bomb windmill is exposed and subject to damage in handling, and is therefore usually shipped separated from the fuze, and is assembled at a field base prior to use. Also, the prior windmill is relatively bulky. In accordance with our invention, a small turbine wheel, totally enclosed within the turbine casing, is employed, eliminating the above disadvantages. Also, such a turbine can be placed in the most convenient location, and a suitable air duct conducted to it, which eliminates many design restrictions imposed by the use of a windmill mounted on the nose of the projectile.

Generally, inertia-actuated arming mechanisms are subject to the disadvantage that they are energized only during the time when the projectile is accelerating, which is usually a very short period while the projectile is still in the gun or still in dangerous proximity to the gun or supporting troops. Moreover, inertia devices are obviously not applicable to bombs, which are released without any initial propelling acceleration. It is an advantage of our arming device that it can be used with any type of projectile and can operate over the entire period of flight of the projectile, if desired, or any part thereof, as predetermined.

When a windmill or airfoil rotor is employed in the nose of the projectile, a relatively long drive shaft is required. At the high speeds usually involved, special precautions must be taken in certain electronic fuzes to prevent undue vibration of the drive shaft. Our invention makes possible the mounting of the arming devices in any convenient location with very close mechanical coupling of the airfoil, and thus simplifies the overall design problems involved in various fuze mechanisms with which it may be used.

Other objects, advantages and features of invention will

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become apparent as the description proceeds, or may be understood from the disclosure herein.

In the drawings:

Figure 1 is a side elevation in partial section showing the nose of a projectile embodying one form of our invention.

Figure 2 is a side elevation partly in section of the tail of a projectile, embodying a slightly different form of our invention. Corresponding parts in Figures 2 through 10 are given the same numbers as in Figure 1, with a prime (') added if the part is changed in construction.

Figure 3 is a perspective view from the rear, partly broken away, of the arming unit of our invention.

Figure 4 is a rear view of the arming unit with case wall 35 and plate 9 removed.

Figure 5 is a side view of the arming unit at the lower side of Figure 4, showing the device initially set and with the switch open.

Figure 6 is a view similar to Figure 5, showing the switch closed and showing the position of the snap-out pin when the device is armed.

Figure 7 is a section on line 7—7 of Figure 4, with the case 35 and plate 9 included.

Figure 8 is a similar view showing the elements in the armed position, plate 9 and wall 35 omitted.

Figure 9 is a section on line 9—9 of Figure 5, with the snap-out pin shown in its lowest position.

Figure 10 is a sectional view taken on line 10—10 of Figure 6.

In the drawings, Figures 1 to 9, the major elements of the projectile consist of the shell body 1, and a fuze housing 7 mounted on the nose of the projectile and having forward entrant duct 19 terminating in a jet nozzle 20 positioned to act on a turbine 11. While the housing 7 and fuze parts are here shown mounted exteriorly on the nose of the shell, it will be understood that this is for convenience in disclosure of essentials, and that they may be mounted in a nose cavity in the projectile provided suitable outlet is provided for air admitted through the duct 19.

Behind the housing 7 a case 7a is shown which may be an electric unit, an electronic unit, or a booster, and alternative arrangements of these various parts may be carried in accordance with conventional practices and requirements of the particular type of fuze which accompanies the particular arming and operating means here disclosed. Since such further features comprise no part of the present invention they are not shown in detail.

The main mechanism of the fuze arming device is mounted in a framing comprising principally two vertical parallel plates or walls 18 and 18a, mounted between circular front and back plates 34 and 9 (the first being of insulating material), held together by an annular metal case wall 35 which is provided with exhaust holes 8 (Figure 7) fitted around the two last named plates, the forward and rearward edges of the wall 35 being crimped inward against the plates 34 and 9 to hold the latter plates and case 35 together. The assembly between plates 34 and 9 and within the wall 35 constitutes a timing unit 36 which may be used to time the arming of the fuze, as one application to use. Other uses will suggest themselves to those working in the art of fuzes.

The framing mentioned includes two horizontal plates 37 (Figures 7—10) secured between the plates 18, 18a, and through plates 37 there is inserted a blast tube 38 fixed in registry with the opening 10a through the plate 34 and the opening 10 through plate 9. A space or channel 39 is afforded between the plate 9 and the adjacent plate 37, and in this channel there is slidable an interrupter 2 having an aperture 3 therethrough normally spaced from the blast tube 38, but movable to align the aperture with the tube.

The housing 7 is provided with air exhaust holes 8a which are aligned with exhaust holes 8 near the base thereof and plate 9 has a hole 10 through the center, (Figures 1 and 7), which may be filled with explosive train material, or may serve as a blast port. The housing 7 receives the unit 36 snugly and the bottom edge 7b is spun in under the timing assembly so as to form a simple, rigid, and protected unit.

In Figure 2, the intake orifice of air duct 19' faces in the direction of motion of the projectile, at the tail end of which the device is mounted.

The turbine 11 is mounted on a fixed shaft 12 and has a small pinion 11a (Figure 4) fixed to its inner side, such pinion constitutes the first element of a gear train consisting of large gears integrally mounted with small pinions and stacked up on two fixed shafts 12 and 13 as seen in Figure 4. The overall gear ratio is quite large so that many revolutions of the turbine 11 are required for a stroke of the arming slider 2. The slider has one face formed into a rack 14 which meshes with two axially aligned rigidly connected but spaced gears 15, 15a, having peripheries exposed through the rearward plate 37, only one of which is seen in Figures 7 and 8. These two gears are linked to the final step in the large gear train by means of a snap-out crank pin 16, extending slidably through each of gears 15 and 15a, its inner end 16b normally engaged in an aperture 21a in the last gear 21 of the train but biased outwardly by an encircling coil spring 16a (Figure 9) between the gear 15 and collar 16c fixed on the pin so as to tend to withdraw the latter from the aperture in gear 21. That end of the pin which is in gear 15a is enlarged for a distance sufficient to extend through the gear and also through plate 18 at times, the collar 16c being at the inner end of this enlargement. The enlargement affords a shoulder 17 at its outer end, beyond which the pin extends with reduced diameter a distance beyond the plate 18. This shoulder limits the outward movement of the pin by the spring 16a (Figures 9 and 10), since it rests normally against the plate 18 beside a slot 28 in plate 18 (Figures 5-6) to be described, when the device is in unarmed condition. The slot 28 and a similar slot 28a (not shown) in plate 18a extends a distance concentric with the shaft 13, so as to permit movement of the pin translatively in the slots incident to rotation of the gear 21 and gears 15-15a. At its distal end the slot 28 is enlarged as at 27, to receive the shoulder 17 there-through as will be explained.

Air duct 19 delivers a jet of air through a port notch 34a in the plate 34, moving tangent to the turbine 11, as shown in Figure 1, when the projectile is fired or otherwise launched. The air pressure at the tip developed by flight of the projectile causes a stream of air to impinge upon the turbine 11 driving it clockwise as seen in Figures 1 and 2. This turns the gears so that all the gears of the right end stack turn counterclockwise as shown in Figure 3. The last gear 21 of this stack as above described drives crank pin 16 and through it the gears 15 and 15a which mesh with the rack 14 of the interrupter slide 2 driving the latter to the right as seen in Figures 7 and 8. Figure 7 shows the position of this slider 2 in the unarmed, or safe, condition, and Figure 8 shows the same in the armed and switch closing condition. It will be seen that the hole 3 for the explosive or blast toward the booster is initially off center and the switch contacts 5 and 6 are initially open.

The visible end 16d of the crank pin 16 projects a distance beyond the plate 18 (Figures 5, 9, 10) and engages through a radial notch 22 in an inner flange 40, of hub 23, which carries an insulating sector 23a on which a bridging switch contact element 24 of a rotary switch device is mounted as appears in Figure 5. As can be seen, the switch in Figure 5 is in the open condition, that is, the bridging element 24 is not in contact with the two stationary spring blade switch elements 25 and 26.

With reference to Figures 5 and 6, upon rotation of

turbine 11, the visible end 16d of the transfer pin 16 moves clockwise in the radial notch 22 turning the flange 23a and causing the rotary switch to close. As the turbine continues to rotate, the transfer pin continues to move clockwise along the slot 28 until its shoulder 17 reaches the enlarged end 27 of the slot 28 in the side plate 18, permitting the small spring 16a previously referred to, to move it toward the observer (Figure 6), and thus disconnect it from its driving gear 21. At this time the interrupter 2 has traveled to its righthand limit as seen in Figure 8 and the bridging contact element 4 contacts resilient contact 6 to close the detonator circuit (not shown). The powder train or blast path from the tube 38 toward the rear is now uninterrupted. The turbine continues to rotate, but has no further effect on the arming mechanism since the crank pin 16 is disengaged from the gear train.

As shown in Figure 10, the pin 16 also serves to lock the interrupter in its position by locking gears 15 and 15a.

In some types of fuzes for which this mechanism is intended, self-destruction is required after a predetermined time of air travel. In order to accomplish this, three more gears 29, 30, and 31 are coupled to and included in the final gear set in the gear train driven by the turbine. They can be seen in Figure 3. The final gear 31 of this train is provided with a metal pin 32, which will finally engage an insulated upstanding spring blade contact 33, which may be utilized in a conventional detonating circuit. The gear 31 rotates much more slowly than the gears 15 and 15a which drive the detonator interrupter 2 into position so that the arming and self destruction cycles can be so designed that the self-destruction takes place at a time several times longer than the interval consumed in the arming of the fuze. The metal pin 32 may accomplish self-destruction by touching the spring contact 33 which is riveted to the front insulator plate 34. This contact can be seen in Figures 3 and 4. This gear rotates in the counter-clockwise direction.

The electrical connections between this arming mechanism and the fuze and the detonator or primer are made by means of small terminal plugs, or any other suitable method, some of which are not shown. The mechanism is normally placed immediately above the main booster charge so that the explosion of the detonator is communicated through the interrupter to the main booster charge (not shown), in any conventional way.

The detonator may be mounted in the tube 38, or otherwise on the axis of the tube 38, with conventional circuit connections. It is apparent that a different form of switch may be employed in place of the single arm 33, so that the self destruction circuit may include an electrical source which may be common with that of any electronic detonating circuit including either or both of the other switches described.

In Figure 2, the housing 7' is inverted from the position shown in Figure 1, and set behind the unit 7a, the two being attached or inserted in the rear or tail of the projectile 1. In this instance an enlarged end of the duct 19' is extended inward through the side of the unit 7a, with an orifice 20' directed toward the turbine 11 at a proper angle to cause the latter to turn in the proper direction by the jet of air produced by the duct when the projectile is in flight. All parts of the device are otherwise the same as above described.

It will be understood that in any construction of the device the conventional practice of embedding a booster in a body of a bursting charge within the body of the projectile may be followed, and in such event an explosive train or blast duct may be extended through the unit 7a in coordinated relation to the opening 10.

We claim:

1. A delayed arming mechanism for an electrically actuated projectile fuze, comprising a powder train interrupter slideable from unarmed to armed position, a

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rack on said powder train interrupter, a pinion cooperating with said rack for moving said powder train interrupter to armed position, a gear train for driving said pinion, a turbine housed in said fuze in driving relation to said gear train, first switch means, means operated by said gear train to close said switch upon predetermined initial movement of said gear train, and second switch means operatively connected with said interrupter for operation by said interrupter to closed position coincident with arming movement of the interrupter.

2. The structure of claim 1 including a slidable spring loaded pin means coupling said first named switch and interrupter in releasable engagement with a gear of said gear train, said pin, means operable to sequentially disconnect said gear train from said first switch means and interrupter, and a further switch connected for operation by said turbine independently of the first and second switch means, said further switch means comprising a terminal driving gear of said gear train having a switch

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contact mounted thereon and adapted to engage a corresponding insulated contact of said mechanism a predetermined time after said interrupter has obtained armed position.

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