April 21, 1964 B. D. NABRESKI ETAL 3,129,666

MECHANICAL TIME FUZE

Filed Dec. 14, 1962 5 Sheets-Sheet 1

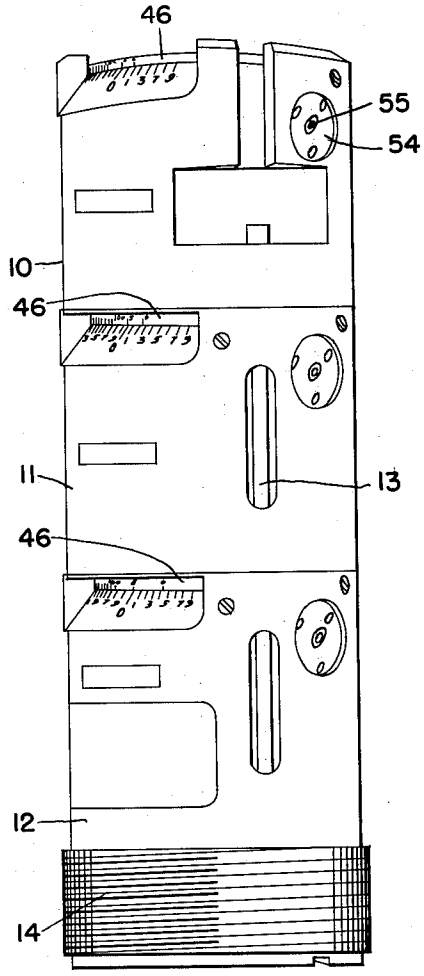


FIG. 1.

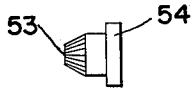


FIG. 9.

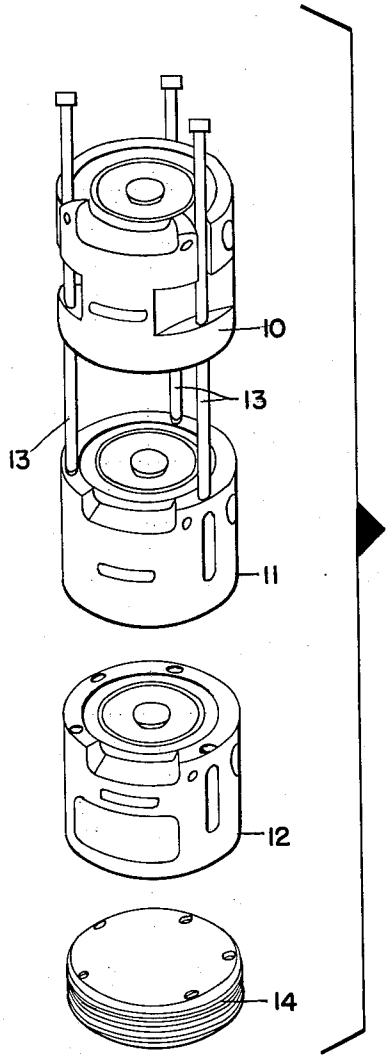


FIG. 2.

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MECHANICAL TIME FUZE

Filed Dec. 14, 1962 5 Sheets-Sheet 2

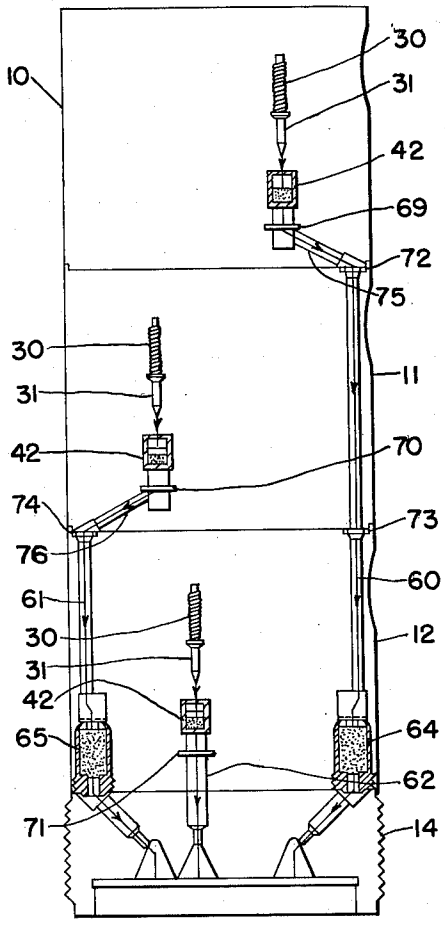


FIG. 8.

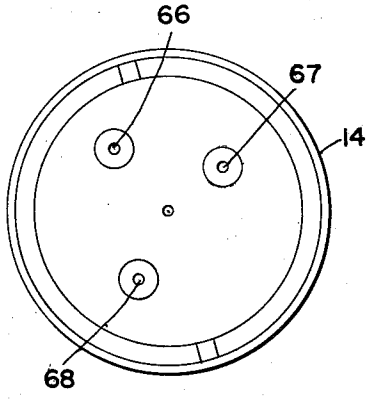


FIG. 3.

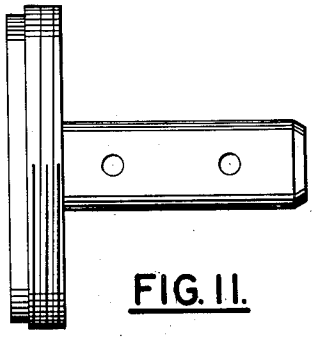


FIG. 11.

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MECHANICAL TIME FUZE

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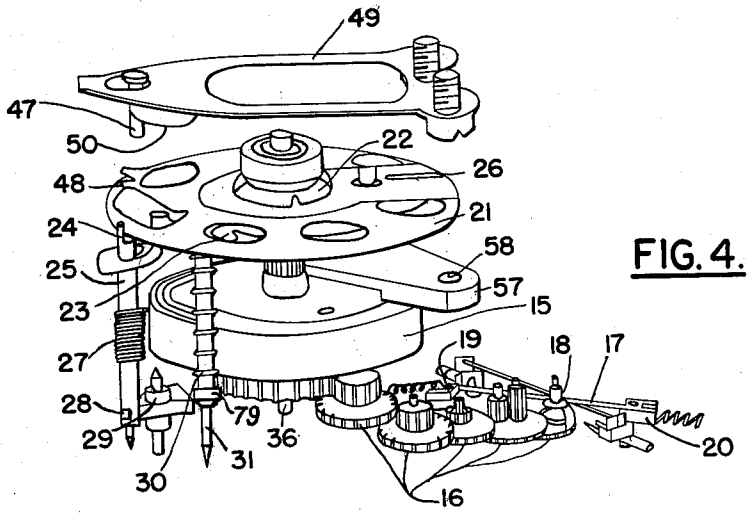


FIG. 4.

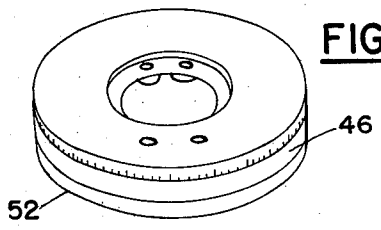


FIG. 6.

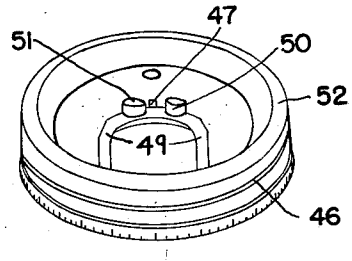


FIG. 7.

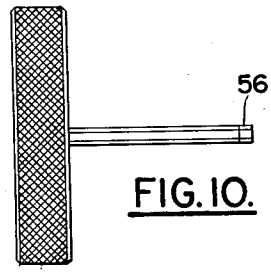


FIG. 10.

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MECHANICAL TIME FUZE

Filed Dec. 14, 1962 5 Sheets-Sheet 4

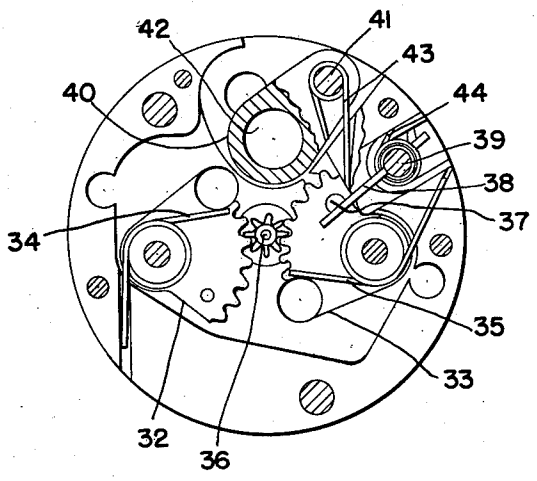


FIG. 5.

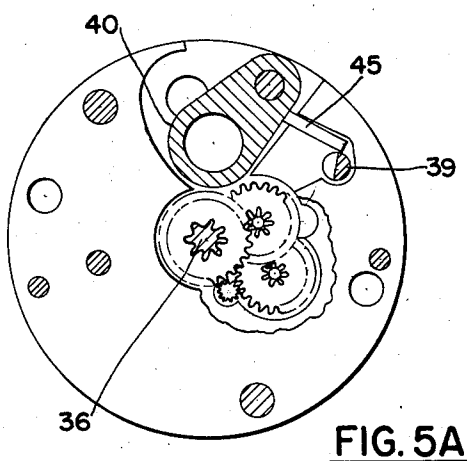


FIG. 5A.

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MECHANICAL TIME FUZE

Filed Dec. 14, 1962 5 Sheets-Sheet 5

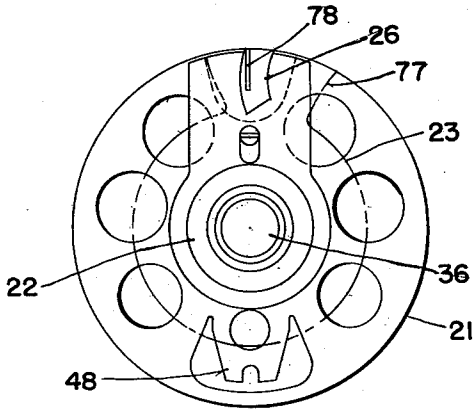


FIG. 12.

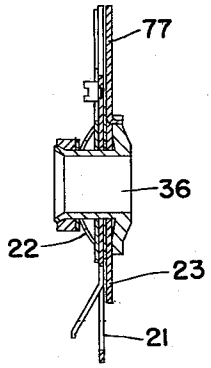


FIG. 13.

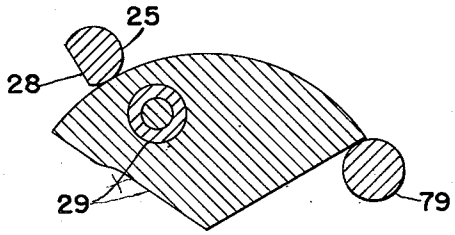


FIG. 14.

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United States Patent Office 3,129,666 Patented Apr. 21, 1964

3,129,666

MECHANICAL TIME FUZE

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Filed Dec. 14, 1962, Ser. No. 244,843
1 Claim. (Cl. 102—84)
(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 purposes without the payment to us of any royalty thereon.

This invention relates to fuzes for internal use in artillery shells, and has for its purpose to provide a fuze which is more reliable and more accurate in its operation than the fuzes heretofore available.

Accuracy and reliability in the operation of such fuzes involves the use of delicate mechanisms. These mechanisms undergo severe shock and strain during their use. As a result, they are prone to fail to function or to function prematurely. The present invention avoids these difficulties by the provision of an improved fuze. This fuze includes three identical units. In each unit, there are (1) a delay arming assembly which functions to prevent arming of the fuze for a predetermined time after the shell is fired and (2) a movement assembly which functions to fire a primer at a longer time after firing of the shell. The firing of the different primers, or any one of them, operates to fire a charge whereby the shell is detonated.

The invention will be better understood from the following description when considered in connection with the accompanying drawings and its scope is indicated by the the appended claim.

Referring to the drawings:

FIG. 1 is an exterior view of the fuze assembly,

FIG. 2 indicates the relation between the different fuze units,

FIG. 3 is a bottom view of the fuze,

FIG. 4 shows the timing mechanism as combined with a mechanism by which the operation of the firing pin is effected,

FIGS. 5 and 5A illustrate, on different levels, the delay arming mechanism, this mechanism being under the control of a timing mechanism identical with that shown in FIG. 4,

FIGS. 6, 7 and 9 illustrate certain features of the time setting mechanism,

FIG. 8 illustrates the explosive trains of the different fuze units,

FIG. 10 show certain elements utilized in setting the fuze,

FIG. 11 shows an igniter which is normally located at the bottom of the fuze,

FIGS. 12 and 13 illustrate the relation between a timing disk and a safety disk which constitute a part of the timing mechanism, and

FIG. 14 illustrates a detail of the firing mechanism.

This application is a continuation-in-part of a copending application Serial No. 27,460, filed May 6 1960, for a "Mechanical Time Fuze," now abandoned.

The fuze of FIGS. 1 and 2 includes three units 10, 11 and 12 which are identical and are mounted one above the other. These units are held together by bolts 13 which are threaded into a breechblock 14. Each unit includes the movement assembly of FIG. 4 and the delay arming assembly of FIGS. 5 and 5A, the movement assembly resting upon the delay arming assembly.

The timing mechanism of the movement assembly

(FIG. 4) operates in a manner similar to a mechanical clock, utilizing a mainspring 15 to provide the driving energy for a gear train 16 and an escapement geared thereto.

In its static condition, the escapement lever 17 which controls the speed of the escapement wheel shaft 18 is locked by two spring loaded detents 19 and 20 which engage the ends of the escapement lever until sufficient rotational velocity is attained to release the detents. The running speed of the gear train 16 is controlled by the oscillating motion of the escapement lever which alternately locks and unlocks the escapement wheel.

The mainspring 15 is attached to a shaft 36 at the slowest moving part of the gear train 16. Also attached to this shaft is a timing disk 21 which rotates with the movement when it is running, but by means of a Belleville spring clutch 22 can be rotated for setting the fuze. Immediately below the timing disk and fixed to the shaft is a safety disk 23 which (1) prevents functioning of the firing pin release mechanism should the fuze be set for too short a time, and (2) prevents premature operation in case the timing disk slips on the shaft. As shown more clearly in FIG. 12, the safety disk 23 has an extension 77 which bears a pair of setting marks 78 and extends to the perimeter of the timing disk 21. FIG. 12 shows the zero setting of the timing disk. At zero and for other short time settings, the extension 77 functions to exclude the upright 24 from the timing notch 26.

As the movement runs, the upright 24 on a firing arm 25 rides along the edge of the rotating timing disk 21. When the notch 26 in the timing disk rotates around to the firing arm upright 24, this upright is moved into the firing notch 26 by a spring 27. At the same time, a D shaft section 28 of the firing arm 25 is rotated to release a safety plate 29 and permit actuation of a firing pin 31 by a spring 30. This actuation of the firing pin is effected by the spring 31 which wedges a collar 79 against the safety plate 29 and rotates it away from the firing pin.

The gear train and escapement of the delay arming mechanism are identical with that described above. The rest of the delay arming mechanism is shown in FIGS. 5 and 5A. It includes two centrifugal drive gears 32 and 33 assisted by two helical torsion springs 34 and 35 to drive the slowest speed shaft 36 of the timing mechanism previously described.

The two centrifugal drive gears are driven by the centrifugal force generated by rotation of the shell at a speed which is controlled by the gear train. Attached to the gear 33 is a pin 37 which engages a pin 38 in a D shaft 39 that locks a rotor 40 in its unarmed position. The rotor 40 is pivoted on a shaft 41, supports a primer 42, and is designed so that centrifugal force acting on the rotor assisted by a helical torsion spring 43 tends to drive the rotor from its illustrated unarmed position to its armed position. The spring 43 thereafter maintains the rotor in its armed position with the primer 42 alined with the firing pin 31 (FIG. 4).

When the centrifugal drive gear 33 bearing the pin 37 moves outward to a point where the pin 38 in the D shaft 39 is no longer locked by the pin 37, the shaft 39 is rotated by a spring 44 releasing an arm 45 (FIG. 5A) on the rotor 40 and permitting the rotor to be snapped to its armed position by the spring 43. In a practical embodiment of the invention, the functioning time of the delay arming mechanism from the moment the escapement lever is unlocked to the movement of the rotor into the armed position is 8 seconds ±1 second.

The setting mechanism consists of two sub-assemblies, the dial assembly and the pinion and bushing assembly. The dial assembly (FIGS. 6 and 7) consists of a geared steel ring 46 which rotates when the fuze is set and sup-

ports the setting pin 47 (FIGS. 4 and 7) which engages a setting lug 48 on the timing disk 21 and rotates this disk to the desired time setting. The outer periphery of the dial or ring 46 is engraved from 10 seconds to 100 seconds at 1 second intervals. A safety line with "S" stamped above it indicates a point in the setting at which the fuze cannot function even if it is fired from the weapon. the zero line on the dial is used in "zero setting" the timing disk 21 during manufacture of the fuze and serves no other purpose. As above indicated, the safety disk 23 is fixed to the shaft 36, underlies the timing disk 21, and prevents functioning of the movement if it is set for a time less than 9 seconds.

The ring 46 supports components which (1) set the timing disk and (2) release it. The elements which perform these functions are the setting pin 47 and a hammer spring assembly 49. The free end of the pin protrudes below the inner surface of the ring and engages the forked upraised leaf 48 (FIG. 4) of the timing disk so as to move this disk when the ring 46 is rotated. The functioning time is determined by the angular distance between the firing arm upright 24 and the notch 26 in the timing disk.

Disengagement of the setting pin 47 from the upraised leaf 48 of the timing disk is effected by two small weights 50 and 51 on the hammer spring 49 which bend the leaf downward under the setback force incident to firing of the shell. When setback is over, the hammer spring 49 returns to its original position, the leaf 48 remains bent down, and the timing disk is disengaged from the setting pin.

The lower edge of the ring 46 has gear teeth 52 which mesh with a pinion 53 mounted in a bushing 54 (FIGS. 1 and 9). The pinion extends through the bushing and has at its outer end a hexagonal recess 55 which receives the end 56 of the setting tool shown in FIG. 10. This tool is a ratchet-type fuze setter. The three fuze units are set individually by turning the setting knobs in a counterclockwise direction. The purpose of the ratchet is to prevent turning the ring in the wrong direction which would result in an "off-time."

Not previously mentioned in connection with FIG. 4 is a member 57 which is pivoted at 58 and biased by a spring (not shown) into locking engagement with the lowest speed shaft of the gear train 16. The member 57, together with the escapement levers of the mechanisms of FIGS. 4 and 5, is released by the centrifugal force generated upon rotation of the shell.

Prior to operation of the fuze, the timing disk 21 is adjusted about the shaft 36 to provide the desired time interval between arming and firing of the fuze as explained above. Assuming this adjustment to have been made and the fuze to have been fired from a gun, the setback force incident thereto forces the setting pin 47 into engagement with the leaf 48 of the timing disk 21 thereby preventing rotation of this disk. When rotation of the fuze has attained a predetermined value, the resulting centrifugal force functions to (1) actuate the member 57 to unlock the mainspring shaft 36, (2) actuate the centrifugal gears 32 and 33 to allow movement of the stab primer 42 into alinement with the firing pin 31. Thereafter the setback force produced by the firing of the fuze from the gun decreases to a value such that the setting pin 47 is disengaged from the timing disk 21 which begins to rotate. When the firing notch 26 engages the upright 24, the firing pin 31 is released as previously explained and the stab primer 42 is fired.

As previously indicated, each of the three delay arming assemblies illustrated in FIGS. 5 and 5A includes a stab primer 42 in a rotor 40 that remains out-of-line until a nominal 8 seconds after firing of the shell at which time the rotor snaps into the armed position, positioning the primer directly under the firing pin 31 (FIGS.

4 and 8). The upper and middle units each have an angular flash passageway 75 or 76 beneath the primer 42. These angular flash holes channel into straight-flash passageways 60 and 61 near the outer casing of the units. The lower unit has a straight flash passageway 62 directly beneath the primer 42. Since the flash from the upper and middle primers has to travel a relatively long distance before reaching the bottom of the fuze, an auxiliary black powder pellet 64 or 65 is placed at the bottom of the two long flash paths. When any of the primers is fired, the flash travels through the breechblock 14 and ignites a black powder charge in an igniter (see FIG. 11) which is fastened to the underside of the breechblock 14.

Each flash path terminates at an opening 66, 67 or 68 (FIG. 3) and is made moisture tight during the fuze assembly. This is accomplished by cementing a polyethylene disk 69, 70 or 71 on the top of each flash hole, by compressing polyethylene washers 72, 73 or 74 around the flash holes in each of the units, and by sealing the threads of the black powder pellet screw assemblies with cement. These pellet screw assemblies are moisture proofed by cementing a polyethylene disk at each end of the black powder charge.

We claim:

In a fuze adapted to be set into rotation upon being fired from a rifle, the combination of

a timing assembly including a clock mechanism having a mainspring shaft,

locking means operated by a centrifugal force incident to the spin of said fuze for releasing said shaft for rotation,

a timing disk rotatable by said shaft and having a firing notch,

a frictional coupling between said shaft and said timing disk for adjusting said timing disk to establish different timing periods,

means including a safety disk fixed to said shaft and having an extension for limiting the setting of said timing periods above a predetermined minimum,

a firing arm having at one end a D-shaped section and at the other end of an off-center extension biased against the edge of said timing disk and adapted to enter said notch,

a safety plate pivoted to engage the rounded part of said D-shaped section,

a firing pin,

means biasing said firing pin against said safety plate, said firing pin being releasable from said safety plate upon entrance of said off-center extension into said firing notch and the rotation of said rounded part of said D-shaped section away from said safety plate, and

means including a delay arming assembly geared to said shaft and operated under the control of said timing mechanism for inserting a primer into the path of said firing pin immediately prior to its release, said delay arming assembly including a rotatable member bearing a primer, means for maintaining said rotatable member in a position to displace said primer from the path of said firing pin, and a pair of centrifugal members geared to said shaft and rotatable to release said maintaining means for rotation of said primer into the path of said firing pin.

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