

May 15, 1945.

T. M. PERRY ET AL

2,376,080

MECHANICAL TIME FUSE FOR ORDNANCE EQUIPMENT

Filed July 1, 1943

2 Sheets-Sheet 1

Fig. 1.

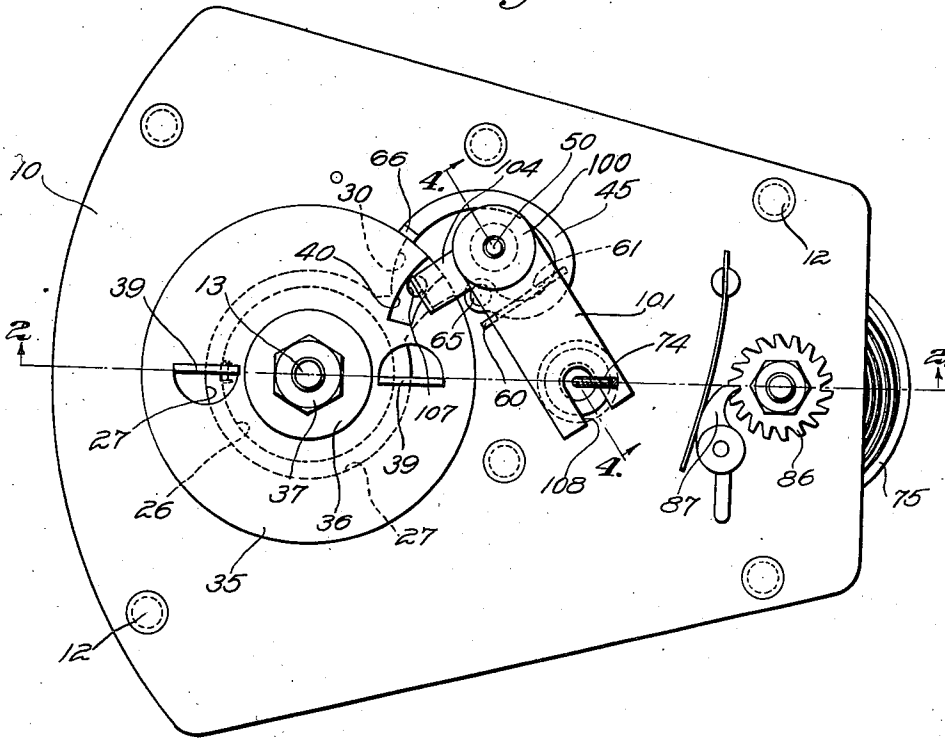
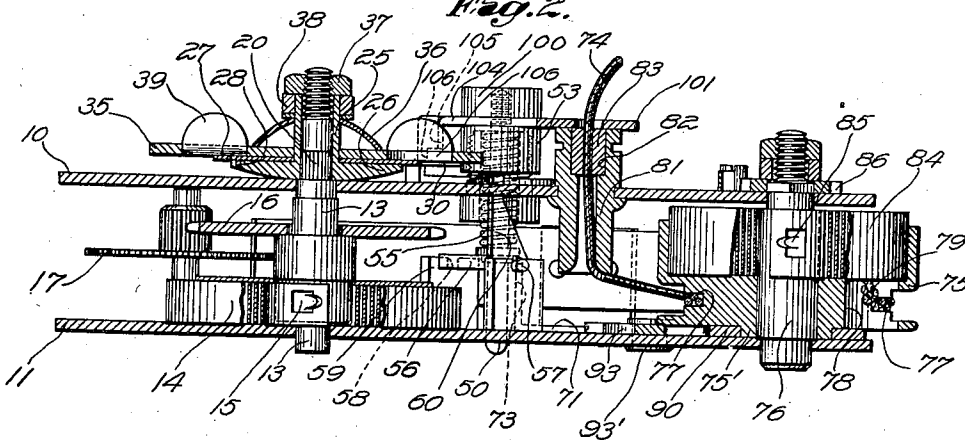


Fig. 2.



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2 Sheets-Sheet 2

Fig. 3.

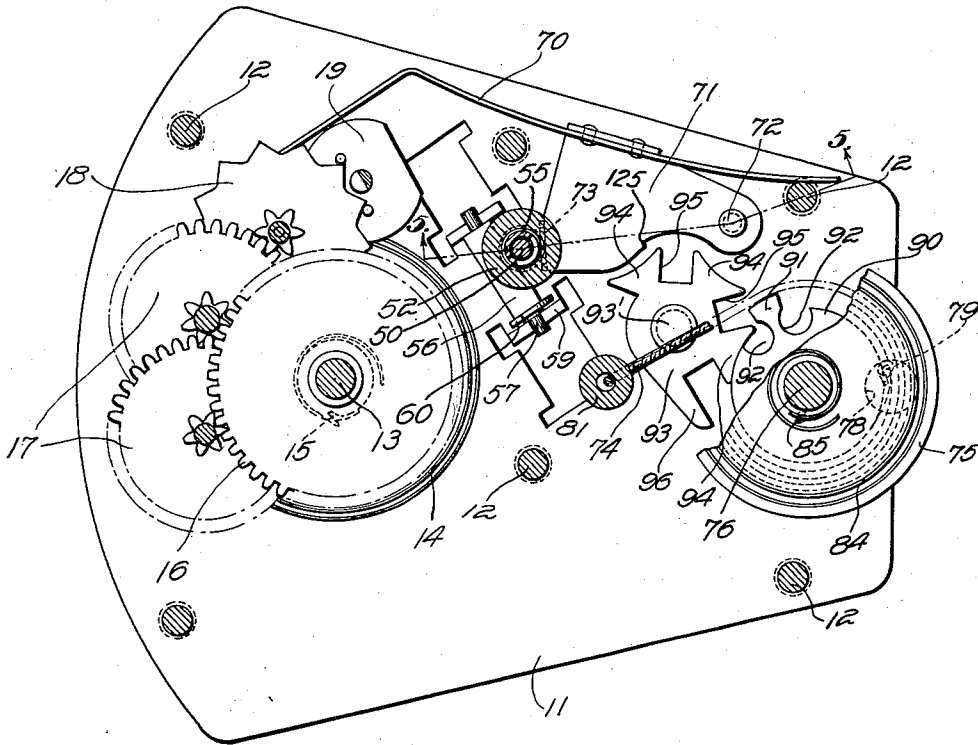


Fig. 4.

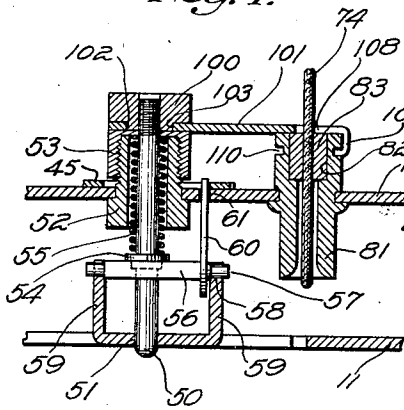
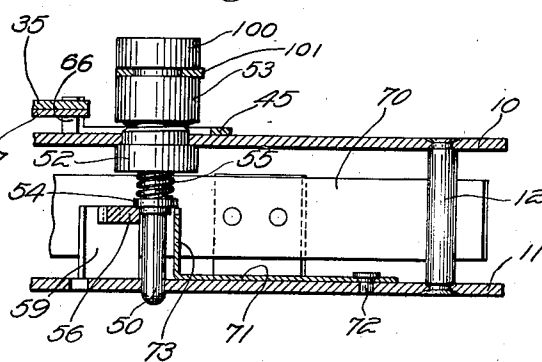


Fig. 5.



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UNITED STATES PATENT OFFICE

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MECHANICAL TIME FUSE FOR ORDNANCE
EQUIPMENT

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corporation of Connecticut

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6 Claims. (Cl. 102-84)

This invention relates generally to mechanical time fuses for ordnance equipment. In the present illustrative disclosure, our improvements are shown for illustrative purposes as embodied in a mechanism having a firing device, time operation of which is controlled by a timing device which is released or armed by pulling out a length of strand or cord. A mechanism constructed in accordance with the present invention has various applications but, as an instance of a use to which it may be applied, reference may be had to the firing of parachute flares and the like.

An object of the invention is to provide an improved time-controlled firing mechanism which is safe to handle and transport.

A further aim of the invention is to provide an improved time-controlled firing mechanism with arming means which are so constructed and arranged that accidental arming or release of the timing device is guarded against during handling and, in operation, it is necessary to draw out a relatively long length of strand or cord so as to insure that arming of the mechanism will not take place accidentally.

A still further aim of the invention is to provide an improved arrangement of this sort with disposable safety means which positively locks the timing device, the firing pin, and the arming means against operation until such time as it is desired to employ the mechanism for the purpose for which it is designed.

A further aim of the invention is to provide a mechanism of this sort which is characterized by its simplicity in construction, its economy in manufacture, and its effectiveness in operation.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

Referring to the drawings, wherein is shown, for illustrative purposes, one of the embodiments which the present invention may take:

Figure 1 is a top plan view of our improved time-controlled firing mechanism;

Fig. 2 is a longitudinal sectional view thereof, the same being taken on line 2-2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a view similar to Fig. 1 but with the top plate and the parts thereabove removed;

Fig. 4 is a detailed view through the firing device and the disposable safety lock, this view be-

ing taken substantially on line 4-4 of Fig. 1 looking in the direction of the arrows; and

Fig. 5 is a sectional view taken substantially on line 5-5 of Fig. 3.

Referring to the drawings in detail, the mechanism has a frame which comprises two spaced plates 10 and 11 secured together by suitable pillars 12. Carried by these plates is a timing device which, for purposes of exemplification, is shown in the drawings as comprising a clock mechanism provided with an arbor 13 journaled in bearings provided in the plates 10 and 11. The timing device has a coiled driving spring 14, the inner end of which is anchored to the arbor 13 as at 15, and the outer end of which is suitably connected to the bottom plate 11, the connection not being shown. Fixed to the arbor is a gear 16 which drives, through a pinion and gear train 17, an escapement wheel 18. Cooperating with this escapement wheel is a pallet wheel 19 which, in the present instance, is shown as being of the well-known type having a disk provided with two pins. Driven onto the knurled portion 20 of the arbor, and located above the upper plate 10, is a collar 25 having on its lower end a radially extending circular flange 26. Positioned on this flange is a safety disk 27 having a depending lug 28 engaged in a notch in the flange 26 whereby this safety disk is fixed against rotation relative to the arbor 13. This safety disk has a radially extending lobe 30, the outer edge of which is of like radius to, and concentric with, the periphery of a timing disk 35 positioned upon the safety disk. This timing disk 35 is angularly adjustable relative to the collar 25 in order to set the time interval between the arming of the device and the release of the firing pin 50, but it is rotatable with the arbor and collar 25 when the arbor is driven by the spring 14 after arming. To these ends, the timing disk is urged into frictional engagement with the safety disk by a crowned resilient spring 36 surrounding the collar 25. On the upper threaded end of the arbor 13 is a nut 37 between which and the spring is interposed a washer 38. By adjusting the nut, the pressure with which the spring urges the timing disk against the safety disk may be varied as desired. Struck up from the timing disk are two ears 39 by means of which the timing disk may be adjusted. The numeral 40 designates a curved slot leading from the edge of the timing disk, and which slot, as hereinafter described more in detail, is adapted to receive the end of a trigger 45 when the slot moves into registry therewith after a predetermined time, depending

on the setting of the timing disk, has elapsed. A purpose of the safety disk 27 is to prevent the trigger 45 from operating before the arbor has rotated through a sufficient angle to insure that the fuse cannot set off the flare before the parachute, for example, has time to fall a safe distance from the airplane. A further purpose of the safety disk is that, should other safety means fail in case of accident or damage to the device, the interlock between the safety piece 101 and the safety disk would prevent operation of the firing mechanism.

Referring now to the firing device, the same includes a firing pin 50, the lower end of which slidably extends through an opening 51 in the bottom plate 11. The upper end of the firing pin extends through a bushing 52 and a cap 53 screwed over the top of the bushing. Encircling the firing pin and interposed between a shoulder 54 thereon and the cap 53 is a coiled spring 55 which, when the firing pin is released from its cocked position shown in Fig. 4, will drive the firing pin downwardly against a primer which is not shown as the construction thereof is immaterial. The firing pin is held in the cocked position shown in Fig. 4 by a sear or detent 56 which is in the form of a bar of rectangular cross section, as shown most clearly in Fig. 5. The bar has at its opposite ends trunnions 57 which are journaled in notches 58 on the upper edges of two parallel lugs 59 struck up from the bottom plate. This sear has, fixed adjacent one end thereof, an upstanding arm 60 the upper end of which extends through a slot 61 in the upper plate 19.

The upper end of this arm cooperates with the trigger 45 in such manner that the trigger will hold the arm in the upright position and the sear in the firing pin holding position shown in the drawings until the slot 40 of the timing plate registers with the free end of the trigger. The trigger is pivoted to the top plate, as at 65, and at its free end has an upstanding lug 66 adapted to bear against the perimeter of the timing disk and to move into the slot 40 when the slot comes into registry with the lug.

Referring now to the arming means, 70 designates a detent in the form of a leaf spring, the free end of which is adapted to engage the teeth of the escapement wheel 18 of the timing device so as to hold the gear train 17 stationary. The spring, adjacent its other end, bears against one of the pillars 12, and connected to the spring between its ends is a safety plate 71 pivoted on top of the bottom plate 11 as at 72. This plate has at one corner an upstanding ear 73, the curved upper edge of which lies below, and in the path of movement of, the shoulder 54 of the firing pin. Due to the resiliency of the detent 70 and the manner in which it is mounted, the free end of the detent is normally urged into engagement with the escapement wheel 18, and the safety plate is urged into the safety position shown in the drawings. The safety plate is for the purpose of preventing the firing pin from moving to fired position in the event that the sear 56 should be accidentally released or broken as might be the case if the mechanism were inadvertently dropped. The detent 70 is moved away from the escapement wheel 18 to arm the timing device, and the safety plate is moved out of safety position by means of a strand or cord 74 which acts through a suitable connection which, in the present instance, is shown by way of exemplification as comprising a Maltese or Geneva

gearing. The cord is wound about a drum or housing 75 journaled between the plates 10 and 11 on an arbor 76. This drum has a groove 77 for accommodating the convolutions of the cord. The inner end of the cord is connected to the drum in such manner that when the cord is entirely pulled out, the cord will come loose from the drum. To this end, the drum has a vertical bore 78 which intersects the groove 77, and on the inner end of the cord is a knot 79 adapted to engage in this bore. The cord passes from the drum up through a tubular guide 81 secured to the top plate 10. The upper end of the opening through this guide is enlarged or counter-bored as at 82 so as to provide a seat for a cylindrical sleeve or stop 83 fixed to a cord adjacent the free end thereof. This sleeve may be of lead or similar material and may be compressed about the cord so as to anchor it thereto.

The drum or housing 75 is normally urged in a direction to wind the cord thereon by a coiled spring 84 located within the drum. The inner end of this spring is anchored to the arbor 76 as at 85, and the outer convolution of the spring is in frictional engagement with the internal periphery of the drum. To wind up the spring, the arbor 76 is turned (clockwise with reference to Fig. 3) while the drum is held stationary. Retrograde rotation of the arbor is prevented by a ratchet wheel 86 fixed to the arbor 76 and a spring pressed pawl 87 pivoted to the top plate 10.

The spring is wound up at the factory until it slips with respect to the drum. In operation, when the apparatus is dropped from an airplane, for example, the upper end of the cord being connected to the airplane, the cord will be unwound from the drum causing the drum to rotate. Rotation of the drum causes actuation of the operative connection between the drum and the detent 70 to release the latter from the escapement wheel 18 and thus arm the mechanism. As stated, this connection, in the present instance, is shown as being in the form of a Maltese or Geneva gearing acting through the safety plate 71. The driving gear 90 of this gearing is fixed to the bottom of the housing 75 by driving the gear onto a hub 75' on the lower end thereof. The driving gear has a single tooth 91 with a notch 92 at each side thereof. The driven gear 93 is journaled on a stud 93' fixed to the bottom plate 11. The driven gear has three lobes 94 with rectangular slots 95 therebetween. The outer edges of the lobes 94 are concentric to the periphery of the gear 90, and the slots 95 are adapted to receive the tooth 91. The driven gear 93 has a finger 96 lying in the plane of the safety plate 71 and adapted to engage the opposing edge thereof to throw the safety plate out of safety position and the detent 70 out of engagement with the escapement wheel 18 when the cord has been substantially completely unwound from the drum. In the present instance, during the operation of unwinding the cord from the drum, the drum will make substantially three revolutions during which time the driven gear will be rotated substantially one-half of a revolution. When the cord 74 has been pulled free of the drum 75, the finger 96 on the driven gear 93 is engaged with the tooth 125 provided on the safety plate 71 and, therefore, the spring 84 cannot rotate the gear 93 in a direction which would permit the plate 71 to again disarm the device. Further, an examination of Fig. 3 will show that once the device is armed, a clockwise rotation of the driving gear would not result in a counter-

clockwise rotation of the driven gear as the driving gear would merely jam against the driven gear since there are no mating surfaces enabling the driving gear to drive the driven gear counterclockwise.

In order to render the mechanism safe during handling and transportation, the firing pin is positively locked or secured in cocked position by a disposable nut, and the timing disk and safety disk are positively secured in safety position and the cord or strand is positively prevented from being pulled out by a disposable lock or member which, in the present instance, is secured in place by the disposable nut. As will be seen most clearly from Figs. 4 and 5, the upper end of the firing pin extends through the cap 53 and is threaded so as to receive a disposable nut 100. This nut is adapted to bottom against the top of the cap 53, and when in place positively secures the firing pin against escape from its cocked position. Thus, it prevents accidental firing of the fuse in the event that the sear should become displaced and the safety plate 71 should be jarred from safety position, which happenings might take place in the event that the mechanisms were accidentally dropped, for example. The safety lock for the timing device and cord comprises a plate 101 adapted to be clamped against the top of the cap 53 by the disposable nut 100. From Fig. 4, it will be seen that the nut has a boss 102 adapted to be received by an opening 103 in the body portion of the plate 101. This plate has a laterally extending arm 104 projecting over the timing disk 35, and the free end of this arm is turned down as at 105 and has a lug 106 adapted to extend through the slot 40 of the timing disk 35 and into an aperture 107 in the lobe of the safety disk 27. The plate, at its other end, overlies the top of the cord guide 81 and the anchor member or sleeve 83, and it is slotted as at 108 so as to accommodate the protruding end of the cord. This end of the plate is bent downwardly and then backwardly so as to provide a hook 109 the free end of which takes into the circumferential groove 110 adjacent the top of the guide 81.

It will be seen from the foregoing description, taken in connection with the accompanying drawings, that when the disposable nut 100 and the lock plate 101 are secured in place, the various instrumentalities or devices of the mechanism are secured against operation. In no event can the firing pin be released; the lug 106 positively locks the timing device against operation with the two disks thereof in safety position, and the plate 101 prevents the cord from being pulled out since it locks the sleeve 83 in the counterbore in the upper end of the guide 81. Thus the mechanism is rendered safe in handling and transportation. When it is desired to put the mechanism into use at the field of operation, it is necessary to unscrew the nut 100 and lift off the safety plate 101 and dispose of them, and these operations may be very rapidly carried out. After the safety nut and lock plate have been removed and disposed of, the mechanism is still relatively safe to handle. The detent 70 prevents operation of the timing device, and the safety disk prevents operation of the trigger even after the timing disk has been adjusted in accordance with the desired time interval between the dropping of the device and the release of the firing pin. Furthermore, if, in handling, the cord should be only partially pulled out, the mechanism will not be armed. It will be ob-

served that, due to the length of the cord wound upon the drum and the extent to which the drum must be rotated before the mechanism is armed, a substantial portion of the cord may be pulled out with safety.

During the drawing out of the cord, the drum 75 will slip with respect to the wound up spring 84, and if the cord is then released, the spring will grip the drum and turn it in a direction to again wind the cord thereon.

In operation, after the safety nut and lock plate have been removed and disposed of, the timing plate 35 is adjusted by means of the wings or lugs 39 in accordance with the predetermined time interval which it is desired to have elapse between the arming of the mechanism and the release of the firing pin.

In the event that the mechanism is used for controlling the firing of a parachute flare dropped from an airplane, the free end of the cord 74 may be secured to the under side of the plane. Then, when the parachute flare and the timing mechanism are dropped, the weight thereof will cause the cord to unwind from the drum, and when the cord has been completely unwound, the knot 79 at the end thereof will be pulled out of the bore or opening

78, thus freeing the cord from the drum. During such unwinding of the cord from the drum, the drum will make substantially three revolutions so as to operate the driven gear 94 in a series

of steps and thus bring the finger 96 of this driven gear against the edge of the safety plate 71, whereupon the safety plate 71 is moved out of safety position and the detent 70 is released from the escapement wheel.

It will be observed that, with this arrangement, the cord 74 is of substantial length and, therefore, the timing device is not armed until the mechanism has dropped a substantial distance away from the plane. When the detent is withdrawn from the escapement

wheel 13, the timing device is free to operate causing rotation of the arbor 13 and withdrawal of the lobe 30 of the safety disk from the path of movement of the free end of the trigger 45.

When the timing disk 35 has been rotated by the spring 14 to a position where the slot 40 therein registers with the free end of the trigger, the trigger is free to pivot (counterclockwise, in Fig. 1) and thus release the sear 56.

When the sear is released, the firing pin spring 55 will move the firing pin downwardly with a sharp movement resulting in firing of the primer of the flare (not shown).

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim as our invention:

1. In a time-controlled firing mechanism, a firing device having a firing pin; a spring operated timing device for controlling the release of said firing pin; means for arming said timing device comprising a member normally holding the same against operation, a drum, an operative connection between the drum and said member

for releasing the member from the timing device

to arm the latter when the drum has been rotated to a predetermined extent, and a cord detachably connected to and wound about said drum and adapted to rotate the same when the cord is pulled out; and disposable safety means for locking said firing pin against operation and for preventing said cord from being pulled out.

2. In a time-controlled firing mechanism, a firing device having a spring operated firing pin; a timing device for controlling the release of said pin; arming means for the timing device comprising an operating cord adapted to be pulled out and a member secured to the cord adjacent its free end; a disposable safety nut screwed onto said pin for positively locking the same in cocked position, and a disposable safety plate secured in position by said nut and cooperating with said member for preventing operation of the cord.

3. In a time-controlled firing mechanism, a firing device having a firing pin; a timing device for controlling the release of said firing pin and having a safety disk with an aperture and an adjustable timing disk provided with a slot; arming means for the timing device having a detent engageable therewith, a rotatable drum, an operative connection between the drum and detent, a cord wound about the drum, a guide through which the cord passes, and a member secured to the cord and adapted to seat within said guide, said guide having adjacent said seat a circumferential groove; a disposable safety nut screwed onto said firing pin for positively locking the same in cocked position, and a disposable lock plate secured in position by said nut and having a lug engaged in the aperture of said safety disk and the slot of said timing disk for preventing rotation thereof, said lock plate further having a hooked end overlying said guide and member seated therein and engaging in said groove.

4. In a time-controlled firing mechanism, a firing device; a timing device for controlling the release of said firing device; and means for arm-

ing said timing device and including a detent engageable therewith, a drum, an operative connection between said drum and detent for disengaging the detent from the timing device after the drum has been rotated a plurality of revolutions, a pull cord of substantial length wound about said drum for rotating the same when the cord is pulled out, and a coiled spring within said drum tending to rotate the same in a direction to wind the cord thereon, said spring being anchored at its inner end and having its outer convolution in frictional engagement with said drum.

5. In a time-controlled firing mechanism, a firing device; a timing device for controlling the release of said firing device; and means for arming said timing device including a detent engageable therewith, a rotatable drum, an operative connection between said drum and detent and including a Maltese gearing having a one-toothed driving gear fixed to the drum and a driven gear, a pull cord of substantial length wound about said drum, and a spring associated with said drum normally tending to rotate the same in a direction to wind the cord thereon.

6. In a time-controlled firing mechanism, a firing device having a spring pressed firing pin provided with a shoulder, a timing device for controlling the release of said firing pin, a pivoted safety plate having a portion normally lying in the path of movement of said shoulder, a spring detent connected to said plate and adapted to engage said timing device, a rotatable drum, a Maltese gearing having a driving gear fixed to said drum and a driven gear provided with a finger adapted to engage the edge of said safety plate to move said plate out of safety position and release said detent from said timing device, a pull cord wound about said drum, and a spring normally tending to rotate said drum in a direction to wind up the cord thereon.

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