

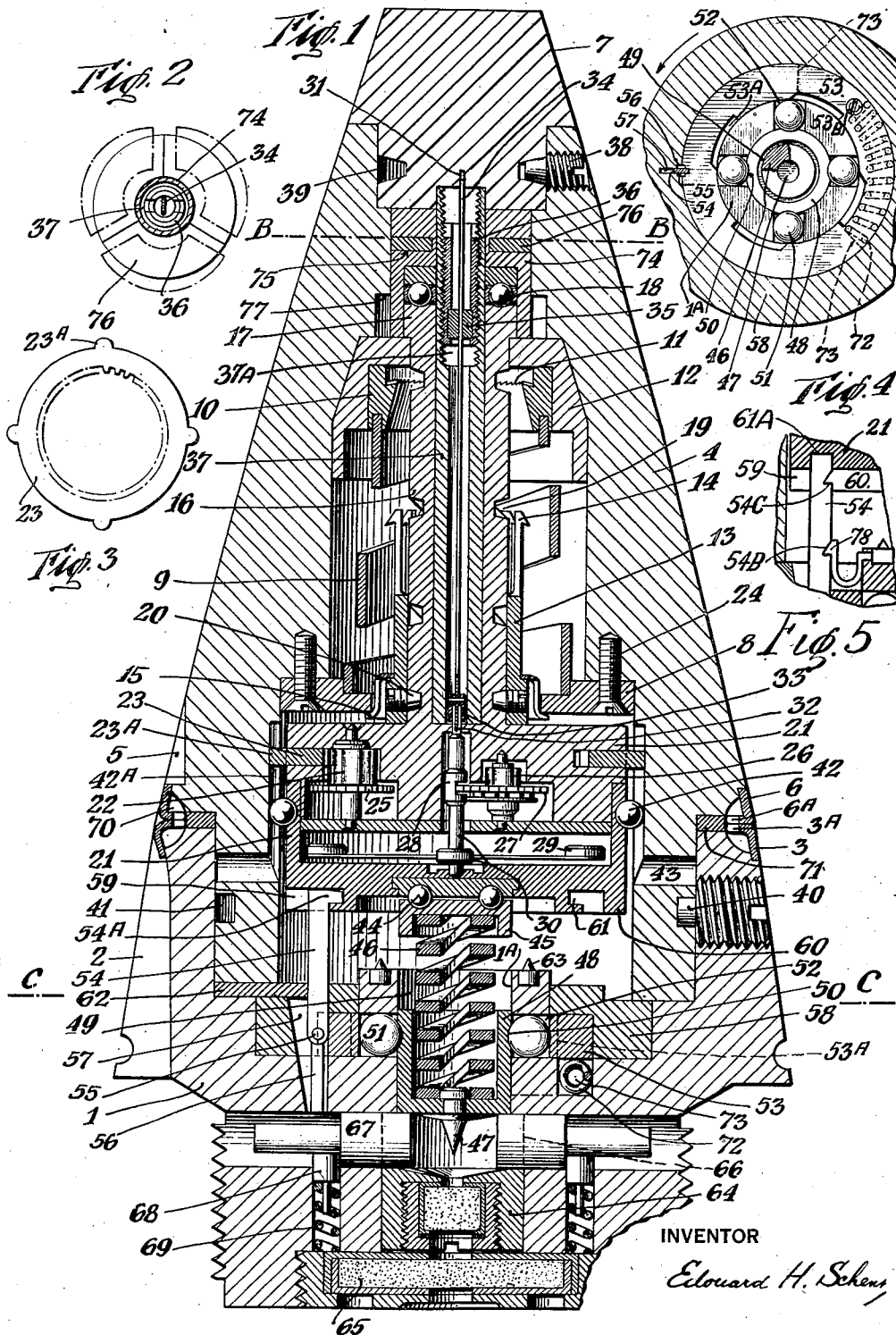
March 7, 1939.

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2,149,470

MECHANICAL TIME FUSE

Filed Sept. 25, 1935



UNITED STATES PATENT OFFICE

2,149,470

MECHANICAL TIME FUSE

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Application September 25, 1935, Serial No. 41,990

9 Claims. (Cl. 102—36)

This invention relates to a mechanical time fuse for artillery projectiles, and more especially to a mechanical time fuse of the type in which the hollow body of the fuse is formed by a fixed base and an adjustable setting cap and in which a rotary timing member, controlling the release of a trigger and hammer mechanism, is set in angular position before the fire by means of the setting cap and is driven during the flight of the projectile in opposite direction by a spring motor at a speed governed by means of a clock mechanism.

In fuses of this type, the rotary timing member is usually a very light and frail disc, ring or arm, which may be easily unset, deformed or broken by the shock of discharge of the gun and considerable difficulties are encountered in practice to couple this member to the setting cap so that no unsetting of the fuse may occur during the firing operation.

Further one usually finds in these fuses a stop which limits the angular displacement of either the setting cap or the timing member and means to prevent the rotation of the setting cap in the wrong direction. All these organs are fragile and grave accidents may occur if one of them is broken during the setting operation or in the bore of the gun.

Moreover, in all known fuses of this type, as the clock mechanism of the fuse is housed in a casing fixed to the base, it is impossible to utilize for the moving parts of the fuse, all the free space inside the body.

The object of the present invention is to realize a mechanical time fuse of the type referred to which will obviate all these difficulties, which will be cheaper, lighter, smaller in diameter and better adapted to mass production than the known fuses of this type, which will have a lower center of gravity and a much better dynamic balance; in which there is a more rational utilization of the free space inside the body of the fuse, a much more powerful motor and a positive coupling between the base and the setting cap directly after the setting operation and between the setting cap and the timing member before and during firing; which will be perfectly safe in handling and in the bore and stable in storage and which can be set either way from 0.5 to 100 seconds.

The main feature of my invention through which this object is attained is the use of a compound organ—that I will hereinafter designate throughout the description and the claims as the "rotor", for lack of a better term—housing the clock mechanism of the fuse and acting as timing

organ, as mainshaft, as eccentric organ of transmission between the motor and said clock mechanism and as means to control the release of the trigger mechanism of the fuse.

Other features of my invention are the provision of means for coupling positively the setting cap to the base, not upon the firing—as it is done in all known fuses of this type—but already at the end of the setting operation of the fuse, for holding the rotor positively coupled respectively to the setting cap before firing and to the base during the positive acceleration of the projectile; for absorbing the shock of discharge of the gun, for arming both the mainspring and the percussion spring by inertia at the time of the firing; for protecting and adjusting the hairspring of the clock mechanism; for journaling the rotor in the axis of the fuse so that the friction be reduced to a minimum and the provision of an auxiliary locking device for the trigger mechanism of the fuse, which permits to set the fuse in either direction and to do away altogether with the usual stops limiting the angular displacement of the setting cap.

With the foregoing and other objects in view which will appear as the description proceeds, my invention consists in the novel use in a mechanical fuse of a rotor housing the clock mechanism of the fuse and acting as the timing member and the mainshaft of the fuse, as an eccentric organ of transmission between the motor of the fuse and the train of said clock mechanism during the flight of the projectile and as the actual means controlling the release of the trigger mechanism of the fuse at the time set for the burst of the projectile, as well as in the novel arrangement and combination of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

For convenience of illustration and explanation, I have shown my present invention as applied to a mechanical fuse having a spring motor and a timing and release mechanism of essentially the type and character of that disclosed in my pending applications for Letters Patent of the United States Nos. 38,012 filed on August 27, 1935, and 38,013 filed on the same day, although without intending thereby to indicate any limitation of the invention thereto.

As an example of application of my invention I

have shown in the accompanying drawing a combination fuse embodying said invention.

In said drawing:

Figure 1 is an axial section of said combination fuse, showing the moving parts of the fuse in their normal position of rest;

Figure 2 is a transversal section made on line B-B of Figure 1;

Figure 3 is an elevation, showing a detached part of this fuse at a reduced scale;

Figure 4 is a transversal section made on line C-C of Figure 1 and shown also at a reduced scale, and

Figure 5 shows a modification of the auxiliary locking device.

In this drawing, 1 represents the base of the fuse; 2 the usual setting slot for engagement with a corresponding pawl and lug of the setter and 3 the usual scale graduated in seconds and located on the upper edge of said base.

According to one feature of my invention, instead of being marked directly on said edge, this scale is marked on a steel band fastened on this upper edge by any suitable means, for instance by having a portion of this band clamped (as shown Figure 1) in the setting slot 2 and provided with an inside projecting rim or flange 3A, cut so as to form a circular series of sharp steel points, converging toward the center of the fuse.

4 indicates the setting cap, or brass cap, which is rotatably mounted into the base 1 and held against axial displacement in relation to said base by means of three set screws or shoulder screws 40, working in a circular groove 41. This setting cap is likewise provided with the usual setting slot 5 and with a steel band 6 fastened on its lower edge and on which is marked the usual index (not shown). This band is flush with the graduated band 3 and is provided, as this latter, with an inner projecting flange 6A, cut so as to form a circular series of sharp steel points. Behind the bands 3 and 6 is cut, half in the setting cap 4 and half in the base 1, an annular groove 70, while a ring or washer 71 of soft metal, for instance of lead, is loosely mounted between said cap 4 and base 1, opposite the steel points 3A and 6A.

These parts 3, 3A, 6, 6A and 71 cooperate at the time of the setting of the fuse to couple positively the setting cap 4 to the base 1 as soon as this setting is performed and that, while the projectile is still in the setter. This is preferably accomplished automatically by means of a pair of diametrically opposed eccentrics, wedges or cams forming parts of the release mechanism of the setter, which crush the bands 3, 6 in two diametrically opposed places so that some of the steel points 3A, 6A are permanently empaied in the lead washer 71.

7 shows the nose cap of the fuse which may be set in angular position and clamped in this position in the eye of the setting cap 4 by means of a set screw 38, provided with a conical end which acts as a wedge in a circular groove 39. Thus assembled, the base 1, setting cap 4 and nose cap 7 form the hollow body of the fuse.

An annular plate 8 is fastened internally to the setting cap 4 by means of screws 24. This plate supports a compression flat volute spring 9, the lower coil of which is secured in a circular recess of said plate, while its upper coil is fixed in an opposite circular recess provided in a ratchet ring 10, having radial ratchet teeth 11.

12 indicates a mass or weight which is used to compress the mainspring 9 by its setback upon

the firing of the projectile. This weight is freely mounted in the setting cap between the ratchet ring 10, upon which it rests, and a shoulder of the setting cap.

13 represents a sleeve, the top part of which is split so as to form a circular series of resilient hooks 14. The lower part of this sleeve carries a washer provided with four springs or flaps 15, which are normally engaged under the inner edge of the plate 8 so as to prevent the accidental sliding of the ring 13 along a shaft 16, arranged in the axis of the fuse and constituting the mainshaft thereof.

This driving shaft is provided with a head 17, forming the lower race of a ball thrust bearing 18, held in place by means of a cylindrical casing 74, freely mounted in the eye of the setting cap 4 between the nose cap 7 and the weight 12.

Two helical grooves 19 with progressive pitch are symmetrically cut into the periphery of the mainshaft 16. 20 indicates a pair of spurs screwed into the reinforced base of the sleeve 13 and provided each with a conical end which is permanently engaged into one of the grooves 19.

The mainshaft 16 is made in one piece with the cover or top of a cylindrical casing 21, which constitutes the rotor defined in the statement of invention at the beginning of the present specification. All the moving parts of the clock mechanism of the fuse, that is, the train, the escape mechanism, the balance and the hairspring are lodged inside this rotor.

22 and 25 are, respectively, the first pinion and the first wheel of this train, while 26 indicates the last pinion thereof and 27 the escape wheel, which cooperates with a cylinder 28, fastened on the spindle 30 of the balance 29 of the fuse. The top end 32 of this spindle carries a staff 33 to which is secured the lower end of the hairspring 34 of the fuse. This latter is of the straight or torsion type used in the galvanometers and is held straight by a steel tube 37, while its upper end is engaged in a narrow slot 31 provided in the nose cap 7 so as to be prevented from turning before the fire but free to expand axially by dilatation.

The inner cylindrical surface of the steel tube 37 is very smooth so as to reduce the friction to a minimum. The upper staff 35 of the hairspring is loosely mounted in a cylindrical groove provided in the inner periphery of a split set grub screw 36, which may be adjusted along the inner threaded part 37A of the steel tube 37 so as to adjust the operative length of the hairspring.

The planetary pinion 22 is in constant mesh with an annular gear 23, freely mounted in the rotor 21 but coupled to the setting cap 4 by means of four semi-circular ears 23A (Figure 3), working in four corresponding longitudinal keyways 42A provided in the inside periphery of the setting cap 4. The cylindrical rotor 21 is slidably mounted in a corresponding bore of the setting cap 4, but is normally coupled to said cap by means of four balls 42, lodged partly in four corresponding spherical sockets provided in the outside periphery of the rotor 21 and partly in the four longitudinal keyways 42A, provided in the inside periphery of the setting cap 4. Four radial escape holes 43 are cut through the wall of said cap at the lower end of said keyways to allow for the escape of these coupling balls 42 under the action of the centrifugal force when the rotor 21 sets back by inertia as will be now more fully described.

The cylindrical rotor 21 is journaled in the axis of the fuse inside the cap 4 on two ball thrust bearings: the upper bearing 18, already mentioned, and a lower one 44, the lower race of which 45 leans upon the percussion spring 46 so as to act as a shock absorber during the acceleration. Upon the firing of the projectile, the rotor 21 sets back by inertia until this lower race 45 meets the upper edge of a cylindrical guide 48, carrying a firing pin 47, while the bottom of the rotor 21 is empaed on four steel points 63, carried by a cylindrical inner projection 1A of the base 1.

The coupling balls 42 are thus brought opposite the radial holes 43 and are then free to escape under the action of the centrifugal force developed by the spin of the projectile, thus uncoupling the rotor 21 from the setting cap 4 at the beginning of the positive acceleration of the projectile, but this rotor 21 is then momentarily coupled to the base 1 and thus prevented from turning, until the end of this positive acceleration, by the steel points 63.

The weight 12 sets back simultaneously with the rotor 21 during this acceleration, thus compressing the mainspring 9, while the casing 21, by its setback compresses the percussion spring 46.

The casing 74 of the ball bearing 18 is provided with a peripheric groove 75, in which are lodged three centrifugal segments 76 (Figure 2), which expand under the action of the centrifugal force as soon as—near the end of the setback of the casing 74—this groove registers with a shoulder 77, provided in the setting cap 4.

49 indicates a cylindrical bore cut in the cylindrical projection 1A of the base 1 in the axis thereof, along which the firing pin 47 is guided by means of its cylindrical carrier 48. This latter is provided with four spherical sockets 50, which cooperate with four locking balls 51, lodged in four radial holes 52, cut through the cylindrical projection 1A of the base 1, carrying the steel points 63. These locking balls 51 are normally held engaged in the sockets 50 by the inside periphery of a release ring 53, provided with four circular release notches 53A, (Figure 4). This ring 53 is rotatably mounted in a larger holding ring 58, which is secured to the base 1 by any suitable fastening means such as a screw or a key (not shown).

A circular groove 73 (Figure 4) is cut in the base 1 directly under the ring 53, while a screw 53B is screwed into said ring 53 and projects thereunder into said groove 73. A spring 72 is normally compressed in the groove 73 between one end of this groove and the projection of the screw 53B, thus tending to rotate the release ring 53 in the direction of the arrow shown in Figure 4, but this ring is normally prevented from turning either way by means of a bar 54, freely mounted in a slot 57, cut part in the base 1, part in the holding ring 58 and part in the release ring 53. The lower end of this bar is guided in a longitudinal keyway 56, cut parallel to the axis of the fuse also part in the base 1, part in the holding ring 58 and part in the release ring 53, by means of a fulcrum or trunnion 55, projecting on both sides of the bar 54, while the upper end of this bar is provided with a lateral projection 54A, which is engaged in a circular path or groove 61, formed in the bottom of the rotor 21. The opposite side of this upper end of the bar 54 penetrates into a release notch 59, cut into an annular rim or projecting edge 60 of this bottom of the rotor 21, at the end of the trajectory of the projectile. Nor-

mally, i. e., until the fuse is set, the bar 54 is held in the position shown in Figure 1 by an inwardly projecting lug 62, secured to the lower edge of the setting cap 4, and constituting the auxiliary locking device defined in the statement of invention. This lug 62, the release notch 59, and the slot 57 have the same width and are slightly wider than the bar 54. This rim 60 constitutes at the same time the timing ring of the fuse and the main locking member or rotary organ controlling the release of the firing pin 47.

64 shows the primer-plunger of the fuse, which is slidably mounted in the cylindrical bore 66 of the base 1, while 65 indicates the usual detonator screwed into said base 1. The plunger 64 is normally held back against the detonator 65 in the usual way by means of two centrifugal bolts 67, kept themselves in operative position by means of two inertia pins 68, submitted to the action of springs 69. This plunger is still held back during the flight of the projectile, i. e., after having been released by the disappearance of the bolts 67 under the action of the centrifugal force, so as to be prevented from creeping towards the firing pin 47, by any suitable known means (not shown) such as a creep spring or a shear-pin.

The operation of the fuse is as follows:

Normally, i. e., before the setting, the movable parts of the fuse are in the position shown in the drawing. In this position the fuse is perfectly safe in handling as the release bar 54 is positively locked by the auxiliary locking member or lug 62, while the primer-plunger 64 is immobilized by the bolts 67. The fuse is also perfectly stable in storage as the mainspring 9 and the percussion spring 46 are then uncompressed.

When the fuse is set, the setting cap 4 and the rotor 21, positively coupled to this cap by the coupling balls 42, are solidarily rotated to the desired angular position, in accordance with the fuse range data, by the fuse setter pawls engaging the slots 2 and 5 of, respectively, the base 1 and the cap 4.

During the setting operation the head 54A of the release lever 54 slides in the groove 61, while this release bar 54 is held in its operative position by the inner periphery of the annular rim 60, which enters in action as soon as the lug 62 releases this bar. As soon as the setting is performed, a pair of diametrically opposed cams or eccentrics forming part of the release mechanism of the setter, squeeze or crush the bands 3 and 6 in two diametrically opposed places so that some of the steel points 3A and 6A are empaed in the lead washer 71. The setting cap 4 is thus positively coupled to the fixed base 1 as the band 3 is fastened to this latter, while the band 6 is fixed to the former and the release notch 59 is therefore immobilized in its set angular position, which determines the duration of the flight of the projectile.

Upon the firing of the projectile, the rotor 21 sets back by inertia against the action of the percussion spring 46 until the race 45, acting as a shock absorber, meets the top of the firing pin plunger 48, while the ears 23A of the internal gear 23 slide in the keyways 42A, the bottom of the rotor 21 is empaed on the steel points 63 and the coupling balls 42 escape in the radial hole 43 under the action of the centrifugal force developed by the spin of the projectile. The rotor 21 is thus simultaneously uncoupled from the setting cap 4 and coupled to the fixed base 1 by means of the steel points 63. During this axial movement of the rotor 21, the release bar 54 is 75

pushed back parallel to itself as its lower end is guided by the sliding of the fulcrum 55 in the keyway 56, while its upper end remains confined between the rim 60 and the groove 61, therefore preventing any accidental release of the release ring 53.

The rotor 21 is also followed in its setback by the casing 74, the weight 12 and the ratchet ring 10. These latter continue their own setbacks after that of the rotor has been stopped until the conical part of the ratchet ring 10 meets the heads of the hooks 14 and push them slightly towards the axis of the fuse until they snap above this conical part, but the former is stopped when its bottom empales on the steel points 63. In this back position, the centrifugal segments 76 expand under the action of the centrifugal force in the bore of larger diameter formed under the shoulder 77 (as shown in dotted lines Figure 2).

Simultaneously with the setback of the rotor 21, the percussion or impact device of the fuse is armed by the setback of the inertia pins 68 and the radial displacement of the bolts 67 under the action of the centrifugal force.

Near the end of the positive acceleration, the force of inertia acting, on one hand, upon the casing 74, the rotor 21 and the percussion spring 46, and, on the other hand, upon the weight 12, the ratchet ring 10 and the mainspring 9, is counterbalanced and immediately afterwards overcome by the energy stored in said springs 46 and 9 and the rotor 21 is, therefore thrust away from the steel points 63 until the segments 76 come to abut against the shoulder 77. As the hooks 14 are thus stopped while the mainspring 9 continues to push the ratchet ring 10 forward: first, a positive engagement is created between these hooks 14 and the teeth 11, thus preventing the sleeve 13 from turning, and, second, a straight force, parallel to the axis of the fuse and tending to pull this sleeve toward the nose of the fuse, is thus applied upon this sleeve.

Were it not for this engagement of the hooks 14 in the ratchet teeth 11, this sleeve 13 would then be spirally wound upon the mainshaft 16 under this pulling action of the mainspring 9, but as it is thereby prevented from turning, this straight pulling force is transformed by the spurs 20, engaged in the helical grooves 19, into a torque, under the action of which the rotor 21 starts to rotate upon itself on the ball thrust bearings 18 and 44. This rotation is facilitated by the fact that—save the friction of the keyways 42A against the ears 23A of the internal gear 23—there exists no friction between the mainshaft 16, together with the solidary rotor 21, and the hollow body of the fuse formed by the base 1 and the setting cap 4.

As the pitch or thread of the helical groove 19 is progressive, the increase in leverage thus obtained compensates for the diminishing pulling force of the mainspring 9 and the value of the torque applied on the mainshaft 16 remains practically constant during the whole flight of the projectile, in spite of the fact that the mainspring loses progressively its energy. During all of its forward movement under the pulling action of the mainspring, the ratchet ring 10 is guided along the bore of the setting cap by the periphery of the weight 12. The angular speed of the rotor thus driven by the main spring 9 is regulated by the action of the hairspring 34 cooperating with the balance 29 and the cylinder 28 to check the rotation of the escape wheel 27, to which is transmitted the motive force through the train 25, 26,

the planetary pinion 22 and the fixed internal gear 23.

The release notch 59 is thus brought back in its initial position opposite the release bar 54. As the lug 62 or auxiliary locking member does no more interfere with the release mechanism, the upper end of this bar is now free to rock about the fulcrum 55 in the slot 57 under the action of the centrifugal force and to enter into said notch 59. This frees the ring 53, which rotates under the action of the spring 72 in the direction of the arrow of Figure 4, thus releasing the locking balls 51, which then, under centrifugal action and considerable leverage or side pressure from the firing-pin plunger 48, enter into the circular notches 53A, thus releasing the firing-pin plunger 48 practically at the instant the upper end of the bar 54 enters into the release notch 59.

Driven by the percussion spring 46—in which has been stored the energy of the shock absorbed during the acceleration of the projectile,—the firing-pin 47 then strikes the primer 64, which detonates the detonator 65 and finally the bursting charge in the projectile.

If, during the flight of the projectile, the nose cap 7 meets an obstacle, or on impact on the ground, if the time mechanism of the fuse has not functioned before, the primer-plunger 66 is driven forward by the shock against the action of the creep spring—or after having sheared the shear-pin—and thus the firing-pin 47 is jammed into the primer composition, which also has for effect to detonate the detonator 65.

The adjustment of the operative length of the hairspring 34, which determines the amplitude of the oscillations of the balance wheel 29 and, therefore, governs the rate or speed of rotation of the rotor 21, is made when the manufacture of the fuse is completed, before mounting the nose cap 7 into the eye of the body 1, 4, by means of a special tool, which permits the screwing or unscrewing of the grub screw 36 in the threaded part 37A of the tube 37, while at the same time preventing the rotation of the upper end of the hairspring 34. Then the nose cap 7 is mounted on the setting cap 4 and this upper end of the hairspring 34 is coupled thereto by its engagement into the slot 31 thereof. It becomes thus possible to adjust the angular position of the hairspring and the relative angular position of the cylinder 28 with respect to the escape wheel 27—or to provide a preliminary torsion of the hairspring—by merely rotating the nose cap 7 and clamping it in the desired position by means of the set screw 38. The staff 35 is mounted in the split end of the screw 36 with enough friction to hold the upper end of the hairspring 34 in its adjusted position, even after this upper end has been separated from the nose cap 7 by the setback of the rotor 21 and also during the entire flight of the projectile, in spite of the alternative torsion given either way to the hairspring by the oscillations of the balance wheel.

Instead of utilizing for the auxiliary locking member the fact that the setting cap 4 is immobilized during the angular return movement of the rotor 21, after having accompanied this latter in its angular displacement during the setting of the fuse, one could utilize an organ, which will accompany the rotor in its axial setback, but will be axially immobilized at the end of the acceleration, while the rotor rebounds axially forward under the combined action of the springs 9 and 46.

An example of such a modification is shown in

Figure 5, in which this organ replacing the lug 62 as an auxiliary locking member is the release bar 54 itself. In this modification, the annular groove 61A is cut in the bottom of the rotor 21 above the rim 60 and the release notch 59. The upper end of the release bar 54 is normally engaged in said groove and is locked in this position by a spring 78, normally engaged in a lower notch 54B of the bar 54, so that the bar 54 acts then as a tie or stay to prop the rotor in its uppermost position. When this bar is pushed down by the setback of the rotor 21, this spring 78 snaps in an upper notch 54C at the end of the travel of the bar and locks this latter in its lowermost position. Thus, this bar cannot follow the rotor when it rebounds forward under the action of the springs 9 and 46 and, therefore, the upper end of the bar is kept behind the rim 60 outside the groove 61A at the level of the release notch 59 ready to rock under the action of the centrifugal force and of the spring 78 as soon as this notch registers with this upper end of the bar 54.

The main advantages of this fuse are as follows:

As the timing ring 60 is a solid part of the rotor 21, there is no risk that it may be deformed or broken by the shock of discharge of the gun.

The setting cap is positively coupled to the base before firing and the timing ring 60 is positively coupled to the setting cap before and during firing, thus avoiding all the defects and risks of the coupling devices of the known fuses of this type, which operate by inertia or centrifugal action only at the time of firing.

Due to the auxiliary locking device and the absence of stop or stops to limit the angular adjustment of the setting cap, this latter may be set either way, even of exactly 360 degrees with perfect safety.

Due to the suppression of the usual fixed casing for the clockwork, the size of the movement of the fuse may be made smaller in diameter, so as to be adaptable to a larger number of projectiles of different caliber or profile, without having to reduce the accuracy of the setting beyond the accepted limits. The weight of this movement is, therefore, considerably reduced. For instance, the weight of the movement of the fuse shown in the drawing will be about 80 gr., which compares with a corresponding weight of 200 gr. at least for the movement of most of the known mechanical fuses of this type.

There is a considerable reduction in the number of parts and the whole fuse has been carefully designed so as to be cheaper to manufacture and especially well adapted to mass production.

Due to the lowering of the center of gravity of the fuse, and to the action of the ball bearings 18, 44 and of the 4 locking balls 51, a much better dynamic balance exists than in the known mechanical fuses.

As the worst of the shock of discharge is absorbed by the percussion spring, it becomes possible to use more delicate—and therefore more efficient—governing means for the clockwork, for instance, it becomes possible to use a cylinder escapement.

Due to the lightness of the bar 54, there is very little friction on the movement of the fuse due to the release mechanism.

As the springs 9 and 46 are normally uncompressed, the fuse may be stored for very long periods without losing any part of its efficiency.

The adjustment of the operative length of the hairspring may be made on a much larger range than in any known mechanical fuses. It thus becomes possible to allow for liberal plays or variations in the weight or equilibrium of the balance masses.

The different parts of the movement are standard for all types of different duration of this fuse, except the balance, the hairspring, and the bands 3, 6. For instance, a 20 seconds type will be made of exactly the same parts than a 100 seconds type, save that the hairspring and the masses of the balance will be made much heavier.

What I claim and desire to secure by Letters Patent is:

1. In a clockwork operated mechanical fuse: an adjustable setting cap, a compression mainspring normally uncompressed and arranged in the axis of said cap, a set back weight axially slidable in said cap to compress this mainspring during the positive acceleration of the projectile, means to transform the straight force thus stored in the mainspring into a torque, a mainshaft pivoted in the axis of this mainspring and directly submitted to the action of this torque during the flight of the projectile, a clockwork casing pivotally and slidably mounted in this cap, a cylindrical cover for this casing made in one piece with this mainshaft and eccentric means of transmission carried by this cover and comprising a non-rotatable internal gear freely mounted in this cover, a planetary pinion driven by said internal gear and driving the train of the clockwork of the fuse and means to couple permanently this internal gear to the setting cap.

2. A mechanical fuse as claimed in claim 1, in which the means to couple permanently the internal gear to the setting cap comprises at least a longitudinal keyway provided in the inside periphery of the setting cap and at least a corresponding lug formed on the periphery of the internal gear and projecting into said keyway so as to act as a slidable key to hold the internal gear constantly coupled to the setting cap.

3. In a mechanical fuse: a hollow body formed of a fixed base and an adjustable setting cap, a rotor rotatably and slidably mounted in said body, a firing pin plunger axially slidable in said base, locking balls normally holding this plunger in the inoperative position of the firing pin, and a trigger mechanism to unlock these balls at the end of the trajectory of the fuse, said trigger mechanism comprising a shiftable locking ring rotatably mounted in the base of the fuse and normally holding the locking balls in their operative position, release notches provided in the inner periphery of said ring, a spring tending to shift this ring so that said release notches come to register with the locking balls and thus release the firing pin plunger at the end of the trajectory, a radial notch provided in the outer periphery of said ring, a rocking bar one part of which is normally held into said radial notch so as to prevent the rotation of the ring under the action of its spring and means to guide the fulcrum of this bar parallel to the axis of the fuse.

4. In a mechanical fuse: a hollow body formed of a fixed base and an adjustable setting cap, a rotor rotatably and slidably mounted in said body, a firing pin plunger axially slidable in said base, locking means normally holding said plunger in the inoperative position of the firing pin, a trigger mechanism to unlock said locking means, a notched circular rim formed at the bottom of the

rotor to lock the trigger mechanism in its active position after the setting operation of the fuse, a continuous circular groove provided in the bottom of the rotor above the level of the notched rim thereof, a shiftable bar provided with two lateral notches and having its upper end engaged respectively into said groove before the fire and behind the notched rim of the rotor during the flight of the projectile and a flat spring carried by the base of the fuse and cooperating with either of these notches to hold this bar in either of these two positions.

5. In a mechanical fuse: a hollow body formed of a fixed base, an adjustable setting cap, held to said base and an adjustable nose cap held to said setting cap, a rotor journaled on ball bearings and axially slidable in said body, a clockwork comprising a train, escape mechanism and balance wheel which are lodged in said rotor, a cylindrical cover fastened to said rotor, a hollow mainshaft made in one piece with this cover, a straight torsion flat hairspring axially arranged in this mainshaft, means to adjust the operative length of this hairspring, a releasable coupling between the top end of this hairspring and said nose cap to allow for angular adjustment of the hairspring before the fire by turning said nose cap and means to lock said nose cap in the desired angular position.

6. In a mechanical fuse as claimed in claim 5: a steel tube with a perfectly smooth inner periphery secured in the hollow mainshaft to protect the hairspring and house the means for adjusting the length thereof.

7. In a mechanical fuse for artillery projectiles; a hollow fuse body formed of a fixed base and

an angularly adjustable setting cap axially held to said base, longitudinal keyways provided in the inside periphery of this setting cap, a spring-driven setback rotor pivotally and slidably mounted in the axis of said setting cap, a clockwork entirely lodged in this rotor to govern the angular speed thereof, releasable coupling means slidably mounted in said keyways and controlled by the setback of this rotor, said means being normally carried by this rotor and normally holding this rotor positively coupled to said setting cap.

8. In a mechanical fuse as claimed in claim 7, at least one spherical socket provided on the outer periphery of said rotor and normally carrying said releasable coupling means, the latter being constituted by at least one coupling ball, and at least one radial bore provided in said setting cap below said longitudinal keyways and into which said coupling ball escapes under centrifugal action for uncoupling said rotor from said setting cap after the firing.

9. In a mechanical fuse: a hollow fuse body formed of a fixed base and an angularly adjustable setting cap axially held to said base, adjacent grooved edges on both the base and the setting cap, a graduated deformable steel band secured on the upper grooved edge of the base, an indexed deformable steel band secured on the lower grooved edge of the setting cap, steel points carried by both of these bands and radially projecting toward the center of the fuse and a lead washer interposed between the base and the setting cap opposite these steel points.

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