

Aug. 10, 1948.

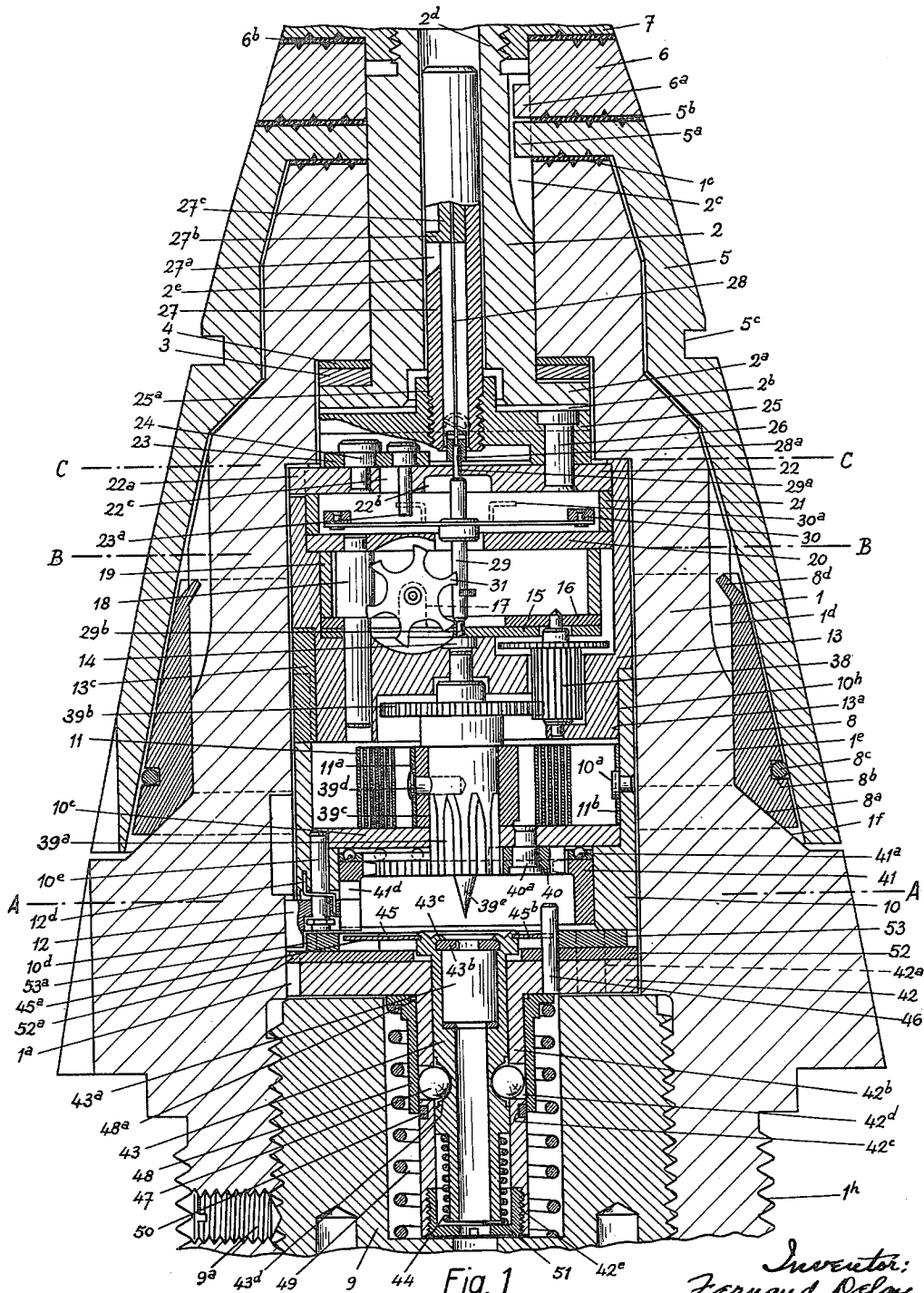
**F. DELAY**

2,446,745

CLOCKWORK OPERATED TIME FUSE

Filed June 22, 1942

6 Sheets-Sheet 1



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F. DELAY

2,446,745

CLOCKWORK OPERATED TIME FUSE

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6 Sheets-Sheet 2

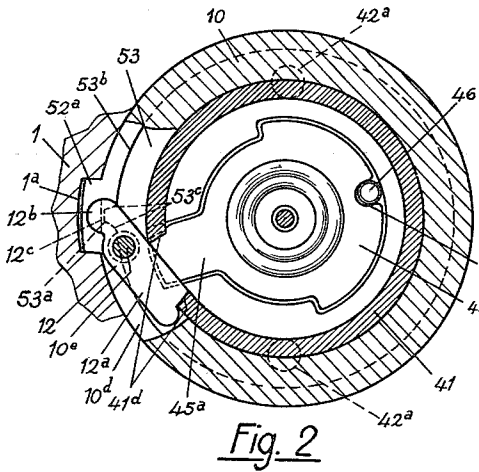


Fig. 2

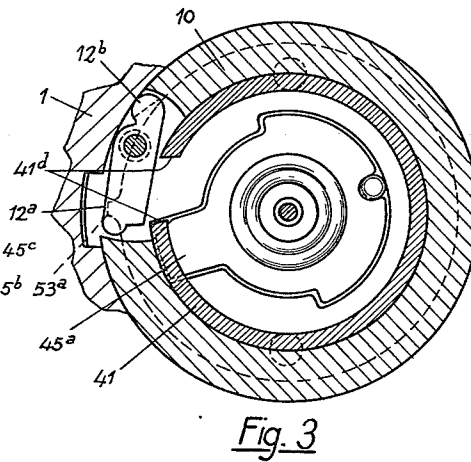


Fig. 3

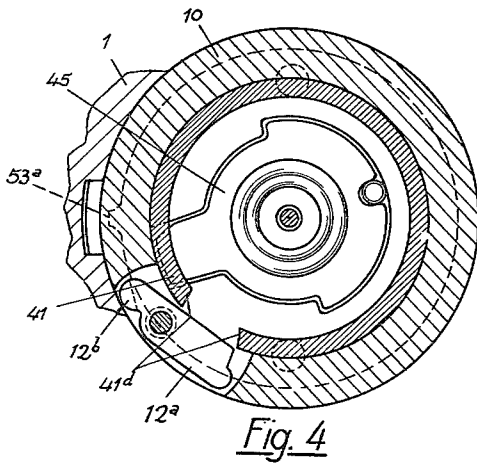


Fig. 4

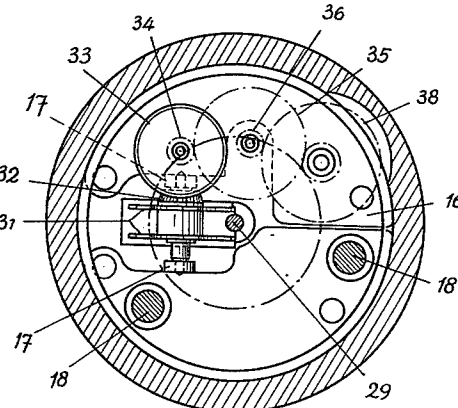


Fig. 5

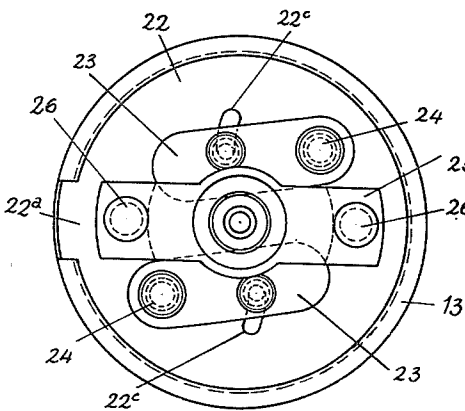


Fig. 6

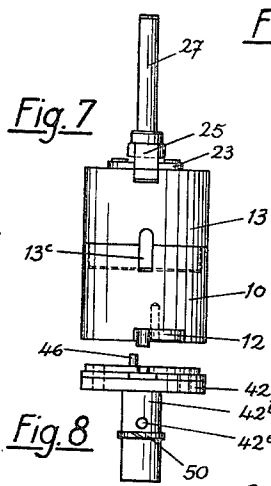


Fig. 7

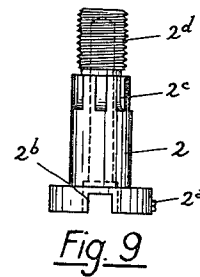


Fig. 9

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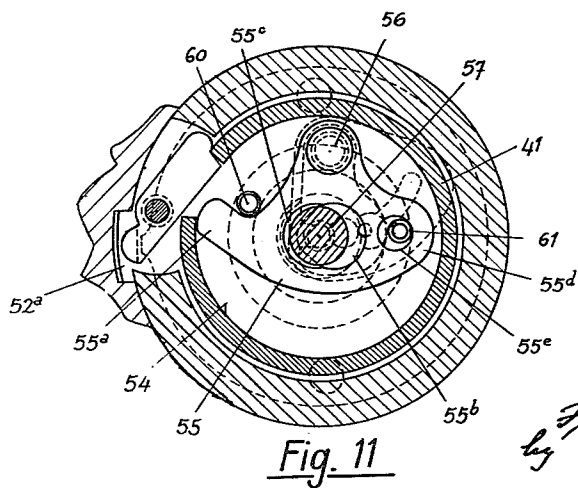
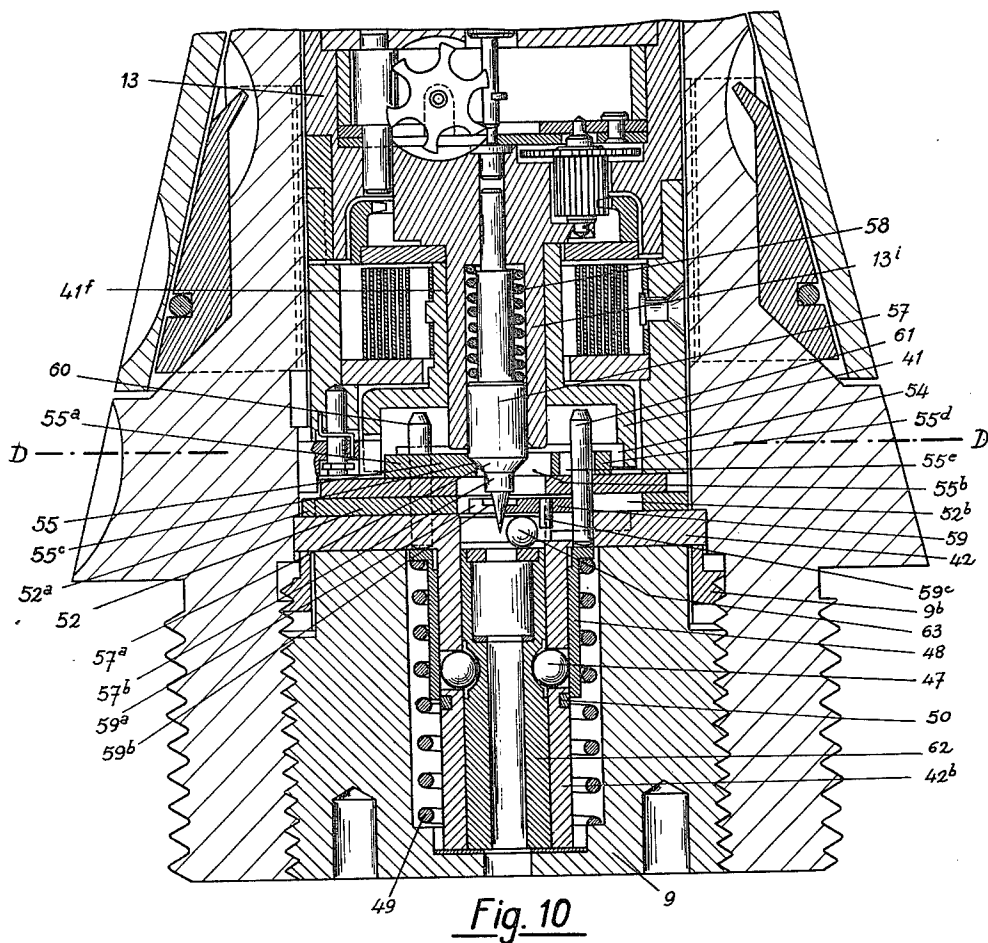
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CLOCKWORK OPERATED TIME FUSE

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6 Sheets-Sheet 3



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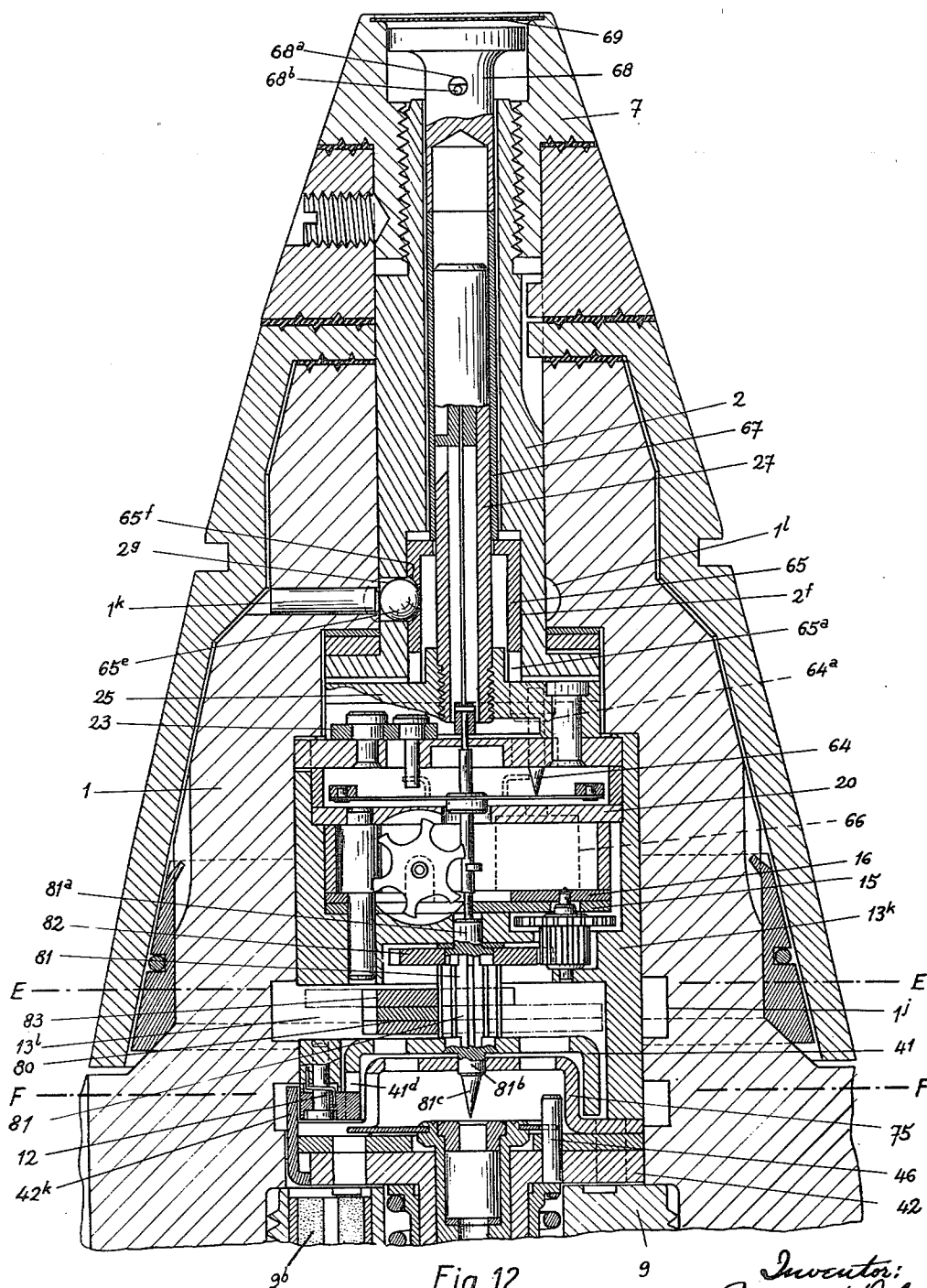
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CLOCKWORK OPERATED TIME FUSE

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6 Sheets-Sheet 4



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CLOCKWORK OPERATED TIME FUSE

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6 Sheets-Sheet 5

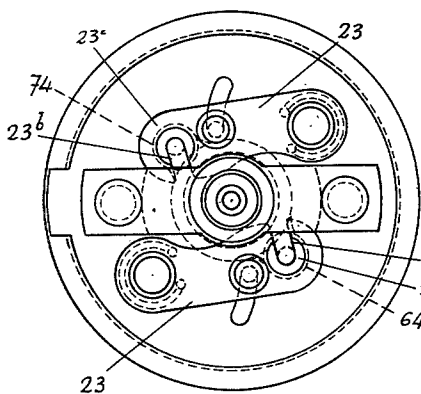


Fig. 13

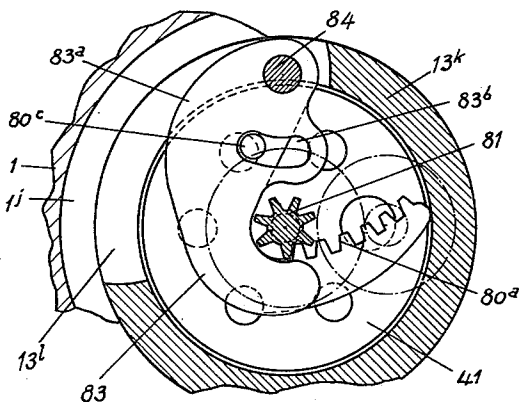


Fig. 14

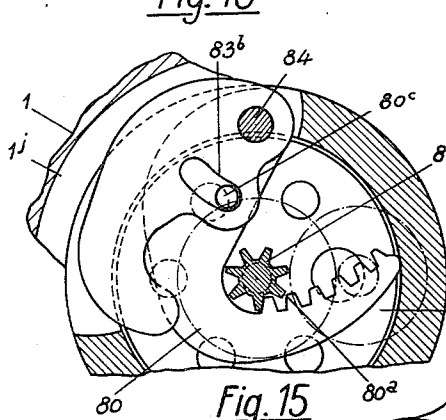


Fig. 15

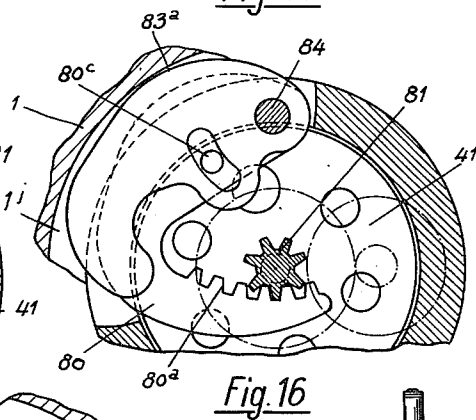


Fig. 16

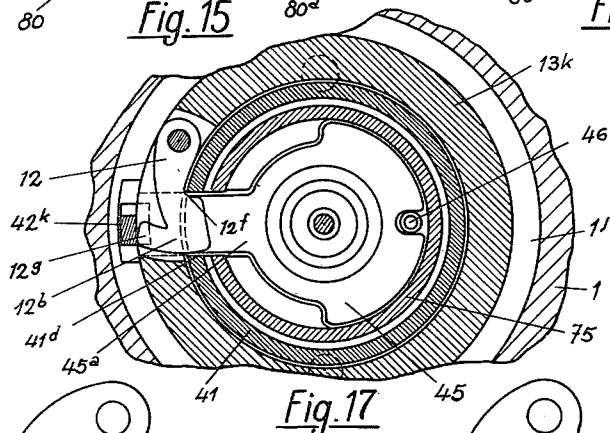


Fig. 17

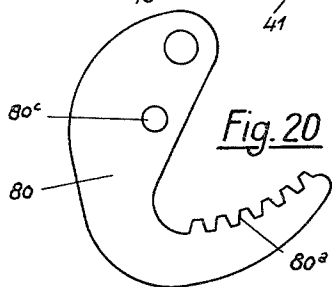


Fig. 20

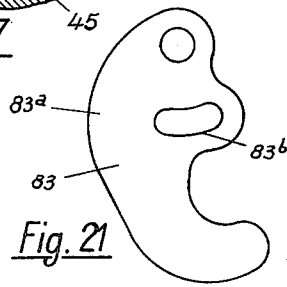


Fig. 21

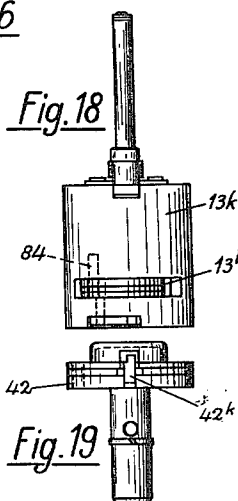


Fig. 18

Fig. 19

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CLOCKWORK OPERATED TIME FUSE

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6 Sheets-Sheet 6

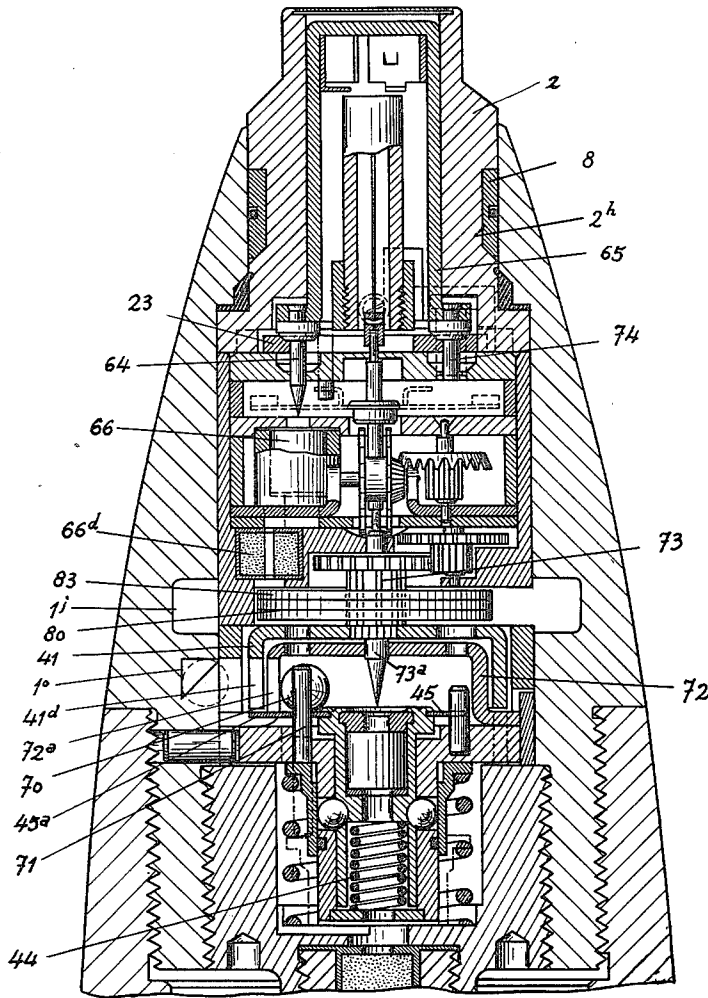


Fig. 22

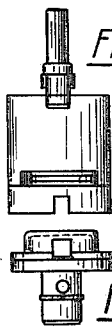


Fig. 25

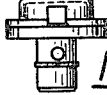


Fig. 26

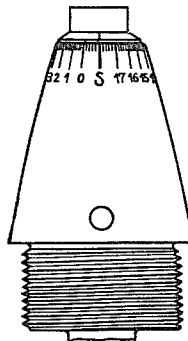


Fig. 23

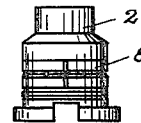


Fig. 24

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## UNITED STATES PATENT OFFICE

2,446,745

## CLOCKWORK-OPERATED TIME FUSE

Fernand Delay, Geneva, Switzerland

Application June 22, 1942, Serial No. 448,026  
In Switzerland June 20, 1941

6 Claims. (Cl. 102—71)

1

This invention relates to improvements in means for setting mechanical time fuses for projectiles and more particularly to time fuses of the kind wherein the setting operation is effected by unrestrained rotation of the setting member in either direction from the zero position.

Some of the time fuses under consideration usually comprise a clockwork rigidly mounted in the fuse body while in other fuses the clockwork is rotatably mounted within the setting cap of the fuse to rotate with this cap during the setting operation and to rotate alone after firing within said cap under the driving action of a motor.

According to an important feature of the invention the clockwork casing including the motor, the rotary timing member and the escapement and spring regulator, is mounted rotatably in the fuse body and is provided with means for coupling it to the setting member so that during the setting of the fuse said clockwork rotates as a whole block within said fuse for previously setting the time for the burst, while after firing it is locked by means released at the time of firing so that only the rotating timing member is allowed to further rotate under the action of the motor for causing detonation at a predetermined time.

Another object of the invention is to provide means adapted to insure reliable working of the fuse and increase the safety thereof against any damage or untimely action especially of the escapement regulator and of the percussion members during the carriage, during the acceleration of the projectile and during the flight thereof.

A further object of the invention is to provide means whereby the power for driving the clockwork may be increased to a maximum extent at least at the beginning of the flight.

Other and further objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawing:

Fig. 1 is an axial sectional view on an enlarged scale with parts in elevation of a first single acting fuse, showing the various members in their normal position of rest;

Figs. 2, 3 and 4 are fragmentary transverse sectional views on an enlarged scale on the line

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A—A of Fig. 1 showing the release mechanism in position of rest and in two distinct positions after the setting operation respectively;

Fig. 5 is a transverse sectional view on an enlarged scale of the clockwork on the line B—B of Fig. 1;

Fig. 6 is a top plan view of the clockwork from the line C—C of Fig. 1;

Fig. 7 is an elevation of the clockwork;

Fig. 8 is an elevation of the base of the time percussion mechanism;

Fig. 9 is an elevation of the setting key of the fuse;

Fig. 10 is an axial sectional view on an enlarged scale of a second single and double acting fuse;

Fig. 11 is a transverse sectional view on the line D—D of Fig. 10;

Fig. 12 is an axial sectional view on an enlarged scale of a third centrifugally actuated and high-sensitive percussion fuse showing the various members in position of rest before the firing;

Fig. 13 is a top plan view of the clockwork showing a part of the high-sensitive percussion device operated by direct impact of the fuse point on the target;

Figs. 14, 15 and 16 are transverse sectional views on the line E—E of Fig. 12 showing the centrifugally actuated driving mechanism in position of rest before the firing, at the beginning of the flight of the projectile and during this flight, respectively;

Fig. 17 is a transverse sectional view on the line F—F of Fig. 12 showing the time percussion members in safety position before the firing.

Fig. 18 is an elevation of the clockwork;

Fig. 19 is an elevation of the base of the time percussion mechanism;

Fig. 20 is a plan view of the centrifugal inwardly toothed sector;

Fig. 21 is a plan view of the centrifugal starting lever acting at the beginning of the flight for momentarily increasing the power driving the clockwork;

Fig. 22 is an axial sectional view on an enlarged scale with parts in elevation of a further centrifugally operated and high sensitive time fuse embodying the invention, for use in projectiles for small-calibre automatic guns;

Fig. 23 is an elevation of the fuse shown in Fig. 22;

Fig. 24 is an elevation of the setting key provided with a locking mechanism acting at the time of firing and during the flight of the projectile;

Fig. 25 is an elevation of the clockwork shown in Fig. 22;

Fig. 26 is an elevation of the base carrying the time percussion mechanism shown in Fig. 22.

The single acting fuse shown in the figures 1 to 6 comprises the following parts: the fuse body made in one piece designated 1 to 1*i*; the setting device mounted on the fuse body, the members of which are designated 2 to 7; the locking device of the timing position acting at the time of the firing, mounted on the fuse body 1, the members of which are designated 8 to 8*d*; the clockwork, the members of which are designated 10 to 41*e*; the percussion device, the members of which are designated 42 to 53*d*; the base plug 9 adapted to maintain into place the clockwork and the base holding the mechanism against the inertia at the time of firing.

The fuse body 1 is made in one piece integral with its ogive and the threaded base 1*h*; on this body there is frictionally mounted the setting device which comprises: a key 2 having a flange 2*a*, the lower face of which is provided with a diametral slot 2*b* which constitutes the female element of a so-called "screwdriver clutch"; a spring-washer 3 of hardened steel interposed between the flange 2*a* and a washer 4 bearing on the bottom of the recessed upper part of the body 1; a conical cap 5 having its top end formed with teeth 5*a* meshing with corresponding longitudinal flutings 2*c* of the key 2; a notch 5*c* for turning said cap; a joint clamping ring 6 formed with inner teeth 6*a* meshing with the flutings 2*c* of the key 2; a cap nut 7 screwed on the threaded top end 2*d* of the key, and finally, three packing rings 1*c*, 5*b*, 6*b* made of elastic material, interposed between the top end of the body 1 and the cap nut 7 so as to cause spring-washer 3 to put a strong pressure on said packing rings upon tightening of the cap nut, in order to simultaneously secure the tightness of the point of the fuse and a sufficient friction between the fuse body and the setting members to avoid any untimely disturbance of the timing position during the manipulations before the firing.

The locking device of the timing position which is also mounted on the fuse body 1 and acts at the time of firing, comprises a set of segments 8 interposed between the conical cap 5 and a cylindrical portion 1*e* of the body 1 which is embraced by these segments. The segments 8 are maintained in position by a split-ring 8*c* lodged in a groove 8*b*; a stop 8*d* projecting from the wall of each segment 8 is engaged in a corresponding recess 1*d* of body 1, so that segments 8 and body 1 are coupled in rotation with each other; segments 8 are also shown having a conical annular surface 8*a* which cooperates with a corresponding conical shoulder 1*f* on the fuse body 1 to cause spreading out of the segments 8 upon firing by inertia under the action of the linear acceleration force.

The casing of the clockwork, which is loosely mounted in the body 1, comprises two parts, namely: a lower part 10 and an upper part 13 which are fitted one within the other by their adjacent surfaces 10*h* and 13*a* and made angularly dependent on each other by means of a stud 13*c* forced in corresponding mortises of the parts

10 and 13. These parts form, a rigid assembly containing the clockwork and adapted to freely rotate in the body during the setting operation.

In the lower casing part 10 are housed the following members: the driving spiral spring 11 bearing on a washer 10*c* which constitutes the bottom of the barrel; a hook 10*a* with which engages the eyelet 11*b* of the free end of the driving spiral spring 11; a safety and stop lever 12 with its spring 12*d*, which lever is pivoted within a recess 10*d* about a pin 10*e* forced in the side wall of the casing part 10; the lever 12, the double function of which will be hereinafter disclosed, has its long arm 12*a* intended as a pawl for setting to a maximum extent the spiral spring 11, by engaging a notch 41*d* of the control crown 41 of the release mechanism; this crown 41 is in gearing relation with the teeth 39*a* of the driving shaft 39 through a gear 40 journaled on a stud 40*a* secured to the washer 10*c*. Driving shaft 39 comprises a bush 39*c* made angularly rigid with it by means of a split pin 39*d* which also constitutes the hook engaging the eyelet 11*a* of the driving spiral 11. Crown 41 is mounted on a ball bearing 41*a*.

Driving shaft 39 comprises at its upper end a gear wheel 39*b* which constantly meshes with the first pinion 38 of the gear train of the clockwork and has its lower end formed with a firing pin 39*e*. 14 is a cap bearing on which is journaled the rounded end of the lower pivot 29*b* of the balance staff 29; 15 is the base plate of the clockwork; 16 is an auxiliary plate or bridge to which is secured the bearing 17 for the escape wheel 31 and the gear train; 18 is a pillar for assembling both the base and the auxiliary plates with casing part 13; 19 is a spacing ring carrying the intermediate plate 20; 21 is a second spacing ring carrying the upper plate 22; 22*a* is a catch made integral with the upper plate 22; catch 22*a* engages in a slot of the casing wall to make the upper plate 22 angularly rigid with the casing part 13. 22*b* is a recess in the upper plate 22, the function of which will be hereinafter disclosed; 23 designates two spring-pressed centrifugal levers journaled on upstanding studs 24 on plate 22 for locking the balance wheel 30 before firing by means of locking pins 23*a* which pass through an opening 22*c* in the upper plate 22 and co-operate with the arms 30*a* of the balance wheel. 25 is a bar secured to the upper plate 22 by means of two rivets 26. Bar 25 has a double function: on one hand it cooperates with slot 2*b* of setting key 2 as the male element of the "screwdriver clutch" interposed between said setting key and the bar 25 for coupling the clockwork with the setting members 2, 5; bar 25 is intended on the other hand to support by its threaded portion 25*a* a tube 27 housed in the central bore 2*e* of the setting key 2; 27*a* designates a slit in which catch 27*b* of the threaded slide 27*c* is movably arranged and engages a nut (not shown) lodged in the interior of the tube 27, for adjusting the operative length of a torsion leaf 28 located in the interior of said tube 27; this torsion leaf constitutes the adjusting member of the balance wheel with which it is connected by means of a ferrule 28*a* secured to the upper pivot 29*a* of the balance staff 29. 32 is the usual bevel pinion of the escape wheel 31; 33 is a bevel wheel, 34 a pinion, 35 a wheel and 36 a pinion of the gear train (Fig. 5).

The time percussion device of the fuse shown in Figs. 1 to 4 is located immediately underneath the clockwork with which it co-operates.



It comprises the following elements: a mechanism holder designated 42 comprising: two split pins 42a, a long guiding sleeve 42b provided with a groove 42c and two radial holes 42d, the lower end of said sleeve being inwardly threaded at 42e; a primer holder 43 slidably mounted in the sleeve 42b; 43a the primer; 43b a washer for fastening the primer 43a; washer 43b is set at 43c; two diametrically opposed sockets 43d in the sliding primer holder 43; a percussion spring 44; a release lever 45 with a toe 45a and a wider portion 45b provided with a guiding notch 45c co-operating with a pin 46 forced in the base 42, which pin serves to fix the angular position of the release lever 45; two locking balls 47 engaged in the sockets 43d of the percussion cap holder 43 through the holes 42d of the guiding sleeve 42b and held in operative locking position by means of a bush 48 slidably mounted on the sleeve 42b and urged upwards by a spring 49; bush 48 is provided at its upper end with an internal groove 48a adapted to co-operate after firing with a locking segment 50 for the sleeve 42b; 51 designates a threaded cap plug screwed in the lower end 42e of sleeve 42b, on which bears the percussion spring 44; 52 is a plate made angularly rigid with the base 42 by means of the pins 42a and having a catch 52a engaged in the corresponding mortise or slot 1a provided in the inner wall of the fuse body 1 for fixing the relative angular position of base 42 and body 1. 53 is a plate, the angular position of which in relation to plate 52 and base 42 is also fixed by means of the pins 42a; plate 53 is formed with a small catch 53a which co-operates in the safety position of the fuse with a flat lug 12c of lever 12 to prevent this lever from swinging before the setting operation; 53b is a circular cam surface the radius of which is smaller than the radius of the catch 53a in order to permit oscillation of the lever 12 by leaving a free space necessary to the effacement of the rounded end of the small lever arm 12b after setting of the fuse (Figs. 3 and 4); 53c designates two small curves connecting the circular cam surface 53b with the top of catch 53a; said curves are intended to cause the flat lug 12c of the lever arm 12b to rise over the catch 53a by swinging the lever 12 when the fuse is brought back to the safety position after setting; 53d designates an opening having the shape of the release lever 45 with a play sufficient to prevent any friction with this lever.

The base 42 which is larger in diameter than plates 52 and 53 is maintained into place in its recess in fuse body 1 by means of a threaded plug 9, on the bottom of which bears the safety spring 49. A radial screw 9a is intended to lock plug 9.

A modified construction of the improved fuse of Figs. 1 to 6 is shown in Figs. 10 and 11. In this modification all members or parts for which no special mention will be made hereinafter are similar to the corresponding members or parts of the first construction.

The control member of the time percussion mechanism is formed rigid with the bush 41f and the crown 41 which both turn about a fixed hollow spindle 13i made rigid with the upper casing part 13, so that crown 41 merely effectuates one revolution during the maximum working period of the clockwork.

The firing pin 57 with its spring 58 is mounted axially movable in the hollow shaft 13i and the

percussion mechanism is double acting by inertia.

Referring to the drawing, 9b designates an intermediate plug screwed in the interior of the base of fuse body 1 for facilitating adjustment of the mechanism holder or base 42; 54 is a spiral recess in the release control drum 41c with which co-operates the nose 55a of a firing pin stop lever 55 which comprises an opening 55b for the passage of the firing pin 57 at the time of releasing the percussion; 55c designates a conical semi-circular notch cut out in the rim of the opening 55b and which in co-operating with a corresponding conical shoulder 57a on firing pin 57 holds the latter in tensioned position against the action of the percussion spring 58; 55d designates a boss adapted to compensate to a certain extent for the centrifugal force which acts at the opposite side of the nose 55a and thus to substantially reduce the friction of this nose on the inner wall of drum 41c; 55e is a hole in the lever 55, in which a safety pin 61 engages before firing; 57b is a cylindrical shoulder on firing pin 57, which shoulder co-operates with a corresponding opening 59b extending through a safety lever 59 lodged in the opening 52b of plate 52; lever 59 has a fork shaped opening 59a through which extends the point of the firing pin 57; safety pin 61 is also intended to hold in operative position the safety lever 59 which oscillates like lever 55 about a stud 56. 59c is a split pin fixed on lever 59 and intended to hold in operative position a safety ball 63 placed between the upper end of a primer holder 62 and the rear face of lever 59; 60 designates an auxiliary locking pin of lever 55 which is guided like safety pin 61 in an opening provided in the base 42 and both the plates 52 and 53. Primer holder 62 which is guided in the sleeve 42b of the base 42 is also locked prior to the firing in the same manner as the sliding primer holder 43 of the first construction, namely by means of two balls 47 held in place by bush 48 and spring 49 bearing on the bottom of base plug 9 which also serves to maintain the base 42 in place in the fuse body 1.

In operation of the first fuse shown in Figs. 1 to 6 and above described, it will be noted that in position of rest, as shown in Figs. 1, 2 and 6, the following members locking the fuse are in operative position: the sliding primer holder 43 is held away from the firing pin 39e against the action of spring 44 by the two balls 47 which are held in locking position by the bush 48 located under the action of spring 49; driving spiral spring 11 is provided at the factory, with a predetermined tension which is sufficient to rotate the driving shaft 39 by several revolutions while crown 41 turns through a smaller angle than 360° owing to the reduction gear ratio between said shaft 39 and crown 41. Spiral spring 11 is maintained in tensioned condition by the long lever arm 12a which serves as a retaining pawl by leaning through notch 41d against the wall of crown 41; lever 12 is held in the position shown in Figs. 1 and 2, by its spring 12d and is prevented from untimely swinging by the safety catch 53a which is located midway the flat lug 12c on the rounded end of the small arm 12b.

In that position, the rounded end of the small arm 12b is located midway the slot 1a of the body 1 and the free space formed by the slot constitutes the dead angle through which lever 12 cannot untimely swing.

The spring-pressed stop levers 23 lock the balance wheel 30 by means of locking pins 23a which engage the arms 30a thereof; balance wheel 30 cannot therefore oscillate as long as said levers 23 are held in the position shown in Figs. 1 and 6. Moreover the locking of the balance wheel 30 constitutes a mean for preventing any untimely retrogression of the driving power like the stud 13c which renders casing part 10 angularly rigid with casing part 13.

When setting the fuse, the clockwork casing is rotated by the key 2 through the medium of the screw driver clutch 2b, 25 so that lever 12 is caused to oscillate when the rounded end of the small lever arm 12b meets with the wall of the fuse body 1 and on the other hand notch 41d and thus crown 41 is released.

Figs. 3 and 4 show the position of lever 12 after a long and a short timing respectively.

In both such positions notch 41d is displaced through a certain angle in two opposite directions with respect to the release lever 45, the angular position of which is fixed by means of the guiding pin 46 co-operating with the corresponding notch 45c.

At the time of firing, the segments 8 for locking the timing position spread out by inertia owing to the co-operation of the conical portions 1f and 8a and put a heavy lateral pressure on the inner wall of cap 5 thus preventing any untimely angular displacement of the latter, the locking of said cap being so secured not only during longitudinal acceleration of the projectile in the bore of the gun, but also during the flight of the projectile under the effect of the centrifugal force.

Simultaneously the bush 48 runs down by inertia compressing spring 49 and becomes immediately locked by the segment 50 which spreads out through the corresponding groove 48a of bush 48. Immediately after complete linear acceleration, the centrifugal force projects out balls 47 from their sockets and spring 44 immediately repels the sliding primer holder 43 thus driving the release lever 45 with its toe 45a against the circular rim of the crown 41.

The levers 23 driven by the centrifugal force, release balance wheel 30 from pin 23a; balance wheel 30 immediately oscillates under the effect of the driving power actuating the gear wheels and the escape wheel, the oscillations of which are regulated by the vibrations of the torsion leaf 28.

The control crown 41 immediately begins to rotate in a clockwise direction as viewed in Figs. 3 and 4 and when notch 41d comes to lie in front of release toe 45a, percussion spring 44 suddenly urges up the primer holder 43 through said notch, thus causing percussion of the primer 43a against the firing pin and consecutive explosion of the projectile.

In the second embodiment shown in Figs. 10 and 11, the process is identical except for the percussion mechanism which works as follows: The fuse is set in the same manner as in the first described construction at a predetermined time so that notch 41d and nose 55a of the release lever 55 become relatively displaced.

At the time of firing, bush 48 runs down by inertia thus compressing spring 49 and being immediately locked in this position by segment 50. Simultaneously safety pins 61 and 60 also run off by inertia thus releasing release lever 55 and safety lever 59 respectively, release lever is still retained by drum 41 whilst the safety lever swings

under the effect of the centrifugal force, thus permitting escape of safety ball 63 into its recess 42f.

Simultaneously, the clockwork begins to rotate as above described and when notch 41d of drum 41 comes to lie in front of the end of nose 55a, lever 55 under the combined action of the centrifugal force and of the percussion spring and owing to co-operation of the conical portions 55c and 57a suddenly oscillates for allowing firing pin 57 to pass through the opening 55b for striking the primer 43a. However, if the projectile collides with an obstacle during its flight before the predetermined time of detonation, primer holder 62 is allowed to run upwards by inertia against the firing pin 57 for igniting the charge at the time of impact. During the flight, the primer holder may be retained away from the firing pin by any suitable means, for example by a stop spring or by friction.

It will be noted that the lower face of bar 25 is so recessed as to clear the centre of the plate 22 and that the latter has a thinner part 22b in order to avoid excessive reaction on staff 29 of balance wheel 30 when the plate is deflected at the time of the firing, thus avoiding any injurious strain on this important regulating member.

In the embodiment shown in Figs. 12 to 21, the fuse differs from the first one in that it comprises

1. A centrifugal device for actuating the clockwork lodged in a casing made in one piece.

2. A high-sensitive percussion device housed in the point of the fuse with its supplemental percussion mechanism and powder relays for ignition of the bursting charge of the projectile.

Referring to Figs. 12 to 21, the casing 13k is made in one piece and houses therein a toothed segment 80 made of several sheets of punched metal, the teeth 80a of which constantly meshes with a central pinion 81 made rigid in rotation on the one hand with a central gear 82 by fluting engagement and on the other hand with the release control drum 41 of the time percussion.

This central pinion is journaled by its upper pivot 81a in the center of casing 13k and by its lower pivot 81b, the extension 81c of which constitutes the firing pin, in the center of a sleeve 75 made rigid with the time percussion mechanism holder 42. A lever 83 superposed to toothed segment 80, the function of which will be hereinafter explained, has a bellied portion 83a and a semi-circular opening 83b coacting with a contact member 80c fixed on segment 80. Both the segment 80 and the lever 83 are pivoted about a common shaft 84 secured to the casing 13k.

In the wall of this casing there is provided an opening 13<sup>1</sup> of a width corresponding to the thickness of both segment 80 and lever 83 so as to permit said lever and said segment to freely oscillate through this opening 13<sup>1</sup> after firing under the action of the centrifugal force within an annular groove 1j provided in the inner wall of the fuse body 1.

The impact percussion device located in the front portion of the fuse comprises a bush 65 mounted, on the one hand axially slidable in the rear portion 2f of the key 2 and on the other hand with its diametrically slotted portion 65a on the bar 25. This bush 65 is provided with a firing pin 64 made rigid therewith, which is counterweighted by a pin 74 (Fig. 13) diametrically opposed thereto. The firing pin is maintained away from a primer 66 by the two stop levers 23 of the balance wheel, said levers having a fork-shaped opening 23b (Fig. 13) and a con-

ical recess 23c arranged concentrically to the firing pin 64 and to the pin 74 respectively and coacting with corresponding conical bevels on the flanges 64a and 74a of firing pin 64 and pin 74 respectively.

The key 2 is bored through its whole length for housing therein a tube 67 of light metal engaged on the tube 27 of the clockwork. Tube 67 serves to transmit to bush 65 the thrust which it should receive from a plunger 68 axially slidable in the cap nut 7 screwed in the point of the fuse. A thin disk 69 seals the upper end of the axial bore of the cap nut 7.

The plunger 68 has a radial bore 68a into which there is fixed a copper wire 68b bearing against the front end of key 2 so as to counterweight the air pressure on said plunger in case disk 69 should untimely break.

The primer 66 is lodged in a sleeve 66a placed between plates 15, 16 and 20 and its burst is intensified at the time of the impact by two powder relays, which are located the one (not shown) in the massive portion of the casing 13k below the primer 66 and the other 9b in the base plug 9.

At rest, before firing, bush 65 is locked against any axial movement by a ball 65e located in a radial bore 2g of key 2 and kept in operative position in an adjacent socket 65f in bush 65 by means of a pin 1k radially adjusted in the front portion of fuse body 1. This latter is provided with an annular groove 1<sup>1</sup> which permits ball 65e to escape after setting of the fuse.

In this embodiment, safety lever 12 (Fig. 17) which co-operates before firing with notch 41d of the release control drum is prevented from swinging in the safety position (Fig. 17) by a lug 42k inserted in the time percussion mechanism holder 42 and coacting with a nose 12g of lever arm 12b; this latter also has another nose 12f engaged in notch 41d with the double purpose of locking drum 41 against any untimely angular displacement and preventing toe 45a of member 45 from passing through.

The working of the fuse shown in Figs. 12 to 21 after the setting thereof is the following:

Upon firing, bush 48 recoils by inertia and compresses spring 49 thus allowing segment 50 to resiliently open, while during linear acceleration bush 65, tube 67 and plunger 68 keep firing pin 64 and pin 74 with their tapered chamfers 64a and 74a close against the conical seat 23c of lever 23 thus preventing the latter from untimely giving off.

Immediately after termination of the linear acceleration, the centrifugal force simultaneously promotes spreading of the segment 50, balls 47, lever 12, levers 23, ball 65e, lever 83 and also of toothed segment 80 which begins to actuate central pinion 81 and thus the whole gear train of the clockwork and the control member 41.

At the beginning of the flight of the projectile, during a certain lapse of time, lever 83 actuates toothed segment or rack 80 by means of the contact member 80c (Fig. 15) thus acting as an important supplemental and provisional source of driving power which is necessary to secure starting of the clockwork; soon after, the bellied portion 83a of lever 83 comes to strike the bottom of the groove 1j (Fig. 16) thus preventing lever 83 from driving segment 80, whose center of gravity lies more distant from the axis of the fuse so as to insure a driving moment which is sufficient to maintain the speed of the clockwork.

This particular characteristic of the centrifugal

driving device is useful because it is well known that centrifugally actuated fuses cannot be used in small calibre projectiles owing to the insufficient initial angular speed which does not allow the centrifugal force to generate a driving moment able to start the clockwork.

The time percussion mechanism works like that of the first embodiment; when notch 41d of the release control drum 41 comes to lie adjacent to toe 45a of the release lever 45, primer 43a drops on firing pin 81c thus promoting the explosion.

However, if during the flight of the projectile the point thereof strikes against any obstacle, the plunger 68 will receive a shock which will be sufficient to draw back, through the medium of tube 67, the bush 65 and thus the firing pin 64 against the percussion cap 66 promoting the explosion of the projectile through the second powder relay 9b.

The tube 67 formed of a thin sheet of light metal is further so weakened as to insure unfailing percussion of the primer and to also avoid any deformation of the plate 22 in the case of an untimely shock on the point of the fuse during carriages or manipulations.

The fuse shown in Figs. 22-26 only differs from that shown in Figs. 12-21 by details and by the fact that it is more specially intended to projectiles for automatic guns of small calibre, for example 37 to 60 mm. Owing to the high speed of rotation of such projectiles and the value of the centrifugal force resulting therefrom, the centrifugally operated starting lever 83 may be omitted.

The locking segments 8 of the timing position are located in a corresponding groove 2b of key 2 and made rigid in rotation therewith. These locking segments work in the same way as described in reference to both the precedent embodiments, that is immediately after firing during the linear acceleration and then during the flight, under the effect of the centrifugal force.

Bush 65, comprising firing pin 64 and counterweighting pin 74 acts directly as a plunger at the time of impact of the fuse point.

Finally the fuse is provided with a complementary safety means against any untimely working of the time percussion mechanism. This means consists of a ball 70 arranged between the release lever 45 and the bottom of the sleeve 72. Before firing, this ball 70 is prevented from escaping from its locking position into the groove 10 of the fuse body by an inertia pin 71 located midway the notch 72a of the sleeve 72 which constitutes the bearing of pivot 73a of central pinion 73. In this position pin 71 locks the passage for the ball 70. This passage still remains locked after timing and during the flight of the projectile by the rim of drum 41 until a short time before notch 41d comes to lie adjacent toe 45a and permits releasing of the percussion spring 44.

It will be noted that, in Fig. 22, the section of the clockwork and of the percussion members, the angular position of which differs from that shown in Fig. 12, clearly shows the high-sensitive impact percussion device, namely firing pin 64, counterweighting pin 74, locking levers 23, primer 66 and powder relay 66d.

What I claim is:

1. A clockwork-operated time fuse for projectiles, comprising a hollow body made in one piece, an annular groove in the inner wall of said body, a setting member arranged rotatably with respect to said body, a clockwork casing made in one piece rotatably mounted in said fuse body

for unrestrained angular displacement in either direction, means coupling said casing to said setting member for rotation thereby, centrifugally actuated means operable on firing of the projectile for locking said setting member and said casing against rotation with respect to said fuse body, said casing including an integral body portion with a median transverse wall separating two chambers, the upper chamber housing the gear train of the clockwork, the balance and the escape wheel; the lower chamber housing a centrifugal driving member for actuating the clockwork and a rotating control member, said centrifugal driving member being adapted to swing under the action of the centrifugal force after firing and to project through an opening provided in the casing into the annular groove of the fuse body; inertia responsive means operative on firing for locking said centrifugal driving means and cooperating balance during the linear acceleration of the projectile, said inertia means releasing said balance when the linear acceleration ceases, and a time percussion assembly within said hollow fuse body adjacent said clockwork casing, said time percussion assembly including a primer holder, a primer seated in said holder and means cooperating with said control member to detonate said primer upon rotation of said control member into a predetermined angular position with respect to said time percussion assembly.

2. A clockwork-operated time fuse as claimed in claim 1 comprising in combination a driving shaft having a median toothed pinion, a centrifugal driving member in mesh with said pinion, a gear on the forward end of said shaft for driving the gear train of a clockwork, a rotatable control drum rigidly secured to said shaft at the rear of the pinion, and bearing means pivotally supporting said shaft, the rear end of said shaft projecting beyond its associated bearing means to constitute a fixed firing pin.

3. A clockwork-operated time fuse as claimed in claim 1, comprising in combination a driving shaft having a median toothed pinion, a centrifugal driving member including a first pivotally mounted lever having an inwardly toothed segment meshing with said median pinion of the driving shaft and a second driving lever pivoted co-axially with the first lever and adapted to swing under the action of the centrifugal force, said second lever having an arcuate slot adapted to cooperate with a contact member fixed on said first lever to form a one-way coupling, whereby said second lever acts at the beginning of the flight of the projectile as a starting member to increase the driving moment and thus facilitate the starting of the clockwork, a gear on the forward end of said driving shaft for driving the gear train of the clockwork, a rotatable control drum rigidly secured to said shaft at the rear of the pinion, and bearing means pivotally supporting said shaft, the rear end of said shaft projecting beyond its associated bearing means to constitute a fixed firing pin.

4. A clockwork-operated time fuse for projectiles comprising a hollow body made in one piece, an annular groove provided in the inner wall of said body, setting means arranged rotatably with

respect to said body; a clockwork casing rotatably mounted in said fuse body and coupled with said setting means for rotation thereby; detonation timing mechanism within said casing including a centrifugal driving member for rotating an axially arranged shaft carrying a release control drum, the lower end of said driving shaft constituting a fixed firing pin; a time percussion mechanism located immediately underneath said firing pin; said time percussion mechanism comprising a safety and stop lever adapted to cooperate with the rotating release control drum, a flanged sleeve, a primer holder slidably mounted in said sleeve, a release lever secured to said primer holder for cooperation with said release control drum, a spring-pressed bush slidably mounted on said sleeve, a percussion spring adapted to upwardly urge said primer holder, means for locking said percussion mechanism before firing; and an auxiliary high-sensitive impact percussion device housed in the front portion of the fuse, said device comprising a primer lodged within the clockwork casing, at least one powder relay for ignition of the bursting charge of the projectile, a recoil bush arranged axially in the point of the fuse body and adapted to run back by impact, a firing pin rigidly fixed eccentrically to the lower end of said recoil bush, and centrifugally released means for locking said impact percussion device before firing.

5. A clockwork-operated time fuse as claimed in claim 4, wherein the locking means of the auxiliary impact percussion device is constituted by two centrifugally actuated stop levers journaled on the upper plate of the clockwork and adapted to cooperate with the firing pin for withholding it from the primer before firing and during the linear acceleration of the projectile.

6. A clockwork-operated time fuse as claimed in claim 4 comprising in combination a safety ball interposed between the release lever and the bottom of the release control drum, said drum having a notch in the wall thereof through which the ball rolls under the action of the centrifugal force, and an inertia-released member blocking movement of said ball through said notch prior to the firing of the projectile.

FERNAND DELAY.

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