

Aug. 10, 1937.

H. H. ZORNIG

2,089,243

FUSE FOR BOMBS

Filed March 20, 1936

3 Sheets-Sheet 1

Fig. 1-

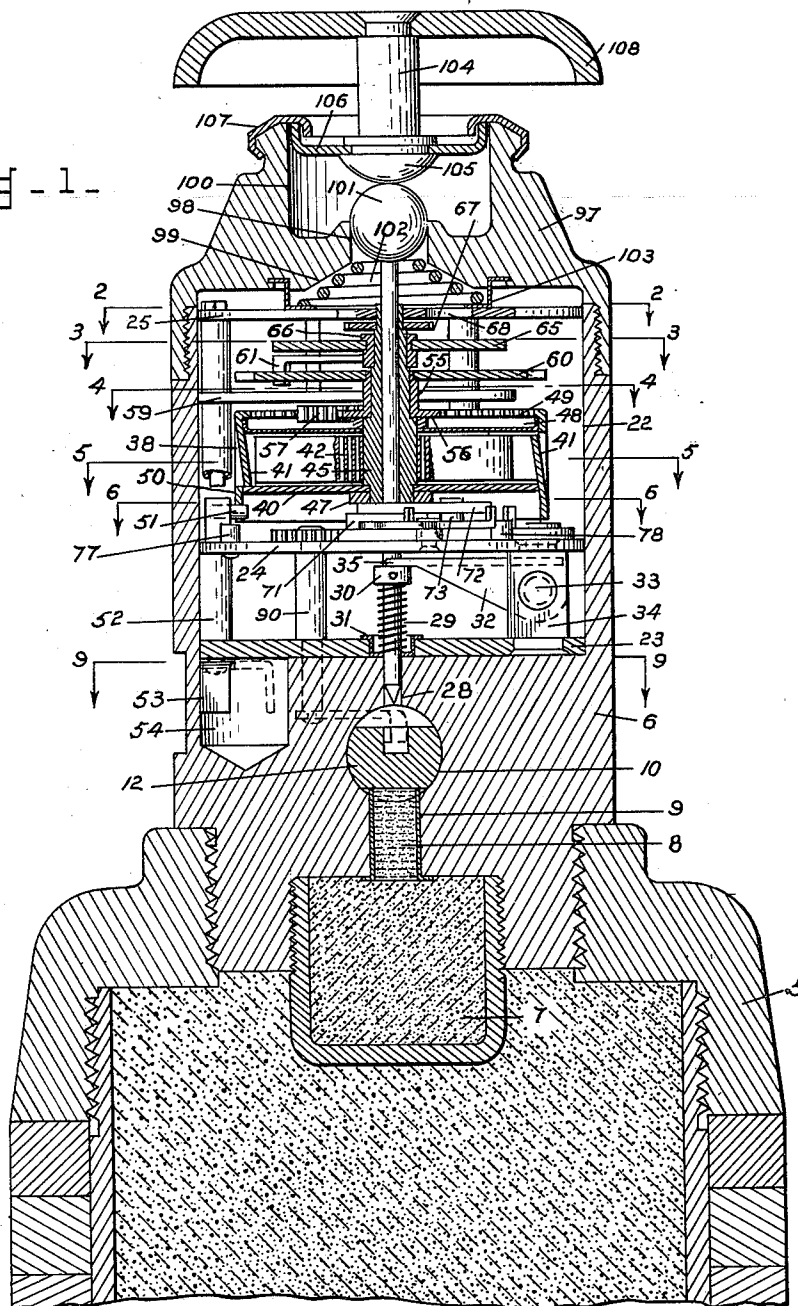
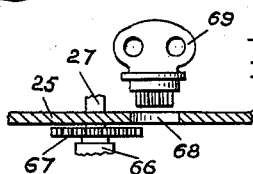


Fig. 12-



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3 Sheets-Sheet 2

Fig. 2.

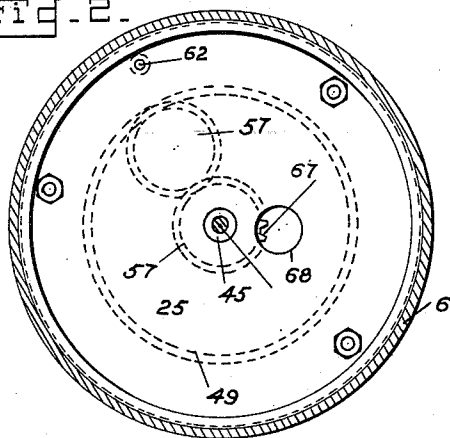


Fig. 3.

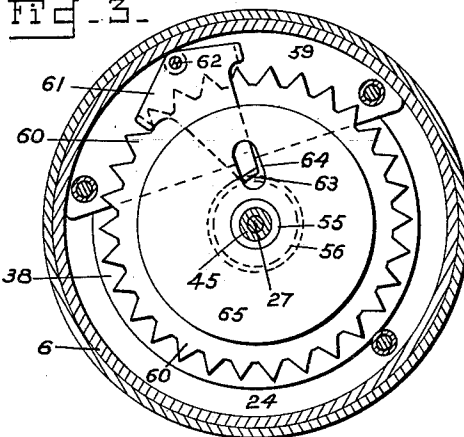


Fig. 4.

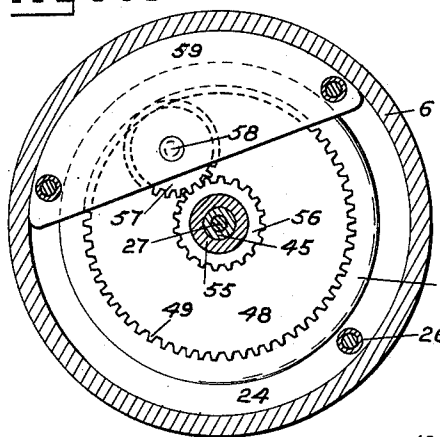


Fig. 5.

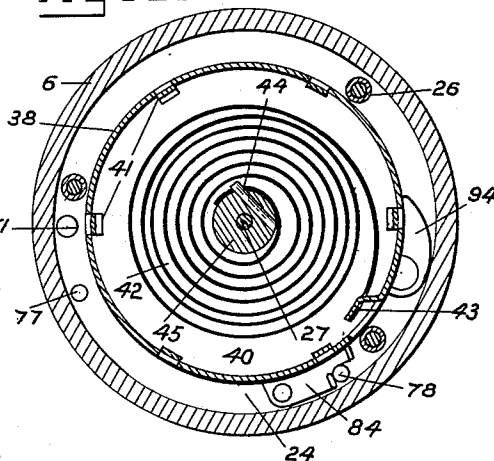
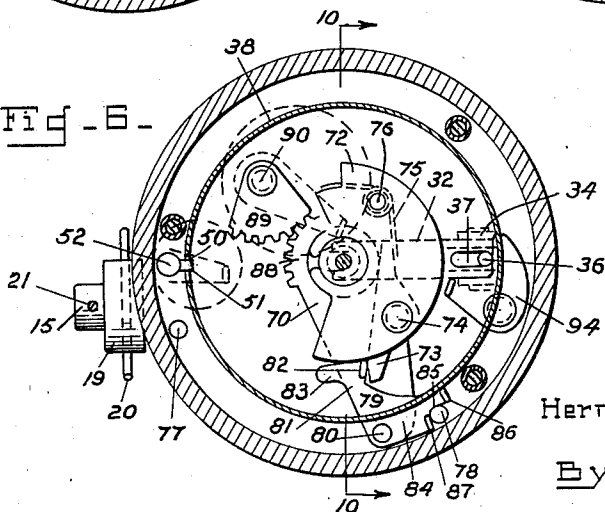


Fig. 6.



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Fig. 7.

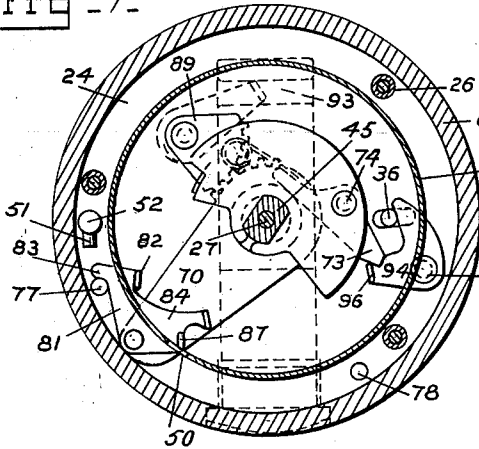


Fig. 8.

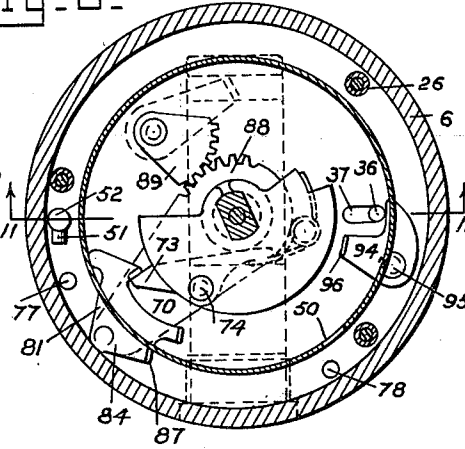


Fig. 9.

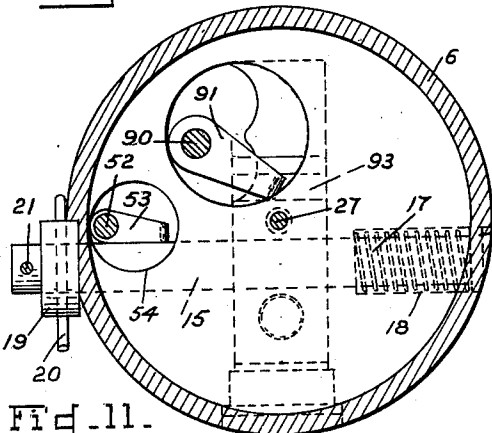


Fig. 10.

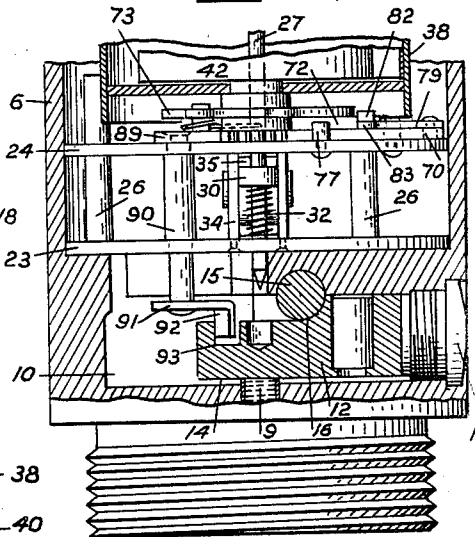
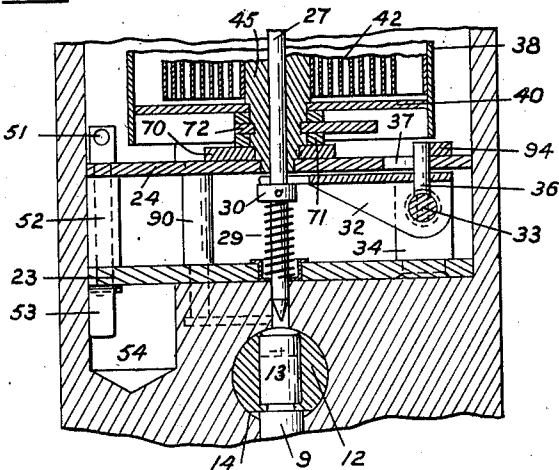


Fig. 11.



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UNITED STATES PATENT OFFICE

2,089,243

FUSE FOR BOMBS

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Application March 20, 1936, Serial No. 69,853

20 Claims. (Cl. 102—37)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a fuse for bomb.

In dropping bombs from low-flying aircraft it is desirable that the bomb remain in flight and the fuse remain unarmed until such time as the aircraft has gained sufficient distance from the place of impact to assure its safety from the effects of the explosion. The delay in flight is obtained by providing the bomb with some form of parachute.

The purpose of this invention is to provide a timing mechanism for controlling delayed arming of a fuse and also for controlling a firing mechanism after a predetermined interval of time.

Another object is to arrange the firing mechanism so that it may be functioned on impact and at variable positions of impact.

A further object is to provide an arming bolt for the detonator slide which also controls starting of the timing mechanism.

With the foregoing and other objects in view, the invention resides 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.

A practical embodiment of the invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of a fuse constructed in accordance with the invention, with operative parts in place therein, and in elevation.

Figs. 2 to 6 are sectional views on the corresponding lines of Fig. 1.

Figs. 7 and 8 are views similar to Fig. 6 and showing the parts in firing and arming positions.

Fig. 9 is a sectional view on the line 9—9 of Fig. 1.

Fig. 10 is a fragmentary sectional view generally on the line 10—10 of Fig. 6 and showing parts in elevation.

Fig. 11 is a sectional view on the line 11—11 of Fig. 8.

Fig. 12 is a detail view of the winding unit.

Referring to the drawings by characters of reference there is shown a bomb 5 (Fig. 1) having a threaded opening for attachment of a fuse body 6. The fuse body carries a booster charge 7 and a booster lead 8 which is contained in a

tube 9 positioned axially of the body and extending forwardly to a transverse passage 10 having one end closed by a plug 11 (Fig. 10).

A cylindrical slide 12 mounted in the passage 10 and carrying a detonator 13 has a flattened side 14 (Fig. 11) engaged by the tube 9 and held thereby against rotational displacement. The slide is normally held in safe position with the detonator 13 out of the line with the booster lead 8 by means of a bolt 15 extending through the fuse body transversely of the slide and engaging a shoulder 16 of the slide (Figs. 9 and 10). A spring 17 acting on the head 18 at one end of the bolt normally tends to eject the bolt from the fuse body. The bolt is held against the action of the spring by means of a washer 19 mounted on the other end of the bolt outside the fuse body and retained by a cotter pin 20 during storage and by an arming wire 21 passing through the bolt when the bomb is placed in the rack of an aircraft. The arming wire 21 is part of a conventional launching apparatus and is withdrawn from the bolt when the bomb is dropped.

The forward part of the fuse body 6 is formed with a large chamber 22 for receiving timing, firing, and slide control mechanisms. These mechanisms are carried in a frame consisting of an inner plate 23, a center plate 24 and an outer plate 25, spaced by means of tubular separators 26. When the frame is inserted in the chamber 22 the inner plate rests on the floor thereof and the outer plate is at the forward edge of the fuse body.

A firing pin 27 disposed axially of the fuse extends through all of the plates of the frame and is normally in the position shown in Fig. 1 with its outer end projecting from the outer plate 25 and its inner end projecting through the inner plate 23 and through a passage 28 in the fuse body leading to the passage 10. The firing pin is held in the normal position by a spring 29 confined between the inner side of a collar 30 on the firing pin and a cup 31 in the inner plate 23. Movement of the firing pin under the influence of the spring is limited by a hammer 32 which is mounted on a pivot pin 33 between cheeks 34—34 fixed between the inner plate 23 and center plate 24. One arm 35 of the hammer engages the outer side of the collar 30 and the other arm 36 extends through a slot 37 in the center plate (Figs. 6 and 11) and is normally against the outer end thereof to limit movement of the hammer and extension of the spring.

The timing mechanism is positioned between the center plate 24 and outer plate 25 and comprises a barrel 38 within which are an outer disc

39 and an inner disc 40 spaced by punched-in portions 41 of the barrel and enclosing a conventional spiral main spring 42. The outer end of the main spring is connected to a hook 43 (Fig. 5) punched from the barrel and the inner end is connected to a pin 44 carried by a hollow spindle 45 which is mounted between plates 24 and 25. The inner disc 40 is held against a shoulder 46 of the spindle by means of a spacer 47 mounted on the spindle and supported, through elements which will be described hereinafter, by the center plate 24. The outer disc 39 has a rim 48 seated against an inturned flange on the outer end of the barrel, which flange is formed into a ring gear 49 (Figs. 1 and 4).

The inner end of the barrel is provided with a recess 50 (Figs. 1, 6, 7, and 8) for receiving a locking pin 51 constituting an arm of a lever and fixed on the upper end of a shaft 52 which extends through the center plate 24 and inner plate 23 outside the periphery of the barrel. An arm 53 (Figs. 1 and 9) on the inner end of the shaft is disposed in a cavity 54 in the fuse body and normally bears against the bolt 15 whereby the shaft 52 is held against rotation and the pin 51 holds the barrel against the action of the main spring. The barrel is not released until the bolt is ejected upon launching the bomb.

A sleeve 55 (Figs. 1 and 4) rotatably mounted on the spindle on the outside of the outer disc 39 of the barrel has a pinion 56 fixed thereto in the plane of the ring gear 49 of the barrel. An idler gear 57 meshing with the pinion 56 and ring gear 49 has its arbor 58 mounted in a segmental plate 59 carried by some of the tubular separators 26.

An escapement wheel 60 (Figs. 1 and 3) is fixed on the outer end of the sleeve 55 and therefore moves in unison with the pinion 56. A pallet 61 whose arbor 62 is mounted between the segmental plate 59 and the outer plate 25 engages the teeth of the escapement wheel. The pallet includes an arm 62 overlying the escapement wheel and having an outwardly turned finger 63 extending through a slot 64 in a balance wheel 65. The balance wheel 65 is fixed to a sleeve 66 rotatably mounted on the spindle on the outer side of the sleeve 55. The escapement operates in the conventional manner, the escapement wheel 60 being engaged by the pallet 61 which transmits successive impulses to the balance wheel 65 and thus checks the escapement wheel until return movement of the balance wheel. In this manner the barrel 38 is controlled.

A winding gear wheel 67 (Figs. 1 and 2) is fixed on the outer end of the spindle directly underneath the outer plate 25 which is provided with an aperture 68 for insertion of a winding key 69.

Referring to Figs. 6, 8, and 11 the firing and slide control mechanisms are disposed on the inner side of the barrel 38 and comprise a latch carrier 70 resting on the center plate 24 and rotatably mounted on the inner end of the spindle, a spacer 71 on the spindle on the outside of the latch carrier, and a rotor 72 keyed to the spindle and positioned between the spacer 71 and spacer 47. A pawl 73 mounted on the underside of the rotor by means of a pivot pin 74 normally has its head projecting beyond the rim of the rotor with its tail held against the spacer 71 by one end of a spring 75 which is mounted on a pin 76 fixed in the rotor and has its other end bearing against the rotor.

The latch carrier 70 extends beyond the rim of the barrel between spaced pins 77 and 78 secured in the center plate 24 and on its outer end it carries a latch 79 which is substantially centrally pivoted on a pin 80. One arm 81 of the latch has an upright finger 82 adapted to be engaged by the pawl 73. This arm also has an extended finger 83 adapted to engage the pin 77 to hold the latch and its carrier against counterclockwise movement (Fig. 7). The other arm 84 of the latch has an extended finger 85 adapted to engage the pin 78 to hold the latch and its carrier against clockwise movement. This arm is also formed with a pair of upright fingers 86 and 87, the finger 86 which is closer to the axis of the fuse being also farther from the axis of the pin 80. In the normal position of the parts the finger 86 bears against the outer side of the barrel 38.

The latch carrier 70 is formed adjacent its pivot with a toothed arc 88 (Figs. 6-9) which meshes with a sector gear 89 constituting an arm of a lever and fixed on the outer end of a shaft 90 extending through the center plate 24 and inner plate 23. An arm 91 fixed on the inner end of the shaft 90 has a bent finger 92 disposed in a groove or slot 93 in the slide 12 carrying the detonator 13.

A firing lever 94 seated on the outer side of the center plate 24 and mounted on a pivot pin 95 carried thereby has one arm adjacent the wall of the fuse body adapted to engage the arm 36 of the hammer and has a finger 96 on the other arm disposed in the path of rotation of the pawl 73 (Fig. 7).

A fuse head 97 (Fig. 1) is threaded to the fuse body and closes the chamber 22. The fuse head is formed with a central passage 98 which is in communication with a flared recess 99 in the inner side of the head and with a cylindrical recess 100 in the outer side of the head. A ball 101 disposed in the passage 98 is seated on the projecting end of the firing pin 27 and on the small end of a valve spring 102 which is disposed in the flared recess 99 and is seated in a shallow cup 103 fixed in the fuse head.

A striker 104 has an inner end 105 which is a portion of a sphere preferably larger than the ball 101 and is disposed in the recess 100 in contact with the ball. The striker is normally maintained axially of the fuse by means of a rocker plate 106 which it carries and which is laterally confined by the walls of the recess 100. The rocker plate is held in the recess by a retaining cap 107 crimped on the forward end of the fuse head. A relatively large impact plate 108 is carried on the front end of the striker and will strike the ground when the angle of impact of the bomb varies from nearly horizontal to vertical. Depending on the angle of impact the striker will be directly driven into the fuse or caused to pivot about an edge of the rocker plate.

The parts of the fuse are in the safe position shown in Figs. 1-6, and 9 and 10, with the arming bolt 15 holding the detonator slide 12 in unarmed position and also preventing movement of the timing mechanism through the instrumentality of the locking mechanism 51, 52, 53. When the bomb is placed in the bomb rack of an aircraft preparatory to being launched the arming wire 21 is applied to the bolt and the cotter pin 20 removed.

Upon launching the bomb the arming wire 21 is withdrawn and the spring 17 immediately

ejects the bolt 15 from the fuse body, the slide 12 now being solely held by the control mechanism 88—92. The arm 53 is no longer opposed by the bolt and the barrel 38 of the timing mechanism commences to be rotated in a counter-clockwise direction under the influence of the main spring 42 and rotates the locking pin 51 until it is clear of the recess 50 in the barrel.

The rotation of the barrel 38 is controlled by the escapement and as the action is similar to that of the conventional clock-work mechanism its operation will not be described in detail.

The spindle 45 is under the influence of the inner end of the main spring 42 which tends to turn it in a clockwise direction and because of the interconnection of the parts, the rotor 72, pawl 73, latch carrier 70 and latch 79 will all be under the same influence. The clockwise movement of these associated parts is normally prevented because of the engagement of the finger 85 of the latch 79 with the pin 78 and the engagement of the catch with the rim of the barrel 38.

However, when the barrel 38 has moved in a counterclockwise direction about three-eighths of a revolution, corresponding to a time interval of about 3 seconds in the present example, the recess 50 of the barrel is opposite the finger 86 of the latch 79 which is moved through the recess (Fig. 8) because the latch 79 is rotated by the pawl 73 which tends to move with the rotor 72 and spindle under influence of the inner end of the main spring. The rotation of the latch is limited when its outer finger 87 is brought up against the rim of the barrel. But the latch no longer functions to prevent clockwise movement of its carrier 70 and the rotor and these associated elements move to the position shown in Fig. 8.

During this angular displacement the toothed arc 88 of the latch carrier 80 drives the sector gear 89 so that the shaft 90 is rotated and the arm 91—92 moves the slide 12 to position the detonator 13 axially of the fuse and in line with the firing pin 27 and booster lead 8. Since the slide is now at the end of its passage and can move no farther it serves to prevent additional clockwise movement of the latch carrier.

The fuse is now armed after the lapse of about three seconds from the time it was launched, and if impact occurs the firing pin 27 will be driven into the detonator to set off the bomb.

If impact does not occur, or if it is not accompanied by sufficient force to drive the firing pin into the detonator, the barrel 38 continues its counter-clockwise rotation under the action of the main spring. When the barrel has moved through one and one-sixth revolutions or 420 degrees, corresponding to ten seconds of time, the recess 50 is brought opposite the latch finger 87 which has been bearing against the rim of the barrel to restrain rotation of the latch by the pawl 73 under influence of the inner end of the main spring. The latch is now rotated and its finger 87 on one end moving through the recess 50 of the barrel (Fig. 7) and its finger 83 on the other end engaging the pin to limit rotation of the latch and also to hold it and its carrier against counterclockwise movement. The finger 87 from now on is in position to bear against the inside wall of the barrel.

As soon as the pawl 73 rotates the latch as just described it is freed therefrom and flies around under the action of the inner end of the

main spring to strike the finger 96 of the firing lever 94 which in turn rotates the hammer and drives the firing pin 27 into the detonator.

In winding the main spring the hollow spindle 45 is turned in a counter-clockwise direction. The rotor moves with the spindle and the pawl 73 carried thereby yields in passing the finger 96 of the firing lever 94 and the finger 82 of the latch. The slide 12 is assembled to the fuse after the spring is wound.

I claim:

1. In a fuse, a casing, a slide mounted in the casing, an element of a firing mechanism in the slide, a bolt removable upon initiation of flight and holding the slide in unarmed position, a timing mechanism in the casing and including a spring-driven barrel having a recess in its rim, a lever having one arm engaging the recess of the barrel and having its other arm engaging the bolt and held thereby against movement, a latch carrier having arms, a latch on one arm bearing against the barrel and movable under influence of the timing mechanism through the recess in the barrel at a predetermined time after starting of the timing mechanism, and means actuated by the other arm of said latch carrier for engaging the slide to move the slide to armed position.

2. In a fuse, a casing, a slide mounted in the casing, an element of a firing mechanism in the slide, a bolt holding the slide in unarmed position, means for ejecting the bolt, means removable upon initiation of flight for normally holding the bolt against ejection, a timing mechanism in the casing and including a spring-driven barrel, a lever having one arm engaging the barrel and having its other arm engaging the bolt and held thereby against movement, a second lever having one arm controlled by the timing mechanism and having its other arm engaging the slide to move the slide to armed position, and a firing pin disposed axially of the fuse and adapted to be actuated on impact and also by the timing mechanism.

3. In a fuse, a casing, a slide mounted in the casing, an element of a firing mechanism in the slide, a bolt holding the slide in unarmed position, means for ejecting the bolt, means removable upon initiation of flight for normally holding the bolt against ejection, a timing mechanism in the casing and including a spring-driven barrel, a lever having one arm engaging the barrel and having its other arm engaging the bolt and held thereby against movement, a second lever having one arm controlled by the timing mechanism and having its other arm engaging the slide to move the slide to armed position.

4. In a fuse, a casing, a slide mounted in the casing, an element of a firing mechanism in the slide, a bolt holding the slide in unarmed position, means for ejecting the bolt, means removable upon initiation of flight for normally holding the bolt against ejection, a timing mechanism in the casing and including a spring-driven barrel, a lever having one arm engaging the barrel and having its other arm engaging the bolt and held thereby against movement.

5. In a fuse, a frame, a firing pin extending axially through the frame, a timing mechanism in the frame and including a barrel, a central spindle enclosing the firing pin and a spring attached to the barrel and spindle, said barrel having a recess in its rim, a starting mechanism engaging the recess in the barrel, a rotor mov-

able with the spindle, a pawl carried by the rotor, a latch carrier freely mounted on the spindle, a latch pivoted on the outer end of the carrier, one arm of the latch having an extended finger and also an upright finger engageable by the pawl, the other arm of the latch having an extended finger and also having a pair of upright fingers adapted to successively engage the rim of the barrel and be moved through the slot therein on successive revolutions of the barrel, spaced pins on the frame engageable by the extended fingers of the latch at the limit of movement of the latch, a member driven by the latch carrier and adapted to limit movement of the carrier, and a firing mechanism operable by the pawl and engaging the firing pin.

6. In a fuse, a frame, a timing mechanism in the frame and including a barrel, a central spindle and a spring attached to the barrel and spindle, said barrel having a recess in its rim, a starting mechanism engaging the recess in the barrel, a rotor movable with the spindle, a pawl carried by the rotor, a latch carrier freely mounted on the spindle, a latch pivoted on the outer end of the carrier, one arm of the latch having an extending finger and also an upright finger engageable by the pawl, the other arm of the latch having an extended finger and also having a pair of upright fingers adapted to successively engage the rim of the barrel and be moved through the slot therein on successive revolutions of the barrel, spaced pins on the frame engageable by the extended fingers of the latch at the limit of movement of the latch, a member driven by the latch carrier and adapted to limit movement of the carrier.

7. In a case, a frame, a timing mechanism in the frame and including a barrel, a central spindle and a spring attached to the barrel and spindle, said barrel having a recess in its rim, a starting mechanism engaging the recess in the barrel, a rotor movable with the spindle, a pawl carried by the rotor, a latch carrier freely mounted on the spindle, a latch pivoted on the outer end of the carrier and having one arm acted on by the pawl, fingers on the other arm of the latch adapted to successively engage the rim of the barrel and be moved through the recess therein on successive revolutions of the barrel, means on the frame and engageable by the latch whereby the latch is held at the limits of its movement, and a member driven by the latch carrier and adapted to limit movement of the carrier.

8. In a fuse, a frame, a timing mechanism in the frame and including a barrel, a central spindle and a spring attached to the barrel and spindle, said barrel having a recess in its rim, a rotor movable with the spindle, a pawl carried by the rotor, a latch carrier freely mounted on the spindle, a latch pivoted on the outer end of the carrier and having one arm acted on by the pawl, fingers on the other arm of the latch adapted to successively engage the rim of the barrel and be moved through the recess therein on successive revolutions of the barrel, means on the frame and engageable by the latch whereby the latch is held at the limits of its movement, and a member driven by the latch carrier and adapted to limit movement of the carrier.

9. In a fuse, a frame, a timing mechanism in the frame and including a barrel, a central spindle and a spring attached to the barrel and spindle, said barrel having a recess in its rim,

a rotor movable with the spindle, a pawl carried by the rotor, a latch carrier freely mounted on the spindle, a latch pivoted on the outer end of the carrier and having one arm acted on by the pawl, fingers on the other arm of the latch adapted to successively engage the rim of the barrel and be moved through the recess therein on successive revolutions of the barrel, means on the frame and engageable by the latch whereby the latch is held at the limits of its movement.

10. In a fuse, a casing, a slide mounted in the casing, a lever having one arm engaging the slide, and having a sector gear on its other arm, a timing mechanism in the casing including a spring-driven rotor, a latch carrier mounted for movement independently of the rotor and arranged to drive the sector gear, a driving connector between the rotor and latch carrier including a latch on the carrier engaging an element of the timing mechanism and adapted to be released at a predetermined time after starting of the timing mechanism, and a firing mechanism arranged to be actuated by the driving connector at a predetermined time subsequent to the release of the latch.

11. In a fuse, a casing, a timing mechanism in the casing including a spring-driven rotor, a latch carrier mounted for movement independently of the rotor, a driving connector between the rotor and latch carrier and including a latch on the carrier engaging an element of the timing mechanism and adapted to be released at a predetermined time after starting of the timing mechanism, a firing mechanism arranged to be actuated by the driving connector at a predetermined time subsequent to the release of the latch, and a member driven by the latch carrier.

12. In a fuse, a casing, a timing mechanism in the casing including a spring-driven rotor, a latch carrier mounted for movement independently of the rotor, a driving connector between the rotor and latch carrier and including a latch on the carrier engaging an element of the timing mechanism and adapted to be released at a predetermined time after starting of the timing mechanism.

13. In a fuse, a casing, a timing mechanism in the casing including a spring-driven member, a member mounted for movement independently thereof, a latch on said independently movable member for holding it against movement until the lapse of a predetermined time after starting of the timing mechanism, a driving connector between the spring-driven member and the latch, a firing mechanism arranged to be actuated by the driving connector, and means whereby the latch disengages the driving connector at a predetermined time after it releases the independently movable member, and a member driven by said independently movable member.

14. In a fuse, a casing, a timing mechanism in the casing including a spring-driven member, a member mounted for movement independently thereof, a latch on said independently movable member for holding it against movement until the lapse of a predetermined time after starting of the timing mechanism, a driving connector between the spring-driven member and the latch, and a member driven by said independently movable member.

15. In a fuse, a casing, a slide mounted in the casing, an element of a firing mechanism in the slide, a timing mechanism in the casing, a lever having one arm controlled by the timing mechanism and movable thereby after a predetermined

delay and having its other arm engaging the slide to control movement of the slide to armed position.

16. In a fuse, a casing, an impact firing pin extending through the casing, a spring normally resisting movement of the firing pin in one direction, a pivoted hammer engaging an intermediate portion of the firing pin and having an arm, a lever engageable with the arm of the hammer, and a timing mechanism in the casing for actuating the lever.

17. In a fuse, a casing to a firing pin extending through the casing, a spring normally resisting movement of the firing pin in one direction, a pivoted hammer engaging the firing pin and having an arm, a lever engageable with the arm of the hammer, and a timing mechanism in the casing for actuating the lever.

18. In a fuse, a timing mechanism including a barrel formed with a ring gear, a central hollow spindle passing through the barrel, a spring connected to the barrel and spindle, a pinion rotatably mounted on the spindle, an idler meshing with the ring gear and pinion, an escapement wheel movable with the pinion, a pallet engageable with the escapement wheel, a balance wheel mounted on the spindle and engaged by the pallet

and a firing pin extending through the hollow spindle.

19. In a fuse, a body, a firing pin within the body and projecting therefrom, a head attached to the body and having a cylindrical recess in its other end, a flared recess in its inner end and a passage connecting the recesses, a seat fixed to the inner side of the head, a valve spring on said seat and disposed in the flared recess, a ball disposed in the passage and resting on the spring and on the firing pin, a striker having a rounded portion engaging the ball, a rocker plate on the striker fitting in the cylindrical recess of the head, means for retaining the rocker plate and an impact plate on the striker.

20. In a fuse, a body, a firing pin within the body and projecting therefrom, a head attached to the body and having a recess in its outer end and a passage leading therefrom, a spring carried by the head, a ball disposed in the passage and resting on the spring and on the firing pin, a striker having a rounded portion engaging the ball, a rocker plate on the striker fitting in the recess of the head, means for retaining the rocker plate, and an impact plate on the striker.

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