MECHANICAL FUSE FOR GRENADES

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Application October 31, 1951, Serial No. 254,181
8 Claims. (Cl. 102—76)
(Granted under Title 35, U. S. Code (1952), sec. 266)

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The present invention relates to fuses generally and more particularly to a mechanical fuse for hand or rifle grenades.

One important object of the invention is to provide a fuse which will detonate regardless of the attitude of the grenade in relation to the target at the time of impact.

Another object of the invention is to provide a fuse having a positive minimum delay, detonation being prevented on premature impact within such minimum time delay.

Another object is to provide a fuse with a delay setting mechanism allowing delay time to be increased or decreased as often as required prior to the throwing or firing of the grenade.

Still another object of the invention is to provide a fuse which may be completely assembled and tested prior to the loading thereof.

A last object to be mentioned specifically is to provide a fuse which is relatively inexpensive to manufacture, simple and safe to handle, and completely dependable in use under widely varying climatic conditions.

With these objects definitely in view, the invention comprises the structure, arrangement and combination of elements hereinafter described in the specification, pointed out in the appended claims and illustrated in the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of a grenade with this fuse incorporated therein;
Figure 2 is an elevational view, taken as from the right hand side of Figure 1;
Figure 3 is an end elevational view;
Figure 4 is a vertical sectional view, fragmentary in character, and taken on the line 4—4 of Figure 1;
Figure 5 is a longitudinal sectional view of a modified form of this invention, a front end portion of the fuse being broken away to conserve space;
Figure 6 is a rear end elevational view of the modified form shown in Figure 5.

Figures 7, 8 and 9 are transverse sectional views taken on the respective section lines in Figure 5; and
Figures 10 and 11 are fragmentary views, in perspective, of mating portions of the setting knob shank and the firing pin employed in the modified form of this invention.

Similar characters of reference relate to similar or identical elements and portions throughout the specifications and the drawings.

Referring now to the drawings, and particularly to Figures 1 to 4, the grenade body 10, with its explosive charge 12, loading plug 14 and booster 16 are all substantially conventional. The fuse head 18 has a bore 20 which is terminally threaded for mounting the booster 16. In this bore 20 the firing pin 22 is fitted for axial movement under the influence of a helical spring 24 compressed coaxially of the firing pin between opposing shoulders on the firing pin and head 18. The firing pin lock pin 26, in addition to the balls 28, normally holds the firing pin in the cocked position shown in Figure 1. A reduced rear portion 30 of the firing pin has hemispherical recesses therein to receive the balls 28, while said balls are held in firing pin locking engagement with a conical portion 32 of the head 18 by a collar 34 on what will be termed the lower disc 36. This lower disc 36 is biased axially by a helical spring 40 into normal position as represented in Figure 1.

An upper disc 42 is normally retained on a shoulder 44 of the head 18 by a star spring 46, considerably stronger than the spring 40, compressed between the upper disc 42 and a nut 48 screwed into the end of the head 18. Since the spring 46 is much stronger than the spring 40, premature shifting of the disc 36 is prevented. The upper disc 42, nut 48 and spring 46 are centrally apertured to receive an arming pin 50 which has a reduced terminal portion or peg 52 extending into an axial bore in a separator 54 held between the upper and lower discs 36 and 42. As illustrated in Figures 1—4, this separator is in the form of a combined hemisphere and cone and said discs are provided with correspondingly shaped recesses in opposing raised portions 37 and 43 on the separator faces. The separator is thus frictionally held in place by the action of the spring biased discs, although positive retention of the separator is achieved only by the arming pin 50.

Withdrawal of the arming pin 50 is achieved by the action of the helical spring 54 compressed between the head 56 of the arming pin and the outer face of the nut 48. A safety lever 58 of substantially conventional design has terminal hooks 60 which engage aligned projections 62 on the head 18 while an intermediate portion of the lever is secured to another portion of the head 18 by a cotter pin 64. As long as the cotter pin 64 secures the safety lever in place, as indicated in Figures 1—4, a portion of the safety lever holds the head 56 of the arming pin 50 in the position shown against the action of the spring 54.

The time delay clockwork mechanism is also maintained inoperative by the safety lever 58, a lug 66 of the lever engaging the head of the time delay lock pin 68 to hold the pin 68 in mechanism-locking position against the action of the spring 70. The exact character of the clockwork portion of the mechanism is not material in this disclosure, the illustration in the drawing showing the pin 68 engaging a bore in an escape wheel arbor 72. This arbor, when released, drives a gear 74 and a gear train operably connected with an inertia wheel or other control means indicated at 76, while the gear wheel 74 is driven by a main gear wheel 78. The main gear wheel is driven by a friction spring 80 fixed to a main arbor 82 which is itself driven by a main spring 84. The main arbor 82 has rigidly fixed thereon a sector 86 which normally holds the firing pin lock pin 26 in engagement with the firing pin 22 against the action of the spring 88.

The setting of the time delay mechanism is achieved by shifting the main arbor 82 and the sector 86 relative to the firing pin locking pin 26 so that the distance remaining to be travelled by the sector before release of the pin 26 can be varied. A setting knob 90 includes a key 92 which fits into and turns the arbor 82 while the main gear wheel 78 along with the associated gear train is held stationary by the time delay lock pin 68 in engagement with the escape wheel arbor 72, the result being that the sector 86 is moved relative to the firing pin lock pin, that is, the starting position of the sector is adjusted so that the time lapse, after the release of the clock mechanism and before the sector releases the firing pin locking pin, is alterable by the setting of the setting knob. Maximum and minimum time stops 94 and 96 are provided on the side of grenade body.
In the embodiment of this invention illustrated in Figures 5 to 9, the grenade body 210, explosive charge 212 and booster 216 are substantially unchanged, as are the firing pin 222, spring 224, locking balls 228, lower disc 236, upper disc 242 and spring 246. The separator 254 is modified slightly to assume a more generally spherical form but is made definitely unbalanced by removal of a lateral portion as indicated at 266.

In the modified form the arming pin 258 has a central portion 260 thereof constituting a journal or axis member for a main arbor 262, while the main spring 264 is connected at one end to a plate 266 in a modified fuse housing and at the other end to the main arbor 262. The main gear wheel 270 is freely rotatably mounted on the main arbor 260 and is driven by the friction drive spring 272 fixed to the arbor and bearing against the main gear wheel 270.

The sector 274 is carried by the sector shaft 276 in a slot 278 in the fuse head member 268 and this sector 274 in one position as indicated in Figure 5 engages the firing pin 222 to hold the same in cocked position. The sector shaft has a tooth 280 which engages the sector gear 282 carried by the main arbor 262. The plate 266 and a similar plate 284 support a clock mechanism generally represented in Figure 8 by the numeral 285 and including a gear wheel 286, as well as a main arbor 262, and the clock mechanism is driven by the main spring 264 when a lock pin 288 is withdrawn. This lock pin 288 may be installed in any suitable manner so as to be operative in controlling the clock mechanism, the representation in Figure 5 showing this pin simply passing through the wheel 286 and spring biased, as indicated at 290, to be withdrawn from the wheel 286 when a heel 292 of the arming lever 294 is released from the head of the pin 288. The arming lever is substantially conventional and is held in normal position by a cotter pin 296 against the action of the spring 298 transmitted through a button 300 on the setting knob 302 which is integral with and arranged coaxially of the arming pin 258.

It is preferred that the fuse head member 268 be in two parts, the part 304 being threaded onto the main portion of the fuse head 268, and the part 304 carries the arming lever 294. The setting of the fuse is accomplished by manual rotary adjustment of the setting knob 302, such adjustment being made while the main wheel 270 is held against rotation, slippage occurring between the spring 272 and the main wheel 270, so that the sector 274 is adjusted or pre-set relative to the firing pin 222. Maximum and minimum time settings are obtained by providing a slot 306 in the fuse head member part 304 to receive a stop pin 308 carried by a shank portion of the setting knob 302. A calibrated scale 310 on the arming lever 294 and a pointer 312 on the setting knob 302 provides visual indication of the time setting. When the cotter pin 296 is withdrawn and the grenade thrown the arming lever 294 is pinned about its hook 314 by the action of the spring 298, releasing the lock pin 288 so that the clock mechanism 285 begins to function and the arming pin 258 simultaneously releases the separator 254 from its positive retention between the discs 236 and 242. The setting knob 302 and the arming pin are separable from the arbor 262 while providing for manual rotary driving connection therebetween as illustrated best in Figures 5, 10 and 11, the setting knob shank 316 having a key 318 which engages in a slot 320 in the corresponding end of the arbor 262. Spaced parallel ridges 322 on the sector 274 prevent the point of the firing pin 222 from engaging the sector.

Finally, it should be noted that the sector shaft tooth 280 is maintained in operative engagement with the sector gear 282 by a spring 324 mounted on the shaft 276 and sector 274 in such manner as to bias the tooth into the position thereof corresponding with minimum time setting of the setting knob 302, this position of the tooth being illustrated in full lines in Figure 8, and this construction allowing the setting not only to be changed from minimum to maximum time delay but also allowing reverse adjustment back to minimum when desired.

The operation of this invention, in each of its herein disclosed forms has been indicated in the foregoing description of the mechanical details of the invention. The clockwork is effective in positively preventing actuation of the firing pin 20 or 222 and detonation until a set time after the grenade has been thrown. Further description would appear to be unnecessary except as to the release of the separator and the firing of the grenade under varying conditions. Detonation will occur on impact, provided that the fusible head has been heated to the proper temperature to release the lock pin 26 or the firing pin 222, regardless of the attitude of the grenade at the time of impact. The operation of the mechanism differs slightly depending upon the attitude of the grenade upon impact. If the force of impact is axial from top to bottom both discs 36 and 42 and the separator will move upward, overcoming the restraint of the star spring 46, and releasing the steel balls 28 from the firing pin, which now fires the primer. If the force of impact is axial from bottom to top, the lower disc 36 will move downward, releasing the separator which, by reason of its imbalance, will fall out from between the discs. The lower disc 36 now moves upward under the pressure of the helical spring 40, releasing the steel balls 28 and permitting the firing pin to fire the primer. If the force of impact is in any direction other than axial, the separator will overcome the restraint of the upper and lower discs and move out from between the opposing raised portions 37 and 43 on the discs, permitting the lower disc to move upward and release the firing pin as previously described. In the modified form of the invention shown in Figures 5-9, the lower and upper discs 236 and 242 and the spring 258 act in a manner completely analogous to the foregoing in releasing the separator 254.

I claim:

1. In a grenade comprising a body having a chamber therein and a safety lever removably secured therein, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, and a detonator comprising a primer, a Spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in said normal position and retained in part at least within cavities in said firing pin, a first disc disposed in a plane perpendicular to the firing pin axis and receiving one end of the said firing pin, a second disc parallel to and normally spaced from the said first disc, a separator between the two said discs, said separator terminating in a point nested in the said first disc, spring means urging said respective discs toward each other, a peg normally held in said separator piercing relationship by the said safety lever, a member normally interferring with said firing pin, and a time delay mechanism disposed to hold said member in firing pin interfering relationship for a predetermined time after release of the said safety lever.

2. In a grenade comprising a body having a chamber therein and a safety lever removably secured thereto, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in said
normal position, a first disc disposed in a plane perpendicular to the firing pin axis, a second disc disposed parallel to and normally spaced from the said first disc, a pointed separator between the two said discs, spring means urging the said respective discs toward each other, a peg normally held in separator piercing relationship, by the said safety lever, a member normally interfering with said firing pin, and a time delay mechanism disposed to hold said member in firing pin interfering relationship for a predetermined time after release of the said safety lever.

3. In a grenade comprising a body having a chamber therein and a safety lever removably secured thereto, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in said normal position, a first disc receiving one end of said firing pin whereby said detent balls are normally between said firing pin and said disc, a second disc parallel to and normally spaced from the said first disc, a separator between the two said discs, said separator being symmetrical about a line passing through the axis of the said firing pin and terminating in a point nested in the said first disc, spring means urging the said first disc against the said separator, spring means urging the said second disc against the said separator, a peg normally held in separator piercing relationship by the said safety lever, a member normally interfering with said firing pin, and a time delay mechanism disposed to remove a said member from firing pin interfering relationship after a predetermined time after release of the said safety lever.

4. A grenade comprising a body having a chamber therein and a safety lever removably secured thereto, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in said normal position, a first disc disposed normal to said firing pin and receiving one end thereof, a second disc parallel to and normally spaced from said first disc, a separator between the two said discs and terminating in a point, a peg normally held in separator piercing relationship by the said safety lever, a member normally interfering with said firing pin, and a time delay mechanism disposed to hold said member in firing pin interfering relationship for a predetermined time after release of the said safety lever.

5. A grenade comprising a body having a chamber therein and a safety lever removably secured thereto, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in said normal position, a first disc disposed normal to said firing pin and receiving one end thereof, a second disc parallel to and normally spaced from said first disc, a separator between the two said discs, said separator being in the form of a combined hemisphere and cone, a peg normally held in separator piercing relationship by the said safety lever, a member normally interfering with said firing pin, and a time delay mechanism disposed to hold said member in firing pin interfering relationship for a predetermined time after release of the said safety lever.

6. The invention according to claim 5 wherein the said member is a spring biased pin piercing the said firing pin in a plane normal to the axis of the said firing pin.

7. A grenade comprising a body having a chamber therein and a safety lever removably secured thereto, an explosive charge, a primer positioned to detonate said charge, a firing pin normally in spaced relation to said primer, a spring urging said firing pin toward said primer, detent balls cooperating to retain said firing pin in normal position, a first disc disposed normal to said firing pin and receiving one end thereof, a second disc parallel to and normally spaced from said first disc, a separator between the two said discs, said separator being substantially spherical and having a lateral portion thereof removed, a peg normally held in separator piercing relationship by the said safety lever, a member normally engaging said firing pin, and a time delay mechanism disposed to hold said member in firing pin interfering relationship for a predetermined time after release of the said safety lever.

8. The invention as set forth in claim 7 wherein the said member is a sector and engages the firing pin at the other end thereof.

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