Nov. 30, 1943. H. J. NICHOLS 2,335,842

FUSE

Filed Jan. 13, 1940

Fig. 1

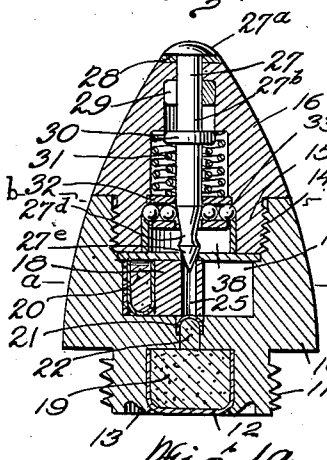


Fig. 2

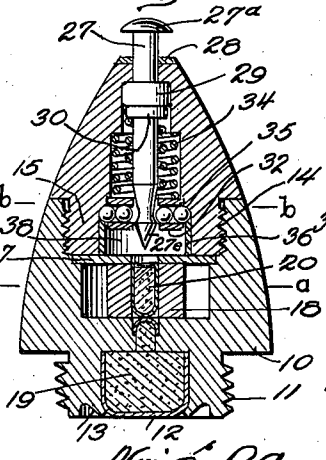


Fig. 3

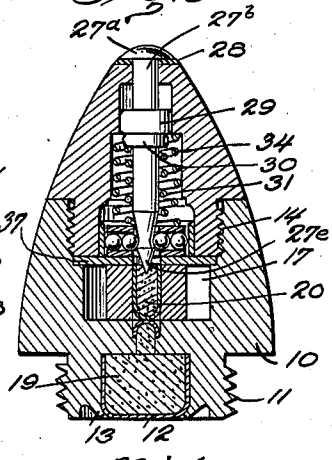


Fig. 1a

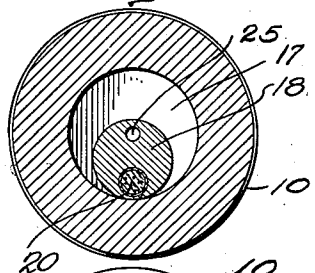


Fig. 2a

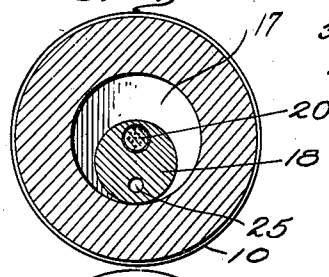
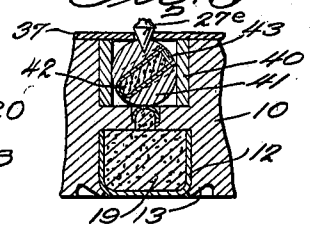


Fig. 5



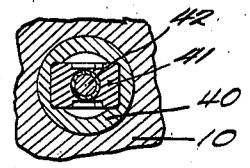


Fig. 5a

Fig. 1b

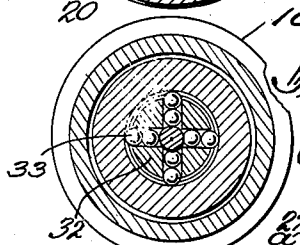


Fig. 4

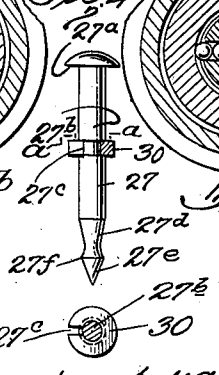


Fig. 2b

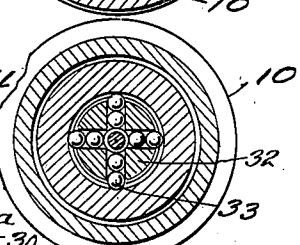


Fig. 4a

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Patented Nov. 30, 1943

2,335,842

UNITED STATES PATENT OFFICE

2,335,842

FUSE

Harry J. Nichols, Binghamton, N. Y.

Application January 13, 1940, Serial No. 313,789

19 Claims. (Cl. 102—71)

This invention relates to point detonating fuses especially designed for anti-aircraft projectiles and the like and will be described with relation to such application although it is to be understood that without material modification many features are equally applicable for other uses.

Detonating fuses for small anti-aircraft projectiles present particular difficulties because of their small size and the great accelerating and rotary forces to which the parts are subject in firing and in flight. It is essential that fuses for this purpose be extremely sensitive in functioning yet at the same time they must be entirely safe in handling and in firing. Because of the great force of "set-back" on firing, the detonator may occasionally be fired by concussion while the projectile is in the bore of the gun. This makes a "bore-safe" feature highly desirable. To be "bore-safe," a fuse must have adequate provisions against arming in the bore of the gun, and in the event the detonator is exploded by concussion, the explosion must be so limited as not to disrupt the fuse nor cause explosion or break-up of the projectile.

Another desirable feature is that the fuse be not completely armed until the projectile has travelled some distance beyond the muzzle of the gun, since a relatively strong retarding force acts on the projectile when it strikes the atmosphere on emerging from the gun, and if the sensitive firing elements can co-act, premature detonation may result. This feature is usually termed a "muzzle-safe" feature. To ensure adequate sensitivity and quickness on impact with light targets, such as wing covering of aircraft, the impact element should be such that the impact element first strikes the target, and as this element is thereby retarded, the projectile drives the detonator into the firing pin, producing instantaneous detonation before the projectile has been sensibly retarded. This is termed "supersensitive" and "super-quick" action.

In anti-aircraft defense, in the event the projectile does not encounter its target, it is highly desirable that the fuse cause the projectile to be completely detonated before reaching the ground, since the small projectile fragments, even when falling from great heights, are relatively harmless as compared to a projectile which detonates on striking or to large fragments from incompletely detonated projectiles. This is termed a "self-destruction" feature.

Provision for protecting the fuse mechanism against moisture during storage and in ammunition dumps, and while in ready condition at the gun is highly desirable. Finally, from the practical standpoint, fuses of this class should be simple in construction, easily loaded and assembled, and adapted to low cost manufacture in large quantity.

It is therefore one of the principal objects of this invention to meet in a highly efficient, reliable and practical manner the general and special requirements above stated.

Another object is to provide simple and reliable arming means which utilize in automatic manner forces generated by the firing process to complete arming, and to ensure self-destruction of the fuse and projectile in which it is assembled.

Another object is to provide novel and effective "bore-safe" and "muzzle-safe" features.

Another object is to provide means by which the distance at which the fuse becomes completely armed after the projectile has left the gun may be predetermined.

Another object is to provide means by which the distance at which the fuse destroys itself after firing may be predetermined.

Other objects will in part be obvious from the annexed drawing and in part hereinafter indicated in connection therewith by the following analysis of the invention.

This invention accordingly consists in the features of construction, combination of parts, and in the unique relation of the members and in the relative proportioning and disposition thereof, all as more completely outlined herein.

To enable others skilled in the art fully to comprehend the underlying features of this invention, that they may embody the same by the numerous modifications in structure and relation contemplated by the invention, a drawing depicting a preferred embodiment of the invention forms a part of this disclosure, and in such drawing like characters of reference denote corresponding parts throughout the several views, in which—

Fig. 1 shows enlarged and in longitudinal cross section a point-impact, detonating fuse illustrating one embodiment of the invention, the mechanism being shown in unarmed or normal safe condition.

Figs. 1*a* and 1*b* are transverse sections of the fuse shown in Fig. 1, the sections being taken on lines *a*—*a*, and *b*—*b* as indicated on Fig. 1, illustrating the unarmed positions of the rotor and "self-destruction" device respectively.

Fig. 2 shows the same fuse as in Fig. 1, in similar section, the mechanism being in armed condition after firing.

Figs. 2*a* and 2*b* are transverse sections of the fuse shown in Fig. 2, taken as indicated, illustrating the armed position of the rotor and "self-destruction" device respectively.

Fig. 3 shows the same fuse as in Figs. 1 and 2, in similar section, the mechanism being in fired position at "self-destruction."

Figs. 4 and 4*a* show details of the firing pin and snap-ring.

Figs. 5 and 5*a* show details of an alternative form of rotor.

Referring now to this drawing and particularly to Fig. 1, the main structural element of the fuse is in the body **10**, with external screw-threads **11** at the base end for assembly to the projectile (not shown). At the base is a cylindrical cavity, adapted to receive the booster cup **12**, the latter being filled with a charge **19** of compressed tetryl or the like. The booster cup is securely held in place by a spun-over lip **13** formed from the fuse body, as shown, or otherwise as desired. The point end of the body is provided with an internally threaded cylindrical cavity **14** adapted to receive the threaded portion **15** of a nose piece **16**. Rearwardly of the threaded cavity **14** is a cylindrical, smooth cavity **17**, called the rotor cavity, adapted to receive a rotor **18** in which a detonator **20** is mounted. Extending from the rotor cavity to the booster cavity is a minor axial hole, counter-bored at the upper end to receive the cord protector cup **21**. The interior of the cup and the axial hole are filled with tightly compressed tetryl or the like to form detonating cord **22** for transmitting the detonating wave from the detonator to the booster charge.

The rotor **18** is of short cylindrical form and considerably smaller in diameter than the rotor cavity **17**, in which it lies flat and eccentrically. The rotor has an eccentric round hole to receive detonator **20**, located so that the detonator can move into concentric relation to the fuse axis at arming, as from Figs. 1*a* to 2*a*. The detonator comprises a thin, drawn copper shell filled with highly compressed detonating material, such as fulminate or the like, and is sealed and cemented in place in well known manner.

The rotor **18** is also provided with a second off-center hole **25** adapted to receive the point **27***e* of firing pin **27**, this hole being located in the rotor so that when assembled in unarmed position it can lie at the axis of the fuse, as shown in Figs. 1 and 1*a*. The construction enables rotor **18** when assembled in unarmed position to swing freely around firing pin **27** as a pivot, but at the same time the detonator **20** is not permitted to come into alignment with detonating cord **22**. Sufficient space is provided transversely between detonator **20** and detonating cord **22** so that in event of premature explosion of the detonating material, the explosion will not be transmitted to the cord and booster. In this connection, it is to be noted that the least mass of the rotor is on the detonator side, and that considerable void space exists in rotor cavity **17**. Also that the cord protector cup prevents direct ignition of the detonating cord. These factors contribute toward rendering the detonator harmless when exploded in the unarmed, hence safe, position.

Referring again to Figs. 1 and 4, the nose piece **16** houses the firing pin **27**, the firing pin arming mechanism, and the self-destruction device. In this embodiment, the firing pin **27**, of steel and of the general form of a nail, has a thin oval head **27***a*, a shank **27***b*, groove **27***c*, a taper **27***d*, a bead **27***f*, and a sharp point **27***e*. The firing pin is of the head striker type, and lies in the axis of the fuse, the head extending outside the nose piece. At assembly of the firing pin in the nose piece a small gasket **28**, preferably of soft metal, is first strung along the firing pin into position under the head, and the firing pin is inserted into the nose piece. Then a small tight fitting split-sleeve **29** is forced along the shank of the firing pin until the latter is secured firmly in place as shown, and the gasket tightly seated between the head and nose piece to produce a seal at that point. Next a small snap ring **30** is pushed along the shank until it seats in groove **27***c*. The split-sleeve **29** is designed in such manner that its effective weight at "set-back" (usually exceeding 20,000 times its normal weight) will overcome the frictional force holding it to the firing pin, and cause it to slip back until stopped by the snap ring **30** which latter engages the pin in a fixed position. Next there is assembled over the firing pin, the firing pin extender spring **31**, a helical compression spring which abuts against snap-ring **30**, and the clutch member or ball-cage **32**, comprising part of the self-destruction device.

The self-destruction device comprises the ball-cage **32** of short cylindrical form having an axial hole to receive the firing pin and cross-diameter holes to receive a number of small balls **33**, called the locking balls, and the exploder spring **34** (a helical compression spring) of somewhat greater force than the extender spring **31**. The bore of the nose piece is step counter-bored from the base to provide working cavities for the split sleeve **29**, the exploder spring **34**, and the ball-cage **32**; and to form part of an annular race **35**, curved to fit the locking balls. Sleeve **36**, termed the race sleeve, preferably having a sloping lip at the top, is of such size externally as to fit tightly in the nose piece, but to provide clearance internally for the ball-cage. As will be explained in connection with the operation of the self-destruction device, the design of the exploder spring, the number of balls, and the slope of the lip of sleeve **36** may be varied to predetermine the range at which self-destruction occurs.

The assembly of the self-destruction device is effected as follows: The exploder spring is inserted in place and the required number of balls are placed in the ball-cage, which latter is slipped over the firing pin and into the nose piece; and the sleeve **36** is pressed into place, completing the assembly of these parts as shown in Fig. 1.

Between the nose piece and the fuse body is assembled a thin but strong metal washer **37**, termed the support washer, having an axial hole of such size as to receive the conical point of the firing pin. As the nose piece with its mechanism is screwed into place, care must be taken that the firing pin point enters the pivot hole **25** of the rotor as shown in Fig. 1.

Referring now to Figs. 1 and 2, the operation of the fuse is as follows: On firing, due to the set-back force, the set-back sleeve **29** slips along the firing pin shank **27***b* until stopped by snap-ring **30**. The firing pin **27**, supported by its head, remains in the pivot hole **25** of rotor **18**. After the projectile emerges from the muzzle of the gun, and at a predetermined distance if desired, the firing pin extender spring extends the firing pin against the head air-pressure into position as shown in Fig. 2.

Consider now the action of the rotor **18**. When

the projectile is in the bore of the gun, the set-back force will exceed the torque force due to the angular acceleration of the projectile, hence the rotor will remain pressed against the base of the rotor cavity in the body and will take up the rotation of the projectile without slipping. Should the detonator **20** be exploded by the set-back force, the explosive gases will be vented into the voids in the fuse without disrupting the fuse or exploding the booster charge **19**. Should the acceleration of the projectile be reversed due to coppering or other obstruction in the gun bore, the rotor would tend to be thrown forward. If the firing pin were projected forward, before its point could clear the rotor pivot hole the rotor would be pressed against the front of the rotor cavity, holding the rotor in unarmed position in a manner reverse to that at set-back. In short, the angular acceleration force tending to produce rotation of the rotor around its axis is minor compared to any conceivable translation acceleration force. Hence it is evident that the firing pin cannot strike the detonator while the projectile is in the bore of the gun.

As the projectile leaves the muzzle of the gun and the firing pin **27** is extended as before described, the rotor **18** is set free and, being in unstable balance, will start rolling around in the rim of the rotor cavity due to the retardation of the spin of the projectile in flight. However, the tendency to roll is curbed due to the centrifugal component and the rotor will stop in stable equilibrium as illustrated in Fig. 2*a*, in which position the detonator is in alignment with the cord **22** and the firing pin **27**. It is to be noted that the force due to the retardation of the spin is minor compared to centrifugal force. Thus it is evident that the fuse is "bore-safe" and "muzzle-safe."

The fuse being completely armed, on striking the target, even though it be a flimsy one such as wing fabric of an airplane, the head of the firing pin will encounter substantial resistance and will be checked in flight. The projectile will then drive the detonator into the firing pin, instantly detonating the former, the booster charge, and the projectile burster charge. It has been shown that under the conditions here described, the detonation proceeds so rapidly that a projectile having a high explosive burster charge is fragmented within a few inches of encountering the target.

Reverting to the manner of predetermining the point of arming of the fuse, the extender spring **31** works against the head air-pressure in flight. By proper design of the extender spring in relation to such pressure, which decreases gradually from a maximum at the muzzle, the approximate range at which the fuse is to arm can be predetermined, if desired. Thus, for example, assume that the projectile is fired with a muzzle velocity of 3,000 f. s. and it is desired to delay arming until the velocity has decreased to approximately 2,500 f. s. or at a range corresponding thereto. Application of known ballistic data and formulae enables the air pressure on the firing pin head at the lower velocity to be calculated, and by designing the extender spring force in extended position to equal this air-pressure force, arming will occur at the approximate range desired. Otherwise, the spring force is preferably designed to be slightly less than the air-pressure force on the firing pin head at the muzzle, and the firing pin is extended and the fuse armed for firing as previously described shortly after the projectile leaves the muzzle.

Consider now the action of the self-destruction device, which is provided to cause fragmentation of the projectile after it has passed the zenith of its trajectory to minimize the danger and damage caused by the projectile when it returns to earth. It is obvious that falling small fragments of a projectile, which fragments can acquire but limited velocity in falling, are less hazardous than a projectile which detonates when it strikes. The novel means here provided to effect self-destruction of the fuse and projectile operates in the following manner. At assembly of the fuse, as shown in Fig. 1, the shank of the firing pin acting on the locking balls causes the latter to be held out so that the balls farthest from the center engage the race formed by the fuse body and the race sleeve **36**. Hence the ball-cage **32** is held in position and sustains the thrust of the exploder spring; and at firing the set-back force of the balls, ball-cage, and exploder spring. After firing, due to the centrifugal force on the balls due to the rotation of the projectile in flight, the balls exert a radial force tending to prevent their displacement inwardly as would be required to permit the ball-cage and balls to pass completely into the cavity **39** in the race sleeve **36**.

Hence, although in extended position the taper **27***d* of firing pin **27** is opposite the balls, removing the restraint against the inward movement of the locking balls, the centrifugal force on the latter tends to resist downward displacement of the ball-cage due to the thrust of the exploder spring. It is evident that the principal factors governing the holding action of the balls are the centrifugal force on the balls, the force of the exploder and extender springs, and the slope on the lip of the race sleeve. By means of a fuse spinning device, and by proper consideration and design of the above factors, the revolutions of the fuse at which the exploder spring will overcome the holding force of the balls and snap the ball-cage downwards can be predetermined as required for the particular application.

The operation of the self-destruction device is as follows: On firing, the locking balls are thrown outward by centrifugal force and temporarily hold the ball-cage in position. The firing pin is extended as described under arming, and the taper **27***d* is moved to a position opposite the locking balls, leaving the firing pin and locking balls free insofar as their mutual co-action is concerned. (See Fig. 2.) After the spinning projectile passes its zenith (assuming that the target is not encountered) the centrifugal force on the balls diminishes to the point where the holding action of the balls is unable to overcome the thrust of the exploder spring, whereupon the balls are forced inwardly by the slope on the race sleeve **36**. The balls re-engage the firing pin at the taper **27***d*, and by reason of the enlarged bead **27***f*, seize or clutch the firing pin near its point. The exploder spring (assumed to be stronger than the extender spring) acts via the ball race and balls to return the firing pin to its original position, and thus drives its point **27***e* into the detonator to explode same. (See Fig. 3.)

In this connection it is to be noted that when projectiles are fired at high angles, as in anti-aircraft defense, the spin of the projectile in flight decreases less rapidly than the linear velocity, since the linear velocity is decreased due to the work done against gravity and air resistance, while the spin is decreased only by

air resistance, which resistance diminishes at high altitudes due to the lesser density of the atmosphere. Hence at the zenith of the trajectory, where the vertical velocity of the projectile is spent, a relatively large percent of the original spin still exists. By proper coordination of results of tests on a fuse spinner and firing tests, the point in the trajectory at which the fuse destroys the projectile can be predetermined within the degree of accuracy required in practice.

Referring to Figs. 5 and 5*a*, which show another embodiment of the invention with respect to the form of the rotor, the main parts of the fuse are as previously described except that the rotor is of different form and operates on a different principle.

The rotor sleeve **40** is of hollow cylindrical form broached with a special rectangular bore adapted to receive the rotor **41**, Fig. 5*a*, the latter being of short cylindrical form and lying edgewise in rotor sleeve **40**. The rotor has a diametral round hole adapted to receive a cylindrical detonator capsule **42**. The detonator capsule is preferably a thin drawn copper shell, in which the highly compressed fulminate detonating charge is loaded. The assembly of the detonator is completed by covering the fulminate charge, loaded not quite to the top, by a thin disc **43** cemented in place by a waterproof cement. When the detonator capsule **42** is loaded into the rotor, it is coated with a strong adherent cement to hold the capsule securely in place in the rotor **41**. The rotor is provided with a small tapered hole, located at an angle of approximately 45° to the axis of the detonator **42**, this hole being adapted to receive the point **27***e* of the firing pin **27** when the rotor is in safe position as shown in Fig. 5.

The rotor **41** is of a particular form, so that while it is virtually statically balanced as it lies in the rotor sleeve **40**, it is dynamically unbalanced with respect to the axis of the fuse, which is likewise the axis of rotation of the projectile while in flight.

Referring to Fig. 5 as to the normal or unarmed position of the rotor **42**, as the projectile leaves the muzzle of the gun and the force of the propellant becomes spent, the acceleration of the projectile and hence the set-back ceases. At the same time the rotation of the projectile due to firing and hence the centrifugal force is a maximum, therefore the unbalanced centrifugal forces tend to cause the rotor to turn into the position shown in Fig. 5*a*, in which the axis of the detonator coincides with the axis of the fuse. The other parts of the fuse having functioned as above described, at some safe distance beyond the muzzle of the gun the firing pin frees the rotor which latter turns the detonator to armed position, thus completely arming the fuse. Also the firing of the fuse on contact or the self-destruction features are as previously set forth.

Without further analysis the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various applications without omitting certain features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of the invention, and therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalency of the following claims.

I claim:

1. In a fuse of impact or self-destroying type, in combination, a fuse body, a nose assembled to said body, a firing pin carried by said nose, arming means therefor contained in said nose including a locking member operable by set-back on firing to release said firing pin for subsequent arming movement, a centrifugally movable detonator holder mounted in the fuse body and held against movement by said firing pin and operable after release to arm the detonator, a detonator contained in said holder and normally maintained safe from action by the firing pin and harmless in the event of premature explosion of said detonator, and centrifugally regulated means adapted to cause said firing pin to impact with and explode said detonator for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

2. In safety arming and firing means for a fuse of the class described, in combination, a firing pin, set-back actuated means for normally holding the firing pin in unarmed position and on firing for freeing said firing pin to permit movement thereof to armed position, spring means effective after the fuse is fired to move the firing pin into armed position, a centrifugally operated movable detonator holder containing a detonator and normally restrained by said firing pin to maintain the detonator in safe position and adapted after firing to move the detonator from said safe to armed position, and means adapted to impact said firing pin with said detonator under predetermined centrifugal conditions with respect to firing for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

3. In safety arming and firing means for a fuse of the class described, in combination, a head-striker firing pin, set back actuated means adapted to free said firing pin on firing, means for moving said firing pin from unarmed to armed position, a detonator, a centrifugally operated movable holder therefor adapted to move said detonator from safe to armed position under predetermined conditions after firing, and means adapted to co-act with said firing pin for exploding said detonator under predetermined conditions with respect to firing for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

4. In safety arming and firing means for a fuse of the class described, in combination, a grooved impact firing pin, set-back actuated means adapted normally to hold said firing pin in unarmed position and on firing to free said firing pin for arming, means effective after firing for extending said firing pin forwardly to armed position, and centrifugally controlled means adapted to co-act with the groove in said firing pin to cause the same to forcibly impact with said detonator to explode the same under predetermined conditions with respect to firing for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

5. A fuse as set forth in claim 4 in which the means for producing self-destruction comprise a ball-cage, a spring member normally tending to thrust said ball-cage out of position of assembly, and a plurality of balls in said ball-cage adapted to maintain same in position of assembly until predetermined conditions prevail with respect to

firing, and thereupon to clutch with the firing pin to impact the same with the detonator.

6. In a projectile fuse of impact or self-destroying type, safety arming and exploding means including an impact firing pin and a detonator, set-back actuated means for normally holding said firing pin in exploding position and on firing adapted to free said firing pin for movement into armed position after firing, and self-energized means controlled by the centrifugal force in flight for forcibly returning the firing pin to the exploding position under predetermined centrifugal conditions after firing for exploding said detonator thereby producing self-destruction of the use and projectile at a predetermined point in the trajectory.

7. In a fuse of the class described, safety arming and exploding means including a detonator, means for maintaining said detonator in safe position before and during firing and for arming said detonator after firing, a firing pin, means for normally holding said firing pin in exploding position and actuated by set-back on firing to free said firing pin for movement into armed position after firing, and kinetic means controlled by the centrifugal force in flight for forcibly returning the firing pin to the exploding position under predetermined centrifugal conditions after firing for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory in the event the projectile does not strike the target.

8. In a fuse of the class described, safety means for producing self-destruction in flight under predetermined conditions comprising, in combination, a firing pin, safety means for normally locking said firing pin in safe position, means for arming said firing pin, a movable detonator normally maintained in safe position by the firing pin, centrifugal arming means for said detonator, and centrifugally controlled means for overcoming said firing pin arming means and for causing said firing pin to forcibly impact and explode said detonator to produce self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

9. In safety arming and firing means for a fuse of the class described, an impact operable firing pin normally held in safe position, set-back actuated means for releasing said firing pin, a centrifugally unbalanced detonator holder normally maintained inoperative by said firing pin and having a detonator in normally safe position out of line with said firing pin, said holder being turnable by centrifugal action of the fuse in flight to bring the detonator in line with said firing pin, and means co-acting with said firing pin for causing said firing pin to forcibly impact said detonator and produce self-destruction of said fuse on a predetermined decrease in centrifugal action after firing in the event the target is not encountered.

10. In fuse means of the character set forth in claim 9, in which said last means includes a spring actuated clutch cooperating with said firing pin for driving said firing pin into exploding contact with said detonator.

11. A self-destroying impact fuse for anti-aircraft projectiles having a movable detonator and impact firing pin, centrifugally actuated means for moving and arming said detonator, means for moving and arming said impact firing pin, and centrifugally controlled spring actuated means co-acting with said firing pin for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing in the event the projectile does not strike the target.

12. In a fuse of the character set forth in claim 11, in which said last named means includes a spring-actuated clutch for forcibly seizing and driving the firing pin into exploding contact with the detonator.

13. In a fuse of the character set forth in claim 11, in which said last means is operative only when the spin of the projectile in flight has decreased a predetermined amount.

14. In safety arming and firing means for anti-aircraft projectile fuses, in combination, an impact firing pin, a normally safe movable detonator, means for conditioning said firing pin and said detonator by relative movement of both for co-action on impact with a target, and centrifugally controlled spring means co-acting with said firing pin for causing said firing pin to impact and explode said detonator at a predetermined point in the trajectory after firing in the event the projectile does not strike a target within a predetermined range.

15. In a fuse of the class described, safety arming and firing means including a detonator mounted in a centrifugally actuated rotor, a grooved impact firing pin normally held safe in exploding position, means for moving the firing pin forwardly from exploding to operative armed position, means for rotating the detonator to armed position under predetermined conditions after firing, and means controlled by centrifugal force, including ball means, for seizing said firing pin where grooved to force it back to its exploding position under predetermined conditions in flight for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

16. In a fuse of the class described, safety means for producing self-destruction under predetermined conditions with respect to firing comprising a movable detonator, a detonator holder rotatable under centrifugal force, safety means therefor, a grooved firing pin, means for moving said firing pin forwardly from exploding to operative armed position after firing, a plurality of locking balls adapted to coact with said grooved firing pin, a member adapted to hold said balls in operative relationship to said firing pin, and spring means adapted to apply force via said member and said balls to overcome the means for moving said firing pin to operative position and to return forcibly said firing pin to exploding position with respect to said detonator to produce self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

17. In anti-aircraft projectile impact fuses, a self-destruction device comprising a grooved firing pin normally held in exploding position, means for moving said pin to armed position after firing, a detonator, a centrifugally actuated safety holder therefor, kinetic detonator firing means including a compression spring, and a combined lock and centrifugally controlled clutch including ball means for normally locking said spring in compressed position and for connecting said compression spring through said ball means directly with said grooved firing pin to produce self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

18. In a fuse of the class described, centrifugally regulated means for producing self-destruction under predetermined conditions with

respect to firing, comprising a detonator mounted in a centrifugally actuated holder, a firing pin formed with an annular grooved portion adapted to unlock said first means after the fuse is fired in a gun, a ball-cage, a stationary ball race, spring means exerting force tending to displace said ball-cage, and a plurality of balls mounted in said ball-cage normally co-acting with said firing pin and said ball race to prevent displacement of said ball-cage, and under predetermined centrifugal conditions coupling with the grooved portion of the firing pin to apply suddenly the force of the spring means to the firing pin to produce self-destruction of the fuse and projectile at a predetermined point in the trajectory after firing.

19. In self-destruction devices for anti-aircraft impact fuses in combination, a grooved firing pin normally held safe in exploding position, a centrifugally actuated safety detonator holder with a detonator movable to armed position after firing, means for moving said pin to armed position after firing and for releasing said detonator holder, a compression spring; an annular ball race in a stationary member, and a clutch mechanism acted upon by said compression spring including a combined spring support and ball cage and a plurality of balls, which balls normally coact with said firing pin and said race to hold said cage in position against the force of said spring and after firing under the control of centrifugal force attach such cage directly to the groove of said firing pin for producing self-destruction of the fuse and projectile at a predetermined point in the trajectory.

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