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DETONATING OR IMPACT FUSE

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Fig. 1

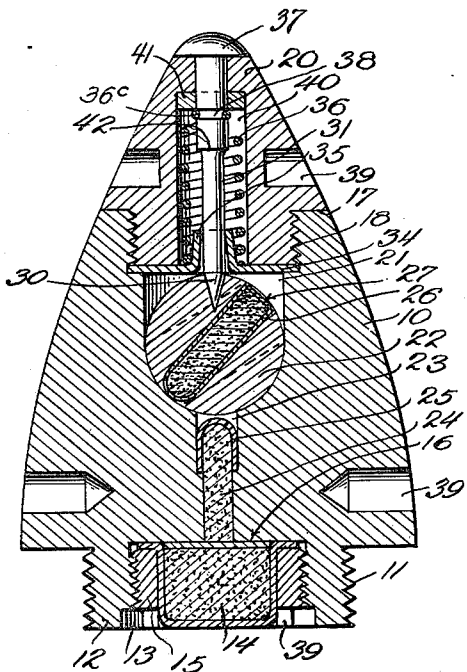


Fig. 2

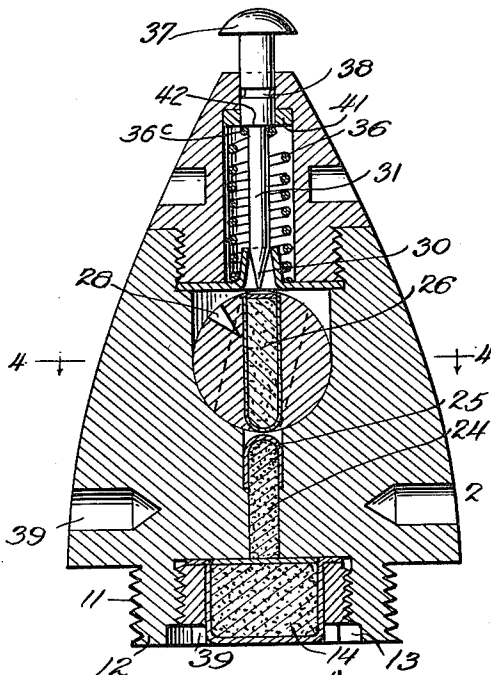


Fig. 3

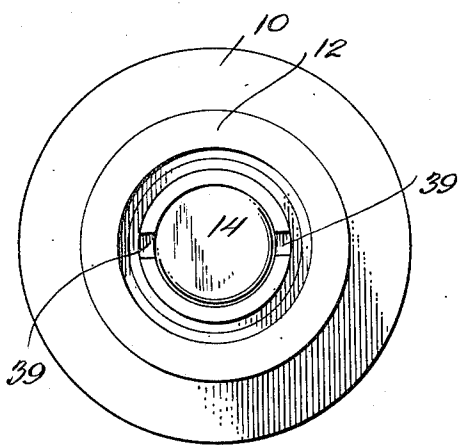


Fig. 4

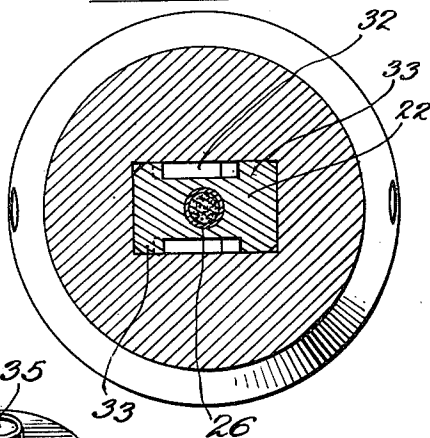
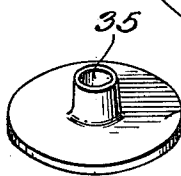


Fig. 5



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DETONATING OR IMPACT FUSE

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7 Claims. (Cl. 102—80)

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This invention relates to detonating or impact fuses especially for anti-aircraft or anti-tank projectiles and the like.

Detonating fuses for small anti-aircraft projectiles, for example, offer numerous difficulties because of their small size and the great accelerating and rotary forces to which the parts are subjected in firing and in flight. Yet it is necessary that fuses for this purpose be extremely sensitive on impact, and at the same time be entirely safe in storage, handling, and firing. Because of the force of "set-back" on firing some projectiles, the detonator may be fired by concussion on firing. This makes a "bore-safe" feature highly desirable. A fuse to be "bore-safe" must have adequate provisions against arming in the bore of the gun, and in the event the detonator is exploded by concussion, provision must be made against the burster charge of the projectile being exploded and the present invention accomplishes this. A further desirable feature is that the fuse be not armed until the projectile has travelled some distance beyond the muzzle of the gun, since a strong retarding force occurs when the projectile strikes the air on emerging from the gun, and if the sensitive firing elements can co-act, premature firing may result. To insure sufficient sensitivity on impact with light targets, such as the wings of aircraft, the firing element must be of light weight. To obtain both super-sensitive and super-quick action, special provision should be made that the firing pin first strike the target, and as this element is thereby retarded, the projectile collides with the firing pin, producing detonation before the projectile has been sensibly retarded. In order to insure certain arming action and sensitivity, it is highly desirable that the arming and firing elements be virtually dynamically balanced with respect to the axis of rotation of the projectile, since otherwise the high rate of rotation of the projectile in flight will produce undesirable unbalanced forces tending to interfere with the intended action and sensitivity.

Finally, from the practical standpoint, fuses of this class should have few parts, 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 rugged arming means which utilize forces gen-

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erated by the firing process to effect arming in part, complete arming being dependent upon the action of supplementary kinetic means.

Another object is to provide means for extending the impact firing element after the projectile is in flight.

Another object is to provide a high degree of safety against premature explosion in handling the fuse, or on firing the loaded and fused projectile.

Another object is to provide a novel and effective "bore-safe" feature.

Other objects will in part be obvious from the annexed drawings 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, drawings depicting a preferred embodiment of the invention form a part of this disclosure, and in such drawings like characters of reference denote corresponding parts throughout the several views, in which—

Fig. 1 shows in longitudinal section a point-impact, detonating fuse according to the invention, the mechanism being shown in unarmed or safe condition.

Fig. 2 is a similar section, showing the mechanism in armed condition or its condition immediately after being fired.

Fig. 3 shows a bottom view of the fuse.

Fig. 4 shows in section details of the rotor or detonator holder taken on 4—4 of Fig. 2.

Fig. 5 is a perspective detail of the spring support.

Referring to these drawings, and especially Fig. 1, the fuse casing includes a body 10 of rugged proportions with external screw threads 11 at the base end 12 for assembly to the projectile not shown. At the bottom is an internally threaded cavity 13 in which a loaded booster cup 14, containing pressed tetryl or the like, is secured by means of a threaded ferrule 15. The tetryl is covered by a paper disc 16 for protective purposes. The point end 17 of the fuse body 10 is provided with an internally threaded cavity 18 adapted to receive the nose piece 20 which forms

part of the fuse casing. Rearwardly of the threaded cavity 18 is a cavity 21 specially shaped to receive the rotor 22 or detonator holder to be described and to cause said rotor at all times to rotate with the projectile when the latter is fired. Because of its shape, this cavity is preferably formed by forging or casting. Extending from the rotor cavity 21, to the booster cavity is a small diameter axial hole 24, counter bored at the upper end to receive a small metal cup 25, called the cord protector cup. The interior of the cup and the axial hole are filled with tightly compressed tetryl or the like, this part of the detonating train being termed the detonating cord. The purpose of the protector cup 25 is to protect the end of the cord from moisture, and also from hot gases likely to be generated in event of premature explosion of the detonator 26, carried by the rotor 22.

The rotor 22 is centro-symmetric, that is, it is symmetric with respect to its center of mass. Consequently, it is statically balanced with respect to any axis passing through its center. Illustratively, such a rotor may take the form of a right-circular cylindrical member disposed edge-wise in the rotor cavity 21, with its axis transverse to the axis of the fuse body. By virtue of its special shaping aforesaid, the rotor cavity, for the right-circular cylindrical rotor illustrated, is provided with a cylindrically curved bottom portion and with plane end walls against which the end faces of the rotor seat. Accordingly, the rotor may turn relatively to the fuse body on its own axis, but is constrained by engagement of its end faces with the end walls of the cavity to at all times rotate with the fuse and projectile when the latter is fired.

Midway of its ends, the rotor has a diametral round hole adapted to receive the cylindrical detonator capsule 26. The detonator capsule preferably is 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 27 cemented in place by a water-proof cement. When the detonator capsule 26 is loaded into the rotor, it is coated with a strong adherent cement to hold the capsule securely in place in the rotor 22. The rotor is provided with a small tapered hole 28 (Fig. 2) located at an angle 45° or more to the axis of the detonator 26, this hole being adapted to receive the point 30 of the firing pin 31 when the rotor is in the safe position as shown in Fig. 1.

In addition to the rotor 22 being formed so that it is virtually statically balanced with respect to its axis, it is also so constructed that in its assembled position and prior to arming, it is dynamically unbalanced with respect to the axis of the fuse, which is likewise substantially the axis of rotation of the projectile accordingly, and referring to Fig. 4, on each end of the rotor 22 a central channel 32 is cut at an inclination of say 10° to the axis of the detonator 26. This leaves two lands 33 on each end of the rotor in the form of segments contained within the circular section of the rotor, each subtending an arc of approximately 120°, which segments produce the dynamic unbalance. The unbalanced areas are indicated by the portions between the dotted lines and periphery in Fig. 2. There is also some minor unbalance due to the detonator hole and its contents, but because of the relatively small diameter of this hole and the po-

sition of the centers of gravity of the unbalanced portions, the rotative effect produced thereby is minor, and for purposes of understanding the principle of the rotor, the unbalanced segments 33 may be considered to produce the main rotative effect.

Referring again to Fig. 1, between a shoulder on the fuse body 10 and the nose piece 20 is assembled a disc 34 with extruded and pierced central projection 35, Fig. 5. This disc supports the firing pin extending spring 36, while the central projection forms a guide for the firing pin 31. The firing pin, having a sharp pointed inner end 30 and a rounded head 37 extending outside the nose piece 20, is larger in diameter at the head of its shank, which shank is circled by a groove 38 (Fig. 2). The nose piece 20 and spring support 34 maintain the firing pin 31 in position in the axis of the fuse. The nose piece axial hole is counter-bored from the inner end to provide a barrel 40 in which works a small setback ring 41, also the extender spring 36. The top coil 36c of the extender spring 36 is of smaller diameter than the other coils, and fits snugly into the groove 38 in the firing pin shank 31.

The various threaded parts of the fuse are assembled by spanners engaging recesses 39 as shown in Fig. 1. Then the operation is as follows: On firing, all parts tend to move away from the point 37 by reason of the acceleration of firing, termed "set-back." The set-back ring 41 and extender spring 36 are affected by this force, and the top coil 36c of the spring is forced out of the groove 38 in the firing pin shank 31, due to the inertia of the ring and of the spring itself, and moves rearwardly until the coil 36c rests below the tapered shoulder 42 of the firing pin. The firing pin 30, supported by its head 37, remains in the hole 28 in the rotor 22, preventing the rotor from rotating, although the set-back force on the rotor is normally adequate to prevent rotation of the rotor while the projectile is in the bore of the gun.

It should be noted here that in event the detonator 26 is exploded by the concussion of firing, the rotor 22 is being pressed against the bottom of the rotor cavity 21 with great pressure, and the effect of the detonator explosion will be to wedge a plug of metal from the rotor into the top of the axial cord hole 24, securely sealing same against the entry of hot gases. The cord protector cup 25 will shield the tetryl cord from mechanical shock to a degree sufficient to prevent shock detonation. The gases from the detonator will expand into the voids in the fuse, the set back force sufficing to prevent expulsion of the firing pin.

Referring now to Fig. 2, as the projectile leaves the muzzle of the gun, and the force of the propellant becomes spent, the acceleration of the projectile ceases, and deceleration due to the air resistance occurs. At this instant, the extender spring 36 advances the firing pin 30 to extended position as shown in Fig. 2. The rotor is now freed of the restraint of the firing pin 30 and the set-back force, and at the same time the rotation of the projectile due to firing is a maximum. Thus the dynamic unbalance of the rotor 22 takes effect and causes the rotor to rotate the detonator 26 into axial position as shown. The fuse is now completely armed (at some distance beyond the muzzle of the gun), and on striking the target, even though the target be a flimsy one, such as the wing fabric of an airplane, the head 37 of the firing pin will en-

counter substantial resistance and will be checked in flight. The projectile will then relatively drive the detonator 26 into the firing pin 30, instantly detonating the former. The wave of detonation will travel through the tetryl cord 24 and booster charge 14 to the projectile burster or high explosive charge (not shown) but of standard construction. The detonation wave travels so rapidly that the projectile will burst within a few inches of the point of encountering the target. As is well known to those versed in this art, the firing point 30 is made sharp, and the top layer of the detonator charge is of particularly sensitive composition to promote sensitive firing action.

It will be evident that the invention provides novel and advantageous features and adequately meets the general and special requirements for fuses of this class.

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 the class described, in combination, a fuse casing, a centrifugally actuated rotatable cylindrical detonator holder mounted therein, a detonator mounted diametrically in said holder in safe position, an axial detonator firing pin in restraining engagement with said holder, safety means for maintaining said firing pin in said restraining engagement, and spring means adapted to act on said firing pin to advance said firing pin from said restraining engagement to armed position after the fuse is fired in a projectile.

2. In a fuse for rotative projectiles, in combination, a fuse body having an axial cavity, a centrifugally rotatable cylindrical detonator holder rotatably mounted in said cavity, a nose piece mounted on said body, a detonator firing pin axially mounted in said nose piece in safe position, a detonator diametrically mounted in said holder and normally maintained in safe position by said firing pin and rotor, and firing pin arming means adapted normally to maintain said firing pin in safe position and on firing of the projectile automatically to release said firing pin and immediately after firing to move it into firing position.

3. In a fuse of the class described, in combination, a head striker detonator firing pin, a centrifugally actuated cylindrical detonator rotor carrying a detonator normally maintained in safe position by said firing pin, and firing pin arming means actuated on firing in a gun to release said firing pin, and after firing to advance said firing pin to armed position, thereby to release said rotor and to permit said detonator rotor to rotate said detonator to armed position.

4. In a fuse for a rotative projectile, a self-aligning and self-locking centrifugally actuated detonator safety rotor comprising a cylinder having a central diametral bore and rotatably mounted with its axis transverse to the axis of the fuse, a cylindrical detonator mounted in said bore with its axis oblique to the axis of rotation of the fuse, and means including a passage in said rotor extending parallelly with respect to the axis of said detonator for generating angularly limited torque responsively to centrifugal force resulting from the spin of the projectile in flight, thereby to rotate said detonator from safe to armed position and to maintain the detonator in armed position.

5. As an article of manufacture, a centrifugally actuated detonator safety rotor having torque-couple masses for use in rotative projectile fuses comprising a cylindrical member with a central diametral cylindrical hole adapted to contain a detonator capsule, and at least one passage in said cylindrical member disposed substantially parallelly to said hole, thereby to produce a torque-couple responsively to centrifugal force acting to rotate said member about its axis.

6. In a detonating fuse for rotative projectiles a centrifugally actuated detonator safety rotor comprising a rotatable member having a central diametral bore adapted to carry a detonator capsule and having integral means for producing torque acting to rotate said member to armed position responsively to centrifugal force, said means comprising symmetrical masses formed by at least one passage extending diametrically across said member in a direction substantially parallel to said diametral bore.

7. In a detonating fuse for rotative projectiles, a centrifugally actuated safety rotor comprising a cylindrical member having a central diametral bore adapted to carry a detonator capsule, and also having integral means for producing a torque-couple responsively to centrifugal force, said torque-couple acting to rotate said member about its axis to armed position, said means comprising lands formed by a groove extending diametrically across the end of said member in a direction substantially parallel to said bore.

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