United States Patent [19]

Brothers

[11] **3,765,340**

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[54] **ARMING AND UNARMING DEVICE**

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[73] Assignee: **The United States of America as represented by the Secretary of the Army,** Washington, D.C.

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[21] Appl. No.: **245,335**

[52] **U.S. Cl.** **102/79,** 102/70.2

[51] **Int. Cl.** **F42c 15/22**

[58] **Field of Search** 102/70, 70.2, 79, 102/80; 73/539, 535, 512

[56] **References Cited**

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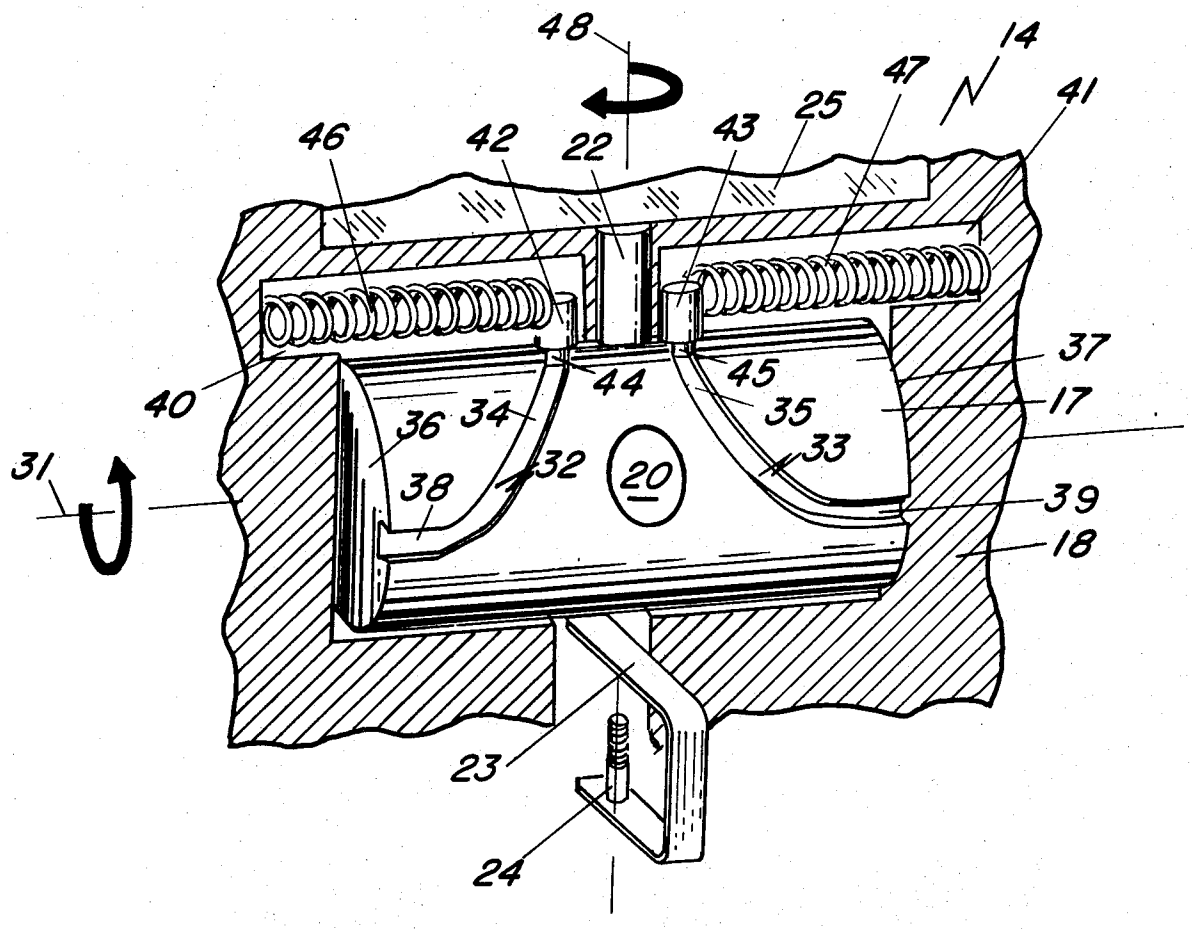
Assistant Examiner—H. J. Tudor
Attorney—Harry M. Saragovitz et al.

[57] **ABSTRACT**

A spin actuated arming and unarming fuze mechanism for a spin stabilized projectile which includes a cylindrical rotor that carries an electrically activated detonator having a contact extending outwardly of the rotor in the path of a stationary fixed switch contact. The rotor is supported within a housing that also has disposed therein a lead cup explosive assembly and positioned such that when the rotor is in one of its terminal positions (armed) the detonator contact is electrically connected to the switch contact and the opposite end of the detonator is in alignment with the lead cup assembly to provide an explosive train in conjunction with a booster explosive. The rotor housing inner wall is formed with an opposed pair of channels in each of which are disposed a spring and a cam follower free to slide therein against the spring bias force. The follower is provided with an extending rider which cams within a cam follower channel groove within the outer surface of the rotor so that as each cam follower traverses its channel the rotor will be rotated thereby from its unarmed to its armed position. This movement can only be induced by spin forces exerted on the projectile within which the fuze mechanism is carried and the springs will return the rotor to its unarmed position in the absence of spin energy.

8 Claims, 6 Drawing Figures



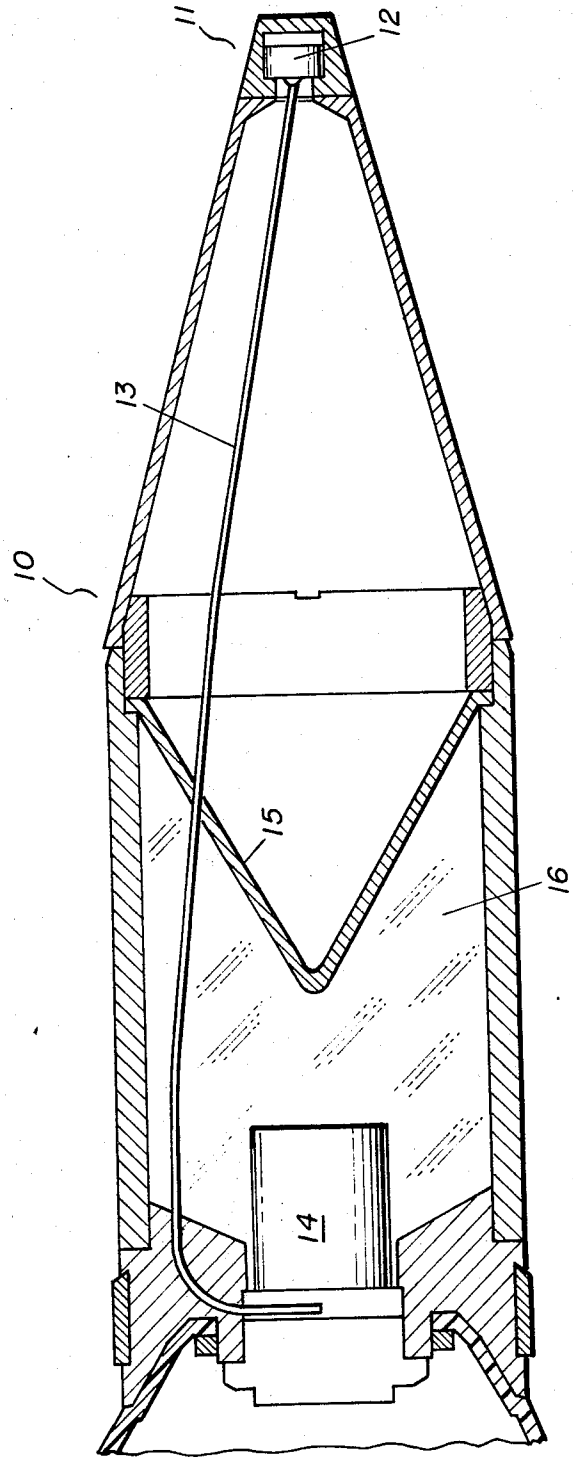


FIG. 1

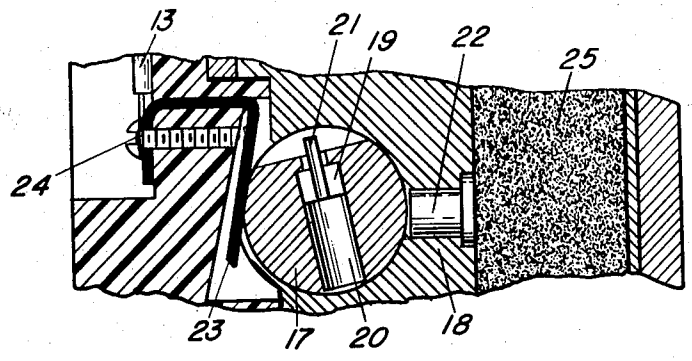


FIG. 2

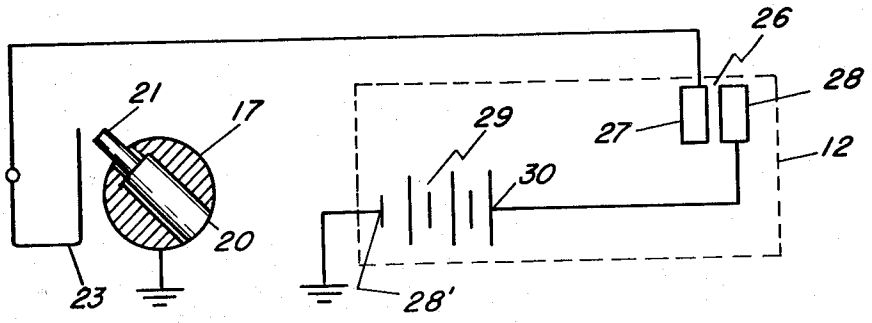


FIG. 3

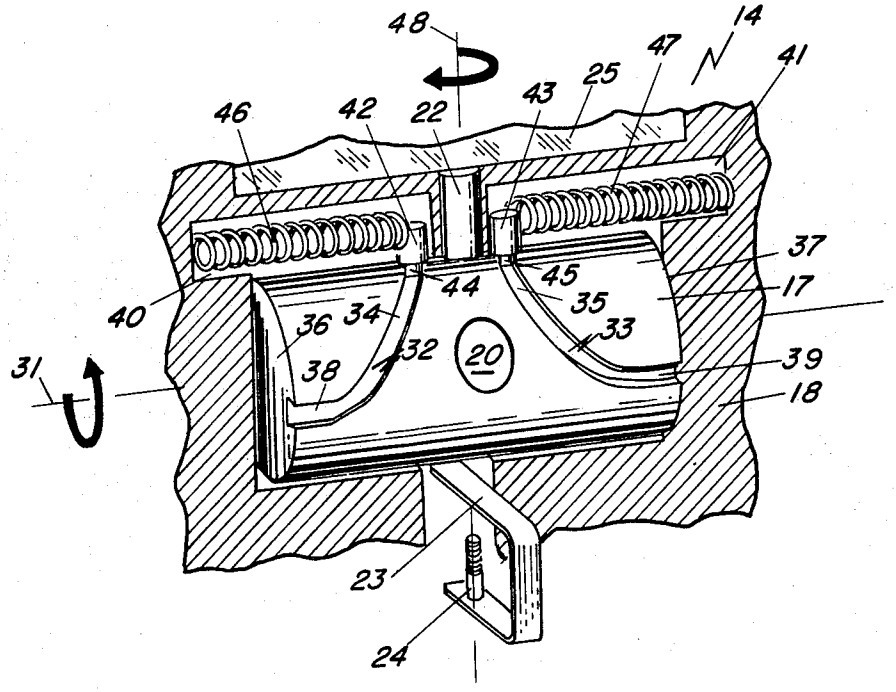


FIG. 4

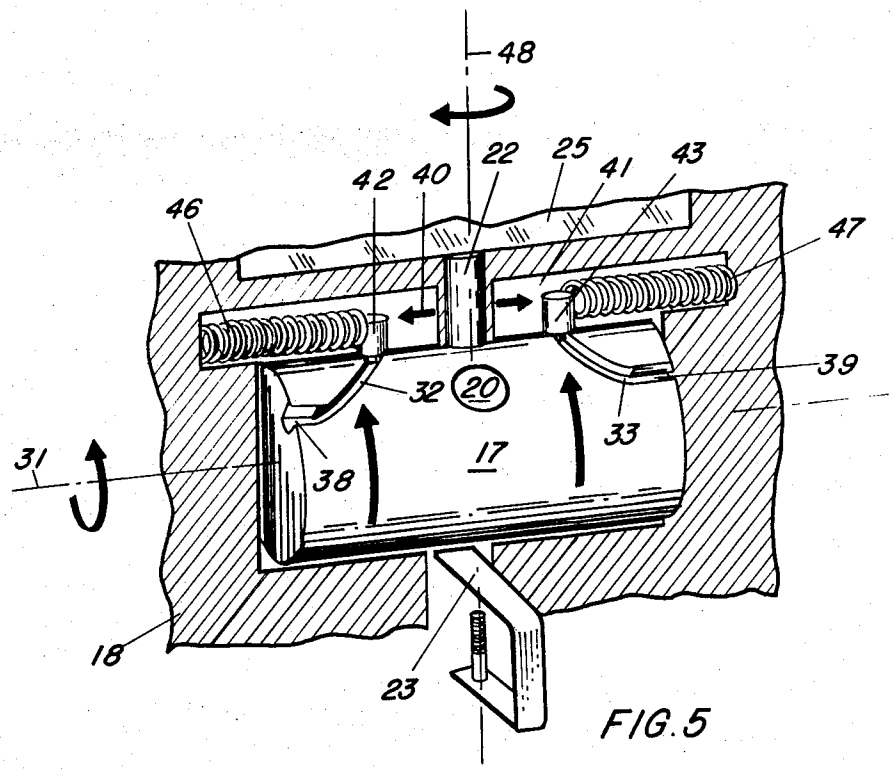

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FIG. 5

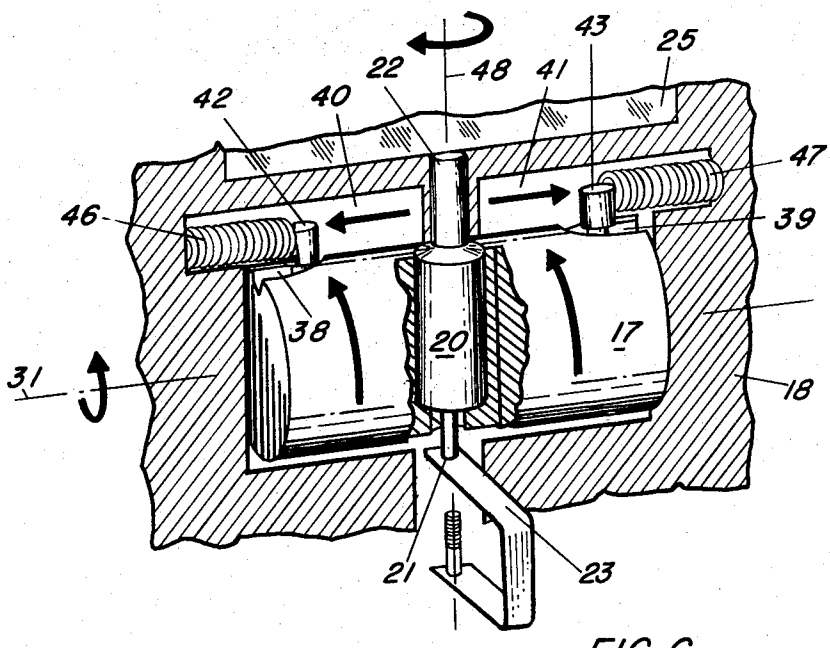
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FIG. 6

ARMING AND UNARMING DEVICE

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

BACKGROUND OF THE INVENTION

The present invention relates to an arming device for a fuze system and more particularly pertains to spin actuated delay fuze arming device wherein a rotor carrying a detonator, is rotated by a pair of biased cam followers under the projectile spin forces to align an explosive train and to complete the necessary electrical circuit only during the presence of spin.

In the field of arming and disarming fuze mechanisms, it has been the general practice to provide electrical or mechanical structures for properly arming the munition but, these are single acting and when they result in "duds" it is not assured that the device is unarmed. In any case, however, there have not been provided to date safe devices where the rotors of the "duds" are automatically returned to the unarmed position as is the situation in the present invention. Delayed arming in conjunction with safe arming are all inherent in the subject device.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide an arming an unarming device for a munition that has all the advantages of similarly employed prior art devices and has none of the above described disadvantages. To attain this, the present invention provides a unique spin actuated arm and unarm fuze mechanism wherein a rotor carries an electrically activated detonator having an extending electrical contact. The rotor is free to rotate and does so under the action of a pair of opposed cams that, under spin induced forces, move outwardly. These cams carry depending riders which move within channels in the rotor surface. Thus, as the cam followers move outwardly and ride in the rotor channels the rotor is compelled to rotate and in so doing aligns the detonator, which it carries, to form an explosive train as well as completing the fuze initiaing electrical circuit. Should the spin terminate, the bias fore applied to the cam followers moves them to their inward position and at the same time, the rotor to the unarmed position.

An object of the present invention is to provide a safe, reliable, simple and inexpensive arming and unarming device for spin stabilized munitions.

Another object is to provide a safe rotor operable arming device which introduces a delay and upon failure to function returns to its unarmed state.

Still another object is the provision of an arming device which incorporates an electrically functionable detonator carried by a spin cam driven rotor which includes both an electrical and mechanical safety.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein;

FIG.1 is a cross-sectional view of a projejtile which has incorporated therein an embodiment of the instant invention;

Fig. 2 is a cross-sectional view of a portion of the fuze assembly of FIG. 1;

FIG. 3 is a schematic diagram of the electrical circuit of the firing and activation of the explosive train; and,

FIGS, 4, 5 and 6 are perspective views of the embodiment made in accordance with the principle of this invention at various stages of operation between the unarmed and the armed state.

A BRIEF DESCRIPTION OF A PREFERRED EMBODIMENT

In the illustration of FIG. 1, the projectile **10** carries at its forward end **11** an impact sensing means **12** and an electrical energy source which could include an impact switch and a battery or only a piezoelectric transducer. The sensing means **12** is connected by electrical lead **13** to the near positioned fuze assembly **14** so as to provide an electrical output signal thereto at the instant of impact. Intermediate the forward end and the fuze assembly **14** the projectile includes a shaped charge liner **15** and a shaped charge **16** while the forward space between the liner and the sensing means constitutes the standoff distance. The projectile is provided with means that may include an obturator that results in proper launch and imparts spin to the projectile. FIG. 2 illustrates, in detail, with portions broken away, the essential fuze assembly that includes a rotor **17** supported for rotation within the housing **18.** The rotor is in the form of a generally cylindrical solid with a transverse recess **19** in which is disposed an electrical detonator **20** that is provided with an outwardly extending electrical contact tip **21.** The rotor housing also supports an explosive lead cup assembly **22** proximate the rotor and opposite thereof a flexible electrical contact **23.** This latter contact is connected via lug **24** to the electrical lead **13** from the sensing means **12.** The cup assembly **22** is in communication with the explosive booster **25** to complete the explosive train. FIG. 3 sets forth the electrical circuit for detonator activation and includes the sensing means **12** that in this example includes a standard impact switch **26** that carries a pair of contacts **27** and **28** that are shorted upon projectile impact. One switch contact **27** is connected via wire lead **13** to the flexible detonator contact **23** and is in a position to make contact with the detonator tip contact **21** when the rotor **17** assumes the armed position. The rotor is grounded and since the detonator case is in electrical contact therewith it is likewise grounded or connected to one side **28'** of the battery **29.** The other battery terminal **30** terminates at switch contact **28** to complete the circuit whereby, upon impact, the switch **26** closes placing a potential at flexible contact **23** allowing current to pass through the detonator **20** when in the armed state to thereby initiate the explosive train.

In the detailed illustration of FIG. 4 the rotor **17** is supported for rotation about a longitudinal axis **31** as by shaft extensions and bearings carried by the rotor housing **18.** The cylindrical rotor surface is formed with mirror imaged guide channels **32** and **33** which start at two points **34** and **35** equally spaced from the longitudinal center of the rotor. The channels then diverge outwardly toward the ends **36** and **37** but terminate at the ends thereof in short straight longitudinal sections **38** and **39.** The rotor housing is provided with a pair of longitudinally and oppositely directed cavities **40** and **41** proximate and communicating with the rotor surface. The central portion of the housing is also formed with communicating recess which carries therein the

explosive lead cup assembly **22** intermediate the booster **25** and one terminus of the path of the detonator **20.** A pair of cam followers **42** and **43** are disposed in the cavities **40** and **41** for movement lengthwise therein and include depending cam extension pins **44** and **45** which extend into and ride within the guide channels. Biasing means are provided for the cam followers to constantly urge them toward a central inward position (as shown) or unarmed state. This aforementioned bias means can be, as illustrated, for each cam follower, a helical or coil spring **46** (**47**). Thus FIG. **4** shows the embodiment in the unarmed state prior to launch and which is positioned within the projectile so that the projectile will be spin stabilized about an axis **48** transverse to the rotor axis and the cam followers so that the centrifugal force generated by spin will be applied to the followers and move them outwardly within their respective cavities.

FIG. **5** illustrates the relative physical displacement of the components at some point intermediate the rotor rotation. The cam followers **42** and **43** have moved outwardly and in so doing have caused partial rotation of the rotor through the guide channels. The curvature of the guide channels **33** and **34** determines the rate at which the rotor turns relative to the projectile spin velocity and therefore is in reality a selectable time delay between the launch and the armed missile condition. FIG. **6** shows the mechanism in it fully rotated armed condition and any further movement of the cam followers in an outwardly direction will not cause further rotor rotation since the guide channel extends axially of the rotor thus providing a stop or a self-limiting feature. In the armed state, the springs are almost fully compressed with the flexible contact **23** connected to the detonator tip **27,** and the detonator is aligned with the explosive lead cup assembly **22** and the booster **25.** Thus, there exists an electrically operable (upon impact) explosive train which is retained in its armed state only through the generated projectile spin forces. This spin condition of the projectile remains only during its flight and upon removal of the spin, the springs **46** and **47** force the cam followers inwardly thereby rotating the rotor in an opposite direction removing the system from the armed state as would be the case of a "dud".

Summarizing the operation, projectile rotation around the axis **48,** results from firing the projectile. Since the rotor is free to rotate on its axis **31** and centrifugal forces on cam followers force them outward radially, they move from the unarmed position to the armed position. In moving to the armed position the cam followers exert forces against the cam surfaces, which induce the rotor to rotate through some angle. In moving to the armed position, the cam followers also compress the springs, and store energy in them.

If the fuze fails to function for any reaons, decay of spin rotation below a predetermined value reduces the centrifugal forces on the cam followers below the point where they can exceed the energy stored in the compressed springs. As a result, the springs force the cam followers toward the unarmed position which in turn cam the rotor to the unarmed position.

Thus, the device prevents arming due to rough handling before firing; it provides a delayed arming feature; it locks the rotor in the armed position while it is rotating; and it returns the rotor to the unarmed position when the projectile stops rotating.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

I claim:

1. A spin actuated arming and unarming device for a fuze projectile which comprises:

a housing including means for rotatably supporting therein

a cylindrical rotor member, having guide means on the cylindrical surface thereof extending outwardly toward the end of said rotor member,

said housing being formed with a longiutdinally extending cavity communicating with said rotor member,

follower means disposed in said cavity for longitudinal movement therein and having means for camming with said guide means,

biasing means urging said follower means centrally of said rotor member,

a detonator carried by said rotor for rotation therewith,

initiating means carried by said housing disposed for alignment with said detonator when said rotor is at one end of its rotational displacement,

whereby when said fuze housing is rotated and spun about an axis central and transverse of said rotor, said follower will be centrifugally directed outwardly of said axis and cause rotation of said rotor via said guide means from an unarmed position to an armed position where said detonator is aligned with said initiating means.

2. The device according to claim **1** wherein said guide means is a channel formed in said surface of said rotor extending curvedly outwardly from the center of said rotor.

3. The device according to claim **2** wherein said channel at its outer end terminates in a portion parallel to the longitudinal axis of said rotor member.

4. The device according to claim **3** wherein said channel constitutes a pair of divergent curved, opposed channels extending outwardly from approximately the center of said rotor member and a follower means for each of said channels.

5. The device according to claim **4** wherein each of said camming means includes an extension tip extending into said channels.

6. The device according to claim **5** wherein said biasing means is a spring for each of said followers disposed in said cavity.

7. The device according to claim **6** wherein said detonator is electrically operable and carries an outwardly extending electrical contact tip and wherein said initiation means includes a flexible electrical contact carried by said housing in the path of said contact tip whereby when a source of electrical energy is applied to said contact and said contact tip connects thereto in said armed position said detonator will initiate an explosive train.

8. The device according to claim **7** further including an explosive lead cup assembly and booster disposed for alignment with said detonator when in said armed position.

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