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[54] **LOW SPIN ARMING FUZE FOR AUTOROTATING MUNITIONS**

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[52] **U.S. Cl.** .....**102/79,** 102/7.2, 102/76 P

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

[58] **Field of Search** 102/76, 79, 80

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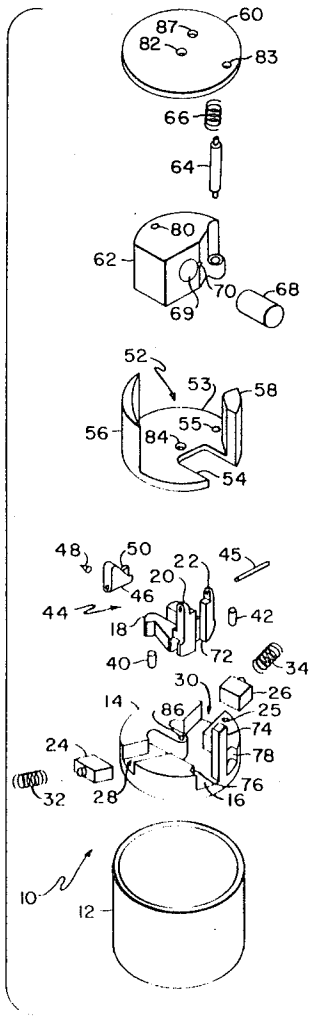
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[57] **ABSTRACT**

An improved low spin arming fuze providing a safer and more reliable fuze for autorotating munitions is disclosed. The spin fuze provides for the arming of the fuze during initial spin-up due to the centrifugal force provided by the rotational velocity when the munition is deployed and permits initiation of the fuze upon spin decay, as occurring at impact. The fuze may ignite either the detonator or multiple pop-up charges combined with a delayed detonation of the munition.

11 Claims, 9 Drawing Figures



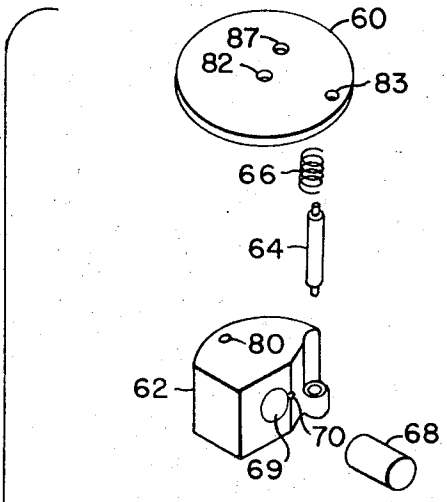


Fig 1

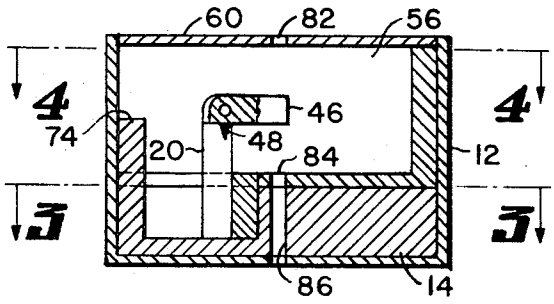


Fig 2

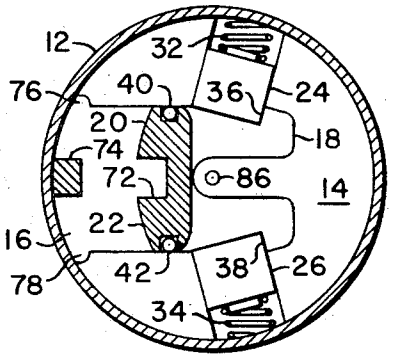
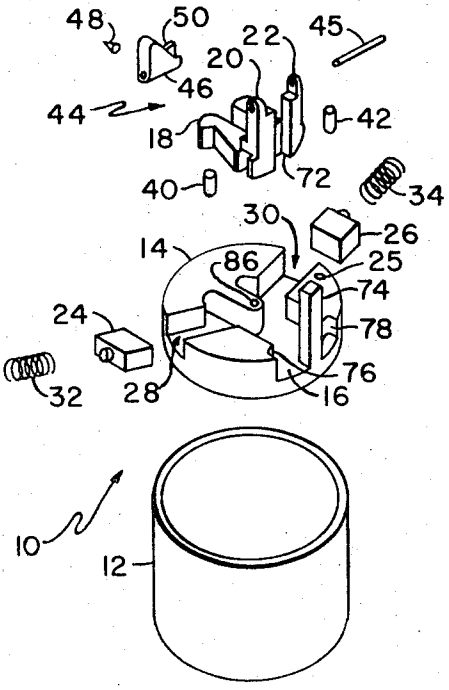


Fig 3



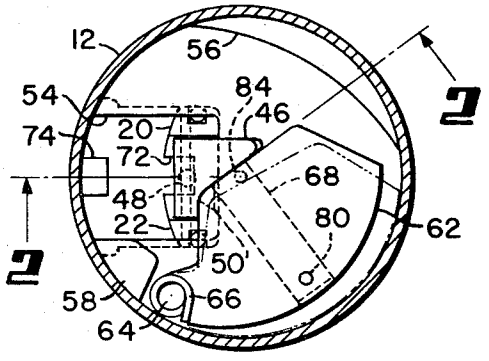


Fig 4

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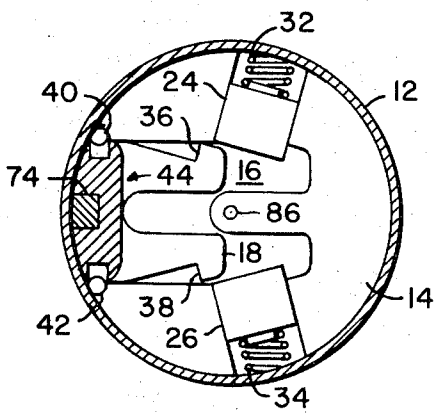


Fig 5

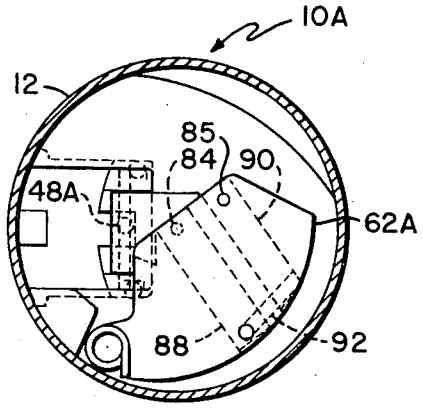


Fig 9

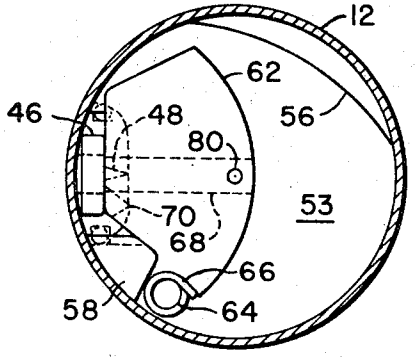


Fig 6

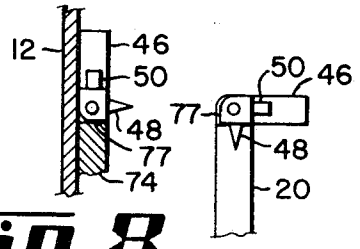


Fig 8

Fig 7

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LOW SPIN ARMING FUZE FOR AUTOROTATING MUNITIONS

BACKGROUND OF THE INVENTION

This invention relates generally to fuzes and more particularly to a spin fuze for use in autorotating munitions which are armed utilizing centrifugal forces.

Numerous centrifugal-inertia type fuzes are in existence. Many such fuzes have complex mechanism and many moving parts. It is, of course, well established that there is a greater chance for non-arming due to malfunction as the number of parts and in particular moving parts increases.

Accordingly, it is an object of this invention to provide a fuze having few moving parts and which is fail safe in operation.

Another object of this invention is to provide a fuze operational in response to the centrifugal force provided by rotational velocity when the munition is deployed.

Yet another object of this invention is to provide fuzes with great commonality of parts which will provide either ground burst or air burst using one basic fuze mechanism.

SUMMARY OF THE INVENTION

This invention provides an improved spin fuze for autorotating munitions. The spin fuze is of simple and economical construction, operates in response to centrifugal forces and is fail safe in operation. The spin fuze comprises a firing pin assembly pivotally mounted on a slider which is locked in the safing position. The firing pin assembly cooperatively engages in a locking manner with a detonator carrying rotor to serve as an additional safing lock to prevent inadvertent arming. The slider is unlocked in response to centrifugal forces due to rotational velocity of the munition to permit the slider and firing pin assembly to move to the armed position.

In different embodiments of this invention impact will ignite either the detonator or multiple pop-up charges followed by a delayed detonation. The resulting ground burst and air burst fuzes have considerable commonality of parts.

Other objects, details, uses and advantages of this invention will become apparent as the following description of exemplary embodiments thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show present exemplary embodiments of this invention in which:

FIG. 1 is an exploded perspective view illustrating the parts of the low spin arming fuze of this invention;

FIG. 2 is a cross-sectional view of the fuze along the line 2—2 of FIG. 4;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2, just below the base plate of the rotor housing, and showing the fuze in the safed position;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 2 showing the fuze in the safed position;

FIG. 5 is a view similar to FIG. 3 showing the fuze in the armed position;

FIG. 6 is a view similar to FIG. 4 showing the fuze in the armed-detonating position;

FIG. 7 is a fragmentary elevational sectional view showing the firing pin in the safed position;

FIG. 8 is a view similar to FIG. 7 showing the firing pin in the armed position; and

FIG. 9 is a sectional view, similar to FIG. 4, of another exemplary embodiment.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Reference is now made to FIG. 1 of the drawings, which illustrates one exemplary embodiment of the improved spin fuze of this invention, which is designated generally by the reference numeral **10**. The spin fuze **10** comprises an outer fuze housing or cup **12** of cylindrical shape in which a slider housing **14** is mounted. The slider housing **14** is formed with a channel **16** in which a slider **18** is placed for sliding movement therealong. The slider **18** is substantially U-shaped, as best seen in FIG. **1**, and includes a pair of upright supports **20** and **22**.

A pair of slider locks **24** and **26** (FIGS. **1** and **3**) are mounted in channels **28** and **30** of the slider housing **14**. The channels **28** and **30** communicate with channel **16**. Springs **32** and **34** bias the slider locks **24** and **26**, respectively, inwardly to engage the leg portions of the slider **18** when the slider is in the safed position. The slider locks **24** and **26** cooperate with shoulders **36** and **38**, respectively, of the slider **18** to lock in the safed position. Lock pins **40** and **42** are carried by the slider **18** to lock the sliders in the armed position, as will be explained hereinbelow.

Firing pin assembly, generally indicated as **44**, is pivotally mounted to the vertical uprights **20** and **22** by a suitable means such as a pin **45**. The firing pin assembly **44** comprises a camming body **46** of generally triangular shape and a firing pin **48** affixed to one surface thereof. Locking ear or finger **50** protrudes from one edge of the camming body **46**. A rotor housing **52** fits within the fuze housing **12** (FIG. **1**) and rests on the top of slider housing **14**. The base plate **53** of rotor housing **52** is formed with a substantially rectangular slot or channel **54** less than the width of the channel **16** in the slider housing **14**. Thus, when assembled, the slider **18** is sandwiched in channel **16** by the base plate **53** of the housing **52**. The slider **18** is free for linear sliding movement within the channel **16** (when slider locks **24** and **26** are not engaged) and is prevented from vertical movement or tilting by the overlap of the base plate **53** which extends slightly over the channel **16**.

Vertical uprights **56** and **58** extend upwardly from the base plate **53** and support a cover plate **60** which may be secured thereto by any suitable mans such as by crimping the ends of the fuze housing **12**. A rotor **62** is pivotally mounted between the base plate **53** and cover plate **60** by any suitable means such as rotor pin **64**. One end of the rotor pin **64** is secured to the cover plate **60** by hole **83** and the other end extends through an aperture **55** in the base plate **53** (FIG. **1**) and is secured in the slider housing **14** by a hole **25**. In this manner, the rotor housing **52** is secured against rotation relative to the slider housing **14**. A suitable biasing means, such as a torsion spring **66** is mounted on the rotor pin **64** to engage the rotor **62** in a known manner so as to bias the rotor in a counterclockwise direction (FIG. **4**) in the manner to be described hereinbelow.

Any suitable detonator **68** may be mounted in the bore **69** formed in rotor **62** to provide initiation of the explosive train for the fuze **10**. A notch **70**, complementary with ear **50**, is formed in the rotor **62** to cooperatively receive the ear **50** (FIG. **4**) when the firing pin assembly **44** is in the horizontal or safed position. When so engaged, the firing pin assembly **44** is prevented from pivoting movement upward and, in addition, the slider **18** is locked against movement towards the housing **12** due to the engagement of the ear **50** with the notch **70**.

Referring now to FIGS. **2**, **3** and **4**, the fuze **10** is shown in the safed position. In this condition, the slider **18** is locked at the inward end of channel **16** by the slider locks **24** and **26**. The firing pin assembly **44** is pivotally mounted to the uprights **20** and **22** and is in a plane parallel to the base plate **53** such that the firing pin **48** is perpendicular to the base plate **53** and pointed towards the base plate (FIG. **2**). The ear **50** is received in the notch **70** and spring **66** biases the rotor **62** against firing pin assembly **44**. It can be seen in this position that the detonator **68** firing pin **48** are out-of-line and there is no accidental way in which the firing pin **48** may engage the detonator **68**.

When a munition having the spin fuze **10** therein is deployed into the airstream, the munition will being autorotating due to its configuration. The fuze **10** begins arming at approximately 1,000 rpm when the slider locks **24** and **26** overcome the biasing force of springs **32** and **34** due to the centrifugal force provided by the rotational velocity of the munition. At this point, the locks **24** and **26** move toward the housing **12** to unlock the slider **18**. At the same time, rotor **62** is moved in a clockwise direction (FIG. **4**) against the biasing force of spring **66** due to centrifugal force. The rotor pivots about pin **64** to the housing **12** as shown in phantom line in FIG. **4**. In this position, ear **50** is disengaged from notch **70** and the slider **18** is free to move towards the housing **12** due to the centrifugal force of the autorotating munition.

As best seen in FIGS. **1**, **3** and **5**, the uprights **20** and **22** of slider **18** define a vertical slot **72** complementally formed to receive camming post **74** of slider housing **14**. The top surface of post **74** is slightly higher than the bottom plane of the camming body **46**. Thus, as the slider **18** moves towards the housing **12**, the camming post **74** engages the edge **77** (FIGS. **7** and **8**) of camming body **46**. Further outward movement of the slider **18** causes the camming body **46** to be pivoted to the armed position shown in FIG. **8** by the camming post **74**. It may also be noted that centrifugal force will assist in pivoting the body **46** to the armed position. The camming post **74**, together with centrifugal force acting on the body **46**, prevents the fuze assembly **44** from again returning to the safed position. The lock pins **40** and **42** secure the slider **18** in the armed position by moving outward into pin receiving grooves **76** and **78**, respectively, due to the centrifugal forces acting on the pins.

Upon rotational velocity decrease or spin decay of a predetermined amount, the spring force of spring **66** will overcome the centrifugal forces acting on rotor **62**. The spring **66** will cause rotor **62** to rotate counterclockwise as viewed in FIGS. **4** and **6**. At the termination of the counterclockwise rotation of rotor **62**, the detonator **68** engages the firing pin **48** (FIG. **6**) such that the detonator is ignited. The rotor **62** is provided with an aperture **80** at the top which is in communication with the detonator **68**. Aperture **80** permits communication between the detonator **68** and a suitable means, such as a lead cup **82** mounted in the cover plate **60** which in turn ignites the high explosive. It can be seen that when the rotor **62** is in the safed position, aperture **80** is not aligned with the lead cup **82**. At the point of detonation, the aperture **80** has moved into the in-line position with the lead cup **82**. The aforedescribed fuze is typically described as a ground burst fuze. In other words, the high explosive is detonated upon impact.

In some instances, it is desirable that the munition detonate at a predetermined height above the ground level. Such munitions may be typically described as a pop-up munition. In these munitions, a delay train is initiated upon impact so that explosive charges may be ignited to cause the munition to jump up to a predetermined height wherein the main high explosive charge is detonated. An exemplary embodiment of a fuze for this type munition is illustrated in FIG. **9** of the drawings. The fuze illustrated in FIG. **9** is very similar to the fuze **10**; therefore, such fuze will be designated generally by the reference numeral **10A** and parts of the fuze **10A** which are very similar to corresponding parts of the fuze **10** will be designated by the same reference numeral as fuze **10** also followed by the letter designation A and not described again. The main difference between the fuze **10A** and the fuze **10** is in the rotor and detonator. In this embodiment, the rotor **62A** is modified to accept a delay primer **88** and a delay detonator **90**. Passage **92** provides communication between the delay primer and delay detonator. An aperture **84** is provided in the base plate **53** (FIG. **1**). The aperture **84** provides communication with aperture **86** in the slider housing **14** (FIG. **1**) so as to provide two communication paths for the explosive train. The arming fuze **10A** is identical to that previously mentioned. Upon impact, the firing pin **48A** ignites the delay primer. The primer provides a present time delay after which two explosive charges (not shown), one on each side of the munition, are ignited to cause the munition to jump up in the air. Communication with the explosive charges is achieved through the two communication paths aforedescribed, i.e., apertures **80**, **82**, **84** and **86**. The delay detonator **90** is also simultaneously initiated and provides a delay until a predetermined height is reached after which the main high explosive charge is detonated through aperture **85** and lead cup **87**.

From the foregoing, it can be seen that the basic low spin arming fuze of this invention may be used for either ground burst or air burst applications. The fuze has a great commonality of parts. To convert from one type fuze to the other, it is only necessary to replace the rotor and rotor housing. In the airburst fuze, it is necessary that the rotor housing have an aperture through the base to establish communication between the delay primer and one external explosive charge. Thus, there are two communications paths from the rotor to the explosive charges.

It can be seen that this invention provides a low spin arming fuze for use in autorotating munitions which is

initially locked in the safed position. Spin up of the munition due to deployment or the like will unlock a firing pin carrying slider so that the slider can move to the armed position. Movement of the slider cams the firing pin assembly to the armed position so that upon spin decay the detonator carrying rotor can engage the firing pin to initiate the explosive train. Thus, this invention provides a low spin arming fuze which is of simple and economical construction, has few moving parts, is fail safe in operation and is armed in response to the centrifugal force provided by rotational velocity when the munition is deployed. Accordingly, the objectives hereinbefore set forth have been accomplished.

While present exemplary embodiments of this invention have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced by those skilled in the art.

What is claimed is:

1. A spin armed fuze for use in autorotating munitions comprising:

a slider housing, said housing being formed with a slider channel therein;

a slider mounted in said slider housing channel or movement therein;

first locking means engaging said slider for locking said slider in the safed position, aid locking means being responsive to centrifugal force to unlock said slider;

a firing pin assembly pivotally mounted on said slider, said assembly being in the horizontal plane relative to said slider housing in the safed position and in the vertical plane in the armed position;

a detonator-carrying rotor pivotally mounted to said slider housing, said rotor cooperatively engaging said firing pin assembly in the safed position, said rotor pivoting away from said firing pin assembly in response to centrifugal forces due to rotational velocity of the fuze;

means for camming said firing pin assembly from the safed position to the armed position when said slider has been unlocked by said locking means and said slider has moved in said slider housing channel to the armed position; and

means for rotating said detonator-carrying rotor to engage said armed firing pin assembly when said means overcomes the centrifugal forces acting on said rotor wherein contact of a detonator in the rotor with said firing pin assembly initiates the explosive train.

2. A fuze as set forth in claim 1 in which said firing pin assembly includes a locking ear and in which said rotor includes a notch complementally formed to receive said locking ear when said firing pin assembly and said slider are in the safed position wherein pivotal movement of said firing pin assembly is prevented and said slider is prevented from sliding in said channel, said ear being disengaged from said notch when said rotor is pivoted in response to centrifugal forces.

3. The fuze as set forth in claim 1 in which said slider includes a pair of vertical uprights at one end thereof, said uprights defining a slot therebetween;

said firing pin assembly being pivotally mounted at the upper end of said vertical uprights, said firing pin assembly comprising

a planar camming body, said body supported in the horizontal plane in the safed position and in the vertical plane in the armed position;

a firing pin affixed to the lower planar surface of said camming body; and

a camming post at the end of said slider housing channel, said camming post extending vertically upward to engage said camming body when said slider is moved from the safed position towards the armed position wherein said camming post engages said camming body to cause said body to pivotally rotate to the armed position.

4. The fuze as set forth in claim 3 further comprising a locking ear formed along one edge of said camming body, said rotor including a notch complementally formed to receive said locking ear when said slider and rotor are in the safed position, said engagement of the locking ear and notch preventing pivotal movement of said camming body about said vertical uprights and linear movement of said slider relative to said rotor, said ear being disengaged from said notch when said rotor is pivoted in response to centrifugal forces.

5. A fuze as set forth in claim 4 further comprising a rotor housing mounted between said slider housing and said rotor, said rotor housing having a rectangular slot formed therein, said slot having a width less than the width of said slider housing channel wherein said slider is held in said slider housing channel by said rotor housing.

6. The fuze as set forth in claim 5 further comprising second lock means cooperating between said slider and said slider housing for locking said slider in the armed position.

7. A spin armed fuze for use in autorotating munitions comprising:

a cylindrical slider housing, said housing being formed with a slider channel transverse the rotational axis;

a slider mounted in said channel for linear movement therein, said slider being at the inward position when said fuze is in the safed condition and at the outer position in the armed condition;

means for locking said slider in the safed position, said means being responsive to centrifugal force to unlock said slider;

a firing pin assembly including a planar camming body and a firing pin attached to one planar surface of said camming body;

means pivotally mounting said camming body in spaced relation to said slider, said planar body having a firing pin attached thereto facing said slider in the safed condition and being pivotally rotated 90° to the vertical in the armed position;

a rotor pivotally mounted to said slider housing; said rotor having a first position for cooperatively engaging the edge of said camming body when said slider and camming body are in the safed position, said rotor having a second position wherein said rotor is pivotally rotated away from said camming body in response to centrifugal forces, said rotor having a third position for engaging said firing pin when said slider has moved to the armed position;

detonator means carried by said rotor wherein said detonator means is ignited when said rotor is urged into the third position;

means for camming said camming body from the safed condition to the armed condition during linear transverse movement of said slider in said slider housing channel; and

means for rotating said rotor to make contact with said firing pin when said means overcomes the centrifugal forces acting on said rotor in the second rotor position.

8. A fuze as set forth in claim 7 in which said camming body mounting means includes a pair of uprights protruding from the outward end of said slider, said uprights defining a slot therebetween; and

in which said camming means includes an upright post protruding from the outward end of said slider housing channel, said upright post and slider uprights being complementally formed for engagement therebetween in the armed condition, said upright post engaging said camming body to cause pivotal rotation of said camming body as said slider moves linearly from the safed to the armed condition.

9. The fuze as set forth in claim 8 further comprising a rotor housing mounted between said slider housing and said rotor, said rotor housing having a rectangular slot formed therein, said slot having a width less than the width of said slider housing channel and said rotor housing mounted so that said rotor housing slot overlies said slider housing channel to hold said slider therein.

10. The fuze as set forth in claim 9 comprising a locking ear formed along one edge of said camming body, said rotor including a notch complementally formed to receive said locking ear when said rotor is in the first position, said engagement of the locking ear with the notch preventing pivotal movement of said camming body about said vertical uprights and linear movement of said slider relative to said rotor, said locking ear being disengaged from said notch when said rotor is pivoted to the second position in response to centrifugal forces.

11. The fuze as set forth in claim 1 in which said rotor provides a preset time delay after which multiple explosive charges cause the munition to pop-up into the air followed by a second delay after which the explosive charge is detonated.

* * * * *