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IGNITER SAFE AND ARM

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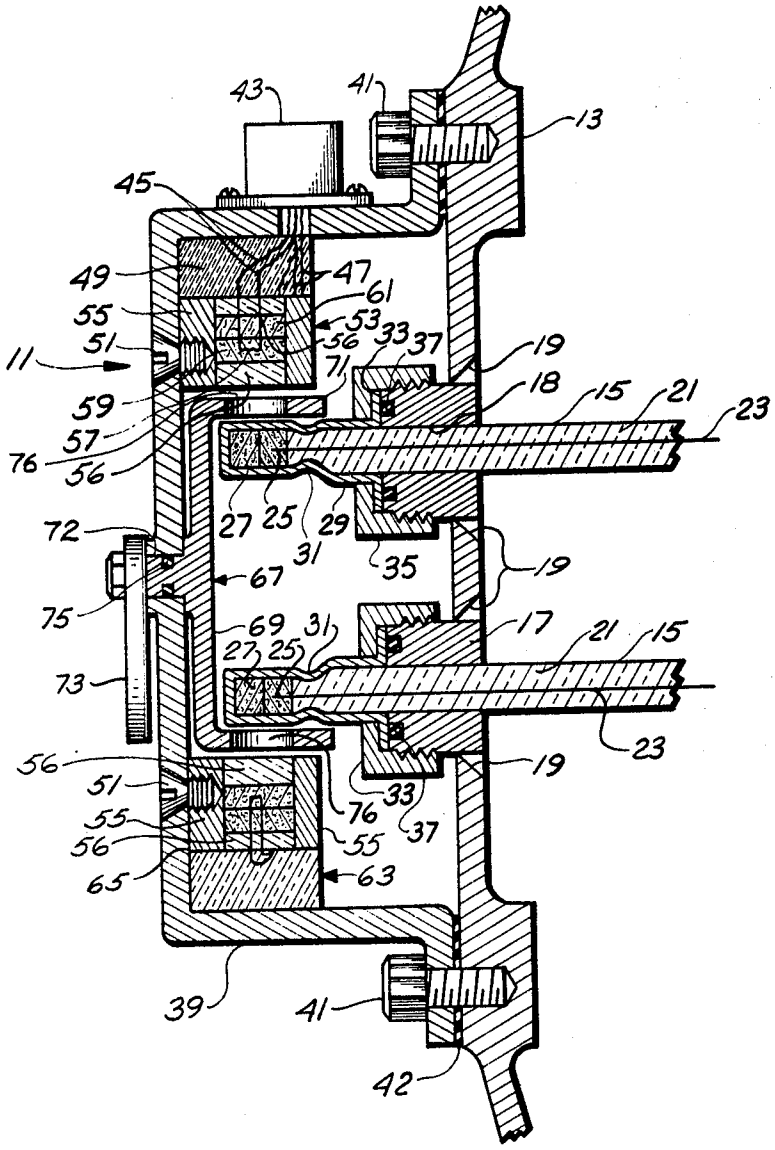

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IGNITER SAFE AND ARM

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ABSTRACT OF THE DISCLOSURE

A safe and arm device for solid propellant igniters having a housing in which is disposed shock detonating material. Fuses leading to the igniter are fixedly held in the housing adjacent the detonating material with a perforated rotor disposed between the fuses and the detonating material.

This invention relates to a safe and arm device. More particularly, the invention relates to a device for utilization with an igniter for solid propellant motors which is used as a safe and arm.

The present invention, relating to an igniter safe and arm, has particular use for the type of igniter disclosed in copending application Ser. No. 469,973 filed June 30, 1965, now abandoned. In the copending application, an igniter is disclosed formed of a mesh screen having attached thereto and wrapped about strands of explosive fuse material such as Pyrocore. The screen is then coated with a combustible mixture. Upon ignition of the Pyrocore, the combustible material and screen were ignited causing virtually instantaneous combustion of the entire igniter. The initial ignition of the igniter transpires from the igniting of the Pyrocore leads which extend from the igniter body. As with most igniters, it is imperative that the Pyrocore be prevented from accidental ignition prior to the desired set time. Thus, a safe and arm device is mandatory for the successful operation of the igniter.

Previous proposed concepts for safe and arm devices for remote ignition for the type of igniter described utilized devices where the charge for igniting the fuse material was in a rotor and thus subjected to rotary movement from a safe to an arm position. The mechanical arrangement of the previous devices has been quite complex and such devices have not been easily adaptable for placement outside of the motor case. Another disadvantage of prior art devices is that normally the electrical detonator is disposed in a line with the fuse, thus extending the axial length of the device.

Thus, it is an object of this invention to provide a simple safe and arm device for ignition of solid propellant igniters.

Another object of this invention is to provide a safe and arm device having a minimum of working parts.

Still another object of this invention is to provide a safe and arm igniter device wherein no additional boost charge is present in the rotor.

The above and other objects of the invention will become apparent in the following description.

The device of this invention comprises an outer shell housing electrical detonators. Mounted on the shell is an electrical conductor for conducting current to the detonators within the shell. Means are provided in the shell or housing for permanently affixing the ends of the fuses which lead to the igniter. The ends of the fuses are affixed to shock sensitive detonating material and are circumferentially disposed adjacent the radially oriented electrical detonators. Disposed between the ends of the fuses and the electrical detonators is a rotor element having apertures therein corresponding to the number of fuses. In a safe position, the rotor is disposed so as to block passage of

shock energy from the electrical detonators if prematurely set off to the ends of the fuses. In an arm position, the rotor is rotated so as to align the apertures with the end of the fuses and electrical detonators such that when detonations occurs in the electrical detonator, the shock force will pass through the aperture to the fuses. It is believed the invention will be better understood with regard to the following detailed description in which:

The figure is a cross-sectional view of the safe and arm device of the invention.

Referring to the figure, there is shown a safe and arm device **11** of this invention mounted on a forward case head **13** of a solid rocket motor. Such a location outside of the forward case head is a usual location for safe and arm devices in that it provides easy access for the arming of the motor, and is normally the shortest distance between the safe and arm device and the igniter which is normally disposed at the front end of the solid propellant grain. In this particular example, two pyrotechnic fuses **15** are shown which lead from the safe and arm device to the igniter for the solid propellant motor. Through-hole bodies **17** are integrally welded at their bases **19** to the motor case head and extend forwardly therefrom. Through the center **18** of these bodies **17** pass the fuses **15**. The pyrotechnic fuse **15** has an insulation material **21** about the center fuse element **23**. As shown the fuse element **23** extends past the end of the insulation at point **25** and meets and is imbedded in a material **27** sensitive to shock waves. An example of the material **27** is lead Styphanate. The shock sensitive material **27** and the end of the insulated fuse **15** extending through the body **17** is enclosed by a sleeve **29** of, for example, brass or thin guilding metal, which is crimped at **31** about the fuse train **15** so as to prevent movement thereof through body **17**. The end of the sleeve **29** is flanged **33** and is enclosed by a nut retainer **35**, which is in threaded engagement with the through-hole body **17**. To ensure a tight fit, O-ring seals **37** can be disposed in the body **17** adjacent the flanged end **33**. The foregoing arrangement thus provides for securing the fuse in a fixed relationship outside of the motor case. Additionally the foregoing arrangement provides for securing in a fixed relationship the fuse to a shock detonating material which will eventually cause the ultimate detonation of the fuse in rocket motor.

In the initial assembly of the device, a longer than necessary length of the insulated pyrotechnic fuse **15** is inserted through the body **17** so the forward case head **13** is moved forward for installation onto the main motor case. The insulated fuse **15** is in a slight friction fit within aperture **18** of the body **17** and is pulled tight from the outside of the head **13** after the head is installed in the motor case until all slack is removed. The friction fit holds the fuse in place while trimming the end before slipping the flanged sleeve assembly **29** onto the fuse and crimping it in place. The O-ring seal **37** is inserted in the end of the body **17** before the uncrimped flanged end **33** of the sleeve assembly is slipped onto the trimmed fuse. The nut retainer ring **35** or other suitable retaining device is then installed to lock the flanged end sleeve **29** in place.

After the previously described installation, the cylindrical housing **39** containing the electric detonator and rotor assembly is secured over the exposed fuse ends to the case head **13** by bolts **41**. A seal **42** between the housing and the motor case prevents moisture and the like from entering the housing. Mounted on the shell **39** is an electrical connector **43** which serves to connect pairs of leads **45** and **47** extending therefrom to an external battery source (not shown). Within the shall **39** the first pair of wires **45** affixed to the connector **43** pass through an electrical potting insulation **49** made of material such as silicone which serves to hold the wires in place and prevent any movement during the vibration of the motor prior to firing. Secured by screws **51** to shell **39** adjacent

the potting composition **49** is an electric detonator assembly **53**. The electric detonator assembly **53** is comprised of a metal outer shell **55**. The electrical potting composition **56** serves to bond the wires **45** in place as they pass through the shell and insulate the material therein. A wire bridge **57** connects the leads **45** and is imbedded in a composition known in the art as the bead **59** which is sensitive and is detonated by heat. An example of such material **59** is lead styphanate. The layer adjacent the bead **59** and within the ceramic enclosure is the sustaining charge **61** which is of a material that is less sensitive than the bead and can be of boron-potassium nitrate composition.

As can be appreciated, the leads **45** with the bridge **57** therebetween are permanently affixed to and extend from the electric detonator body and are of sufficient length to pass through the potting composition **49** to the electrical connector **43**. As shown a second pair of leads **47** pass through the potting composition **49** to a second potting composition 180° from the first described assembly to a second potting composition **63** where the leads are connected to a second electrical detonator **65** disposed adjacent the other fuse in the shell. As is apparent, as many electrical detonators are used in the invention as the number of fuses require, there being one detonator per fuse. Thus, the device is arranged so that the electrical detonators are adjacent the crimped end of the fuses. Disposed between the crimped end of the fuse and the electrical detonator body is a rotor **67** which has a flat base portion **69** and perpendicular extending side **71** that pass between the electrical detonator **53** and flanged sleeve assembly **31**. An extension **72** of the base **69** of the rotor extends through the shell **39** to a rotor arm **73** mounted outside of the shell. To prevent any leakage of air or atmosphere into the housing, an O-ring seal **75** can be inserted in the portion of the extension **72** that extends through the shell. As shown in the drawing, the rotor is in the armed position wherein the apertures **76** in the wall **71** are aligned with the sleeve assembly **31** and electrical detonator **53**. In this particular device, two such apertures would be provided, one for each fuse 180° apart. The number of apertures would always correspond to the number of fuses and detonators.

In operation, the rotor **67** is rotated manually by moving arm **73**, or electrically if arm **73** is connected to a suitable means, from a safe position where there are no through-holes between the flanged end sleeve assembly and the electrical detonator to an armed position as shown in th figure where the through-holes are between the primer end and the electrical detonator. Upon command an electrical current through the electrical connector **43** activates an electrical detonator **53**. The activation is caused by the current passing through the bridge **57** warming the material **59** to its ignition point detonating it and in turn detonating the sustaining charge **61**. This causes a significant shock force which passes through the apertures **76** in the rotor to the primer material **27** which is sensitive to such shock force, detonating this material, which in turn detonates fuse end **25** carrying such detonation to the main igniter.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

We claim:

1. A safe and arming device for a combustible charge, comprising;

a support structure,

a fuse connected to the support structure,

a detonator positioned in fixed relationship with one end of the fuse, the detonator being separated from said fuse end by a space defining a portion of the detonating path,

a rotor rotatably connected to the support structure,

an annular wall connected to the rotor extending parallel to the axis of rotation, the wall defining a hollow cavity in which said fuse end is disposed,

means in the wall forming an opening having an arcuate path of movement intersecting the detonating path,

whereby when the device is in its safe position the opening is misaligned with the detonating path and when the device is in its armed position the opening is aligned with the detonating path.

2. The device according to claim **1** wherein;

at least two detonators and two fuses are provided constituting at least two detonating paths,

the support structure is a housing that encloses the detonators and fuse ends,

a control is connected to the rotor and extends outside the housing, and,

the wall includes at least two openings that are simultaneously moveable into alignment with respective detonator paths.

3. The device according to claim **2** wherein;

the fuses are attached to shock sensitive material, and,

the detonators generate shock waves to ignite the fuses when the openings are aligned with their respective detonating paths.

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