Sept. 24, 1968 W. J. BOLSTER ET AL 3,402,666

ARMING AND FIRING MECHANISM

Filed June 28, 1967 2 Sheets-Sheet 1

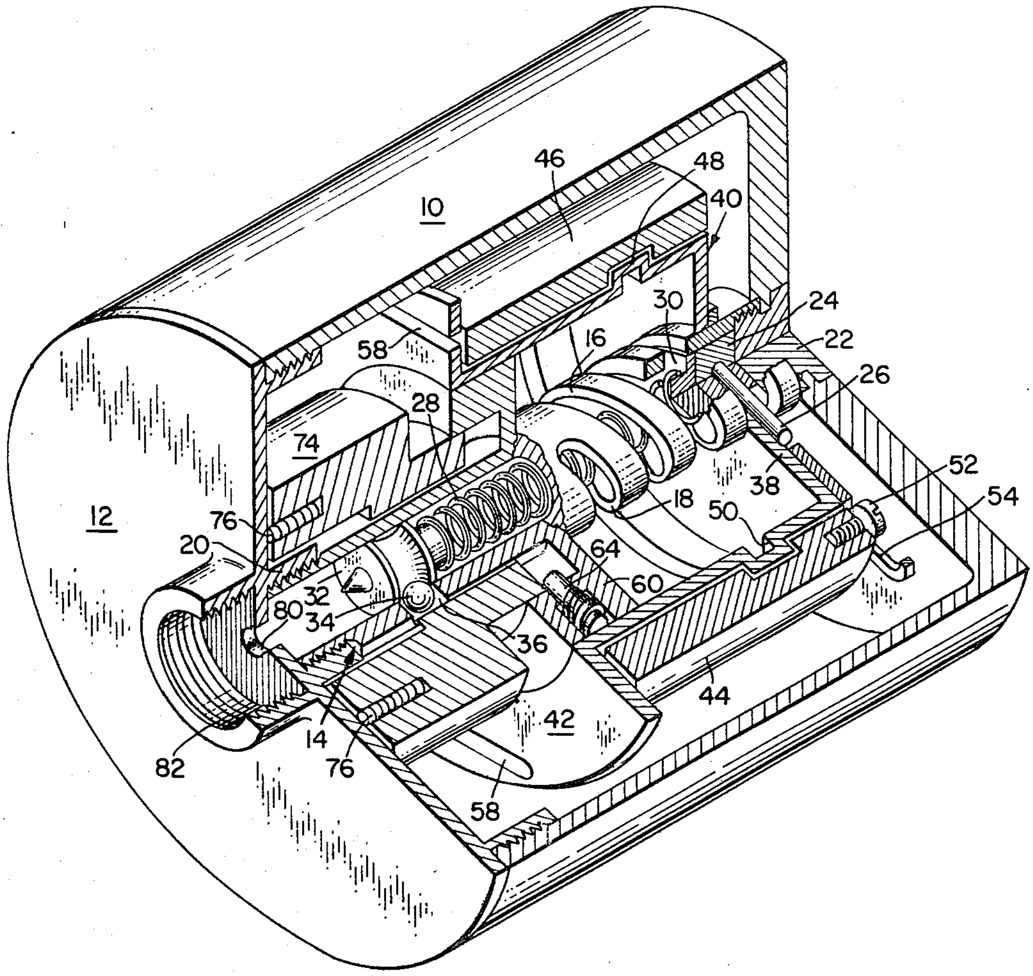

Fig. 1

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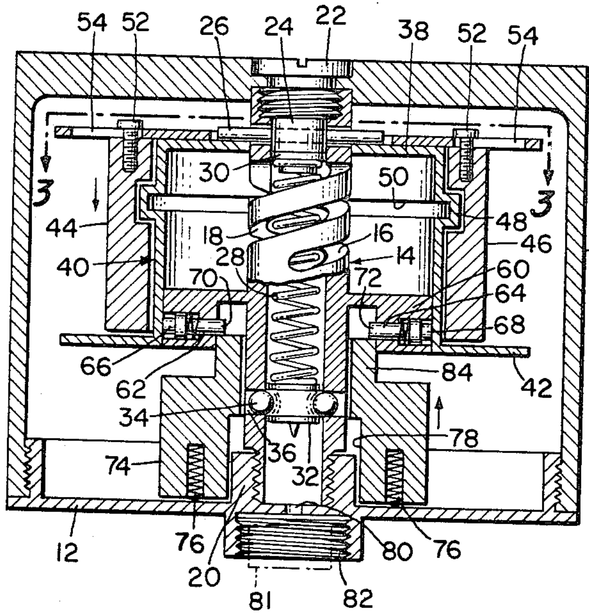

Fig. 2

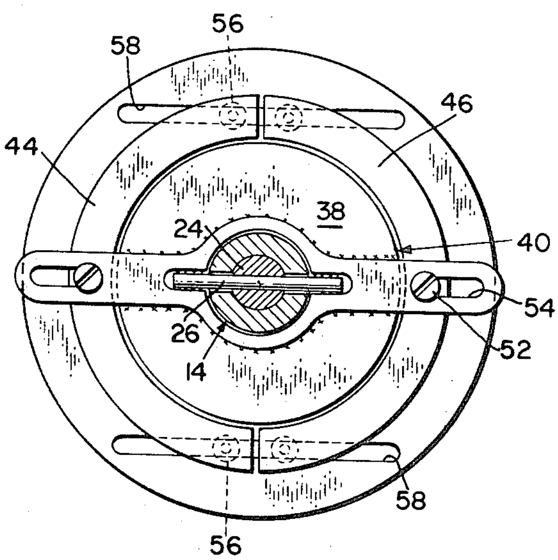

Fig. 3

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ARMING AND FIRING MECHANISM

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ABSTRACT OF THE DISCLOSURE

A mechanical, percussion type initiator for firing a booster-carried rocket, the device utilizing high energy level acceleration force to arm the initiator and a lower energy level deceleration force to fire the initiator when a predetermined deceleration point is achieved. It includes a time delay means in the acceleration responsive mechanism.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Background of the invention

The fuzing of multistage rocket components which are subject to high acceleration force levels, substantial launching shocks and vibrations and frequently to ambient ratio frequency force fields imposes safety and reliability problems which have long plagued the art. Devices currently used require frequent testing, adjustment and verification of operability during prelaunch checkout resulting in a loss of time and imperilling launch crews. Prior mechanical fuzes have utilized complex, closely interfitting sliding parts and cumbersome timing arrangements in order to perform the arming function, and, after arming, the firing sequence usually occurs immediately without requiring imposition of a deceleration force of a selected magnitude before firing action occurs. Obviously a simple, reliable and safe arming and firing mechanism which is immune to the effects of spurious electric or radioactive fields is urgently needed.

Summary

The present invention provides a compact, simple and reliable fuzing arrangement with predeterminable time delay characteristics and relies upon readily available lineal acceleration and deceleration forces to unlock a deceleration responsive mass and permit it, upon arrival at a set deceleration state, to release a spring-biased firing pin to drive said pin into contact with a primer. The acceleration responsive means is adjustable to vary the arming time and the firing pin spring is not under bias until after the imposition of acceleration movement.

Other objects, advantages, and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein;

Brief description of the drawings

FIG. 1 is a perspective view of one embodiment of the present invention partially broken away along the longitudinal axis.

FIG. 2 is a vertical sectional view, partially in elevation and slightly reduced in size, of the embodiment of FIG. 1.

FIG. 3 is a transverse sectional view of the embodiment of FIG. 2 with cover removed taken along a line substantially corresponding to line 3—3.

Description of the preferred embodiment

An important feature of the present invention resides in the simplicity of the parts and their ease of assembly without demanding close tolerances. Thus they may be formed by inexpensive manufacturing processes and of low-priced materials and their operation will not ordinarily be adversely affected by changes in dimensions due to variations in temperature. Furthermore such construction avoids damage due to deterioration or corrosion and assures long shelf life.

As illustrated, an inverted cup shaped cylindrical cover **10** having an end or bottom plate **12** forms an enclosure which supports a centrally positioned guide tube **14** which has opposed helical slots **16, 18,** in its upper half. This guide tube is supported at its lower end in a threaded boss **20**, and, at its upper end by a threaded screw **22.** The guide tube is hollow and receives a helical slot-follower assembly **24** which is transversely drilled to receive a follower pin **26,** the ends of which extend into the helical slots as shown. Below this follower is a firing pin spring **28** which may have a spring end cap **30.** At its lower end, spring **28** bears against a peripherally grooved firing pin **32** normally locked against axial movement by groove engaging lock balls **34** mounted in spaced opening **36.**

The ends of the follower pin **26** may be welded or otherwise affixed to the upper surface of an inturned top ledge **38** of an arming shell **40.** The bottom of this shell has an outwardly extending ledge **42.** Weights **44** and **46** in the form of half cylinders are mounted on opposite sides of the shell **40** and may be internally channeled to accommodate the peripherally extending rib **48** which is formed during the manufacture of the internal groove **50.** These weights may be retained in place by cap screws **52** received in upper slots **54** and cap screws **56** received in lower slots **58.**

Within the shell **40** and slidably disposed along the guide tube **14** is a latch carrier **60** having latches **62, 64** which are spring urged so that the outer ends **66, 68** will snap into groove **50** when in registry therewith. This pin movement brings the inner ends **70, 72** thereof out of the path of a heavy deceleration responsive collar **74** which may normally be urged upwardly by several small springs **76.** It will be apparent that upon missile launch, the shell **40** with its weights will be caused to spin around the guide tube **14** as the follower pin **26** rides in opposed helical slots **16, 18** until internal groove **50** in the shell registers with the outer ends of **66, 68** of latches **62, 64.** When this occurs, the shell's bottom ledge **42** is substantially bottomed against the interior of bottom plate **12** and the shell can descend no further. At this point the latch springs force the latches **62, 64** into groove **50,** removing their inner ends **70, 72** from the path of the deceleration collar **74.** This arms the fuze, at the same time, downward movement of the follower assembly **24** compresses firing pin spring **28.** Thereafter, deceleration of the missile causes deceleration weight **74** to move upwardly until interval groove **78** is adjacent lock balls **34** permitting them to be outwardly displaced by the camming action of the peripheral firing pin groove when the firing pin **32** is urged toward the primer by compressed spring **28.** Thereafter the sharp point of the firing pin passes through small opening **80,** and strikes the primer **81** located in the threaded opening **82** and detonation occurs.

It will be noted that throughout this operation the acceleration responsive assembly comprising the shell and its associated weights simultaneously rotates and moves axially in response to the heavy initial acceleration forces. When this mass has proceeded far enough groove **50** permits pins **62, 64** to be liberated to clear the reduced upper end **84** of the deceleration weight collar. Thereafter, it is not until a suitable deceleration condition exists that collar **74** can begin its upward ascent. This movement continues until the lock balls **34** are released and firing pin **32** is then free to strike the primer and produce detonation.

It will be obvious that it is the sequence of heavy sustained acceleration forces followed by lighter deceleration forces that causes the device to be armed and then fired at the appropriate time during rocket flight. Furthermore, lengthy or sustained heavy acceleration force is necessary. The device will not respond to short applications of force such as might occur during shipping or if the missile is dropped. Also the deceleration force required is not that caused by impact or by sudden change but is that achieved when a sufficiently stable missile flight occurs and it is time for another stage to be initiated.

It will also be observed that the firing pin spring is normally not compressed and hence is incapable of imparting a detonating force to the firing pin. It is compressed slowly only while the device is being armed, and is fully compressed only when the device is armed.

With the foregoing described arrangement it will be apparent that sustained acceleration is required to arm and lock the device in armed position and that a predetermined deceleration must occur before the firing pin is free to cause detonation. This occurs during the decrease in acceleration at first stage burn-out.

The simplicity of this construction is readily apparent as well as the absence of electrical components or structures which can adversely be affected by electrical or radio frequency influences, furthermore it will be apparent that, when adjusted, it need not be checked out during missile checkout but remains safely in the completely unarmed condition until armed by missile acceleration forces.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically describde.

We claim:

1. A detonator exploding device comprising:
- a firing pin located adjacent a detonator;
- a firing pin spring;
- means responsive to sustained acceleration force to store energy in said spring;
- means for retaining said stored energy in said spring and delaying application of the same;
- a deceleration responsive means;
- means interconnecting the acceleration and deceleration responsive means to enable operation of the latter only upon completion of the operation of the former; and
- lock means for retaining the firing pin in fixed position, said means being releasable upon movement of the deceleration responsive means to free the firing pin and permit energy stored in the firing spring to drive the firing pin into the detonator.

2. The apparatus of claim **1** wherein the means responsive to sustained acceleration force includes a housing surrounding the firing pin and the firing pin spring, an inclined plane associated with said housing, and a follower movable along said incline in response to acceleration forces to thereby compress and store energy in said spring.

3. The apparatus of claim **1** wherein the deceleration responsive means includes a weighted member normally restrained from movement until the acceleration responsive means completes its movement, said deceleration responsive means normally serving to secure the firing pin lock means against operation to release the firing pin.

4. The apparatus of claim **1** wherein the firing pin is housed within a tubular guide tube, said guide tube having an elongate inclined surface, a follower movable along said surface during missile acceleration, said follower being positioned to compress the firing pin spring during such movement.

5. The apparatus of claim **4** wherein said inclined plane is in the form of a helical surface mounted on said guide tube.

6. The apparatus of claim **1** wherein the means associated with the acceleration responsive means and adapted to retain the stored energy in said spring is a pin which is spring biased toward the acceleration responsive means and movable upon sufficient response of said acceleration responsive means to shift a deceleration responsive means lock portion out of the path of the deceleration responsive means to thereafter permit movement of said deceleration responsive means in response to deceleration forces.

7. The apparatus of claim **4** wherein the acceleration responsive means includes weights which are radially adjustable to vary the polar moment of inerita and hence the rate of travel of the follower pin along the inclined plane.

8. The apparatus of claim **6** wherein the lock means includes lock balls releasable from a detent in the firing pin upon predetermined movement in the deceleration responsive means.

9. The apparatus of claim **1** wherein the entire assembly is contained within a sealed container.

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