United States Patent

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[72] Inventor George H. Hopmeier
Rochester, Mich.

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[73] Assignee LTV Aerospace Corporation
Dallas, Tex.

[54] IGNITING DEVICE
5 Claims, 6 Drawing Figs.

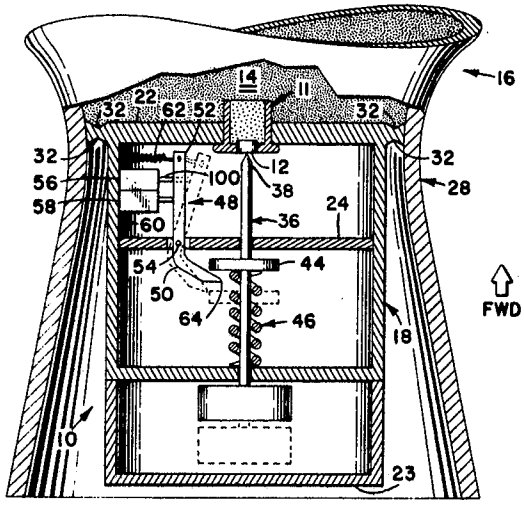
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[51] Int. Cl. F42c 15/04, F42c 15/24, F42c 15/34
[50] Field of Search 102/70, 71, 75

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Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—Thomas H. Webb
Attorney—H. C. Goldwire

ABSTRACT: A device for actuating a propellant charge of a launched projectile wherein a member moves in response to positive and/or negative acceleration of the projectile to actuate the propellant charge or to actuate a delaying means and obtain, at a preselected time thereafter, setting off of the propellant charge.



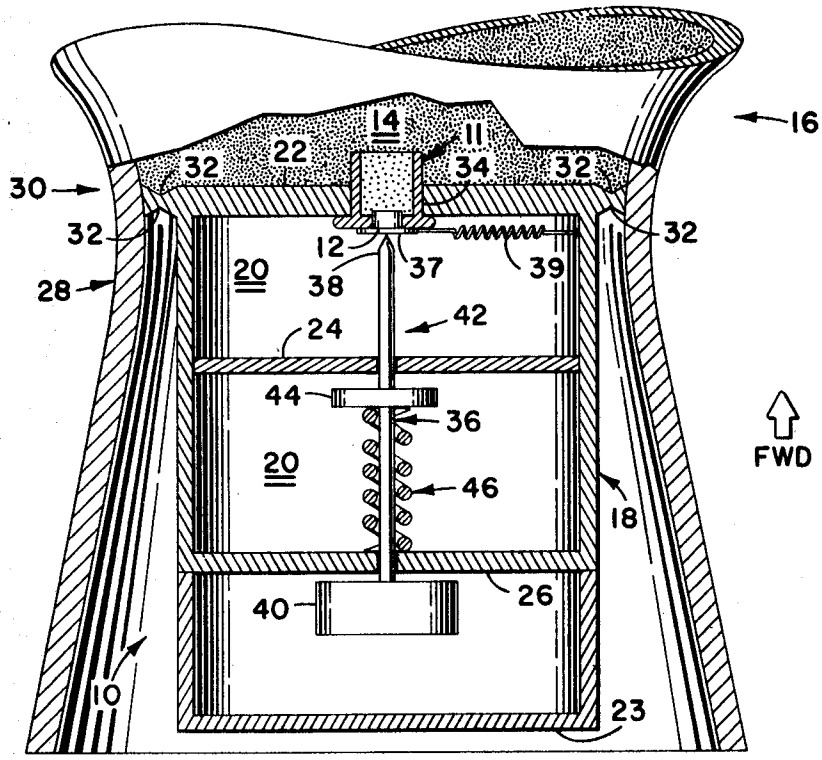


FIG 1

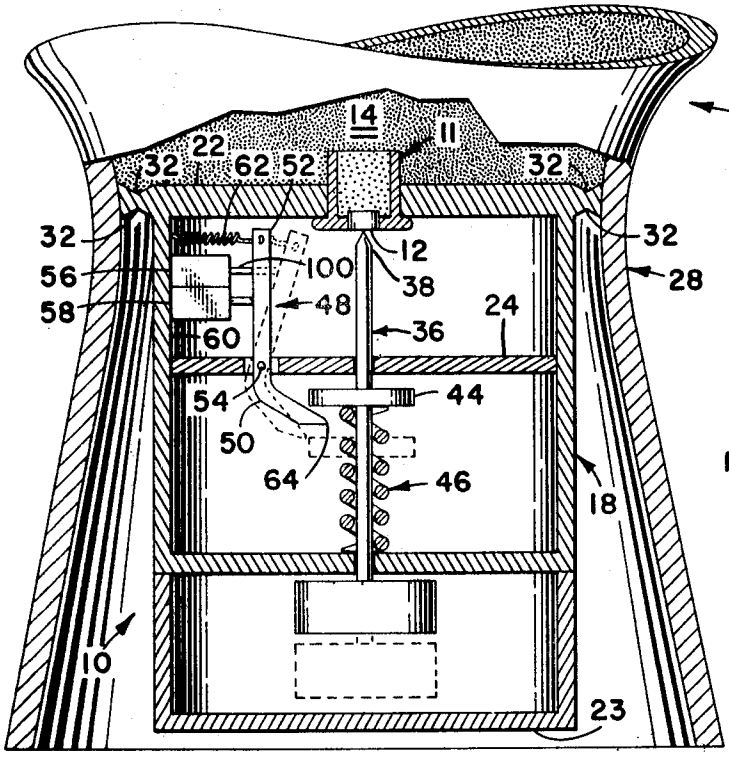
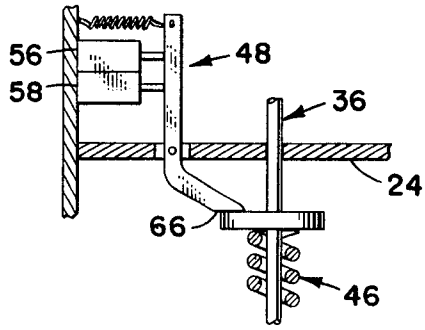


FIG 2

GEORGE H. HOPMEIER
INVENTOR
BY H. C. Goldsmith
ATTORNEY

FIG 3



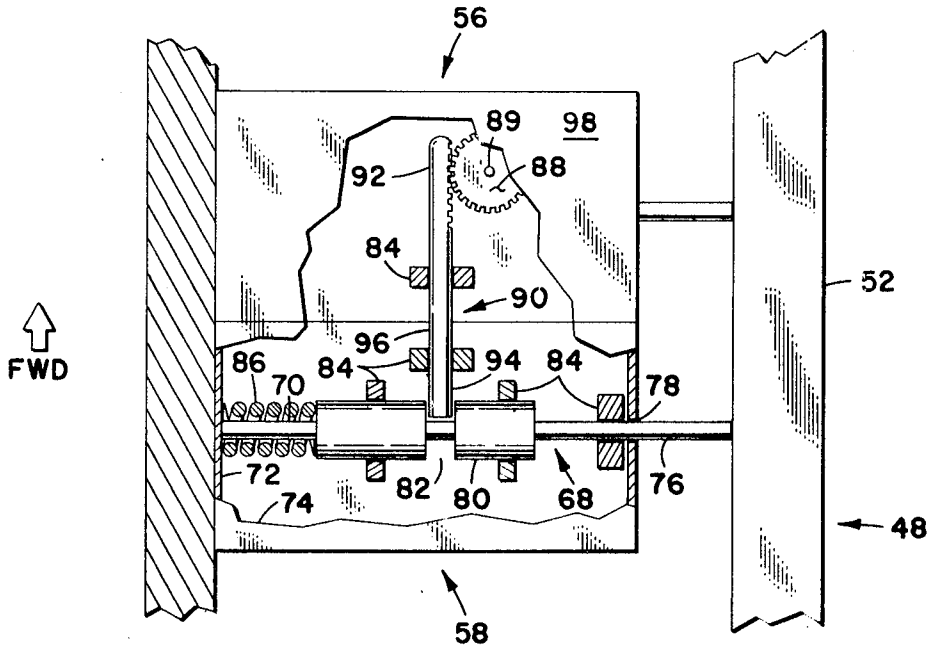


FIG 4

GEORGE H. HOPMEIER
INVENTOR
BY H C Goldwin
ATTORNEY

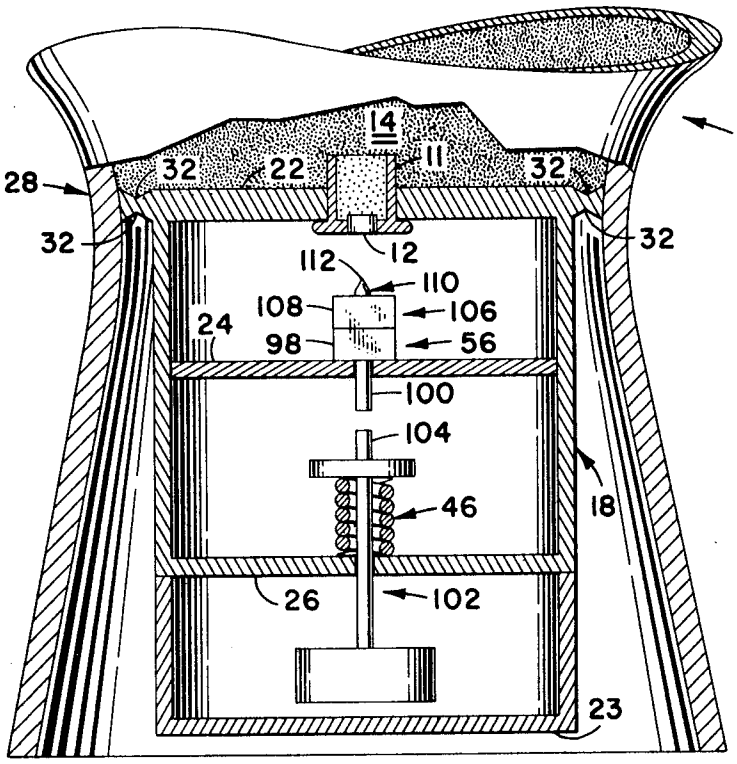


FIG 5

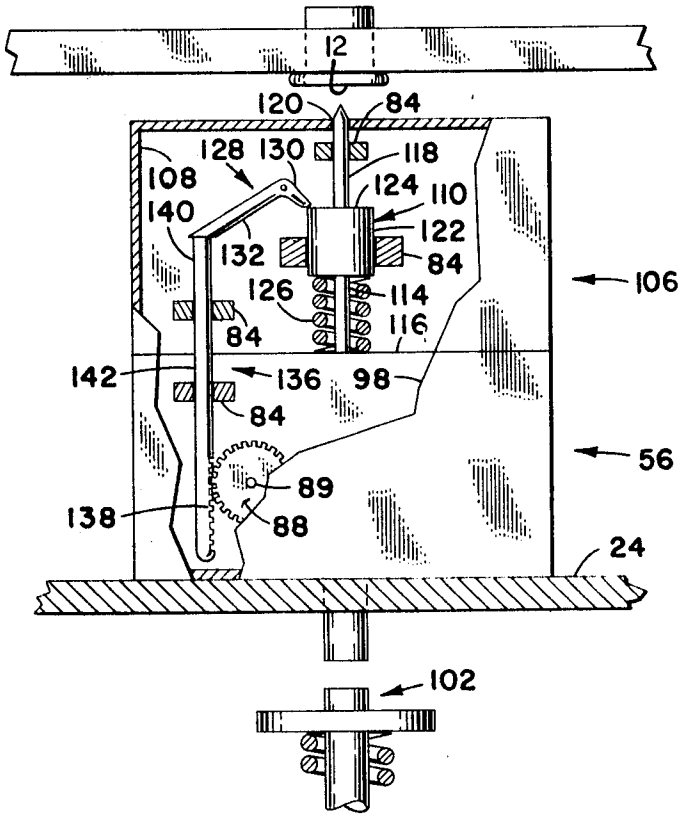


FIG 6

GEORGE H. HOPMEIER
INVENTOR
BY H.C. Goldwin
ATTORNEY

IGNITING DEVICE

This invention relates to ammunition and explosive devices and, more particularly, to an improved igniting device for propellant charge for a projectile.

Modern projectiles are often designed to obtain additional thrust by the combustion of a projectile-contained, secondary propellant charge. It has also been found advantageous to ignite this secondary propellant charge at one or another of several positions on the projectile's flight path. By so utilizing a primary or initial charge to propel the projectile from its resting position and, at a preselected time thereafter, imparting additional thrust to the projectile, projectiles can be designed to follow an infinite number of flight path configurations.

Projectiles of this type are generally launched either by gun-boosting the projectile or by combusting a projectile-contained, first-stage, propellant charge. In the gun-boosting method, the projectile is placed in a gun barrel in adjacency to a separate propellant charge. Expansion of gases during combustion of the initial charge propels the projectile from the gun barrel, and igniting means within the projectile thereafter ignite the secondary propellant charge. In the other, common launching method, the primary charge is an integral part of the projectile. This projectile is either free-launched or tube-launched by combusting the projectile-contained, first-stage propellant charge. The emission of gases from the rearward end of the projectile propels the projectile from its resting position, and igniting means within the projectile thereafter ignite the secondary propellant charge.

Regardless of the launching method employed, relatively high velocities are obtained during the first portion of the projectile's flight path. Frictional and other forces constantly produce a reduction of projectile velocity which, combined with the effects of gravitational forces, is accompanied by alterations of the projectile attitude and flight path. Properly igniting the secondary propellant charge at an exact, preselected instant during a time within which these alterations occur thus becomes a critical problem in designing a projectile which will follow a predictable flight path.

The mechanical devices heretofore employed for ignition of the secondary charges of missiles of this type are generally of complex construction and operation, require costly, manual assembly, and are notoriously unreliable. While they have proven slightly more reliable than previously used mechanical devices, electrical initiating devices are disadvantageous in that they tend to be fragile, possess hazardous handling characteristics, and need electrical power sources.

These ignition problems become increasingly acute as ignition-delay devices are incorporated. Most time-delay devices are pyrotechnic trains which, for proper operation, must combust at a stable rate which is rarely attained. Because of the extreme temperatures and severe shocks imposed on these devices during combustion of their primary charges, malfunctions of pyrotechnic devices are common. These failures are generally caused not only by erratic burning or impact destruction of the delay train by inertial forces during primary acceleration, but also by other factors including high-temperature preignition of the secondary charge. Prior time-delay devices of other than pyrotechnic nature have commonly employed motors, clockworks or the like, relatively complicated linkages, and other complexities which tend to make them both expensive and of less than satisfactory reliability.

Because of the complex construction of the previously used ignition and timing devices, they generally are bulky, require comparatively large housings, have sometimes numerous moving parts which may malfunction, and are relatively difficult to install and adjust properly. Considering the problems of construction and operation experiences with presently used igniter and timing devices it becomes evident that the flight paths of supposedly identical projectiles may vary greatly. Effective, predictable projectile operation therefore substantially depends on reproducible timing of ignition of the secondary propellant charge.

It is, accordingly, an object of this invention to provide means yielding improved accuracy of control over the time of ignition of the secondary propellant charge of a projectile.

Another object is to provide means of the above character, which means is of improved reliability.

Yet another object is to provide a device for setting off the percussion igniter for the secondary propulsive charge of a projectile, which device has safe handling characteristics.

A still further object is to provide a device of above character and of a sturdy construction which employs few moving parts.

Still another object is to provide such a device which is relatively small and compact and which is well adapted to functioning in a small housing.

An additional object is to provide a device as characterized above, which device is simple and economical to construct.

Other objects and advantages will be apparent from the specification and claims and from the accompanying drawing illustrative of the invention.

In the drawing:

FIG. 1 is a fragmentary, front view, partially in longitudinal section, of a projectile provided with the igniting device of the invention.

FIG. 2 is a similar view of a modification of the invention;

FIG. 3 is a view of a portion of the modification of FIG. 2 in which the firing pin is shown in its rearward, latched position;

FIG. 4 is an enlarged view of the timing and triggering means of the modification shown in FIG. 2, portions of the housings thereof being cut away;

FIG. 5 is a view, similar to FIG. 1, of another modification of the invention, and

FIG. 6 is an enlarged view of the timing and firing means of the modification shown in FIG. 5, portions of the housings thereof being cut away.

Referring to FIG. 1, a device **10** for setting off or actuating a percussion igniter **11** having a striking face **12** for a secondary propellant charge **14** of a gun-boosted projectile **16** or missile has a longitudinal axis (not shown) which is aligned along the forward direction of the projectile **16**. A cylindrical housing **18** has a chamber **20**, forward and rearward disc-shaped end members **22, 23**, and narrow first and second middle members **24, 26**. The forward end member **22** of the housing **18** is attached to a nozzle **28** which is connected to the rearward end **30** of the projectile **16**. Grooves **32**, for example, are formed on the forward end member **22** adjacent the nozzle **28** to facilitate prompt removal of the device **10** from the projectile **16** in response to forces exerted on the forward end member **22** upon initiation of combustion of the secondary propellant charge **14**. Each housing member **22, 23, 24, 26** spans the chamber **20** substantially perpendicularly to the longitudinal axis (not shown) of the housing **18**. The forward end member **22** has a hole **34** which is formed therethrough at substantially the center (not shown) of the member **22** and is adapted to hold, by frictional forces, a percussion igniter **11** which is in contact with the secondary propellant charge **14**. Appropriate locking means (not shown) may be used to maintain the igniter **11** in the hole **34**. An igniting shield **37** having a biasing means **39** is in contact with and covers the igniter striking face **12**.

The first and second middle members **24, 26** each have an opening formed therethrough at substantially the enter of the respective member, through which openings a firing pin **36** having first and second ends **38, 40** extends for movably and slidably mounting the same on the middle members **24, 26** and for movement, along the longitudinal axis (not shown) of the projectile **16** between a first or forward position, (shown) and a second or rearward position. At its forward position, the first end **38** of the pin **36** is in contact with the igniter striking face **12**. At its rearward position, the first end **38** of the pin **36** is rearwardly spaced from the igniter **11** and is located, for example, in register with the point **42**. Intermediate its two ends **38, 40** the pin **36** has a laterally extending portion such as a disc-shaped flange **44** or collar which is rearwardly spaced

from the housing first middle member 24 in all positions of the pin.

A resilient means 46 urges the pin 36 to its first or forward position (shown) and is capable of being deflected during and by motion of the pin 36 from the pin's first to its second or rearward position. In the embodiment shown, the resilient means 46 is a coiled spring 46 through which the pin 36 extends, the spring 46 being footed at one of its ends against the rearward housing second middle member 26 and, at its other end, against the flange 44 of the pin 36. The spring 46 is in compression between the housing second middle member 26 and the pin flange 44.

An ignition shield 37 having a planar surface with dimensions larger than the igniter striking face 12 may be inserted, for safety purposes, between the igniter striking face 12 and the pin fist end 38 prior to ignition of the primary propellant charge when the pin is in its first position. A biasing means 39, such as a coiled spring, has one end connected to the ignition shield 37 and the other end connected to an inner wall of the housing 18. With the ignition shield 37 in contact with the igniter striking face 12 and pin first end 38, the biasing means 39 is in tension.

FIG. 2 shows a device 10 for a gun-launched or multistage projectile 16 which is subject to forward propulsion by an initial charge (not shown) and, at a predetermined time after initial charge acceleration, to further forward acceleration by a subsequent charge 14. In this embodiment of the invention, the projectile 16, secondary propellant charge 14, housing 18, nozzle 28, percussion igniter 11, resilient means 46 and firing pin 36 are essentially the same as previously described in reference to Flg. 1. In addition, a detaining means 48 is pivotally mounted on the first middle member 24 at a location spaced from the housing's longitudinal axis (not shown) for movement between first (shown) and second (broken lines) positions. The detaining means, for example, is an angular arm 48 which has first and second portions 50, 52. The first portion 50 of the arm 48 extends from its pivot point 54 inwardly toward the longitudinal axis (not shown) of the housing 18, and, in its first position (shown), terminates at a location adjacent and inwardly spaced from the periphery of the pin's flange 44. When the pin 36 is in its first position (shown), the flange 44 is located forwardly of the arm first portion 50. A timing means 56 and a triggering means 58 are attached to the inner surface of the wall 60 of the housing 18 at a location forwardly spaced form the housing first middle member 24 and adjacent the second portion 52 of the arm 48, the timing means 56 and triggering means 58 being disposed between the housing wall 60 and the arm second portion 52. Biasing means 62 such as a tension spring 62 is attached between the housing wall 60 and the arm second portion 52 and urges the second portion 52 of the arm 48 toward its first position (shown), in which position the arm 48 is in contact with the timing 56 and triggering means 58.

In the second position of the arm first portion 52, the distal end 64 of the arm second portion 50 rides on the periphery of the flange 44.

Referring to FIG. 3, the timing means 56, triggering means 58, arm 48, and pin 36, previously described with reference to FIG. 2, are shown with the pin 36 in its second position and the arm 48 in its first position. When the pin 36 is in its second position (shown), its flange 44 is located rearwardly of the first portion 50 of the arm 48 and a foot 66 located on the rearward surface of the arm first portion 50 is in contact with the forward surface of the flange 44 and holds the pin 36 at its second position (shown).

Referring to FIG. 4, which shows in more detail the timing means 56 and triggering means 58 previously described with reference to FIG. 2, a rigid triggering bar 68 having a first end-portion 70 adjacent one wall 72 of the triggering means housing 74, a second end-portion 76 extending from that housing through an opening 78 therein and in contact with the arm second portion 52, and an enlarged-diameter middle portion 80 which has a circumferential notch or groove 82 formed therein is slidably mounted within the housing 74 by and in contact with a plurality of guiding rings 84 rigidly attached to the inner walls of the housing 74 for movement from a first position (shown) to a second position (to be described). In the first position of the bar 68, the first end-portion 70 is adjacent one wall 72 of the housing 74 and the second end-portion 76 is in contact with the arm second portion 52 when the arm 48 is in its first portion (shown). In the second position (not shown) of the bar 68, its first end-portion 70 is spaced from the wall 72 of the housing 74 and its second end-portion 76 is in contact with the arm second portion 52 and the arm 48 is in its second position (not shown).

A coiled spring 86, through which the first portion 70 of the bar 68 extends, is footed at one of its ends against the bar middle portion 80 and, at its other end, against an inner surface of the wall 72 of the triggering means housing 74. In the first position of triggering bar 68 (shown), the spring 86 is in compression between the triggering means housing 74 and the bar middle portion 80; in the second position (not shown) of the triggering bar 68, the spring is substantially expanded.

The timing means 56 is of any desired, conventional type which has an output shaft 89 that remains motionless during a preselected time and thereafter rotates for actuation of an associated member 88. The shaft 89 is provided with a driving gear 88 which is mounted within the timing means housing 98 and spaced forwardly from and in register, laterally of the bar 68, with the triggering bar groove 82. A detaining means comprising a rigid, elongated member 90 having a toothed end-portion 92 in register with and engaging the timing gear 88, a smooth, opposite end-portion 94 extendible into the triggering bar groove 82 when the bar 68 is in its first position (shown), and a smooth middle portion 96 extending from the timing means housing 98 into the triggering-means housing 74 through openings in the respective housings is mounted by and in contact with a plurality of guiding rings 84 rigidly attached to the triggering and timing means housings 74, 98 and allowing sliding movement of the detaining member 90 therethrough from a first position (shown) to a second position (to be described). In the first position of the detaining means 90, its smooth end-portion 94 is positioned within the triggering bar groove 82; in the second position of the detaining means 90, its smooth end-portion 94 is outside the triggering bar groove 82.

Referring to FIG. 5, another embodiment of this invention is shown which is particularly adapted for controlled ignition of a secondary propulsive charge 14 of a multistage projectile 16 at a predetermined time after burnout of the initial charge (not shown). The projectile 16, secondary propellant charge 14, housing 18, nozzle 28, percussion igniter 11 and resilient means 46 of this embodiment are essentially the same as previously described with reference to FIG. 1. In addition, a timing means 56 having a housing 98 and a switch 100 is mounted on the forward surface of the first middle member 24 in coaxial relation to the longitudinal axis (not shown) of the projectile 16. The switch 100 extends through an appropriate opening (not shown) in first member 24 and terminates at a location spaced rearwardly of the middle member and adjacent an actuator 102. The actuator 102 is essentially the same as the firing pin 36 described in reference to FIG. 2, with the exceptions that a first end 104 of the actuator 102 is preferably more blunt and shorter than the first end 38 of the pin 36 of FIG. 2.

A firing means 106 having a housing 108 and an igniting pin 110 is rigidly mounted on the forward surface of the timing means housing 98 and in coaxial relation to the longitudinal axis (not shown) of the projectile 16. The igniting pin 110 has a distal end 112 which, when the pin 110 is in its first position (shown), is spaced form and in proximity to the striking face 12 of the percussion igniter 11.

Referring to FIG. 6, which shows in more detail the timing and firing means 56, 106 previously described with reference to FIG. 5, a rigid igniting pin 110 having a longitudinal axis (not shown), a first end-portion 114 adjacent one wall 116 of

the firing means housing **108**, a second end-portion **118** extending from that housing through an opening **120** therein, and an enlarged-diameter middle portion **122** which has a forward end **124** substantially perpendicular to the longitudinal axis (not shown) is slidably mounted within the housing **108** by and in contact with a plurality of guiding rings **84** rigidly attached to the inner walls of the housing **108** for movement from a first position (shown) to a second position (to be described). In the first position of the igniting pin **110**, the first end-portion **114** is adjacent one wall **116** of the housing **108** and the second end-portion **118** is adjacent the igniter striking face **12**. In the second position of the igniting pin **110**, the first end-portion **114** is spaced from the wall **116** of the housing **108** and the second end-portion **118** is in contact with the igniter striking face **12**.

A coiled spring **126**, through which the first portion **114** of the igniting pin **110** extends, is footed at one of its ends against the pin middle portion **122** and, at its other end, against an inner surface of the wall **116** of the firing means housing **108**. In the fist position of the igniting pin **110** (shown), the spring **126** is in compression between the firing means housing **108** and the pin second portion **122**. In the second position of the igniting pin **110** (not shown) the spring **126** is substantially expanded.

A firing arm **128** having first and second portions **130**, **132** is pivotally mounted for movement from a first (shown) to a second (not shown) position on the housing **108** of the firing means **106** at a location forwardly and laterally spaced from the forward end **124** of the middle portion **122** of the igniting pin **110** when the igniting pin is in its first position (shown). In the first position of the firing arm **128** (shown), its first portion **130** is in contact with the forward end **124** of the igniting pin middle portion **122** and holds the pin **110** at its first position. In the second position (not shown) of the firing arm **128**, the arm is laterally spaced from the igniting pin **110**.

The timing means **56** is of any desired, conventional type which has an output shaft **89** that remains motionless during a preselected time and thereafter rotates for actuation of an associated member **88**. The shaft **89** is provided with a driving gear **88** which is mounted within the timing means housing **98** and spaced rearwardly from the second portion **132** of the firing arm **128**. An actuating means: comprising a rigid, elongated actuating member **136**, a force-transmitting means distinct from the actuator **102**, having a toothed end-portion **138** in register with and engaging the timing gear **88**, a smooth end-portion **140** in contact with the firing arm second portion **132**, and a smooth middle portion **142** extending from the timing means housing **98** into the firing means housing **108** through openings in the respective housings (not shown) is mounted by and in contact with a plurality of guiding rings **84** rigidly attached to the firing and timing means housings and allowing sliding movement of the actuating member **136** therethrough from a first position (shown) to a second position (to be described). In the first position of the actuating member **136** its smooth end-portion **140** is positioned in contact with the firing arm second portion **132** and the arm **128** is in its first position (shown). In the second position (not shown) of the actuating member **136** its smooth end-portion **140** is in contact with the firing arm second portion **132** and the arm is in its second position (not shown).

In the operation of the device of this invention, a primary propellant charge (not shown) launches the projectile **16**. That initial charge may be separate from the projectile **16**, as in a gun-launched projectile, or an integral part of the projectile, such as the first stage of a tube-launched or free-launched multistage rocket.

During combustion of the primary propellant charge (not shown), the projectile **16** is launched into space. The maximum velocity of the projectile **16** in response to the primary propellant charge (not shown) is relatively high and is attained in a relatively short period of time; i.e., the projectile **16** is rapidly accelerated during combustion of the primary charge.

With reference to FIG. **1** described above as showing a device preferably used with gun-launched projectiles, a rearwardly directed inertial force is imposed on the pin **36** during acceleration of the projectile **16** in response to the primary propellant charge (not shown). The inertial force is greater than the forwardly directed force exerted on the pin **36** by the spring **46** and, during forward acceleration of the projectile **16**, causes the pin to move from its first to its second position and thereby further compresses the spring. Where a shield **37** has been used and as the pin **36** moves toward its second position, the biasing means **39** removes the igniting shield **37** from the striking face **12**.

As the projectile **16** leaves the barrel of the gun (not shown), the gases generated by combustion of the primary propellent charge (not shown) escape to the atmosphere and acceleration of the projectile is sharply terminated. Correspondingly, the inertial force exerted by the rapidly **36** on the spring **56** is suddenly ended and the potential energy stored in the compressed spring is released. The pin **36**, in response to the spring **46**, moves rapidly to its first position and strikes and sets off the percussion igniter **11**, which thereupon ignites the secondary propellant charge **14**. The force rearwardly exerted on the device **10** by the combustion of the secondary propellant charge **14** breaks the forward end member **22** along its grooves **32** and removes the device from the projectile **16**.

In gun-launched projectiles, it is preferred that the secondary propellant charge be ignited only at locations outside of the gun barrel. By so restricting the location for ignition of the secondary propellant charge, the gun barrel is not subjected to the increased pressure and corrosive products associated with combustion of the secondary propellant charge.

Since the device **10** functions to set off the igniter **11** only in response to the termination of acceleration of the projectile **16**, it has extremely safe handling characteristics and the time of ignition of the secondary propellant charge **14** is accurately and reliably controlled. Because of the few moving parts and the limited movement of these parts, the device of this invention is sturdy, small, compact, adapted to function in a small housing, and simply and economically constructed.

In the operation of the embodiment shown in FIG. **2**, the pin **36** is constructed to function in response to acceleration of the projectile **16**, as previously described, with the exception that the percussion igniter **11** is actuated at a preselected time after initial acceleration of the projectile by the primary propellant charge **14**.

Rearward movement of the pin **36** toward the second position in response to the acceleration induced by the primary propellant charge causes the flange **44** to strike that arm first portion **50** and pivot the arm **48** to its second position. Movement of the arm second portion **52** to its second position releases and thereby actuates the timing means switch **100** and extends the biasing spring **62**. Upon the flange **44** continuing its rearward movement until it reaches a position rearwardly spaced from the arm first portion **50**, the biasing spring **62** pivots the arm **48** back to its first position, whereupon the arm lies in the path of the flange and prevents forward movement of the pin **36** beyond its second position, shown in FIG. **3**. Its switch **100** having been released, the timer begins a measuring of a preselected time interval.

With reference to FIG. **4**, at a preselected time after acceleration of the projectile **16** has caused the pin **36** to move to its second position, the timing means **56** supplies a torque to the output shaft **89** and thereby rotates the gear **88** in a direction moving the detaining member **90** from its first position (shown) to its second position in which the detaining smooth end means portion **94** is removed from the bar groove **82** and thus releases the triggering bar **68**. In response to the force exerted on the triggering bar **68** by the spring **86**, the triggering bar moves promptly to its second position and thereby forces the arm **58** to pivot to its second position, shown in broken line in FIG. **2**, and releases the pin **36**. The pin **36**, in response to the forwardly directed force exerted on

it by the compressed spring **46**, moves rapidly to its first position and strikes and sets off the percussion igniter **11**, thereby igniting the secondary propellant charge **14**. The rearward force exerted on the device **10** by combustion of the secondary propellant charge **14** breaks the forward end member **22** along the grooves **32** and removes the device **10** from the projectile **16**. In projectiles using the device shown in FIG. **2**, the ignition time of the secondary propellant charge **14** can be controlled to occur at a preselected time after a gun-launched projectile leaves the gun barrel or, in a multistage rocket, after burnout of the rocket primary propellant charge. Since the secondary charge ignition time is preselected, the projectile **16** reaches a desired height, distance, and attitude before ignition of the secondary propellant charge **14** and follows a flight path of preselected configuration.

The embodiment of the invention shown in FIG. **5** is constructed to function in response to acceleration of the projectile **16**, as previously described with reference to FIG. **2**, except that the pin **36** of FIG. **2** is replaced with an actuator **102**. Upon decrease of the projectile's acceleration, the actuator **102** moves forwardly to its first position, engages and depresses the switch **100**, and actuates the timing means **56**. Its switch **100** having been released and depressed, the time **56** begins a measuring of a preselected time interval.

Referring to FIG. **6**, at a preselected time after its actuation (and as described previously in connection with FIG. **4**), the timing means **56** rotates the driving gear **88**, thus moving forwardly the actuating member **136**. This motion of the actuating member **136** forces the firing arm **128** to pivot to its second position, in which position the arm first portion **130** is removed from the pin middle portion **122**, and thus releases the igniting pin **110**. The igniting pin **110**, in response to the forward force exerted by the compressed spring **126**, moves rapidly to its second position and strikes and sets off the percussion igniter **11** and thereby ignites the secondary propellant charge **14**. The force rearwardly exerted on the forward end member **22** (FIG. **5**) by the secondary propellent charge **14** breaks that member along its grooves **32** and removes the device **10** from the projectile **16**.

The embodiment of the invention shown in FIG. **5** accurately aNd reliably controls the secondary propellant charge ignition time of a multistage rocket having gradual deceleration rates.

While only one embodiment of the invention, together with modifications thereof, has been described in detail herein and shown in the accompanying drawing, it will be evident that various further modifications are possible in the arrangement and construction of its components without departing from the scope of the invention.

What is claimed is:

1. For a multistage projectile having a longitudinal axis and a percussion igniter, the projectile being subject to forward acceleration by an initial propulsive charge and to further forward acceleration by a subsequent propulsive charge, a device for controlled ignition of the subsequent charge at a predetermined time after actuation of the initial charge, said device comprising:

a firing pin which has a first end and is movably mounted with relation to the projectile for movement along said longitudinal axis between a forward position wherein the first end of the pin is in contact with the percussion igniter and a rearward position wherein the first end of the pin is rearwardly spaced from the igniter, a firing pin being movable to its second position by inertial forces thereon during acceleration of the projectile by the primary propulsive charge;

resilient means urging the pin to the forward position with a force less than rearwardly directed inertial forces imposed on the resilient means by the firing pin during forward acceleration of the projectile by the primary propulsive charge, the resilient means having a portion contactable by said pin and displaceable by the inertial forces of the pin;

detaining means responsive to movement of the pin to its rearward position for locking the pin in said rearward position and actuatable for releasing the pin to allow movement of the pin, by forces provided by the resilient means, to its forward position and into striking contact with the igniter;

timing means actuated in response to movement of the firing pin from its forward position and toward its rearward position and operable for providing a signal at a preselected time thereafter; and

a triggering means receptive and responsive to the signal provided by the timing means for actuating the detaining means, whereby the pin is released from its rearward position, travels forward and strikes the percussion igniter.

2. A device as set forth in claim **1**, wherein the detaining means comprises an arm.

3. A device as set forth in claim **1**, wherein the detaining means comprises:

an arm pivotally mounted on the projectile in contact with the timing means, adjacent the triggering means, and positioned where it is contacted and moved relative to the timing means by the pin during rearward motion thereof induced by forward acceleration of the projectile, whereby movement of the arm actuates the timing means.

4. For a multistage projectile which has a longitudinal axis and a percussion igniter and which is subjected to forward acceleration by an initial propulsive charge and to further forward acceleration by a subsequent propulsive charge, a device for controlled ignition of the subsequent charge at a predetermined time after ignition of the initial charge, said device comprising:

an actuator which has a member portion movably mounted with relation to the projectile for movement along said longitudinal axis between a forward position and a rearward position and which further has resilient means urging the member portion to the forward position with a force less than inertial forces rearwardly imposed on the resilient means by the member portion during forward acceleration of the projectile by the primary propulsive charge;

timing means having a force-transmitting means distinct from the aCtuator, said timing means being actuated by contact with the member portion during movement thereof from its rearward to its forward position and operable for providing a signal, supplied through said force-transmitting means to the firing means recited below, at a preselected time thereafter; and

firing means receptive and responsive to the signal provided by the timing means through said force-transmitting means for striking of the percussion igniter.

5. A device as set forth in claim **4** wherein the firing means comprises:

an igniting pin movably mounted relative to the percussion igniter for movement from a first position wherein the igniting pin is spaced from the igniter to a second position wherein the igniting pin is in contact with the percussion igniter;

resilient means urging the igniting pin to the second position; and

means for holding the igniting pin in its first position and receptive and responsive to the signal provided by the force-transmitting means of the timing means for releasing the igniting pin.