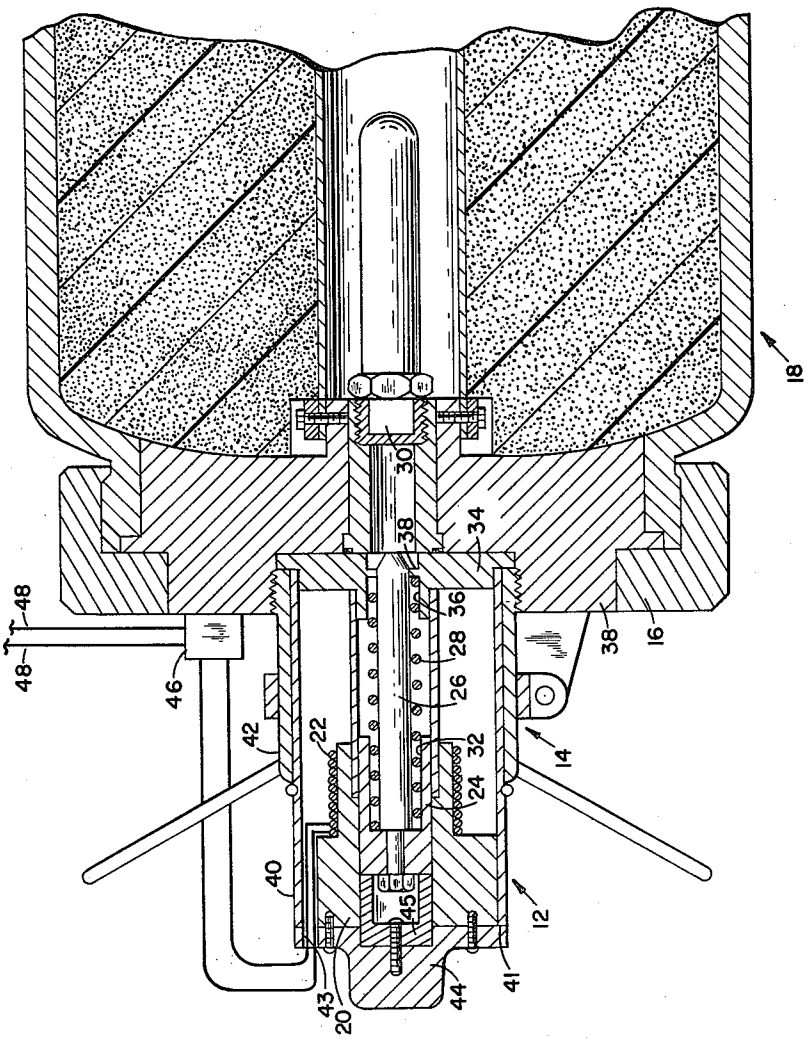
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ELECTRO-MECHANICAL IGNITER

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Harry J. Margraf
Douglas J. Robinson
Carl E. Berglund
INVENTOR.
BY S. J. Rotondi
A. P. Dupont
L. Plank

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ELECTRO-MECHANICAL IGNITER

Harry J. Margraf, Altadena, Douglas J. Robinson, Glendora, and Carl E. Berglund, Pasadena, Calif., assignors to the United States of America as represented by the Secretary of the Army

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This invention relates to an electro-mechanical igniter for use in rockets having solid propellants and in which a solenoid is used for directly driving a firing pin to detonate a primer cap for ignition of the propellants.

More particularly, this invention relates to means to assure that the impact of the firing pin with the cap will be of sufficient force so as to assure detonation thereof, and means to assure that detonation will occur only after the rocket has been erected for launching thereof.

Conventionally, a variety of spring loaded igniters, operated by solenoids, were utilized in such a manner so that the spring was the major driving force for the firing pin and the solenoid was used for release of the spring. However, a safety hazard existed in these conventional devices in that the spring could accidentally be released thereby permitting the firing pin to detonate the cap and ignite the propellant.

An object of this invention is to provide an igniter in which accidental or premature operation thereof is prevented.

A further object of the present invention is to provide an igniter which will operate only after the rocket in which the igniter is being used is raised to substantially an upright position.

A still further object of the present invention is to provide an igniter which will not only be dependent upon the erection of the rocket for the firing thereof but also to provide the rocket with means to insure that the force of impact of the firing pin with the detonation cap will be of sufficient force so as to assure detonation of the cap responsive to the impact.

The igniter of the present invention incorporates a push-type D.C. solenoid having an integral firing pin-plunger arrangement.

The solenoid is mounted in a housing which is secured to one end of the motor casing. At the other end of the housing is an end cap which encloses a permanent magnet which restrains the firing pin-plunger, after the solenoid has been energized until the magnetic field thereof has reached a predetermined value of its final E/R value, thereby increasing solenoid impact output a significant amount.

To prevent premature ignition from unwanted electrical signals, at least 37 volts D.C. (550 watt, 25 ohm coil) is required to move the firing pin-plunger away from the magnet.

As a further safety means a mercury switch is provided in the firing circuit and serves to automatically isolate the solenoid from the firing circuit whenever the missile is in the horizontal position and automatically closing the circuit and arming the solenoid whenever the rocket is elevated to an upright position.

Further aims and objects of the present invention will become more fully apparent from the following description and accompanying drawings in which:

The FIGURE is a sectional view of the igniter of this invention as used in connection with a rocket motor shown fragmentarily.

As shown in the figure, an igniter assembly 12 includes a housing 14 which is secured to one end 16 of motor 18 of a rocket. The igniter assembly comprises a stator 20, having a coil 22 circumferentially mounted around the stator 20. An armature 24 is slidably

mounted in the stator 20 and has a firing pin 26 secured thereto for movement therewith. A spring 28 is mounted about the firing pin 26 and is seated at one end in the bottom of an axial recess 32 provided within the armature 24.

To serve as a guide for firing pin 26 there is provided an end flange 34 in housing 14 having an axial cavity 36 therein. An annular shoulder 38 protrudes into cavity 36 to serve as a means to seat spring 28 at its other end. The end flange 34 extends into a mating annular recess in motor casing 38 of the rocket.

Housing 14 further includes a pair of tubular members 40 and 42 extending from end flange 34 and enclosing the stator 20, a coil 22, armature 24, firing pin 26 and spring 28. Tubular member 42 is threadedly connected into the motor casing 38 and serves to hold the end flange 34 in place.

To enclose the housing 14 at its other end, there is provided a flanged cap 44 which is secured to stator 20 and abuts the end 41 of the tubular member 40 to complete the enclosure.

Armature 24 and cap 44 are provided with a longitudinal bore 43, and coil 22 is connected to an external source (not shown) by leads 48 extending through the bore 43. Armature 24 is provided with a normal position in coil 22.

To restrain the armature 24 and firing pin 26 from moving until the magnetic field of the solenoid has reached a predetermined value of E/R there is secured in cap 44 a permanent magnet 45 which is placed adjacent one end of the armature 24 to hold the armature until a desired build-up of the magnetic field in the stator 20 is reached.

To assure that the rocket will not fire accidentally while in its horizontal position, a mercury switch 46 is secured adjacent the housing 14 at end 16 of motor 18. The switch is located in electrical leads 48 between the source of electrical energy and igniter assembly 12.

Mercury switch 46 is designed so that the igniter assembly will be electrically isolated from the source of electrical current until at such time that the rocket is raised to a predetermined angle. At this time the contacts of switch 46 will be automatically closed and the igniter armed for firing.

Operation

As electric energy is supplied through leads 48 to the coil 22 of igniter 12, a magnetic field is induced in this coil which tends to expel armature 24 and firing pin 26 in a rectilinear path from the normal position to contact with a primer cap 30 located adjacent the propellant in the motor 18 of the rocket.

However, because of the magnetic attraction of magnet 45 located in cap 44 and adjacent one end of armature 24, the armature 24 and firing pin 26 is prevented from movement until the magnetic field has reached a predetermined value of E/R. When this value has been reached the firing pin will be released with such velocity so as to virtually assure that impact force with the detonation cap 47 will be sufficient to cause the cap 47 to detonate.

To prevent premature or accidental firing of the igniter 12 by unwanted electrical signals, a mercury switch 46 is placed in leads 48 and electrically isolates the igniter 12 from the source of electric energy.

Raising the rocket to an upright position closes the contacts of switch 46 automatically arming the igniter for energization thereof at the desired time.

What is claimed is:

1. In an igniter for igniting a solid propellant motor of a rocket for launching thereof subsequent to the erection of said rocket, said igniter including a housing se-

cured to one end of said motor and enclosing a solenoid including a stator having a coil wound thereon, a source of electric energy connected to said coil for energization thereof for generation of a magnetic field therein, an armature slidably mounted in said stator and provided with a normal position therein, a firing pin secured to said armature for displacement in a rectilinear path and contact with a primer cap adjacent the propellant for ignition thereof responsive to the energization, the improvement comprising; magnetic restraining means secured in said housing to restrain said firing pin in said normal position for increase of the magnetic field in the generation to a predetermined value to produce a high value of the velocity of the displacement and consequent high force of impact at said contact and a mercury switch connected between said source of electric energy and said igniter to prevent energization of the igniter until said rocket is erected to a predetermined angle for launching thereof.

2. The igniter as in claim 1 wherein said restraining means comprises a permanent magnet secured in said housing for engagement with said armature for retention of the firing pin and subsequent release thereof responsive to the increase of the magnetic field of the solenoid to said predetermined value.

3. An igniter for igniting a solid propellant rocket motor for launching thereof subsequent to the erection of said rocket to a predetermined angle, said igniter comprising: a housing secured to one end of said motor and provided with an end plate having an axial cavity therethrough and including an annular shoulder extending into said cavity, said end plate being mounted in a recess provided in said end of said motor; a tubular member having a circumferential groove therearound and disposed for enclosing said end plate and having one end extending into said cavity of said motor; a second tubular member rotatably carried by said first tubular member

and having one end extending into said cavity of said motor for connection to the motor; a snap ring mounted in said groove in engagement with the other end of said first tubular member for retention thereof of said second tubular member; an end closure member provided at the other end of said first tubular member; a firing assembly mounted in said housing and provided with a solenoid including a stator having coils wound thereon for connection to a source of electric energy for generation of a magnetic field of predetermined value, said stator provided with an axial aperture and secured to said closure member; an armature slidably disposed in said stator; a primer cap disposed in said motor adjacent said propellant; a firing pin secured to said armature for slidable movement therewith from a normal position to an impact position with said primer cap for detonation thereof; a permanent magnet secured to said end closure member and disposed in said aperture of said stator to retain said firing pin in said normal position until the magnetic field generated by energization of said coils reaches said predetermined value and overcomes the reluctance of said magnet for release of said firing pin at high velocity of displacement and consequent high force of impact with said primer cap to assure detonation thereof; a mercury switch secured to said motor and connected between said source of electrical energy and said igniter to prevent energization of said igniter until said rocket is erected to said predetermined angle at which the mercury will close electrical contact to allow energization of said coils.

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