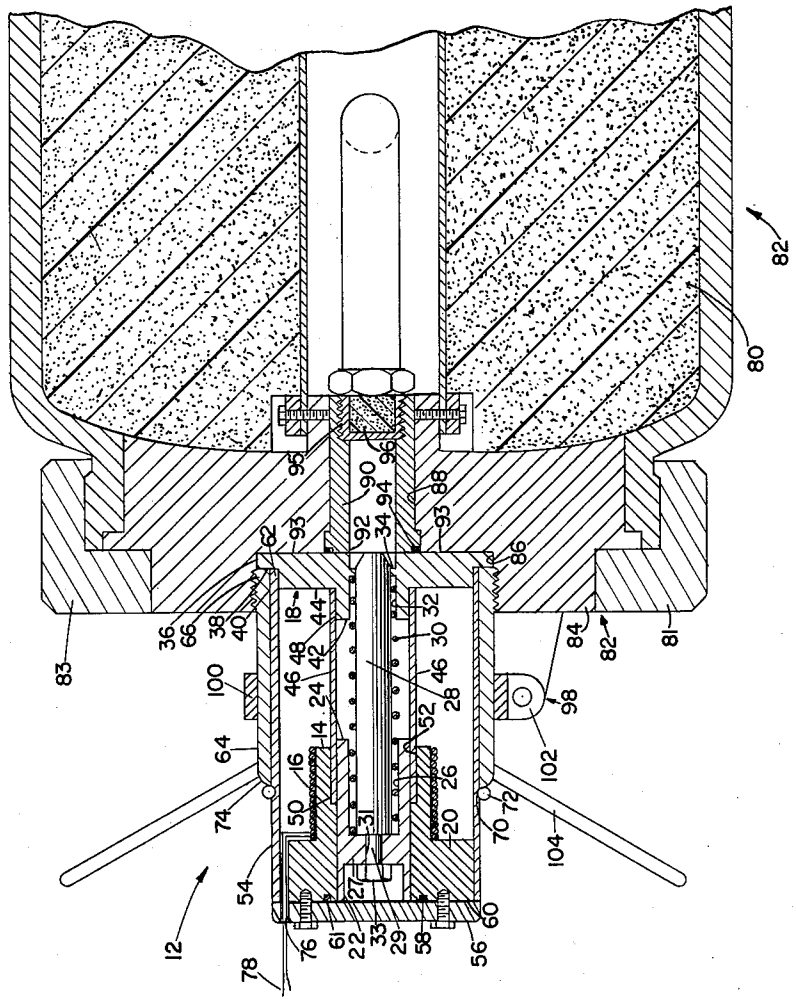
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ELECTRO-MECHANICAL IGNITER

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# 3,063,374
# ELECTRO-MECHANICAL IGNITER

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This invention relates to an electro-mechanical ignition mechanism in which a solenoid is used to directly drive a firing pin for combustion of an explosive medium, i.e., such as solid propellants in rocket motors.

Conventionally, a variety of spring loaded firing mechanisms operated by electric solenoids were combined in such a manner that the spring was the major driving force for the firing pin and the solenoid was used for the release of the spring. In this type of mechanism, if a misfire should occur, it becomes necessary to disassemble the igniter mechanism to rearm it for another attempt at firing.

Also, a safety hazard exists in these conventional devices in that the spring could accidently be released thereby permitting the firing pin to detonate the cap and ignite the propellants.

An object of this invention is to provide an igniter which can be repeatedly operated in case of misfires.

Another object is to provide an igniter wherein a greater margin of safety is achieved by the prevention of accidental or premature operation thereof.

The principal feature of the present invention is the utilization of a strong solenoid for directly driving a firing pin to contact and, therefore, detonate a primer cap located in a rocket motor chamber casing which encloses a combustible solid propellant disposed for combustion responsive to the detonation of the primer cap.

The firing device, enclosed within a housing, is secured to the combustion chamber and includes a solenoid connected to a source of electric energy. The solenoid has an armature or plunger slidably mounted therein and disposed for displacement along a rectilinear path responsive to the energization of the solenoid. Secured to the armature and carried therewith is a firing pin disposed to contact and detonate a primer cap which is located adjacent the solid propellant in the rocket motor combustion chamber and which, upon detonation, ignites the propellant.

Carried by the firing pin is a resilient member to return the armature and firing pin back to their normal position responsive to their displacement. Therefore, if a misfire should occur it is merely necessary to re-energize the solenoid for another attempt at firing the rocket.

A safety feature of this invention is provided by the resilient member carried by the firing pin which also serves to hold the firing pin away from the cap until such time when detonation is desired.

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 firing device of this invention as used in connection with a rocket motor shown fragmentarily.

As shown in the drawing, a device for igniting the solid propellant of a rocket motor is provided by a firing assembly **12**. The assembly **12** has a solenoid stator **14** made in the form of a spool with windings **16** around the spool and with one end of the windings abutting a stator body **20**. The stator body **20** has an annular passage **22** cut axially therethrough. An armature **24**, preferably made of mild steel, in the form of a cylindrical sleeve is disposed for slidable axial movement into and out of passage **22**.

The armature **24** is a cylinder-like member having an



axial cavity **26** therethrough, and has an annular shoulder **27** protruding into the cavity **26** to define a restricted aperture **31** in the cavity **26**.

To permit the attachment of a firing pin **28** to the armature **24**, one end **29** of the firing pin **28** is externally threaded and extends through the aperture **31** to receive a nut **33** thereon.

The firing pin **28** extends from the armature **24** and through an aperture **32** in an end flange **18** of the assembly **12**. The aperture **32** has an annular shoulder **34** therein to serve as a guide for the firing pin **28** and as a seat for one end of a spring **30** circumferentially mounted about the firing pin.

The spring **30** is disposed in the cavity **26** of armature **24** and is seated therein against shoulder **27**. The spring **30** extends, with the firing pin, through the aperture **32** of flange **18** and is seated therein against shoulder **34** of flange **18**.

Flange **18** is annularly recessed on its outer surface **36** to form a surface **40** and a shoulder **38** in stepped relation. An annular neck **42** extends in stepped relation from the inner surface **44** of flange **18** with an outside diameter matching the outside diameter of armature **24** and in coaxial alignment therewith.

To serve as a guide for armature **24** and for securing flange **18** and body **20** together, a tubular member **46** is disposed on the outer surface **48** of the neck **42** and extends therefrom to surround and be secured to the outer surface **50** of armature **24** and to bear against a shoulder formed by an annularly cut back portion **52** of the passage **22** of stator body **20**.

To provide a mount for an outer cylindrical casing **54**, the stator body **20** has an outside diameter matching the diameter of the annular recess of flange **18**. The casing **54** fits onto the recessed surface **40** of flange **18** and surrounds the stator body **20**. An end plate **56** is secured to body **20** by any suitable means to hold the casing **54** in place between the end plate and flange **18**.

In order to effect a seal between end plate **56** and stator body **20** an annular groove **58** is provided in the outer surface **60** of stator body **20** to receive therein a seal **61** which may be any of the conventional "O-ring" types.

The cylindrical casing **54** has a sleeve **64** rotatably mounted thereon and extending from an inner end **66** of the sleeve to a point intermediate the ends of the casing. The sleeve **64** is externally screw-threaded at its inner end **66** and so mounted that the inner end **66** abuts against shoulder **38** of flange **18**.

To hold sleeve **64** in place the cylindrical casing **54** is provided with an annular groove **70** adapted to receive therein a snap ring **72** which fits snugly against the outward end **74** of sleeve **64** thereby retaining sleeve **64** in place.

To permit a source of electrical energy to reach coils **16** of stator **14** there is provided a longitudinal bore **76** through end plate **56** and through stator body **20** which can receive therethrough electrical leads **78** connected from an external source of electrical energy (not shown).

To attach the firing assembly **12** to casing **81** of a combustion chamber **80** of a rocket motor **82** there is provided in the top **83** of the rocket motor a booster block **84** which has a large annular cavity **86** therein. The cavity **86** is internally screw threaded to match the external screw threading of the inner end **66** of sleeve **64** thereby permitting the ignition device **12** to be secured onto motor **82**.

The booster block **84** has an axial bore **88** therethrough which communicates with the cavity **86** and which is adapted to receive a collar **90** therein. The inner end **92** of the collar **90** abuts against the outer surface **93** of flange **18**. There is provided at the inner end **92** of collar **90** an annular groove adapted to receive a sealing ring **94**

between flange **18** and collar **90**. The outer end **95** of collar **90** is internally screw threaded to receive therein an externally screw threaded primer cap **96**. The cap **96** is located in the collar **90** adjacent the combustion chamber **80** of the rocket motor.

To enable the assembly **12** to be unlatched and swung open there is provided between the booster block **84** and assembly **12** a pivotal retaining means **98**. The retaining means **98** comprises a narrow, heavy, metal slip ring **100** rotatably mounted on sleeve **64** and having a pivot eye **102** radially mounted thereon. The eye **102** is secured to booster block **84** as by welding. Two handles **104** are mounted on opposite sides of the sleeve **64** to permit sleeve **64** to be unscrewed from the booster block **84** for opening of the assembly **12**.

Responsive to the unscrewing of sleeve **64** from the booster block **84** the retaining means **98** and the firing device **12** swings in an arcuate path about the pivot eye **102** to permit access to the interior of firing device **12** while also holding firing device **12** in its open position on booster block **84**.

As electric energy is supplied through connections **76** to the coils **16** of stator **14** a magnetic field is induced in these coils which expels armature **24** and firing pin **28** from the passage **22** of stator **14** in a rectilinear path causing the firing pin **28** to contact primer cap **96** causing it to detonate and ignite the propellant in the combustion chamber **80** of rocket motor **82**.

Due to the movement of the firing pin **28** as described above the spring **30** carried by firing pin is forced from a normal to a compressed state. After the firing pin strikes the primer cap **96** it, along with the armature, is returned to the normal position by virtue of spiral **30** expanding from its compressed state back to its normal position. This above described movement permits repeated operation of the igniter should a misfire occur.

I claim:

1. In a rocket motor of the type having a motor chamber, a combustible solid propellant and a primer cap for igniting the propellant disposed in said chamber, a firing assembly including a housing, means for attaching said firing assembly to said rocket motor comprising a booster block having a large internally screw threaded annular cavity therein and a longitudinal bore in axial alignment and communicating with said cavity, a collar disposed within said bore having a portion extending into said chamber, a primer cap disposed in said extended portion, a sleeve rotatably carried by said housing and externally screw threaded to match the internal screw threading of said cavity to provide for the attachment of said firing assembly and said combustion chamber, a slip ring rotatably



mounted on said sleeve, a pivot eye radially mounted on said slip ring and secured to said booster block to permit said housing to swing open in an arcuate path about said pivot eye responsive to the unscrewing of said sleeve from said booster block for the opening of said housing.

2. The device as set forth in claim 1 wherein the firing assembly comprises: a solenoid mounted in said housing, said solenoid provided with a stator having coils wound thereon; an armature slidably disposed in said stator; a firing pin secured to said armature for slidable movement therewith; a source of electrical energy connected to said coils for energization thereof, said armature disposed for displacement of said firing pin from a normal position to impact with said primer cap for detonation of said primer cap responsive to energization of said coils.

3. The device as set forth in claim 2 further comprising: an end flange secured within said cavity of said booster block and provided with an axial aperture therethrough and an annular shoulder protruding into said aperture, said armature provided with an axial cavity therethrough and an annular shoulder protruding into said cavity of said armature, said firing pin secured within said cavity of said armature and extending therefrom through said aperture of said end flange to be guided in its slidable movement by said shoulder of said end flange; a spring circumferentially mounted about said firing pin and seated at one end against said shoulder of said armature and extending therefrom into said aperture of said end flange to be seated at its other end against said shoulder of said end flange, said spring disposed for return of said firing pin to said normal position responsive to said slidable movement.

4. The device of claim 3 wherein said housing includes an end plate secured to said stator; a tubular member secured between said stator and said end flange to serve as a guide for said armature in its slidable movement; said housing having an outwardly disposed annular groove thereon and disposed within said sleeve; a snap ring disposed in said groove of said housing and in engagement with the end of said sleeve for retention thereof on said housing.

5. The device of claim 4 wherein said end plate and said stator are provided therethrough with aligned longitudinal bores; electrical conductors disposed in said bores and connected to said source of electrical energy and to said coils for energization thereof.

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