United States Patent [19]

McAllister

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[54] **IGNITER**

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[52] **U.S. Cl.** ..... **102/34,** 102/49.7, 102/70.2 A

[51] **Int. Cl.** **F42b 15/00,** C06d 1/04

[58] **Field of Search** 60/256; 102/34, 34.1, 102/34.2, 34.3, 34.4, 34.5, 49.7, 70.2

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[57] **ABSTRACT**

A device specially adapted for igniting model rocket engines which includes a thin wedge-shaped paper or deformable plastic substrate, a thin electrically conductive metal foil on one side of the substrate and a pyrotechnic igniting bead carried on the tip end of the wedge-shaped device. A slit extends from the base of the wedge to a point spaced from the tip end, dividing the foil into two conductor portions which join at the tip end to form a resistance heating portion in thermal contact with the pyrotechnic igniting bead.

4 Claims, 6 Drawing Figures

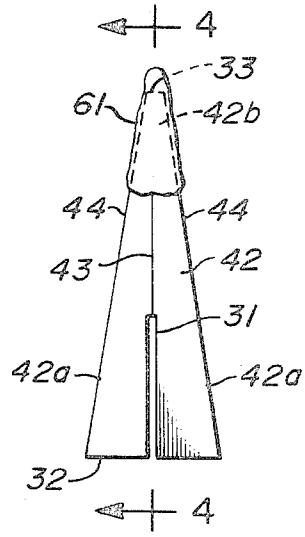

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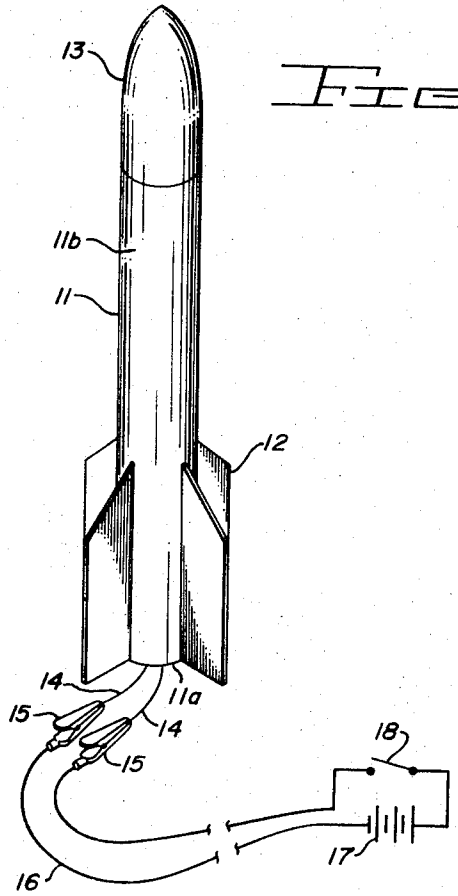
Fig. 1



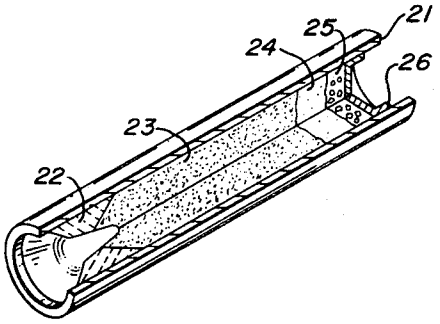


Fig. 2

Fig. 3

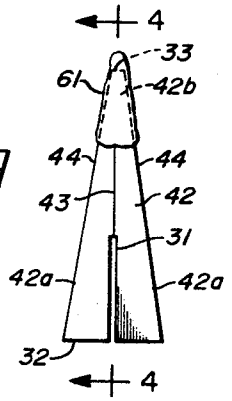


Fig. 4

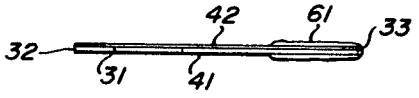


Fig 6

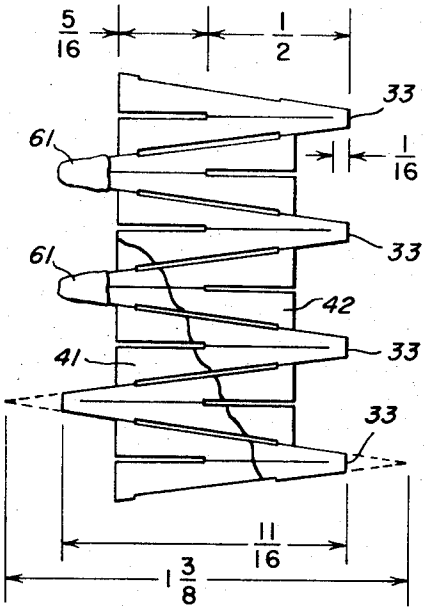
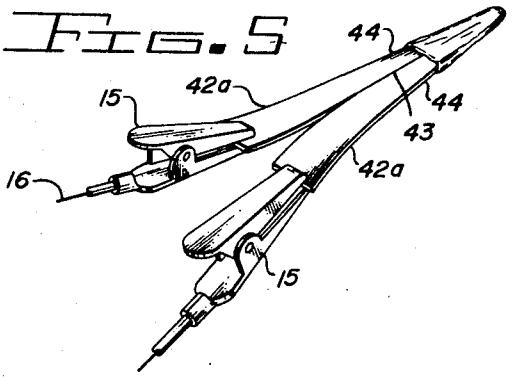


Fig. 5



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This invention relates to igniting devices.

More particularly, the invention relates to electric resistance heating actuated igniting devices.

In a particular aspect, the invention concerns igniting devices specially adapted for use in igniting model rocket engines.

Several types of electrically actuated igniters for model rocket engines are known in the art. The simplest type is a very fine wire formed of nichrome or other appropriate resistance heating material. A length of the wire is merely inserted into the nozzle end of a model rocket engine and the ends of the wire are coupled by means of suitable alligator clips to a pair of conductors leading to a battery and switch connected in series. When the switch is closed, the current flowing through the resistance wire causes the wire to heat to a temperature at which it will ignite the propellant charge of the model rocket engine. According to further improvements, resistance wire igniters are provided with a heat-sensitive pyrotechnic composition in the form of a bead or tubular coating on a portion of the wire. When the wire is heated, it ignites the pyrotechnic composition which, in turn, ignites the propellant charge of the rocket engine.

According to another prior art technique, a pyrotechnic fuse is inserted into the nozzle of the model rocket engine and in close proximity to the propellant charge within the engine. The end of the fuse extending outside the engine is ignited by means of a resistance heating wire wrapped around the end of the fuse or maintained in thermal contact with the fuse by adhesive tape.

The above-described prior art igniters do reduce the safety hazards involved in igniting a rocket engine by making it possible for the operator to initiate the ignition sequence from a remote position. However, it would be advantageous to provide an igniter device which is less expensive and easier to produce, which is more convenient to use and which provides reliable and prompt ignition of the rocket engine and which has a relatively low electrical current requirement.

It is therefore a principal object of the present invention to provide an igniting device.

Another object of the invention is to provide an igniting device specially adapted for use in igniting solid propellant model rocket engines.

Another object of the invention is to provide a model rocket engine igniting device which can be manufactured economically and which can be used more conveniently than certain of the prior art igniters.

Still another object of the invention is to provide an igniter which has a low electrical current requirement but which insures prompt and reliable ignition of the rocket engine.

These and other, further and more specific objects and advantages of the invention will become apparent from the following detailed description thereof and the drawings, in which:

FIG. 1 is a schematic prospective view of a typical model rocket and associated electrical ignition equipment;

FIG. 2 is a sectional prospective view of a typical model rocket engine;

FIG. 3 is a plan view of a model rocket engine igniter embodying the features of my invention;

FIG. 4 is a sectional view of the igniter of FIG. 3 taken along section line 4—4 thereof;

FIG. 5 is a perspective view of the igniter device of FIGS. 3 and 4 showing the method of connecting the igniter to the electrical leads of the ignition initiating equipment; and

FIG. 6 is a plan view illustrating how the igniter of FIGS. 3–5 may be conveniently manufactured.

Briefly, in accordance with my invention, I provide an electrically actuated igniter which is specially adapted for use in igniting a solid propellant model rocket engine although, as will be appreciated by those skilled in the art, the igniter could be used for many other purposes such as igniting various industrial and military pyrotechnic devices such as wire-laying rockets and in many other practical applications.

The typical model rocket engine includes an elongate tubular case, a restrictive refractory nozzle disposed in the lower end of the engine casing and a solid propellant charge disposed within the casing above the restrictive nozzle. My igniter device comprises an electrically insulating substrate, an electrical resistance heating metal foil carried on a side of the substrate, the substrate and foil being dimensioned to permit the tip of the igniter to be inserted into the restrictive nozzle of the rocket engine proximate the solid propellant charge. The device is preferably shaped and dimensioned to be frictionally engaged by the restrictive nozzle to hold the tip of the igniter in proximity to the propellant charge. However, the utility of the device is not restricted to require that it be held in the engine nozzle by frictional engagement and, for example, can be readily secured in the proper operative position by a piece of narrow adhesive tape inserted between the downwardly extending conductor portions and having each end secured to the outside of the engine casing.

The metal foil has a slit therein extending from the base edge of the wedge-shaped substrate to a point spaced from the tip edge thereof, thereby dividing the foil into two conductor portions. The conductor portions join at the tip end of the slit to form a resistance heating portion. A pyrotechnic igniting bead is carried on the tip end of the igniter and disposed in thermal contact with the resistance heating portion.

Turning to the drawings, FIG. 1 illustrates a typical model rocket and associated electrical igniting equipment. The model rocket will generally include a tubular body shell **11**, appropriate stabilizing fins **12** and a noze cone portion **13**. The tubular body portion encloses the rocket engine contained in the lower end **11a** of the body and may contain a parachute packed in the upper end **11b** of the rocket body which lowers the nose cone and the rocket back to the earth at the terminal portion of the powered flight period. The electrical leads to the igniting device **14** are connected by means of suitable alligator clips **15** to conductor wires **16** which connect the igniter in series electrical connection with a battery **17** and an actuating switch **18**. When the switch **18** is closed, the igniter is actuated, firing the engine. The igniter wires **14** are pulled from the alligator clips **15** as the rocket rises from the ground. To better illustrate the principles of my invention, FIG. **2** is a sectional perspective view of a typical model rocket engine showing the tubular engine casing **21**, the ceramic restrictive nozzle **22** and solid propellant charge **23**. In the case of a single-stage engine, the casing will usually contain a delay charge **24**, an ejection charge **25** and suitable

wadding **26.** The ignition sequence includes the ignition of the propellant charge which, in turn, ignites the delay charge which, in turn, ignites the ejection charge. When the ejection charge **25** is fired, the nose cone **13** is separated from the body portion **11** of the rocket, pulling the packed parachute out of the end **11b** of the rocket body **11.**

Referring to FIGS. **3, 4** and **5,** my igniter comprises a base or substrate portion **41** formed of a suitable electrically insulating material such as cardboard or plastic. In a preferred embodiment, I employ 0.010 inch thick polyvinylchloride. The substrate material should be deformable so that the conductor portions of the foil may be separated slightly when the alligator clips **15** are attached to the igniter. In a preferred embodiment, the substrate has a slit **31** extending inwardly from the base edge **32** to facilitate deformation to permit attachment of the clips **15.** It is much more convenient to attach the alligator clips **15** to the conductor portions **42*a*** in my igniter device than to the fine nichrome wire of leads in several of the prior art igniters.

The substrate **41** carries a thin electrically conductive metal foil **42.** The foil **42** has a slit **43** extending from the base edge **32** toward the tip end **33** of the substrate **41.** The slit **43** extends to a point within a short distance of the tip **33,** thus dividing the foil **42** into conductor portions **42a** which join at the tip **33** to form a resistance heating portion **42b.**

Although the exact dimensions are, of course, not critical, the convenience of use of my igniter is greatly enhanced if the device is dimensioned to be held within the engine casing by frictional engagement between the side edges **44** of the igniter and the nozzle **22,** such that the tip end **33** of the igniter is in close proximity to, or even touching, the solid propellant charge **23.** Any suitable resistance heating metal foil may be employed such as nichrome foil, or as presently preferred, steel foil of a thickness of 0.001 inch. The foil may be adhesively attached to the substrate or by any other suitable means.

The igniter devices of FIGS. **3–5** may be conveniently manufactured by stamping and die-cutting a sheet of the foil-covered substrate as shown in FIG. **6** and thereafter dipping the tips **33** into a suitable plasticized pyrotechnic flare composition to form the igniting beads **61.** The dimensions shown on FIG. **6** are, of course, nonlimiting and merely illustrate a convenient size of the igniter which is adapted to be frictionally engaged within the nozzles of certain present standard model rocket engines which are generally available in the industry.

Suitable pyrotechnic igniting compositions are well known in the art and, for example, in a presently preferred embodiment, I employ a mixture as follows:

Parts by Wt.	
2	Manganese Dioxide
100	Potassium Chlorate
25	Iron Powder
100	Contact Cement

The foregoing ingredients are thoroughly mixed with sufficient contact cement thinner to achieve the desired degree of plasticity to permit coating the tips of the igniters by dipping them into the mixture to form the pyrotechnic igniter bead on the tip.

I claim:

1. An electrically actuated igniter specially adapted for use in igniting a solid propellant rocket engine, said engine including

an elongate tubular casing,

a restrictive refractory nozzle disposed in the lower end of said engine casing, and

a solid propellant charge disposed within said casing above said restrictive nozzle,

which igniter comprises:

a. an electrically insulating substrate;

b. an electrical resistance heating metal foil carried on a side of said substrate;

c. said substrate and foil carried thereon being wedge-shaped to permit the narrower tip thereof to be inserted into said restrictive nozzle proximate said solid propellant charge;

d. said metal foil having a slit therein extending from the base edge of said wedge-shaped substrate to a point spaced from the tip edge thereof, said slit dividing said foil into two conductor portions, each conductor portion joining at the tip end of said slit, forming a resistance heating portion of foil, and

e. a pyrotechnic igniting bead carried on the tip end of said igniter and disposed in thermal contact with said resistance heating portion.

2. Igniter of claim **1** wherein said substrate is deformable and has a slit extending inwardly from the base edge thereof a distance sufficient to separate the ends of said conductor portions.

3. Igniter of claim **1** which is dimensioned to be frictionally engaged by said nozzle to hold said tip in said proximate position.

4. A method of manufacturing igniter squibs comprising:

a. forming a laminate structure of

an electrically insulating substrate sheet, and

an electrical resistance heating metal foil carried on a side of said substrate sheet;

b. slitting said foil from one edge of said laminate sheet to a point spaced from another edge thereof, said slit thereby dividing said foil into two conductor portions, each conductor portion joining at the end of said slit spaced from said side, forming a resistance heating portion of said foil; and

c. coating said resistance heating portion with a heat-sensitive pyrotechnic igniting composition.

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