July 11, 1961 C. McKINLEY SLOUGH 2,991,715

ELECTRIC INITIATOR

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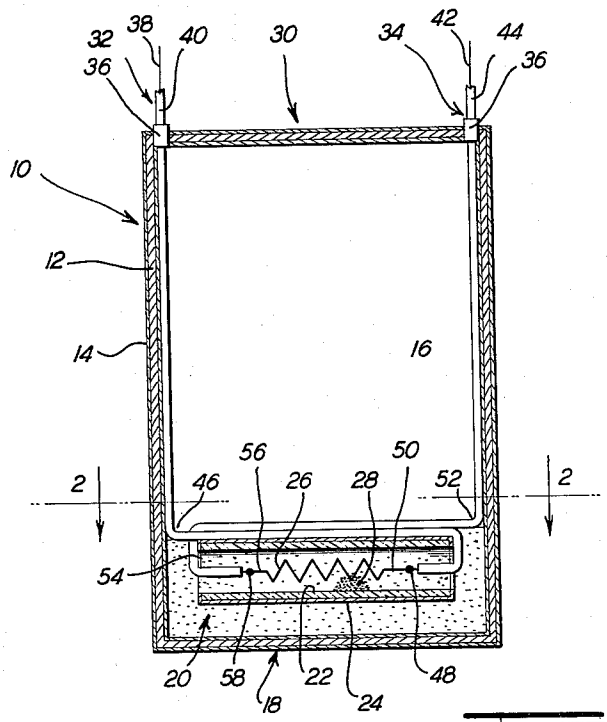


Fig. 2.

Fig. 1.

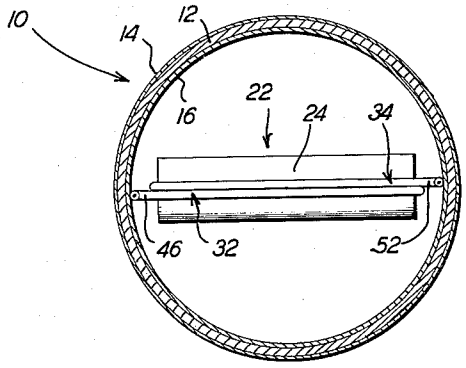


Fig. 3.

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ELECTRIC INITIATOR

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This invention relates to improvements in electric firing initiating devices and, more particularly, to electric initiators which are highly resistant to premature firing by radio frequency radiations.

The invention relates to electrical firing initiating devices which generally include a shell or casing in which is disposed an electrical resistance element or fuse wire which heater element or fuse wire is in contact with a heat-sensitive ignition composition or matchhead, which, in turn, is embedded in or located adjacent to an explosive charge.

Such electrical firing initiating devices are commonly employed to initiate various explosive compositions used as the primary igniter for reaction propelled motors of the liquid or solid propellant types. In general, such electric initiators are designed to be actuated by direct current or low frequency alternating current. The art has long recognized the dangers inherent in accidental discharge of electric initiators by accidentally induced radio frequency currents. However, the problem has become more acute in recent years since radio frequency initiated guiding systems and control means have been employed in reaction propelled space vehicles.

It is, therefore, a primary object of the present invention to provide a direct current or low frequency alternating current electric initiator safeguarded against premature or accidental initiation by radio frequency currents induced therein.

A further object is to provide improved radio frequency protected electric initiators without substantially reducing the degree of sensitivity of the electric initiator to direct or low frequency current.

In general, the invention consists of an electric initiator safeguarded against premature initiation from high frequency currents induced therein and includes a casing, a hollow dielectric member maintained in the casing remote from one end thereof, an electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element being shaped to provide a high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into said casing adjacent said one end, one of said conductors extending across the hollow member in close proximity to the conductive coating thereon and then into electrical contact with one end of the heater element, the other of the conductors extending across the hollow member in the opposite direction to said one conductor and in close proximity to said one conductor and said conductive coating on said hollow member and then into electrical contact with the other end of the heater element.

The invention will be more particularly described with reference to the illustrative embodiments thereof shown in the accompanying drawings wherein:

FIG. 1 is a vertical sectional view of an electric initiator embodying the principles of the present invention;

FIG. 2 is a transverse section through the electric initiator shown in FIG. 1 substantially on line 2—2 thereof; and

FIG. 3 is a diagrammatic view of a modified form of high frequency choke fuse wire.

Referring to the drawings, 10 generally designates the

improved electric initiator safeguarded against premature ignition by high frequency currents induced therein. The initiator includes a casing 12 preferably provided with a bright silvered outer surface 14. As will be apparent to those skilled in the art, the silvered surface may be replaced with a surface of some other bright highly conductive material to reduce the generation of currents from high frequency radiations in the elements maintained in the casing. Also, as illustrated, the internal surface of the casing 12 may also be provided with such a coating.

Adjacent the lower end 18 of the casing 12 is maintained a heat-sensitive ignition composition 20 which has embedded therein a glass or other dielectric hollow tube member 22. The hollow dielectric member 22 is provided with a silvered outer surface as indicated at 24 and as hereinbefore described with reference to the casing 12, other highly conductive coatings may be substituted for the silver coating 24.

Positioned within the hollow tube member 22 is an electrical resistance heater element 26. The heater element 26 extends substantially from end to end of the hollow body and is in heat exchange relationship to the ignition composition 20 within the tube. Further, as illustrated in FIG. 1, a primer spot or matchhead 28 may be maintained within the hollow tube 26 in contacting relationship to the resistance element 26 and provide the initial ignition composition. A suitable primer spot may comprise mercury fulminate or, for example, lead azide.

The upper end 30 of the casing 12 may be provided with openings through which a pair of electrical conductors generally designated 32 and 34 pass. Moisture sealing means 36 may be provided between the openings in the top 30 of the casing and the pair of conductors 32 and 34. Conductor 32 consists of a conductive wire element 38 and an outer insulating coating 40. Similarly, electrtical conductor 34 comprises a conductive metal wire 42 having an insulating coating 44. Conductor 32, after passing through the opening in the top 30 of the casing 12, extends downwardly into the casing in close proximity to the inner wall of the casing to a point 46 adjacent the extended surface of the hollow tube member 22 and then across the surface 24 of the hollow member 22 to the opposite end thereof and then into electrical contact as at 48 with one end 50 of the electrical resistance heater element 26.

The other electrical conductor 34 after passing through the opening in the top 30 of the casing 12 extends downwardly in close proximity to the wall of the casing 12 to a point indicated at 52 adjacent the surface of the hollow dielectric tube member 22; then across the outer surface of the hollow tubular member to the open end 54 thereof and then into electrical contact with the end 56 of the electrical resistance element 26 as indicated at 58.

The electric resistance heater element 26, as illustrated in FIG. 1 of the drawings, is shaped to provide a high frequency or radio frequency choke to present high reactance at certain frequencies and offer impedance to the flow of alternating currents in the heater element 26. In FIG. 1, the radio frequency choke is provided by folding the fuse wire into a corrugated structure. Similar results may be provided by the helical fuse wire as indicated in FIG. 3 at 26'.

The form of the corrugations of corrugated fuse wire 26 or the shape and number of the coils of helical fuse wire 26' is determined by the particular radio frequency radiations which are to be safeguarded against. For example, if the predominant radio frequency radiations are in the range of about 1 kmc., then the length of

each of the folds of the corrugations of the fuse wire **26** would be about 1.2$\mu\mu$ or an even multiple thereof.

In operation of the improved electric initiator safeguarded against premature ignition by high frequency currents of the present invention, radio frequency voltage entering the casing **12** on the pair of conductors **32** and **34** will be in close proximity to the inner wall of the casing. A part of this energy will, therefore, be transferred to the casing reducing the induced energy on the conductors. As the pair of conductors travel along the silvered surface **24** of the hollow dielectric member **22**, they travel in opposite directions and induced high frequency currents in these conductors also flow in opposite directions affording some cancellation of the currents induced therein. There will also be a transfer of energy to the silvered hollow tubular member through the capacitive effect existing between the conductors and the tube. Since the hollow tubular member has a large surface area of lower resistance than the actual fuse wire or electrical resistance heater element **26**, it is capacitively coupled to the fuse wire providing a large reduction in induced radio frequency currents. The folds or coils of the fuse wire aid in further cancellation of induced radio frequency voltage that may reach the fuse wire since the currents in adjacent folds or coils flow in opposite directions. Further, the exterior silvered surface **14** of the initiator case **12** acts as an efficient reflector for external radio frequency waves preventing their entry into the interior of the initiator, further safeguarding against premature ignition from high frequency currents.

From the foregoing description, it will be readily apparent to those skilled in the art that the present invention fully accomplishes the aims and objects hereinabove set forth. It will also be apparent to those skilled in the art that modifications may be made in the disclosed form of the invention without departing from the scope of the appended claims. For example, it will be readily appreciated that by increasing the length of the casing, the greater will be the protection against premature ignition from high frequency currents induced in the conductors as the longer casing will provide for greater transfer of energy to a wall thereof.

I claim:

1. An electric initiator safeguarded against premature initiation from high frequency currents induced therein comprising a casing, a hollow dielectric member maintained in the casing remote from one end thereof, an electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element comprising a high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into said casing, one of said conductors extending across the conductive coating on the hollow member and then into electrical contact with one end of the heater element, the other of the conductors extending across the conductive coating on the hollow member in the opposite direction and in side-by-side relationship to said one conductor and then into electrical contact with the other end of the heater element.

2. An electric initiator safeguarded against premature initiation from high frequency currents induced therein comprising a casing, a hollow dielectric member maintained in the casing remote from one end thereof, an electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element comprising a high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into said casing along a wall thereof from an end remote from said hollow dielectric member, one of said conductors extending from a wall of the casing across the conductive coating on the hollow member and into electrical contact with one end of the heater element, the other of the conductors extending from the wall of the casing across the said conductive coating on the hollow member in the opposite direction and in side-by-side relationship to said one conductor and then into electrical contact with the other end of the heater element.

3. An electric initiator safeguarded against premature initiation from high frequency currents induced therein comprising a casing, said casing comprising a hollow metallic member having a silvered coating on its external surface, a hollow dielectric member maintained in the casing remote from one end thereof, an electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element comprising a high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into said casing, one of said conductors extending across the conductive coating on the hollow member and then into electrical contact with one end of the heater element, the other of the conductors extending across the conductive coating on the hollow member in the opposite direction and in side-by-side relationship to said one conductor and then into electrical contact with the other end of the heater element.

4. An electric initiator safeguarded against premature initiation from high frequency currents induced therein comprising a metallic casing, a hollow dielectric member maintained in the casing remote from one end thereof, a bright electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element comprising a corrugated high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into the casing from an end remote from said hollow member and along a wall thereof, one of said conductors extending across the conductive coating on the hollow member and into electrical contact with one end of the heater element, the other of the conductors extending across said conductive coating on the hollow member in the opposite direction and in side-by-side relationship to said one conductor and then into electrical contact with the other end of said heater element.

5. An electric initiator safeguarded against premature initiation from high frequency currents induced therein comprising a metallic casing, a hollow dielectric member maintained in the casing remote from one end thereof, an electrical conductive coating about the external surface of said dielectric member, an electrical resistance heater element positioned within said hollow dielectric member, said heater element comprising a helical high frequency choke, a heat-sensitive ignition composition in heat exchange relationship to the heater element, a pair of electrical conductors extending into the casing from an end remote from said hollow member and along a wall thereof, one of said conductors extending across the conductive coating on the hollow member and into electrical contact with one end of the heater element, the other of the conductors extending across said conductive coating on the hollow member in the opposite direction and in side-by-side relationship to said one conductor and then into electrical contact with the other end of said heater element.

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