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Stevens

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[54] **ONE WATT/ONE AMP NO-FIRE MATCH TYPE INITIATOR**

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[51] **Int. Cl.²** **F42B 3/12**

[58] **Field of Search** ..... 102/28 R, 28 M; 149/18, 149/24, 27, 28

[56] **References Cited**

UNITED STATES PATENTS

1,798,332	3/1931	Littlebury	149/27 X
1,935,495	11/1933	Young	102/28 M
2,506,229	5/1950	Lowe et al.	102/28 M
2,995,780	8/1961	Scott	102/28 M
3,055,780	9/1962	Finnegan et al.	149/27
3,291,046	12/1966	Dahl	102/28

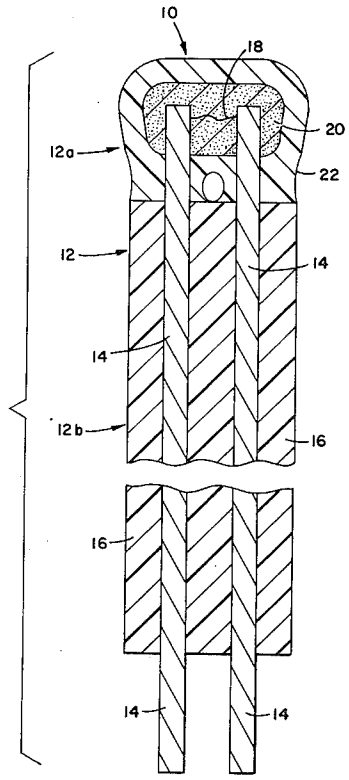
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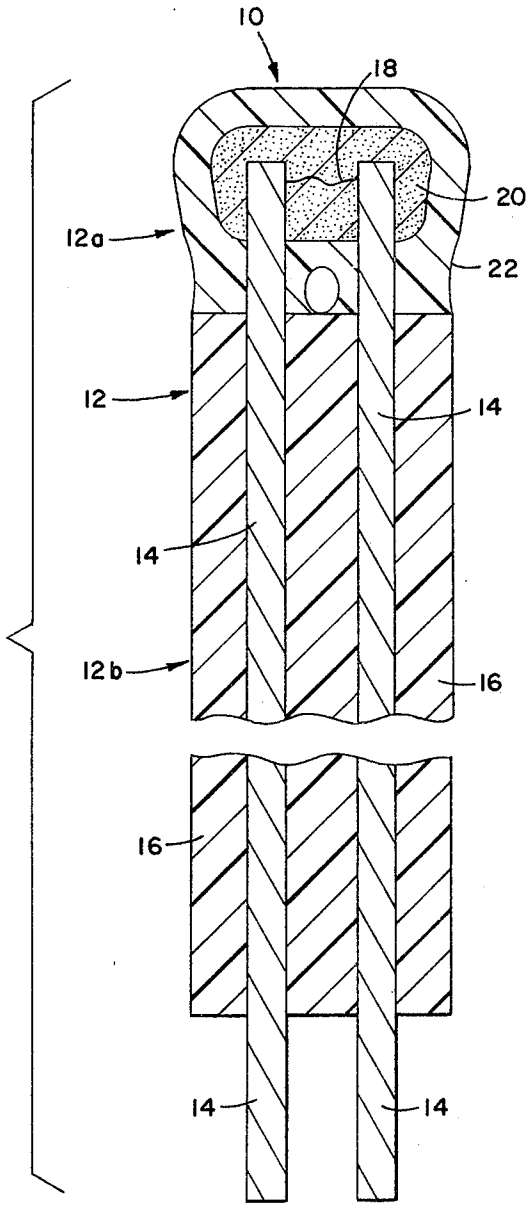
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[57] **ABSTRACT**

A match type electrical initiator which has a 1 watt/1 amp no-fire characteristic utilizes an insulated dual conductor flat cable, such as polystrip cable, as an integral part. The initiator has a head portion and a body portion, the body portion being the insulated dual conductor cable whose conductors terminate in the head portion. The head portion is comprised of the conductors which have been bared of insulation, fitted with a bridgewire fastened therebetween, covered with an ignition material with about 90% by weight of the material being comprised of a stoichiometric mixture of lead thiocyanate, potassium chlorate, and charcoal and with about 10% by weight of the material being a binder, and covered with an external epoxy adhesive coating which serves to seal the head portion thereby obviating the requirement of an initiator case. The initiator can be manufactured in mass production to a thinness of about 0.070 inch which makes it ideally suited for initiating action of a destruct unit for rocket motor cases for weather rockets. The small initiator can be easily fitted into the approximate 0.100 inch space envelope of the honeycomb of a rocket motor case.

2 Claims, 1 Drawing Figure




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18
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12a
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12b
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ONE WATT/ONE AMP NO-FIRE MATCH TYPE INITIATOR

BACKGROUND OF THE INVENTION

The most vulnerable components of a weapon's propulsion system is generally agreed to be the initiators. These initiators are most commonly called electroexplosive devices. Their activation is by the application of electric energy, through conductors into a resistive element which is called a bridge which converts the electric energy into other energy forms. This conversion is primarily to heat, but sometimes may be in the form of high velocity particles or vapors and plasmas at high pressure. These initiators are susceptible to accidental initiation when the applied energy through the bridge is exceeded above where the item is designed to function. As an example, an electric initiator designed to fire at ½ amp current through the bridge, will fire at this point and above, regardless of the source from which the energy is emitted. A nuclear device generating an electromagnetic pulse (EMP) which would induce a current in the bridge to above ½ amp would then cause the item to be activated. The items are also susceptible to accidental initiation from electrostatic energies imparted into the bridgewire or imparted through the explosive mixtures.

Because of military safety requirements, standards have been set which require a specified minimum value of amperes or watts to which an initiator can be subjected to without firing. A small initiator of the match type is difficult to construct with an ampere all-fire rating which exceeds about ½ ampere or approximately ¼ watt.

Prior art match type initiators have been constructed with an all-fire rating of ½ ampere or approximately ¼ watt. These initiators have a thickness of about **0.120** inch. Because of the manner of construction, the thickness and the all-fire rating have been accepted as the best that can be delivered within the state-of-the-art.

Desirable is an initiator of the match type which possesses the one watt/one amp no-fire characteristics.

Also desirable is an initiator of the match type which can be made as thin as **0.070** inch thickness to enable it to be positioned within the honeycomb structure of a consumable rocket motor case.

Therefore, an object of this invention is to provide a match type initiator which possesses the one watt/one ampere no-fire characteristics.

Another object of this invention is to provide a match type initiator with a thickness of about **0.070** inch.

A further object of this invention is to provide an initiator which can be manufactured in mass production and which does not require a separately made outer case.

SUMMARY OF THE INVENTION

The initiator of this invention is of the match type having a head portion and a body portion. The initiator is comprised of a dual conductor flat cable having conductors which extend through the body portion and terminate in the head portion. The conductors are bared of insulation in the head portion for a predetermined distance from the end of the flat cable, a bridgewire (pyrofuze) is soldered between the spaced apart conductors, a coating of ignition material is applied to the conductors and bridgewire, and a coating of an external epoxy adhesive is applied to the ignition material which coating serves to seal the head portion and to function as the initiator case.

The match type initiator of this invention possesses a **1** watt/**1** amp no-fire characteristic. The initiator can be manufactured to a thinness of about **0.070** inch with a head portion that extends about ⅛ inch from the body portion which may have an optional length. The conductors may be bared of insulation at the opposite end from the head portion for one type of installation to an electrical power source.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE of the drawing is a sectional view of the match type initiator of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The match type initiator of this invention is comprised of a pyrofuze bridgewire soldered between a bared length of the conductors of a dual conductor flat cable and covered with an ignition material with about **90%** by weight of the material being comprised of lead thiocyanate, potassium chlorate, and charcoal and with about **10%** by weight of the material being a binder. An external epopxy adhesive coating seals the initiator thereby obviating the requirement of an initiator case.

The drawing shows a match type electrical initiator **10** of this invention that is comprised of an insulated dual conductor flat cable **12** having a head portion **12***a* and a body portion **12***b*. The conductors **14** extend through the body portion and terminate in the head portion. The body portion includes insulation means **16** for covering the conductors. A bridgewire **18** is fastened between the conductors in the head portion. An ignition material **20** covers the head portion which is sealed with an external epoxy adhesive coating **22.**

The dual conductor flat cable which is shown in the trade as polystrip cable is preferred for use in this invention since it has the dimensions of about **0.310** inch wide and about **0.010** inch thick along with dual copper conductors with each conductor being about **0.045** inch wide, about **0.003** inch thick and having the proper line resistance of **0.07** ohm per foot of conductor. The head portion of the finished initiator can be manufactured to a size which is only **0.070** inch thick thereby making it ideally suited for its intended use to initiate destruct action in a weather rocket motor case or a rocket motor case for similar use. The initiator can be positioned within the approximate **0.100** inch space envelope of the honeycomb structure of a rocket motor case. Since the initiator has a **1** watt/**1** ampere no-fire characteristic it offers a high safety factor required for military use. The initiator of this invention can be manufactured to a size of about ⅔ the size of available match-type initiator which has an all-fire rating of ½ ampere and approximately ¼ watt. In actual testing of the match-type initiator of this invention the assembly requires in excess of **3** amperes or **1.78** watts to initiate.

The general procedure followed in preparing the dual conductor, soldering the bridge, and the coating and forming "matchhead", and curing coating for the initiator include:

1. baring the dual conductors about **0.125** ± 0.025 inch, from end, for head portion, use solder gun to prevent insulation from unraveling;

2. soldering pyrofuze bridgewire between conductors;

3. coating of bridge and conductors to form a matchhead: sufficient butyl acetate is added to ignition material (pyrotechnic) and binder to insure complete coating of bridge and conductors, followed by drying at 120°F for 12 hours; and,

4. coating with epoxy adhesive (4 parts) and 1 part amine curing agent or activator which allows coating to be thin enough to remove excess by dipping and following by curing at 120°F for 12 hours. The coating of bridge and conductors to form a matchhead may be accomplished by brushing the pyrotechnic and binder or by dipping to insure complete coating. A further description of the preferred binder, adhesive coating, and their respective functions are given below.

A preferred binder material for use with the ignition material of this invention contains a solid material, lead styphanate, which contributes to the reaction plus an appropriate amount of Egyptian lacquer, well known in the initiator art. A ratio of 2 grams of lead styphanate to about 1.2 cubic centimeters of Egyptian lacquer or similar composition provides a suitable consistency. The Egyptian lacquer contains about 3–4 parts of dewaxed bleached shellac, 0.019–0.025 parts of oxalic acid, about 9.5–10.5 parts nitrocellulose, about 12.5–14.5 parts non-volatile solvent, and about 84.5–87.5 parts of mixed solvent comprised of one or more parts each of denatured ethanol, isopropyl alcohol, methylisobutyl carbinol, butyl alcohol, methyl ethyl ketone, methyl isobutyl ketone, toluol, and xylol. The non-volatile solvents can be those which are well known in the paint and varnish art which serve as hardener and binders for the solids.

The function of the binder material serves to fix the lead styphanate and ignition material to the conductors and bridgewire. The function of the epoxy adhesive is to form a seal for the ignition material and to serve in the function of the ignitor case. The epoxy adhesive is curable with an amine curing agent for epoxy adhesive. Epoxy adhesive 4 parts to about 1 part of amine curing agent is used.

When the electrical power source is applied to the initiator, the bridgewire undergoes reaction which supplies heat to cause a rapid release of energy which is accelerated by the lead styphanate to promote burning of the ignition material. The results produce a controlled release of energy from the initiator after the one watt/one ampere values are exceeded. Generally, the assembly requires about 3 amperes or about 1.78 watts to initiate which makes this initiator far exceed the 1 watt/1 ampere no-fire characteristic to thereby provide a high safety factor as required for military use.

I claim:

1. A match type electrical initiator comprising:

i. an insulated dual conductor flat cable having a head portion and a body portion, said conductors extending through said body portion and having first ends terminating in said head portion;

ii. insulating means covering said body portion;

iii. a bridgewire fastened between said conductors in said head portion;

iv. an ignition material covering said head portion, and ignition material being comprised of about 90% by weight of a stoichiometric mixture of lead thiocyanate about 35.6 parts, potassium chlorate about 44.4 parts, and charcoal about 20.0 parts, and of about 10% by weight of a binder material comprised of lead styphanate in ratio of about 2 grams to about 1.2 cubic centimeters of a lacquer formulated of about 3–4 parts of dewaxed bleached shellac, of about 0.019–0.025 parts of oxalic acid, of about 9.5–10.5 parts nitrocellulose, of about 12.5–14.5 parts non-volatile solvent, and of about 84.5–87.5 parts of a mixed solvent comprised of one or more parts each of denatured ethanol, isopropyl alcohol, methylisobutyl carbinol, butyl alcohol, methyl ethyl ketone, methyl isobutyl ketone, toluol, and xylol; and,

v. an external epoxy adhesive that is curable with an amine curing agent for coating and for sealing said ignition material.

2. The match type electrical initiator of claim 1 wherein said conductors have second ends terminating outside said body portion.

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