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BURN INHIBITOR FOR FLUOROCARBON BOUND PROPELLANTS

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United States of America as represented by the Secretary of the Navy
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5 Claims. (Cl. 149-109)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a burn inhibitor material for propellant grains having a fluorocarbon copolymer as one of its constituents.

To prevent burning on certain selective areas on the surface of a propellant grain, these surfaces are coated or covered with a material which is not readily burned. This inert material is called an "inhibitor," and the process of applying these is called "inhibiting." The inhibitors in early rockets consisted of strips of plastic cemented to the grain according to a prescribed pattern. More recent rockets use the internal tubular charge in which burning is initiated at the inner surface, progressing outward. These grains must be so inhibited that no burning occurs on the outer surface, and the ends may also be protected from burning. The development of satisfactory inhibiting materials and techniques is considered by many to be one of the greatest problems to overcome in the advancement of rocket technology. There is a distinct difference between the materials and techniques used for inhibiting homogeneous and composite propellants. The nitrocellulose-base systems (homogeneous) use cellulosic materials such as cellulose acetate and ethyl cellulose, while the composite propellants use the fuel or binder material without the oxidized. In case-bonded propellants, that is, those propellants whose outer surface is bonded directly to the rocket motor casing, only the ends need the inhibitor. The greatest use of inhibitors is for the cartridge loaded propellants or flares whereby the propellant is fully cured and then slipped into a case. The problem of finding materials suitable for inhibiting the extruded and cast fluorocarbon bound propellants (propellants containing fluorocarbon polymer constituents) had not been successfully solved up to the present because of plasticizer migration into the grain, incompatibility of the inhibitor and fluorocarbon propellant composition and cracking of the material after curing. The present invention overcomes the above mentioned difficulties.

It is therefore an object of this invention to provide a material which will prevent burning on certain selective areas on the surface of an extruded or cast fluorocarbon containing propellant grains.

Another object is to provide a material for inhibiting the burning of cartridge-loaded igniters and flares utilizing a fluorocarbon binder.

A further object is to provide a non-burning material which is compatible with fluorocarbon bound compositions and has the economic advantages of being inexpensive and simple to apply.

Other objects, advantages and novel features of the in-

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vention will become apparent from the following detailed description of the invention.

The present invention is a paste which may be applied to the exposed areas of the fluorocarbon type propellant or as an adhesive on one surface of a fluorocarbon tape such as Teflon. The paste is compounded from a solution of the copolymer of vinylidene fluoride and perfluoropropylene (Viton A) dissolved in methyl ethyl ketone, ethyl acetate, or other suitable solvent, to which is added a catalytic amount of a curing agent. Tetramethylene tetramine, hexamethylene tetramine, dicumyl peroxide, and benzoyl peroxide were among those used. This mixture is stirred until a thick paste forms. The paste is applied by dipping or brushing the selected surfaces of the fluorocarbon bound propellant, flare or igniter and allowed to cure. In the curing process the solvent evaporates leaving a strong elastomeric burn inhibitor.

It was also discovered that the paste composition could be applied to a Teflon (polytetrafluoroethylene) tape which was made adhesive on one surface by treatment with sodium which etches the surface producing a carbonaceous layer to which the paste will stick. Teflon itself is unreactive and has a very low friction coefficient. By application of the paste to the Teflon a pressure sensitive tape was formed which is ideal for wrapping the fluorocarbon containing propellants, igniters and flares.

The paste inhibitor may be applied to the outside surface and ends of a tubular designed grain, or the saturated Teflon tape may be wrapped around the grain and the paste applied to the ends.

The control of diameter of a propellant grain is critical and this may be accomplished easily with tape for it is of constant dimension. It was found that a single layer of 20 mil tape was sufficient to inhibit burning in an extruded fluorocarbon containing propellant even after vigorous temperature cycling procedure. The ends were inhibited with the paste. This combination of tape and paste proved the most practical method of inhibiting the fluorocarbon containing propellants, flares and igniters.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A burn inhibitor paste for fluorocarbon-containing propellant grains consisting essentially of the following ingredients

- (1) a ketone solution of the copolymer of vinylidene fluoride perfluoropropylene, and
- (2) a curing agent selected from the group consisting of tetramethylene tetramine, and hexamethylene tetramine.

2. A burn-inhibitor tape for fluorocarbon-containing propellant grains comprising

- (1) polytetrafluoroethylene tape having one adhesive surface, and
- (2) a burn inhibitor paste adhering to said surface; said paste consisting essentially of a ketone solution of the copolymer vinylidene fluoride and perfluoropropylene and a catalytic amount of a curing agent selected from the group consisting of tetramethylene tetramine and hexamethylene tetramine.

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3. A burn inhibitor paste for fluorocarbon-containing propellant grains consisting essentially of

- (1) an ethyl acetate solution of the copolymer of vinylidene fluoride and perfluoropropylene; and
- (2) tetramethylene tetramine.

4. A burn inhibitor paste for fluorocarbon-containing propellant grains consisting essentially of

- (1) a methylethyl ketone solution of the copolymer of vinylidene fluoride and perfluoropropylene; and
- (2) hexamethylene tetramine.

5. A method for preparing a burn inhibitor tape comprising the steps of

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- (1) etching one side of a polytetrafluoroethylene tape with sodium so as to form a carbonaceous surface, and
- (2) brushing onto said surface a paste consisting of
 - (a) an ethyl acetate solution of a copolymer of vinylidene fluoride and perfluoropropylene; and
 - (b) a catalytic amount of hexamethylene tetramine.

No references cited.

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