United States Patent Office 3,671,341 Patented June 20, 1972

3,671,341

DENSE PROPELLANT COMPOSITION

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No Drawing. Filed June 24, 1965, Ser. No. 467,826
Int. Cl. C06d 5/06
U.S. Cl. 149—19 3 Claims

ABSTRACT OF THE DISCLOSURE

A propellant which has a flame temperature of 4700° F. or lower. It consists of a mixture of Teflon, Viton, a dense metal oxidizer such as mercuric oxide, and a heavy metal such as uranium.

The invention described herein 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 novel dense propellant composition.

Old methods of increasing rocket propellant performance places emphasis on increasing specific impulse. This tends to result in higher flame temperatures, increased propellant sensitivity, and considerable condensed combustion products all of which tend to reduce reliability. Present useful dense propellants have impact sensitivities of less than 110 kg./cm. The present propellant composition has a lower flame temperature and less sensitivity than most others known today.

It is an object of the present invention to provide a propellant composition that will give maximum performance in current and future rocket vehicles.

Another object is to provide a propellant which will fit a wide range of rocket mass-to-volume ratios.

Still another object is to provide a propellant composition which is simple and easy to manufacture and which is relatively economical.

A further object of the present invention is to provide an improved propellant composition for use in single- or first-stage rockets.

Other objects, features, and many of the attendant advantages of this invention will become readily appreciated as the same become better understood by reference to the following detailed description.

The present invention consists essentially of the copolymer of vinylidene fluoride and hexafluoropropylene (hereinafter called Viton A), polytetrafluoroethylene (hereinafter called Teflon), mercuric oxide and uranium. The formulation was processed in a Cowles Dissolver using an open mix pot. Viton A was dissolved in acetone (15 to 20% concentration) and added to the pot by hand. The Teflon and mercuric oxide were then added to the mix pot while agitated. Uranium was added by hand. (It should be noted that flame-resistant clothing, safety shoes, and glasses should be worn at all times.) After all the ingredients were added the Viton A was shock-gelled (precipitated) onto the solids by the addition with agitation of hexane in a ratio of approximately a 4 to 1 hexane to acetone. The material may be washed several times with hexane. After each addition of hexane agitation is stopped and the hexane is decanted. After

the final wash, the material was removed from the mix pot by hand and placed on stainless steel drying trays. The hexane was allowed to evaporated partially in air at ambient temperature, then the material was placed in an oven at 110°–180° F. to complete curing.

The preferred composition for the invention consists of the following

Ingredients:	Percent by weight
Viton A	9.3
Teflon	4.7
Mercuric oxide	56.0
Uranium powder (5–70 micron mean particle size)	30.0

The above ingredients may only be varied ±1.0% by weight without altering the physical properties.

The impact sensitivity of this propellant composition is negative at 480 kg./cm. Present useful dense propellants have impact sensitivities of less than 110 kg./cm. The burning rate of this invention is 0.08 in./sec. at 1000 p.i.s.a. The pressure exponent is zero in the range of 200–1000 p.s.i. Both of these parameters indicate the low sensitivity of the propellant.

The present invention reveals that a dense propellant can be fabricated with a flame temperature of 4700° F. or lower by using a dense inert diluent such as mercury or lead in combination with a dense reactive material such as uranium, thorium, or zirconium. The diluent soaks up the heat while the reactive ingredient furnishes enough energy to give a density times specific impulse product of 700 g./sec./cc. or higher.

By using a very dense metal oxidizer which decomposes in the temperature range of 250–1000° C., such as mercuric oxide, the metallic or lower oxide, part of which boils at a temperature lower than the rocket nozzle exhaust temperature, a binder containing fluorine, and a heavy metal whose fluoride also boils at a temperature lower than the nozzle exhaust temperature, an all gaseous nozzle flow is possible. Any carbon present is oxidized by oxygen present in the dense metal oxidizer to carbon monoxide which is a gas at room temperature. The dense metal from the oxidizer which is inert at temperatures higher than the nozzle exhaust temperature, and the heavy metal fluoride both act as heat sinks to soak up combustion energy. The result is an all gaseous nozzle flow, a low flame temperature, and a high specific impulse. Thus no increase in propellant sensitivity for increased performance is necessary.

Reactive metals which produce stable gaseous oxides or fluorides at combustion temperatures are potential candidates for this new dense propellant composition. Other heavy metal oxidizers may be used. Binders containing fluorine solid and stable at 250° C. are possible alternate binders.

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 propellant composition consisting essentially of:
mercuric oxide
uranium

copolymer of vinylidene fluoride and hexafluoropropylene, and
polytetrafluoroethylene.

2. A propellant composition consisting essentially of the following

Ingredients:	Percent by weight
Mercuric oxide	56
Uranium	30
Copolymer of vinylidene fluoride and hexafluoropropylene	9.3
Polytetrafluoroethylene	4.7

3. The composition of claim 2 wherein the uranium ranges in size from 5 to 70 microns.

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U.S. Cl. X.R.

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