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HIGH TEMPERATURE COMPOSITE PROPELLANT SYSTEM

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ABSTRACT OF THE DISCLOSURE

The invention consists of a composite solid propellant which will withstand 600° F. for at least two hours, 500° F. for more than 48 hours, and 450° F. for over 400 hours without significant change in performance.

Component	Percent by weight (1)	(2)	(3)
Viton	10.95	10.95	10.95
Diak	.05	.05	.05
Teflon	11.00	11.00	11.00
Magnesium dust	13.04	13.47	14.30
Cyanuric acid	26.45	25.95	24.98
Barium nitrate	38.51	38.58	38.72
Heat of reaction, B.t.u./lb	946	960	987
Computed chamber temp., ° F	3,400	3,600	3,800

Pressure generated in a vented vessel are as follows:

Test No.	Specimen length, inches	Specimen dia., inches	Wt., gms.	Firing temp. (° F.)	Vent dia., inches	Pressure generated, p.s.i.g.
(1)	2.060	1.014	33.1	70	.089	1,700
(2)	2.045	1.019	33.2	70	.101	1,700
(3)	2.078	1.016	32.3	−65	.101	1,300
(4)	2.075	1.014	32.7	70	.101	2,200
(5)	2.071	1.017	32.3	500	.101	2,800

The present invention relates broadly to the formulation of propellant mixtures which are suitable for use in high temperature environments.

It is the principal aim of this invention to provide a propellant formulation system which will allow prolonged exposure of devices in which it is used to temperatures in the 500° F. to 600° F. range.

It is a further objective to provide a solid pyrotechnic substance which when ignited at any temperature from −65° F. or lower to approximately 600° F. will provide high pressure gases for the purpose of actuating devices which require high pressure gases or liquids in order to function. Other objects and advantages of the present invention will become more apparent during the course of the following description.

Applicants invention lies principally in the discovery that chemicals which are virtually inert up to their decomposition temperatures can be mixed and bound solidly together with a high temperature resistant fuel and oxidizer, the resulting solid when ignited in a vented vessel decomposing the inert chemical thereby generating gases at high pressure and at temperatures which vary with the percentages of ingredients. Results from one combination of ingredients are shown in the following example.

Example

The principal ingredients of one mixture that has undergone testing are cyanuric acid ($C_3H_3N_3O_3$), magnesium powder, Teflon (polytetrafluoroethylene), Viton (Copolymer of hexafluoropropylene and vinylidene fluoride), and barium nitrate. The Teflon and Viton, which are supplied by E. I. du Pont de Nemours & Company and barium nitrate are the oxidizing ingredients. They react with the magnesium powder upon ignition. A fifth ingredient, Diak (hexamethylenediamine carbamate), which is also a product of E. I. du Pont de Nemours & Company, serves to chemically cross link the molecules of Viton. The Viton-Teflon binder provides good physical characteristics over the entire temperature range from −65° F. to 600° F. The following compositions have been tested with excellent results:

A 33.5 gm. specimen was held at 500° F. for 24 hours with a .7 gram weight loss. The same specimen was held at 500° F. for an additional 24 hours with an additional .6 gram weight loss. A specimen was held at 600° F. for two hours without signs of physical deterioration. The weight loss was not recorded.

Propellants were made and tested in which barium perchlorate was substituted for barium nitrate. However, barium perchlorate made the propellant more hygroscopic than barium nitrate and is considered less desirable from that standpoint although satisfactory otherwise. Additional Teflon can also be substituted for the barium nitrate. However, propellant samples for which this was done had less desirable physical properties.

Propellants were also made and tested using oxamide ($C_2H_4N_2O_2$) as a substitute for cyanuric acid. These propellants were satisfactory for prolonged storage at 400° F. but were marginally acceptable at 500° F. due to sublimation of the oxamide on the propellant surface at that temperature.

I claim as my invention:

1. A solid propellant which will withstand temperatures in the 400 to 600° F. range and consisting essentially of 5 to 30 weight percent of a fuel, magnesium dust; 5 to 30 weight percent of oxidizer, polytetrafluoroethylene; 5 to 30 weight percent of oxidizer, copolymer of hexafluoropropylene and vinylidene fluoride; 30 to 50 weight percent of an oxidizer selected from the group consisting of barium nitrate and barium perchlorate; approximately .05 weight percent of cross linking agent, hexamethylenediamine; and 10 to 40 percent of a coolant selected from the group consisting of cyanuric acid and oxamide.

References Cited

UNITED STATES PATENTS

1,756,255	4/1930	Meek	144—43 X
2,033,966	3/1936	Wiley	149—43
2,900,242	8/1959	Williams et al.	149—22
3,002,830	10/1961	Barr	149—83 X
3,122,462	2/1964	Kaufman	149—22 X
3,163,113	12/1964	Davis et al.	149—44 X
3,203,171	8/1965	Burke et al.	149—44 X

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