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STABLE PROPELLANTS

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Our invention relates to new propellants for reaction motors, and more particularly, to propellant mixtures prepared from hydrazine, monomethylamine nitrate and a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine.

The missile industry constantly searches for new propellant systems which are safe, versatile, and economical. Currently used bipropellant systems include oxidants such as liquid oxygen, red and white fuming nitric acid and dinitrogen tetroxide and fuels such as alcohols, kerosene, etc. Compounds such as hydrazine which can theoretically produce great thrust have found some use in propellant systems for example as monopropellants in gas generator systems. However, the use of hydrazine has generally been restricted because of its high freezing point. Due to this undesirable property, it is necessary to incorporate with hydrazine freezing point depressants such as hydrogen sulfide, water, and ammonium thiocyanate which in turn greatly reduce the thrust theoretically obtainable from hydrazine.

We have now discovered that our new combinations of hydrazine, monomethylamine nitrate, and a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine are excellent monopropellants for gas generators and fuels for bipropellant reaction motors. These propellants are thermally stable and relatively insensitive to shock resulting from induced pressures or impact. But even more important, the inclusion of monomethylamine nitrate and dimethylhydrazine or monomethylhydrazine in our new combinations does not materially effect the thrust obtainable from hydrazine. Our new compositions can also be used as oxygen-enriched fuels for bipropellant systems. However, the compositions of our invention cannot all be used for the same purpose as each propellant usage requires relatively specific properties. For example, a liquid monopropellant for prime propulsion should have a high specific impulse and a high density, while fuels useful in auxiliary power units should be liquids which burn at combustion temperatures not exceeding the fatigue properties of the turbine blades and which yield large amounts of gaseous products.

Our new compositions are relatively non-corrosive to stainless steel and aluminum and non-reactive with nylon, Teflon, polyethylene, etc. They also have low vapor pressures, on the order of 10 pounds or less at room temperature, and can be stored for long periods of time without decomposition.

Oxidants which may be utilized with our fuel mixtures for bipropellant systems are any of the commonly used bipropellant oxidants, such as liquid oxygen, red and white fuming nitric acid, dinitrogen tetroxide, fluorine, etc.

While monomethylamine nitrate is a known explosive, we have found that the addition of hydrazine and a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine desensitizes the monomethylamine nitrate.

The compositions of our invention can contain from about 20 to about 60% by weight monomethylamine nitrate, based on the weight of the composition, 20 to about 75% by weight of hydrazine, based on the weight of the composition and 1 to about 40% by weight of a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine, based on the weight

of the composition. The exact composition will depend upon such factors as the storage temperatures, the desired combustion temperature and whether the composition is to be used as a monopropellant or a bipropellant fuel.

Our new compositions can be prepared by first adding hydrazine to monomethylamine nitrate to form a mixture and then adding a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine. Our compositions are hypergolic with liquid dinitrogen tetroxide.

To utilize the compositions of our invention, we introduce them, at a desired rate, into a chamber containing a suitable igniter such as a starting squib to initiate combustion.

Compositions containing 20 to about 60% by weight of monomethylamine nitrate, 20 to about 75% by weight of hydrazine and 1 to about 40% by weight of a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine are useful as fuels for gas generators and air-breathing engines and as fuels for bipropellant systems. These compositions, when used as gas generator fuels, burn at relatively low temperatures with the formation of large amounts of gases.

When our compositions are used in air-breathing engines such as turbojet engines and ramjet engines, principles of operation which apply are similar to those applicable to present day engines employing ordinary hydrocarbon fuels.

The following examples further illustrate our invention, but it is not intended that our invention be limited to the exact compositions, reaction motors, or processes set out; but rather it is intended that all equivalents obvious to those skilled in the art be included within the scope of our invention as claimed.

Example I

To test one of our compositions as a monopropellant, a mixture of 40% monomethylamine nitrate, 30% hydrazine and 30% unsymmetrical dimethylhydrazine was injected into a small rocket thrust chamber through an injector nozzle. Ignition was initiated by injecting 30 ccs. of dinitrogen tetroxide into the combustion chamber over a period of 2.5 seconds. This propellant, having a specific gravity of 1.062 at 25° C., burned at 1627° F., with a specific impulse of 195.5 lbs. sec./lb.

Example II

To test one of our propellant compositions in a bipropellant system, a small water cooled rocket thrust chamber was prepared from available stainless steel pipe and pipe fittings. It had a net volume of 1,580 milliliters and an exhaust nozzle of 0.75 inch in diameter. A bipropellant fuel of 40% by weight of monomethylamine nitrate, 30% by weight hydrazine and 30% by weight of monomethylamine was introduced into this thrust chamber through multiple injector nozzles at a rate of 1 lb. per second. Dinitrogen tetroxide was also introduced into the thrust chamber at the rate of 1.3 lb. per second. This fuel burned with a combustion temperature of 5,300° F. and delivered a thrust of 550 lb.

This application is a continuation-in-part of our U.S. patent application Serial No. 735,990, filed May 19, 1958, our U.S. patent application Serial No. 860,726, filed December 21, 1959, and our U.S. patent application Serial No. 21,094, filed December 8, 1960, all of which are now abandoned.

Now having described our invention, what we claim is:

1. A process for producing thrust in a reaction motor which consists essentially of burning in a reaction motor a fluid mixture containing from about 20 to about 60% by weight of monomethylamine nitrate, 20 to about 75% by weight of hydrazine and 1 to about 40% by weight of

a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine, all weights being based on the weight of the mixture.

2. A process for producing thrust in a bipropellant reaction motor which consists essentially of burning in the presence of an oxidant selected from the group consisting of liquid oxygen, red and white fuming nitric acid, dinitrogen tetroxide, and fluorine a mixture of from about 20 to about 60% by weight of monomethylamine nitrate, from about 20 to about 75% hydrazine by weight and from about 1 to about 40% by weight of a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine, all weights being based on the weight of the mixture.

3. The process of claim 2 wherein the compound is dimethylhydrazine.

4. The process of claim 2 wherein the compound is monomethylhydrazine.

5. A propellant composition which consists essentially of a mixture of from 20 to about 60% by weight of monomethylamine nitrate, from about 20 to about 75% by weight of hydrazine, and from about 1 to about 40% by weight of a compound selected from the group consisting of dimethylhydrazine and monomethylhydrazine, all weights being based on the weight of the mixture.

6. The composition of claim 5 wherein the compound is monomethylhydrazine.

7. The composition of claim 5 wherein the compound is dimethylhydrazine.

No references cited.