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STABILIZED PROPELLENT COMPOSITIONS CONTAINING HYDRAZINE NITROFORM AND NITROCELLULOSE

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This invention relates to new propellent compositions. More specifically, it relates to propellents comprising a mixture of nitrocellulose and hydrazine nitroform, which are characterized by greatly improved stability.

There have recently been introduced into the propellant art high impulse propellent compositions comprising nitrocellulose and hydrazine nitroform, in which the nitrocellulose, preferably plasticized, serves as a gas-generating fuel binder, and the hydrazine nitroform is dispersed therein and functions as an oxidizer and gas-generating compound.

Both nitrocellulose and hydrazine nitroform tend to degrade with the production of gaseous by-products, unless stabilized. Stabilizers for each of the compounds individually are known in the art. Stabilizers for nitrocellulose include, for example, ethyl centralite, 2-nitrodiphenyl amine, magnesium oxide and magnesium. Hydrazine nitroform stabilizers include, for example, mercuric oxalate, P_2O_5 and oxalic acid. Unfortunately, it has been found that stabilizers hitherto effective with nitrocellulose tend to degrade the hydrazine nitroform and vice versa.

The object of this invention is to provide stabilizers which are effective for both the nitrocellulose and hydrazine nitroform in admixture.

I have discovered that the salts of a Group II–A metal, such as beryllium, magnesium, calcium, barium and strontium, very effectively stabilize mixtures of nitrocellulose and hydrazine nitroform. The mechanism of such stabilizers is not entirely understood, but it is believed that the cation stabilizes the nitrocellulose component, and the anion stabilizes the hydrazine nitroform.

The anion can be an inorganic or organic radical, such as sulfate, bisulfate, sulfite, bisulfite, nitrate, nitrite, phosphate, hydrogen phosphate, carbonate, bicarbonate, chloride, acetate, oxalate, tartrate, lactate and benzoate.

The Group II–A metal salts are effective in amounts as low as 0.05% by weight of the propellent composition. Amounts up to 1 or 2% are generally completely adequate. Above these rates of addition, some further improvement in stabilization can be obtained, but at progressively smaller increments relative to the percentage of stabilizer addition. In general, it will not be desirable to add more than about 10% of the stabilizer since, beyond this point, further improvement in stability, if any, is so minimal as not to warrant further addition of a component which is ballistically inert.

Plasticizers for the nitrocellulose, both active and inert, conventionally employed in the nitrocellulose propellant art, can be included in the compositions.

The term "active," as employed herein, refers to compounds which contain a molecularly-combined oxidizing element, such as oxygen or fluorine, which is available for combustion of other molecularly-combined components, such as carbon and hydrogen. Such plasticizers include, for example, liquid, organic polynitrates such as nitroglycerine, trimethylol ethane trinitrate, triethylene glycol dinitrate, pentaerythritol trinitrate and the like.

The liquid plasticizer can also be, in whole, or in admixture with an active plasticizer as above defined, a high-boiling organic liquid, which is "inert" inasmuch as it requires an external or separate source of oxidizer for combustion. Examples of such suitable liquid plasticizers include hydrocarbons, e.g. triethyl benzene, dodecane, phenyl xylylethane; esters, e.g. butyl laurate, dibutyl phthalate, triacetin, tributyl acetyl citrate, dioctyl adipate, etc.; alcohols, e.g. benzyl alcohol, diethylene glycol, triethylene glycol, etc.; ethers, e.g. bis(dimethyl benzyl) ether; propylene glycol monobutyl ether, etc.; ketones, e.g. isophorone; acids, e.g. caproic acid, n-heptylic acid; aldehydes, e.g. cinnamaldehyde; nitrogen-containing organic compounds such as nitriles, e.g. adiponitrile; phosphorous-containing compounds, e.g. tricresyl phosphate; sulphur-containing compounds, e.g. N-ethyl-toluene sulfonamide; and many others. Such inert organic liquid plasticizers function as a fuel component when adequate oxidizer, such as the hydrazine nitroform, is included to provide for their combustion.

Of particular importance because of their high performance, are nitrocellulose-hydrazine nitroform propellent compositions which contain a powdered metal fuel component, such as aluminum, magnesium, beryllium, boron, zirconium and their hydrides. The hydrazine nitroform functions as oxidizer for these fuels. Other insoluble solid fuel components can also be dispersed in the nitrocellulose-hydrazine nitroform propellants, such as carbon, silicon and the like.

The relative proportions of the components such as nitrocellulose, plasticizer, hydrazine nitroform, metal and the like vary for different applications according to required performance. Such variations are known to, and can readily be calculated by, those skilled in the propellant art. The amount of hydrazine nitroform, for example, must be sufficient to provide for combustion of inert components of the composition, such as metal fuel and inert plasticizer, but the actual amount required will be determined by the particular inert components, their concentrations, and the desired level of performance.

Example I

Tests were made to determine the stabilizing effect of various Group II–A metal salts. The following propellent compositions were prepared:

	Control, Weight Percent	Test Sample, Weight Percent
Trimethylol ethane trinitrate	32.5	32.5
Nitrocellulose	12.5	12.5
Aluminum	20.0	19.0
Hydrazine nitroform	30.0	30.0
Gr. II–A metal salt (varied as indicated below)	----------	1.0

Decomposition of the control and test samples into gaseous products was determined by Taliani test as described in NavOrd Report No. 5688, entitled "Taliani Tests for Assessment of Stability of Solid Propellants" 5% $MgCO_3$ on the propellent composition of Example I. Technical Information Agency.

Time, Min.	Pressure, cm. Hg	Increase in pressure, cm. Hg
(A) CONTROL		
0	40.4	----------
5	47.9	7.5
10	52.7	12.3
15	56.7	16.3
20	60.8	20.4
25	65.2	24.8
30	70.0	29.6
35	74.8	34.4
40	79.5	39.1
45	84.9	44.5
(B) $MgCO_3$		
0	39.2	----------
5	47.0	7.8
10	48.9	9.7
15	49.8	10.6
20	50.8	11.6
25	51.4	12.2
30	51.9	12.7
35	52.5	13.3
40	53.1	13.9
45	53.8	14.6
(C) $Mg_3(PO_4)$		
0	37.1	----------
5	43.3	6.2
10	45.4	8.3
15	46.7	9.6
20	47.7	10.6
25	48.6	11.5
30	49.4	12.3
35	50.0	12.9
40	50.8	13.7
45	51.5	14.4
(D) $MgSO_4$		
0	33.1	----------
5	39.4	6.3
10	42.3	9.2
15	43.1	10.0
20	44.1	11.0
25	44.8	11.7
30	45.5	12.4
35	46.3	13.2
40	46.9	13.8
45	47.4	14.3
(E) $MgHPO_4$		
0	40.4	----------
5	50.3	9.9
10	51.8	11.4
15	52.6	12.2
20	53.4	13.0
25	54.1	13.7
30	54.6	14.2
35	55.3	14.9
40	56.0	15.6
45	56.7	16.3
(F) $Mg(OOCCH_3)_2$		
0	35.7	----------
5	40.8	5.1
10	42.6	6.7
15	43.5	7.6
20	44.1	8.2
25	44.6	8.7
30	45.2	9.3
35	45.8	9.9
40	46.2	10.3
45	46.6	10.7
(G) $CaCO_3$		
0	37.5	----------
5	43.2	5.7
10	44.9	7.4
15	46.2	8.7
20	47.0	9.5
25	47.9	10.4
30	48.7	11.2
35	49.3	11.8
40	49.9	12.4
45	50.6	13.1

Time, Min.	Pressure, cm. Hg	Increase in pressure, cm. Hg
(H) $Be(NO_3)_2$		
0	37.2	----------
5	42.3	5.1
10	43.6	6.4
15	44.7	7.5
20	45.3	8.1
25	45.9	8.7
30	46.4	9.2
35	47.0	9.8
40	47.6	10.4
45	48.1	10.9

It will be noted from the foregoing that all of the Group II–A salts tested were exceedingly effective in stabilizing the nitrocellulose-hydrazine nitroform compositions.

Example II

A test was made to determine the stabilizing effect of 5% $MgCO_3$ on the propellent composition of Example I. The concentration of aluminum was reduced to 15%. Taliani test results were as follows:

Time, Min.	Pressure, cm. Hg	Increase in pressure, cm. Hg
0	37.5	----------
5	45.0	7.5
10	46.8	9.3
15	47.6	10.1
20	48.7	11.2
25	49.9	11.8
30	50.0	12.5
35	50.6	13.1
40	51.2	13.7
45	51.9	14.4

Although this invention has been described with reference to illustrative embodiments thereof, it will be apparent to those skilled in the art that the principles of this invention may be embodied in other forms but within the scope of the appended claims.

I claim:

1. In a propellent composition comprising nitrocellulose and hydrazine nitroform, the improvement comprising the addition of up to about 10% by weight of a salt of a Group II–A metal, said salt serving to stabilize said nitrocellulose and hydrazine nitroform.

2. The propellent composition of claim 1 which contains in addition a plasticizer for the nitrocellulose and a finely-divided solid fuel component selected from the group consisting of metals, metal hydrides, carbon and silicon.

3. The propellent composition of claim 2 in which the solid fuel is aluminum.

4. The propellent composition of claim 1 in which the salt is a magnesium salt.

5. The propellent composition of claim 1 in which the salt is a beryllium salt.

6. The propellent composition of claim 1 in which the salt is a calcium salt.

7. The propellent composition of claim 2 in which the salt is a magnesium salt.

8. The propellent composition of claim 2 in which the salt is a beryllium salt.

9. The propellent composition of claim 2 in which the salt is a calcium salt.

No references cited.

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