Feb. 26, 1974 Y. H. BERTRAND ET AL 3,794,535

PYROTECHNIC LACQUER

Filed July 14, 1972 3 Sheets-Sheet 1

Fig. 1

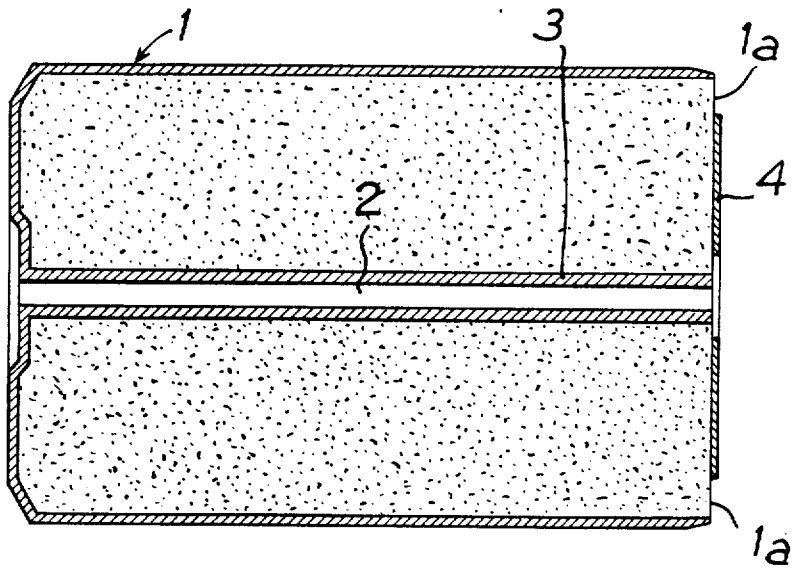


Fig 2

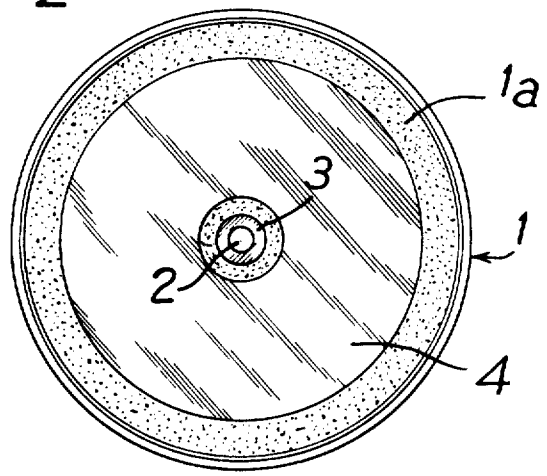
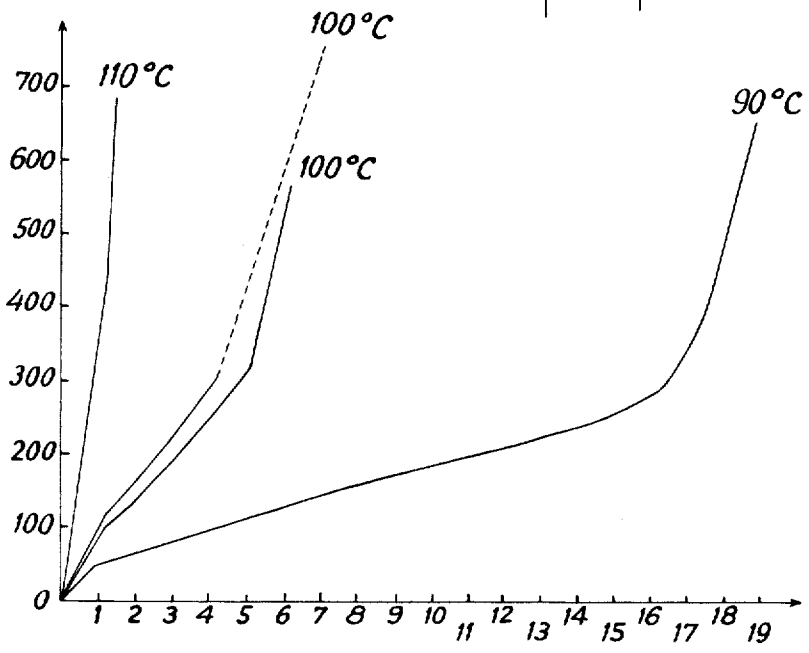


Fig. 3


110°C
100°C
100°C
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700
600
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200
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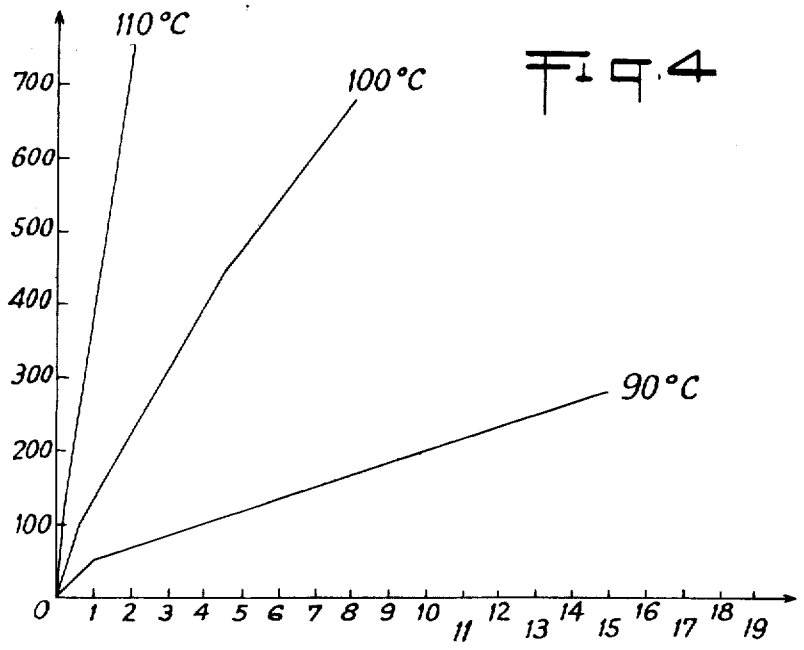
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 4


110°C
100°C
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700
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

FIG. 6

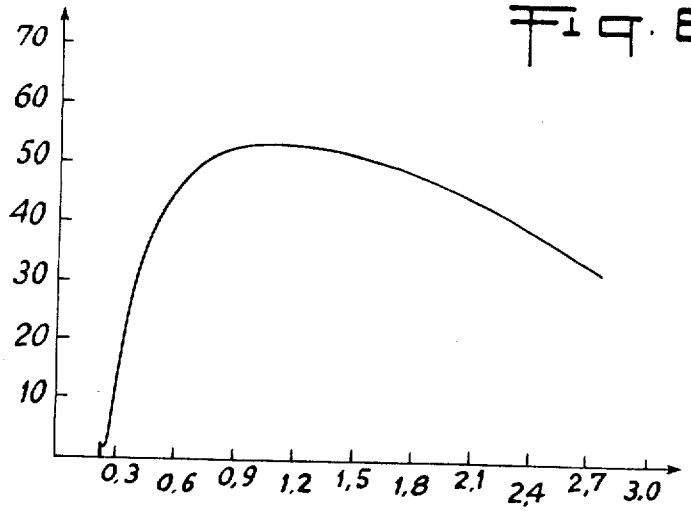
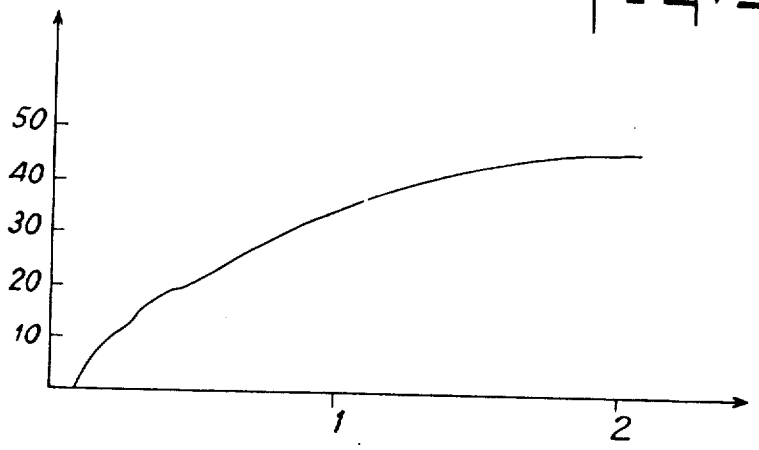


FIG. 5



United States Patent Office

3,794,535

Patented Feb. 26, 1974

3,794,535

PYROTECHNIC LACQUER

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Filed July 14, 1972, Ser. No. 271,803
Claims priority, application France, July 19, 1971, 7126285
Int. Cl. C06b 19/02
U.S. Cl. 149—3 7 Claims

ABSTRACT OF THE DISCLOSURE

Lacquers comprising a dispersion of a pyrotechnic composition in a collodion, which are useful in forming ignition coatings on blocks of propellant and gas generators. The pyrotechnic compositions may be alumino-thermal powders, thermites, black powders or zirconium/barium chromate/ammonium perchlorate/ammonium bichromate, and the collodion may be a nitrocellulose or nitroglycerine powders (or mixtures of the two), or a plastics material, in solution in solvent.

The present invention relates to a pyrotechnic lacquer used especially for producing ignition compositions for blocks of solid propellant and charges for gas generators.

According to the invention, there is provided a lacquer which comprises a dispersion of: (a) a pyrotechnic composition in a finely divided form, chosen from the group comprising aluminothermal powders (a mixture of potassium perchlorate and aluminium powder), so-called thermite powders (a mixture of potassium perchlorate, iron oxide and magnesium), black powder and powders based on zirconium, barium chromate, ammonium perchlorate or ammonium bichromate, in (b) a collodion containing either a powder based on nitrocellulose, on plasticized nitricellulose or on a mixture of nitrocellulose and nitroglycerine, dissolved in a volatile solvent for the said powder, especially a ketone solvent such as acetone or methyl ethyl ketone, or a plastics material dissolved in an organic solvent, especially polyethylene dissolved in trichloroethylene, polyvinyl chloride dissolved in methyl ethyl ketone or a cellulosic polymer dissolved in ethyl acetate.

The proportions in which the pyrotechnic composition and the collodion are used are from 5 to 99.5%, preferably from 40 to 60%, by weight for the former and from 95 to 0.5% and preferably 60 to 40%, by weight of the latter. Furthermore, the collodion preferably contains 75% by weight of powder or of plastics material and 25% of solvent.

Additionally, the pyrotechnic composition should preferably have a particle size of less than 500 microns.

The pyrotechnic lacquer of the invention is especially useful as an ignition composition for blocks of solid propellant. For this purpose, that face of the block to be ignited is coated with a layer of the pyrotechnic lacquer and the solvent is evaporated. The ignition composition thus obtained can advantageously replace the conventional triggering box containing black powder, which is usually fixed by glue to a face of the propellant block and which can become detached and thereby cause spoilage of the guide system during ignition.

The pyrotechnic lacquer according to the invention can also be used to produce pyrotechnic charges for gas generators of the type described in our French patent applications Nos. 70/44,837 and 70/44,838. For this purpose, the outer wall of the vaporizable liquid chamber of the gas generator is coated, partially or completely, with the pyrotechnic lacquer of the invention and the solvent is evaporated from the layer of lacquer.

The pyrotechnic lacquers of the invention have numerous advantages:

they do not require baking and polymerization operations;
they are stable on storage in a leakproof container; and
their speed of combustion can easily be varied by varying the charge content or by changing the nature of the collodion or the nature of the pyrotechnic composition.

In order that the invention may be more fully understood, the following examples are given by way of illustration only. In addition, reference is made to the accompanying drawings, in which:

FIG. 1 is a cross-section in side elevation of a block of propellant provided with a layer of a lacquer of the invention;

FIG. 2 is a front elevation of the same block;

FIGS. 3 and 4 are graphs illustrating the results of experiments carried out in vacuo on the pyrotechnic lacquer and on the propellant; and

FIGS. 5 and 6 are graphs illustrating the ignition phase of firings of the blocks of propellant of Examples 2 and 3, respectively.

EXAMPLE 1

Preparation of the pyrotechnic composition

45 parts by weight of zirconium, 34 parts of barium chromate, 14 parts of ammonium perchlorate and 7 parts of ammonium bichromate were mixed together by means of a Moritz mixer running at low speed, for one hour.

Preparation of the collodion

75 parts by weight of GB Tu powder (a powder based on nitrocellulose and on nitroglycerine, in the ratio of 58:42, containing 1.1% of centralite as a stabilizer) were dissolved in 25 parts of acetone.

Preparation of the pyrotechnic lacquer

60 parts by weight of the pyrotechnic composition were mixed with 40 parts of collodion. Mixing was carried out in a climatically controlled area at 21–29° C. and 30–40% relative humidity.

The pyrotechnical lacquer thus obtained was used to produce, by coating, an ignition composition on a block of Epictète propellant plasticized nitrocellulose and nitroglycerine) for frontal combustion, of which a cross-section in side elevation is shown in FIG. 1 of the accompanying drawing, and a front elevation in FIG. 2.

This cylindrical block **1**, diameter 78 mm., was perforated by an axial cylindrical channel **2**, 1.5 mm. in diameter, and was covered with a layer of inhibitor **3** on its side wall, in the said channel and on its front face.

The rear face **1***a* of this block was coated with a layer **4** of the pyrotechnic lacquer prepared above, 5 g. of this lacquer being uniformly spread over a ring of external diameter 60 mm. and internal diameter 10 mm.

The layer of lacquer was thereafter dried in a climatically controlled area at 21–29° C. and at 30–40% relative humidity for several hours in order to produce, on this block of propellant, a layer of ignition composition of about 1 mm. thickness.

The compatability of the pyrotechnic lacquer with the propellant was demonstrated by the following tests:

"Vacuum test"

This test was carried out at temperature of 90° C., 100° C. and 110° C.

The test sample, for a test at a given temperature, was 1 g.

"Vacuum test"—test on the pyrotechnic lacquer

In view of the high sensitivity of the composition to mechanical pyrotechnic factors, this test was carried out on a dry mixture of 2 parts of the said pyrotechnic composition and of 3 parts of finely ground collodion slab.

The results shown on the graph of FIG. 3 give, the pressure loss in mm. (as the ordinate) as a function of the time in days (as the abscissa).

"Vacuum test"—on chips of propellent

The results are shown on the graph of FIG. 4.

Superposition of the graphs of FIGS. 3 and 4 shows an identical behaviour of the propellant and of the "pyrotechnic composition/collodion" mixture in the experiments of the vacuum test.

Furthermore, the resistance to ageing of the ignition composition obtained from the pyrotechnic lacquer was demonstrated by the so-called "test cube" test.

The study was based on ageing for two to six months at 60° C. The tests were carried out on four cubes of 25 mm. side length, of which one face was entirely coated with pyrotechnic lacquer to a thickness equivalent to that produced on the block of propellant.

A test cycle comprised:

(a) 18 hours' temperatuure exposure in an oven thermostated to ± 1.50 C. and

(b) Removal from the oven for 6 hours, during which a visual and radiographic check of the propellant-ignition composition interface was made on each cube.

The results obtained after 22 cycles at 60° C. were that, at 60° C., no detachment of the ignition composition, and no cracking in the propellant, was observed.

EXAMPLE 2

A pyrotechnic lacquer was prepared by mixing 40 parts by weight of a thermite powder of the following composition:

	Percent
Fe_2O_3	34
Mg	36
$KClO_4$	30

with 60 parts of collodion of the type described in Example 1.

The face of a Butalpite block of propellant (polybutadiene-potassium perchlorate) which was to be ignited, of diameter 94 mm., was coated with 5 g. of this lacquer.

The graph in FIG. 5 shows the pressure in bars (as the ordinate) as a function of the period of combustion in seconds (as the abscissa), illustrating the ignition phase of a firing using the block of propellant which was ignited by means of the pyrotechnic lacquer of this example, applied by coating.

EXAMPLE 3

A pyrotechnic lacquer was prepared by mixing 40 parts by weight of blackpower with 60 parts of collodion of the type described in Example 1.

The face of a homogenous block of powder (nitrocellulose-nitroglycerine), 33 mm. in diameter, was coated with 5 g. of this lacquer.

The graph in FIG. 6 shows the pressure in bars (as the ordinate) as a function of the period of combustion in seconds (as the abscissa), illustrating the ignition phase of a firing using the block of propellant which was ignited by means of the pyrotechnic lacquer of this example, applied.

EXAMPLE 4

A pyrotechnic lacquer was prepared by mixing 2 parts by weight of a thermite powder having the following composition:

	Percent
Fe_2O_3	34
Mg	36
$KClO_4$	30

with 3 parts by weight of a collodion of the type described in Example 1.

This lacquer was directly coated onto the outer wall of the vaporizable liquid chamber of the gas generator described in Belgian Pats. 775,997 and 775,422, both granted Dec. 15, 1971, to which correspond U.S. applications, Ser. No. 206,662 and Ser. No. 205,046, and was dried in a climatically controlled area at 21–29° C. and at 30–40% relative humidity for several hours so as to yield a 2.25 mm. layer of a gas generator composition, as a replacement of the charge of propellant in hollow strands, with which the said gas generator was equipped.

We claim:

1. A lacquer which comprises a dispersion of: (a) a pyrotechnic composition in finely divided form, selected from the group consisting of powders consisting of (1) ferric oxide, magnesium and potassium perchlorate, (2) of black powder and (3) of powders consisting of zirconium, barium chromate, ammonium perchlorate and ammonium bichromate. in (b) a collodion which consists of a powder based on nitrocellulose and nitroglycerine cerine dissolved in a ketonic solvent, the dispersion containing from 40 to 60% by weight of the pyrotechnic composition, and from 60–40% by weight of said collodion.

2. A lacquer according to claim 1 which comprises a dispersion of 3 parts by weight of a pyrotechnic composition consisting of zirconium, barium chromate, ammonium perchlorate and ammoium bichromate in the respective proportion 45:34:14:7, in 2 parts by weight of a collodion consisting of 75% of a power based on nitrocellulose and nitroglycerine in the respective proportions of 58 to 42 and containing 1.1% of centralite and 25% of acetone.

3. A lacquer according to claim 1, which comprises a dispersion of 2 parts by weight of a pyrotechnic composition consisting of Fe_2O_3, Mg and $KClO_4$ in the respective proportions 34:36:30 in 3 parts by weight of a collodion consisting of 75% of a powder based on nitrocellulose and nitroglycerine in the respective proportions of 58 to 42 and containing 1.1% of centralite and 25% of acetone.

4. A lacquer according to claim 1, which comprises a dispersion of 2 parts by weight of a pyrotechnic composition consisting of black powder in 3 parts by weight of a collodion consisting of 75% of powder based on nitrocellulose and nitroglycerine in the respective proportions of 58 to 42 and containing 1.1% of centralite and 25% of acetone.

5. A solid propellant grain having an ignition face coated with a layer of a lacquer which comprises a dispersion of: (a) a pyrotechnic composition, in finely divided form, selected from the group consisting of (1) powders consisting of ferric oxide, magnesium and potassium perchlorate, (2) black powder and (3) powders consisting of zirconium, barium chromate, ammonium perchlorate and ammonium bichromate in (b) a collodion which consists of a powder based on mixtures of nitrocellulose and nitroglycerine, said powder being dissolved in a ketonic solvent, the dispersion containing from 40 to 60% by weight of the pyrotechnic composition and from 60 to 40% by weight of said collodion.

6. A charge for a gas generator comprising a vaporizable

liquid chamber having an outer wall, said charge consisting of a layer of lacquer coating said outer wall, said lacquer comprising a dispersion of: (a) a pyrotechnic composition, in finely divided form, selected from the group consisting of powders consisting of ferric oxide, magnesium and potassium perchlorate, black powder and powders based on zirconium, barium chromate, ammonium perchlorate and ammonium bichromate in (b) a collodion which consists of a powder based on mixtures of nitrocellulose and nitroglycerine, said powder being dissolved in a ketonic solvent, the dispersion containing from 40 to 60% by weight of the pyrotechnic composition and from 60 to 40% by weight of collodion.

7. A lacquer according to claim 1 wherein the ketonic solvent is selected from acetone and methyl ethyl ketone.

References Cited

UNITED STATES PATENTS

2,830,886	4/1958	O'Neill et al.	149—96 X
2,973,257	2/1961	Ryker et al.	149—96 X
2,988,436	6/1961	O'Neill	149—96 X
3,137,741	6/1964	Vandersmith et al.	149—10 X
3,329,743	7/1967	Coffee	149—96 X
3,473,982	10/1969	Herzog et al.	149—96 X
2,932,251	4/1960	Hamilton	149—8 X

STEPHEN J. LECHERT, JR., Primary Examiner

U.S. Cl. X.R.

149—8, 12, 38, 40, 42, 44, 65, 73, 76, 85