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PREPARATION OF ROCKET PROPELLANTS

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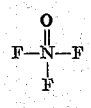
1 Claim. (Cl. 52—.5)

My invention relates to rocket fuels and the like whereby the free energy stored in organic compound are burned producing a hot gas and an explosive impulse capable of propelling a rocket or other device. This is a continuation in part of my earlier filed application, Serial No. 606,205, filed August 27, 1956.

While organic compounds have hitherto been employed for such purposes, it has been found that organic residues tend to form at the jet end of the rocket obstructing the outflow and diminishing the efficiency of the combustion as well as the propellant. Incomplete utilization of the fuel leads to abortive results in propulsion. A still further difficulty with rocket fuels is that the explosive state of the fuel is highly dangerous to personnel handling the fuel prior to the launching of the rocket. Hitherto it was found that the better the fuel, the greater was the problem of handling.

I have found that these difficulties may be overcome by a unique preparation supplying an organic compound formed during the period of combustion, uniting the most desirable elements of a rocket fuel. Thus, one of the ideal reactions desired in a rocket fuel is the interaction of nitrogen, oxygen and fluorine with a possible arrangement of —



if possible burned with atomic hydrogen. No such compound has hitherto been attained.

I have found that this type of reaction can be catalyzed during explosion of my system of compounds embodying graphitic acid made into a paste with hydrofluoric acid or benzene hexafluoride and combusted by aluminum triethyl or its analogues or other spontaneously inflammable metal alkyl or aryl compounds.

To prepare my graphitic acid I may use potassium chlorate and nitric acid or with potassium chlorate, nitric and sulphuric acid. When employing nitric acid of 90% (red acid) a green to brown or red color results. The graphite is wetted, swells up and disintegrates. The excess potassium is evaporated off leaving a brownish to reddish mass but evaporation is mild enough not to diminish the increased volume which the graphite has assumed. Both oxygen and hydrogen are taken up between the aromatic lattice structure of the graphite and an estimated composition of $C_{2.7\text{-}3}O$ with water adsorbed on the surface of the colloidal material. The color of the composition may vary with the amount of water adsorbed. Between the sheets of the lattice structure of the graphite there are also trapped nitrate radicals. The insertion of the oxygen and nitrogen atoms between the graphite sheets forces them apart and alters the spacing to twice or three times the normal 3.4A. To induce greater reactivity of the graphite, I irradiate the graphite with 100 million R to 400 million R by either a cobalt 60 source, high voltage or neutron flux.

The semi-dry mass is now made into a paste by the addition of a 35% benzene hexafluoride (C_6F_6). The presence of the adsorbed water on the surface of the graphite lattice inhibits spontaneous explosion by combination of the hydrogen fluoride with the carbon. Either the removal of the adsorbed water or heat is required to initiate the explosion. This composite material which I designate "graphigen" becomes violently explosive when aluminum triethyl is added in the presence of air. Carbon monoxide and dioxide are formed. The reaction then proceeds to the formation of mellitic acid which is completely combusted to CO_2 and water. In the intense heat, the water is ionized to atomic oxygen and hydrogen. The residue is fine crystallites of graphite which are not adherent to the jet end of the rocket.

The layer of adsorbed water between the lattice structure of the graphite intensifies the reaction of the aluminum triethyl leading to the complete combustion.

To instantaneously trigger the explosion of the aluminum triethyl and the "graphigen" I may add a solution of ammonium chloride in liquid ammonium thus providing atomic hydrogen according to the following formula.

$$NH_4Cl \rightleftharpoons NH_4^+ + Cl^- : NH_4 \rightleftharpoons NH_3 + H^+$$

Instead of ammonium chloride I may use other ammonium salts or amides in liquid ammonium.

Example I

100 grams of finely divided graphite is mixed with 300 grams of potassium chlorate and sufficient red acid (90% nitric acid) to give a liquid mass. It is allowed to stand for four to six days. As the nitric acid is absorbed it is renewed four or five times until a yellow red mass results. It is allowed to dry at room temperature. While heating in a water bath hastens the reaction, it may also be conducted at room temperature. The "graphigen" may be stored in this condition at room temperature. Before use, the "graphigen" is soaked in 35% benzene hexafluoride (C_6F_6) for several hours and filled with the rocket cartridge. The aluminum triethyl contained in glass lined jet container sealed under argon is arranged so that a stream of aluminum triethyl may be sprayed on the graphigen simultaneously with a stream of ammonium chloride in liquid ammonium.

Detonation may be accomplished also by standard methods commonly practised in the art.

Yet another aspect of my invention is the use of benzene hexafluoride to promote combustion where other rocket propellant materials are employed.

I may also use benzene hexafluoride to improve the octane value of gasoline and fuel oils. In addition, benzene hexafluoride has solubilizing properties which lowers the viscosity of heavier hydrocarbon fuels and promotes better jet extrusion. Where jet extrusion is employed instead of carburation, the addition of benzene hexafluoride promotes greater velocity of extrusion by lowering the viscosity of the hydrocarbon. Simultaneously, it has a cleansing effect on the valve mechanism.

Example II

1 cc. benzene hexafluoride is added to 100 cc. 90 octane gasoline. The octane value of the gasoline is increased to well over 100 octane.

Example III

To 100 cc. Number 4 fuel oil is added 1 cc. benzene hexafluoride. The B.t.u. value is increased approximately 10 percent and the viscosity is lowered.

In this specification I have used the word "graphigen" to mean the product formed as in Example I wherein graphite mixed with potassium chlorate and 90% nitric acid is allowed to form a mass where the nitric acid and potassium chlorate enter into the lattice structure of the graphite.

What I claim is:

A rocket fuel consisting essentially of a mixture of benzene hexafluoride with graphitic acid, said graphitic acid being the partially dried product of the combination of finely-divided graphite with an alkali-metal chlorate and an acid medium selected from the group consisting of nitric acid, and nitric acid and sulfuric acid, and said benzene hexafluoride having a concentration of the order of about 35 percent and sufficient to form a composite paste with said graphitic acid.

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