

Jan. 1, 1957

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2,775,863

PROCESS FOR INITIATING THE IGNITION OF ROCKET FUELS

Filed Sept. 19, 1951

2 Sheets-Sheet 1

Fig. 1

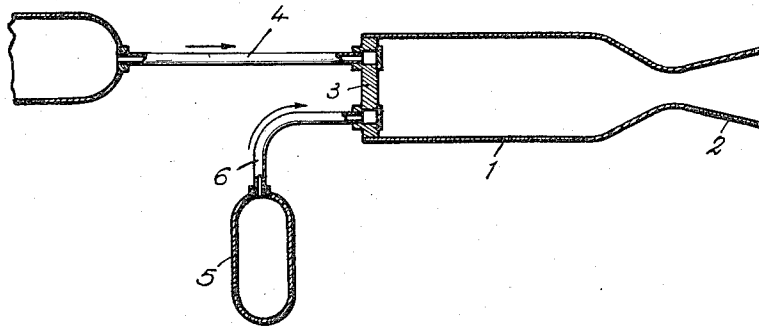


Fig. 2

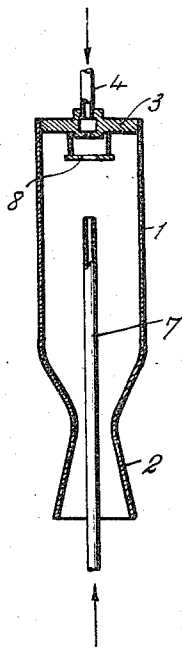


Fig. 3

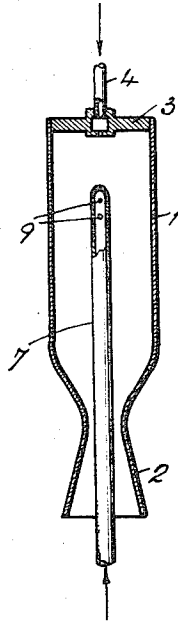
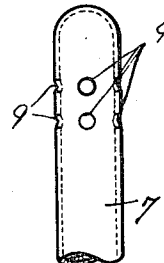


Fig. 4



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2 Sheets-Sheet 2

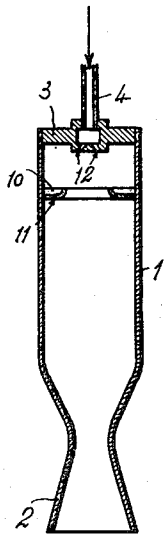


Fig. 5

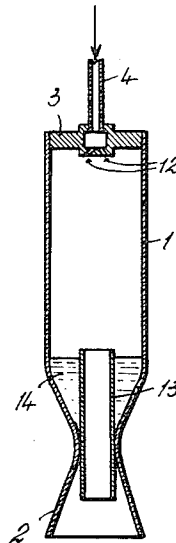


Fig. 6

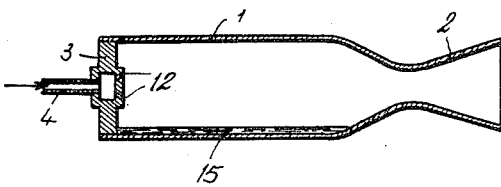


Fig. 7

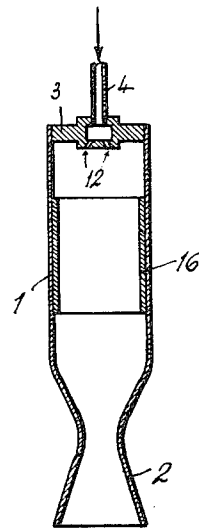


Fig. 8

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**PROCESS FOR INITIATING THE IGNITION
OF ROCKET FUELS**

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Application September 19, 1951, Serial No. 247,246

Claims priority, application France September 25, 1950

6 Claims. (Cl. 60—35.4)

The present invention relates to rockets controlled by propellants and has for its object a method for carrying out the initial ignition of the propellant or propellants of such rockets.

This initial ignition is brought about by itself when hypergolic propellants are used, i. e. propellants the mutual contact of which produces an exothermic reaction capable of igniting the mixture. On the contrary, when non-hypergolic propellants are used, auxiliary means should be provided for carrying out this ignition. In the same manner, when a monergol, such as the mononitromethane is used, it is necessary to provide means for bringing the combustion chamber into temperature and pressure conditions capable of producing the initial decomposition of the monergol which starts then by itself.

Various ignition means are used up to now, but these means show numerous drawbacks. One may burn, for instance, a certain quantity of powder in the combustion chamber, but this method is not very practical and does not allow a reignition when the operation of the rocket has been stopped. The use of sparking-plugs, as in the explosion engines, is possible only if the monergol or non-hypergolic propellants are in presence of an excess of oxygen. One may also insure the ignition by means of a solid product called initiator, at the contact of which the monergol ignites, with a weak delay, provided it contains a certain quantity of nitric acid, but the product containing nitric acid in thus sensibitized; it may explode if pressure variations occur during the ignition. Finally, the use of ignition hypergolic carburents has the disadvantage, in the case of use of monergols, of necessitating the employment of numerous mechanical fittings, due to the fact that three liquids are to be injected in the combustion chamber. In case an oxidizer such as concentrated nitric acid should be used, special materials must be used for the walls of the combustion chamber. Moreover, none of the above mentioned means is sufficiently safe.

The method according to the invention which is particularly advantageous in the case of monergol rockets, such as mononitromethane rockets, cuts out these drawbacks and has further the advantage of insuring a large security, which is the fundamental criterion when a monergol is used.

This method consists in bringing into contact with the propellant or propellants in the combustion chamber of the rocket a complex organo-metallic compound adapted to burn upon contact with oxygen or oxygenated compounds, or a mixture of such compounds.

When this bringing into contact is realized, the organo-metallic compound or compounds ignite: the gas from the reaction bring the reacting medium into the conditions suited for the ignition of the monergol or the non-hypergolic mixture, which ignition is next kept up by itself in proportion to the introduction of said monergol or mixture. The total weight of the products neces-

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sary to an ignition is very small, lower than a fourth of the feed in weight of the injected propellants.

Another advantage of the method according to the invention is the possibility of reignition, after one or more operations with only simple devices.

As composite organo-metallic compounds, suitable for the above mentioned use, I may indicate the diethyl aluminum bromide or iodide, the dimethyl aluminum bromide or iodide, the ethyl aluminum iodo-bromide, the methyl aluminum iodo-bromide, the methyl zinc iodide, the ethyl zinc iodide, the ethyl aluminum di-iodide, the methyl zinc di-iodide.

The method according to the invention causes a very small delay in the ignition. Consequently, the problem of the progressivity of admission of the propellants in the combustion chamber is not serious and the adjustment of the injectors is very simple; variations of the ignition pressure are very weak, risks of explosion when the ignition occurs being thus practically eliminated. It is not necessary to provide oxygen, and the absence of nitric acid, in the case of a monergol, warrants the good resistance to deterioration of the material forming the walls of the combustion chamber.

The bringing into contact of the composite organo-metallic derivative with the propellant or propellants may be effected, when the compound is liquid, by injecting the latter at the same time as the propellant or propellants.

The complex organometallic compound may also be placed before the monergol in the combustion chamber.

In the case of injection, the latter is preferably made during a very short time, less than one second for instance; for this injection, one may use an auxiliary tank filled with the ignition liquid and connected to the combustion chamber so as to inject into it the ignition liquid in the same direction as the propellants. This latter arrangement has the advantage of allowing as many startings of the propeller as desired, the said propeller being thus completely self-contained.

One may also inject the ignition liquid into the combustion chamber by means of an injector housed in the nozzle of the rocket and directing the liquid jet either against a deflecting plate which sprays the liquid before it comes into contact of the propellant, or through holes suitably orientated so as to direct the ignition liquid towards the jets of propellant.

In the first embodiment, the plate may be arranged so as to melt as soon as the device begins to operate.

In the case the organo-metallic compound should be placed first in the combustion chamber, this compound may be placed, if it is liquid, either in a flange secured to the inner wall of the combustion chamber, or along a tube maintaining the ignition liquid above the neck of the nozzle, or simply along the inner wall of the chamber between the bottom and the nozzle of said chamber, if the latter is horizontal.

The flange or tube may be arranged so as to melt as soon as the device begins to operate.

Finally, if a solid ignition product is used, it may be fixed on the inner wall of the combustion chamber, in all suitable points according to the direction of the jet or jets of propellants which ought to meet this solid ignition product.

In the appended drawings, there have been shown diagrammatically in Figs. 1 to 8 various embodiments given as non-limitative examples of devices for the ignition of rocket propellants by means of the ignition products according to the invention.

In these figures 1 is the combustion chamber with its outlet nozzle 2 and its bottom 3 into which penetrates the propellant (monergol) through the pipe 4.

In Fig. 1 the ignition liquid contained in a tank 5 is

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injected into the chamber 1 through a pipe 6 in the same direction as the propellant.

In Fig. 2 the ignition liquid is injected into the chamber 1 through the nozzle 2 by means of an injector 7 fastened to the ground for instance, which simplifies the combustion chamber and the propeller. In the bottom of the chamber 1 opposite to the inlet of the propellant is a deflecting plate 8 which sprays the ignition liquid before it comes into contact with the propellant. This plate 8 may be such that it melts after a few seconds operation.

In Fig. 3 the injector of Fig. 2 is provided with holes 9 (Fig. 4) suitably orientated so as to direct the ignition liquid toward the jet of propellant. The deflecting plate is omitted.

In Fig. 5 the ignition liquid is previously placed in 10 in a cupel 11 secured to the wall of the chamber 1 and which may be arranged so as to melt at the beginning of the operation.

The divergent jets of propellant coming from the openings 12 of the bottom 3 will meet thus the ignition liquid placed in the cupel 11.

In Fig. 6 a tube 13 is fitted in the neck of the nozzle 2 and is used for maintaining in 14 the ignition liquid while allowing the combustion gases to pass through the nozzle; this tube 13 melts at the beginning of the operation. In this embodiment also the propellant enters the chamber 1 under the shape of divergent jets in order to come into contact of the ignition chamber 14 in a better manner.

In Fig. 7 the combustion chamber is horizontal; the ignition liquid is previously placed in 15 against the inner wall of the chamber 1.

In Fig. 8, there was used as an ignition agent a solid product containing chiefly organo-metallic compounds such as, for instance, diethyl aluminum bromide; this product may be then fixed against the inner wall of the chamber 1 under the shape of a sleeve 16 which will be hit by the divergent propellant jets coming from the openings 12 in the bottom 3.

What I claim is:

1. In a method for initiating the ignition at a very high speed of mononitromethane inside a rocket, the

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step consisting of contacting said mononitromethane, within the combustion chamber of a rocket, with an ignition-initiating amount of at least one complex organo-metallic compound of the formula $RMeX$, in which R is at least one lower alkyl radical from the group consisting of methyl and ethyl radicals, Me is a metal from the group consisting of aluminum and zinc and X is at least one halogen from the group consisting of iodine and bromine.

2. The method of claim 1 wherein the complex organo-metallic compound is diethyl aluminum bromide.

3. The method of claim 1 wherein the complex organo-metallic compound is dimethyl aluminum bromide.

4. The method of claim 1 wherein the complex organo-metallic compound is ethyl aluminum iodobromide.

5. The method of claim 1 wherein the complex organo-metallic compound is methyl zinc iodide.

6. The method of claim 1 wherein the complex organo-metallic compound is methyl aluminum diiodide.

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