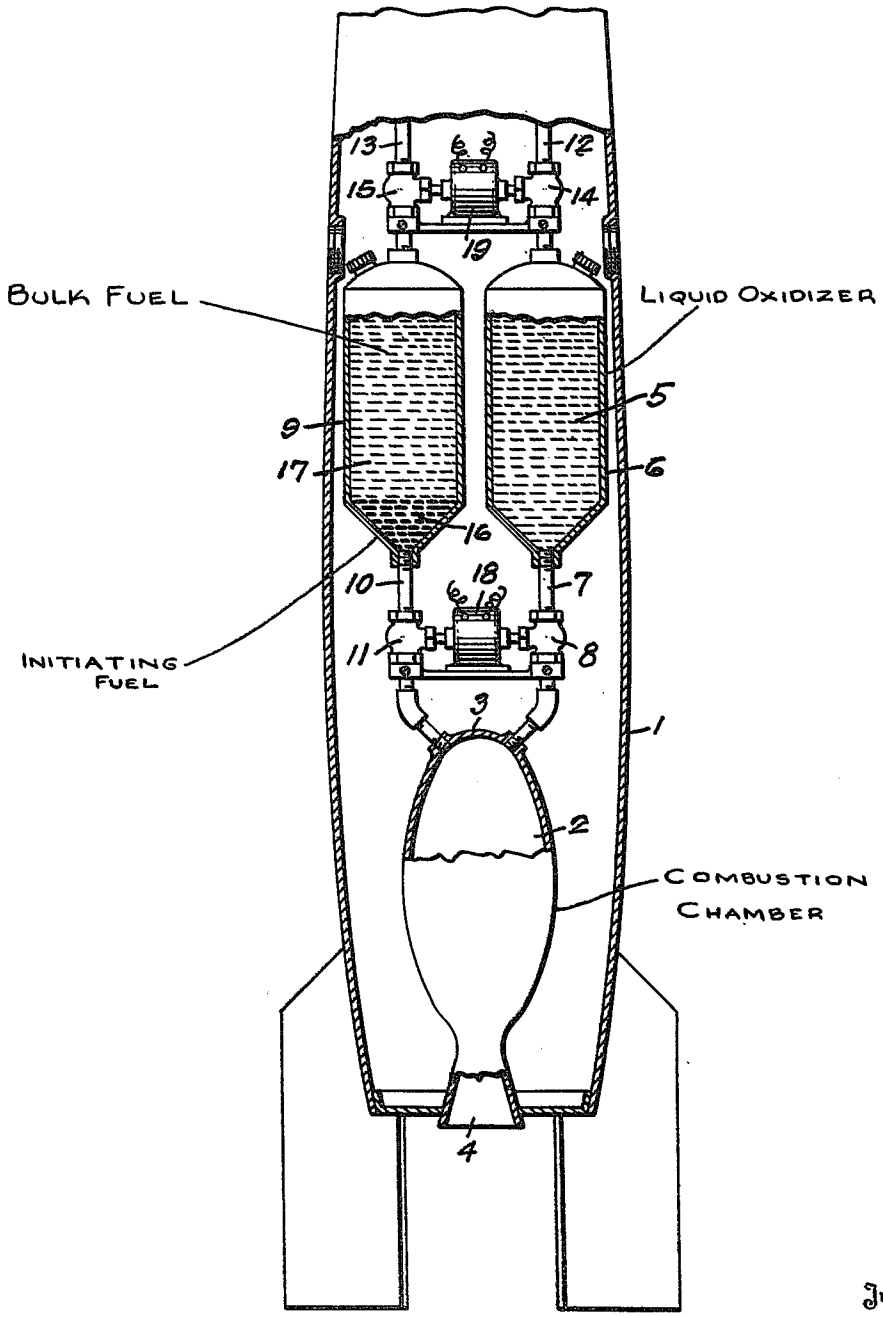
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PROCESS OF IGNITION FOR ROCKETS AND THE LIKE

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PROCESS OF IGNITION FOR ROCKETS AND THE LIKE

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6 Claims. (Cl. 60—35.4)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to a process for burning fuel and more particularly to a process for energizing rocket motors supplied with liquid fuel and liquid oxidizer.

An object of the invention is to provide a process for initiating and continuing combustion in a combustion zone that does not require any auxiliary igniting device, that assures positive and safe functioning, that is simple to operate and that requires a minimum of supplies.

These and other objects and advantages of the invention, as will appear more fully hereinafter, are realized in a process for burning fuel which comprises bringing together in a combustion zone an oxidizer and a fuel spontaneously combustible therewith to initiate combustion and thereafter supplying to the combustion zone an oxidizer and another fuel to continue combustion. The process finds particular application in the energization of rocket motors, in which use the fuel tank of the rocket is charged with a layer of an initiating fuel and a layer of bulk fuel of a different specific gravity and substantially immiscible therewith, the fuels are passed in a continuous stream to the combustion chamber of the rocket, the initiating fuel entering the chamber first followed by the bulk fuel, and simultaneously there is introduced into the combustion chamber and mixed with the fuel therein a continuous stream of an oxidizer that first reacts spontaneously with the initiating fuel to start combustion and thereafter reacts with the bulk fuel to continue combustion.

In the drawing, the single figure is a somewhat diagrammatic view of a portion of a rocket, a part of the shell being broken away to show the interior.

Referring to the drawing, the rocket shell 1 houses, inter alia, a rocket motor or combustion chamber 2 closed at the front 3 and having a reaction nozzle 4 opening to the rear. Liquid oxidizer 5 contained in oxidizer tank 6 is fed through pipe 7 under control of motor operated valve 8 to the combustion chamber 2. Similarly, liquid fuel contained in fuel tank or reservoir 9 is fed to the combustion chamber 2 through pipe 10 under control of motor operated valve 11. Compressed gas, from a source carried by the rocket (not shown) may be applied to the surfaces of the liquids in the tanks 6 and 9 to force the liquids from the tanks into the combustion chamber.

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Such gas may enter the tanks through pipes 12 and 13 having control motor operable valves 14 and 15 respectively. Valve operating motors 18 and 19 may be remotely controlled by well known mechanisms.

As seen in the drawing, 16 represents a layer of initiating fuel and 17 represents a supernatant layer of bulk fuel. The initiating fuel is substantially immiscible with the bulk fuel and has a density greater than the density of the bulk fuel, as a result of which the fuels separate into two layers as shown. The initiating fuel 16 and the oxidizer 5 are so selected that they ignite spontaneously when they are mixed in the combustion chamber even at ordinary temperatures. Thus, no preheating or compression is required to ignite the mixture of initiating fuel and oxidizer and no auxiliary igniting device is needed.

Sufficient initiating fuel is charged into the fuel tank 9 to start combustion and to heat the combustion chamber to normal operating temperature. After the initiating fuel has been expended, it is immediately followed by the bulk fuel 17 which continues to burn at operating temperature. Enough liquid oxidizer 5 is stored in the tank 6 to effect combustion of all of the fuel, both initiating and bulk, contained in tank 9. Ordinarily, the amount of initiating fuel will be less than 5% of the amount of the bulk fuel.

Effective fuel and oxidizer combinations for use in the process of the invention are listed in the following table:

Table

Example	Bulk Fuel	Initiating Fuel	Oxidizer
1	Gasoline	Aniline	Nitric Acid.
2	do	Furfuryl Alcohol	Do.
3	do	Furfyl Alcohol	Nitrogen.
4	Benzene	Pyrocatechol	Tetroxide.
		Hydrazine Hydrate	Hydrogen Peroxide.

These are merely exemplary and many other combinations satisfying the conditions outlined herein are available.

The initiating fuel and the bulk fuel may be stored and transported in the same tank or in separate tanks. Where one tank is used for both fuels, separate discharge lines enable each fuel to be separately drained from the tank.

Since the rocket usually is filled in a vertical position, or at least is kept in a vertical position for some time after filling and before firing, there is sufficient time for substantially complete separation of the fuel into two layers to take place,

even though the fuels may have become mixed to some extent during filling of the tank.

It is also contemplated that the oxidizer may be employed as a two-phase system in which the first phase to reach the combustion chamber is hypergolic or spontaneously combustible with the first increment of fuel to reach the combustion chamber and the second phase or bulk of the oxidizer is non-hypergolic with the first phase of the fuel.

I claim:

1. A process for burning fuel in a rocket motor having one combustion zone comprising the steps of bringing together in the combustion zone an oxidizer selected from the group consisting of nitric acid, nitrogen tetroxide and hydrogen peroxide and a fuel spontaneously combustible therewith selected from the group consisting of aniline, furfuryl alcohol, pyrocatechol and hydrazine hydrate to initiate combustion, and thereafter supplying to the combustion zone said oxidizer and another fuel selected from the group consisting of gasoline and benzene to continue combustion.

2. A process for energizing a rocket motor having a combustion zone and a fuel reservoir zone which comprises the steps of charging into the fuel reservoir zone of the rocket a layer of initiating fuel and a supernatant layer of bulk fuel, withdrawing the initiating and bulk fuel from adjacent the bottom of the reservoir zone in a continuous stream, introducing said continuous stream of fuel into the combustion zone of the rocket, and simultaneously introducing into the combustion zone of the rocket an oxidizer in an amount and at a rate sufficient to initiate and support combustion of the fuel.

3. A process for energizing a rocket motor having a combustion zone and a fuel reservoir zone which comprises the steps of charging into the fuel reservoir zone of the rocket a layer of initiating fuel and a supernatant layer of bulk fuel, of lesser density and substantially immiscible therewith, withdrawing the initiating and bulk fuel from adjacent the bottom of the reservoir zone in a continuous stream, introducing said continuous stream of fuel into the combustion zone of the rocket, and simultaneously introducing into the combustion zone of the rocket an oxidizer in an amount and at a rate sufficient to initiate and support combustion of the fuel.

4. A process for energizing a rocket motor including a combustion zone and a fuel reservoir zone which comprises the steps of charging into the fuel reservoir zone of the rocket a first layer of initiating fuel, superimposing thereon a second, supernatant layer of bulk fuel, withdrawing successively the first and second layers of fuel from adjacent the bottom of the reservoir zone in a continuous stream, introducing said continuous stream of fuel into the combustion zone of the rocket, and simultaneously introducing into the combustion zone of the rocket an oxidizer in an amount and at a rate sufficient to initiate and support combustion of the fuel.

5. A process for energizing a rocket motor including an oxidizer reservoir zone, a fuel reservoir zone and a combustion zone which comprises the steps of charging into the oxidizer reservoir zone of the rocket a liquid oxidizer, charging into the fuel reservoir zone of the rocket a first layer of initiating fuel spontaneously combustible with said oxidizer at ordinary temperatures, superimposing thereon a second, supernatant layer of bulk fuel spontaneously combustible with said oxidizer only at elevated temperatures, withdrawing successively the first and second layers of fuel from adjacent the bottom of the reservoir zone in a continuous stream, introducing said continuous stream of fuel into the combustion zone of the rocket, and simultaneously introducing into the combustion zone of the rocket an oxidizer in an amount and at a rate sufficient to initiate and sustain combustion of the fuel.

6. A process for energizing a rocket motor including an oxidizer reservoir zone, a fuel reservoir zone and a combustion zone which comprises the steps of charging into the oxidizer reservoir zone of the rocket a liquid oxidizer, charging into the fuel reservoir zone of the rocket a first layer of initiating fuel spontaneously combustible with said oxidizer at ordinary temperatures, superimposing thereon a second, supernatant layer of bulk fuel immiscible with said initiating fuel and spontaneously combustible with said oxidizer only at elevated temperatures, withdrawing successively the first and second layers of fuel from adjacent the bottom of the reservoir zone in a continuous stream, introducing said continuous stream of fuel into the combustion zone of the rocket, and simultaneously introducing into the combustion zone of the rocket an oxidizer in an amount and at a rate sufficient to initiate and sustain combustion of the fuel.

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