NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF:

July 27, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No.	:	3,120,738
Corporate Source	:	California Institute of Technology
Supplementary Corporate Source	:	Jet Propulsion Laboratory
NASA Patent Case No.	:	XNP-00249

Please note that this patent covers an invention made by an employee of a NASA contractor. Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of. . . ."

G Parker

Gayle Parker

Enclosure:
Copy of Patent

FACILITY FORM 602

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N70-38249

Feb. 11, 1964 J. E. WEBB, ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION **3,120,738**

IGNITION SYSTEM FOR MONOPROPELLANT COMBUSTION DEVICES

Filed March 3, 1962

FIG. 1

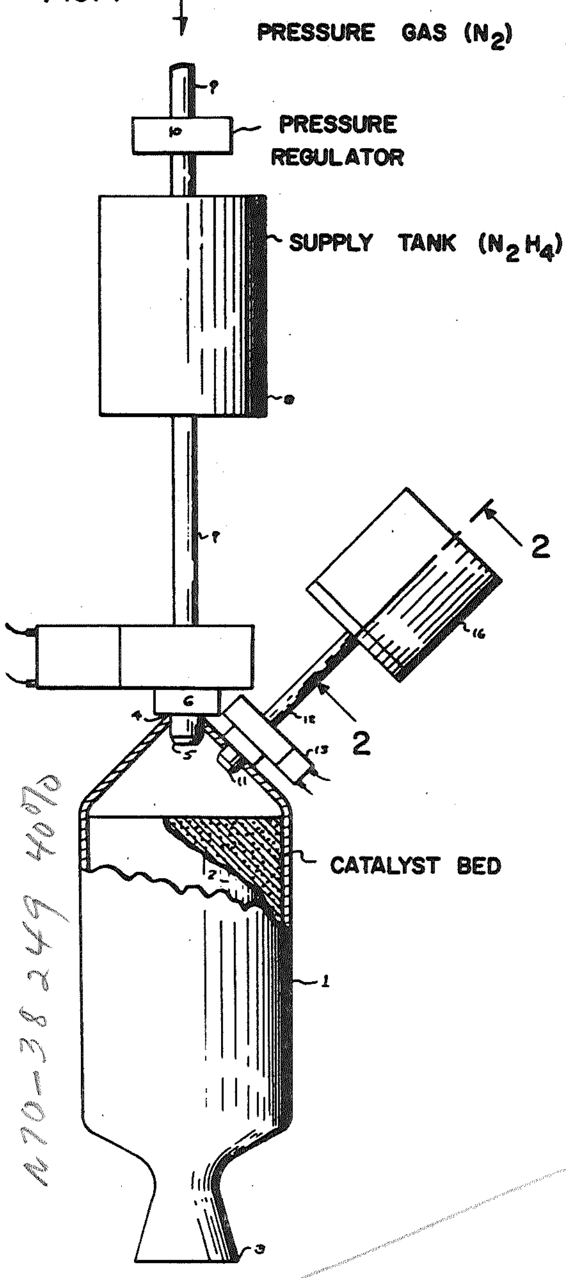

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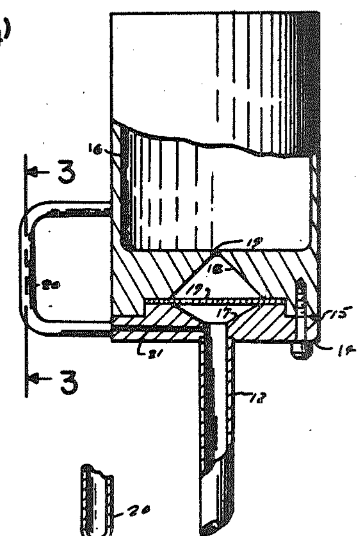
FIG. 2



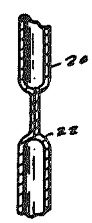


FIG. 3

INVENTOR.
JOHN J. CHILENSKI

BY

ATTORNEY

United States Patent Office

3,120,738

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3,120,738
IGNITION SYSTEM FOR MONOPROPELLANT COMBUSTION DEVICES

James E. Webb, administrator of the National Aeronautics and Space Administration, with respect to an invention of John J. Chilenski

Filed Mar. 3, 1962, Ser. No. 180,391
4 Claims. (Cl. 60—35.6)

Monopropellant devices, such as rocket motors, utilize a porous catalyst bed suitably supported in the rocket motor chamber. A monopropellant is forced into the catalyst bed, and when ignited, continues to decompose and generate a pressure until the supply is terminated. This invention is directed to ignition systems for effecting ignition and decomposition of the monopropellant and included in the object of this invention are:

First, to provide an ignition system for monopropellant devices wherein a predetermined charge of an oxidizer is introduced into the combustion chamber of the device simultaneously with initial introduction of the monopropellant to produce a hypergolic action which instantly ignites the catalyst bed so as to ignite and sustain decomposition of the monopropellant.

Second, to provide an ignition system of this class which is lightweight and free of moving parts, except for valves, thereby providing an ignition system which is particularly adapted for use in rocket vehicles.

Third, to provide an ignition system of this class which is capable of operation irrespective of gravity conditions or atmospheric pressure, including conditions of zero gravity and zero pressure.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings, in which:

FIGURE 1 is a diagrammatical view showing a conventional monopropellant rocket motor, and monopropellant supply and indicating diagrammatically the ignition means in association therewith.

FIGURE 2 is an enlarged, substantially diagrammatical, partially sectional, partially elevation view of the ignition means taken through 2—2 of FIG. 1.

FIGURE 3 is a further enlarged fragmentary sectional view of the pinch tube taken through 3—3 of FIG. 2.

Illustrative of a monopropellant device is a rocket motor 1, having a cylindrical motor chamber 2, a nozzle 3 at the aft end thereof, and a closed head 4 at its forward end. Suitably supported in the chamber 2 is a porous catalyst bed. A conventional catalyst bed is prepared from small porous cylinders of alumina (Al_2O_3) and equimolal solutions of the

nitrates of iron ($Fe(NO_3)_3 \cdot 9H_2O$)
nickel ($Ni(NO_3)_2 \cdot 6H_2O$), and
cobalt ($Co(NO_3)_2 \cdot 6H_2O$)

impregnating and coating the cylinders. The solution is evaporated to dryness and heated until evolution of nitrogen dioxide (NO_2) is terminated leaving oxides of the iron, nickel and cobalt.

The head 4 is provided with one or more nozzles 5 connected through a control valve 6 to a supply line 7. The supply line is connected with a monopropellant supply tank 8, filled with a monopropellant such as hydrozene (N_2H_4). The monopropellant is pressurized by an inert pressure gas such as nitrogen (N_2) supplied from a pressure tank, not shown, through a supply line 9 and pressure regulator 10. The structure thus far described may be considered as conventional.

The hydrazine reacts with the oxides of iron, nickel and cobalt so that they are reduced to free metals.

Fitted in the head 4 is an oxidizer nozzle 11 connected with an oxidizer tube 12 through a control valve 13. The

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oxidizer tube is dimensioned to receive a predetermined charge of an oxidizer, such as nitrogen tetroxide, chlorine trifluoride or nitric acid. The amount of oxidizer contained in the tube 12 is calculated to afford positive ignition of the catalyst bed when discharged into the rocket motor chamber 2. The extended end of the tube 12 is joined to a flange plate 14 which caps an end wall 15 of a pressure vessel 16. The confronting sides of the plate 14 and the end wall 15 have confronting conical cavities 17 and 18. Interposed between the cavities and clamped between the flange plate 14 and end wall 15 is a rupture diaphragm 19. The cavity 17 communicates with the tube 12; whereas, the cavity 18 communicates with the interior of the pressure vessel 16 through an orifice 19.

A small tube 20 communicates initially between the interior of the pressure vessel 16 and a radial passage 21 communicating with the cavity 17 and oxidizer tube 12. The tube 20 is adapted to be sealed by being pinched or flattened as indicated by 22 in FIG. 3.

Operation of the ignition device is as follows:

With the control valve 13 closed, a charge of oxidizer is introduced into the tube 12, for example a supply port, not shown, similar to the passage 21 in the plate 14. While the valve 13 remains closed, but with the connecting tube 20 open, the pressure vessel 16 is charged with an inert gas such as nitrogen. The gas pressurizes the tube 12 also so that the pressure on opposite sides of the rupture diaphragm 19 is equalized. After the pressure vessel is charged, the connecting tube is sealed by being flattened as indicated by 22.

The supply tank 8 and supply line 7 are filled with a monopropellant, and are pressurized to a pressure determined by the regulator 10. On command, the control valves 6 and 13, which may be solenoid operated, are opened. The monopropellant flows from the supply tank under a constant pressure determined by the regulator 10. The opening of the valve 13 first bleeds the small quantity of inert pressure gas sufficiently to cause the diaphragm to rupture whereupon the inert gas in the pressure vessel functions to drive the oxidizer forcibly into the motor chamber. The oxidizer, on entering the motor chamber, ignites the catalyst and causes the monopropellant to decompose. Once started, the monopropellant continues to decompose as long as the supply lasts.

It will be observed that flow of the oxidizer is not dependent upon gravitational forces, nor is it affected by external pressures. Consequently, the oxidizer may be depended upon to be discharged instantaneously on command into the rocket motor chamber irrespectively of these conditions.

Although I have shown and described a particular embodiment of my invention by way of illustration, the invention is not limited thereto, but includes the constructions, combinations, and arrangements set forth in the appended claims.

I claim:

1. An ignition means for monopropellant devices, having a catalyst bed, and means for introducing on command, a monopropellant therein, said ignition means comprising: a pressure container for a charge of an oxidizer; a pressure vessel for a charge of inert propelling gas; a rupture diaphragm for separating said vessel and container; means for initially equalizing pressures in said vessel and container to provide an initial condition of zero pressure differential across said diaphragm; means for introducing said oxidizer into said catalyst bed; and a valve interposed between said introducing means and pressure container, operable on opening to reduce the pressure in said oxidizer container thereby to cause rupture of said diaphragm and propulsion of said oxidizer into said catalyst bed.

2. An ignition means for monopropellant devices having a chamber containing a catalyst bed, and valve means for introducing a monopropellant therein, said ignition means comprising: valve means for controlling introduction of an oxidizer into said catalyst bed chamber; means defining a compartment initially closed by said valve for receiving a pressurized charge of oxidizer; means defining a chamber for an inert pressure gas, said oxidizer and inert gas being pressurized to essentially the same pressure; means initially isolating said oxidizer compartment and inert gas chamber, said means being operable on opening of said valve means to release said inert gas into said oxidizer compartment thereby to drive said oxidizer from said compartment into said catalyst bed chamber.

3. An ignition means for monopropellant devices having a chamber containing a catalyst bed, and valve means for introducing a monopropellant therein, said ignition means comprising: valve means for controlling introduction of an oxidizer into said catalyst bed chamber; means defining a compartment intially closed by said valve for receiving a charge of oxidizer; means defining a chamber for an inert pressure gas; a rupture diaphragm initially isolating said oxidizer compartment and inert gas chamber; an equalizer tube initially bypassing said diaphragm whereby on pressurizing said chamber with inert gas, said compartment is likewise pressurized to equalize the pressure across said diaphragm; said diaphragm adapted on opening of said valve means to rupture, thereby to cause said inert gas to propel said oxidizer into said catalyst bed chamber.

4. A monopropellant rocket motor, comprising: a rocket motor having a motor chamber and nozzle; a catalyst bed in said motor chamber; a first means containing a pressurized supply of monopropellant; a first valve means responsive to remote command for connecting said first means with said motor chamber to introduce said monopropellant therein; a second means containing a pressurized charge of oxidizer; an inert gas pressure vessel; a rupture diaphragm initially isolating said second means and pressure vessel; and a second valve responsive to remote command for opening said second means to said motor chamber thereby to reduce the pressure therein and cause said diaphragm to rupture, whereby said inert gas propels said oxidizer into said motor chamber.

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