60-251 SEARCH ROOM

July 4, 1961 G. J. MULLANEY 2,990,682

FUEL CHARGE

Filed Nov. 7, 1951

6532

Hybrid propellant

Fig. 1.

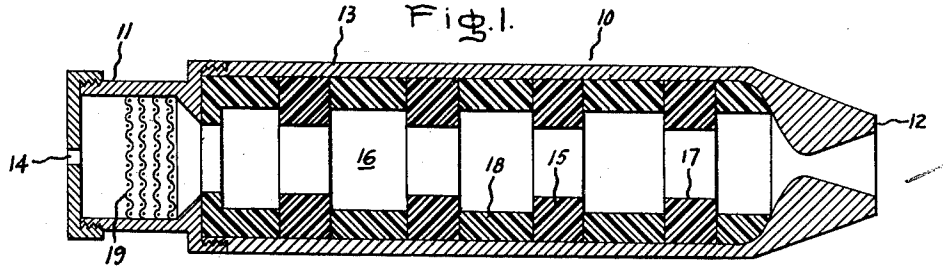
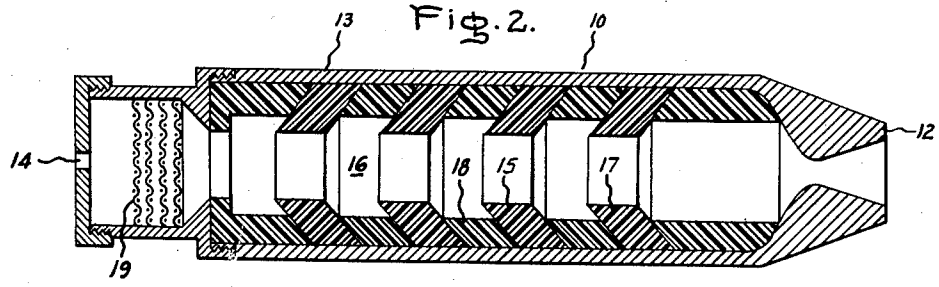


Fig. 2.



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FUEL CHARGE

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This invention relates to a shaped charge of solid fuel for use in a rocket of the type which has a combustion supporting agent separate and apart from the fuel itself. More particularly, the invention relates to a solid rocket fuel charge having a configuration to increase the turbulence of combustion gases in contact therewith, thereby increasing the efficiency of the combustion.

Many of the rockets presently being produced derive their thrust from the rapid combustion of a liquid fuel such as alcohol with air oxidizer such as liquid oxygen. Rockets propelled in this manner require rather complicated apparatus to insure safe and efficient admixture of the liquid fuel with the oxygen. Solid fuels have also been used. Their use simplifies some of the control apparatus but makes more difficult the problem of obtaining efficient combustion.

Accordingly, it is an object of this invention to provide a rocket having a solid fuel from which efficient combustion may be obtained.

It is a further object of this invention to provide a rocket using solid fuel having a configuration to promote turbulence in the combustion gases making contact with the solid fuel whereby a more intimate admixture of the fuel with the combustion supporting agent takes place.

To this end, an important feature of the present invention comprises providing a rocket with a charge of solid fuel having a longitudinal passageway therethrough, the walls of said passageway having a plurality of spaced baffles composed of the fuel material which promote turbulence in fluids traversing the passageway.

Other objects and features will become apparent from a perusal of the following specification taken in conjunction with the attached drawing, wherein:

FIG. 1 is a sectional view of one embodiment of my invention; and

FIG. 2 is a sectional view of another embodiment of my invention.

Referring to either figure, my invention may be seen to be comprised of a casing **10** having a front portion **11** and a back portion **12** separated by a central portion **13**. Each of these three portions serves a different functional purpose, the front portion **11** being adapted for feeding a combustion supporting agent such as hydrogen peroxide through an opening **14**. In operation the front portion **11** has a container (not shown) for instruments and hydrogen peroxide or other combustion supporting agents attached thereto.

The back portion **12** of the casing **10** is equipped with a converging-diverging nozzle as shown in order to further aid in the efficient combustion of the fuel and to accelerate the combustion gases to the optimum exit velocity. The converging-diverging nozzle is of the type normally used in the art.

The central section **13** of the casing **10** contains a solid fuel **15** which may preferably be polymerized ethylene or a similar source of hydrogen and carbon.

The casing **10** will normally have a cylindrical configuration but it need not necessarily be so. The cylindrical form is easy to fabricate and has a good contour for passage through air when the motor cylinder is used as the outer surface of a missile. Whatever form the casing takes, the solid fuel **15** conforms on its exterior side to the interior walls of the casing **10**. The solid fuel **15** surrounds a longitudinal passageway **16** the walls of which

are very irregular due to portions of the solid fuel **15** projecting into the passageway **16**. While the solid fuel **15** could be machined in one piece to give it the appearance illustrated, it is preferable to fabricate it from several different sizes of stampings from sheet material.

The stamping technique above mentioned can best be applied to the embodiment illustrated in FIG. 1. All stampings have the same outside dimensions but in one case the wall thickness is not great as shown at **18** and in the other case the wall thickness is considerable as shown at **17**, thereby enabling the alternate stampings to project some distance toward the center of the longitudinal passageway.

The front portion **11** of the casing **10** encloses a space wherein decomposition of hydrogen peroxide takes place. This decomposition reaction is catalyzed by a series of screens **19** positioned in the decomposition space. Silver is a good agent for promoting the decomposition of hydrogen peroxide and the screen **19** may be fabricated either of pure silver or of a base metal coated with silver. Copper, iridium and other metals are also satisfactory decomposition catalysts.

During operation, hydrogen peroxide, preferably of about 90% purity, is passed through the opening **14** into contact with the screens **19**. The silver at once decomposes the peroxide to produce a mixture of oxygen and steam at a temperature of about 700° C. This gaseous mixture then passes into the longitudinal passageway **16** where it comes into contact with the solid fuel **15**. I have found that ignition of the fuel **15** commences very quickly and the gaseous reaction products build up a pressure within the passageway **16** which forces the products of combustion through the nozzle at the back end **12** of the casing **10**. As pressure builds up within the passageway **16**, the rate of combustion increases. The projecting portions **17** of the fuel charge promote turbulent flow of the gases supporting combustion and increase not only the frequency of contact between the gases and fuel **15** but also the contact area.

A fuel charge shaped in accordance with my invention has given an impulse as high as 95% of that which can be obtained theoretically. It might appear that the projections **17** would be consumed more rapidly than the surfaces of the fuel **15** which do not project. I have discovered that this is not the case but that the entire fuel charge is consumed at a fairly constant rate irrespective of the type of surface exposed to the combustion supporting gases although there is a tendency for the sharp angles to become rounded. This shows that the turbulence introduced by the portions **17** is a satisfactory way to insure even burning of the fuel **15**. At the same time the rounding of the sharp angles during combustion tends to keep the surface area of the charge constant during combustion.

The structure of FIG. 2 operates in a manner similar to that shown in FIG. 1 except that the fuel projections extend toward the front end of the casing **10**. This introduces a slightly different turbulent flow pattern which also asures intimate contact between the gases which support combustion and the fuel.

The dimensions of the various parts illustrated in the figures depend entirely upon design considerations. For a rocket 5 to 6 inches in diameter designed to operate at 400 to 500 lbs. pressure, I have found a high-strength steel of about ⅛ inch thickness satisfactory for the casing **10**. For this size of casing, the turbulator rings **17** and **18** are satisfactory if fabricated from ethylene polymer of about 1 inch thickness. This size of rocket will give a 250-lb. thrust when operating on a solid fuel of the configuration shown in FIG. 1.

While the present invention has been described by ref-

erence to two particular embodiments thereof, it will be understood that numerous modifications may be made by those skilled in the art without actually departing from the invention. I, therefore, aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a rocket driven by a solid fuel having a separate source of oxygen, a fuel charge defined by a peripheral wall of fuel encompassing a combustion chamber, the outside of said wall being cylindrical in configuration, said wall including inwardly extending annular baffles to increase the turbulence of gases passing through said chamber during combustion.

2. A rocket fuel charge as claimed in claim 1 wherein the baffles are perpendicular to the axis of the cylinder.

3. In a rocket driven by solid fuel having a separate source of oxygen for supporting the combustion of said fuel, a fuel charge comprising a plurality of rings, the outside diameters of said rings being equal and the inside diameters being of a small dimension and a large dimension, a small inside diameter ring being alternately spaced with a large inside diameter ring whereby said rings create turbulence in any fluid flowing through the interior space defined by said rings.

4. A rocket fuel charge as claimed in claim 3 wherein the rings have symmetrical spatial configuration along their axis from either side.

5. In a rocket driven by a solid fuel having a separate source of oxygen for supporting the combustion of said fuel, a fuel charge of cylindrical configuration having an axial passageway therethrough, the interior walls of said cylinder having a plurality of spaced annular constructions to promote turbulence in fluids traversing said passageway.

6. A rocket fuel charge as claimed in claim 5 wherein the spaced annular constrictions extend inward at an angle normal to the walls of the cylinder.

7. In a rocket motor driven by a solid fuel having a separate source of oxygen for supporting the combustion of said fuel, a fuel charge composed of combustible material the walls of which define a longitudinal passageway, said walls including a plurality of straight-sided spaced inwardly extending baffles to create turbulence in gases passing through the passageway during combustion of said fuel charge.

8. A rocket comprising an elongated casing having a central section defining a fuel chamber, a front end and a back end, means for introducing a combustion supporting substance through the front end of said casing, a nozzle positioned in the back end of said casing, and a solid fuel positioned in the central section of said casing, said solid fuel having a longitudinal passageway extending therethrough, spaced portions of which are constricted by projections of said fuel extending into said passageway normal to the direction of flow therethrough.

9. A rocket motor as claimed in claim 8 wherein said elongated casing is of circular cross-sectional configuration.

10. A rocket motor as claimed in claim 9 wherein the projections extending into the passageway are of annular configuration.

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