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GLOW PLUG IGNITER STRUCTURE

Filed Jan. 31, 1952

2 Sheets-Sheet 1

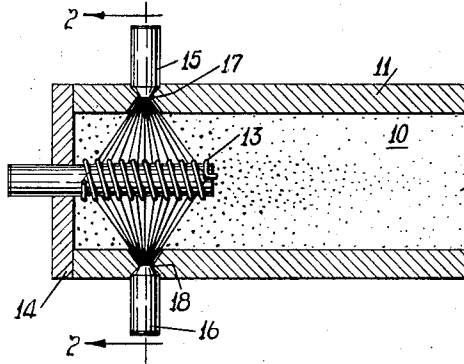


Fig. 1

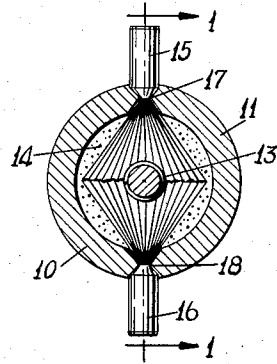


Fig. 2

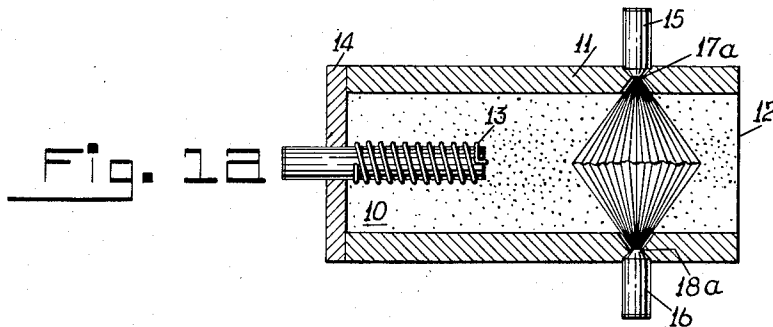
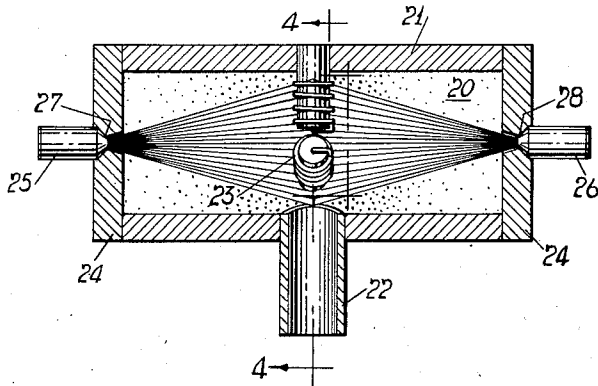
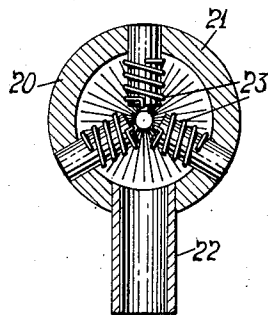


Fig. 3

Fig. 4



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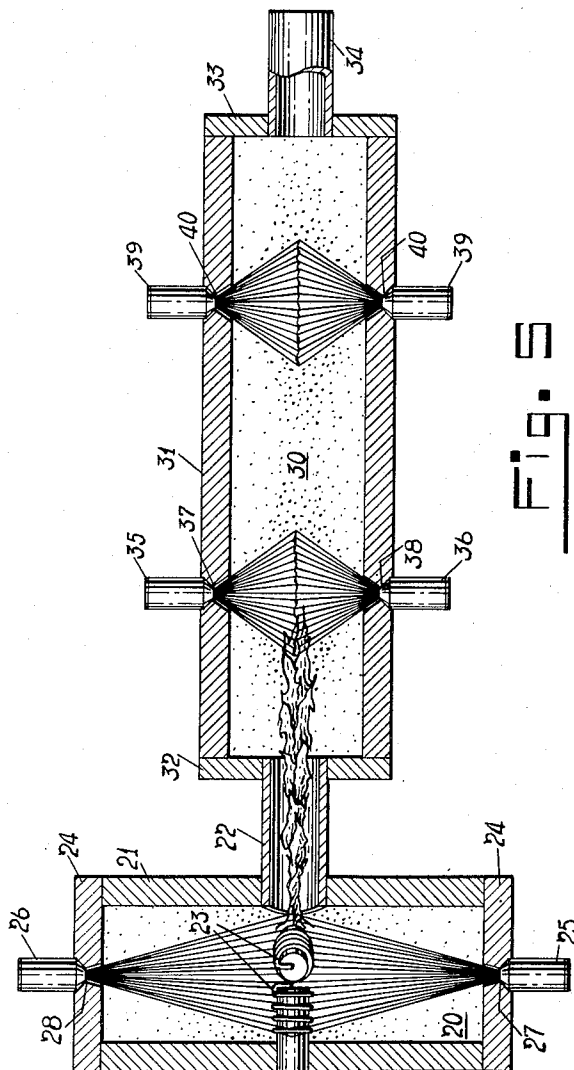


Fig. 5

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2 Claims. (Cl. 60—39.82)

This invention relates to the combustion apparatus in a jet propulsion or similar device, and more particularly is directed to a structure which ignites a mixture of two or more fluid propellant components, the resultant flame being used to start a reaction in the combustion chamber of a jet propulsion or similar device.

It is an object of this invention to provide an improved means for igniting a mixture of two or more fluid propellant components.

It is another object of this invention to provide an improved igniter structure whereby an ignition flame is secured without undue wear resulting thereto.

It is a further object to apply the means for igniting mixed fluid propellant components to the start of the combustion process in a jet propulsion or similar device.

Another further object of this invention is to apply a means for ignition to the combustion of non-hypergolic propellant components, e. g. oxidizer and fuel, in rocket thrust cylinders and the like.

These and other objects and advantages of this invention will become apparent from a reading of the following description of preferred embodiments thereof as illustrated in the accompanying drawings in which:

Fig. 1 is a partly cross sectional view of a general form of an igniter structure, taken along line 1—1 of Fig. 2.

Fig. 1a is a similar cross sectional view of a modification of the general form of igniter structure disclosed in Fig. 1.

Fig. 2 is a sectional view taken along the lines 2—2 of Fig. 1.

Fig. 3 is a view, similar to that of Fig. 1, of a preferred form of igniter structure.

Fig. 4 is a sectional view taken along line 4—4 of Fig. 3.

Fig. 5 is a diagram showing the application of the igniter structure of Fig. 3 to a gas generating device.

Referring to the drawings, the embodiment of the invention as illustrated in Fig. 1, discloses an igniter structure 10, consisting of a tubular body 11, of substantial cylindrical shape, with an open end 12, and a heating element 13, mounted at the center of the opposite closed end 14. The heating element can be a conventional type, electrically operated glow plug, consisting of either platinum or nichrome wires, which may or may not be supported on a ceramic core. Also the wires may be enclosed in a metal or ceramic jacket. The use of a common spark plug is not proscribed in this igniter structure.

At 15 and 16 are disclosed oppositely spaced injectors for the admission of fluid propellant components (e. g. oxidizer and fuel respectively), which are inserted in undercut orifices 17 and 18, in the wall of the tubular body adjacent the heating element 13, and directed at right angles toward it. The propellant components can be admitted either in the form of a hollow cone, atomizing spray or as a stream, and generally are nitric acid as the oxidizer and either a hydrocarbon or ammonia as the

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fuel. The depth of the undercut of the orifices 17 and 18 is limited, so that the injection of the propellant components is not adversely affected, yet there is sufficient protection from the heat of combustion to prevent overheating of the injector tips.

In Fig. 1, the injected propellant components are disclosed directed against the heating element. In the event that hollow cone, atomizing spray injection is used, contact of the propellant components with the heating element is made adjacent the locus of contact of the opposed spray cones and, depending on the dimensions of the cones and length of heating element, either along one or two curves of intersection. When stream injection is used, the injectors can be directed at the heating element for a splash and spray effect from the impingement of the streams therewith or they may be aimed to provide the same effect by contact of opposed streams away from the heating element. Furthermore, the injectors can be located so that the propellant component sprays or streams impinge on each other downstream of the heating element as shown in Fig. 1a, the injectors 15, 16, being inserted in downstream located undercut orifices 17a and 18a.

In the modification illustrated in Figs. 3 and 4, an igniter structure is disclosed at 20, consisting of a cylindrical body 21, an outlet or exit nozzle 22, and a plurality of equally spaced heating elements 23 (for purposes of illustration, three are shown), inserted radially into the chamber defined by the cylindrical body and the closed ends 24, at the center of which, injectors 25 and 26 are inserted in undercut orifices 27 and 28, for the respective admission of the fluid propellant components of oxidizer and fuel (e. g. nitric acid and a hydrocarbon such as gasoline). These injectors may be either the hollow cone, atomizing spray type or the stream type and are directed so that the loci of the impingements of the cone sprays or streams are in the vicinity of the mid-points of the radially inserted heating elements.

In this manner, the portions of the heating elements on either side of the loci of propellant component impingements are not exposed to the injected fluids and provide hot surfaces for starting the ignition of the spray resulting from the collision of the injected propellant components. Even though impingement of fluids on the heating elements will provide a cooling effect, by striking the elements, the fluids will splash and spray so that the overall tendency is for the resulting intermixture to vaporize. With a plurality of heating elements or hot surfaces in a single igniter structure, any one of them is capable of starting the required ignition, because only a very small fraction of the total of the propellant components injected enter into the initial ignition.

The means for mixing the injected fluid propellant components on or in the vicinity of the heating elements provides an ignitable mixture of propellant components at the most favorable location for ignition, while the mixing of the total injected flow provides an ignitable mass for sustaining the combustion after start of the ignition at any of the heating elements.

Fig. 5 discloses a specific application of the preferred form of igniter structure, disclosed in Figs. 3 and 4, to a gas generator 30. (A combustion chamber of a jet propulsion device is just as pertinent for an illustration.) The gas generator has a generally cylindrical body wall 31, and end wall 32, on which the igniter structure is mounted and opposite end wall 33, with outlet 34 mounted thereon. Oxidizer and fuel injectors are shown respectively at 35 and 36, inserted through undercut orifices 37 and 38 and so located that the injected components are in the path of the flame from the igniter structure.

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In those cases where a high performance mixture ratio is maintained adjacent this injection stage, a stable flame at elevated temperatures is obtained so that it becomes possible to inject excess fuel which takes part in the chemical reaction of combustion, with the result that there is a stable operation at a predetermined temperature over the entire gas generator unit. The excess fuel is admitted by injectors 39 inserted through undercut orifices 40 and the quantity can be varied so that the exit gas temperatures are controlled over a wide range of reproducible limits. In this manner, the initial flame from the igniter structure may be increased into a flame of any size desired.

Although many changes can be made in the disclosed apparatus without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not limitative.

What is claimed is:

1. An igniter structure for the initiation of the combustion of a plurality of fluid propellant components comprising a hollow substantially cylindrical body hav-

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ing closed ends and an outlet opening intermediate said ends; means mounted on said ends for admitting fluid propellant components into said body, means for igniting said components comprising a heating element, said first mentioned means being arranged in opposed relationship and located for contact of the admitted components to occur at the approximate mid-point of said last mentioned means.

2. The combination of elements as set out in claim 1 where in said last mentioned means comprise a plurality of equally spaced glow plugs, inserted radially into said body substantially intermediate the ends thereof.

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