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IGNITER

Filed Jan. 12, 1959

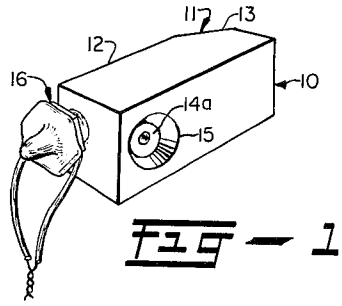



Fig — 1

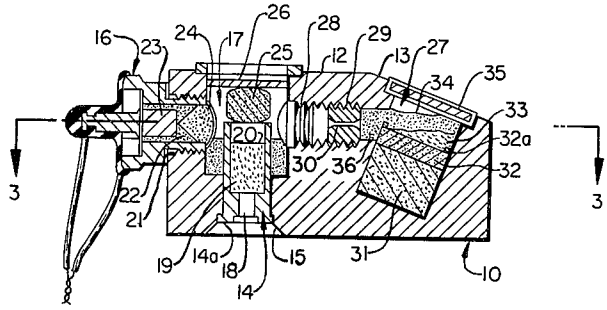



Fig — 2

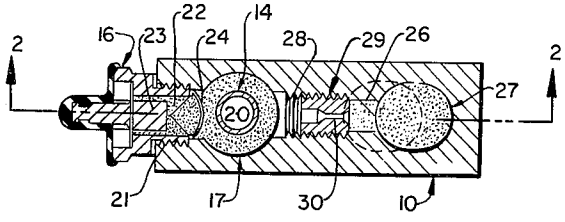



Fig — 3

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# 3,054,351
# IGNITER

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13 Claims. (Cl. 102—70)

The present invention relates generally to ignition means for equipment operated by a charge of propellant, and particularly to apparatus such as flame throwers or liquid fuel rockets or the like in which a portion of the fuel is fed into a flame cone under pressure and ignited therein to effect ignition of the main stream of fuel.

The invention will be hereinafter described with relation to the flame thrower generally described in copending patent application Serial No. 786,350, filed January 12, 1959, and the gas generator specifically described in the same application, to which copending applications reference may be made for information on parts having cooperative relation to the ignition means to which the present invention specifically relates.

In the flame thrower for use with which the igniter of this invention is particularly adapted, the fuel tank is pressurized by a gas generator containing a charge or grain of solid propellant, and the nozzle from which the pressurized fuel is projected in a rod-like stream is positioned adjacent the gas generator.

The issuing stream of fuel requires ignition for which purpose the nozzle is arranged within a flame cone or combustion chamber into which a small secondary jet of fuel is sprayed. The combustion of the secondary jet is initiated by the ignition means, and is thereafter supported by air flowing into the flame cone.

It is therefore the principal object of the present invention to provide a novel method of and improved means for ignition of a pressurized liquid fuel stream.

Another object of this invention is to provide a novel method of and improved means for dual ignition from a single source of separate and individual gas generating means.

And another object is to provide a novel method of and improved means for ignition from a single source of a pressurizing charge of propellant and a stream of fluid expelled by the pressure generated therefrom.

With the above objects in view and further objects and features of the invention which will hereinafter appear from the following specification read with reference to the accompanying illustrative drawings, the invention comprises an igniter device containing a pair of chambers one of which is charged with pyrotechnic material developing sufficiently intense heat when ignited to cause the propellant grain to start burning to generate a sufficient volume of gas at a pressure capable of pressurizing a tank of fuel to expel a rod-like stream of fuel from a nozzle. The other chamber is charged with an incendiary oxidizing combustible mixture furnishing flame for a length of time sufficient to cause ignition of a spray of fuel bled into a flame cone surrounding a nozzle arranged in a flame cone to ignite the surface of said fuel rod in the flame cone. The chambers are connected by a fine aperture which is effective to cause ignition of the material in the second chamber without passing sufficient gas from the first chamber to cause smothering of the flame in the flame cone or disruption of the stream of fuel.

In the drawings:

FIG. 1 is a perspective view of the igniter device of this invention.

FIG. 2 is a section on the line 2—2 in FIG. 3.

FIG. 3 is a section on the line 3—3 in FIG. 2.

Referring now to FIG. 1, the igniter, indicated by the



numeral 10, comprises a rectangular steel block having one corner 11 angled off.

A first chamber containing a pyrotechnic material together with means for initiating the combustion thereof opens into the face 12. This acts to ignite the grain in a gas generator containing a solid propellant (not shown). A second chamber containing an incendiary oxidizing combustible mixture opens into angled face 13, serving to ignite the jet of fuel sprayed into the flame cone (not shown).

The pyrotechnic materials in the first chamber may be ignited by a conventional black powder cartridge 14, the base 14*a* of which is shown mounted in a flared opening 15 serving to receive the head of a hollow clamping screw (not shown) by which the igniter is positioned in a stirrup projecting from the base of the gas generating chamber and through which the firing pin of a trigger device extends. The flame of the ignited pyrotechnic material in the first chamber is directed against the grain to furnish sufficient heat to cause the grain of propellant to start burning after which it will generate the temperature and pressure to continue burning until completely consumed.

The material in the first chamber may be ignited alternatively by the glow plug indicated at 16.

As shown in FIG. 2, the first chamber comprises a bore 17 which is narrowed to closely fit the base 14*a* of the blank cartridge 14 which is fired by the percussion cap 18 in the base, which ignites the charge of black powder 19 in the cartridge case. The surface of the powder is covered by a film 20 of "Mylar," a polyester plastic film produced by the Du Pont Company, or other suitable material to retain the powder in place.

An opening 21 in which the glow plug 16 is mounted is also filled with black powder 22 into which the heating filaments 23 of the plug extend and the inner end of the opening is covered with a thin film of highly inflammable cement 24 consisting of a mixture of cellulose nitrate and black powder in an acetone solvent.

A pellet 25 of pyrotechnic material consisting of powdered aluminum and ammonium perchlorate, is secured in position on the end of the cartridge by a nitrocellulose adhesive and the open end of the first chamber beyond the pellet 25 is closed by a waterproof plastic closure 26. The whole of the space in the first chamber except that shut off by the films of inflammable material is filled with powdered aluminum and ammonium perchlorate which, though not easy to ignite, produces high temperatures when burnt. The purpose of the pellet 25 is to prolong the period of combustion in chamber 17 to ensure ignition of the grain of propellant contained in the gas generator. Other pyrotechnic materials such as thermit or the like may be used.

The second chamber 27 is connected to the first chamber 17 by a passage 28 which is threaded for a portion of its length, and a threaded plug 29 is screwed into the passageway. Plug 29 is axially drilled with a fine hole 30, the diameter of the hole being important since it should be plugged as soon as the inflammable material placed in the second chamber has been ignited by flame or white hot gas from the combustion of the material in the first chamber 17. A plug of copper drilled with a No. 80 drill which has a diameter of .0135" works well.

The use of a drilled removable plug has the advantage of enabling different sized passages to be provided to suit different materials.

The second chamber 27 is formed as a bore extending in from the sloped face 13. An incendiary pellet 31 of cylindrical shape is positioned on the bottom of the chamber, a starter pellet 32 being preferably placed above it and the two elements held in place by a snap ring 32*a* and a layer of starter paste 33, leaving a space 34 com-

municating with passageway 28. The opening of chamber 27 in the side 13 is closed by a frangible cover or closure 35 and the space in the passage and above the starter paste 33 is packed with black powder 36.

The cylindrical incendiary pellet 31, starter pellet 32 and starter paste 33 may be composed of an incendiary oxidizing combustible mixture such as, for example, cellulose nitrate and black powder in acetone solvent. Alternatively, a pyrotechnic type material may be employed. The apparatus of the present invention is particularly adapted to employ within the second chamber 27 a solid propellant having a higher temperature of burning than the pyrotechnic material by virtue of provision of means to close the second chamber 27, raising the pressure therein to ensure continued burning. As used herein a solid propellant material shall be understood to mean generally a mixture of an organic resin binder material acting as a fuel, combined with an inorganic oxidizing salt.

The closures 26 and 35 are destroyed immediately on the activation of the igniter but until that time ensure that the igniter materials are protected from dampness.

*Operation*

When it is desired to cause operation of the igniter an electrical contact is closed sending current through the fine wires 23 of the plug 16 and making them red hot, thus igniting the black powder in which the wires are embedded, destroying closure 24 and igniting the inflammable powder in chamber 17, thus generating a sufficient degree of heat to cause the pyrotechnic pellet 25 to burn, the heat and pressure destroying seal 26 and providing the conditions required to start combustion of the propellant grain notwithstanding a slight loss of pressure through the small aperture communicating with the second chamber of the igniter.

It it is preferred to initiate operation manually, the percussion cap 18 is fired and the black powder in the blank cartridge 14 is ignited and the above-described sequence of events takes place.

The incendiary oxidizing combustible mixture in the chamber 27 burns vigorously with a long tongue of flame momentarily but no high pressure rush of gas into chamber 27 due to the pressure of the burning grain takes place since the small diameter of the passage between the chambers of the igniter acts to both throttle the pressure and reduce the temperature of the fine stream of gas.

In actual practice it was found that the small diameter hole 30 became clogged very quickly and that combustion of the auxiliary fuel around the nozzle took place under steady conditions after initiation thereof by the igniter.

A preferred embodiment has been specifically described and shown by way of illustration only and not as limitative of the invention since various modifications in the described embodiment may be made by those skilled in the art without departing from the scope of the invention as defined by the appended claims.

We claim:

1. A dual purpose igniter comprising: an igniter body provided with a first and a second chamber communicating with the surface of the body; a charge of gunpowder positioned in said first chamber together with a charge of loose powdered aluminum with potassium perchlorate; a diaphragm within said first chamber separating said gunpowder from the powdered aluminum with potassium perchlorate; a pellet of compressed powdered aluminum and potassium perchlorate positioned in the loose powdered aluminum with potassium perchlorate to be ignited by the combustion thereof and prolong the flame of said combustion; said igniter body having a first port directing the products of combustion in the first chamber; said igniter body having a restricted passageway means leading products of combustion from the first chamber to said second chamber and adapted to be clogged by the products of combustion; a charge of an incendiary oxidizing combustible mixture positioned in the second chamber; said igniter body having a second port directing the flame issuing from the second chamber when the material therein is ignited; a diaphragm of rupturable material closing said first port until destroyed by the combustion of material in the first chamber; and means for igniting the gunpowder within the first chamber.

2. Apparatus as in claim 1 wherein said incendiary oxiding combustible material comprises a cellulose nitrate and black powder in acetone solvent.

3. Apparatus as in claim 1 wherein said incendiary oxidizing combustible material comprises a pyrotechnic mixture.

4. Apparatus as in claim 1 wherein said incendiary oxidizing combustible material comprises a solid propellant material.

5. A dual purpose igniter as set forth in claim 1 in which said igniting means comprise: a percussion cap fitted in the base of a cartridge containing gunpowder extending into the first chamber; and an opening in a wall of the first chamber in which said base of said cartridge is mounted in pressure-tight relation therewith.

6. A dual purpose igniter as set forth in claim 1 in which said igniting means comprise: a glow plug mounted in a passage leading from the surface of said body to said first chamber and in pressure-tight relation with said passage; and a charge of gunpowder in said passage between the glow plug and the inner end of said passage.

7. A dual purpose igniter as set forth in claim 1 in which said igniting means comprise: a percussion cap fitted in the base of a cartridge containing gunpowder extending into the first chamber; and said first chamber having an opening therein in which said base of said cartridge is mounted in pressure-tight relation therewith; a glow plug mounted in a passage leading from the surface of said body to said first chamber and in pressure-tight relation with said passage; and a charge of gunpowder in said passage between the glow plug and the inner end of said passage.

8. A dual purpose igniter comprising: an igniter body provided with a first and a second chamber communicating with the surface of the body; a charge of pyrotechnic material positioned in said first chamber and adapted to produce an intense flame when ignited to ignite said charge of propellant; said igniter body having a restricted passage of such a size to be clogged by the passage of products of combustion connecting the first and second chambers; a charge of gunpowder positioned in said second chamber to be ignited by products of combustion from said first chamber; a cohesive layer of pyrotechnic material contacting said charge of loose gunpowder and positioned above and adhered to a charge of incendiary oxidizing combustible mixture positioned between said layer of pyrotechnic material and the bottom of said second chamber, said incendiary charge being effective to provide a large volume of flaming gas at low pressure; means for holding said layer of pyrotechnic material in place in said second chamber; a port in the surface of the igniter body directing the flaming gas generated by said incendiary material in the second chamber; a closure for said port disrupted by the ignition of the loose gunpowder positioned between the closure and the layer of pyrotechnic material; and means for igniting the pyrotechnic material in the first chamber.

9. A dual purpose igniter as set forth in claim 8 and in which said means for holding said layer of pyrotechnic material in the second chamber and incendiary oxidizing combustible mixture in place comprises a snap ring engaging with the periphery of the chamber and bearing against the upper edge of said cohesive layer of pyrotechnic material.

10. A dual purpose igniter as set forth in claim 8 and in which said cohesive layer of pyrotechnic material posi-

tioned in the second chamber is formed from a paste consisting of cellulose nitrate and gunpowder with an acetone solvent mixture, and a quantity of the paste form of the material is positioned in contact with the cohesive layer of the pyrotechnic material and with the gunpowder.

11. A dual purpose igniter as set forth in claim 8 and in which said charge of pyrotechnic material is thermit.

12. An igniter comprising a block having a first chamber and a second chamber separated from each other within the block, each of said chambers communicating separately with the exterior of said block, a pyrotechnic material in said first chamber and a combustible material in said second chamber, means for igniting said pyrotechnic material to cause flame to leap from said first chamber to the exterior of said block and a duct interconnecting said chambers within the block, said duct comprising a passageway of sufficiently large cross section to enable heat and soot from the first chamber to pass through it to the second chamber to ignite the combustible material in said second chamber, but sufficiently small to become clogged by said soot after the combustible material ignites, whereby a tongue of flame extends from said second chamber to the exterior of said block.



13. An igniter according to claim 12 in which a plug is situated in said duct and said passageway is a hole through the plug.

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