

May 14, 1963

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3,089,418

GAS GENERATOR FOR GUIDED MISSILES

Filed Nov. 2, 1960

2 Sheets-Sheet 1

Fig. 1

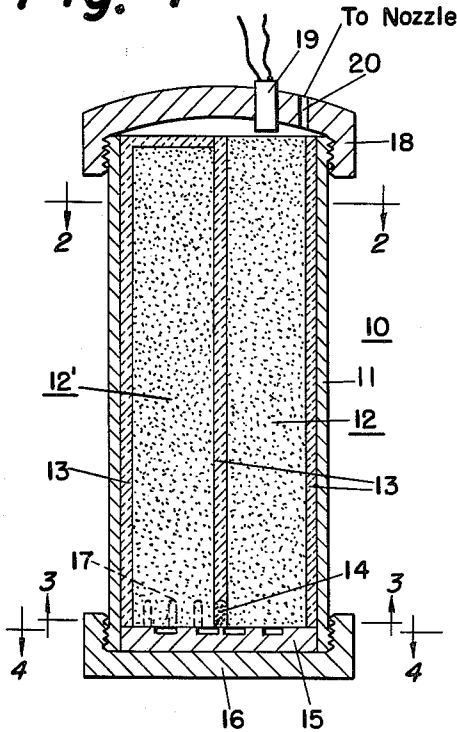


Fig. 2

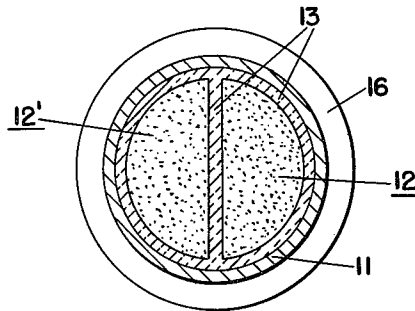


Fig. 4

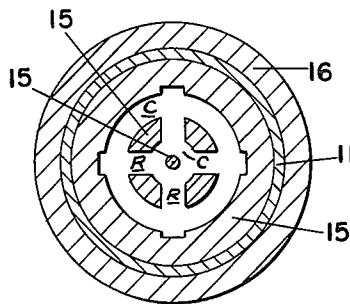
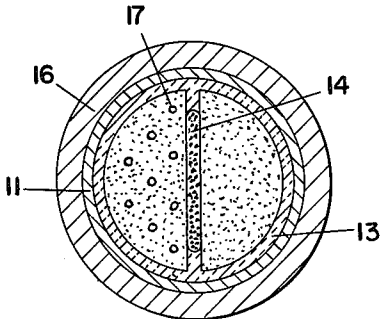


Fig. 3



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Fig. 5

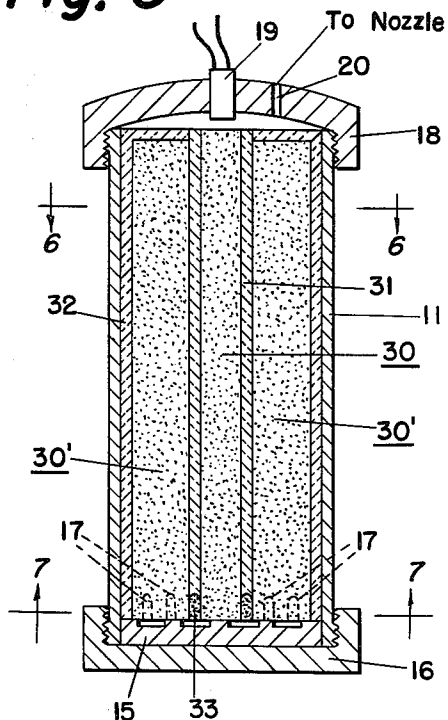


Fig. 6

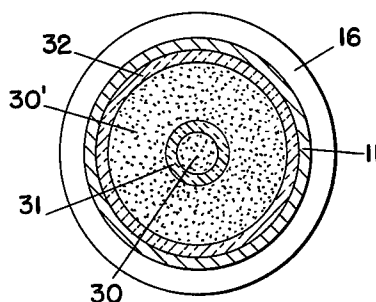
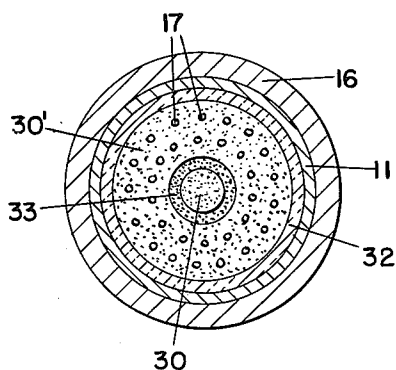


Fig. 7



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GAS GENERATOR FOR GUIDED MISSILES
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3 Claims. (Cl. 102-39)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention relates to gas generators and more particularly concerns solid propellant gas generators for use in missiles and the like.

Constant improvements in the propulsion systems of low altitude anti-aircraft guided missiles, such, for example, as the Hawk missile, have resulted in flight times extending beyond those for which these missiles were originally designed. These increased flight times have necessitated the requirement of additional auxiliary electric power to the missiles while in flight.

The simplest approach to extending the operating time of the electric power unit of these missiles would appear to involve increasing the length of the propellant charge. Space limitations, however, are critical in missiles and such an approach would be prohibitive if the missile length is to remain unaltered.

Another approach involves reducing the burning rate of the fuel or propellant to effect a longer burning time, and thus gas production over a longer interval of time would be effective to turn the turbines or alternator for supplying auxiliary electric power to the missile. The adoption of this approach appears presently unfeasible since, although there are a limited number of slow burning propellant compositions, none have been found as yet which possess the desired properties for gas generator operation in accordance with the instant invention. For example, such propellants did not have the required temperature sensitivity of performance, or burned at a low flame temperature, etc.

It is therefore a broad object of the invention to provide a gas generator suitable for use in guided missiles.

Another object of the invention is to provide a solid propellant gas generator for use in guided missiles wherein extended or prolonged operating times are effected without invading the length limitations allocated thereto.

A still further object of the invention is to provide a gas generator of the solid propellant type which is compact, inexpensive and easily fabricated and yet sufficiently productive of gas at desired pressures for guided missile use in extended flight.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures and wherein:

FIG. 1 shows an elevational view, in vertical section, of an embodiment of the invention;

FIGS. 2, 3 and 4 are sectional views taken along lines 2-2, 3-3 and 4-4 respectively of FIG. 1;

FIG. 5 is a sectional elevation of another embodiment of the invention; and

FIGS. 6 and 7 show sections of the device along lines 6-6 and 7-7 respectively of FIG. 5 looking in the direction of the arrows.

Very briefly, the aforementioned objects are accomplished by juxtaposing two insulated end-burning propellant sticks in such fashion that a "crossover" element

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is permitted to sequentially burn the propellants with generally constant gas production. Optionally, the propellant charges may be concentrically mounted with insulation therebetween and then sequentially burned to produce a constant flow of gas by means of the identical crossover piece.

Referring now to the drawings, and more particularly to FIG. 1 thereof, a gas generator is shown at 10 and comprises an open-ended cylindrical casing 11 having aligned therewithin solid propellant charges 12 and 12' of a configuration as shown in FIG. 2. The propellants may suitably partake of the well-known nitrocellulose-nitroglycerine type although various other known solid propellants may be herein employed in the practice of the invention. The charges 12 and 12' are separated from each other and from the casing 11 by an insulator 13, which may be, for example, a phenolic-nylon-asbestos. Other materials offering good resistance to temperatures within the range of about 2000-3000° F. have been found to operate equally satisfactory. That portion of the insulator 13 which separates the propellant charges is provided adjacent one end by an igniting charge 14 which consists of a mixture of zirconium-lead dioxide, or materials such as black powder may be employed advantageously. A refractory metal or ceramic disc 15, as shown in FIG. 4 of the drawings, contacts the igniting charge 14 and the ends of propellant charges 12 and 12', while a closure member 16 embraces the disc 15 and is screw-threadedly mounted to casing 11, thus insuring a gas-tight seal at this end of the generator. Disc 15 is provided with a plurality of interconnected radial passageways R which communicate with a pair of circular or concentric passageways C to afford a positive mode of travel for the hot gases evolved when propellant 12 has almost completely burned out as will be explained more fully below. The propellant 12' is illustrated as having bores 17 adjacent its disc end to provide increased burning surface area thereat when crossover from propellant 12 to propellant 12' occurs and thus yielding a generally constant gas production throughout.

I have found that the depth of penetration of bores 17 may conveniently be about 1/8 inch but this figure will vary slightly in accordance with the propellant selected. It is to be understood that the invention is not intended to be limited to bores, but that slots, grooves, and the like, may be optionally employed for increasing the surface area.

The other end of casing 11 has a cap 18 threaded thereto but additionally carries a conventional igniter 19 and has disposed therewithin a nozzle outlet 20. Igniter 19 is connected to any suitable source of direct current (not shown) while the nozzle outlet articulates with a nozzle, also not shown.

In the operation of my inventive gas generator, the propellant 12 is ignited at its exposed surface by means of igniter 19. The propellant 12 is caused to end burn, i.e., to burn generally uniformly along the entire length of the charge, and to this end, an inhibitor may be applied to the lateral surfaces thereof prior to placing the propellants within the casing. Cellulose acetate or polyester resins have been found to work admirably well, although other inhibitors may be used advantageously. The gases produced by the combustion of propellant 12 are, for the most part, exited through the nozzle outlet 20. However, when end-burning of propellant 12 has proceeded sufficiently to ignite charge 14, a portion of the hot gases resulting from combustion of these charges will travel the passageways R and C of disc 15, and, being under pressure, will function to start combustion of propellant charge 12' before propellant 12 is completely consumed. The preburning of charge 12' before charge 12 has been completely burned is necessary in order to compensate for any dimi-

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nution of gases which would result if propellant 12 were allowed to become expended before propellant 12' started to burn. Therefore, the crossover piece or disc 15 and bores 17 of propellant 12' permit uninterrupted sequential burning of the propellants and a generally constant gas pressure at nozzle outlet 20. The cross-sectional area of the passageway R and C is made slightly larger than the cross-sectional area of nozzle outlet 20 to preclude the passageways from functioning as a nozzle.

In the modification shown in FIG. 5, concentrically mounted solid propellant charges 30 and 30' have an insulator 31 disposed therebetween while the outer propellant 30' and casing 11 are separated by insulator 32. Insulator 31 is provided at its disc end with an annular igniting charge 33 functioning similarly to charge 14 of FIGS. 1 and 3. The crossover element or disc 15 is equally effective with the device of FIG. 1 or FIG. 5.

It will thus be seen that there has been provided by my invention a unitary gas generator for guided missiles which comprises a simple structure and requiring no expensive parts or fabrication techniques. Further, it is apparent that my gas generator is usable with a wide variety of solid propellants, insulators and inhibitors. Its most unique advantage however resides in its ability to operate over extended periods of time and yet occupying no additional length than heretofore solid propellant gas generators.

I claim:

1. A compact gas generator comprising a generally similar first and second discontinuous and separate solid propellant for powering a turbine and the like in a missile system wherein the propellants are inclosed in a casing having an upper end and a lower end, a first igniter at said

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upper end for initial ignition of the first propellant, said propellants being in adjacent parallel relation to each other and having coplanar ends, thermal insulation between said propellants, a second igniter adjacent a lowermost portion of said insulation and contacting each of said propellants, a crossover member at the lower end of said casing in contact with said second igniter and propellants, said second propellant having a plurality of spaced bores in its end adjacent the crossover member, said crossover member being devoid of any propellant therein and containing a series of passageways solely for passage of hot gases therethrough, said passageways communicating between said second igniter and propellants and means adjacent said first igniter for exiting a constant flow of gases upon the separate and sequential burning of the propellants.

2. The device of claim 1 further characterized by said propellants being elongate and generally semicircular in cross section and disposed within said casing in opposed face-to-face relation.

3. The device of claim 1 wherein said first propellant is concentrically disposed in said second propellant and said second propellant is thermally insulated from said casing.

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