United States Patent

[11] **3,570,766**

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[21] Appl. No. **791,528**
[22] Filed **Jan. 15, 1969**
[45] Patented **Mar. 16, 1971**
[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **INTEGRAL PLUG AND STRUT NOZZLE**
2 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **239/265.11,** 239/601
[51] **Int. Cl.** **B64d 33/04**
[50] **Field of Search** 60/263, 271; 239/265.11, 265.15, 422, 428, 433, 601

[56] **References Cited**

UNITED STATES PATENTS

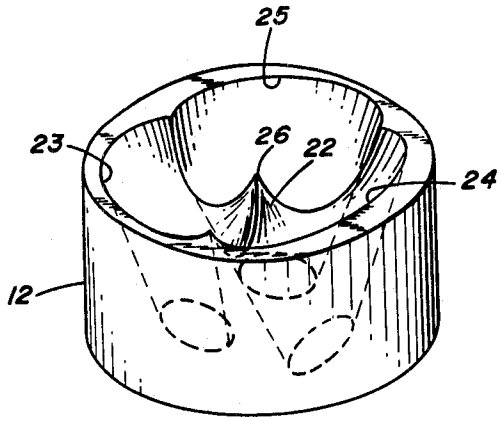
2,755,620	7/1956	Gillot	60/263X
2,875,577	3/1959	Odenkirchen	60/271X
3,245,620	4/1966	McEwen	239/265.15X
3,300,142	1/1967	Brown	239/265.15
3,343,766	9/1967	Biehl et al.	239/265.11X
3,292,865	12/1966	Short et al.	239/265.25

FOREIGN PATENTS

636,026	1/1928	France	60/263

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ABSTRACT: A one-piece exhaust nozzle for rocket motors. It is substantially cylindrical with three funneled inlet holes at its forward end, blending into a single opening at the aft end. A center body, pyramid shaped, forms a contoured inner wall for the nozzle which has a constantly expanding exhaust area.



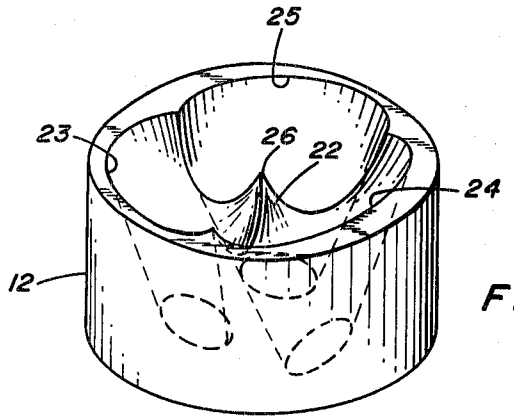


FIG. 1

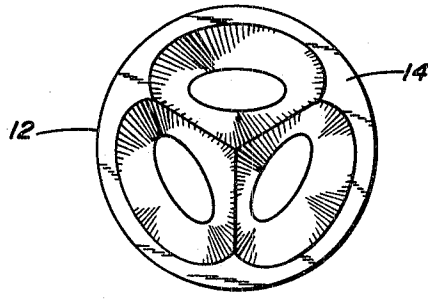


FIG. 2

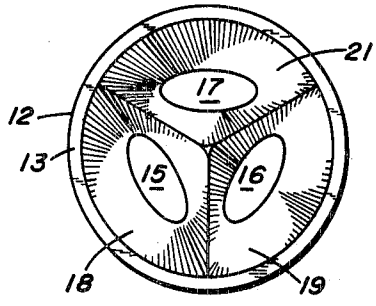


FIG. 3

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INTEGRAL PLUG AND STRUT NOZZLE

STATEMENT OF GOVERNMENT INTEREST

The invention defined herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the invention

This invention relates to a plug exhaust nozzle for a rocket motor and more particularly to a nozzle where the exhaust gases are received through three inlets and are recombined in the downstream flow and discharged through a single aft opening.

2. Description of Prior Art

Heretofore annular exhaust nozzles have been formed of an outer body and a center body, with the center body supported by crossbars or tripodlike arms. These supports interfere with the flow of gases and form crosscurrents in the exhaust which reduce the efficiency of the motor. The inner contour of the nozzle is formed by inserts which makes for leakage of exhaust gases and, by edge interference of these inserts, causes cross-currents in the flow.

SUMMARY OF THE INVENTION

A nozzle made in one piece, where the expansion of the gases is controlled so that the explosion ratio to nozzle length is a forward step. The integral molded nozzle is without the possibility of gas leakage, while the form of intersecting elliptical cones reduces the turbulence and provides greater efficiency.

An object of the present invention is to provide an exhaust nozzle formed in one piece.

Another object of the present invention is to provide an exhaust nozzle having a contoured inner and outer wall, integral, of substantially cylindrical form and so controlling the flow of gases as to prevent any leak path and provide a high thrust.

It is another object of the present invention to provide an integral plug and strut nozzle, which for low temperature propellants, could be molded from a carbon molding compound.

It is still another object of the present invention to provide an integral plug and strut nozzle which may be manufactured at a comparatively low cost.

It is still another object of the present invention to provide an integral plug and strut nozzle which will provide the highest expansion ratios with the shortest length.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated in the accompanying drawing in which:

FIG. **1** is a perspective view of the plug and strut nozzle;

FIG. **2** is a view looking at the aft end of the nozzle; and

FIG. **3** is a view looking at the forward end of the nozzle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings wherein like parts are designated by like numbers, the integral plug and strut nozzle has a cylindrical outer wall **12**, a forward rim **13** and an aft rim **14**.

The forward end of the nozzle receives the exhaust gases from the motor and divides these gases to pass the gases through individual distinct throats **15**, **16** and **17**. Sloping sidewalls **18**, **19** and **21**, respectively, on the approach side of the throats funnel the gases into the throats. The strut or center body **22** is shaped to recombine the exhaust gases coming through the different throats with the least turbulence. Gas flow from subsonic to supersonic is only disturbed to the extent of flow over an airfoil. The shape of the entire body is that of elliptical cones intersecting and forming at their juncture, a strut or center body, the sides of which are shaped to provide an airfoil construction over which the gases flow.

The aft end of the nozzle is as though a plane was passed through the intersecting cones, together with the strut at a point beyond the apex of the strut. The arcs of the side of the cones **23**, **24** and **25** serve as the outer extremity of the outer wall of the nozzle, while the slopes of the strut or center body forms the inner wall of the nozzle and as these slopes terminate in the apex **26**, the gases are progressively expanded in the shortest possible length of nozzle.

The integral plug and strut nozzle of the present invention has many advantages over the annular nozzle in use at present. It is less expensive to manufacture. The thrust coefficient proves its high efficiency. There is the highest expansion ratio in the shortest length, the short length allowing a greater length of gain and a consequent greater or longer flight of missile. For low pressure and/or low temperature propellants, the entire nozzle could be molded out of good graphite or carbon molding compound.

I claim:

1. An integral exhaust nozzle for a rocket motor having a cylindrical outer shape, three inlet openings formed in the forward end of said nozzle to receive exhaust gases from said rocket motor, three separate cone-shaped passages extending from said inlet openings and intersecting to form a single terminal outlet in the aft end of said nozzle where the exhaust gases are recombined, and a substantially pyramid-shaped center body formed by the intersection of said three cone-shaped passages.

2. An integral exhaust nozzle for a rocket motor according to claim **1** wherein the cones are elliptical.