

Jan. 11, 1966

G. K. OSS

3,228,334

BONDLESS "HIGH PERFORMANCE" ROCKET NOZZLE CLOSURE

Filed Feb. 12, 1964

2 Sheets-Sheet 1

FIG. 1

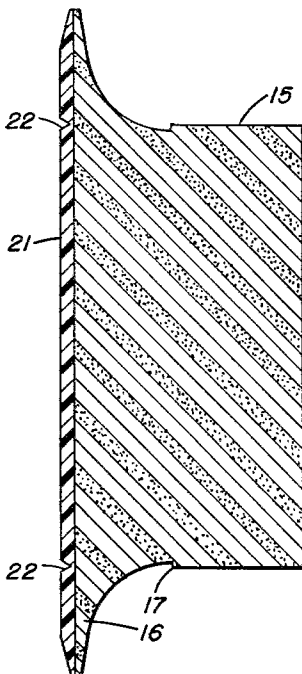
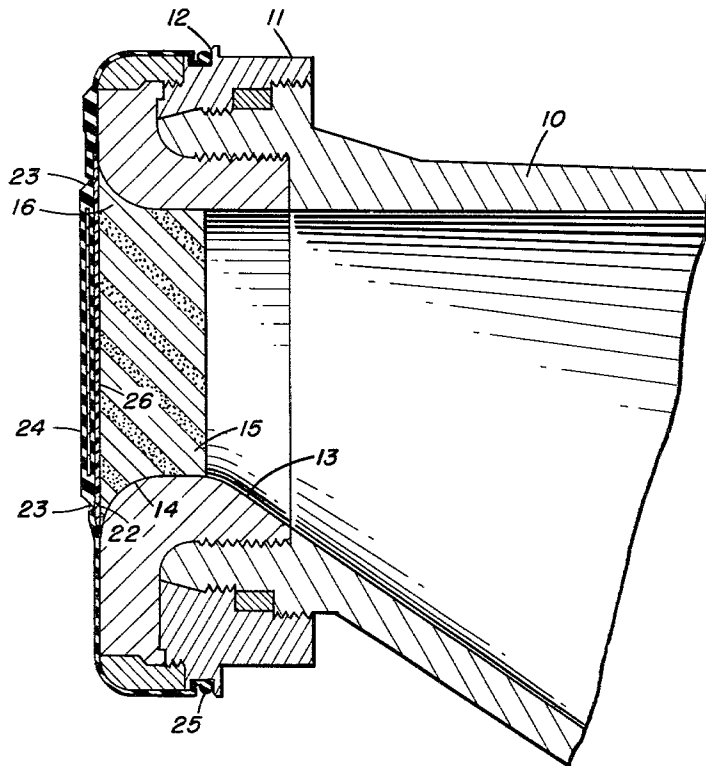


FIG. 2

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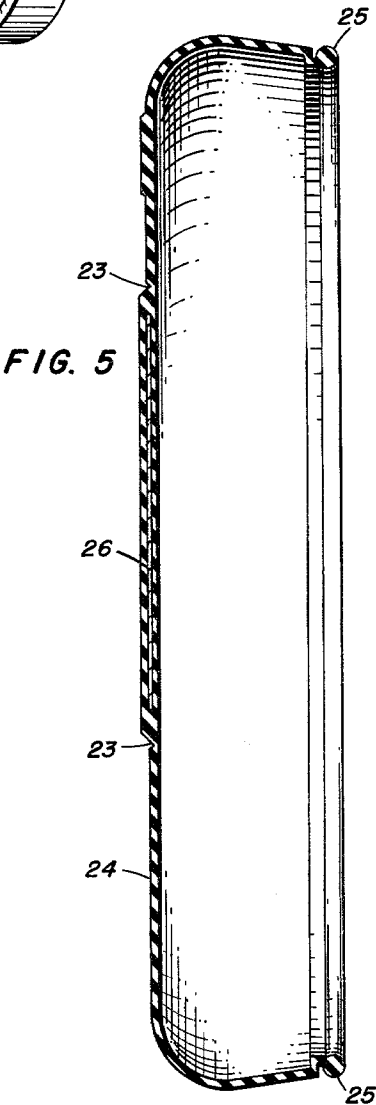
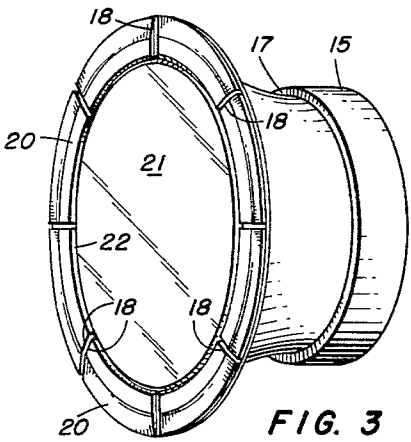
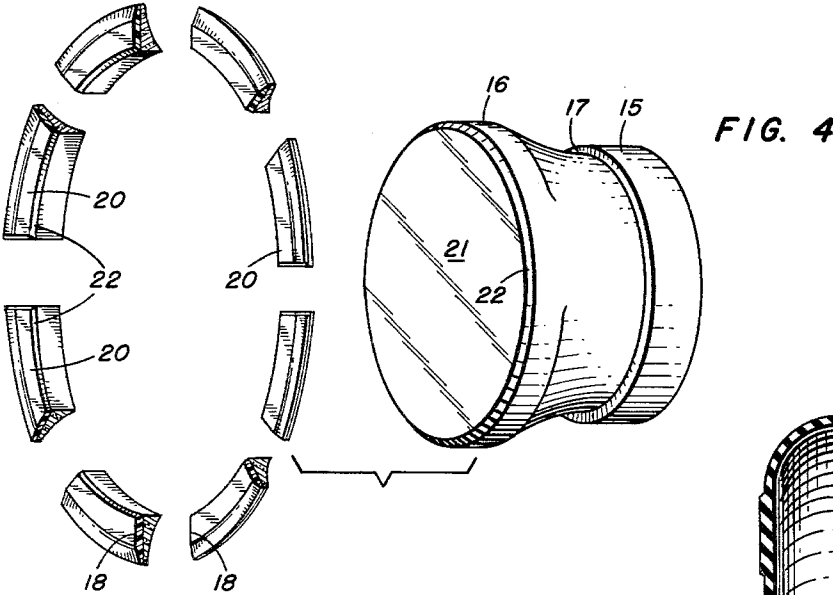
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BONDLESS "HIGH PERFORMANCE" ROCKET NOZZLE CLOSURE

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Filed Feb. 12, 1964, Ser. No. 344,510

1 Claim. (Cl. 102-49)

This invention relates to a nozzle closure and diaphragm seal primarily adapted for the exhaust nozzles of missiles of the Polaris type.

In missiles of the Polaris type which are launched underwater, closures for the exhaust nozzles are required. These closures should withstand pressurization of 70 p.s.i.a. at altitudes for extended periods of time with no appreciable drop. These closures would be required to release within a pressure range of 90 to 140 p.s.i.a. and, in addition, these closures upon release should not become miniature missiles which could damage or interfere with the passage of the missile.

The material from which these closures can be made is extremely limited and after the testing of many otherwise desirous materials such as polystyrene plastics or polyurethane, molded plastic RPD-150, asbestos phenolic, Spauldite grade A-A, Syntane, and aluminum and graphite, the only material which was found to give the desired results was Styrofoam.

The physical requirements necessitated something other than metal, a material which did not have to be bonded into the inside of the nozzle and one which could be quickly attached to the nozzle and conform to any irregularities in the nozzle structure of different missiles. Tests were made with the above materials mentioned other than Styrofoam and these tests showed failure in one or more desirable attributes of the plug.

In connection with the plug, it was also necessary to provide a covering diaphragm seal which would engage the outside of the nozzle in sealing relationship and yet would provide no hindrance in the ejection of the plug.

An object of the present invention is to provide a plug for the nozzle of a missile motor which does not require an adhesive bond between the nozzle and the plug to provide a sealing relationship and which can be ejected at a predetermined blow-out pressure and will repeat this blow-out time after time within a close variation.

Another object is to provide a plug which required a minimum of assembly time and which after ejection will not form dangerous moving particles which could interfere with the missile guidance.

Another object of the present invention is to provide a segmented plug which upon the application of a discharge pressure will be discharged and which will leave the nozzle of the missile free of any parts of the plug which might interfere with the exhaust gases.

A further object of the present invention is to provide a segmented plug for a missile nozzle which would adhere to the nozzle by press fitting and which would be ejected at a predetermined pressure.

It is still a further object of the present invention to provide a three-piece closure for the end of a rocket nozzle which would provide a water-tight seal which would maintain an internal pressure for a long period of time without

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pressure drop and which would eject under a predetermined pressure with a tolerance to insure that the plug will remain intact under 90 and would eject when subjected to 130 p.s.i.a.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a longitudinal cross-section of the nozzle showing the plug in position;

FIG. 2 is a cross-section of the plug;

FIG. 3 is a perspective view of the plug;

FIG. 4 is a view of the plug after blow-out;

FIG. 5 is a vertical cross-section of the diaphragm seal.

Referring particularly to the drawings wherein like parts are indicated by like numbers in the several views, a portion of a rocket nozzle 10 is shown. The nozzle has a movable end piece 11 which may be oriented to regulate the direction of the blast. This end piece is formed with an external annular groove 12. The interior of the nozzle is substantially conical along its inward face 13 and flared outwardly at 14 to provide a smooth exit for the exhaust gases.

A Styrofoam unit formed with a substantially cylindrical portion 15 and a rim portion 16 is press fitted into the nozzle. This unit is slightly enlarged throughout the cylindrical portion as at 17 (FIG. 2) to insure a press fit relationship with the interior nozzle which tight fit provides for ejection at a pressure between 90 and 112 p.s.i.a. The rim portion of the Styrofoam unit which fits the flared portion of the nozzle is formed with partial radial cuts 18 to divide the rim portion into a plurality of segments 20.

The radial cuts dividing the rim into segments insures the ejection of the entire Styrofoam unit plug. This eliminates any possibility of nozzle-throat area restriction.

The forward side of the plug is covered with a cellulose acetate facing plate 21 which reinforces the plug. This plate is bonded to the exposed side of the plug with cement and grooved at 22 to control the blow-out pressure and the rupture pattern. It is also cut or grooved radially to conform to the radial cuts of the rim. The depths and design of this grooving determines the blow-out pressure and the pattern of the segments at blow-out.

The plug and facing is covered with a diaphragm 24 which extends across the entire face of the nozzle, terminating in a circumferential rim formed of an integral O-ring 25 which is seated in the annular groove 12 of the nozzle and provides a sealing relationship across the entire outlet of the nozzle. The diaphragm is grooved similarly to the cellulose acetate facing at 23, the central portion of the diaphragm outlined by the groove being reinforced with a cloth insert 26 which results in the desired failure of pattern and insures a complete and uniform separation of the central disk at nozzle closure blow-out.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

A covering for a rocket motor nozzle formed with an inner cylindrical portion terminating in a flared rim por-

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tion, the outer annular surface of the rim portion being formed with an annular recess, said covering comprising:

- a Styrofoam plug formed with a cylindrical portion friction fitting the cylindrical portion of the nozzle, and with an outer rim portion divided by score lines into arcuate shaped segments, said rim portion friction fitting the flared portion of the nozzle; 5
- a cellulose acetate facing plate adhering to and forming the exposed outer surface of the plug, said facing being scored similarly to the rim portion of the plug; 10
- and
- a diaphragm having a central reinforced portion covering the end of the nozzle, said diaphragm extending across the facing of the plug and around the rim of

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the nozzle and terminating in the annular recess of the nozzle.

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