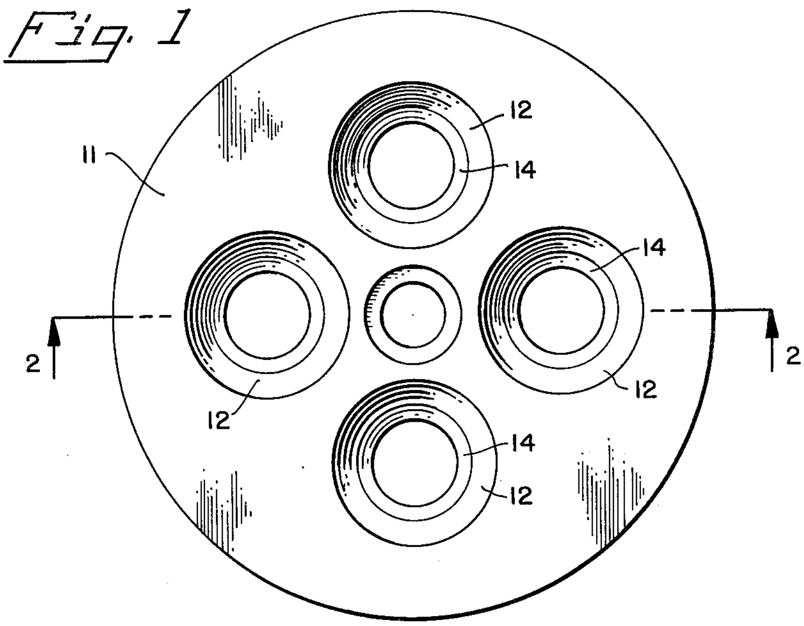
Sept. 4, 1962 S. H. HERZOG 3,052,090

HEAT SHIELD AND NOZZLE SEAL FOR ROCKET NOZZLES

Filed Nov. 20, 1958

Fig. 1



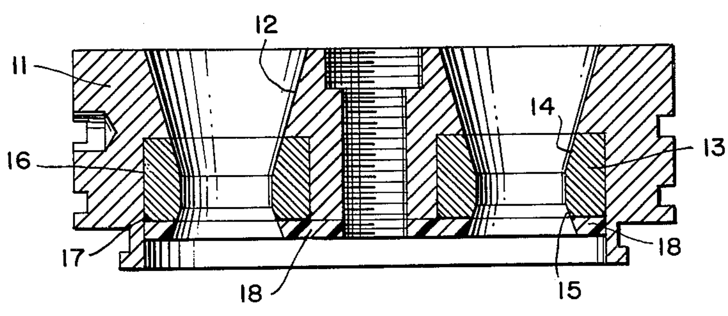


Fig. 2

INVENTOR.
STEPHEN H. HERZOG

BY

ATTORNEYS.

United States Patent Office

3,052,090

Patented Sept. 4, 1962

1

3,052,090

HEAT SHIELD AND NOZZLE SEAL FOR ROCKET NOZZLES

Stephen H. Herzog, China Lake, Calif., assignor to the United States of America as represented by the Secretary of the Navy

Filed Nov. 20, 1958, Ser. No. 775,325
2 Claims. (Cl. 60—35.6)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described 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.

This invention is directed to rocket motors; more specifically it relates to improvements in discharge nozzles.

Steel nozzles have been used successfully in the past with the propellants then in use. At present, it is common to place an insert of erosion-resistant material in the constricted or throat portion of the nozzle where the most erosion occurs. However, some of the propellants in use today are so energetic that the steel surrounding the insert is eroded away by the hot exhaust gases and the insert is expelled during the burning of the propellant.

It is therefore an object of this invention to provide a nozzle plate with an insert which will not be expelled during the operation of the motor.

With this and further objects in view, as will hereinafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a plan view of a nozzle plate, and

FIG. 2 is a cross-sectional elevational view of the nozzle plate taken along line 2—2 of FIG. 1.

Referring now to the drawing wherein like reference numerals designate like or corresponding parts throughout the several views, there is shown in FIGS. 1 and 2 a plate 11 having an annular skirt portion, a centrally positioned threaded hole, and a plurality of wells 16 depending from the side having the skirt portion. On the opposite side of plate 11 are exit ports corresponding to the wells 16 and centrally positioned with respect thereto, each exit port having a beveled surface 12. Positioned inside the wells 16 and contacting the surfaces thereof are tubular erosion-resistant inserts 13 having beveled surfaces 14 and 15; inserts 13 are secured inside the wells by shims 17. Surfaces 12 and 14 are beveled so as to form a smooth continuous diverging conduit. A heat shield 18 having apertures corresponding to the apertures of plate 11 is securely positioned inside the skirt portion and in contact with the face of plate 11.

The apertures of shield 18 corresponding to the openings in the erosion-resistant inserts may be beveled if desired to form a smooth continuous surface with beveled surface 15 of the insert, but if not done, has no appreciable effect.

The heat shield 18 is made of a thermosetting resin, preferably a phenol-formaldehyde resin having a low degree of polymerization which incorporates up to 70% of a filler. The filler is preferably chopped glass or asbestos fibers although other suitable materials may be used.

2

Inserts 13 are made of graphite, a refractory metal, or certain metal oxides, all well known for their resistance to erosion.

Plate 11 is conventional and made of steel, as are shims 17 which are integral therewith. The nozzle plate is made by first machining plate 11, then inserting the inserts 13 and staking them down by the use of shims 17. Then the shield 18 is simply pressed in position; it can be bonded to the face of plate 11 if desired. Shield 18 is bonded by merely coating it with some of the uncured resin, placing it in position and heating until the resin is cured. Rupture diaphragms which seal the discharge ports hermetically are molded in place similarly.

After assembly, the nozzle plate is simply screwed into position at the end of the combustion chamber.

A number of the instant nozzle plates have been tested under the same conditions which caused conventional steel nozzle plates to expel their erosion-resistant inserts and no such expulsion occured.

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 claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A nozzle plate assembly for rocket motors, comprising a metal plate having an annular skirt portion and a plurality of wells in the side of the plate having the skirt portion, said plate having exit ports on the unskirted side of the plate corresponding to said wells, an insert positioned within each of said wells and secured therein by a shim, a heat shield having apertures corresponding to the wells and ports of said plate, said heat shield being pressed into position inside the skirt portion of the plate against said plate and inserts and covering the junction therebetween, whereby the shield protects the junction between the inserts and the plate from the combustion products of the rocket motor.

2. In a rocket nozzle plate comprising a metal plate having a plurality of exit ports and an annular skirt portion, said skirt portion having a plurality of wells therein corresponding to and in alignment with said ports, and a tubular erosion-resistant insert secured within each of said wells; the improvement which comprises a thermosetting resin heat shield coving the upstream ends of said inserts and the junctions between the inserts and said plates; said plate having a plurality of openings corresponding to the upstream openings of said inserts and bonded to said plate within the skirt portion.

References Cited in the file of this patent

UNITED STATES PATENTS

2,755,620	Gillot	July 24, 1956
2,759,326	Brandt	Aug. 21, 1956
2,762,193	Johnson	Sept. 11, 1956
2,816,418	Loedding	Dec. 17, 1957
2,835,107	Ward	May 20, 1958
2,849,860	Lowe	Sept. 2, 1958
2,958,184	Sanders	Nov. 1, 1960
2,968,919	Hughes et al.	Jan. 24, 1961
2,987,874	Nicholson	June 13, 1961