Nov. 29, 1960 H. R. KUNZ 2,962,221

ROCKET NOZZLE CONSTRUCTION WITH COOLING MEANS

Filed May 12, 1959

FIG. 1

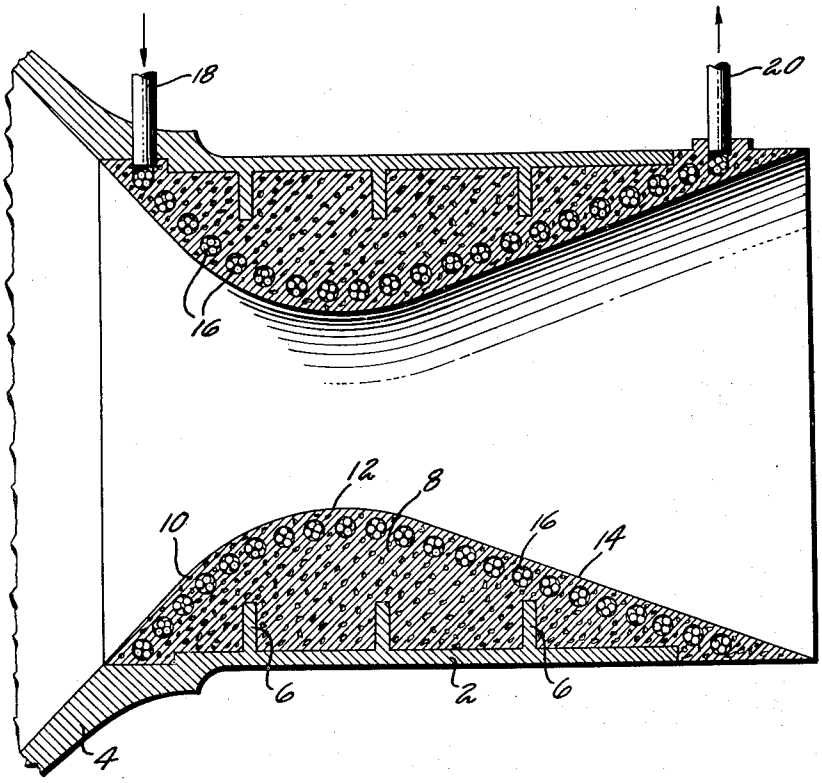
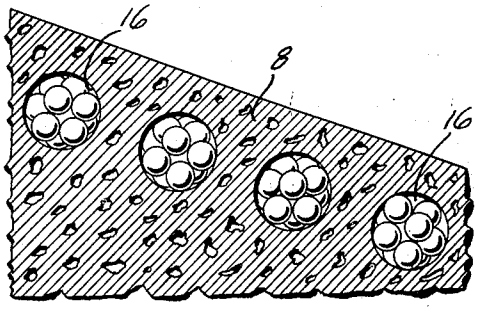


FIG. 2



INVENTOR
HAROLD R. KUNZ
BY Charles Allmen
ATTORNEY

United States Patent Office 2,962,221 Patented Nov. 29, 1960

2,962,221

ROCKET NOZZLE CONSTRUCTION WITH COOLING MEANS

Harold R. Kunz, Warehouse Point, Conn., assignor to United Aircraft Corporation, East Hartford, Conn., a corporation of Delaware

Filed May 12, 1959, Ser. No. 812,716

9 Claims. (Cl. 239—132)

The present invention relates to a nozzle arrangement for rockets and the like.

One feature of the invention is an arrangement for cooling the nozzle especially at the throat by means of transpiration or sweat cooling and for supplying a cooling fluid to the nozzle passage. Another feature is a nozzle of porous material with coolant passages therein of greater porosity than the nozzle to assure a passage for coolant to all portions of the nozzle. Another feature is the reenforcement of the nozzle material so that it will stand the pressures thereon.

Other features and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a longitudinal sectional view through a nozzle embodying the invention.

Fig. 2 is a fragmentary sectional view similar to Fig. 1 on a larger scale.

The nozzle, as shown, is made up of a sleeve **2** of high strength material which is attached to or integral with the body **4** of the combustion chamber of the rocket. This sleeve which is somewhat shorter than the nozzle structure itself may have a plurality of annular radially inwardly extending fins **6** on the inner wall which are axially spaced apart, as shown.

The flow path through the nozzle is defined by an annulus of low porosity material which is in engagement with the inner surface of the sleeve **2** and which has an axial passage therein which forms the convergent portion **10**, the throat **12** and divergent portion **14** of the flow passage through the nozzle. This low porosity material may be of sintered aluminum or other metal or of other material as silicon carbide although other materials with the desired porosity may be equally satisfactory.

Formed within the annulus **8** and extending parallel to the inner wall of the annulus is a spiral passage **16**, the successive convolutions of which are closely adjacent to each other. This passage is filled with a high porosity material such as metallic or plastic beads or steel wool or other equally suitable material preferably made up of discrete elements.

Coolant is introduced to one end of the spiral passage as by the coolant inlet pipe **18** and any coolant not used within the nozzle may be discharged through a pipe **20**. Obviously, this coolant may be a liquid fuel and accordingly, the pipe **20** would be connected into the fuel system. As the coolant enters the spiral passage under pressure it will flow along the spiral passage losing coolant into the less porous material of the annulus **8** and this coolant passes through the material of the annulus and cools the surface of the nozzle passage thereby effecting transpiration or sweat cooling.

The pressure drop in the coolant passage will match approximately the pressure drop through the nozzle to assure an adequate and uniform flow of the coolant over the entire wall surface. With this arrangement, if the portion of the annulus **8** between the coolant passage and

the nozzle wall surface should become plugged to any extent, cooling would still be continued through the spiral passage.

The spiral passage **16** may be formed within the ring **8** by using a copper tube as a core for the passage and forming the material of the ring **8** around the copper tube, in a mold. The material of the ring **8** is then sintered at the necessary high temperature and the copper tube core is then removed by dissolving it as with nitric acid. The resulting passage **16** may then be blown or poured full with beads or other flowable high porosity material.

Alternatively, the annulus **8** may be made up of a plurality of angular segments in which event the passages **16** may be formed in the individual segments to line up with each other. With this arrangement, it will be understood that the resulting passage **16** would be only approximately spiral since the portions of the passage in each segment would be straight. Other methods of construction will be apparent from the description of these two possible methods.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A nozzle construction including a ring of a low porosity material and having an axial passage therein forming a nozzle throat, small circumferentially extending passages within said ring and positioned substantially concentric to said axial passage, and a material of higher porosity in said smaller passages.

2. A nozzle construction including a ring of low porosity material having an axial passage therein for the flow of a propellant gas therethrough, a substantially spiral passage within said ring and extending in substantially parallel relation to the wall of the axial passage therein and means for delivering a coolant to said spiral passage to be discharged through the low porosity material to the surface of the axial passage.

3. A nozzle construction including a ring of low porosity material having an axial passage therein for the flow of a propellant gas therethrough, a substantially spiral passage in said porous material and extending substantially parallel to the wall of the axial passage therein, and a material of higher porosity in said spiral passage.

4. A nozzle construction including a ring of a low porosity material and having an axial passage therein forming a nozzle throat, smaller circumferentially extending passages within said ring and substantially concentric to said axial passage, a material of higher porosity in said smaller passages, and a metallic ring surrounding said first ring and in contact therewith for reenforcement of said first ring.

5. A nozzle construction as in claim 4 in which the axial passage forms a convergent portion, a throat portion and a divergent portion and in which the smaller passages are adjacent to but substantially uniformly spaced from the surfaces of the axial passage.

6. A nozzle construction as in claim 4 in which means are provided for delivering a cooling fluid to the smaller passages.

7. A nozzle construction as in claim 4 in which the smaller passages form a continuous spiral passage and in which a cooling fluid is delivered to said spiral passage.

8. A nozzle construction as in claim 4 in which the material of high porosity permits a substantial flow therearound through the small passages and in which the low porosity material permits a flow from the small passages to the surface of the axial passage.

9. A nozzle construction as in claim 4 in which the smaller passages form a continuous spiral passage and in which cooling fluid is delivered to the end of the spiral

passage adjacent to the upstream end of the axial passage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,354,151 Skoglund ---------- July 18, 1924
2,594,735 Crumley ---------- Apr. 29, 1952
2,862,828 Glaser ---------- Dec. 2, 1958

FOREIGN PATENTS

874,469 France ---------- May 4, 1942