July 6, 1965 S. L. HARDY 3,192,709

VARIABLE THROAT NOZZLE

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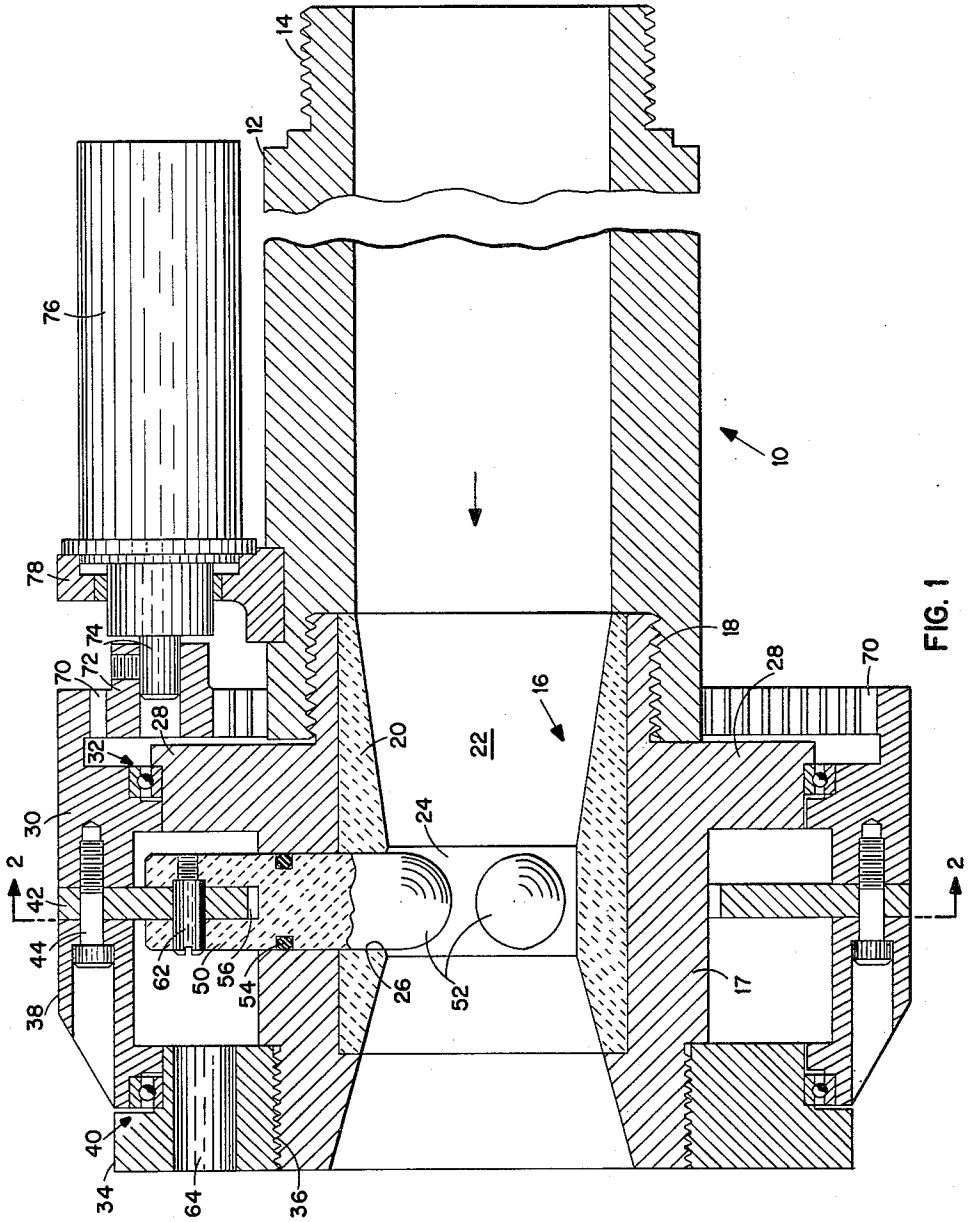


FIG. 1

Sammie L. Hardy,
INVENTOR.

BY S. J. Rotondi
A. P. Dupont
Herbert H. Murray

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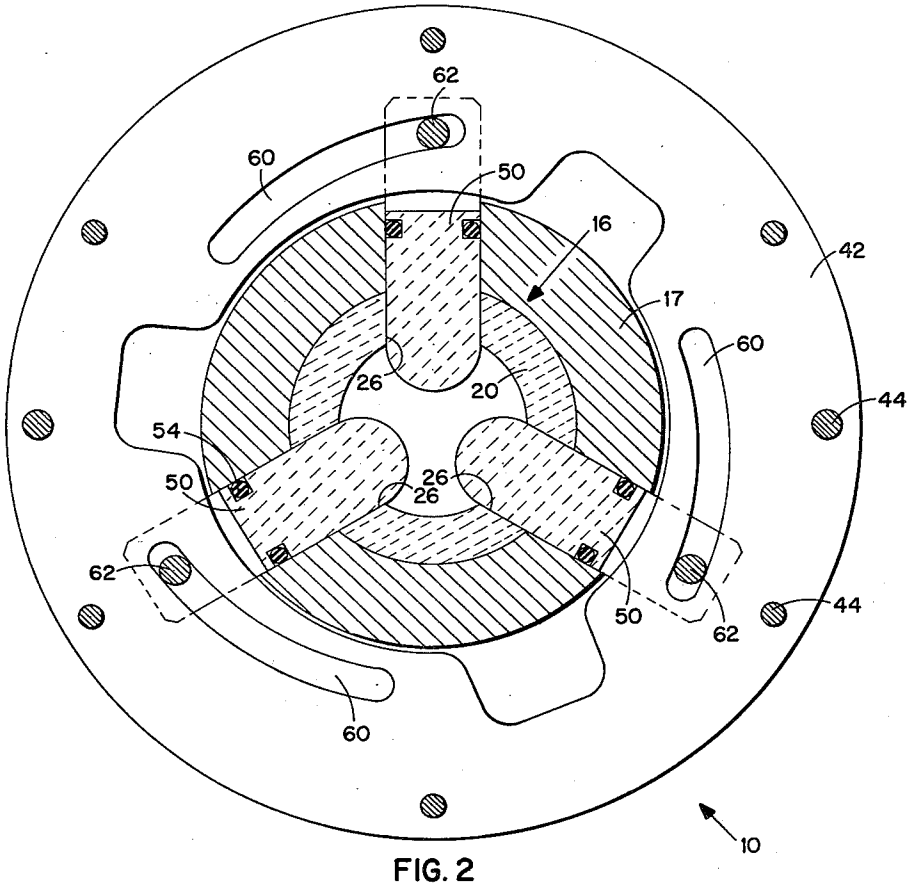


FIG. 2

Sammie L. Hardy,
INVENTOR.
BY S. J. Rotondi
A. P. Dupont
Herbert H. Murray

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VARIABLE THROAT NOZZLE

Sammie Lloyd Hardy, Madison, Ala., assignor to the United States of America as represented by the Secretary of the Army

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1 Claim. (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 for governmental purposes without the payment of any royalty thereon.

This invention pertains to a variable throat nozzle. More particularly the invention relates to a nozzle having a variable throat area for use with a rocket or other jet type motor.

In the use of missiles and other jet driven devices it is advantageous to be able to vary the size of the throat orifice of the emission nozzle to regulate the amount of thrust developed by the motor.

An object of the present invention is to provide a nozzle having means to vary the size of the orifice at the nozzle's throat.

Another object of the invention is to provide a nozzle wherein the unobstructed cross sectional area of the throat zone may be changed to vary the thrust developed by the discharge of gas through the nozzle.

Another object of the invention is to provide a nozzle wherein the previous objects can be accomplished during flight of the missile or other device upon which the nozzle is mounted.

An important feature of the invention is the provision of a nozzle employing a plurality of radially reciprocable probes for insertion into the nozzle throat to restrict the unobstructed area of the throat orifice.

These and other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a sectional view through a nozzle which employs the principles of the present invention; and

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1.

Referring now to the drawings the numeral 10 indicates a nozzle for use with a jet type motor. Nozzle 10 comprises a tubular member 12 provided with threads 14 at its forward end for attachment to the gas generating portion of the motor (not shown). A nozzle assembly 16 is provided with a central sleeve 17 connected by threads 18 to the rear end of tubular member 12. A liner 20 of suitable heat resistant material is inserted within sleeve 17 and locked therein by the threaded connection of sleeve 17 to tubular member 12.

Liner 20 has a venturi shaped passage 22 therethrough defining a throat zone 24 at its narrowest point. A plurality of radial passageways 26, spaced equidistant about the longitudianl axis of the nozzle at throat zone 24, extend through liner 20 and sleeve 17. In the particular embodiment disclosed, these passageways are three in number with their axes spaced 120 degrees from each other.

Sleeve 17 is provided adjacent its front end with a radially projecting peripheral flange 28. A sleeve 30 is mounted on flange 28 by a bearing 32 for rotary movement with respect thereto.

A cap 34 is screwed onto threads 36 at the rear end of sleeve 17. A second rotatable sleeve 38 is mounted on cap 36 by means of a bearing 40. A cam plate 42 is clamped between sleeves 30 and 38 by means of a plurality of cap screws 44 which project through apertures provided in the sleeve 38 and cam plate 42, and are

screwed into threaded apertures in the sleeve 30. Cam plate 42 projects inwardly from rotatable sleeves 30 and 38 for coaction with a plurality of probes 50.

Probes 50 are slidably mounted one within each of radial passageways 26 and are made of heat resistant material. Probes 50 are provided at their inner ends with rounded nose portions 52 which project into throat zone 24 of the nozzle. An O-ring 54 is mounted in a suitable groove in the periphery of probe 50 and seals against the wall of passageway 26. The outer end of each of the probes 50 is bifurcated as indicated at 56 and slidably embraces cam plate 42.

Cam plate 42 is provided with a plurality of cam slots 60 (FIGURE 2), one for each probe 50, which slots are eccentric with respect to the axis of rotation of the cam plate. A pin 62 extends through each of the slots 60 and the bifurcated end of the associated probe 50. Whereby, rotational movement of cam plate 42 is translated into radial movement of probe 50. Access for installing pins 62 is provided by a plurality of axially extending bores 64 in cap 34 (FIGURE 1).

Rotational movement of sleeves 30 and 38 and cam plate 42 is effected by means of an internal ring gear 70 formed on a forwardly projecting flange on sleeve 30. The ring gear meshes with a spur gear 72 fixed to the shaft of a reversible servomotor 76 mounted on a bracket 78 fixed to tubular element 12.

From the foregoing description it may be seen that by rotating servomotor 71 in one direction or the other cam plate 42 will be rotated to cause probes 50 to be withdrawn or projected further into throat zone 24 of the nozzle to vary the unobstructed cross sectional area thereof thus varying the thrust developed by the engine.

While a preferred embodiment of the invention has been described herein, various changes could be made in the design without departing from the spirit of the invention as defined in the appended claim.

The invention having thus been described, what is claimed as new and desired to be protected by Letters Patent is:

A variable throat area exhaust nozzle for a jet type motor comprising a liner having a venturi shaped longitudinal passageway therethrough defining a restricted throat area, a plurality of radial passageways of circular cross section in said liner communicating with said restricted throat area, a plurality of cylindrical probes mounted for reciprocation one within each of said radial passageways, said probes having spherical inner ends projecting into said throat area, the outer ends of said probes being bifurcated, a cam plate slidably received between the ears of the bifurcated ends of all of said probes, said cam plate having a plurality of cam slots formed therein corresponding in number to the number of said probes, a pin fixed to the ears of the bifurcated end of each of the probes and extending through one of the cam slots in said cam plate, a sleeve rotatably mounted by antifriction bearings on the outer surface of said nozzle, said cam plate being fixed to said sleeve, an internal ring gear on said sleeve, a servomotor fixed to said nozzle, and a spur gear fixed to said servomotor and meshing with said ring gear.

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SAMUEL LEVINE, *Primary Examiner.*

ABRAM BLUM, *Examiner.*