ABSTRACT

A nozzle having four blades extending radially therein about the inner periphery thereof. Each blade reciprocates radially with respect to the axis of the nozzle to control the cross-sectional area of the nozzle and thereby serves as a thrust mass control. The blades are also independently capable of rotating motion to form a thrust vector control in any plane.

7 Claims, 3 Drawing Figures
3,743,184

CYLINDRICAL THROAT NOZZLE WITH MOVABLE SONIC BLADES FOR OBTAINING DUAL AREA THROAT AND THRUST VECTOR CONTROL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to nozzles and more particularly to a variable control nozzle.

2. Description of the Prior Art

The prior art shows variable control nozzles affected by reciprocating members extending into the throat of the nozzle, to control the area thereof. U. S. Pat. No. 3,534,831 to Nagamatsu and No. 3,192,709 to Hardy are typical of this type of variable control nozzle.

Rotating members have been used in nozzles to affect the flow therefrom, for example as shown in U. S. Pat. No. 2,936,578 to Chamberlain.

U. S. Pat. No. 3,096,049 to Karasinski shows vanes which reciprocate and other vanes which rotate.

The prior art does not show vanes or blades in a nozzle throat which both reciprocate and rotate.

SUMMARY OF THE INVENTION

The present invention incorporates the desirable features of the prior art into a device which serves to control both the cross-sectional area of the nozzle and the precise direction of thrust vector control.

OBJECTS OF THE INVENTION

An object of the present invention is to provide a throat nozzle which controls the thrust vector and thrust mass or volume.

Another object is to obtain a more dependable and more economical means for controlling a variable throat nozzle.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a longitudinal cross-sectional view of the present invention.

FIG. 2 shows a transverse cross-sectional view of the present invention.

FIG. 3 shows another form of the split matrix member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows the variable throat nozzle device 10. Cylindrical rod members 14 extend through composite body member 11 and connect with sonic blades 13.

Sonic blades 13 are in complementary, reciprocating, and sliding relationship with split matrix members 15 which are rotatably received in composite body member 11. Members 15 are formed in two pieces for easy insertion into body member 11.

The nozzle of the preferred embodiment shown in the drawings has a short cylindrical throat section 12 containing four, one in each quadrant, retractable blades 13 aligned perpendicularly with respect to the gas stream. Sonic blades 13 reciprocate from a point where they do not extend into nozzle throat 12 to a point near the center of nozzle throat 12 to thereby control the area of the nozzle. Sonic blades also rotate as best shown in FIG. 1 for example as in the dotted lines showing one of the sonic blades 13 turned slightly. Any or all of sonic blades 13 may be reciprocated or rotated to achieve any combination of throat area and vector control.

The blades 13 are independently capable of reciprocating motion in and out of the gas stream and changing the throat area for thrust mass control. By varying the amount that each blade is inserted into the throat orifice, and unbalanced deflection of exhaust gases results in a thrust vector control in any plane. The blades 13 also have the capability of rotary motion by using split cylindrical matrix 15 that revolves with the blade, thereby acting as a rudder and increasing its gas stream deflection ability for hard over thrust vector control.

FIG. 3 shows one way that split matrix 15 of the other Figures may be held operatively in place. Annular ridge 16 extends around matrix 15 and is snapped into a complementary groove, not shown, in the body of the nozzle. The opposite arrangement of a groove in matrix 15' and an annular complimentary ridge in the nozzle body member may alternatively be used. These two arrangements allow the matrix to rotate but not to reciprocate with respect to the nozzle body.

Any mission employing both then low throat area operations utilizing the present invention will permit blades constructed from refractory metals to first heat slowly while retracted, reducing the chance of thermal shock when they are commissioned to use. The blades may be constructed from ablative materials, and, as erosion occurs, they may be controllably fed into the throat, compensating for the material loss.

Obviously many modification and variations of the present invention are possible in 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 control comprising: a nozzle having a throat with an axis of symmetry; at least one blade member having a longitudinal axis substantially perpendicular to the axis of symmetry of said throat; and means for allowing reciprocating and rotary movement of said at least one blade member, whereby said blade member is moveable into and out of said throat by said reciprocating motion in any rotated position thereof.

2. The device of claim 1 wherein control of said reciprocation and rotation of said blade are independent of one another.

3. The device of claim 1 wherein said blades are substantially in the shape of a parallelogram in cross-section.

4. The device of claim 1 wherein there are four blade members.

5. The device of claim 4 wherein the longitudinal axis of each of said blade members is perpendicular to the longitudinal axis of each adjacent blade member.

6. The device of claim 1 wherein said means comprises a cylindrical matrix member rotatably received in said nozzle; said cylindrical matrix member slidably receiving said blade member to allow reciprocating motion of said blade member with respect to said nozzle and said cylindrical matrix member.

7. The device of claim 6 wherein said cylindrical matrix member has an annular shoulder which is received in an annular groove in said nozzle to allow rotation and inhibit reciprocation of said matrix member with respect to said nozzle.

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