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[54] **FUEL SPRAY NOZZLE**

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[52] **U.S. Cl.** **239/534,** 239/582

[51] **Int. Cl.** **B05b 1/30**

[58] **Field of Search** 239/534, 551, 580, 582

[56] **References Cited**

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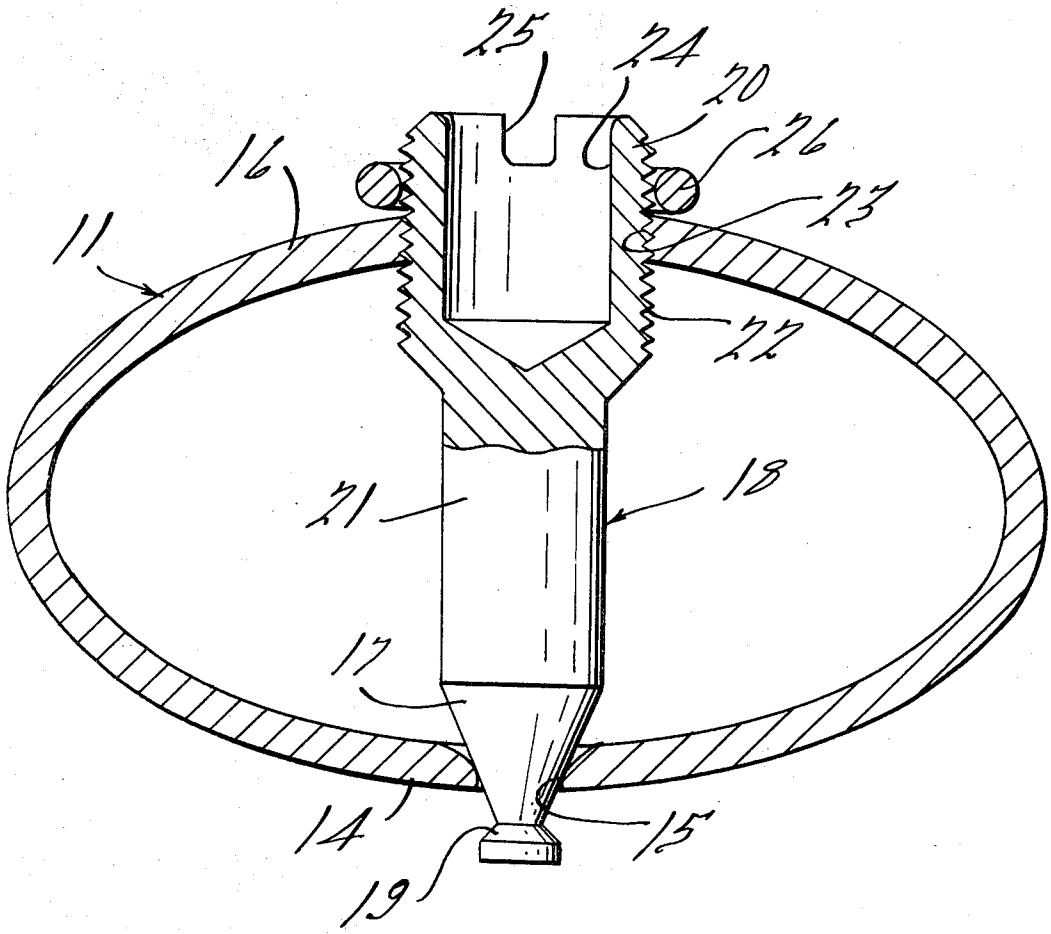
Primary Examiner—Lloyd L. King

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[57] **ABSTRACT**

A nozzle integrally mounted in a manifold tube which distends in response to internal pressure to vary the flow rate. The nozzle comprises a pintle having a threaded mounting section and a conical seat engageable with the manifold orifice. The mounting section is threaded directly into the manifold tube and the pintle is adjustable by a screwdriver slot to achieve the proper flow setting. A brazing ring is carried by each mounting portion, and all pintles on the manifold are simultaneously secured in position by placing the manifold in a brazing furnace.

6 Claims, 4 Drawing Figures



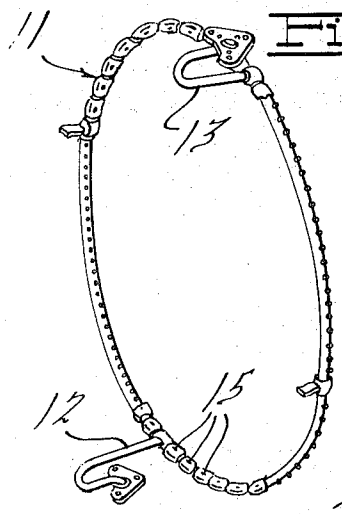


Fig. 2.

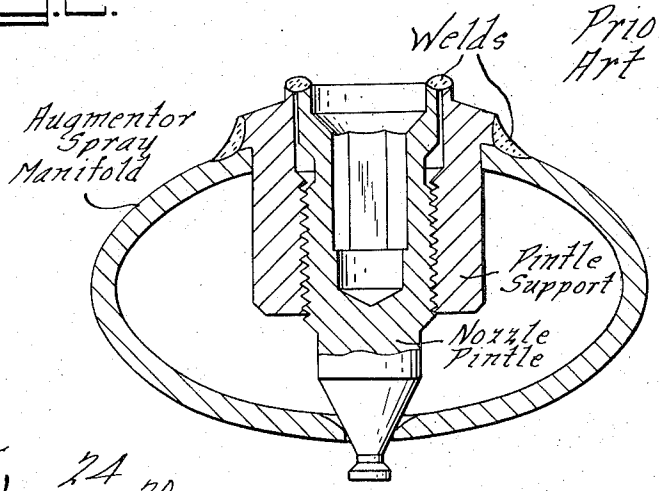


Fig. 1.

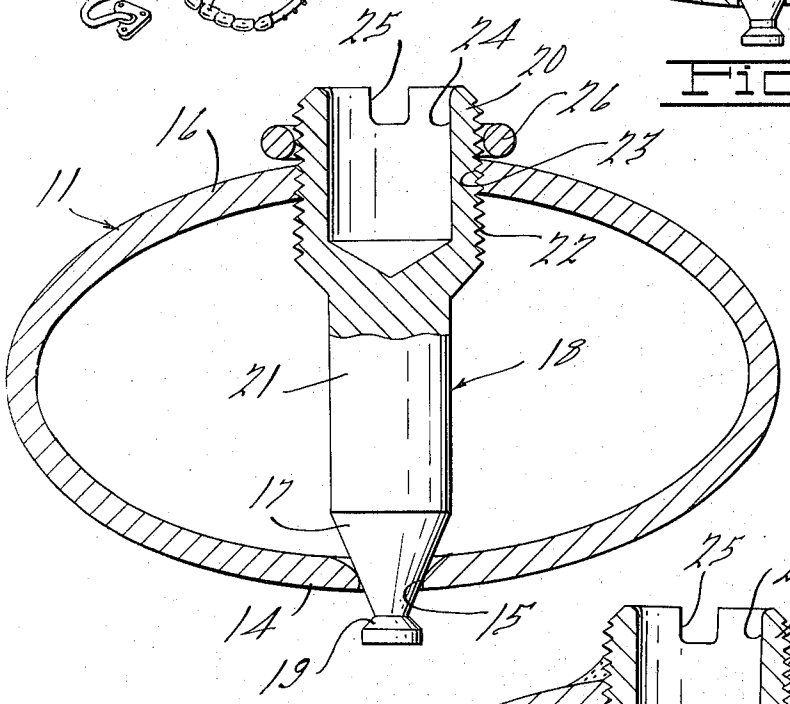


Fig. 3.

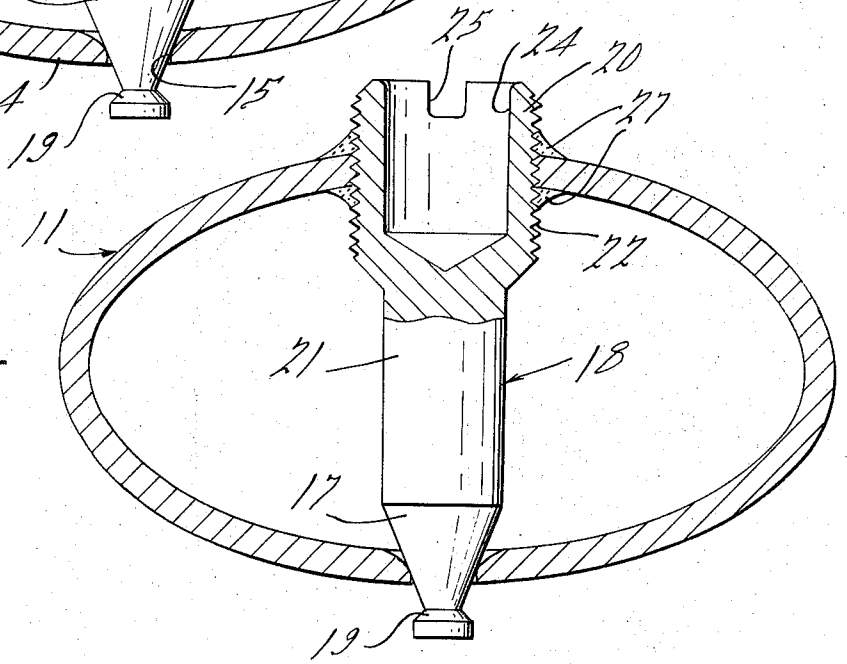


Fig. 4.

FUEL SPRAY NOZZLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to fuel spray nozzles of the type used in gas turbines, and particularly the afterburners or thrust augmentors of turbojet and turbofan engines. Conventionally, such augmentors have chambers with fuel spray manifolds extending circumferentially or radially therein. These manifolds are of elliptical cross section and carry a series of nozzles. The invention is particularly concerned with the nozzle construction.

2. Description of the Prior Art

The closest known prior art is illustrated in FIG. 1 which shows the elliptically shaped manifold and a nozzle pintle carried by a pintle support. This construction is made by drilling the two holes in the manifold which are required for each nozzle assembly, and inserting the pintle support in the large hole at the back of the manifold. The pintle support is then welded into place. After further fine machining, the nozzle pintle is threaded into the support and tightened with a torque wrench against the orifice through which it projects. When the proper setting has been obtained, the nozzle pintle is welded to the pintle support. Upon application of fuel pressure inside the manifold, it will distend to a more circular cross section, its orifice moving away from the conical pintle seat to allow the fuel to discharge against the outer spray deflector and become atomized. The quantity of fuel being discharged depends on the pressure differential between the inside and outside of the manifold which varies the size of the annular opening between the pintle seat and the orifice.

The prior art construction of FIG. 1 has a number of important disadvantages. The large size of the pintle support protruding into the manifold causes substantial blockage of fuel flow. Since fuel is supplied to the manifold only at certain points the pressure loss caused by this blockage affects downstream nozzles with a cumulative effect.

Because of the large hole size needed for the pintle support, the area of the manifold wall available for distention is greatly reduced, causing the spring rate of the manifold section to become high and incapable of deflecting as far as required for efficient and accurate operation. The manual welding attachment reduces still further the available deflecting area of the manifold cross section, this reduction varying from one nozzle to another. The weld also introduces a potential fuel leakage point and the possibility of undesirable metallurgical qualities such as weld undercutting, enlarged material grain structures, and strain-aged cracking. Considerable weight is also added to the manifold assembly by the pintle supports and requisite welding, impairing efficiency of the unit in which it is installed. The pintle support also increases manufacturing costs and the complexity of the pintle required.

A further disadvantage of the prior art construction is the requirement for welding the pintle to its support after it has been threaded therein and adjusted. This manual weld varies from pintle to pintle with regard to amount of heat and resulting weld shrinkage, affecting the preadjustment between the nozzle pintle seat and the manifold orifice. This will cause wide variations in fuel flow between individual fuel spray nozzles in a given manifold. The weld also introduces an additional

potential leakage point and the possibility of the above described undesirable metallurgical qualities.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a novel and improved fuel spray nozzle which overcomes the above-described shortcomings of the previous construction, eliminates the need for an intermediate pintle support as well as the requirement for welding and instead provides only the basis essentials of a simple nozzle pintle and manifold assembly.

It is another object to provide a novel nozzle construction of this type which has improved fuel metering characteristics by elimination of the pintle support and its manually variable structural welding.

It is a further object to provide a novel manifold and nozzle construction of this nature which permits a lower spring rate of the manifold section and thus a reduced seat angle for the pintle to provide improved fuel metering accuracy and more equal patternation between the individual nozzles of the manifold.

It is another object to provide a nozzle and manifold construction of this type in which the manifold section spring rate remains more consistent between nozzles due to a non-variable cross section furnace brazing method of sealing the nozzle pintle to the manifold.

It is also an object to provide an improved nozzle and manifold construction of this character which reduces internal flow blockage by eliminating the pintle support and reducing the pintle cross section, thus minimizing pressure drop between nozzles and helping to equalize patternation between nozzles at high fuel flow conditions.

It is a further object to provide a nozzle and manifold construction of the nature which reduces the number of potential leakage points by eliminating the pintle support and its structural weld.

It is also an object to provide a nozzle and manifold construction having the above characteristics, which permits more accurate adjustment of the pintle flow setting by eliminating the manually variable pintle support seal weld that can vary in the amount of weld shrinkage and thus alter flow adjustment.

It is a further object to provide improved nozzle and manifold construction of this type which permits uniform adjustment of all the nozzles in a manifold.

It is another object to provide a nozzle and manifold construction of this character which reduces weight due to elimination of the pintle support and its structural welding as well as reduction in the nozzle pintle size.

It is also an object to provide a novel nozzle and manifold construction which has improved metallurgical qualities by eliminating welding at the individual nozzles, thus avoiding the possibility of weld undercutting, enlarged material grain structures and strain-age cracking.

It is a further object to provide an improved nozzle and manifold construction of this character which reduces manufacturing costs by eliminating the pintle support and its attendant manufacturing procedures and through simplification of the pintle construction, thus requiring only a simple threading operation of the manifold and permitting burrs developed by threading to be seen and removed without requiring x-rays.

It is another object to provide a novel nozzle and manifold construction which reduces manufacturing

costs by elimination of the pintle support and its complex machining, de-burring and manual welding operations and through simplification of the pintle construction, thus permitting brazing rings to be assembled to the pintle and the latter assembled and adjusted in the manifold segments so that large quantities may be furnace brazed in one operation.

Briefly, the above objects are accomplished by a nozzle and manifold construction in which the manifold of elliptical cross section has a threaded aperture for each nozzle pintle aligned with the pintle orifice. The nozzle pintle has a threaded mounting portion and a conical seat protruding through the orifice. After forming these apertures the pintle is threaded into the manifold, carrying a brazing ring on its threaded portion. It is preset by insertion of a screwdriver and rotation, preferably by supplying pressurized air to the manifold and rotating the pintle to obtain the desired air flow through the orifice. After all pintles are preset, the manifold is placed in a furnace so that all brazing rings seal the pintles to the manifold.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a manifold showing the prior art nozzle and pintle support.

FIG. **2** is a perspective view of the ring type of manifold.

FIG. **3** is an enlarged cross-sectional view showing a nozzle constructed according to the present invention, with the brazing ring in place.

FIG. **4** is a view similar to FIG. **3** but showing the braze seal.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A heat-shielded augmentor spray manifold is generally indicated at **11** in FIG. **2,** the manifold being shown as ring-shaped with portions of the heat shield broken away and having a pair of diametrically opposed fuel supply connections **12** and **13.** A number of these manifolds may be mounted in the afterburner or augmentor section of a gas turbine. In some cases the manifolds extend radially into the augmentor but the invention is equally applicable to these types of manifolds. Typically, the manifold is fabricated of a stainless heat-resisting superalloy such as a nickel-base precipitation hardening alloy containing strengthening elements of titanium and aluminum.

Manifold **11** is of elliptical cross-sectional shapes as seen in FIG. **3,** with the wider portions of the ellipse forming the front and rear walls of the manifold. The front or inwardly facing wall **14** has a number of fuel ejection orifices **15** formed therein. These orifices have a compound conical shape as seen in FIG. **3,** and during operation the pressure of fuel within manifold **11** will cause front wall **14** to distend away from rear wall **16,** thus lifting orifice **15** away from the conical seat **17** of a nozzle pintle generally indicated at **18.** The annular opening thus created will permit the pressurized fuel to escape from the manifold chamber and impinge upon the reversely conical spray surface **19** of the pintle, atomizing the fuel into a spray cone.

Pintle **18,** which may be fabricated of material similar to manifold **11,** has a mounting portion **20,** a central portion **21,** conical seat **17** and spray deflector **19.** Section **20** is of relatively large diameter and has an external thread **22.** A threaded aperture **23** is formed in alignment with orifice **15** and pintle **18** is threaded therein. Intermediate section **21** of the pintle is of considerably narrower diameter than section **20** and occupies a major portion of the distance between manifold walls **14** and **16.**

A drilled lightening recess **24** is preferably formed in section **19** of the pintle, and a screwdriver slot **25** is formed at the outer end of this recess for adjustment purposes.

A preferred method of manufacturing the manifold assembly is as follows: Apertures **23** are drilled and tapped and orifices **15** are also formed in the manifold. The pintles **18** are then threaded into apertures **23** with their seats projecting through the orifices. One way of accomplishing this assembly is to pick up each pintle **18** with a screwdriver or similar tool (not shown) having some means for holding the pintle to the tool blade. The pintle is then manipulated to scoop up a braze ring **26,** the internal diameter of this ring having a slight interference fit with threads **22.** The pintle is then inserted in aperture **23** with the braze ring staying in place as seen in FIG. **3.**

The pintles **18** of manifold **11** or a segment of the manifold, if the manifold is to be faricated of joined segments, are preadjusted for proper metering. One method of preadjustment is to apply air pressure to the manifold interior and rotate each pintle by a screwdriver inserted in slots **24** to obtain a certain air flow of air pressure drop through the orifice.

After all the pintles have been preadjusted, the manifold or manifold segment may be placed in a furnace so that rings **26** will form a brazed connection **27** (FIG. **4**) between manifold wall **16** and mounting portion **20** of the nozzle.

In cases where titanium and aluminum strengthening elements are used in the superalloy, their precipitation may cause difficulty in the wetting action of the base metal during furnace brazing. A preferred method of overcoming this problem is to follow these steps when brazing:

1. Carefully select all tools, lubricants and finishing materials to make sure they do not contain constituents which would inhibit wetting action of the braze filler metal.

2. Place the parts to be brazed in annealed condition to put the gamma-prime compound $Ni_3(Al_1 Ti)$ in solution and thus minimize its stop-off action.

3. Just prior to assembly and brazing, clean base metal surfaces by mechanical or chemical means to provide a nickel-rich surface at the interface, assuring maximum wetting action.

I claim:

1. A pressurized fuel manifold comprising an elongated chamber of elliptical cross section, a plurality of orifices along one of the wide walls of said chamber, a plurality of threaded apertures aligned with said orifices in the opposite wall, and fuel spray nozzle pintles having externally threaded mounting sections in said apertures, intermediate portions extending through said chamber, said intermediate portions being of substantially smaller diameter than said mounting sections, and conical seats protruding through said orifices.

2. The combination according to claim **1,** said mounting portions being brazed to said threaded apertures.

3. The combination according to claim **1,** said mounting portions having recesses, and screwdriver

slots in the outer ends of said mounting portions for preadjusting said nozzles.

4. A fuel spray nozzle pintle for use in conjunction with a manifold of elliptical cross section having an orifice on one wide wall thereof, said nozzle pintle comprising an elongated member having an externally threaded mounting portion at one end thereof directly threaded in a manifold aperture aligned with said orifice, an intermediate portion of substantially smaller diameter than said mounting portion and extending through said manifold, and a conical seal protruding through said orifice.

5. The combination according to claim 4, said mounting portion being brazed to said manifold.

6. The combination according to claim 5, said mounting portion having a lightening recess and a screwdriver slot for preadjustment of the pintle.

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