

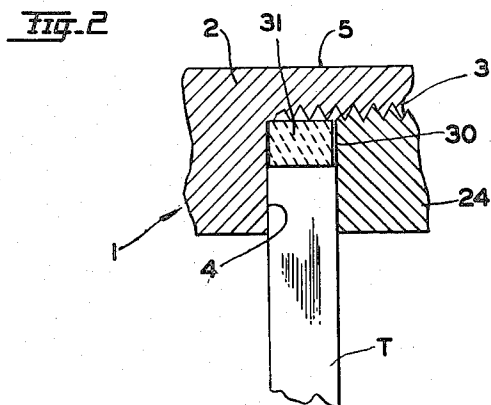
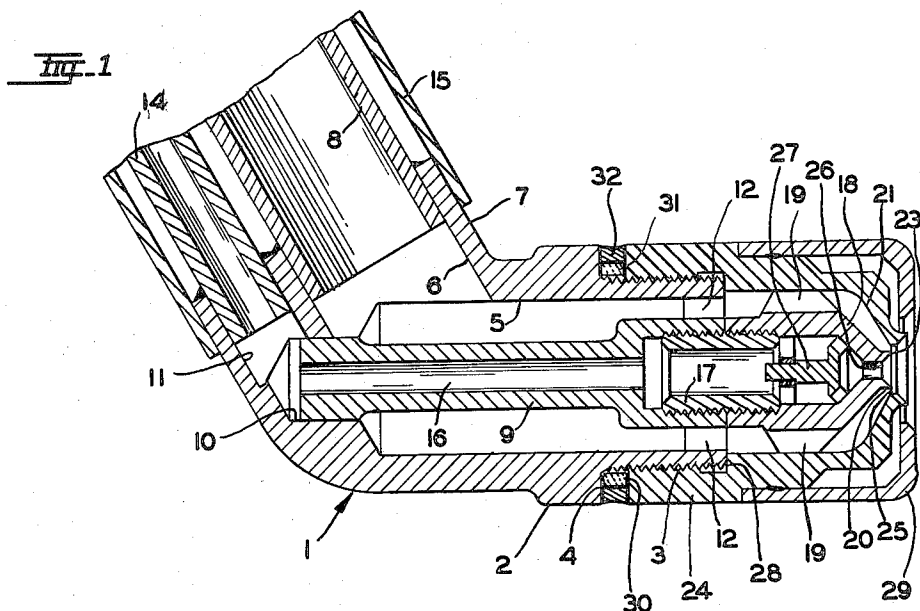
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FUEL INJECTION NOZZLE

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FUEL INJECTION NOZZLE

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The present invention relates generally as indicated to a fuel injection nozzle and more particularly to improvements in a fuel injection nozzle for gas turbines and the like.

At the present time so-called dual orifice nozzles are in extensive use and essentially such nozzles are formed with a primary fuel supply passage which leads to the primary discharge orifice of the nozzle by way of swirl slots or the like, which impart to the fuel a whirling motion so that upon leaving the orifice it is broken up into fine droplets and spread out in conical spray pattern form. Such nozzle is also provided with a secondary fuel supply passage through which fuel is supplied through a secondary discharge orifice (usually annular) disposed concentrically around the aforesaid primary orifice, and again, swirl slots are provided in the secondary fuel passage to impart whirling motion to the fuel for discharge in fine droplet and conical spray pattern form. Such nozzle usually has associated therewith a flow divider so that at low fuel flows, the fuel is discharged only through the primary orifice to achieve efficient atomization while for greater fuel flows, the fuel is discharged from both the primary and secondary orifices, proper atomization being achieved by reason of the greater velocities through the nozzle.

Such dual orifice nozzles include a holder and a nozzle body threadedly connected thereto, the nozzle body being a member which defines the outer wall of the secondary fuel passage, secondary swirl chamber, and secondary orifice. Such threaded joint is usually sealed by a suitable packing ring interposed between radially opposed shoulders of the holder and nozzle body. However, it has been found that under varying conditions of operation of the gas turbine with which the nozzle is used, such packing ring is not reliable as a leakproof seal and will, in time, evidently due to alternate expansion and contraction of the nozzle parts, lose its effectiveness in preventing leakage of fuel through the threaded joint between the holder and nozzle body. Heretofore it has been impractical to braze or weld together these threadedly engaged nozzle parts, since, although the problem of fuel leakage may be solved thereby, it would then be substantially impossible to disassemble the holder and nozzle body for cleaning, adjustment, or replacement of internal parts thereof because the brazing or welding metal would inevitably find its way to the threads. Thus, if such nozzles of welded or brazed construction would become wholly or partly inoperative due to foreign matter or wearing of parts therewithin, it would be necessary to discard the complete nozzles and replace them with new ones.

Accordingly, with the foregoing in mind, it is one principal object of this invention to provide a fuel injection nozzle in which the holder and nozzle body are threadedly engaged and are bonded together, that is welded or brazed, in such a manner that the bonding agent is isolated from the threads whereby it is a simple matter to machine away the bonding agent to permit unscrewing of the nozzle body to get access to the interior parts of the nozzle for cleaning, adjustment, or replacement.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

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To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a fragmentary cross-section view diametrically through a preferred form of fuel injection nozzle embodying the present invention; and

FIG. 2 is a fragmentary and much enlarged radial cross-section view showing how the threaded-on nozzle body is rendered readily removable despite the fact that it is bonded by welding or brazing to the nozzle body to provide the required foolproof fluid-tight connection between the holder and nozzle body.

Referring now in detail to the drawing, the holder 1 is herein shown as being in the form of an elbow of which one leg 2 is externally threaded at 3 up to an annular shoulder 4 which preferably lies in a plane perpendicular to the axis of such threads 3, said leg 2 being formed with a secondary fuel flow passage 5. Intersecting the passage 5 is the secondary fuel passage 6 formed in the other leg 7 of the holder 1 and connected to said passage 6 as by welding is the end portion of the secondary fuel supply conduit 8 which has its other end (not shown) connected in well-known manner to a suitable flow divider or the like, which is effective to supply fuel into said secondary conduit 8 in accordance with the demand for fuel required by the gas turbine or the like.

Located concentrically within the leg 2 of the holder 1 is a tubular insert 9 which has its inner end fitted into and brazed in an opening 10 which communicates with the primary fuel passage 11 formed in the leg 7 of the holder 1. The outer end portion of said tubular insert 9 is formed with circumferentially spaced radially extending legs 12 which also are secured by brazing or like expedient, in fixed position at the end of the secondary fuel passage 5.

Leading to the primary passage 11 and secured thereto as by welding, is the end portion of the primary fuel supply conduit 14 which has its other end (not shown) connected with a fuel supply source, usually a port which has constant communication with the inlet of the aforesaid flow divider. Surrounding the primary and secondary fuel supply lines 8 and 14 is a heat shielding tube 15 which is telescoped over the leg 7 of the nozzle body 1 and over a corresponding leg or boss (not shown) formed on the fuel flow divider valve.

Coming back now to the tubular insert 9, which is bored to provide the primary fuel passage 16, its outer end portion is internally threaded for screwing thereinto the externally threaded connector 17 which thus provides exposed axially extending external threads on which the primary nozzle 18 is screwed with its inner end in firm abutting engagement with the end of the tubular insert 9.

Said primary nozzle 18 has an enlarged head which is formed with a plurality of helically disposed grooves or swirl slots 19 on its periphery, and with a frusto-conical end portion which terminates in an axially extending lip 20 which, together with the frusto-conical wall 21 and central opening 23 in the nozzle body 24, define a swirl chamber and the secondary annular discharge orifice 25. Thus, as shown, when fuel is supplied through the secondary fuel line 8, the fuel flows through the annular space between the passage 5 and the tubular insert 9, between the legs 12 of the tubular insert 9, and thence through the swirl slots 19 whereby the fuel has imparted thereto a progressively increasing swirl velocity as it approaches the secondary orifice 25 and, of course,

the swirling fuel under pressure emerges from the secondary orifice 25 in fine droplet and conical spray pattern form.

Said primary nozzle 18 is also formed with the primary orifice 26 and, in addition, has the swirl producing primary plug 27 disposed therein which, as shown, has a support spider or guide at one end and a swirl slot head at the other end disposed to impart swirling velocity to the fuel which is supplied from the primary fuel supply line 14 and flows through the passage 16 of the tubular insert 9, through the connector 17, and through the openings in the spider and the swirl slots in the head of the primary plug 27 for discharge in fine droplet and conical spray form from the primary orifice 26.

The nozzle body 24 previously referred to is formed with internal threads which have threaded engagement with the threads 3 of the leg 2 of the holder 1 and said nozzle body 24 is adapted to be screwed on tightly until the internal shoulder 28 therein engages the annular end face of the holder 1.

Spot welded, or otherwise secured, on the nozzle body 24 is a shroud 29 which forms an annular air space around the discharge end portion of the nozzle body 24.

As shown in FIG. 1, the internally threaded end of the nozzle body 24 terminates in an annular end surface 30 which is axially spaced from and parallel to the shoulder 4 of the holder 1. Positioned between the annular faces 4 and 30 and surrounding the threads 3 of the holder 1 is a refractory ring 31 made, for example, of carbon or like material, which is capable of withstanding the high temperatures to which the holder 1 and nozzle body 24 are subjected when the welding operation is performed. It has been found that the axial length of the refractory ring 31 should be slightly less (.010" to .020", for example) than the axial distance between the faces 4 and 30 so that no stress is imposed on said ring 31 when the nozzle body 24 is screwed onto the holder 1. As a matter of fact, it has been found that an axial clearance such as indicated above between the opposite ends of the refractory ring 31 and the surfaces 4 and 30 is not at all objectionable since the weld metal 32 is effectively prevented from flowing inward to the interengaged threads of the nozzle body 24 and the holder 1.

In FIG. 1 is shown the assembled condition of the present fuel injection nozzle with a ring 32 of weld metal integrally joining the holder 1 and nozzle body 24 so as to form a safe fluid-tight joint which will not only prevent leakage of fuel but also loosening of the nozzle body 24 due to vibration.

However, despite the fact that the nozzle body 24 and holder 1 are thus inseparably secured together in leak-proof manner and against loosening due to vibration, yet, if one so desires, the nozzle body 24 may easily be removed from the holder 1 for cleaning or servicing of the interior of the nozzle and then may be reassembled and rewelded to the holder 1.

Such disassembly is preferably done with a cut-off tool T or the like which is effective to cut away the welded section 32 to a width which is preferably at least equal to the axial length of the refractory ring 31, whereby, when the metal 32 is cut away down to the outside diameter of the ring 31 as shown in FIG. 2, it is a simple matter to unscrew the nozzle body 24 from the holder 1 to perform the necessary cleaning or other servicing operations. Then, after the servicing operation has been completed the nozzle body 24 is rescrewed onto the holder 1 and rewelded as in FIG. 1, to form an inseparable unitary assembly having a fluid-tight threaded joint.

It is to be understood, of course, that a narrower tool T, even a hacksaw or the like, may be employed just so the tool penetrates the welded section 32 down to the outside diameter of the refractory ring 31, in which case

the nozzle body 24 may be unscrewed from the holder 1 despite the fact that the ring 31 then will be disposed in a counterbore constituted by the weld metal 32. It has been found that a preferred refractory material for the ring 31 is carbon since it appears not to be wetted by the fused steel alloy weld metal 32 whereby it serves as an effective barrier against capillary flow of the fused metal into the threads. Of course, other refractory materials may be employed.

It is apparent that the joint in accordance with the present invention may be applied to articles other than nozzles. Thus, it may be applied to any members which have interlocking, overlapping, or adjacent surfaces in the vicinity of the welding or brazing location and which are to be protected or isolated so that the bonding material will be kept away therefrom.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

We therefore particularly point out and distinctly claim as our invention:

1. A leak-proof, welded, and threaded joint for a holder and nozzle body of a fuel injection nozzle or the like comprising a holder and a body formed with interengaged threads and defining an externally open peripheral groove adjacent the interengaged threads constituted by integral axially spaced annular shoulders of said holder and body respectively; a ring of refractory material in such groove having an outside diameter less than the outside diameters of said shoulders; and a ring of weld metal within said groove surrounding said refractory ring and bridging the gap between said shoulders thus to secure said holder and body together in leak-proof manner and against inadvertent loosening, said refractory ring constituting a barrier against flow of weld metal into the interengaged threads whereby said holder and body may be unscrewed upon cutting away of weld metal to the outside diameter of said refractory ring but without cutting away of any of the interengaged threads of said holder and body.

2. The joint of claim 1 wherein said holder and body are further formed with abutting shoulders that determine the minimum axial length of the space between said annular shoulders and that predetermine the relative axial positions of said holder and body irrespective of the number of times that the joint is disassembled and reassembled.

3. The joint of claim 2 wherein said refractory ring is of axial length shorter than the axial length of the space between said annular shoulders to preclude axial clamping stresses being imposed thereon while yet being effective to preclude flow of weld metal between the ends of said refractory ring and the respective annular shoulders.

4. The joint of claim 1 wherein said refractory ring is made of carbon.

5. The joint of claim 1 wherein said refractory ring is made of a material that is not wetted by the weld metal.

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