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(54) ULTRASONIC TRANSDUCER

(71) We, SONO-TEK CORPORATION, a corporation organised under the laws of the state of New York, United States of America, of 313 Main Street, Poughkeepsie, New York 12601, United States of America, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The present invention relates to ultrasonic transducers and to apparatus employing same for achieving efficient combustion of fuels. An example of same is found in the U.S. Patent to H. L. Berger 3,861,852, issued January 21, 1975.

In the past fuel creepage onto the faces of piezoelectric discs of transducers used as atomizers in fuel burner assemblies has caused degradation of the discs and has resulted in poor long-term atomizer performance. The phenomenon causes a loss in mechanical coupling between elements of the transducer.

According to the present invention there is provided an ultrasonic transducer comprising first and second ultrasonic horns, each having an end face secured to a respective face of a piezoelectric driving assembly which includes a piezoelectric crystal, and a sealing gasket surrounding, and in light sealing contact with the outer surface of the crystal.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawing wherein the sole Figure is a side view, partly in section of a piezoelectric ultrasonic atomizer.

Referring to the drawing, an ultrasonic atomizer 11 is seen as including a front 12 and a rear 13 ultrasonic horn and a driving element 14 comprising a pair of poezoelectric discs 15, 16 and an electrode 18 positioned therebetween, excited by high frequency electrical energy fed thereto from a terminal 18A.

The driving element 14 is sandwiched between flanges 19, 20 of the horns 12, 13 and securely clamped therein by means of a clamping assembly that includes a mounting ring 21 (for securing the assembly to other apparatus) and a plurality of assembly bolts 22 which pass through holes in the electrode 18 and the flanges 19 and 20 into threaded openings in mounting ring 21. The assembly bolts 22 are electrically isolated from the electrode 18 by means of insulators 23.

The atomizer 11 further includes a fuel tube 24 for introducing fuel into a passage 34 within the front horn 12 and a pair of sealing gaskets 26, 27 compressed between horn flanges 19, 20.

The horns 12, 13 are of good acoustic conducting material such as aluminium, titanium or magnesium; or alloys thereof such as Ti-6A1-4V titanium-aluminum alloy 6061-T6 aluminum alloy, 7025 high strength aluminum alloy, AZ 61 magmesium alloy and the like; the discs 15, 16 are of lead-zirconate titanate such as those manufacture by Vernitron Corporation or of lithium niobate such as those manufactured by Valtec Corporation; the electrode 18 is of copper; the terminal 18A, mounting ring 21, and assembly bolts 22 are of steel; the insulators 23 are nylon, polytetrafluoroethylene or some other plastics material with good electrical insulating properties; and, the sealing gaskets 26, 27 are of silicone rubber.

The front horn 12 is seen as including a large diameter portion 28, a small diameter portion 30 so as to form an amplification shoulder 31, a flanged tip 32 with an atomizing surface 33, a central passage 34 for delivering fuel to the atomizing surface 33 and an internally mounted decoupling sleeve 35. The decoupling sleeve 35 is made of polytetrafluoroethylene which does not couple well acoustically to the material of the front horn 12.

The long-term reliability of the atomizer 11 is dramatically enhanced by sealing the discs 15, 16 since fuel contamination is then no longer possible. The space between the flanges 19, 20 is filled with a silicone rubber compound by the sealing gaskets 26, 27. In the past, fuel creepage onto the faces of piezoelectric discs of transducers used as atomizers in fuel-burner assemblies has

caused degradation of same and has resulted in poor long-term atomizer performance. The phenomenon causes a loss in mechanical coupling between elements of the transducer. The gaskets 26, 27 solve the problem and atomizer performance is not affected by the added mass as has been confirmed by before and after measurement of impedance, operating frequency and flange displacement. The slightly higher internal heating caused by sealing the discs 15, 16 does not reduce the atomizer's useful life since internal temperatures are still well below the maximum operating temperature for piezoelectric crystals. The gaskets 26, 27 are of compressible material and have an inner periphery conforming to, but initially slightly greater than, the outer circumference of the discs 15, 16. Upon clamping the inner periphery of gaskets 26, 27 come into light contact with the outer circumference of the discs 15, 16.

A method of making the ultrasonic transducer shown in the drawing forms the subject of and is claimed in application No. 45799/77. (Serial No. 1 595 715).

WHAT WE CLAIM IS:—

1. An ultrasonic transducer comprising first and second ultrasonic horns, each having an end face secured to a respective face of a piezoelectric driving assembly which includes a piezoelectric crystal, and a sealing gasket surrounding, and in light, sealing contact with the outer surface of the crystal.

2. A transducer according to claim 1 in which the crystal is cylindrical.

3. A transducer according to claim 1 or claim 2 in which the driving assembly includes a pair of piezoelectric crystals and an electrode of greater lateral cross-section than the crystals and there is a sealing gasket surrounding each respective crystal and positioned between an end face of a said horn and the electrode.

4. A transducer according to any preceeding claim in which the or each gasket is of elastomeric material.

5. A transducer according to claim 4 in which the elastomeric material is silicone rubber.

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1595716 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*