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(54) **Nozzle with intersecting liquid jets**

(57) A liquid fan jet nozzle (1) having a housing (2) with a central passage (3) having an inlet and an outlet. A subnozzle (6) is arranged in the central passage (3)

and has two round orifices (8) arranged along converging axes so that round liquid jets exiting the round orifices (8) collide at a distance from the orifices and form a fan-shaped jet (5).

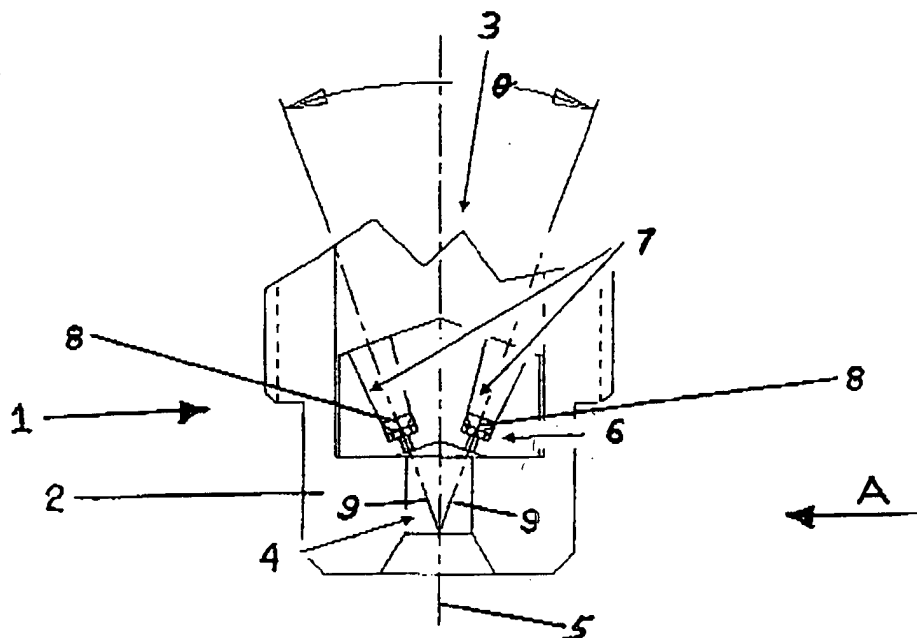


Fig. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present invention is based on and claims priority to U.S. Provisional Patent Application No. 60/515,356 filed October 28, 2003 entitled INTERSECTING JET -WATERJET NOZZLE, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a liquid jet nozzle, and more particularly to a liquid jet nozzle which causes the fluid exiting the nozzle to have a fan pattern.

[0003] Numerous types of nozzles for fluids are presently known, and are used for various different purposes. For example, U.S. Patent Application Publication No. US2003/0015604 discloses a nozzle to promote a flat fluid stream. The nozzle of this reference relates to an atomizing nozzle for injecting fuel into, for example, a furnace. In this nozzle, a central liquid stream is impacted on two sides by air jets in order to shape the spray pattern of the liquid stream.

[0004] U.S. Patent No. 6,267,301 also shows an atomizing nozzle. In this construction once again, two air flow paths are directed toward a central liquid flow to shape the spray pattern of the liquid.

[0005] U.S. Patent No. 6,161,778 also shows an atomizing nozzle. In this construction, however, the mixed flow of air and liquid exits from two orifices that are directed toward one another.

[0006] U.S. Patent No. 5,435,491 teaches another type of spray nozzle which produces a fan-shaped pattern by surrounding the central liquid emitting orifice with air emitting orifices so that the compressed air changes the shape of the spray pattern.

[0007] All of the above discussed references utilize air and a liquid and are intended for relatively low nozzle discharge pressures.

[0008] A nozzle for a different purpose is disclosed in U.S. Patent No. 3,927,833. This nozzle is intended for providing a mixed spray of a plural component liquid resin and a curing agent with granular and fiber material entrained in the mixed spray.

[0009] The nozzle of the present invention is intended for use as a waterjet cutting nozzle. Such a nozzle and the equipment it is used with is disclosed in U.S. Patent Application Publication No. U.S. 2002/0066345. As can be seen from this reference, a typical waterjet system includes a waterjet head that is supplied with liquid at an ultra high pressure, for example, 10,000-60,000 per square inch. The ultra high pressure liquid is discharged from the head in a high velocity stream against the work piece. The liquid stream is used to cut through the work piece.

[0010] A conventional waterjet nozzle has a round sapphire orifice. A known problem encountered with us-

ing such a nozzle is a taper being formed at the cut. In order to address this problem, fan jet nozzles have been used which provide a fan-shaped stream. These known nozzles are not durable and have a limited life span when used at pressures above 20,000 pounds per square inch (psi). The life expectancy of presently available fan jets above 20,000 psi (more importantly in the 30,000-40,000 psi range) is nowhere near what commercially available round sapphire orifice nozzles can produce.

SUMMARY OF THE INVENTION

[0011] Accordingly, it is an object of the present invention to provide a waterjet nozzle that outputs a fan-shaped stream and has a working life expectancy that is greater than existing fan jet nozzles.

[0012] Pursuant to this object, and others which will become apparent hereafter, one aspect of the present invention resides in a waterjet nozzle constructed to have two round water jets directed toward one another so that fluid leaving the jets intersects to form a fan jet pattern. By creating the fan jet pattern with two round orifices, namely, round sapphire orifices, the fan jet nozzle of the invention has a much longer useful life than conventional fan jet nozzles at operating pressures above 20,000 psi.

[0013] Furthermore, due to the highly cohesive nature of the round jets formed prior to intersection, the resulting combined or intersected jet retains a very high percentage of the energy available prior to intersection.

[0014] Additionally, it is an easy matter to vary the resulting angle of the fan jet by changing the angle between the nozzles forming the round jets.

[0015] Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Fig. 1 is a cross-section through the inventive nozzle;

[0017] Fig. 2 is a view of the fan jet along the arrow A in Fig. 1; and

[0018] Fig. 3 is a schematic view of the pattern of the fan jet produced by the inventive nozzle.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Fig. 1 shows a cross-section through the fan jet nozzle 1 of the present invention. The nozzle 1 has a housing 2 with a central channel 3 via which water enters the nozzle and an outlet 4 via which the formed fan jet 5 exits the nozzle. A subnozzle 6 is arranged in the central channel 3 and has two converging sections 7. The subnozzle 6 has a round sapphire orifice 8 arranged in each converging section 7 for forming a round

jet 9. The orifices 8 are arranged on converging axes so that the two round water jets 9 leaving the orifices 8 collide with one another at a distance from the exit of the orifices 8. By properly aligning the orifices 8 of the subnozzle 6 the horizontal component of the left orifice in Fig. 1 cancels the corresponding horizontal component of the right orifice. This results in a combined jet 5 that consists completely of vertical components of the two round forming jets 9. Also, the resulting combined jet 5 is substantially at the center space between the two initial forming jets 9.

[0020] The resulting single vertical jet 5 is shown in Fig. 2, where it is seen to have a fan-shape, instead of remaining circular. The angle α of the fan jet results from the intersection of the forming jets 9 and is mainly a function of the angle θ between the initial forming jets 9.

[0021] Although the round orifices can be constructed of any suitable material, sapphire is desirable due to its relatively long working life.

[0022] Fig. 3 is a top view of the fan jet 5 produced by the intersecting initial jets 9.

[0023] Although the present invention has been described in relation to particular embodiments thereof, many other variations and modifications and other uses will become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

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Claims

1. A liquid fan jet nozzle, comprising:

a housing having a central passage with an inlet and an outlet; and
a subnozzle arranged in the central passage, the subnozzle having two round orifices arranged along converging axes so that round liquid jets exiting the round orifices collide at a distance from the orifices and form a fan-shaped jet.

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2. The nozzle according to claim 1, wherein the round orifices are sapphire orifices.

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3. The nozzle according to claim 1, wherein the round orifices of the subnozzle are aligned so that a horizontal component of a first of the orifices cancels a horizontal component of a second of the orifices.

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4. The nozzle according to claim 3, wherein an angle that encompasses the fan jet is a function of an angle between the converging axes of the round orifices in the subnozzle.

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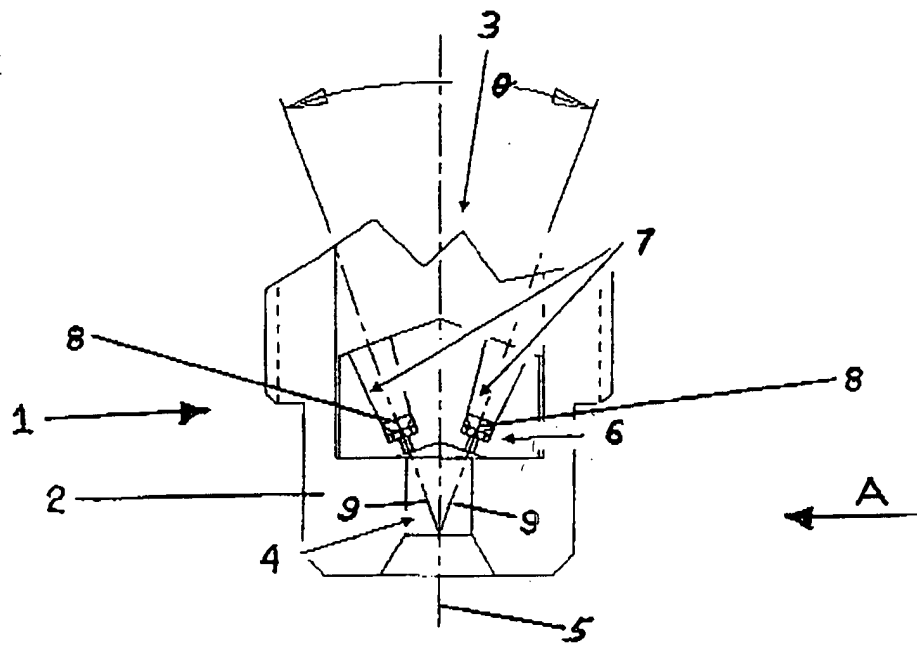


Fig. 1

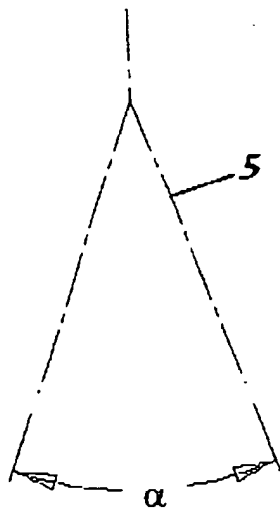


Fig. 2

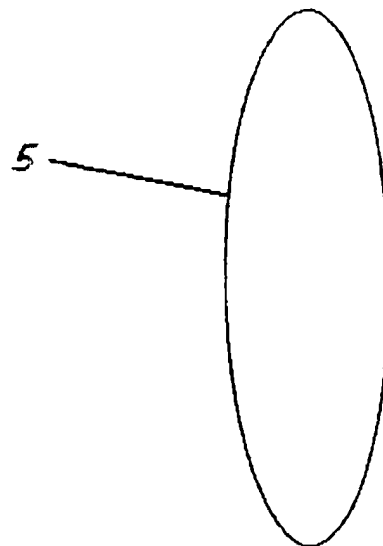


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 04 02 5521

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 February 2005	Examiner Thanbichler, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 02 5521

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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