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(54) **HYDROENTANGLING JET STRIP DEVICE  
DEFINING AN ORIFICE**

6,668,436 B2 12/2003 Noelle et al.  
2004/0010894 A1\* 1/2004 Goldwasser et al. .... 28/104  
2005/0273989 A1\* 12/2005 Dixon et al. .... 28/104

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FOREIGN PATENT DOCUMENTS

WO WO 2005/123616 A2 12/2005  
WO WO 2006/063110 \* 6/2006

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OTHER PUBLICATIONS

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 377 days.

Begenir et al., "The Role of Orifice Design in Hydroentanglement", Master of Science Thesis, North Carolina State University, Raleigh, 2002.

Ghassemieh et al., "Effect of Nozzle Geometry on the Flow Characteristics of Hydroentangling Jets", *Textile Res. J.*, 2003, pp. 444-450, vol. 73 No. 5.

Tafreshi et al., "The Effects of Nozzle Geometry on Waterjet Breakup at High Reynolds Numbers", *Experiments in Fluids*, 2003, pp. 364-371, vol. 35.

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\* cited by examiner

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(51) **Int. Cl.**  
**B24C 5/04** (2006.01)

(57) **ABSTRACT**

(52) **U.S. Cl.** ..... **451/102; 451/40**

(58) **Field of Classification Search** ..... 451/102,  
451/75, 38-40; 28/104-106, 167; 239/266,  
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A hydroentangling jet strip device is provided, wherein such a device comprises a plate member having opposing sides and defining at least one nozzle orifice extending between the opposing sides. Each of the at least one nozzle orifice includes an axially-extending capillary portion having an aspect ratio between a length of the capillary portion and a diameter of the capillary portion, wherein the aspect ratio is less than about 0.70 so as to be capable of providing a cavitation-free constricted waterjet.

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,403,862 A \* 10/1968 Dworjanyan ..... 239/566  
4,805,275 A 2/1989 Suzuki et al.  
4,880,168 A \* 11/1989 Randall et al. .... 239/553.5  
6,063,717 A \* 5/2000 Ishiyama et al. .... 442/387

**17 Claims, 12 Drawing Sheets**

