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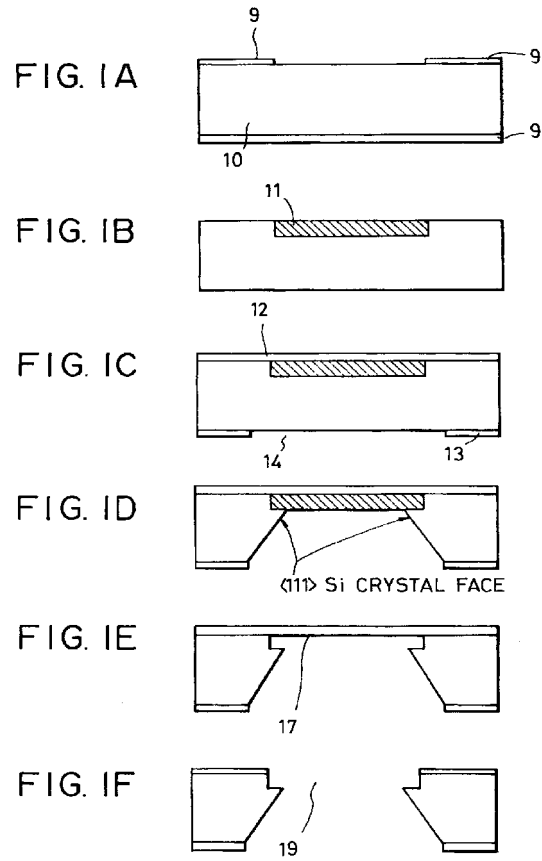
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(54) Method of producing a through-hole, silicon substrate having a through-hole, device using such a substrate, method of producing an ink-jet print head, and ink-jet print head

(57) The invention provides a method of producing a through-hole, a substrate used to produce a through-hole, a substrate having a through-hole, and a device using such a through-hole or a substrate having such a through-hole, which are characterized in that: a through-hole can be produced only by etching a silicon substrate from its back side; the opening length d can be precisely controlled to a desired value regardless of the variations in the silicon wafer thickness, and the orientation flat angle, and also regardless of the type of a silicon crystal orientation-dependent anisotropic etchant employed; high productivity, high production reproducibility, and ease of production can be achieved; a high-liberality can be achieved in the shape of the opening end even if temperature treatment is performed at a high temperature for a long time; and a high-precision through-hole can be produced regardless of the shape of a device formed on the surface of a substrate. The method of producing a through-hole comprises the steps of: (a) forming a dummy layer on the principal sur-

face of the substrate at a location where the through-hole will be formed, the dummy layer being capable of being selectively etched without etching the material of the substrate; (b) forming a passivation layer having resistance to an etching process on the substrate in such a manner that the dummy layer is covered with the passivation layer; (c) forming an etching mask layer on the back surface of the substrate, the etching mask layer having an opening corresponding to the dummy layer; (d) etching the substrate by means of a crystal orientation-dependent anisotropic etching process until the dummy layer is exposed via the opening; (e) removing the dummy layer by etching the dummy layer from the part which has been exposed in the step of etching the substrate; and (f) partially removing the passivation layer so as to form a through-hole.

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 4 784 721 A (HOLMEN JAMES O ET AL) 15 November 1988 (1988-11-15) * the whole document *	1,16,30, 32,47	B41J2/16
A	EP 0 609 012 A (HEWLETT PACKARD CO) 3 August 1994 (1994-08-03) * abstract * * column 6, line 5 - column 9, line 9 * * figures 4-6 *	30,32,47	
A	US 5 308 442 A (TAUB HOWARD H ET AL) 3 May 1994 (1994-05-03) * the whole document *	30,32,47	
P,A	EP 0 750 992 A (CANON KK) 2 January 1997 (1997-01-02) * the whole document *	30,32,47	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B41J
Place of search	Date of completion of the search	Examiner	
THE HAGUE	12 January 2000	Didenot, B	
CATEGORY OF CITED DOCUMENTS		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	
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 97 11 9648

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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12-01-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4784721 A	15-11-1988	CA 1295055 A	28-01-1992
		DE 68919870 D	26-01-1995
		DE 68919870 T	29-06-1995
		EP 0330105 A	30-08-1989
		JP 1309384 A	13-12-1989
EP 0609012 A	03-08-1994	US 5387314 A	07-02-1995
		DE 69403352 D	03-07-1997
		DE 69403352 T	18-09-1997
		JP 6238904 A	30-08-1994
		US 5441593 A	15-08-1995
		US 5608436 A	04-03-1997
US 5308442 A	03-05-1994	DE 69401134 D	30-01-1997
		DE 69401134 T	03-04-1997
		EP 0609011 A	03-08-1994
		HK 91597 A	01-08-1997
		JP 7001738 A	06-01-1995
EP 0750992 A	02-01-1997	JP 9011479 A	14-01-1997
		AU 5626996 A	09-01-1997
		AU 7868198 A	01-10-1998
		CA 2179869 A	31-12-1996
		CN 1145305 A	19-03-1997