

EXHIBIT 7

(12) **United States Patent**
Hanaoka et al.

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(54) **LIQUID CRYSTAL DISPLAY**
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Related U.S. Application Data
 (60) Continuation of application No. 12/261,788, filed on Oct. 30, 2008, now Pat. No. 7,872,719, which is a division of application No. 11/029,965, filed on Jan. 5, 2005, now Pat. No. 7,499,132, which is a division of application No. 10/095,626, filed on Mar. 12, 2002, now Pat. No. 6,977,704.

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G02F 1/1337 (2006.01)

(52) **U.S. Cl.**
 USPC **349/129**; 349/93; 349/130
 (58) **Field of Classification Search**
 USPC 349/129
 See application file for complete search history.

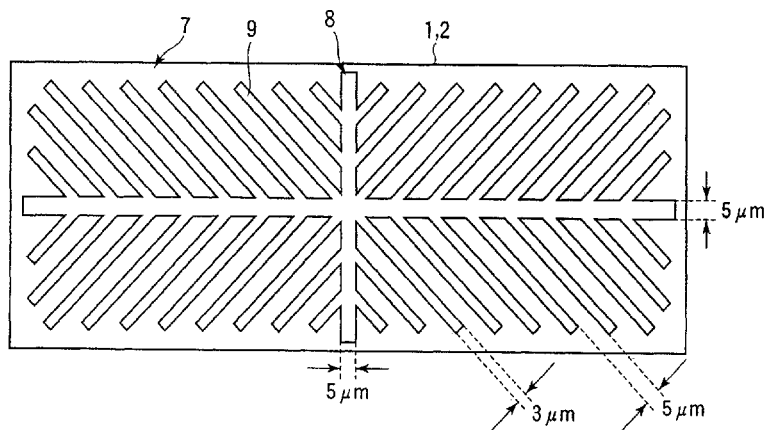
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(57) **ABSTRACT**
 A liquid crystal display including a pair of substrates arranged opposite to each other to form a gap; spaced vertical alignment films formed on the substrate in the gap; a cured material formed on at least one of the alignment films in the gap; and a liquid crystal layer of liquid crystal molecules. The display also includes a pixel electrode formed on one of the substrates in a pixel region and having either a plurality of elongated members arranged with spaces therebetween and connected by a connecting member or a plurality of elongated openings arranged in patterns. Finally, the cured material is at least formed on the vertical alignment films so that an alignment direction of at least the liquid crystal molecules adjacent the alignment films is regulated.

17 Claims, 52 Drawing Sheets



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FIG.1A

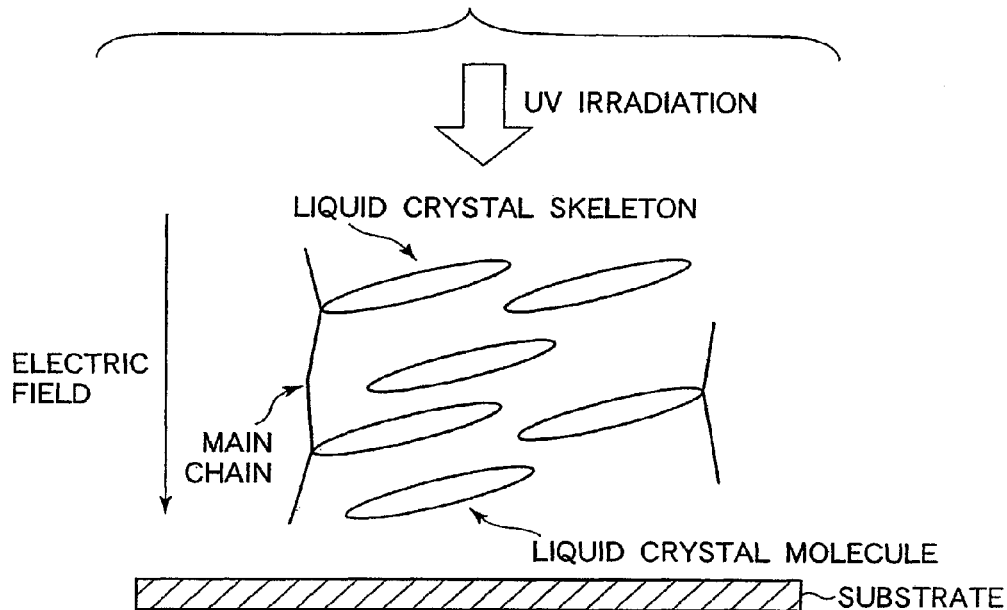


FIG.1B

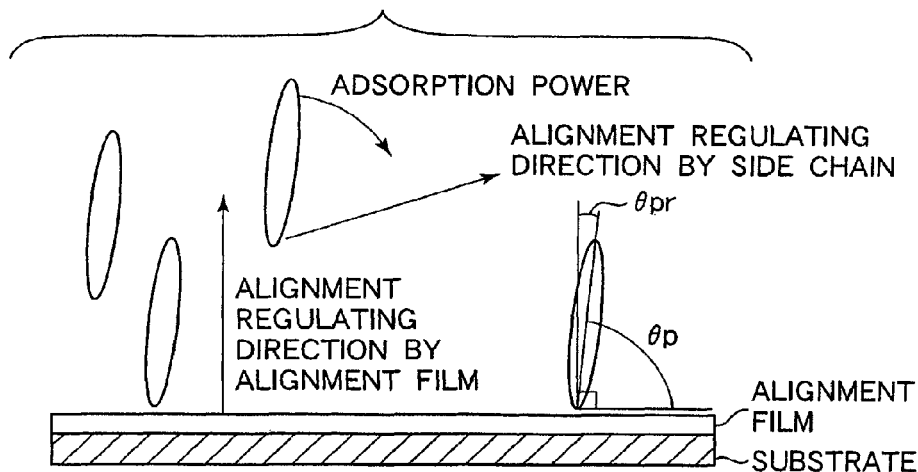


FIG.2

MODE	TN	a-TN	ECB (HORIZONTAL)	OCB	IPS	ASM	FLC	MVA
INTERFACE ALIGNMENT PROCESSING	PERFORMED	NOT PERFORMED	PERFORMED	PERFORMED	PERFORMED	NOT PERFORMED	PERFORMED	NOT PERFORMED
MAIN EFFECT	FIXATION OF DISCRIMINATION (AT A TIME OF ALIGNMENT DIVISION) HIGH PRE-TILT	SUPPRESSION OF REVERSE OF TILT	IMPARTING OF TILTING POWER TOWARD RISING DIRECTION	FIXATION OF BEND ORIENTATION	IMPARTING OF TILTING POWER TOWARD SWITCHING DIRECTION	FIXATION OF AXIS SYMMETRY ALIGNMENT ERASURE OF PROPAGATION OF TILT	DISAPPEARANCE OF BISTABILITY (MULTI- GRADATION DISPLAY) SUPPORTION OF CHEVRON STRUCTURE	APPEARANCE OF BULK TILT ERASURE OF DEVIATION IN ORIENTATION ANGLE DIRECTION OF PROPAGATION OF TILT
RESPONSE SPEED IMPROVEMENT	X~Δ	Δ	Δ~O	X	Δ	O	X	⊙
PRODUCED PROBLEM	DROP IN OPTICAL ROTATORY POWER DROP IN CONTRAST	DROP IN OPTICAL ROTATORY POWER DROP IN CONTRAST	DETERIORATION IN BLACK LUMINANCE	DROP IN RESPONSE SPEED DROP IN TRANSMITTANCE SCATTERING	DETERIORATION IN BLACK LUMINANCE DROP IN TRANSMITTANCE	(DIFFICULT IF THERE IS NO PS)	DROP IN RESPONSE SPEED DECREASE OF TILT ANGLE	ALIGNMENT DISTURBANCE AROUND SINGULAR POINT
USE VALUE	X	Δ	Δ	X	X	⊙	X	⊙
TOTAL PERFORMANCE OF PS	X	Δ	Δ	X	X	⊙	O	⊙

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