

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

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(54) **IPS-LCD HAVING A THIRD ELECTRODE HAVING APERTURE AND FORMED ON COUNTER SUBSTRATE**

(75) Inventors: **Jin-Tae Yuh**, Kyungki-do (KR);  
**Kye-Hun Lee**, Kyungki-do (KR);  
**Byoung-Sun Na**, Kyungki-do (KR);  
**Dong-Gyu Kim**, Kyungki-do (KR);  
**Jong-Woong Chang**, Kyungki-do (KR);  
**Jung-Uk Shim**, Kyungki-do (KR);  
**Jang-Kun Song**, Seoul (KR);  
**Hyun-Sik Lee**, Seoul (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon (KR)

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Mar. 12, 1998	(KR)	98-8233
Mar. 12, 1998	(KR)	98-8235

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(52) **U.S. Cl.** ..... **349/141**

(58) **Field of Search** ..... 349/141, 38, 39, 349/139, 143

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*Primary Examiner*—Toan Ton

(74) *Attorney, Agent, or Firm*—McGuireWoods LLP; Hae-Chan Park

(57) **ABSTRACT**

A liquid crystal display having electrodes on a single substrate. A transparent planar electrode elongated in the transverse direction is formed on the inner surface of a substrate, and an insulating film is deposited thereon. A plurality of linear electrodes, which are elongated in the longitudinal direction and either transparent or opaque, are formed on the insulating film. Potential difference between the planar and the linear electrodes generated by applying voltages to the electrodes yields an electric field. The electric field is symmetrical with respect to the longitudinal central line of the linear electrodes and the longitudinal central line of a region between the linear electrodes, and has parabolic or semi-elliptical lines of force having a center on a boundary line between the planar and the linear electrodes. The line of force on the planar and the linear electrodes and on the boundary line between the planar and the linear electrodes has the vertical and the horizontal components, and the liquid crystal molecules are re-arranged to have a twist angle and an tilt angle. The polarization of the incident light varies due to the rearrangement of the liquid crystal molecules.

**13 Claims, 73 Drawing Sheets**

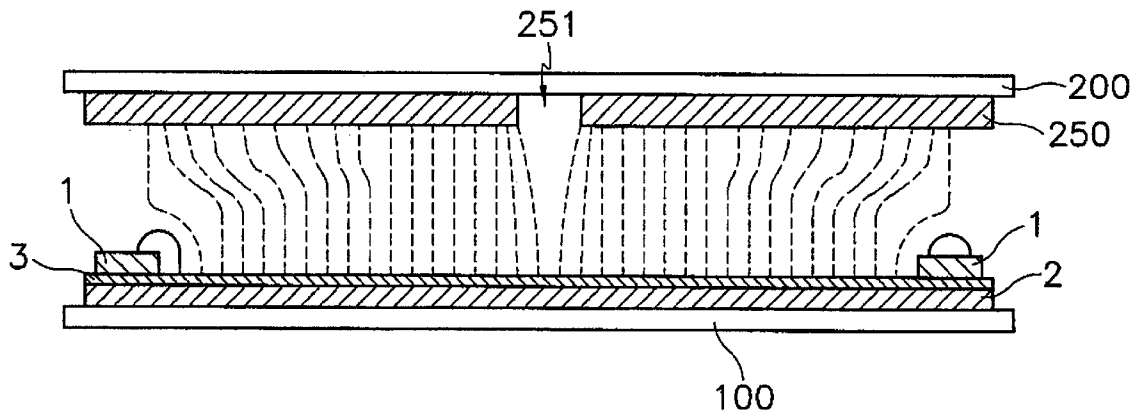


FIG. 1

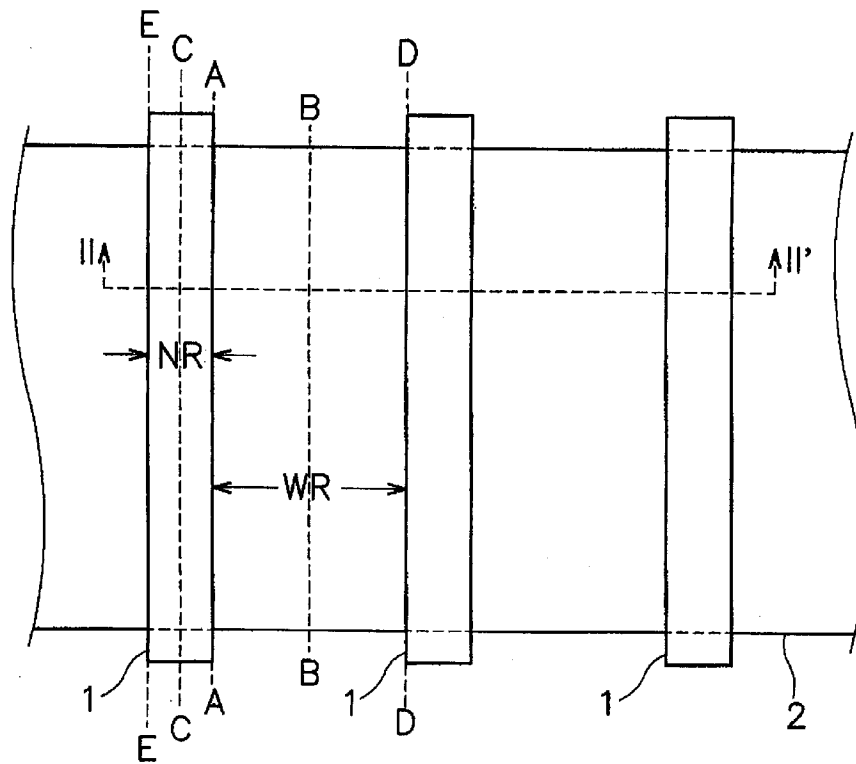


FIG. 2

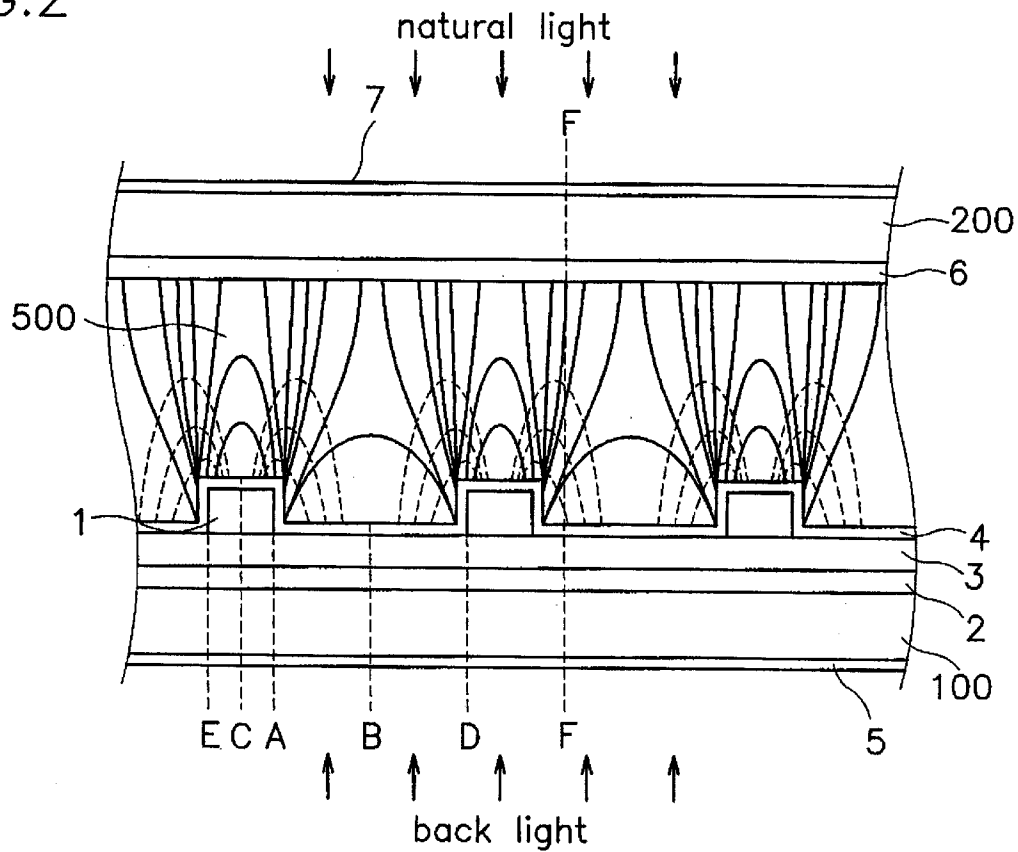


FIG.3

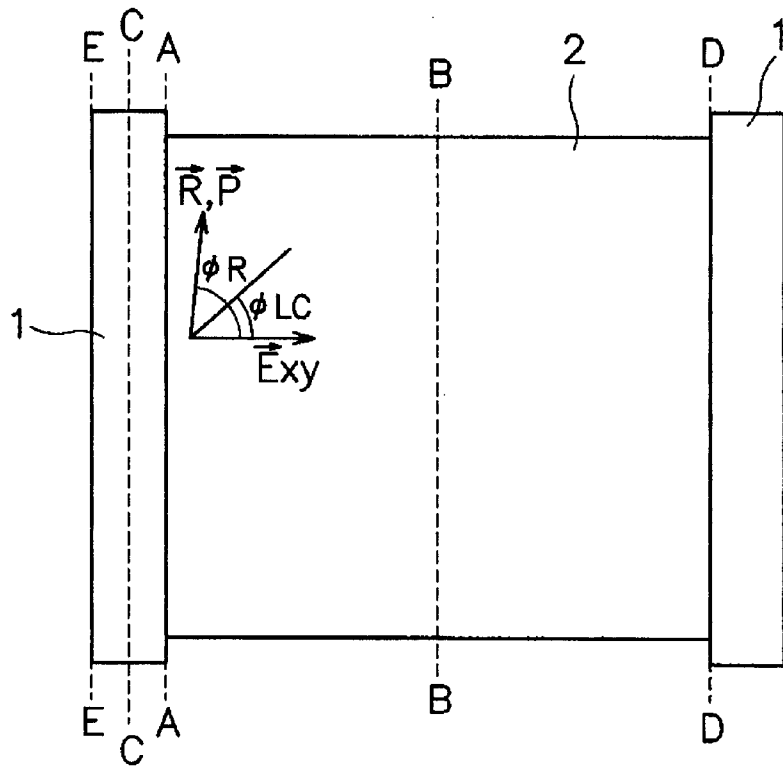


FIG.4

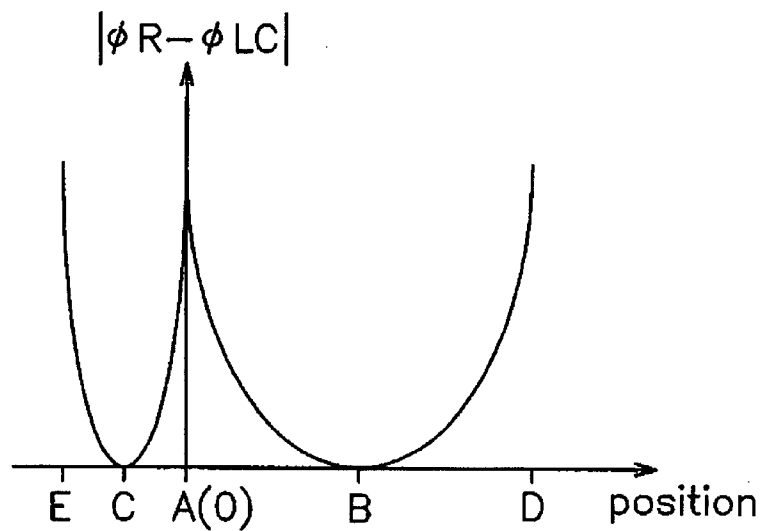


FIG.5

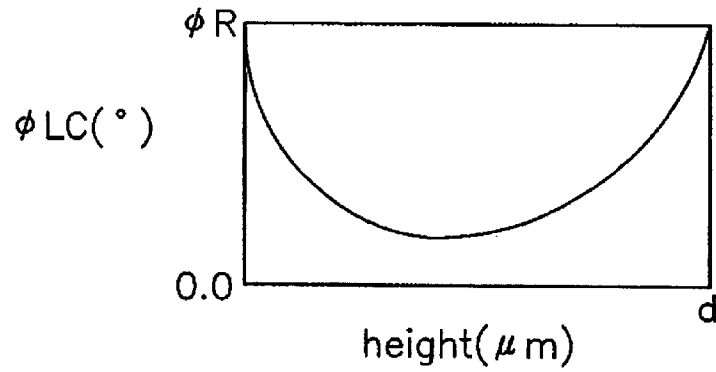


FIG.6

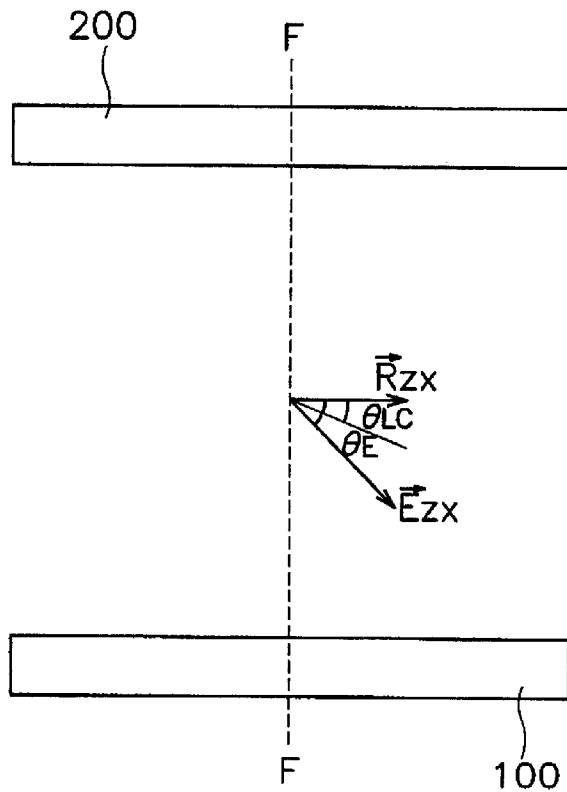


FIG.7

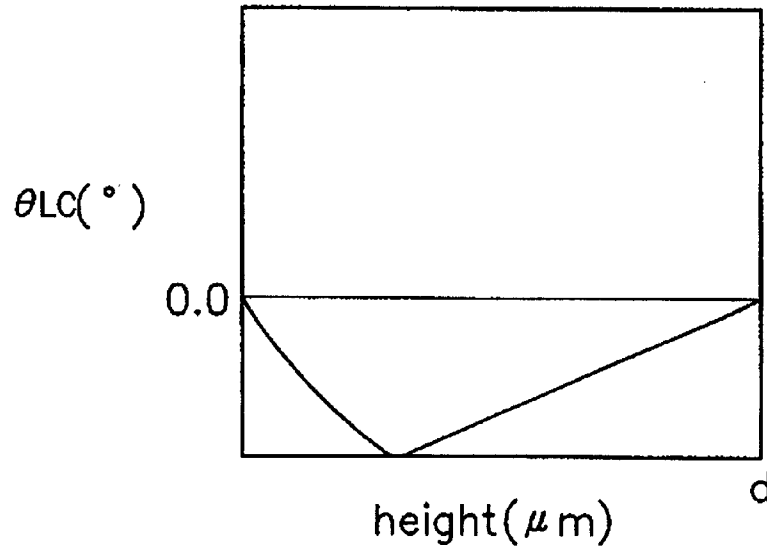
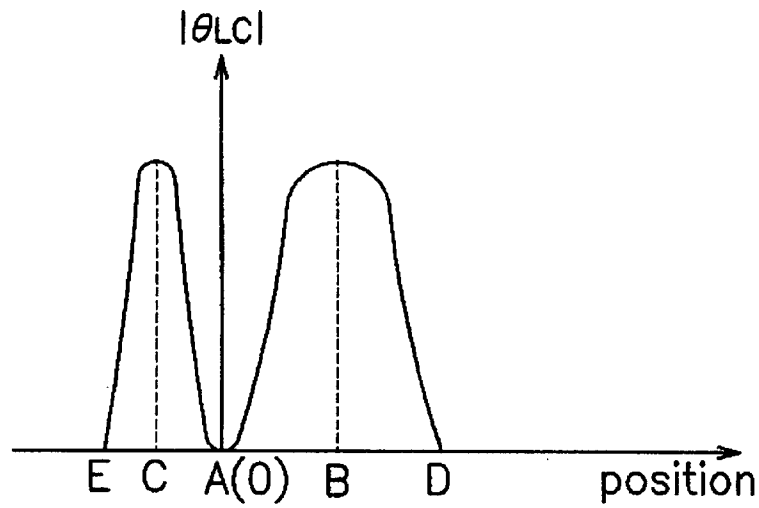


FIG.8



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