

EXHIBIT 4

(12) **United States Patent**
Sasabayashi et al.(10) **Patent No.:** **US 8,044,907 B2**(45) **Date of Patent:** **Oct. 25, 2011**(54) **LIQUID CRYSTAL DISPLAY AND METHOD OF MANUFACTURING THE SAME**(75) Inventors: **Takashi Sasabayashi**, Kawasaki (JP); **Arihiro Takeda**, Sagamihara (JP); **Hiroyasu Inoue**, Kawasaki (JP); **Kazuya Ueda**, Kawasaki (JP); **Yoshio Koike**, Kawasaki (JP); **Hideaki Tsuda**, Kawasaki (JP); **Yasutoshi Tasaka**, Kawasaki (JP); **Hidefumi Yoshida**, Kawasaki (JP); **Kunihiro Tashiro**, Kawasaki (JP); **Tsuyoshi Kamada**, Kawasaki (JP); **Kimiaki Nakamura**, Kawasaki (JP)(73) Assignee: **Sharp Kabushiki Kaisha**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/961,009**(22) Filed: **Dec. 6, 2010**(65) **Prior Publication Data**

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Related U.S. Application Data

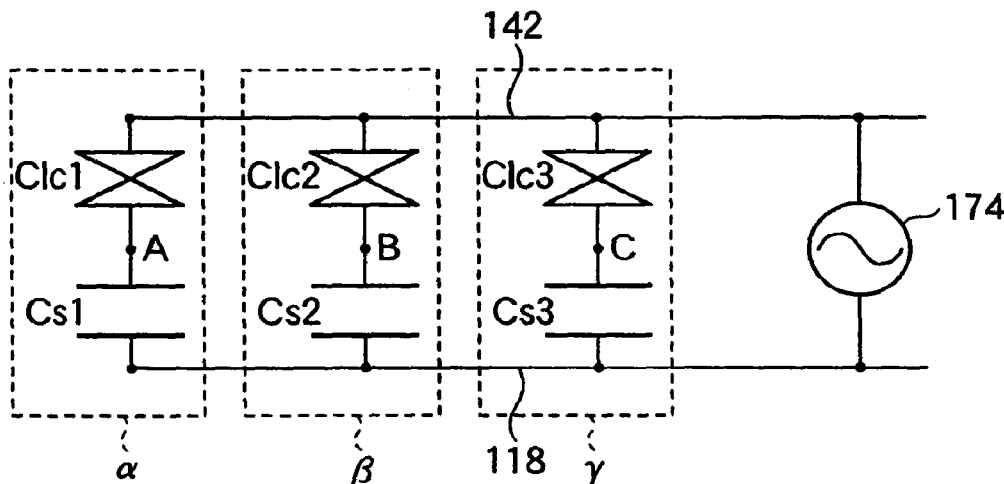
(62) Division of application No. 12/827,030, filed on Jun. 30, 2010, which is a division of application No. 11/299,799, filed on Dec. 12, 2005, now Pat. No. 7,859,500, which is a division of application No. 10/796,783, filed on Mar. 9, 2004, now Pat. No. 7,262,824.

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G09G 3/36 (2006.01)(52) **U.S. Cl.** **345/92**; 345/87; 345/89; 345/90; 345/204; 349/42; 349/144(58) **Field of Classification Search** 345/87-100, 345/204, 211-213, 690; 349/42, 43, 144
See application file for complete search history.(56) **References Cited****U.S. PATENT DOCUMENTS**4,840,460 A * 6/1989 Bernot et al. 349/144
(Continued)**FOREIGN PATENT DOCUMENTS**EP 0 884 626 12/1998
(Continued)*Primary Examiner* — Quan-Zhen Wang*Assistant Examiner* — Jennifer T Nguyen(74) *Attorney, Agent, or Firm* — Greer, Burns & Crain, Ltd.(57) **ABSTRACT**

A liquid crystal display including two substrates, gate bus lines, liquid crystal molecules, and a polymer that determines directions in which the liquid crystal molecules tilt. A plurality of divisional areas are arranged on one of the substrates. The pixels are aligned in a column between drain bus lines. A pixel electrode is formed at each of the divisional areas. A first thin film transistor drives a first divisional area, and a second thin film transistor drives a second divisional area of the same column. The first and second thin film transistors are electrically connected to the same gate bus line. Either the pixel electrodes formed at each of the divisional areas are electrically insulated from each other, or they are connected to each other through a high resistance. A first threshold voltage within the first divisional area is different from a second threshold voltage of the second divisional area.

8 Claims, 57 Drawing Sheets

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U.S. PATENT DOCUMENTS

5,204,659 A * 4/1993 Sarma 345/89
 5,319,480 A * 6/1994 McCartney 349/85
 5,321,535 A 6/1994 Ukai et al.
 5,477,351 A 12/1995 Takahara et al.
 5,519,519 A 5/1996 Nakajima et al.
 5,559,615 A 9/1996 Takei et al.
 5,897,187 A 4/1999 Aoki et al.
 5,923,311 A * 7/1999 Edwards 345/92
 5,969,781 A 10/1999 Matsuyama et al.
 6,081,315 A 6/2000 Matsuyama et al.
 6,306,469 B1 10/2001 Serbutoviez et al.
 RE37,591 E 3/2002 Shimada et al.
 6,507,381 B1 1/2003 Katsuya et al.
 6,633,356 B1 10/2003 Kataoka et al.
 6,710,827 B2 3/2004 Kubo et al.
 6,781,665 B2 8/2004 Nakanishi et al.
 6,856,373 B2 2/2005 Sekido et al.
 7,262,824 B2 8/2007 Sasabayashi et al.
 7,286,200 B2 10/2007 Inoue et al.
 7,289,178 B2 10/2007 Sasabayashi et al.

7,511,789 B2 3/2009 Inoue et al.
 2001/0020992 A1 9/2001 Takeda et al.
 2001/0030726 A1 10/2001 Yoshida et al.
 2002/0050966 A1 * 5/2002 Asao et al. 345/87
 2003/0048401 A1 3/2003 Hanaoka et al.
 2003/0058374 A1 3/2003 Takeda et al.
 2003/0095229 A1 5/2003 Inoue et al.
 2003/0160750 A1 8/2003 Ueda et al.
 2006/0097972 A1 * 5/2006 Takeuchi et al. 345/90

FOREIGN PATENT DOCUMENTS

JP 11-242225 9/1999
 JP 11-326927 11/1999
 JP 2000-356773 12/2000
 JP 2002-229518 8/2002
 JP 2002-357830 12/2002
 JP 2003-177408 6/2003
 JP 2003-255305 9/2003
 JP 2003-287755 10/2003
 KR 2000-0028957 5/2000

* cited by examiner

FIG.1A

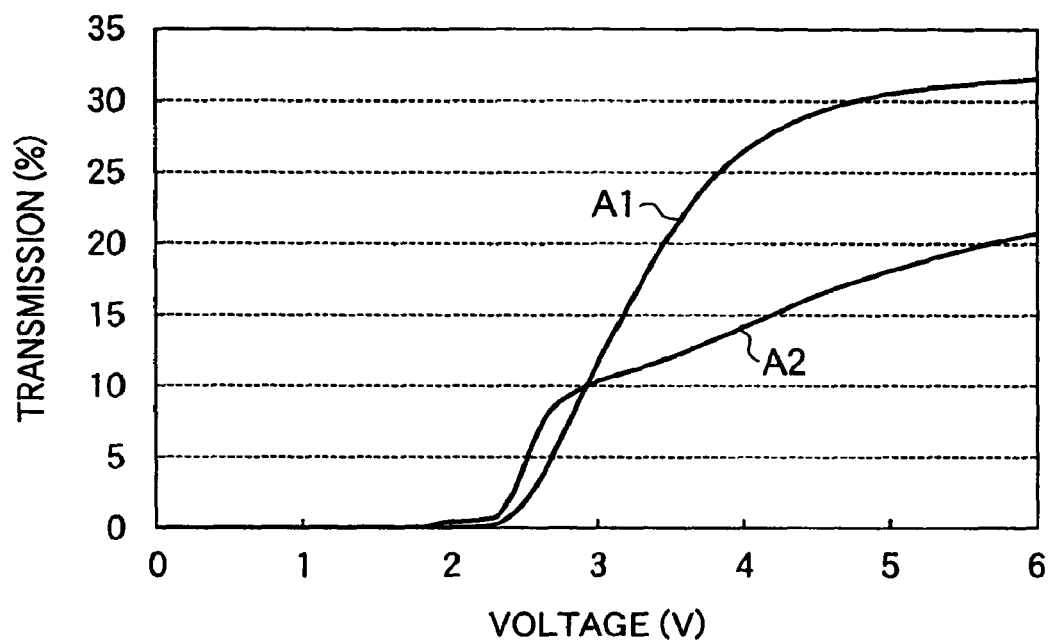


FIG.1B

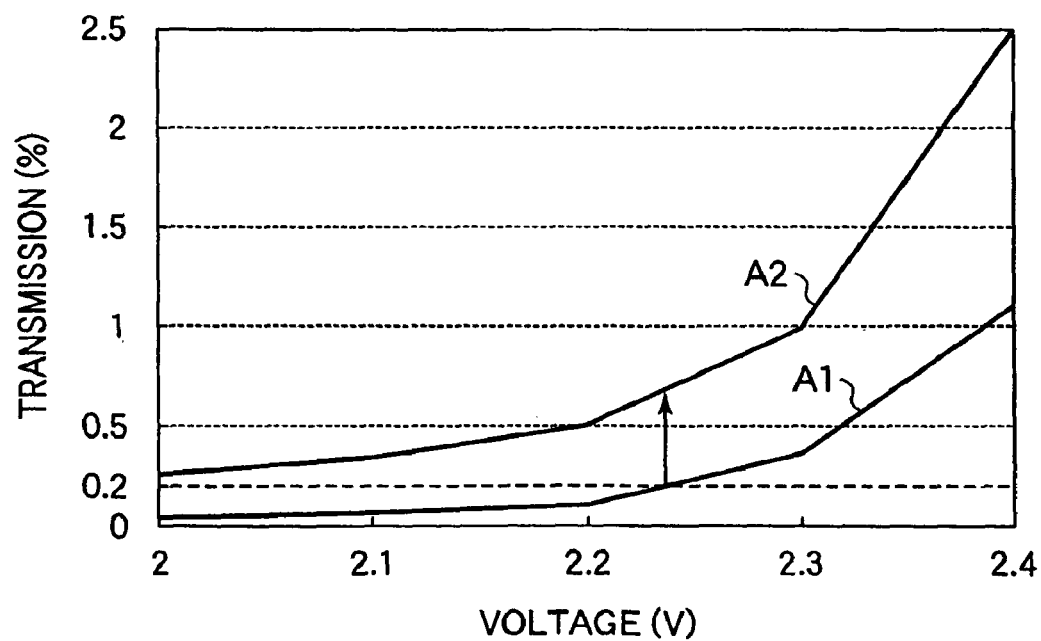


FIG.2

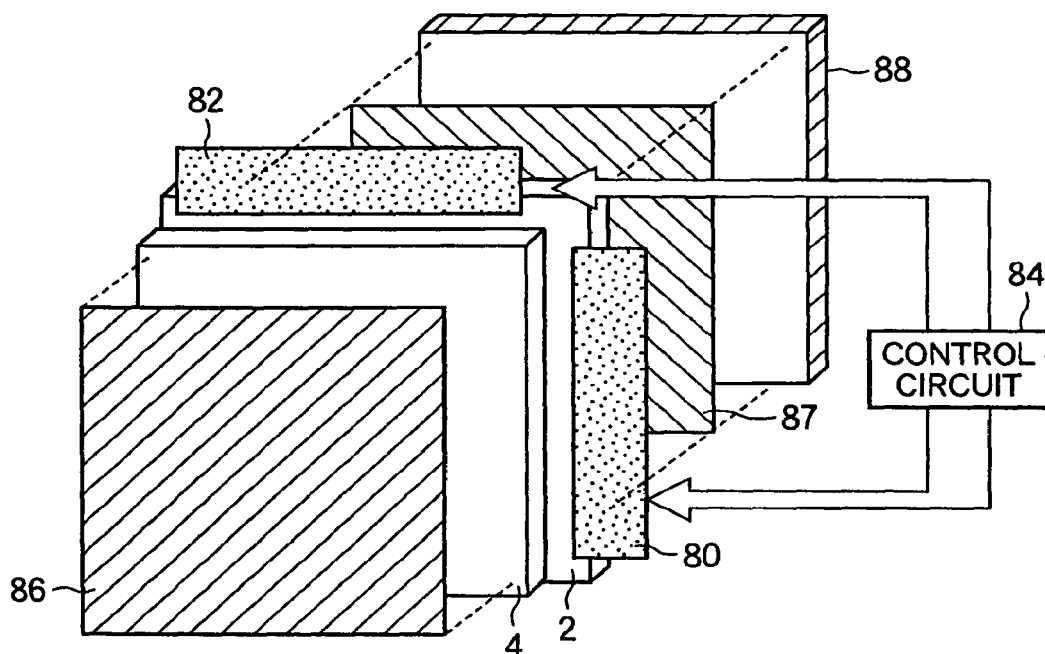
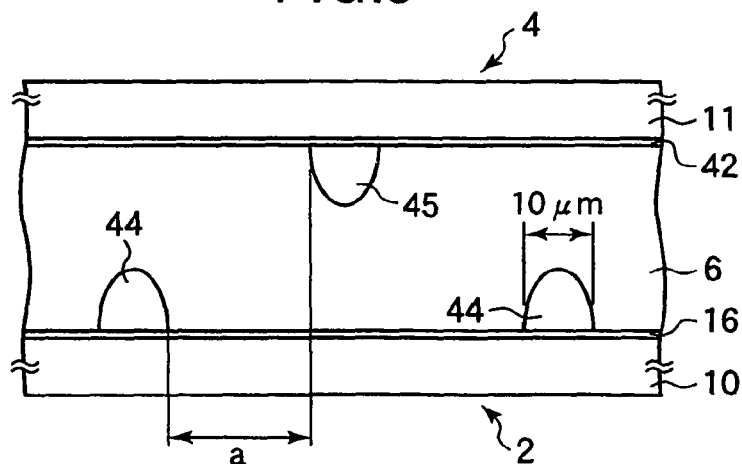


FIG.3



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