US010330989B2

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

(10) **Patent No.: US 10,330,989 B2**
(45) **Date of Patent: Jun. 25, 2019**

(54) **LIQUID CRYSTAL DISPLAY DEVICE, DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF**

(71) Applicants: **Japan Display Inc.**, Tokyo (JP); **Panasonic Liquid Crystal Display Co., Ltd.**, Hyogo-ken (JP)

(72) Inventors: **Yoshiaki Nakayoshi**, Ooamishirasato (JP); **Kazuhiko Yanagawa**, Mobara (JP)

(73) Assignees: **JAPAN DISPLAY INC.**, Tokyo (JP); **PANASONIC LIQUID CRYSTAL DISPLAY CO., LTD.**, Hyogo-Ken (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 300 days.

(21) Appl. No.: **15/271,422**

(22) Filed: **Sep. 21, 2016**

(65) **Prior Publication Data**

US 2017/0010509 A1 Jan. 12, 2017

Related U.S. Application Data

(60) Continuation of application No. 14/942,120, filed on Nov. 16, 2015, now Pat. No. 9,488,880, which is a (Continued)

(30) **Foreign Application Priority Data**

Oct. 15, 2001 (JP) 2001-317149

(51) **Int. Cl.**
G02F 1/13 (2006.01)
G02F 1/1333 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G02F 1/134309*** (2013.01); ***G02F 1/1343*** (2013.01); ***G02F 1/1368*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G02F 1/134309; G02F 1/133345; G02F 1/1343
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,060,036 A 10/1991 Choi
5,185,601 A 2/1993 Takeda et al.
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1242854 A 3/1999
JP 2000-08408 9/1998
(Continued)

OTHER PUBLICATIONS

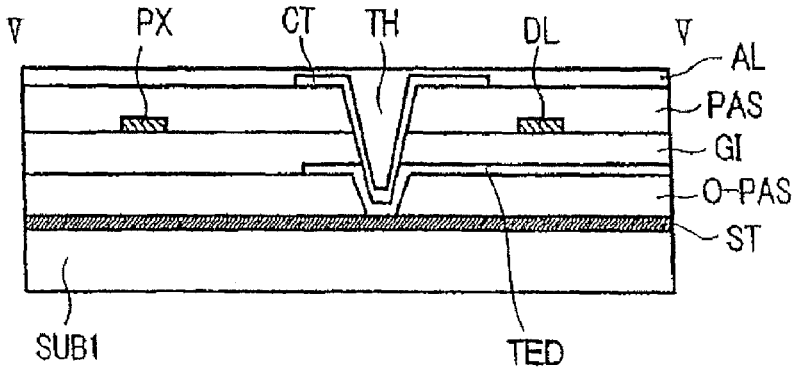
JPO Office Action dated Apr. 8, 2018, in Japanese.
Chinese Office Action dated May 9, 2008 regarding Chinese Patent Application No. 2007100057283, in Chinese.

Primary Examiner — Lucy P Chien
(74) *Attorney, Agent, or Firm* — Juan Carlos A. Marquez; Marquez IP Law Office, PLLC

(57) **ABSTRACT**

Image display device having an electrode forming layer which includes a plurality of gate lines, a plurality of drain lines, a plurality of switching elements and the a plurality of pixel electrodes, and having reference electrode layer between the electrode forming layer and a substrate where the electrode forming layer formed thereon, and the reference electrode layer and the electrode forming layer are insulated by insulating layer.

2 Claims, 63 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/708,348, filed on May 11, 2015, now Pat. No. 9,213,204, which is a continuation of application No. 14/285,006, filed on May 22, 2014, now Pat. No. 9,086,600, which is a continuation of application No. 13/927,539, filed on Jun. 26, 2013, now Pat. No. 8,760,609, which is a continuation of application No. 13/650,203, filed on Oct. 12, 2012, now Pat. No. 8,493,522, which is a continuation of application No. 13/364,092, filed on Feb. 1, 2012, now Pat. No. 8,310,641, which is a continuation of application No. 12/926,735, filed on Dec. 7, 2010, now Pat. No. 8,248,549, which is a continuation of application No. 12/292,728, filed on Nov. 25, 2008, now Pat. No. 7,872,696, which is a division of application No. 11/976,884, filed on Oct. 29, 2007, now Pat. No. 7,605,876, which is a division of application No. 11/409,076, filed on Apr. 24, 2006, now Pat. No. 7,307,673, which is a division of application No. 11/211,574, filed on Aug. 26, 2005, now Pat. No. 7,423,701, which is a division of application No. 10/237,911, filed on Sep. 10, 2002, now Pat. No. 6,970,222.

(51) **Int. Cl.**

G02F 1/1343	(2006.01)
G02F 1/1362	(2006.01)
G02F 1/1368	(2006.01)

(52) **U.S. Cl.**

CPC ***G02F 1/13439*** (2013.01); ***G02F 1/133345*** (2013.01); ***G02F 1/136213*** (2013.01); ***G02F 1/136286*** (2013.01); *G02F 1/13* (2013.01); *G02F 2201/123* (2013.01); *G02F 2201/40* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,668,379	A		9/1997	Ono et al.
5,686,980	A		11/1997	Hirayama et al.
5,742,365	A		4/1998	Seo
5,745,207	A		4/1998	Asada et al.
5,771,082	A		6/1998	Chaudet et al.
5,892,562	A		4/1999	Yamazaki et al.
5,914,762	A		6/1999	Lee et al.
5,946,066	A		8/1999	Lee et al.
6,001,539	A	*	12/1999	Lyu H01L 27/1214 430/317
6,069,678	A		5/2000	Sakamoto et al.
6,233,034	B1		5/2001	Lee et al.
6,256,081	B1		7/2001	Lee et al.
6,259,502	B1		7/2001	Komatsu
6,266,116	B1		7/2001	Ohta et al.
6,285,429	B1		9/2001	Nishida et al.
6,335,148	B2		1/2002	Lee et al.
6,337,726	B1		1/2002	Kawano et al.
6,356,330	B1		3/2002	Ando et al.
6,362,858	B1		3/2002	Jeon et al.
6,380,672	B1		4/2002	Yudasaka
6,404,470	B1		6/2002	Kim et al.
6,449,026	B1	*	9/2002	Min G02F 1/134363 349/141
6,456,351	B1		9/2002	Kim et al.
6,462,800	B1		10/2002	Kim et al.
6,469,765	B1		10/2002	Matsuyama et al.
6,493,046	B1		12/2002	Ueda
6,552,770	B2		4/2003	Yanagawa et al.
6,556,265	B1		4/2003	Murade
6,580,487	B1		6/2003	Kim et al.
6,587,162	B1		7/2003	Kaneko et al.
6,597,413	B2		7/2003	Kurashina
6,600,541	B2		7/2003	Kurahashi et al.
6,600,542	B2		7/2003	Kim et al.
6,611,310	B2		8/2003	Kurahashi et al.
6,621,545	B2		9/2003	Park et al.
6,633,360	B2		10/2003	Okada et al.
6,639,640	B1		10/2003	Matsuoka et al.
6,646,707	B2		11/2003	Noh et al.
6,650,389	B1		11/2003	Sakamoto
6,661,476	B1		12/2003	Abe et al.
6,667,790	B2		12/2003	Yanagawa et al.
6,671,019	B1		12/2003	Petschek et al.
6,721,028	B2		4/2004	Kim et al.
6,724,444	B2		4/2004	Ashizawa et al.
6,771,342	B1		8/2004	Hirakata et al.
6,784,964	B2		8/2004	Nakayoshi et al.
6,985,194	B2		1/2006	Kawano et al.
2001/0030717	A1	*	10/2001	Kaneko G02F 1/134363 349/43
2002/0041354	A1		4/2002	Noh et al.
2002/0048500	A1		4/2002	Hermann et al.
2003/0071952	A1		4/2003	Yoshida et al.
2003/0086045	A1		5/2003	Ono et al.
2005/0105034	A1		5/2005	Ono et al.
2007/0153203	A1		7/2007	Kim et al.

FOREIGN PATENT DOCUMENTS

JP	3591513	4/2001
JP	2001-228493	8/2001

* cited by examiner

FIG. 1

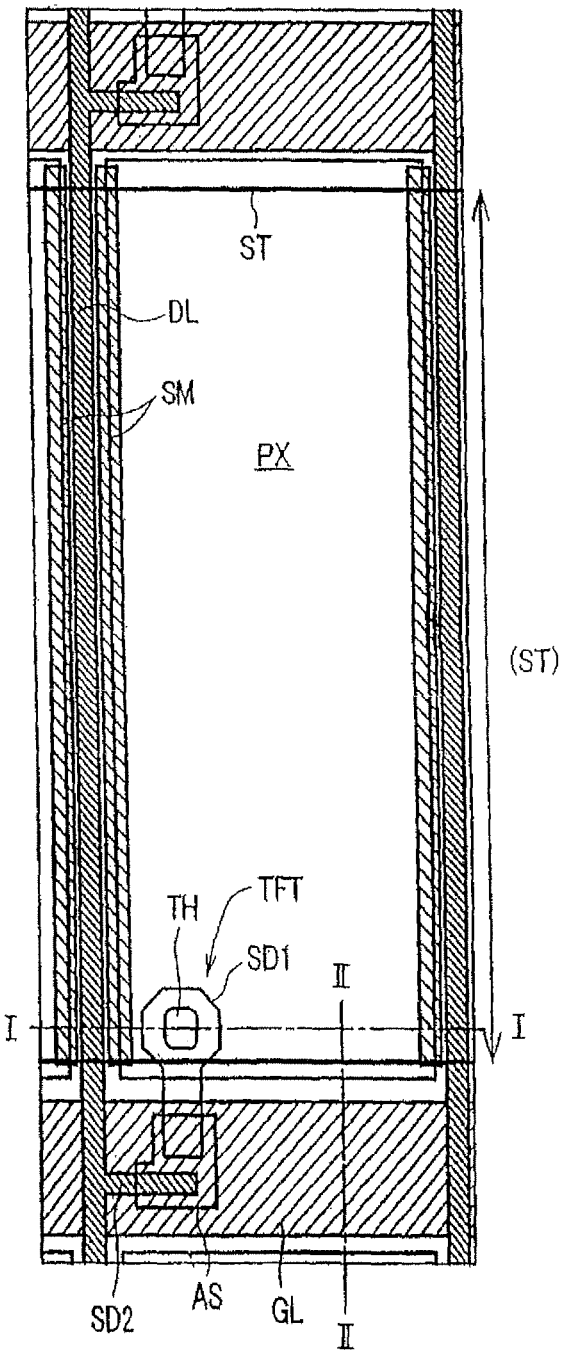


FIG. 2

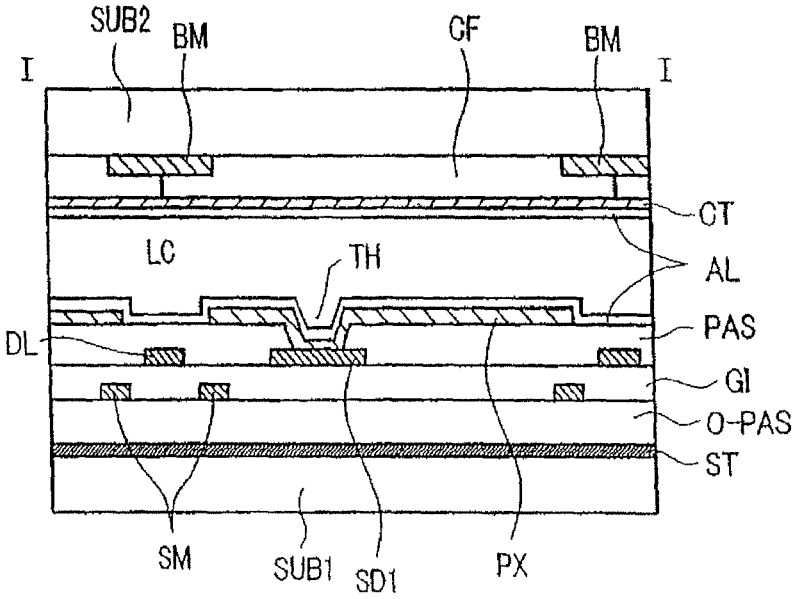


FIG. 3

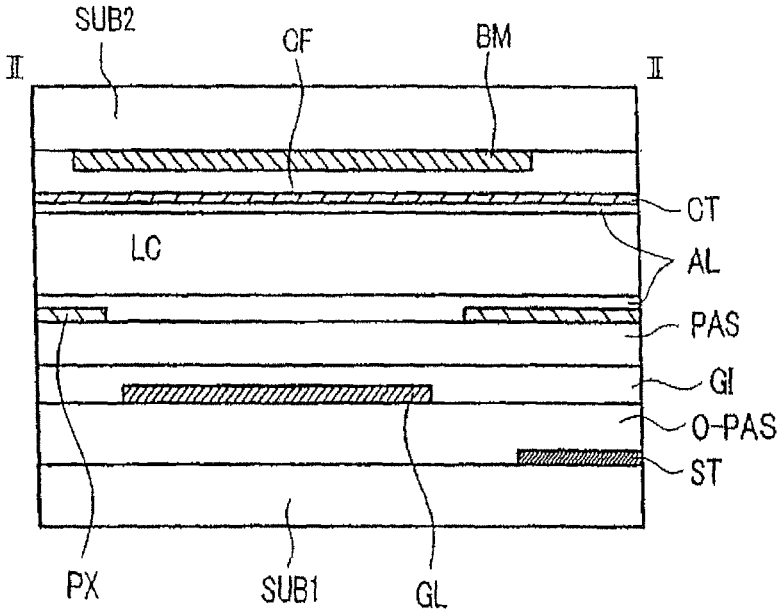
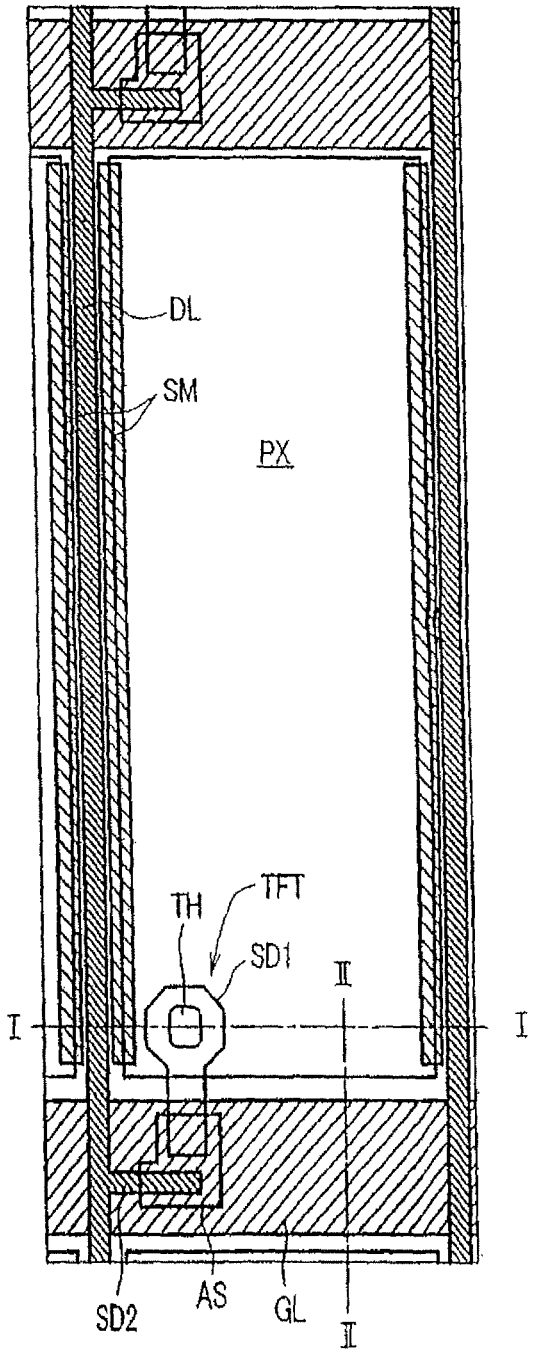


FIG. 4



DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.