US005592332A

United States Patent [19]

Nishio et al.

[11] Patent Number: 5,592,332

[45] Date of Patent: Jan. 7, 1997

[54] **RENTICULAR LENS, SURFACE LIGHT SOURCE, AND LIQUID CRYSTAL DISPLAY APPARATUS**

[75] Inventors: **Toshikazu Nishio**; **Yoshiyuki Yamashita**; **Hiroyuki Amemiya**; **Michiko Takeuchi**; **Nobu Masubuchi**, all of Tokyo, Japan

[73] Assignee: **Dai Nippon Printing Co., Ltd.**, Japan

[21] Appl. No.: **173,118**

[22] Filed: **Dec. 27, 1993**

[30] **Foreign Application Priority Data**

Dec. 25, 1992 [JP] Japan 4-358319
Apr. 16, 1993 [JP] Japan 5-112397
Jun. 16, 1993 [JP] Japan 5-168376

[51] **Int. Cl.**[6] **G02B 27/10**; G02B 17/00; G03B 21/60

[52] **U.S. Cl.** **359/619**; 359/591; 359/621; 359/455

[58] **Field of Search** 359/455, 456, 359/615, 619, 591, 625, 639, 640, 707, 620, 621, 622, 626, 627, 628, 454, 459, 592, 597

[56] **References Cited**

U.S. PATENT DOCUMENTS

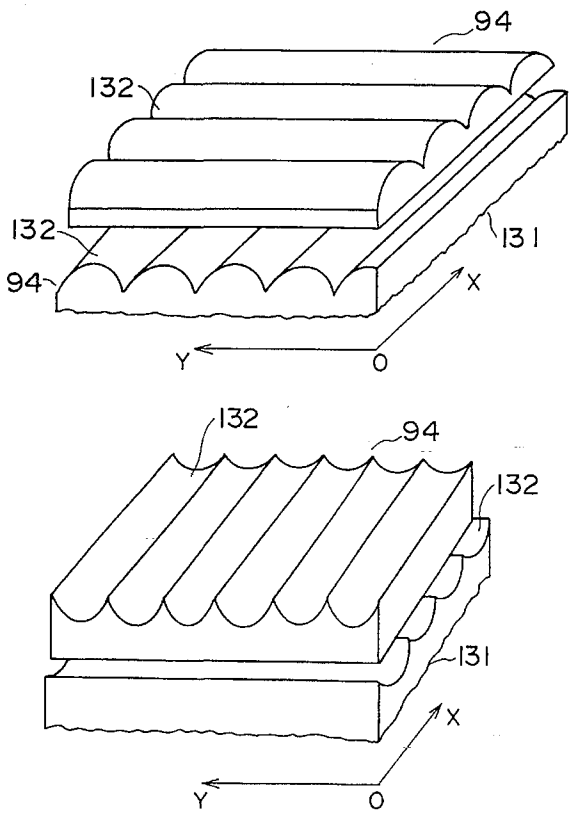
4,432,010 2/1984 Oguino 348/786
4,573,764 3/1986 Bradley 348/786
4,730,897 3/1988 McKechnie 359/452
4,919,518 4/1990 Ogino 359/457

Primary Examiner—Georgia Y. Epps
Assistant Examiner—Ricky Mack
Attorney, Agent, or Firm—Parkhurst, Wendel & Burr, L.L.P.

[57] **ABSTRACT**

A lenticular lens has a light transmitting substrate and a plurality of lens elements formed on the light transmitting substrate. The lens elements are defined in such a way that ridges thereof are aligned in parallel with each other, wherein $30° \leqq \theta_{10\%} \leqq 100°$ and $R \leqq 20\%$, where $\theta_{10\%}$ is a diffusing angle range with respect to normal of the one surface in the case that when light is entered from the opposite surface and transmitted from the one surface, the intensity of the light transmitted is equal to or more than 10% of the intensity of the light transmitted in a peak direction of a main lobe; and R is the ratio of side lobes to main lobe. The intensity of side lobes which causes light loss and light stray can be remarkably reduced. Light can be equally and isotropically focused on in a predetermined diffusing angle range.

62 Claims, 47 Drawing Sheets



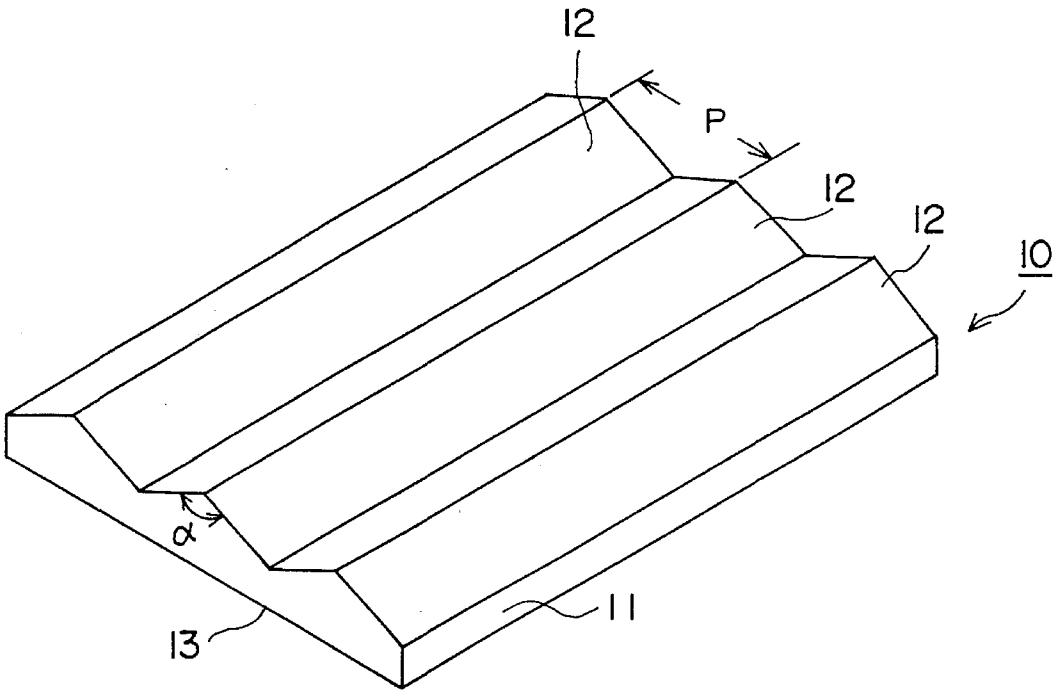


FIG. 1

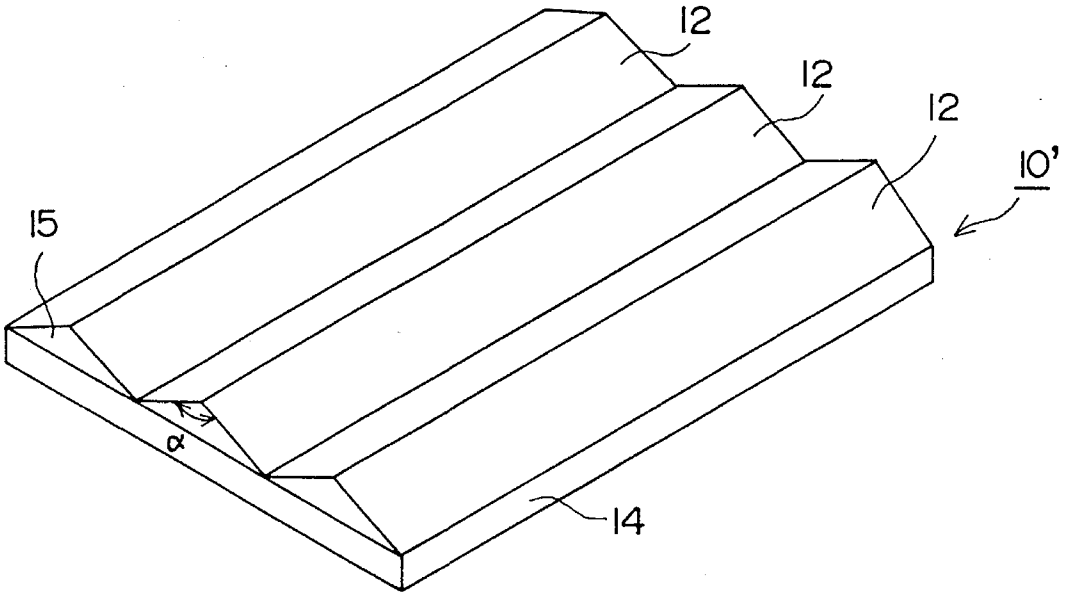
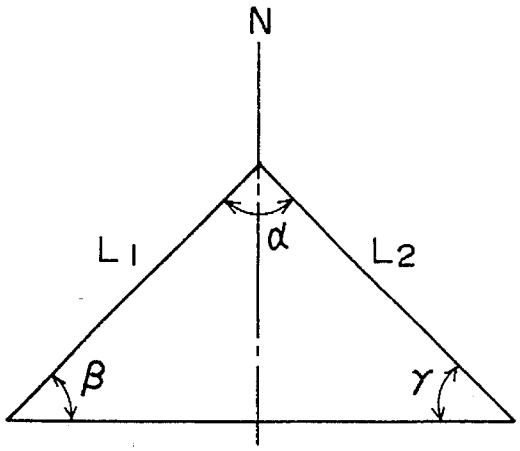


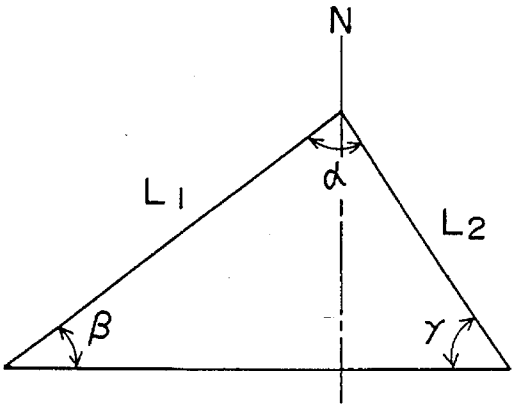
FIG. 2



$$\beta = \gamma = \frac{180° - \alpha}{2}$$

$$L_1 = L_2$$

FIG. 3



$$\beta \neq \gamma \quad , \quad \alpha + \beta + \gamma = 180°$$

$$L_1 \neq L_2$$

FIG. 4

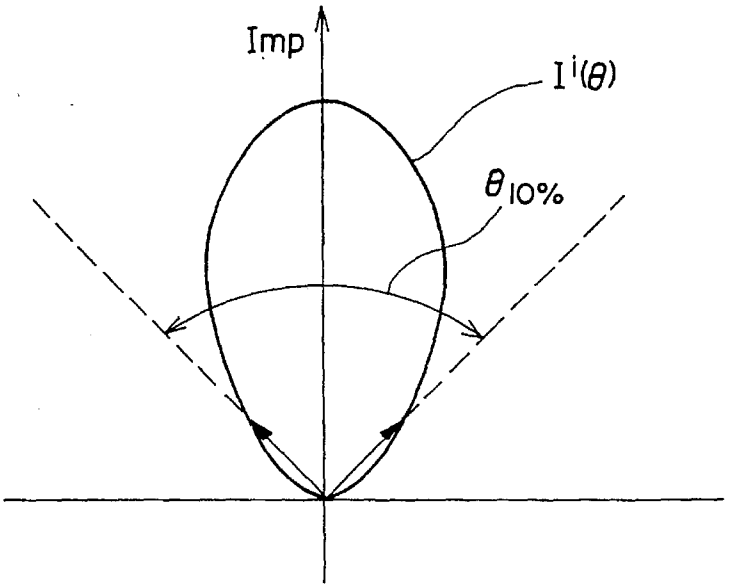


FIG. 5

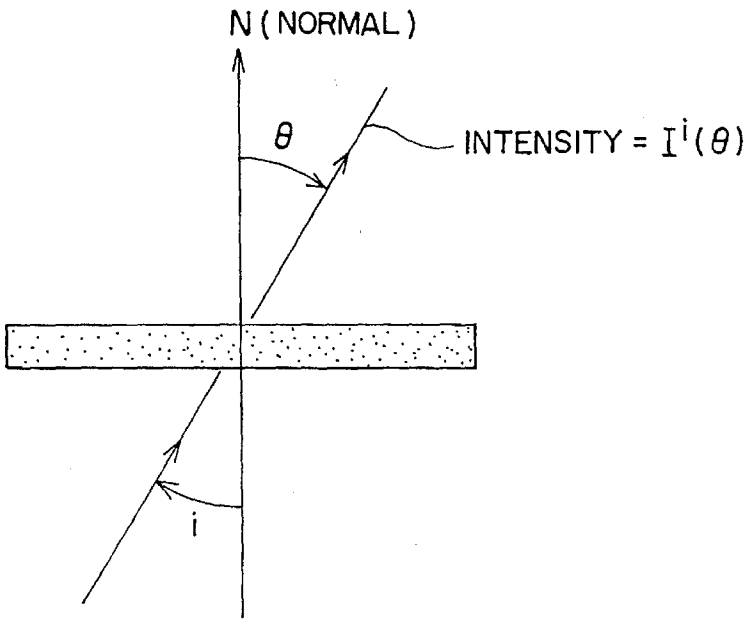


FIG. 6

FIG. 7A

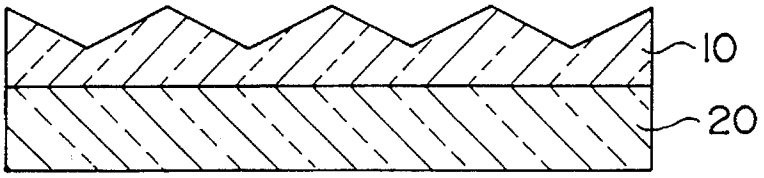


FIG. 7B

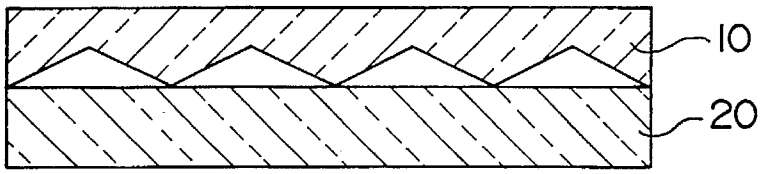


FIG. 8A

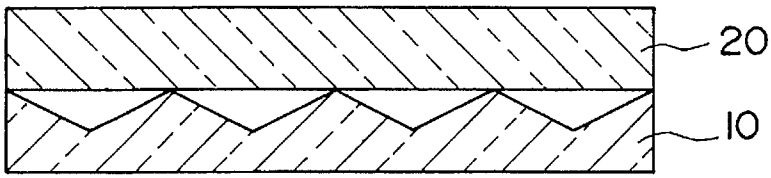
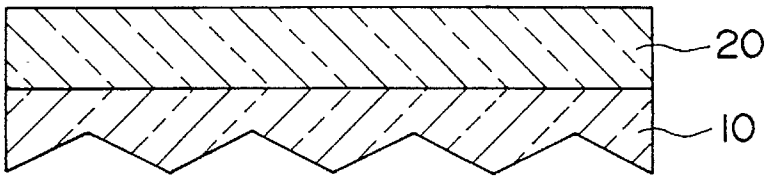


FIG. 8B



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.