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United States Patent [19]

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Takeuchi et al.

[45] Date of Patent: ***Aug. 31, 1999**

[54] **FLAT LIGHT SOURCE USING LIGHT-DIFFUSING SHEET WITH PROJECTIONS THEREON**

5,521,725	5/1996	Beeson et al.	362/26
5,521,797	5/1996	Kashima et al.	362/26
5,572,411	11/1996	Watai et al.	362/31
5,598,280	1/1997	Nishio et al.	362/31
5,641,219	6/1997	Mizobe	362/26

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FOREIGN PATENT DOCUMENTS

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

55-162201	9/1980	Japan
61-55684	3/1986	Japan
62-3226	1/1987	Japan
1-112202	4/1989	Japan
1-245220	9/1989	Japan
3-9306	1/1991	Japan
4-107201	9/1992	Japan
5-196940	8/1993	Japan
6-15008	2/1994	Japan

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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Assistant Examiner—Marshall Honeyman
Attorney, Agent, or Firm—Parkhurst & Wendel LLP

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§ 102(e) Date: **May 30, 1996**

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PCT Pub. Date: **Feb. 22, 1996**

[30] Foreign Application Priority Data

Aug. 12, 1994 [JP] Japan 6-210694

[51] Int. Cl.⁶ **F21V 7/04**

[52] U.S. Cl. **362/31; 362/551**

[58] Field of Search 362/26, 31, 551

[56] References Cited

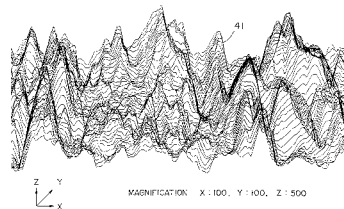
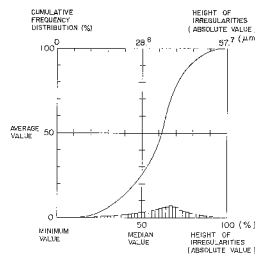
U.S. PATENT DOCUMENTS

4,729,067	3/1988	Ohe	362/26
4,729,068	3/1988	Ohe	362/26
4,775,222	10/1988	Ohe	362/26
4,998,804	3/1991	Horiuchi	362/26
5,262,928	11/1993	Kashima et al.	362/26
5,289,351	2/1994	Kashima et al.	362/26
5,408,388	4/1995	Kobayashi et al.	362/26
5,442,523	8/1995	Kashima et al.	362/26
5,467,208	11/1995	Kokawa et al.	362/26
5,467,417	11/1995	Nakamura et al.	362/26

[57] ABSTRACT

A flat light source used as back-lighting for a liquid crystal display device includes an optically conductive plate (1) having a light reflecting layer (2), and a light source (3). A light-diffusing sheet (8) is provided outside the optically conductive plate (1) opposite to the light reflecting layer (2). A lens sheet (4) is provided outside the light-diffusing sheet (8), with a transmission type of display element (6) provided on the outer side of the lens sheet (4). The light-diffusing sheet (8) is formed of a transparent material free from light-diffusing agent particles and has minute irregularities (41) formed at random on the front surface thereof. The irregularities are of a surface roughness that is at least the wavelength of the light from the light source, but is no more than 100 μm. When the percentage of the cumulative frequency distribution of the heights of the minute irregularities are plotted along the Y-axis and the heights of these minute irregularities are plotted along the X-axis, the cumulative frequency distribution curve has a convex portion oriented towards the lower side of the coordinates and the average value of the heights of the minute irregularities is greater than the median value thereof. Thus, a flat light source is provided which emits highly luminant light uniformly within a predetermined angular range, and which has no local differences in intensity over the surface thereof.

11 Claims, 20 Drawing Sheets



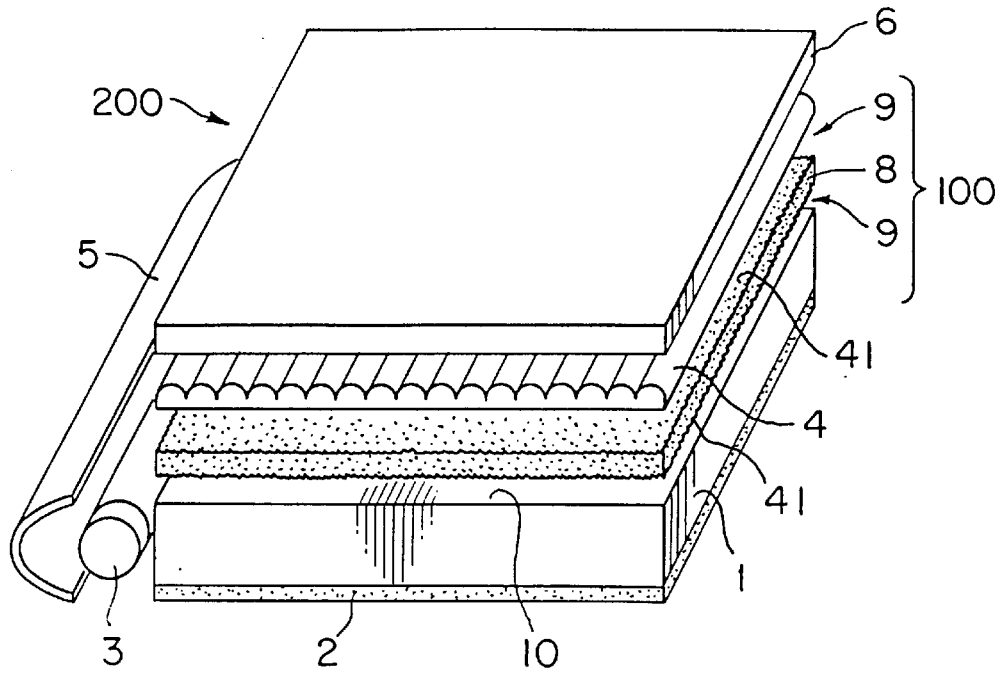


FIG. 1

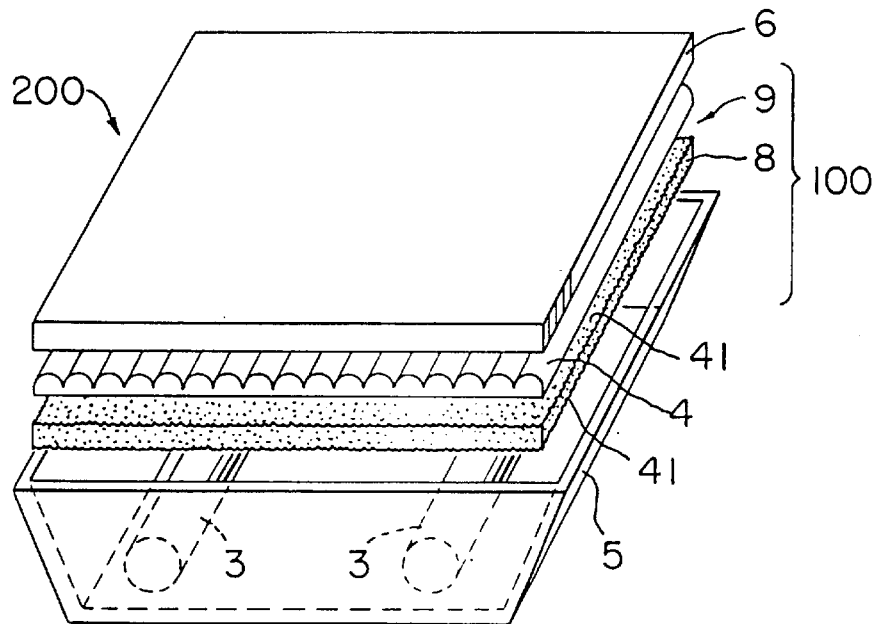


FIG. 2

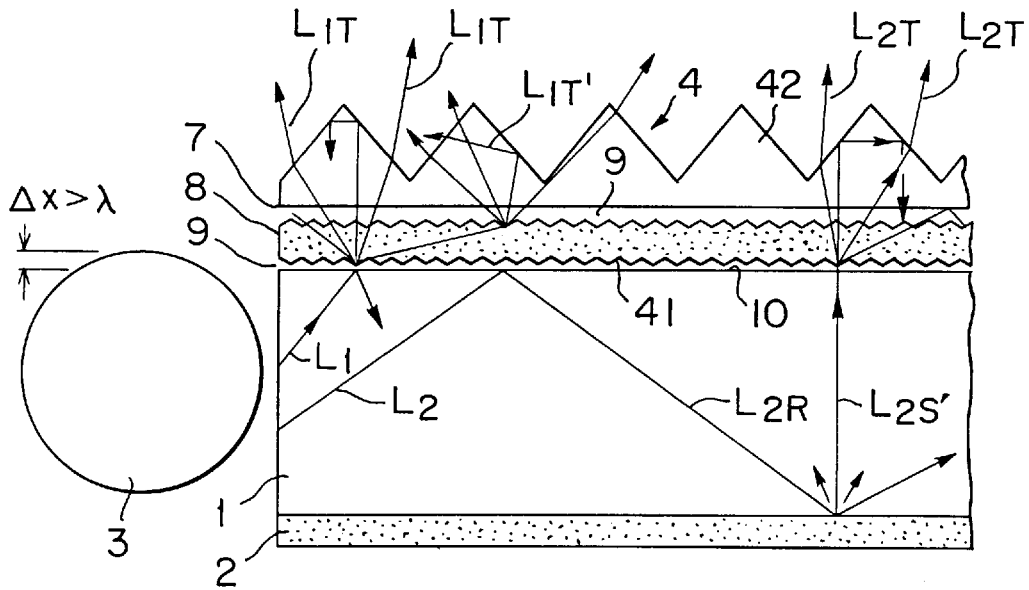


FIG. 3

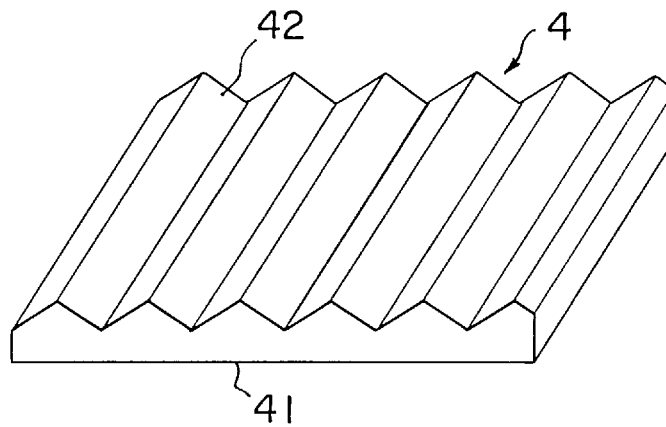


FIG. 4

FIG. 5

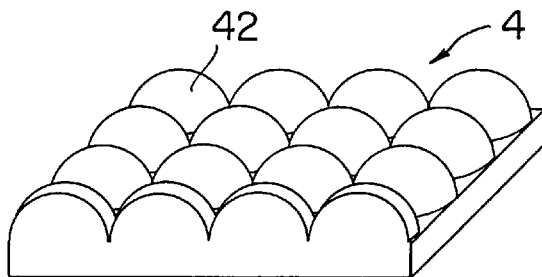


FIG. 6

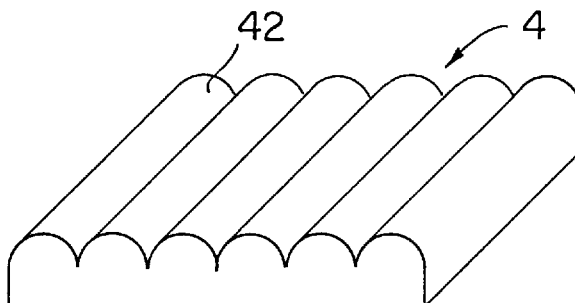


FIG. 7

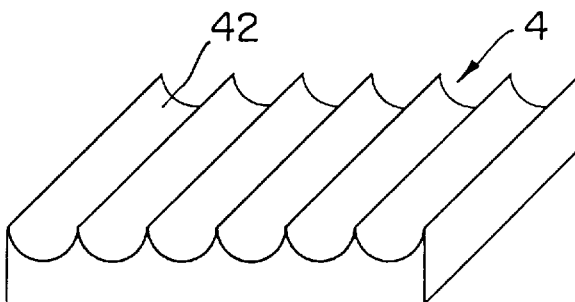
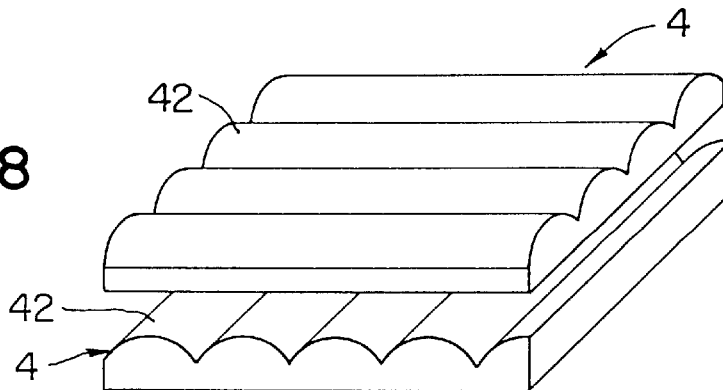


FIG. 8



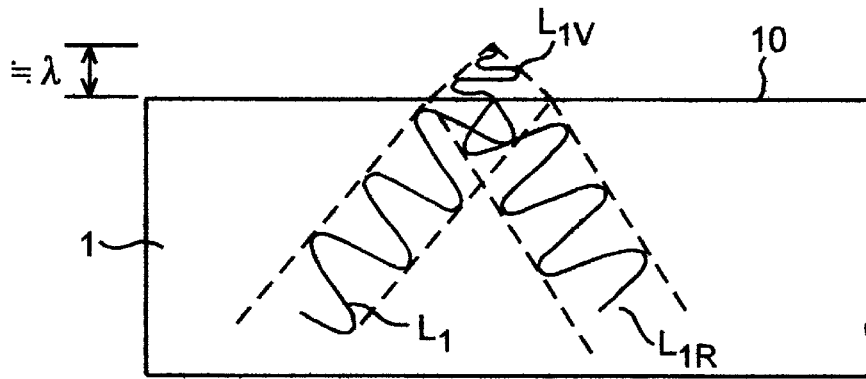


FIG. 9

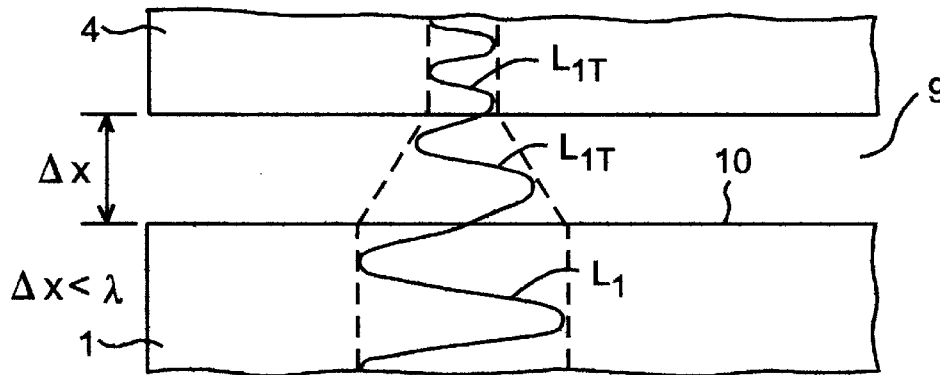


FIG. 10

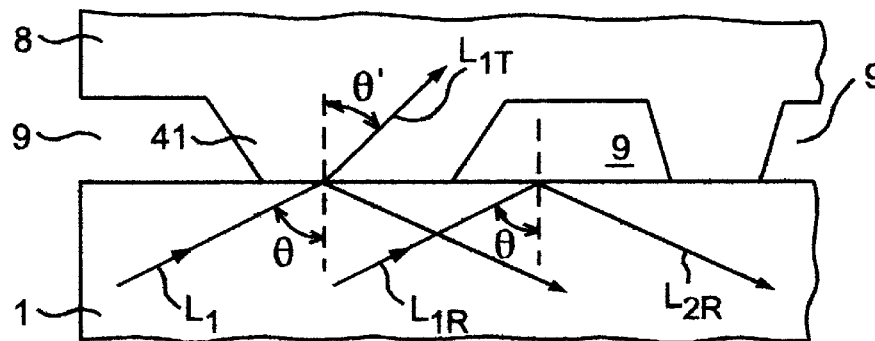


FIG. 11

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