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United States Patent [19]

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Akahane et al.

[45] Date of Patent: ***Sep. 16, 1997**

[54] **BACKGROUND LIGHTING APPARATUS FOR LIQUID CRYSTAL DISPLAY**

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[75] Inventors: **Fumiaki Akahane; Tooru Yagasaki; Tatsuaki Funamoto**, all of Suwa, Japan

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[73] Assignee: **Seiko Epson Corporation**, Tokyo, Japan

[*] Notice: The portion of the term of this patent subsequent to Jul. 14, 2009, has been disclaimed.

[21] Appl. No.: **864,772**

[22] Filed: **Apr. 7, 1992**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 525,408, May 18, 1990, Pat. No. 5,130,898.

[30] Foreign Application Priority Data

May 18, 1989	[JP]	Japan	1-57274
Sep. 29, 1989	[JP]	Japan	1-253863
Feb. 27, 1990	[JP]	Japan	2-46356
Apr. 8, 1991	[JP]	Japan	3-075093
Sep. 17, 1991	[JP]	Japan	3-236347

[51] Int. Cl.⁶ **F21V 8/00**

[52] U.S. Cl. **362/31; 362/27; 362/307; 362/330; 349/70**

[58] Field of Search **362/31, 26, 32, 362/227, 235, 236, 237, 307, 311, 330, 343, 27; 359/49, 50**

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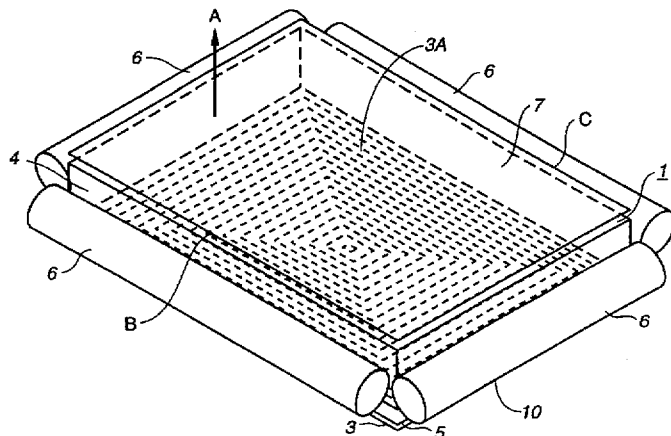
Primary Examiner—James C. Yeung
Assistant Examiner—Alan Cariaso

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[57] ABSTRACT

A background lighting apparatus includes a light entering edge surface around substantially the entire periphery of a highly internally reflecting transparent plate wherein light beams enter from peripheral light sources and travel toward the central portion of the plate and are dispersed and diffused by a diffusion system formed relative to the transparent plate. Uniformity of luminance provided from the background lighting apparatus is enhanced as a whole by increasing the incident quality of the input light beams into the transparent plate while easing the incident directivity of the light beams on the transparent plate with the overall substantial enhancement of luminance produced from the apparatus. Further, the temperature distribution on a liquid crystal panel positioned adjacent to the output surface of the background lighting apparatus is substantially uniform across the panel so that the transmission quality of the liquid crystal material, which is dependent upon ambient temperatures, is made substantially more uniform resulting in significantly higher levels of uniformity in luminance across the display as well as uniformity of displayed colors and gradations thereof emanating from the display panel.

20 Claims, 9 Drawing Sheets



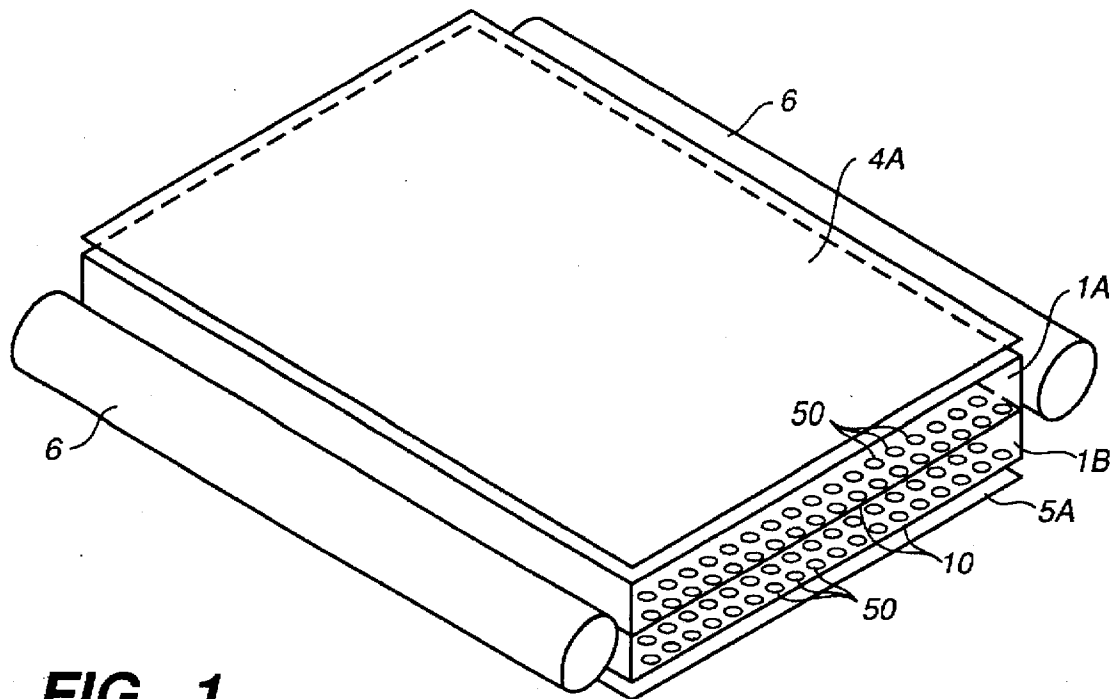


FIG. 1
(PRIOR ART)

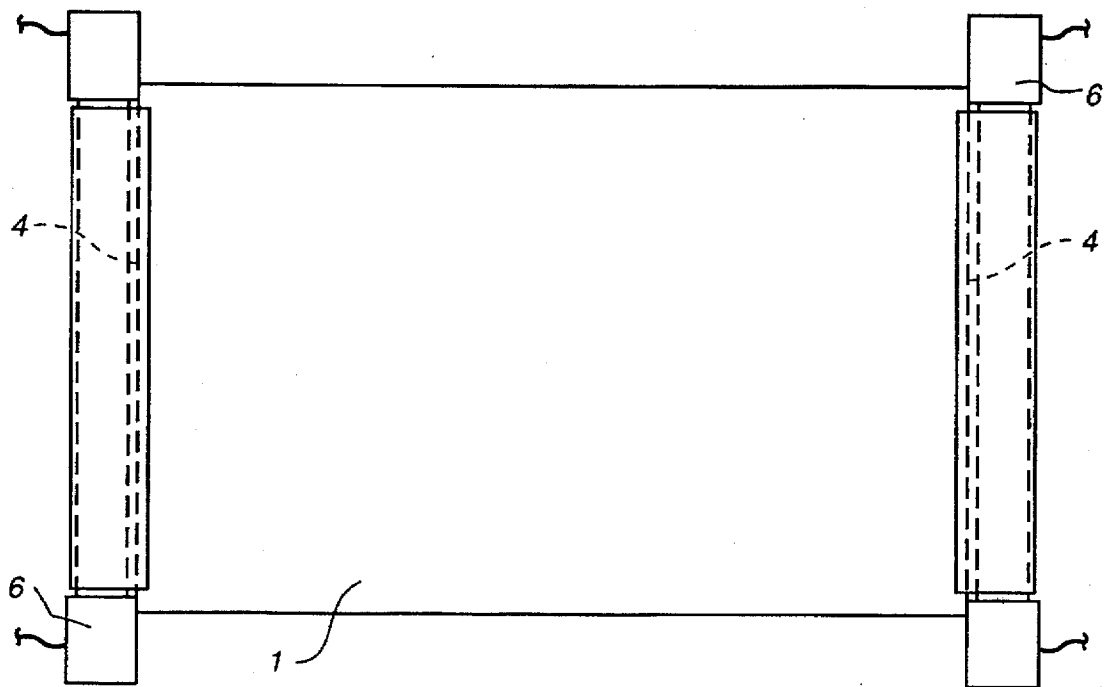


FIG. 2
(PRIOR ART)

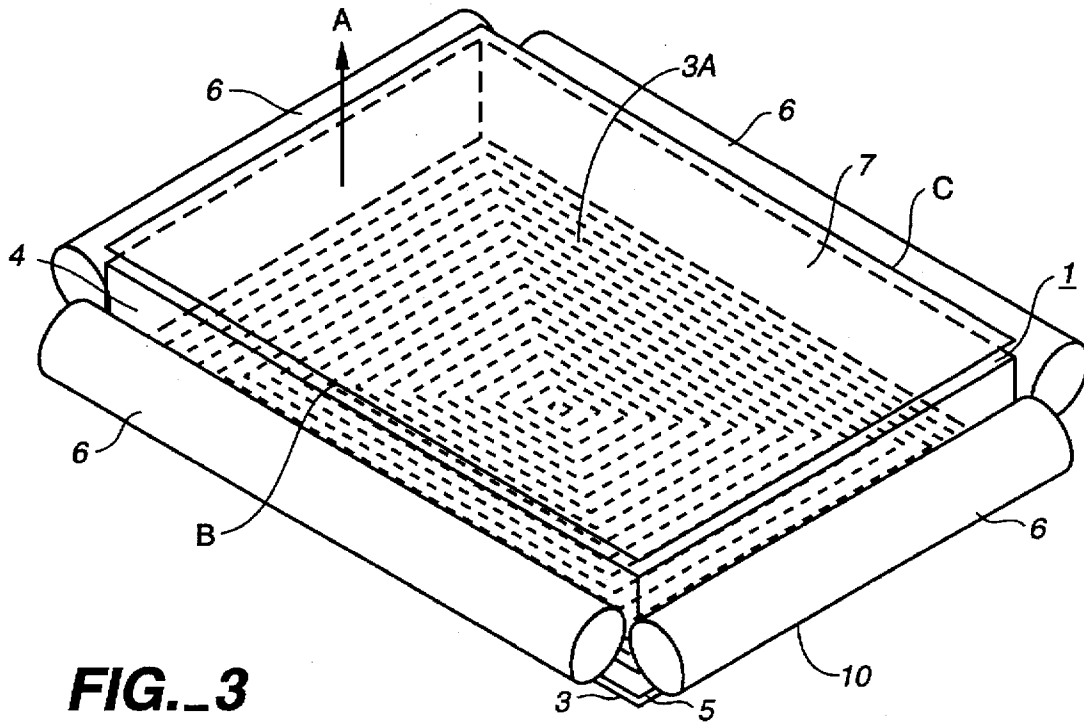


FIG. 3

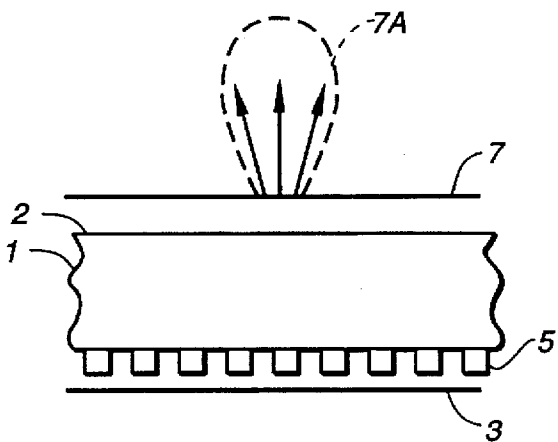
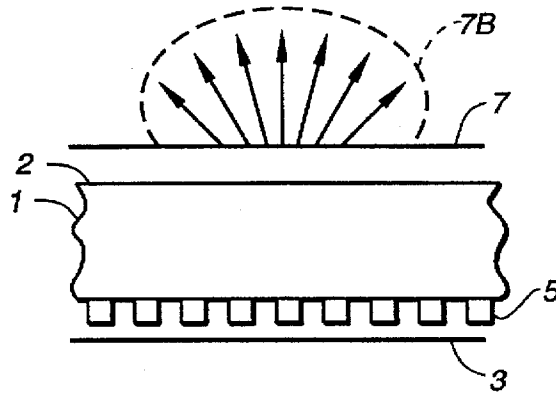


FIG. 3A



**FIG. 3B
(PRIOR ART)**

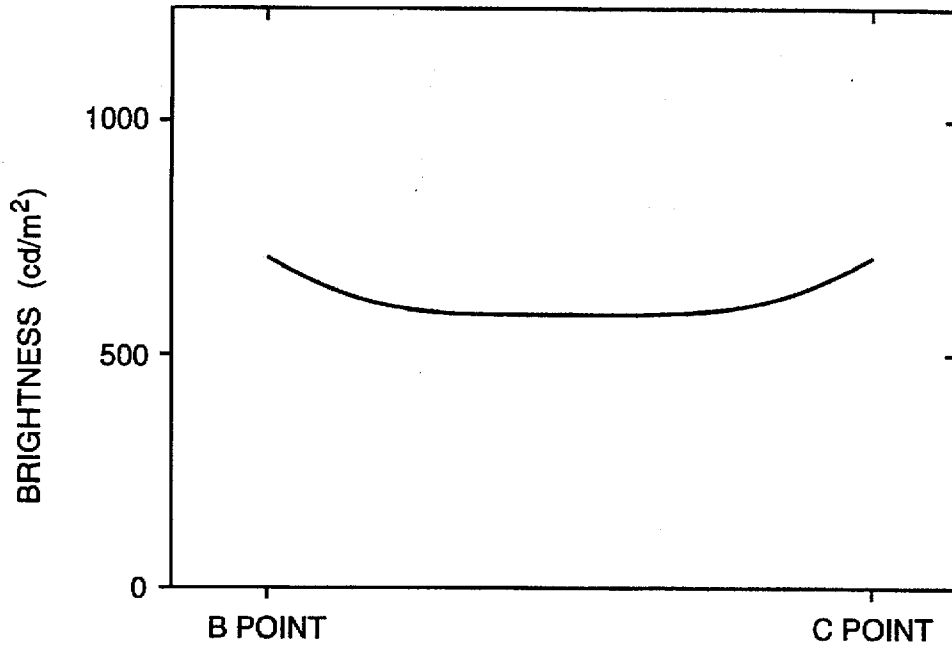


FIG. 4

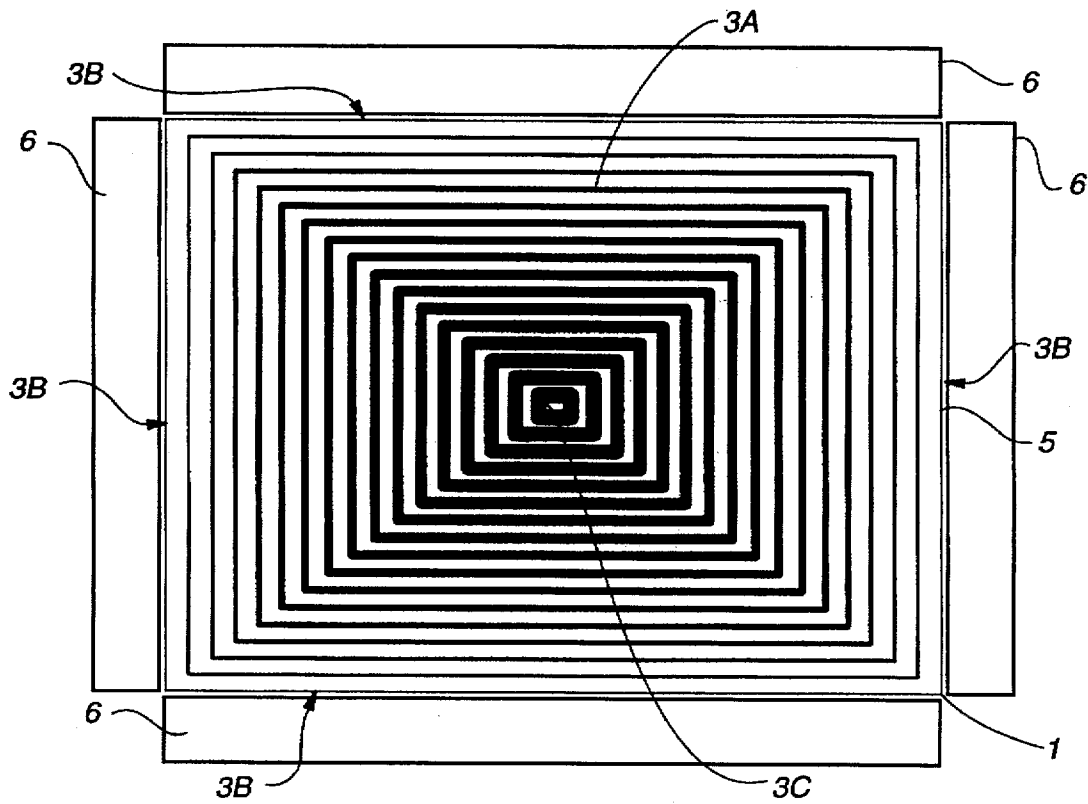


FIG. 5

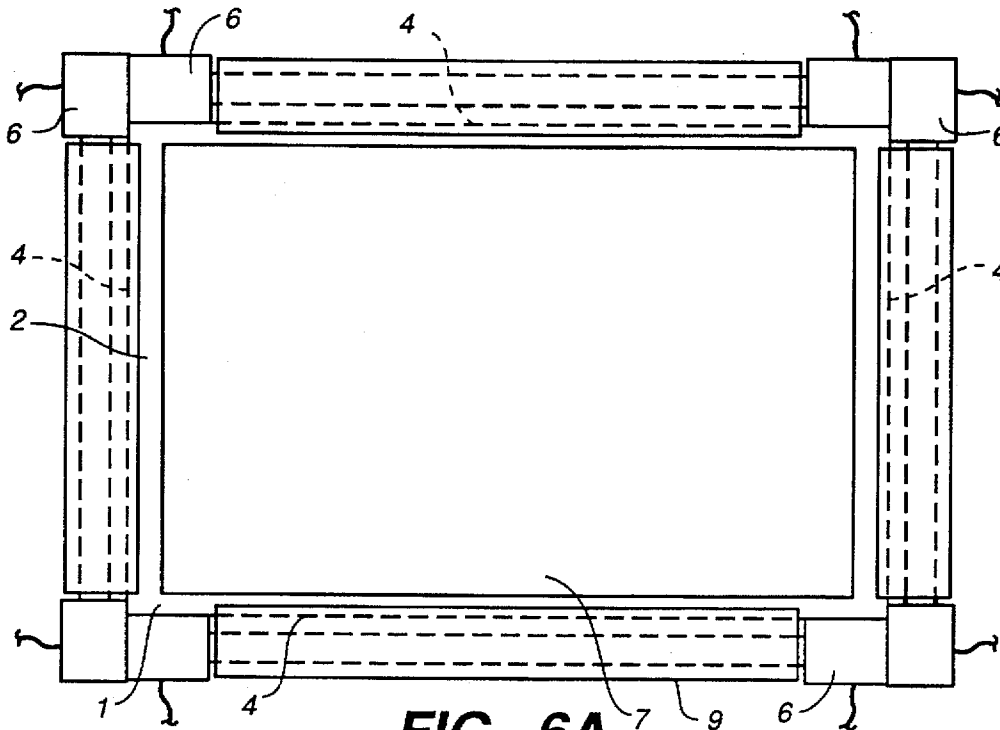


FIG. 6A

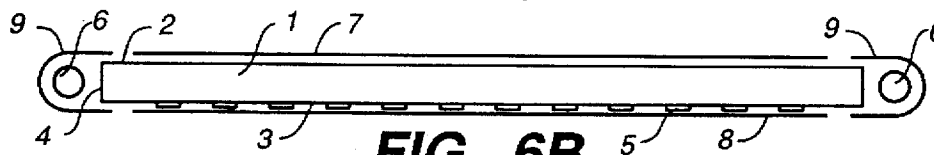


FIG. 6B

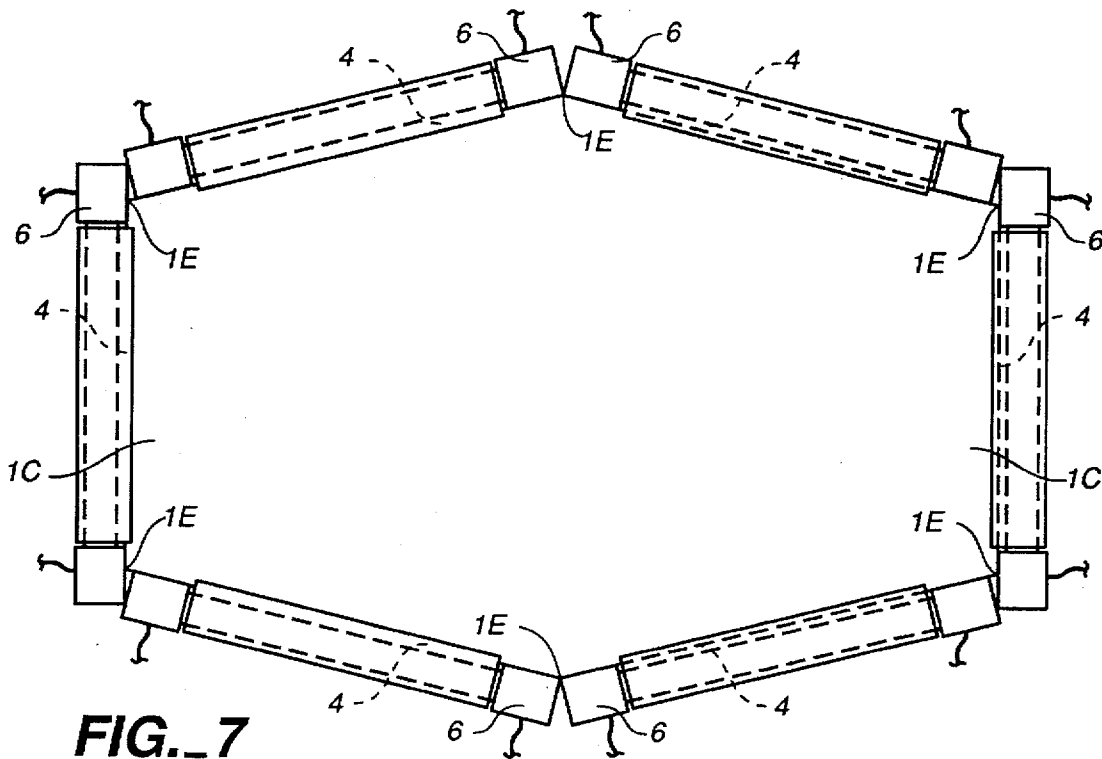


FIG. 7

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