



- [54] **TAPERED MULTILAYER LUMINAIRE DEVICES**
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- [21] Appl. No.: **29,883**
- [22] Filed: **Mar. 11, 1993**

4,649,462	3/1987	Dobrowolski et al. ....	362/2
4,706,173	11/1987	Hamada et al. ....	362/341
4,729,068	3/1988	Ohe .....	362/31
4,735,495	4/1988	Henkes .....	362/310
4,737,896	4/1988	Mochizulki et al. ....	362/301
4,747,223	5/1988	Bonds .....	40/219
4,765,718	8/1988	Henkes .....	359/49
4,799,050	1/1989	Prine et al. ....	340/765
4,799,137	1/1989	Abo .....	362/309
4,832,458	5/1989	Ferguson .....	350/338

(List continued on next page.)

**Related U.S. Application Data**

- [63] Continuation-in-part of Ser. No. 855,838, Mar. 23, 1992, Pat. No. 5,237,641.
- [51] Int. Cl.<sup>5</sup> ..... **G02B 6/26**
- [52] U.S. Cl. .... **385/146; 385/43; 385/901; 385/129; 385/131**
- [58] Field of Search ..... **385/43, 129, 130, 131, 385/140, 146, 147, 901, 31; 359/599, 833, 834**

**References Cited**

**U.S. PATENT DOCUMENTS**

2,347,665	5/1944	Christensen et al. ....	362/31
2,712,593	7/1955	Merchant .....	362/27
3,617,109	11/1971	Tlen .....	385/43
3,752,974	8/1973	Baker et al. ....	240/1
3,832,028	8/1974	Kapron .....	385/43
3,980,392	9/1976	Aunacher .....	385/43
4,059,916	11/1977	Tachihara et al. ....	40/130
4,111,538	9/1978	Sheridon .....	353/122
4,114,592	9/1978	Winston .....	126/270
4,161,015	7/1979	Dey et al. ....	362/263
4,176,908	12/1979	Wagner .....	350/96.15
4,212,048	7/1980	Castleberry .....	362/19
4,240,692	12/1980	Winston .....	350/96.10
4,257,084	3/1981	Reynolds .....	362/31
4,277,817	7/1981	Hehr .....	362/31
4,323,951	4/1982	Pasco .....	362/27
4,373,282	2/1983	Wragg .....	40/546
4,420,796	12/1983	Mori .....	362/32
4,453,200	6/1984	Troka et al. ....	362/31
4,528,617	7/1985	Blackington .....	362/32
4,547,043	10/1985	Penz .....	362/32
4,573,766	3/1986	Bournsy, Jr. et al. ....	350/345
4,618,216	10/1986	Suzawa .....	359/49
4,648,690	3/1987	Obe .....	350/321

**OTHER PUBLICATIONS**

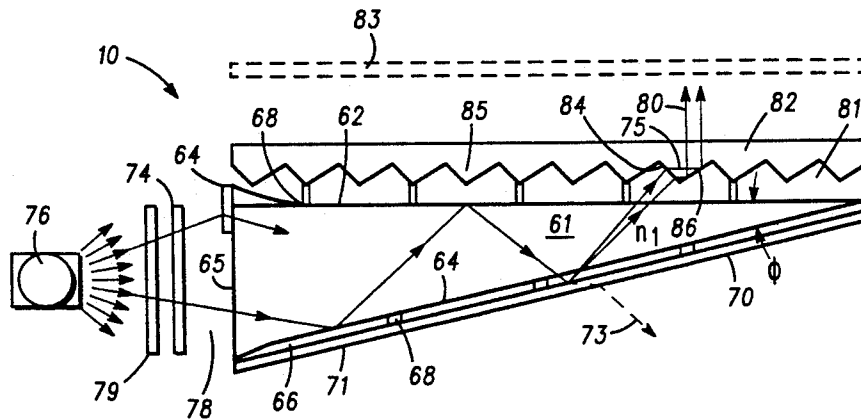
- "Flat Panel Backlight Reflecting Device," R. L. Garwin and R. T. Hodgson, *IBM Technical Disclosure Bulletin*, vol. 31, No. 2, Jul. 1988, pp. 190-191.
- "Dielectric Totally Internally Reflecting Concentrators" Xisohui, Ming, Roland Winston and Joseph O'Gallagher, *Applied Optics*, vol. 26, Jan. 15, 1987, pp. 300-305.

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**[57] ABSTRACT**

An optical device for collecting light and selectively outputting or concentrating the light. A wedge layer has an optical index of refraction  $n_1$ , and top, bottom and side surfaces intersecting to define an angle of inclination  $d$ . A back surface spans the top, bottom and side surface. A first layer is coupled to the bottom surface of the layer and has an index of refraction  $n_2$ . The first layer index  $n_2$  causes light input through the back surface of the layer to be preferentially output into the first layer. A second layer is coupled to the bottom of the first layer and selectively causes output of light into ambient. Additional layers, such as an air gap, can be provided adjacent to the wedge shaped layer. The wedge shaped layer can also have a variable index of refraction  $n(x,y,z)$ .

**69 Claims, 23 Drawing Sheets**



## U.S. PATENT DOCUMENTS

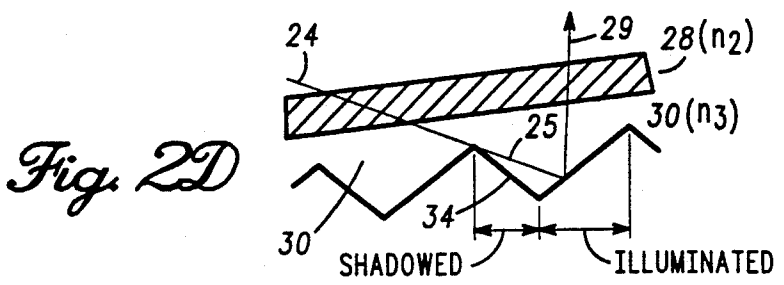
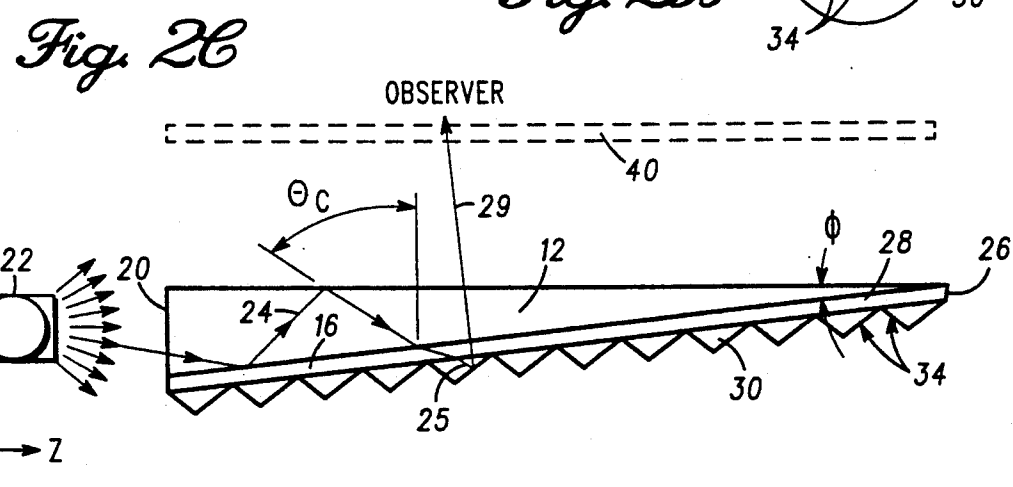
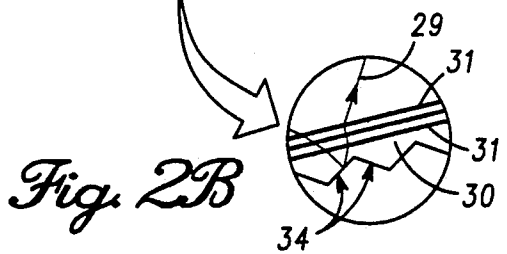
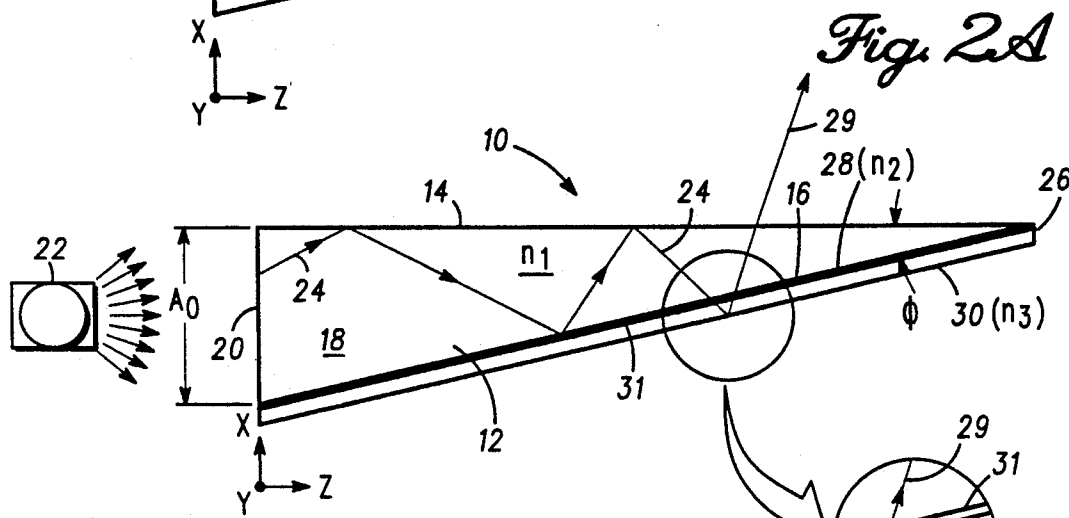
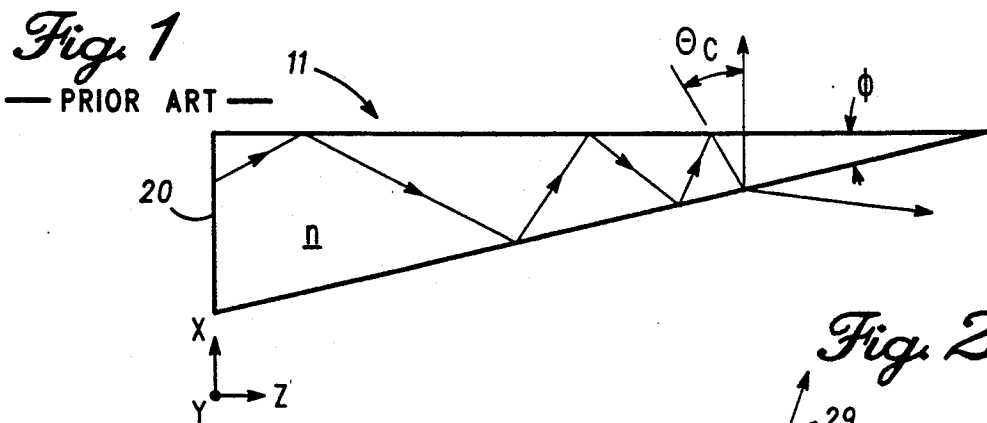
4,838,661	6/1989	McKee et al. ....	350/345
4,842,378	6/1989	Flasck et al. ....	350/345
4,907,044	3/1990	Schellborn et al. ....	357/17
4,907,132	3/1990	Parker .....	362/32
4,914,553	4/1990	Hamada et al. ....	362/321
4,915,479	4/1990	Clarke .....	358/345
4,936,659	6/1990	Anderson et al. ....	359/49
4,950,059	8/1990	Roberts .....	362/32
4,958,915	9/1990	Okada et al. ....	350/345
4,965,876	10/1990	Foldi et al. ....	362/247
4,974,122	11/1990	Shaw .....	362/31
4,974,353	12/1990	Norfolk .....	40/447
4,985,809	1/1991	Matsui et al. ....	362/31
4,989,933	2/1991	Duguay .....	350/96.10
4,992,916	2/1991	Henkes .....	362/255
4,998,188	3/1991	Degelmann .....	362/147
5,019,808	5/1991	Prince et al. ....	340/765
5,039,207	8/1991	Green .....	359/49
5,040,098	8/1991	Tanaka et al. ....	362/31
5,040,878	8/1991	Eichenlaub .....	350/345
5,044,734	9/1991	Sperl et al. ....	359/49
5,046,805	9/1991	Simon .....	385/31

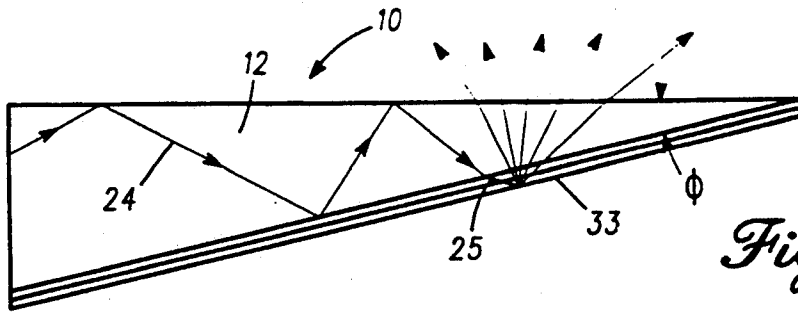
5,046,829	9/1991	Worp .....	359/49
5,050,946	9/1991	Hathaway et al. ....	385/33
5,051,551	9/1991	Doyle .....	250/341
5,053,765	10/1991	Sonehara et al. ....	340/815.31
5,083,120	1/1992	Nelson .....	340/784
5,101,325	3/1992	Davenport et al. ....	362/31
5,128,783	7/1992	Abileah et al. ....	359/49
5,128,787	7/1992	Blonder .....	359/70
5,128,846	7/1992	Mills et al. ....	362/224

## OTHER PUBLICATIONS

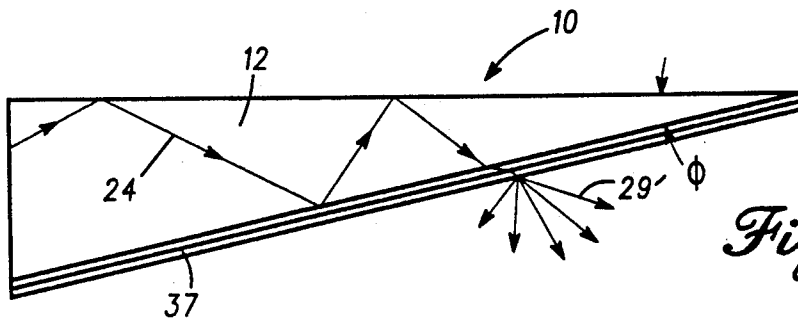
"Optics of Two-Stage Photovoltaic Concentrators with Dielectric Second Stages", Xisohul, Ning, Roland Winston and Joseph O'Gallagher, *Applied Optics*, vol. 26, Apr. 1, 1987, pp. 1207-1212.

"New Backlighting Technologies for LCDs", Hathaway et al., *Society for Information Display Digest*, vol. 22, May 1991, pp. 751-754. "Parts that Glow", A. Bhumenfeld and S. Jones, *Machine Design*, Jul. 1985, pp. 1-11. "Directional Diffuser Lens Array for Backlit LCDs", R. I. McCartney and D. Syroid, *Japan Display*, pp. 259-262 (1992).

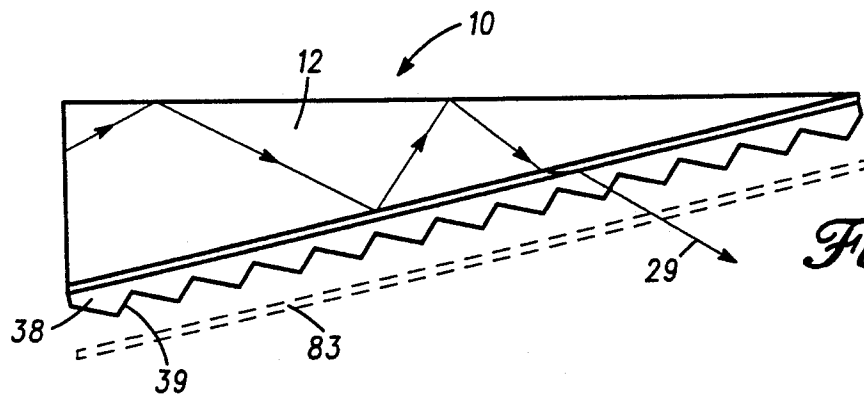




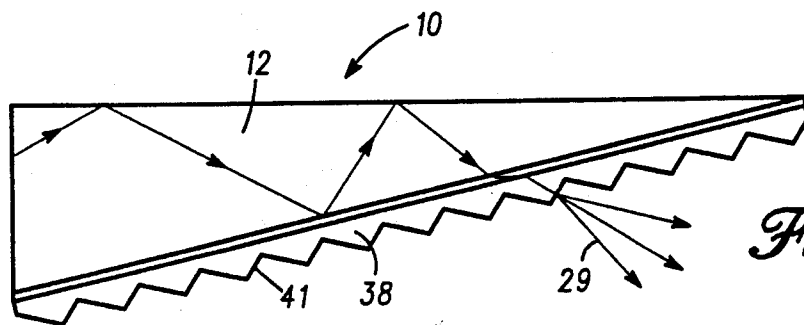
*Fig. 2E*



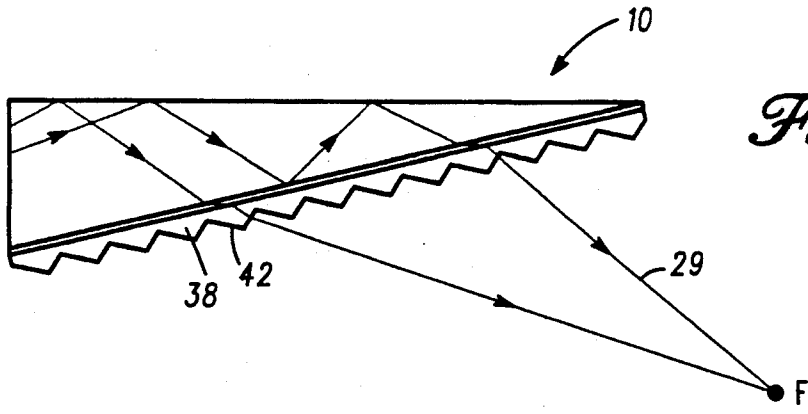
*Fig. 2F*



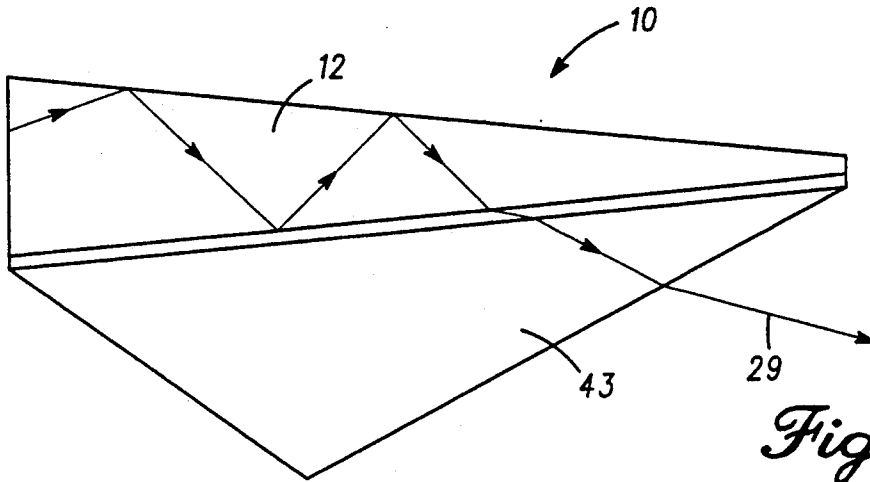
*Fig. 2G*



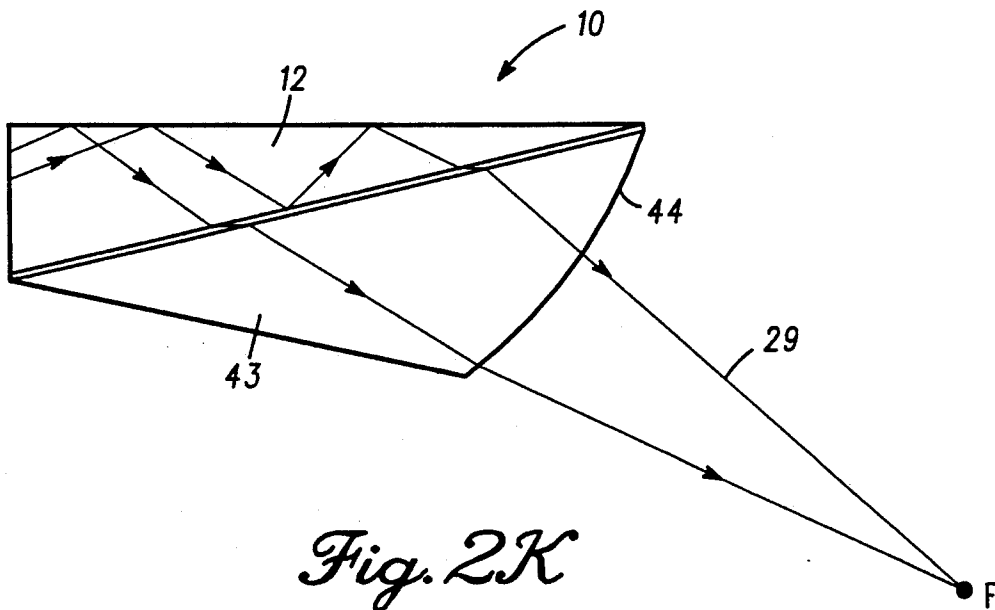
*Fig. 2H*



*Fig. 2I*



*Fig. 2J*



*Fig. 2K*

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