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United States Patent [19]

Patel et al.

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- [54] **FREQUENCY-SELECTIVE OPTICAL SWITCH EMPLOYING A FREQUENCY DISPERSIVE ELEMENT, POLARIZATION DISPERSIVE ELEMENT AND POLARIZATION MODULATING ELEMENTS**
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- [73] Assignee: **Bell Communications Research, Inc.**, Livingston, N.J.
- [21] Appl. No.: **125,607**
- [22] Filed: **Sep. 22, 1993**

Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 70,591, Jun. 1, 1993.
- [51] Int. Cl.⁶ **G02F 1/137; G02F 1/13; H04J 14/06; H04J 14/02**
- [52] U.S. Cl. **359/39; 354/94; 354/122; 354/128; 354/124; 385/37; 385/20; 385/17; 359/93; 359/245; 359/246**
- [58] Field of Search **359/94, 39, 122, 128, 359/124, 130, 245, 246, 494, 496, 615, 123, 139, 131, 127, 97; 385/17, 37, 20**

[56] References Cited

U.S. PATENT DOCUMENTS

3,506,834	4/1970	Bushsbaum et al.	359/138
3,536,375	10/1970	Mansell	359/246
4,655,474	4/1989	Heritage et al.	350/162.12
5,002,349	3/1991	Cheung et al.	350/96.13
5,005,166	4/1991	Suzuki et al.	359/123
5,111,321	5/1992	Patel	359/92
5,132,824	7/1992	Patel et al.	359/78
5,150,236	9/1992	Patel	359/71
5,319,484	6/1994	Jacob et al.	359/123

FOREIGN PATENT DOCUMENTS

62-305152 12/1987 Japan 359/122

OTHER PUBLICATIONS

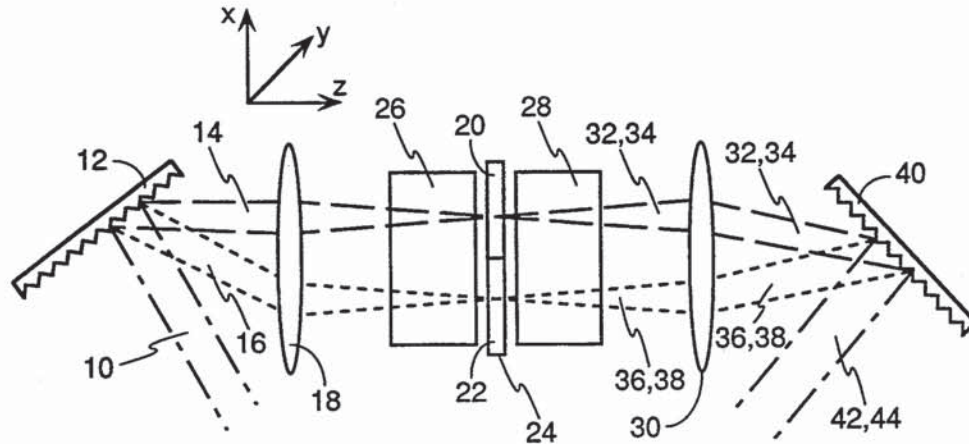
- I. Nishi et al., "Broad-passband-width optical filter for multi/demultiplexer using a diffraction grating and a retroreflector prism," *Electronics Letters*, 1985, vol. 21, pp. 423-424.
- M. Shirasaki et al., "Broadening of bandwidths in grating multiplexer by original dispersion-dividing prism," *Electronics Letters*, 1986, vol. 22, pp. 764-765.
- Shirosaki et al., "Bistable magneto-optic switch for mut-work optical fiber", *Applied Optics* vol. 21, #11, Jun. 1, 1982, pp. 1943-1949.

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Assistant Examiner—Kenneth Parker
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[57] ABSTRACT

A liquid-crystal optical switch capable of switching separate optical signals in a physical input channel to a selected output channel. A diffraction grating spatially divides the input channel into its frequency components, which pass through different segments of a liquid-crystal modulator. The liquid-crystal modulator segments are separately controlled to rotate the polarization of the frequency channel passing therethrough or to leave it intact. The channels then pass through a polarization-dispersive element, such as calcite, which spatially separates the beams in the transverse direction according to their polarization. A second diffraction grating recombines the frequency components of the same polarization into multiple output beams.

16 Claims, 9 Drawing Sheets



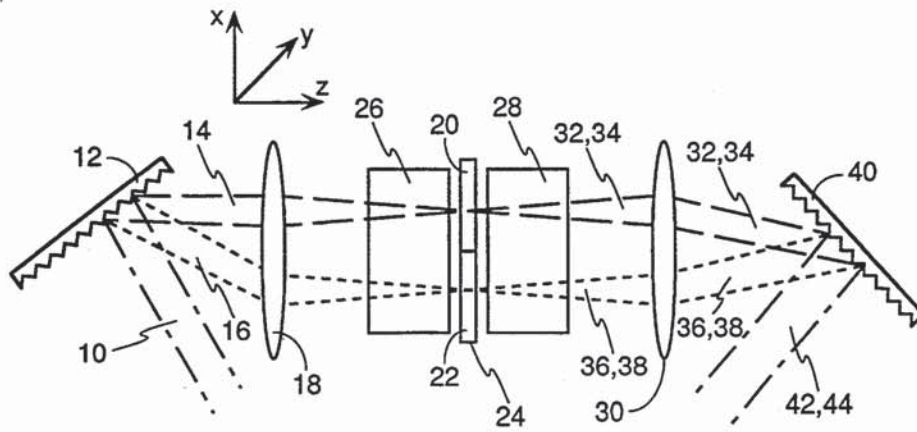


FIG. 1

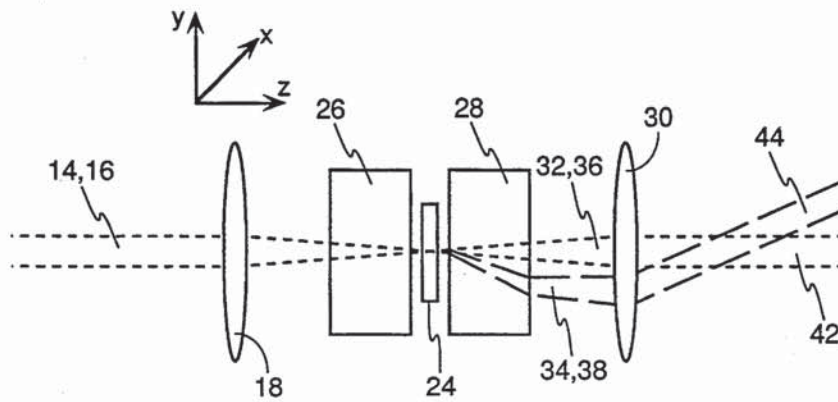


FIG. 2

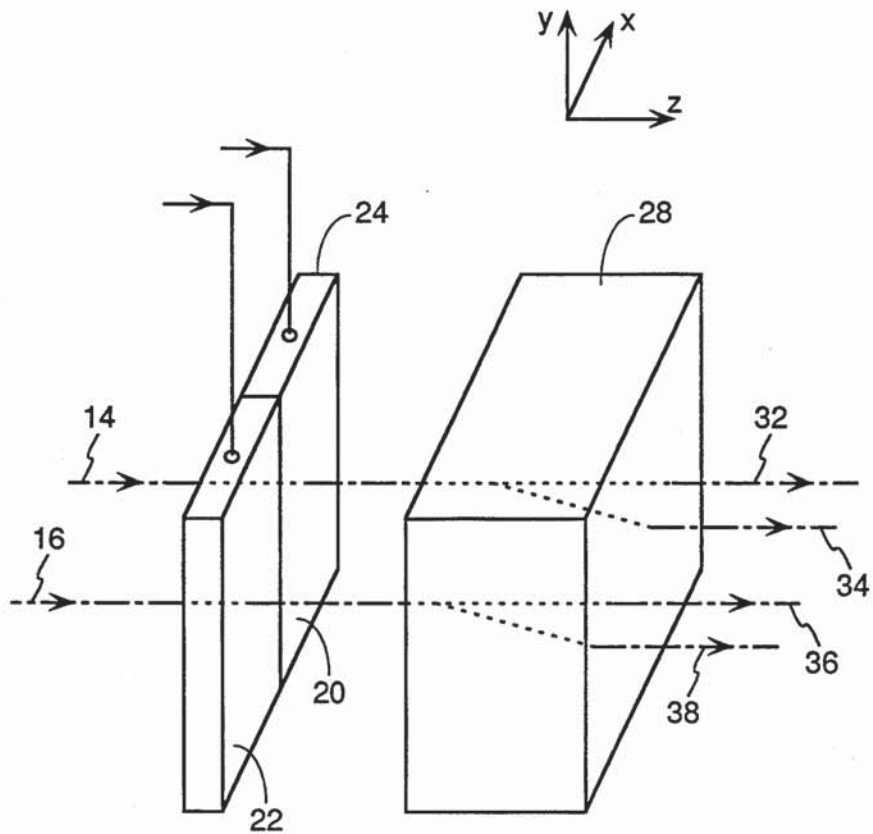


FIG. 3

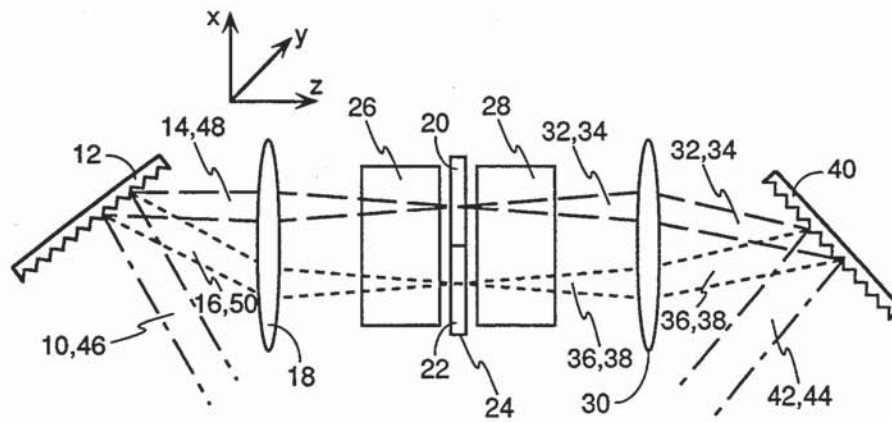


FIG. 4

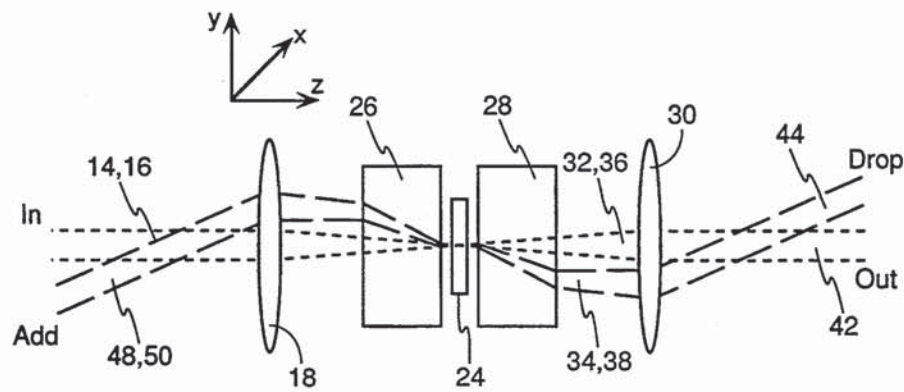


FIG. 5

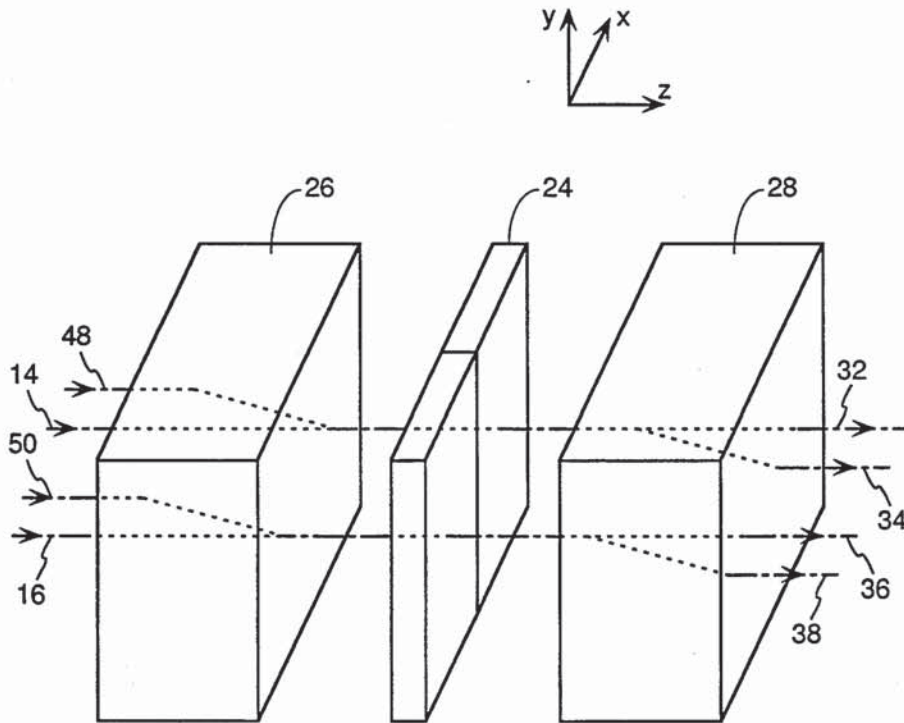


FIG. 6

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