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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Related U.S. Application Data

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[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

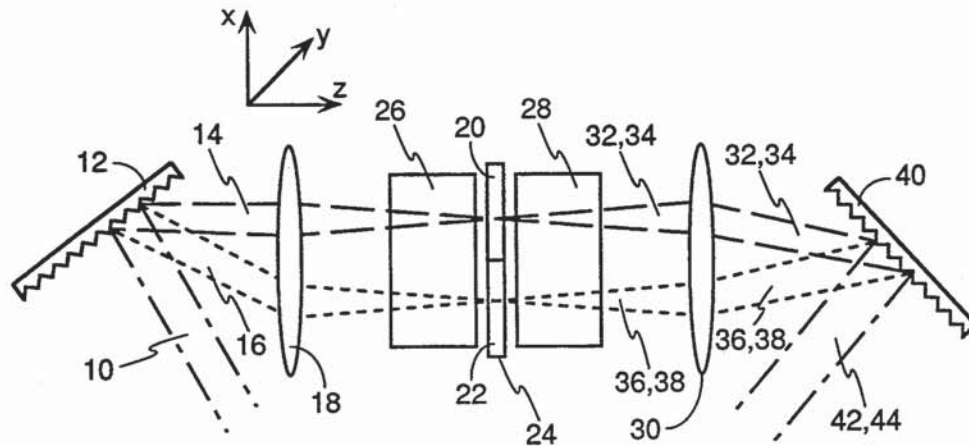62-305152 12/1987 Japan 359/122

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 magnetooptic switch for mut-work optical fiber", Applied Optics vol. 21, #11, Jun. 1, 1982, pp. 1943–1949.

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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.
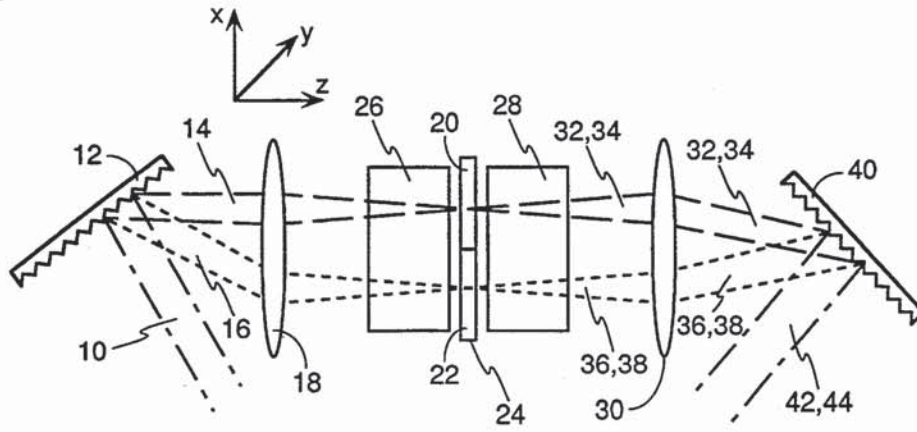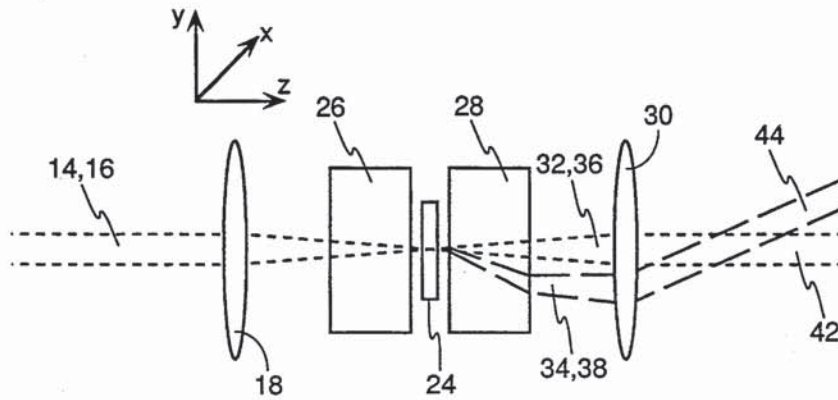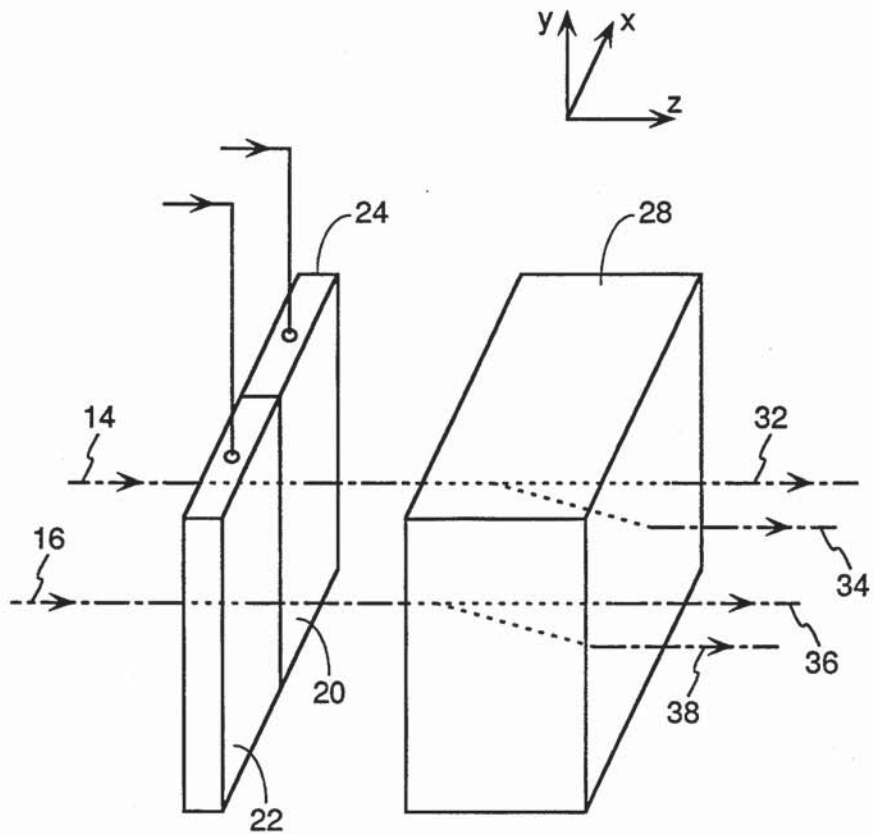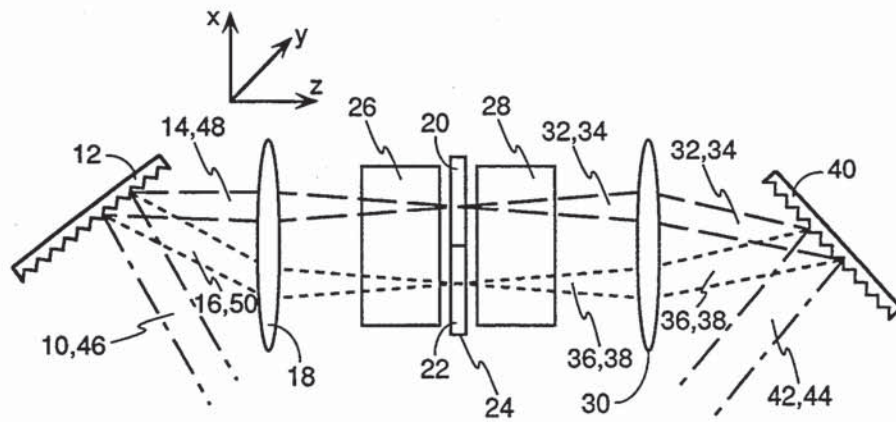
16 Claims, 9 Drawing Sheets

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

DOCKET ALARM
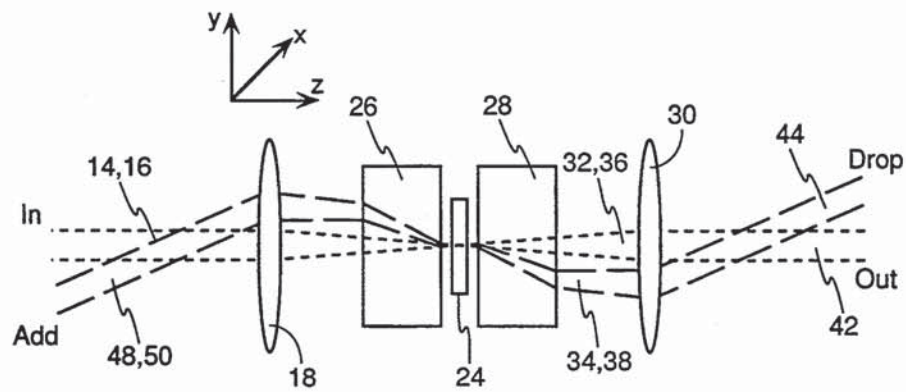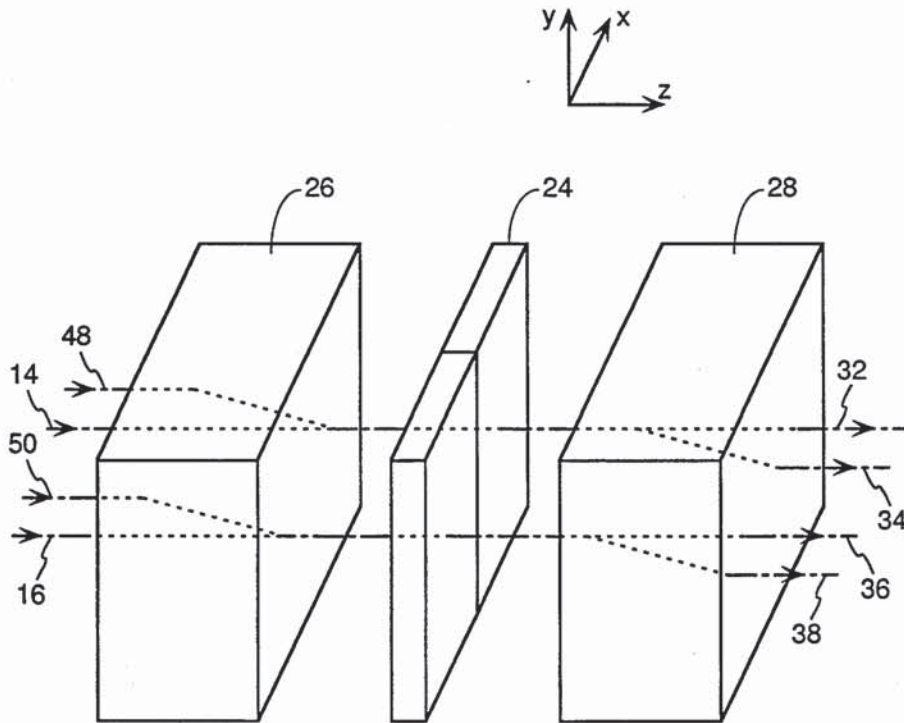
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