



US005414540A

# United States Patent [19]

Patel et al.

[11] Patent Number: **5,414,540**

[45] Date of Patent: **May 9, 1995**

[54] **FREQUENCY-SELECTIVE OPTICAL SWITCH EMPLOYING A FREQUENCY DISPERSIVE ELEMENT, POLARIZATION DISPERSIVE ELEMENT AND POLARIZATION MODULATING ELEMENTS**

[75] Inventors: **Jayantil S. Patel, Red Bank; Yaron Silberberg, West Windsor Township, Mercer County, both of N.J.**

[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.<sup>6</sup> ..... **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**

### 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 multi-work optical fiber", *Applied Optics* vol. 21, #11, Jun. 1, 1982, pp. 1943-1949.

Primary Examiner—William L. Sikes

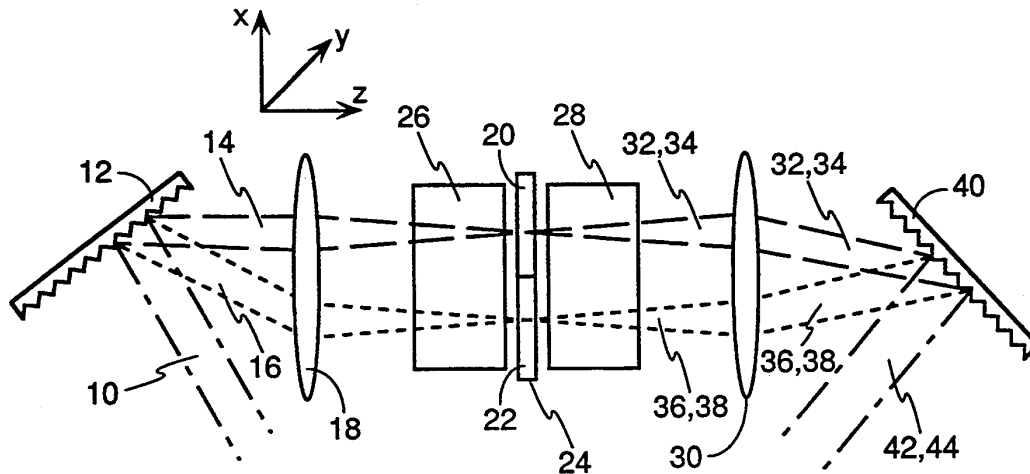
Assistant Examiner—Kenneth Parker

Attorney, Agent, or Firm—Leonard Charles Suchyta; James W. Falk

### [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



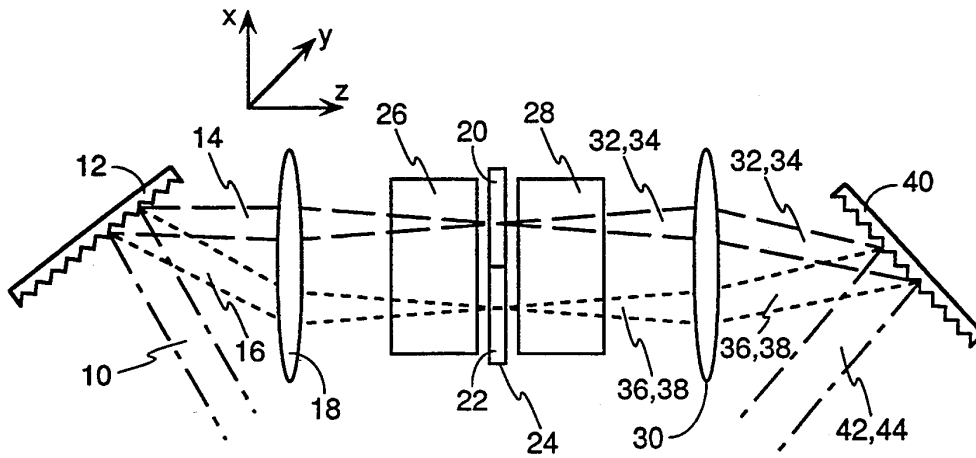


FIG. 1

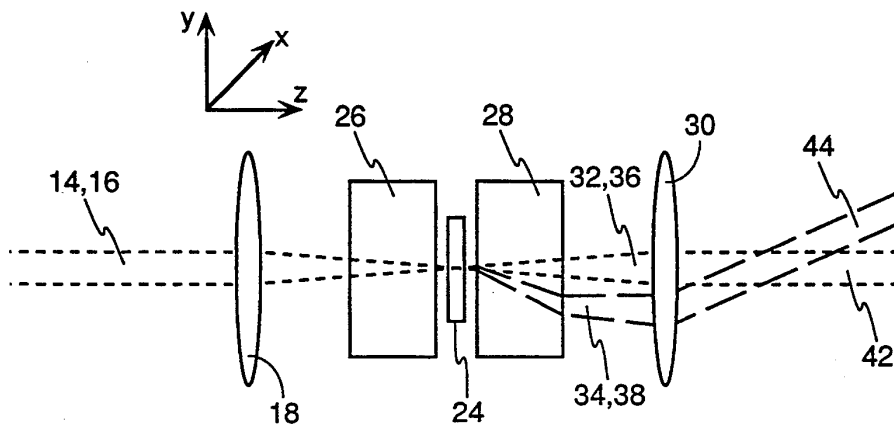


FIG. 2

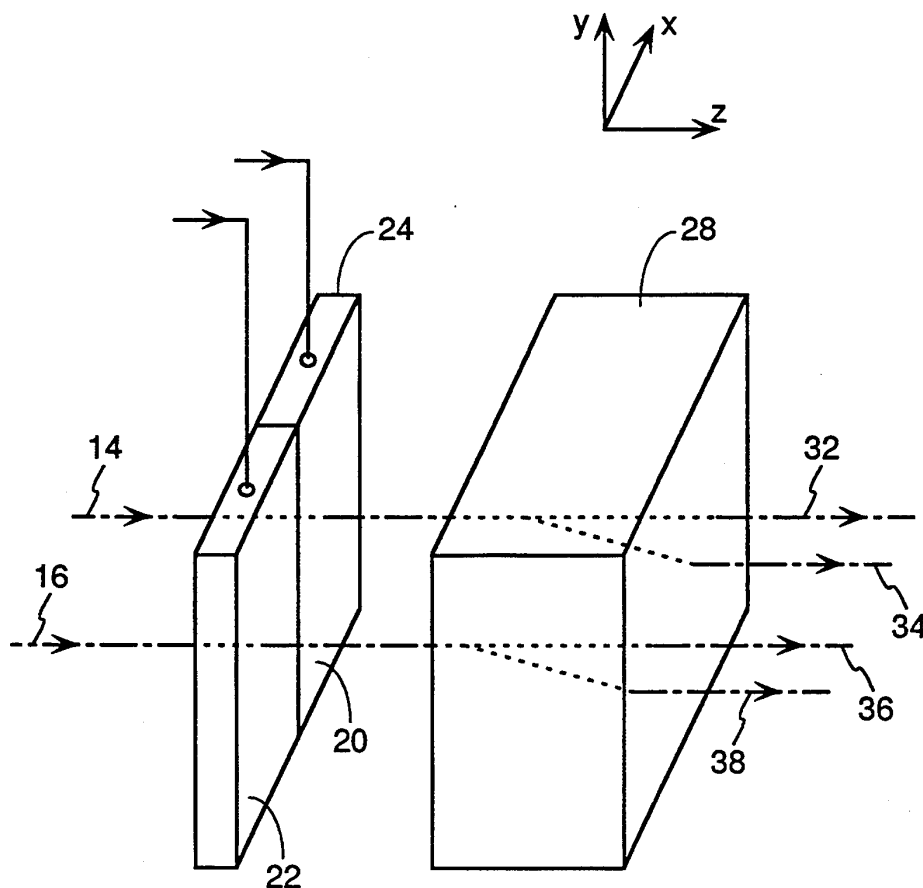


FIG. 3

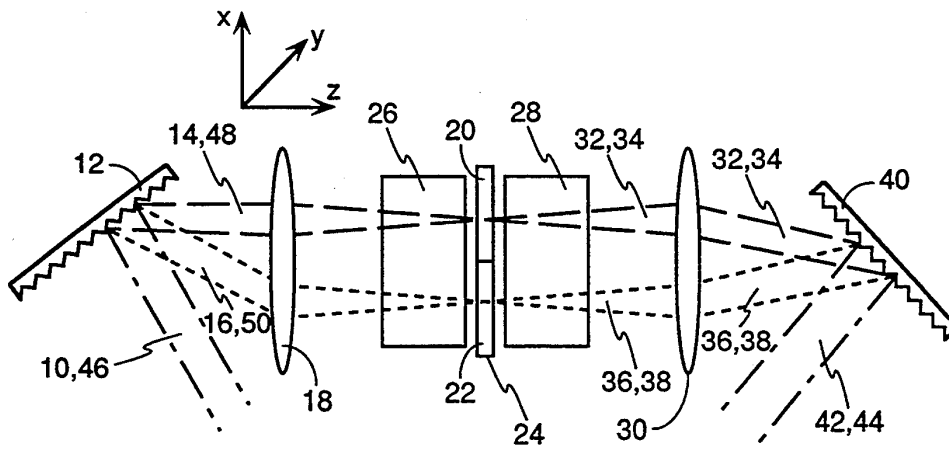


FIG. 4

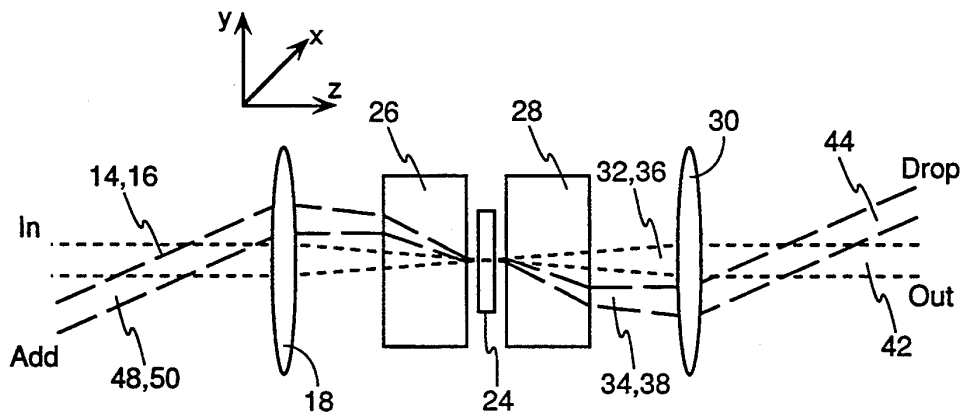


FIG. 5

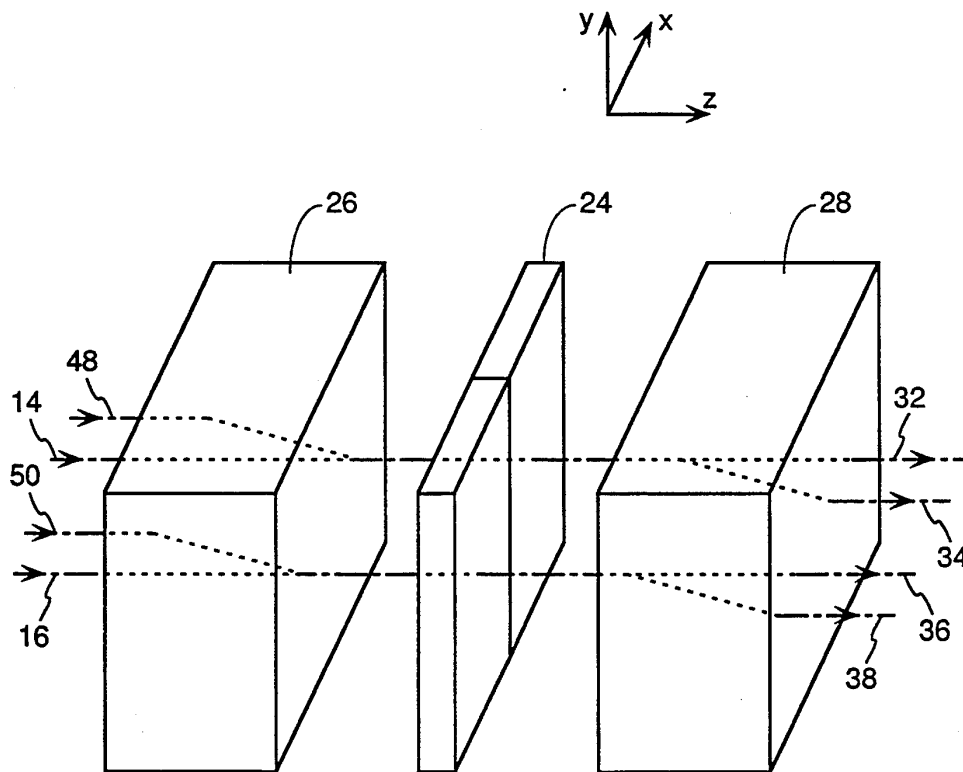


FIG. 6

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.