US006128422A

United States Patent [19]

Hodgson

[11] Patent Number: 6,128,422

[45] Date of Patent: Oct. 3, 2000

[54] **ALL FIBER POLARIZATION SPLITTING SWITCH**

[75] Inventor: **Craig W. Hodgson**, Thousand Oaks, Calif.

[73] Assignee: **The Board of Trustees of the Leland Stanford Junior University**, Stanford, Calif.

[21] Appl. No.: **09/307,091**

[22] Filed: **May 7, 1999**

Related U.S. Application Data

[63] Continuation of application No. 08/906,559, Aug. 5, 1997, Pat. No. 5,943,453

[60] Provisional application No. 60/036,587, Mar. 14, 1997.

[51] **Int. Cl.**[7] **G02B 6/28**

[52] **U.S. Cl.** **385/11**; 385/16; 385/24; 385/37

[58] **Field of Search** 385/24, 16, 37, 385/147, 11; 359/122, 124, 127, 128, 130, 156, 160

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,872,738	10/1989	Risk et al.	359/285
5,297,224	3/1994	Shaw	385/12
5,317,658	5/1994	Bergland et al.	385/16
5,428,697	6/1995	Dolfi et al.	385/4
5,703,975	12/1997	Miller et al.	385/16
5,793,905	8/1998	Maier et al.	385/16
5,943,453	8/1999	Hodgson	385/16

FOREIGN PATENT DOCUMENTS

63-157133	6/1988	Japan .
04025821	1/1992	Japan .

OTHER PUBLICATIONS

William P. Risk, III, Fiber–Optic Modulators Using Acoustically–Induced Polarization Coupling, *Doctoral Dissertation*, Stanford University, Jun. 1986.

A. Mecozzi, et al., All–optical switching and intensity discrimination by polarization instability in periodically twisted fiber filters, *Optics Letters*, vol. 12, No. 4, Apr. 1987, pp. 275–277.

S. Trillo, et al., Picosecond nonlinear polarization switching with a fiber filter, *Applied Physics Letters*, vol. 53, No. 10, Sep. 5, 1988, pp. 837–839.

Stefano Trillo, et al., Observation of Ultrafast Nonlinear Polarization Switching Induced by Polarization Instability in a Birefringent Fiber Rocking Filter, *IEEE Journal of Quantum Electronics*, vol. 25, No. 1, Jan. 1989, pp. 104–112.

(List continued on next page.)

Primary Examiner—Hung N. Ngo

Attorney, Agent, or Firm—Knobbe, Martens, Olson & Bear, LLP

[57] **ABSTRACT**

An all-optical polarization splitting switch of the Mach-Zehnder type includes a polarization maintaining fiber, an optical input signal, an optical pump signal, two polarization cross couplers, and a polarization splitting coupler. The polarization maintaining fiber carries the optical signal and the optical pump signal while maintaining polarization orientation. The first polarization cross coupler splits the optical signal into two portions having mutually perpendicular polarization states which have approximately equal power. The optical pump signal, when present, changes the phase of the first portion of the optical signal with respect to the second portion of the optical signal. The second polarization cross coupler combines all the optical power into a combined optical signal. The polarization splitting coupler couples the combined optical signal into a first output port or a second output port in accordance with the polarization state of the combined signal. This configuration eliminates many of the signal phase discrepancies that occur due to thermal instability and unequal fiber lengths which the Mach-Zehnder type switch exhibits. One application for this invention is a polarization splitting switch for a distributed sensor array.

20 Claims, 5 Drawing Sheets