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[54] **OPTICAL FIBER SENSOR HAVING DIGITAL INTEGRATING DETECTION SYSTEM UTILIZING ELECTRONIC PHASE LOCK LOOP**

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Related U.S. Application Data

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[52] **U.S. Cl.** **356/350**; 356/351

[58] **Field of Search** 356/350, 351

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[57] **ABSTRACT**

An interferometer used as a rotation sensor is constructed using a strand of optical fiber, a portion of which is formed into a sensing loop. A pair of light waves are caused to counterpropagate in the sensing loop and are combined to form an optical output signal that has an intensity that varies in accordance with the difference in the phases of the two counterpropagating light waves. A phase modulator is positioned on the optical fiber in the sensing loop at a location such that the two counterpropagating light waves are modulated approximately 180 degrees out of phase. The time-varying phase modulation causes a time-varying phase difference that is combined with a rotationally-induced Sagnac effect phase to provide a total phase difference that is detected by a photodetector. The photodetector provides an electrical output signal this is processed to determine the Sagnac phase difference. The rotation rate is then calculated from the Sagnac phase difference. The processing occurs in a feedback loop in which a reference signal is multiplied by the electrical output signal to provide a feedback signal. The reference signal is adjusted so that the feedback signal is maintained at a predetermined value. The magnitude of the adjustment of the reference signal is measured and the Sagnac phase difference is determined from the measured magnitude. Preferably, the difference between the magnitude of the feedback signal and the predetermined value is measured and the calculated rotation rate is adjusted in response to the measured difference.

17 Claims, 20 Drawing Sheets