United States Patent [19]

Jasper

[11] **Patent Number: 4,802,767**

[45] **Date of Patent: Feb. 7, 1989**

[54] **METHOD AND APPARATUS FOR OPTICAL NUTATION SENSING**

[75] Inventor: **Warren J. Jasper**, Raleigh, N.C.

[73] Assignee: **Hughes Aircraft Company**, Los Angeles, Calif.

[21] Appl. No.: **881,433**

[22] Filed: **Jul. 2, 1986**

[51] **Int. Cl.**[4] **G01B 9/02**; G01C 19/64

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

[58] **Field of Search** 356/350; 372/94

[56] **References Cited**

PUBLICATIONS

Advanced Electronics & Digital Sensor Technology Final Report, vol. V, Inertal Sensors, Jan. 1979, Martin Marietta Corp., Orlando, Fla., pp. (1-9) one page.

"The Ring Laser", Macek et al., Sperry Eng. Rev., vol. 19 (1966), p. 14.

"Fiber-Optic Rotation Sensor: Toward and Integrated Device", Arditty et al., Conf. on Lasers & Electro-Optics, 1981.

"Fiber-Optic Rotation Sensors and Related Technologies" Ezekiel e t al., Proc. of 1st Inter. Conf. MIT, Cambridge, Mass., Nov. 9-11 (1981).

"Dual-Spin Spacecraft Stabilization Using Nutation Feedback and Inertia Coupling" Smay, Journal of Space Craft & Rockets, vol. 13, #11, 650-659 (1976).

"Sagnac Effect", Post, Reviews of Modern Physics, vol. 39, pp. 475-494 (1967).

"Fiber Optic Ring Interferometer" Vali et al., Applied Optics, vol. 15, #5, pp. 1099-1100 (1976).

"Fiber Optics for Communications & Control", Gross, Proc. Soc. Photo'4 Opt. Instrum. Eng., vol. 224, pp. 38-45 (1980).

"An Optical Rotation Sensor Based on the Sagnac Effect Using a Fiber Ring Interferometer", Schiffner, Meeting on Opt. Comm-Berlin, Germany (1980).

Primary Examiner—Vincent P. McGraw

Attorney, Agent, or Firm—S. M. Mitchell; M. J. Meltzer; A. W. Karambelas

[57] **ABSTRACT**

An optical nutation sensing method and apparatus is provided which is functional at low spin rates and during thruster firings while being relatively insensitive to spacecraft flexures. The advantageous operation of the present invention is afforded by provision of first and second beams of coherent light energy in opposite directions into a coil of optic fiber or other suitable means for restraining the path thereof. The coil lies in a plane normal to the transverse angular momentum vector. The beams are combined at the output ends of the coil in such a way as to create an interference pattern which varies as the satellite nutates. The variation in the interference pattern is detected by photodetector circuitry to provide an output signal representative of the nutation.

9 Claims, 3 Drawing Sheets