

[54] VIBRATING ELEMENT ANGULAR RATE SENSOR SYSTEM AND NORTH SEEKING GYROSCOPE EMBODIMENT THEREOF

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[57] ABSTRACT

An angular rate sensor system preferably comprising closely spaced vibrating drive and sensing elements in a paired tuning fork configuration mounted to rotate about a rotational axis oriented perpendicular to the sensitive axes. The rotational drive assembly includes an

encoder to modulate sensing element orientation, and coupling means to transmit drive and output signals to and from the rotating elements. Each pair of sense and drive elements are disposed in non-aligned parallel side-by-side opposition across the axis of rotation. The elements may be carried on torsional masses including a resilient coupling therebetween. The angular rate sensor system may be utilized as a north-seeking gyroscope in applications such as mining, surveying, or artillery. The phase of the sinusoidal sensor output signal corresponds to the orientation between the sensitive axis of the sensing elements and the earth's angular rate vector to produce a reference to geographic north. The electronic filter includes a signal generator, two phase-locked loops, AC amplifiers, bandpass filter, comparator, counter-divider, and latch to iterate a steady phase reading. A settling time of approximately 30–60 seconds is required to resolve a heading reference within  $\pm 0.1^\circ$  of geographic north. A two axis low bias embodiment of the angular rate sensor system may be utilized alone or in combination with a similar system to provide complete angular rate sensing along a desired common axis, or with a second stationary angular rate sensor to enhance the bandwidth and DC response of the stationary angular rate sensor.

44 Claims, 4 Drawing Sheets

