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Bose et al.

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[54] **METHOD AND APPARATUS FOR MEASURING PRESSURE IN A CORIOLIS MASS FLOWMETER**

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[52] U.S. Cl. **73/861.56**

[58] Field of Search 73/861.355, 861.356, 73/861.357, 861.354

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[57] **ABSTRACT**

A method for determining pressure in an operating Coriolis effect mass flowmeter. The Coriolis flowmeter flow tubes are vibrated in both a bending mode (as is normal for measuring mass flow rate) and in a twisting mode. The ratio of the fundamental frequencies at which the flow tubes vibrate in each of the two vibration modes is proportional to the pressure within the flow tubes. In the preferred embodiment, a sum/difference method initially isolates the superposed sinusoids representing the fundamental frequencies of the two vibrational modes. Fast conjugate gradient (FCG) digital filters are then used to rapidly estimate the fundamental frequencies in each of the two vibration modes. The estimated frequencies are then used by filter chains including digital notch and band pass filters as well as recursive maximum likelihood (RML) digital filter techniques to enhance the bending mode and twisting mode fundamental frequency estimates. The enhanced bending mode and twisting mode frequency estimates are used to determine the pressure within the flow tubes as a function of the ratio of the two frequencies as well as to center the notch and band pass filter chains used to enhance the bending mode frequency of the two vibration sensor channels for mass flow rate computations. The pressure so determined may then be used to correct mass flow rate computations or for other pressure measurement purposes per se.

27 Claims, 11 Drawing Sheets

MASS FLOW INSTRUMENTATION

FIG. 1

FIG. 2

FIG. 3

30

W

14

BEND MODE
VIBRATION
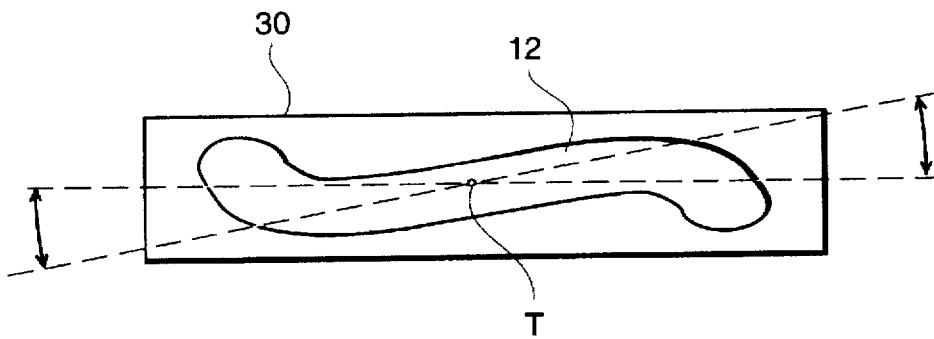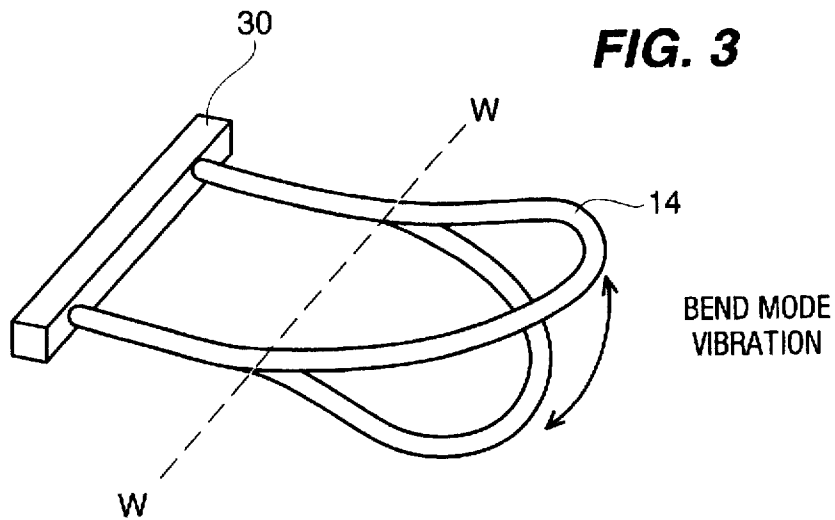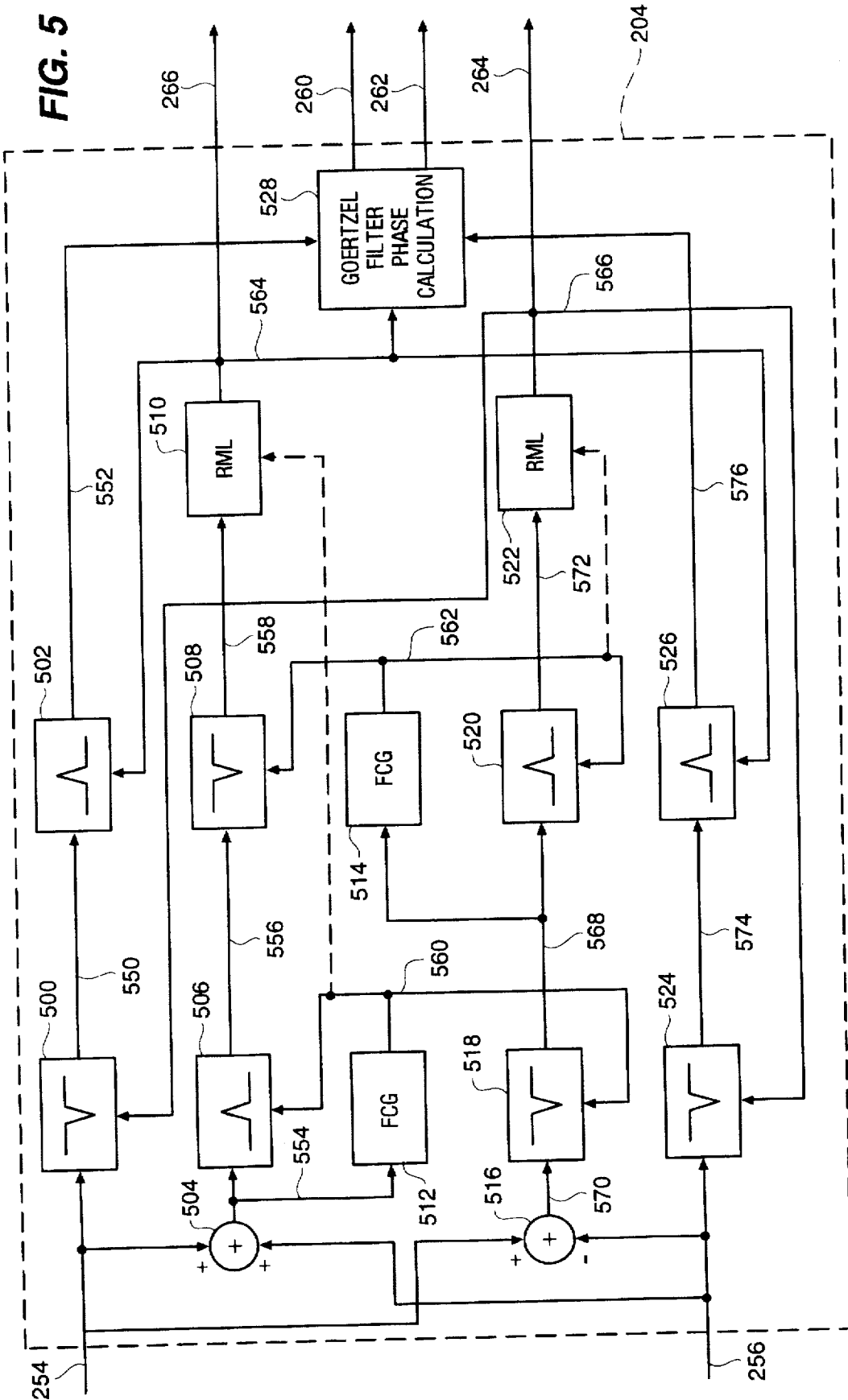
W

FIG. 4   TWIST MODE VIBRATION

30

12

T

FIG. 5

DOCKET ALARM

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