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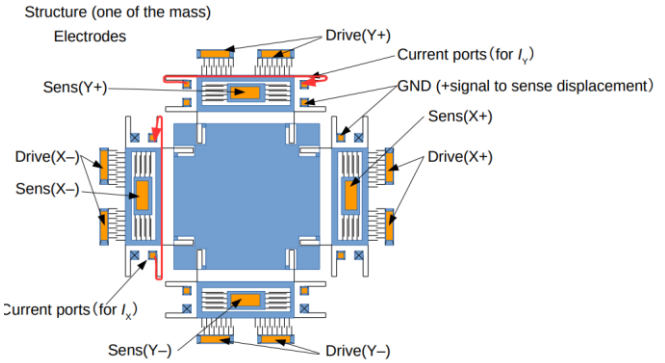
Multi-Use FM Gyro Sensor

New method enhances gyro use cases



Overview

This invention related to a FM gyro sensor.

Conventional FM gyro has technical issue that accuracy is affected by temperature fluctuation. This is because it needs 2 different oscillators, thus, temperature different, manufacturing irregularity exists in between these two oscillators.

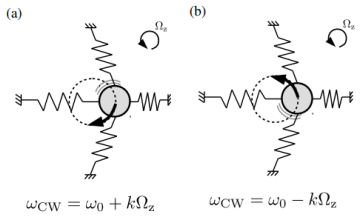
This invention hires single oscillator and different oscillation mode are excited to it.

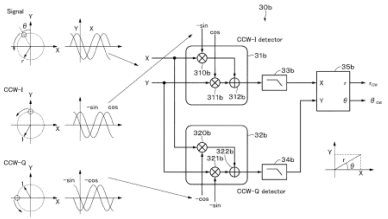
By above mentioned method, high independency from temperature effect has been achieved.

In addition to it, thanks to its unique method, this gyro sensor can be used as magnetic sensor, pressure sensor and so on.

Various patent has been applied/granted and mature patent portfolio has been developed.

Features・Outstandings





- **Not affected by temperature fluctuation**
- **Work as multi-sensor(magnetic, pressure)**
- **Angle-lock phenomenon can be cleared**

Product Application

- ☐ Gyro sensor
- ☐ Magnetic sensor
- ☐ Pressure sensor

Related Works

[1]塚本 貴城, 田中 秀治(2019),
MEMS 振動型ジャイロスコープの動作原理と最近の動向
(http://www.mems.mech.tohoku.ac.jp/documents/MEMS_gyroscope_overview2019.pdf)

IP Data

IP No. : JP6559327 and others
Inventor : Takashiro TSUKAMOTO, Shuji TANAKA
Admin No. : T15-153,T17-161,T18-098,T21-087,T21-089,T21-090

Contact

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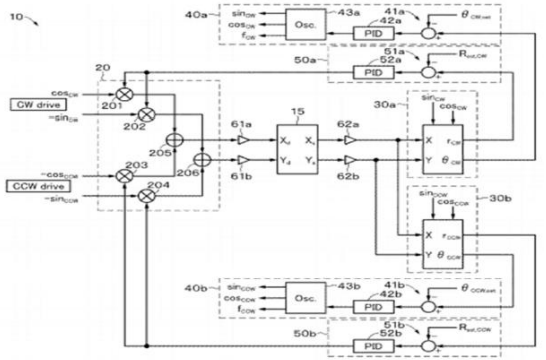
FM Gyroscope and Control method

Avoid angle lock phenomenon without applying external force



Overview

FM gyroscope generates a phenomenon known as angle lock where the vibration angle is arrested due to the Q factor mismatch.

The angle lock phenomenon does not occur for an ideal oscillator where the resonant frequency and Q factor are uniform in all directions. However, since the Q factor of a real oscillator has directional dependency, the vibration direction rotates toward the maximum Q factor direction with the time.

In order to solve this issue, there is a method known to provide constant rotation (virtual rotation) to the oscillator. However, this method needs the device to be more complicated and large due to its mechanism and control.

This invention can generate a virtual rotation by adjusting the control system parameters without applying any external force.

Related Works

[1] T. Tsukamoto and S. Tanaka, "Virtually Rotated MEMS Whole Angle Gyroscope using Independently Controlled CW/CCW Oscillations," in Proc. Inertial 2018, 2018, pp. 49

[2] T. Tsukamoto and S. Tanaka, "MEMS Rate Integrating Gyroscope with Temperature Corrected Virtual Rotation," in Proc. 2019 IEEE International Symposium on Inertial Sensors and Systems (INERTIAL), 2019, pp. 21-24. -- 52.

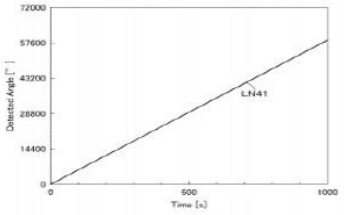
IP Data

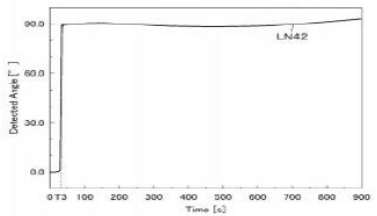
IP No. : JP2018-054256
Inventor : TSUKAMOTO Takashiro, TANAKA Shuji
Admin No. : T17-161

Configuration example of this gyro device

Rotate virtually the 2D oscillator without applying any physical external force

Angle lock phenomenon can be avoided (Left: this invention. Right: without any control)





Product Application

- Gyro sensor

Contact

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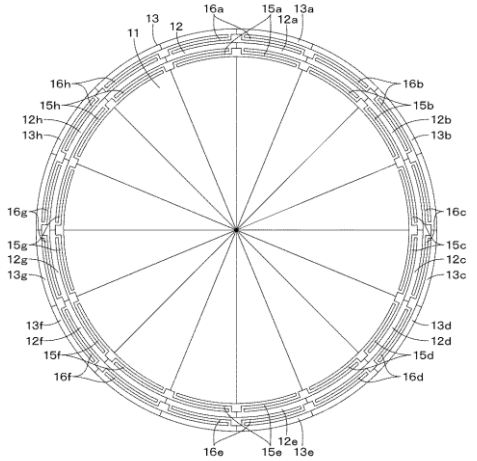
Q factor trimming for Oscillator

adjust the Q factor of multiple orthogonal modes



Overview

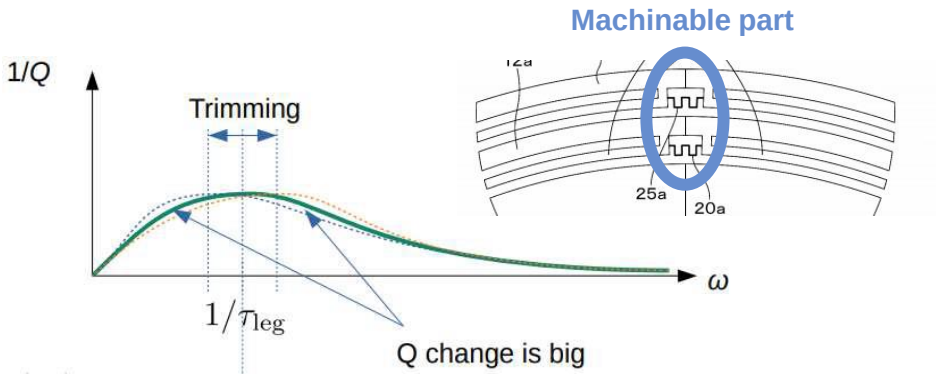
Although the Q factors of the 2D oscillator used in gyroscope must be matched in the x and y axial directions, they may differ slightly due to manufacturing error, etc. Thus, Q factor in each x and y axial direction needs to be matched independently.

In a oscillator, vibration generates heat flow which affects the Q factor (thermoelastic loss). Therefore, it is possible to adjust the Q factor by adding a heat flow path in the structure or by blocking the heat flow.

The 2D oscillator of this invention has a pre-fabricated machinable part to control the heat flow without changing significantly the stiffness, in addition to its basic structure. The Q factors in the 1st and 2nd modes, which are orthogonal to each other, can be controlled independently by cutting this machinable part appropriately.

Example of gyroscope configuration

Adjust the Q factor by machining the machinable part



Related Works

[1] A. Hamza, T. Tsukamoto and S. Tanaka, "Quality Factor Trimming Method Using Thermoelastic Dissipation for Ring-Shape MEMS Resonator," in Proc. 2020 IEEE International Symposium on Inertial Sensors and Systems (INERTIAL), 2020, pp. 1-4.

Product Application

- Oscillator used in gyrosensor

IP Data

IP No. : JP2019-195011
Inventor : TSUKAMOTO Takashiro, TANAKA Shuji
Admin No. : T19-369

Contact

Tohoku Techno Arch Co., Ltd.
Please visit CONTACT here