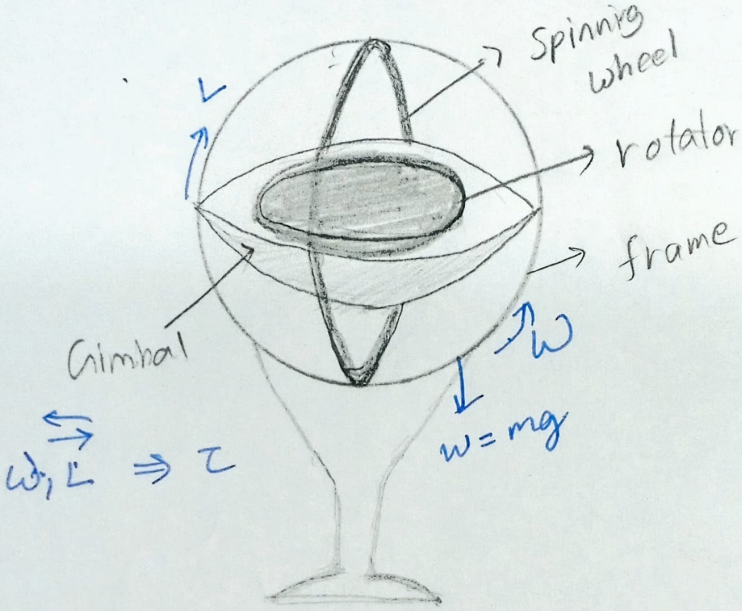
09/10/22

Cyroscope

Device - to monitor or measure angular velocity without changing its magnitude ~~and~~ (orientation.)

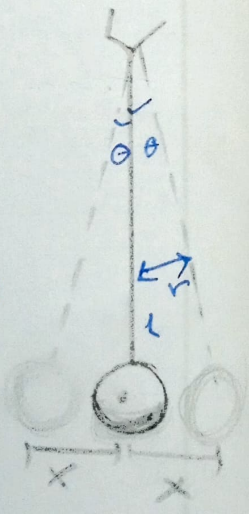
Types - Mechanical / optical / gas bearing



Principle - ω, L and τ

Uses - to monitor direction (spacecraft).

Torsoral Pendulum.



Law of Conservation of Energy

$T.E = P.E + K.E$

a constant $= C\frac{\theta^2}{2} + \frac{1}{2}I\omega^2 \rightarrow (1)$

Differentiate (1) w.r to t

$$\frac{C}{2} 2\theta \frac{d\theta}{dt} + \frac{1}{2} I\omega^2 \frac{d\omega}{dt} = 0$$

$$C\theta.\frac{d\theta}{dt} + I\omega \frac{d\omega}{dt} = 0 \rightarrow (2)$$

We know

$\omega = d\theta/dt$

$\omega^2 = d^2\theta/dt^2$

from ② we have

$$C\theta \cdot \frac{d\theta}{dt} + I \frac{d\theta}{dt} \frac{d}{dt}\left(\frac{d\theta}{dt}\right) = 0$$

$$C\theta \cdot \frac{d\theta}{dt} + I \frac{d\theta}{dt} \frac{d^2\theta}{dt^2} = 0$$

$$\frac{d\theta}{dt}\left[C\theta + I \frac{d^2\theta}{dt^2}\right] = 0$$

$$\therefore a = d^2\theta/dt^2 = C\theta/I$$

$T = 2\pi \sqrt{\text{displacement / acceleration}}$

$$\Rightarrow T = 2\pi \sqrt{\theta/a} = 2\pi \sqrt{\theta/C\theta/I}$$

$$T = 2\pi \sqrt{T/C}$$

$$\therefore f = 1/T = 1/2\pi \sqrt{C/I}$$