TIME PERIOD OF BALANCE WHEEL

GROUP 3

ME251

1 Introduction

The balance wheel keeps time for the watch. It consists of a weighted wheel which rotates back and forth, which is returned toward its center position by the balance spring. The wheel and spring together constitute a harmonic oscillator. The mass of the balance wheel combines with the stiffness of the spring to precisely control the period of each *beat* of the wheel. A balance wheel's period of oscillation T in seconds,is the time required for one complete cycle i.e two beats.

2 Concept

For the balance wheel, the hairspring constant should be such that:

$$T = 2\pi\sqrt{\frac{I}{\kappa}} \qquad (1)$$

where I = Moment of Inertia of Wheel in kgms^{-2} and
κ = the stiffness (spring constant) of its balance spring in Newton-Meters per radian.
T = 5, 6, 8 or 10 beats per second generally.
Since,2 beats = 1 cycle:
So, T = 18000, 21600, 28800 or 36000 beats per hour(BPH).

The frequency of the balance wheel can be changed by adjusting the effective length of the balance spring. In most watches there is a regulator lever on the balance spring which is used to adjust the rate of the watch. It has two curb pins which embrace the last turn of the spring, holding the part behind the pins motionless, so the position of the curb pins determines the length of the spring.

Sliding the pins up the spring, shortening the spring's length, makes it stiffer, increasing κ , in the equation above, decreasing the wheel's period T, so it swings back and forth faster, causing the watch to run faster.

Longer the Effective Length = Lower The Frequency

3 Calculations

From the model that we made on Fusion360,we calculated the moment of inertia of the Balance wheel from the Properties section which came out to be

$I = 11.097 g/mm^2$ which translates to 11.097 x$10^3 kg/m^2$.

Considering,our balance wheel to have a frequency of $2.5 Hz$ and hence a Time Period(T) of $0.4 s$.

Substituting all this in the formula above marked as (1),we get the stiffness of the spring to be:

$\kappa = 2.743$ **x** $10^6 Nm/rad.$

Therefore,this should be taken as the spring constant of the hairspring for our Balance Wheel.