UNIVERSITY OF NAIROBI

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FME 211/212 – THEORY OF MACHINES II

MOMENT OF INERTIA OF A FLYWHEEL

Objective:

To determine the moment of inertia of a flywheel using the work-energy and the force-inertia equations.

Apparatus

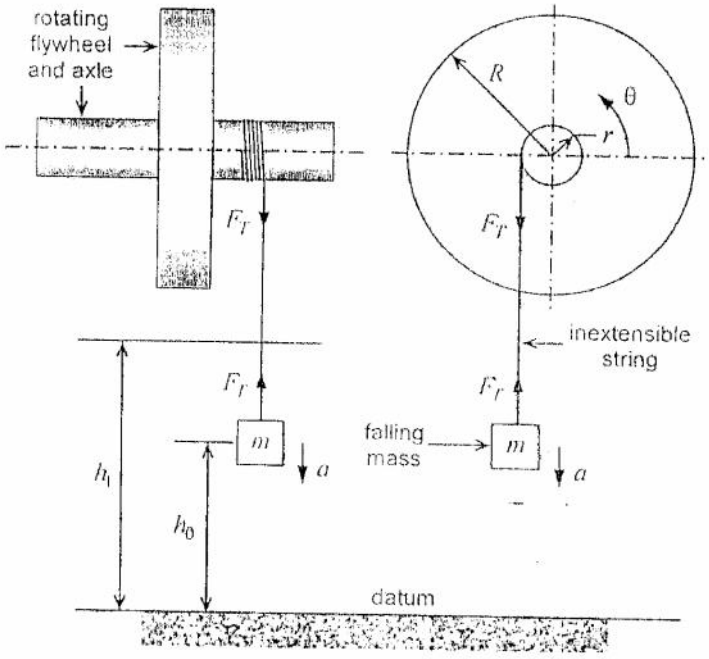

Fig. 1 – The Flywheel and Falling Mass

A flywheel with mass M and moment of inertia I is mounted horizontally in ball bearings. A string with a mass m hanging from its lower end can be wound

around the shaft. When the mass m is allowed to fall through a height h, the flywheel rotates an angle θ.

Procedure

- Measure and record the radii of the flywheel and the axle (R, r), the mass of the flywheel (M) and the mass to be hung from the string (m).
- Measure and record the lowest height of the hung mass (h_0) for which the string will remain attached to the axle.
- Wind the string through two to five complete revolutions (θ_1) around the axle and then measure and record the new height (h_1) of the hung mass.
- Release the system, allowing the mass to fall and rotate the flywheel and axle. As you release the system, use a stop watch to measure and record the duration (t_1) from the moment the system is released to the moment the string falls of the axle as well as the duration (t_2) from when the system is released to the moment the flywheel finally stops rotating. Measure and record too, the number of revolutions (θ_2) - including fractions – that the flywheel rotates through from the moment the system is released to the moment the flywheel finally stops rotating.
- Repeat the experiment to check measured values.
- Repeat the experiment with a two different and larger values of θ.
- Repeat the experiment with two different and larger masses (m).

Calculations

- Establish the energy and acceleration equations for the system.
- Compute the moment of inertia (I) of the flywheel.

Hints:

Note that the angular accelerations are constants and use this fact together with the measurements of t and θ.

The bearings resistance due to friction is the product of the gravitational force and frictional coefficient and the bearing radius.

Results

- Present the experiment, the equations and calculations neatly in a report.
- Discuss your results and main sources of errors.
- Compute the moment of inertia of the flywheel using the equation $I = \sum mr^2$ and compare this with the value obtained through the experiment.
- Draw your conclusions.

Reference.

Hannah and Stephens: Mechanics of Machines Chapter 1.