K J Somaiya College of Engineering

(A Constituent College of Somaiya Vidyavihar University)

Batch: Roll No.:
Experiment / assignment / tutorial No.
Grade: AA / AB / BB / BC / CC / CD /DD

Signature of the Staff In-charge with date

Title: Flywheel

<u>CO5:</u> Analyze the dynamic system using D'Alembert, work energy and impulse momentum principle.

Objective

To determine the mass moment of inertia of a flywheel.

Theory

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have a significant moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by applying torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing its rotational speed.

Common uses of a flywheel include:

- Providing continuous energy when the energy source is discontinuous. For example, flywheels are used in reciprocating engines because the energy source,torque from the engine, is intermittent.
- Delivering energy at rates beyond the ability of a continuous energy source. This is achieved by collecting energy in the flywheel over time and then releasing the energy quickly, at rates that exceed the abilities of the energy source.
- Controlling the orientation of a mechanical system. In such applications, the angular momentum of a flywheel is purposely transferred to a load when energyis transferred to or from the flywheel.

AIM:

To find the moment of inertia of a flywheel theoretically and compare the same with experimental value.

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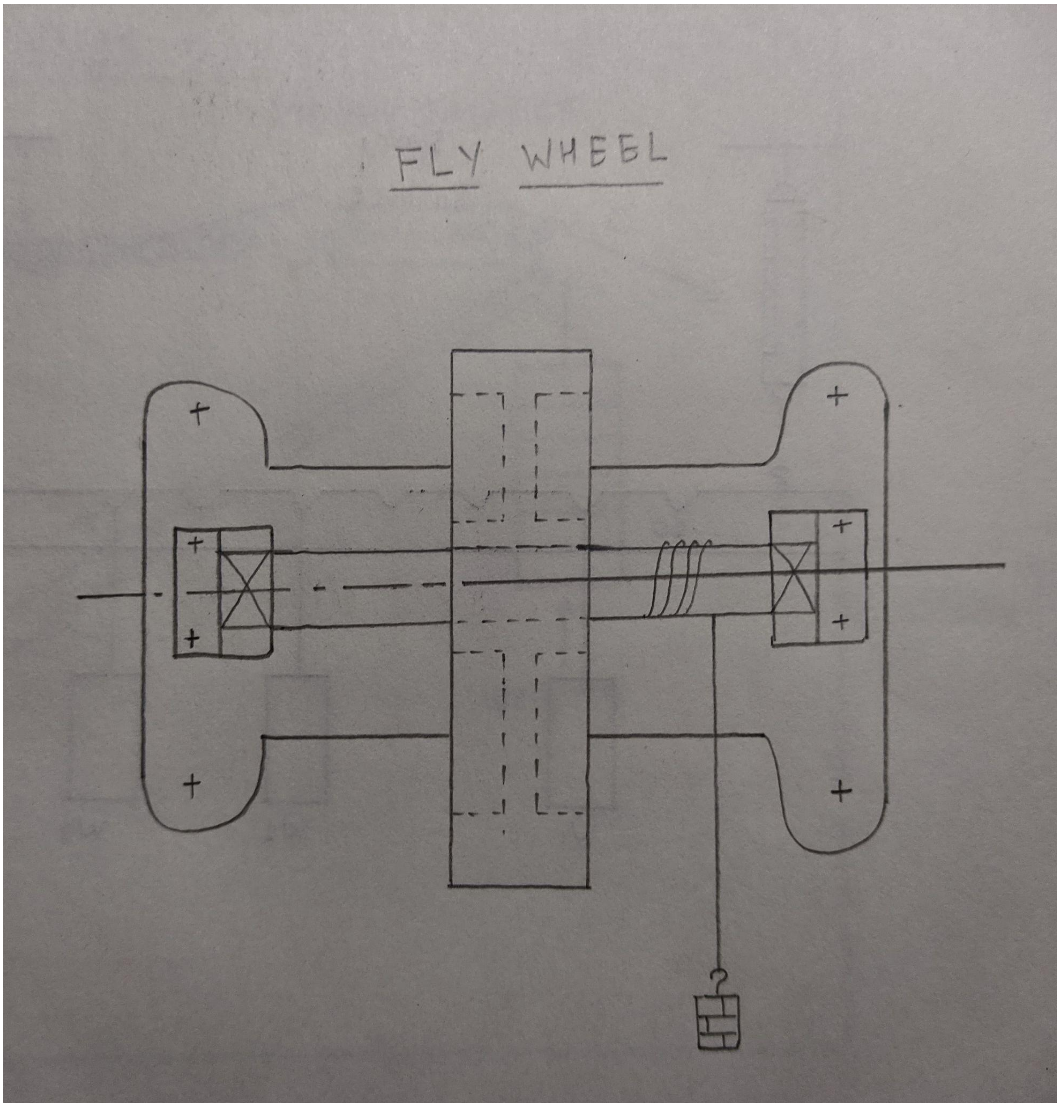
APPARATUS:

Flywheel mounted on ball bearings, stop watch, set of weights, string and meter scale

Setup Diagram:



PROCEDURE:

1. From the specifications of the flywheel calculate the theoretical value of Moment of Inertia.
2. Take a string of length equal to the height of the spindle of the flywheel from the ground; to one end attach a hook to carry the weight. Make a small loop on the other and attach it over the peg on the spindle of the flywheel. Wind the string over the spindle. Check whether the looped end of the stringis released from the peg when the weight touches the ground.
3. Note down the 'h' from which the mass is allowed to fall. See that the red mark on the rim of the flywheel is coinciding with the pointer.
4. Attach a suitable mass on the hook and allow the mass to fall. Count the number of revolutions made by the flywheel (n) before the weight touches the ground. When the sound of the mass touching the ground is heard, starta stop watch and find the

time taken (T) for the flywheel to come to rest and number of revolutions (N) made during this time.

5. Repeat the procedure for different masses.
6. Calculate the Moment of Inertia of the flywheel with the formula derived.

OBSERVATION TABLE

Number of windings of string on the spindle (n) = 5

Height through which mass m falls (h) = 40cm

Sr. No	Mass Kg	Time (T) sec	No of Rev. (N)	Ang. vel. (ω) rad/sec	M.I. $Kg.mm^2$

		1	2	3	Avg.	1	2	3	Avg.		
1	0.087	79	88	81	83	29	30	29	29	4.89	30210
2	0.112	99	105	102	102	41	40	42	41	5.05	30709
3	0.137	118	114	109	114	52	51	56	53	5.84	28793

CALCULATION:

Avg (ω) = ($\omega_{initial} + \omega_{final}$)/2
$\omega_{final} = 0$
$\omega_{initial} = 4\pi N/T$

mgh = KE_{mass} + Rotational KE_{fly} + Friction loss mgh = ½ mV^2+ ½ I ω^2+ nF

NF = ½ I ω^2
nF = n/N ½ I ω^2

mgh = ½ mV^2+ ½ I ω^2+ n/N ½ I ω^2
2mgh = $mr^2\omega^2$+ I ω^2+ n/N I ω^2
(2mgh - $mr^2\omega^2$) = I ω^2(1+ n/N)
I = (2mgh - $mr^2\omega^2$) / ω^2(1+ n/N)

1)
ω=(4πN)/T
=(4xπx29)/83
=4.39

I = (2mgh - $mr^2\omega^2$) / ω^2(1+ n/N)
I=(2x0.087x9810x400-0.087(10.35)²(4.39)²) /((4.39)²(1+5/29)
=682596.3609/22.5948
=22.5948
=30210

2)
ω=(4πN)/T
=(4xπx41)/102
=5.05

I = (2mgh - $mr^2\omega^2$) / ω^2(1+ n/N)
I=(2x0.112x9810x400-0.112(10.35)²(5.05)²) /((5.05)²(1+5/41)
=878670.0281/28.6125
=30709.30639

3)
ω=(4πN)/T
=(4xπx53)/114
=5.84

I = (2mgh - $mr^2\omega^2$) / ω^2(1+ n/N)
I=(2x0.137x9810x400-0.137(10.35)²(5.84)²) /((5.84)²(1+5/53)
=1074675.474/37.3231
=28793

%error= (|observed-theoretical|/theoretical)*100
=(|29904-28511|/28511)*100
=.04885*100
=4.885%

RESULTS

Theoretical M.I. of flywheel = 28511 Kg.mm^2

Experimental M.I. of flywheel = 29904

Kg.mm^2

% error = 4.885%

Signature of faculty in-charge