Instruction Manual

for

Epicyclic Gear Train Apparatus

Introduction

Any combination of gear wheels by means of which motion is transmitted from one shaft to another shaft is called a gear train. In case of epicyclic gear trains, the axes of the shafts on which the gears are mounted may move relative to a fixed axis.

Specifications

1. Sun and planetary gear box with sun gear (14 teeth) and two planet gears (21 teeth each)

2. Rope and spring balance arrangement to measure output torque and holding torque

3. 1 H.P. D.C. shunt motor, 3000 RPM, 230 V

4. Control panel with dimmerstat (DC) for speed variation and ammeter and voltmeter

Theory

Torque analysis in epicyclic gear train If the parts of an epicyclic gear train are all moving at uniform speeds, so that no angular accelerations are involved, the algebraic sum of all the external torques applied to the train must be zero, or,

$\sum (T) = 0$

There are three external torques for every train. These are,

T_i , Input torque on the driving member

T_o , Output torque or load torque on the driven member

T_h , Holding torque or braking torque on the fixed member

Hence, if there is no acceleration,

$$T_i + T_o + T_h = 0$$

Experiment

To study and verify the torque relationship,

$$T_i + T_o + T_h = 0$$

Where,

T_i = Input torque on the driving member

T_o = Output torque or load torque on the driven member

T_h = Holding torque or braking torque on the fixed member

Input Torque, T_i

Here,

Motor torque × Motor angular velocity = Output torque × Output shaft angular velocity

Motor torque = Input torque

$$T_i \times \omega_m = T_o \times \omega_{os}$$

or,
$$T_i \times \frac{2\pi}{60} \times N_m = T_o \times \frac{2\pi}{60} \times N_o$$

or,
$$T_i = T_o \times \frac{N_o}{N_m} \qquad \text{............ (A)}$$

Where,

N_m = RPM of motor

N_o = RPM of output shaft

Output Torque, T_o

Here,

$$T_o = (S_2 - S_3) \times R_P \qquad \text{............ (B)}$$

Where,

S_2 = Load in spring balance 2 in Newtons

S_3 = Load in spring balance 3 in Newtons

R_P = Effective radius of pulley in Meters (0.125 m)

Holding Torque, T_h

Here,

$$T_h = S_1 \times R_{HD} \qquad \text{............ (C)}$$

Where,

S_1 = Load in sring balance 1 in Newtons

R_{HD} = Effective radius of holding drum in Meters (0.185 m)

Hence, using equations A, B and C all the three torques can be determined

Observation Table

S. No.	RPM N_o	RPM N_m	Load, S_1 (N)	Load, S_2 (N)	Load, S_3 (N)	Input Toque, T_i (N.m)	Output Torque, T_o (N.m)	Holding Torque, T_h (N.m)

Remarks