National Institute of Technology, Durgapur

Department of Electrical Engineering

Electrical Machines Laboratory

Swinburne's Test

Object:

To determine efficiency vs. load characteristics of a dc shunt machine (motor as well as generator) by Swinburne's method.

Apparatus Used:

1. Machine under test – one D.C. machine.
2. Ammeters-MC-1 No.
3. Voltmeter-MC-2 Nos.
4. Tachometer-1.

Theory: As this is a no-load test, it cannot be performed on a dc series motor. In this method, the machine is run at no-load as a shunt motor at rated speed. The iron and friction losses are determined by measuring the input to the dc machine at no-load.

Circuit Diagram:

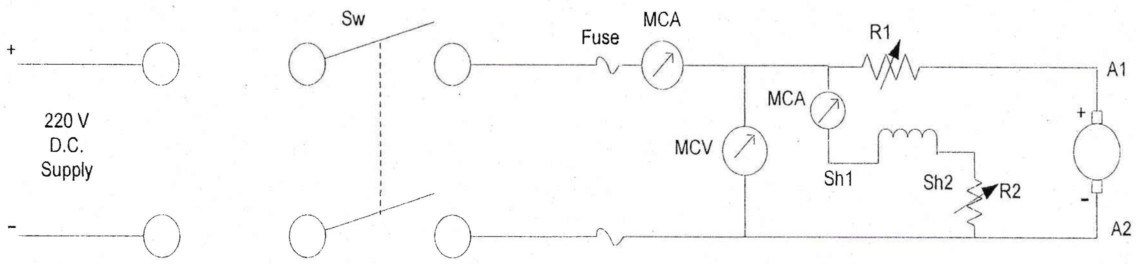

Fig. 1 Circuit diagram for Swinburne's Test

Let, I_0 = No-load input current as a motor
I_f = No-load field current
I_{a0} = No-load armature current
V = Terminal voltage
$I_{a0} = I_0 - I_f$
Power absorbed by the armature at no-load = No-load rotational loss, W_0 + small amount of armature copper loss, $I_{ao}^2R_a$
Hence, no-load rotational losses, $W_0 = VI_{a0} - I_{ao}^2R_a$ Watts

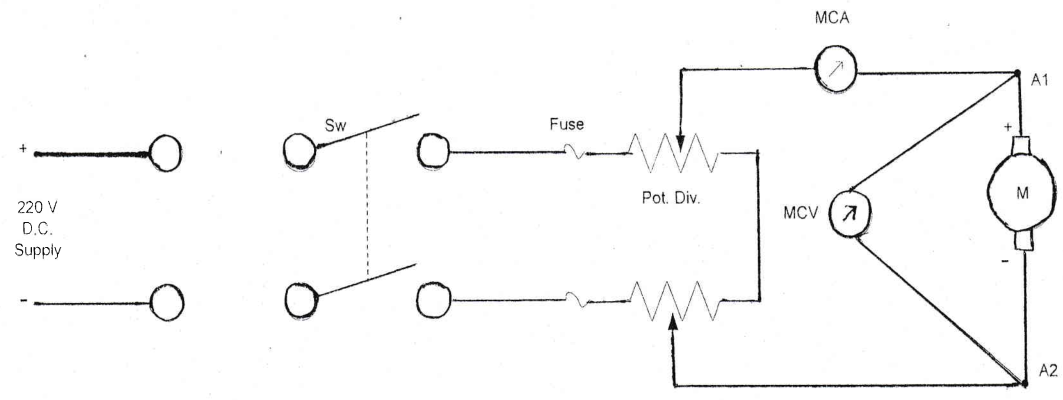

Fig. 2 Circuit diagram for Drop test

Procedure:

1. Connect the D.C. motor as shown in the circuit diagram Fig. 1.
2. With maximum resistance in the armature circuit, start the motor gradually cutting out the armature resistance and run the motor at rated speed 'on no load' at rated terminal voltage.
3. Measure the terminal voltage, current through the armature, current through the shunt field and speed. Note them in Table No. 1.
4. Measure its armature resistance (R_a) by 'voltage drop' method. For this, make connection as shown in Fig. 2 and take three sets of readings for armature current and armature voltage. Note them in Table No. 2.

Observations:

Table No. 1

SL. No.	*Motor terminal voltage (V)*	*Motor input current (I_L) (amps)*	*Motor field current (I_f) (amps)*

Table No. 2:

No. of observations	*Voltage across armature (V)*	*Current through armature (A)*	*Armature resistance (Ω)*	*Mean resistance (Ω)*
1. 2. 3.				

Calculations:

Calculate the efficiencies of the machine as a motor and as a generator for different values of load currents and write in the tables.

As a motor:

Load Current I_L = ______ Amps (Assume 15%, 25%, 50%, 75% of rated current)
Armature current $I_a = I_L - I_f$ Amps
Armature copper loss = $I_a^2R_a$ watts
Shunt field loss = VI_f watts
Total losses = Armature copper loss + Shunt field loss + Constant losses
Input Power = VI_L watts
Output Power = Input Power – Total losses

$$\text{Hence, efficiency, } \eta = \frac{\text{Output power}}{\text{Input Power}} \times 100\%$$

SL. No.	*Motor input voltage (V)*	*Motor input current (I_L) (amps)*	*Motor field current (I_f) (amps)*	*Motor armature current ($I_a = I_L - I_f$) (amps)*	*Armature copper loss ($I_a^2R_a$) Watts*	*Total Loss (Watts)*	*Input power ($V \times I_L$) Watts*	*Output power (Watts)*	*Efficiency*

As a generator:

Load Current I_L = ______ Amps (Assume 15%, 25%, 50%, 75% of rated current)
Generator output = VI_L Watts
Armature current $I_a = I_L + I_f$ Amps
Armature copper loss = $I_a^2R_a$ Watts
Shunt field loss = VI_f watts
Total losses = Armature copper loss + Shunt field loss + Constant losses
Input Power = Output power + Total losses

$$\text{Hence, efficiency, } \eta = \frac{\text{Output power}}{\text{Input Power}} \times 100\%$$

SL. No.	Terminal voltage (V)	Load current (I_L) (amps)	Field current (I_f) (amps)	Armature current ($I_a = I_L + I_f$) (amps)	Armature copper loss ($I_a^2 R_a$) Watts	Total Loss (Watts)	Input power (Watts)	Output power (Watts)	Efficiency

Reports and Calculation:

1. Determine the armature copper loss under no load condition.
2. Determine the values of efficiency at different loads as mentioned above at rated terminal voltage and speed.
3. Draw efficiency vs. load current characteristics of the machine for motor as well as generator mode of operation.