3- Retardation or Running Down Test.

This Method is applicable to shunt motors and Generators and is used for finding "Stray Losses".
Then, knowing the armature and shunt Cu losses at given Load Current, efficiency can be calculated.

* The machine under Test is speeded up slightly beyond its normal speed and then supply is "cut off" from the Armature while keeping the field excited.

* Consequently, the Armature slows down and it's kinetic energy is used to meet the "rotational Losses" i.e [Friction, windage and iron losses]

- Kinetic Energy of the armature is $K.E = \frac{1}{2} I \omega^2$

I = moment of inertia of the Armature.

ω = angular Velocity

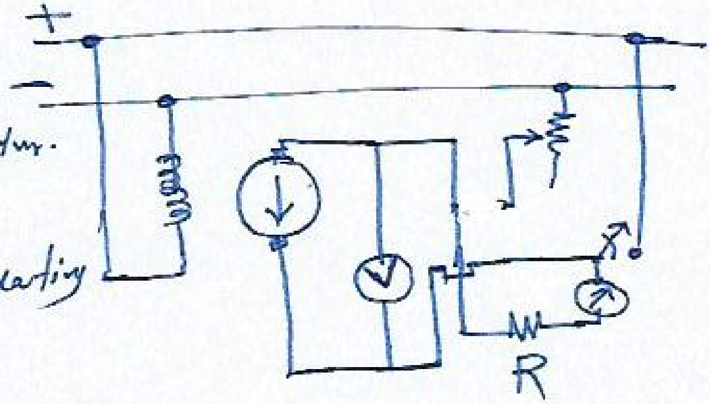
$\therefore$ Rotational Losses, W = Rate of loss of K.E.

$$W = \frac{d}{dt}\left[\frac{1}{2} I w^2\right] = I w \cdot \frac{dw}{dt} \quad \text{— (i)}$$

$\therefore I = ?$, $\frac{dw}{dt}$ or $\frac{dN}{dt} = ?$ Should be find.

a) Finding $\frac{dw}{dt}$

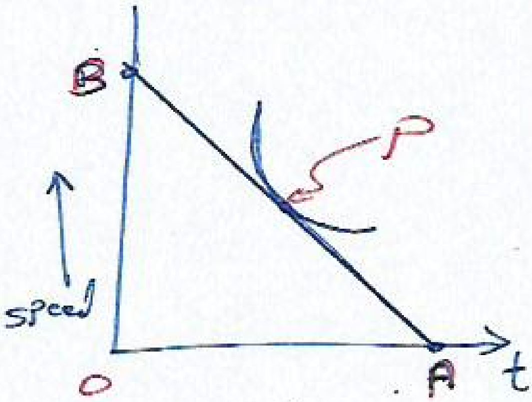
* ~~Voltameter~~ Voltmeter (V) is connected across the Armature. it is used as a speed indicator by suitably graduating it.



* because $E \propto N$ when supply is cut off, the Armature speed and Voltmeter reading is falls.

« Fig. 31·3 »

* by noting different amounts of Voltage fall in different time. This observe is fig 31·4



« Fig 31·4 »

* From any point «P» which corresponds to normal speed, a tangent AB is drawn

$$\frac{dN}{dt} = \frac{OB \text{ « in (r.p.m) »}}{OA \text{ « in second »}}$$

From (i) above $\Rightarrow W = I w \frac{dw}{dt}$, $w = \frac{2\pi N}{60}$ in r.p.m

$\therefore W = I \frac{2\pi N}{60} * \frac{d}{dt}\left(\frac{2\pi N}{60}\right) \Longrightarrow \boxed{W = (2\pi/60)^2 I N \cdot \frac{dN}{dt}}$ *

b) Finding Moment of Inertia "I" $\underline{\underline{I \text{ is Calculat}}}$

first, Slowing down curve is drawn with Armature ~~along~~ alone. Next, a fly wheel of known moment of inertia I_1 is keyed on to the shaft and slowing down curve is drawn again.

slowing down time $\Longrightarrow$ I is increas.

$$* \quad W = \left(\frac{2\pi}{60}\right)^2 I N \frac{dN}{dt_1} \quad \therefore \text{first case.}$$

$$W = \left(\frac{2\pi}{60}\right)^2 (I + I_1) N \cdot \frac{dN}{dt_2} \quad \therefore \text{Second Case.}$$

$$\Rightarrow I = I_1 \frac{t_1}{t_2 - t_1}$$

second method

* $\underline{\underline{I \text{ is eleminated}}}$:-

Let W' be this power, I_a = average current Through "R"

V = average Voltage across "R"

$$W = \left(\frac{2\pi}{60}\right)^2 I N \left(\frac{dN}{dt_1}\right)$$ rate of chang speed without extra load

$$W + W' = \left(\frac{2\pi}{60}\right)^2 I N \left(\frac{dN}{dt_2}\right)$$ with extra elec. Load.

} dN is same.

$$\therefore W = W' \frac{t_2}{t_1 - t_2}$$

4- Field's Test for Series Motor.

* Two Similar series Motor, Coupled Mechanically.

* one run as Motor and drives a generator whose o/p is wasted in a variable Load "R"

* Two series field coil connected in the Armature circuit of for Motor, so both Machines are equally excited and runing together in same speed.

from fig 31.5

I_1 Motor current

I_2 Load current

V = supply voltage

V_2 : terminal of gen.

V_1 : terminal of M.

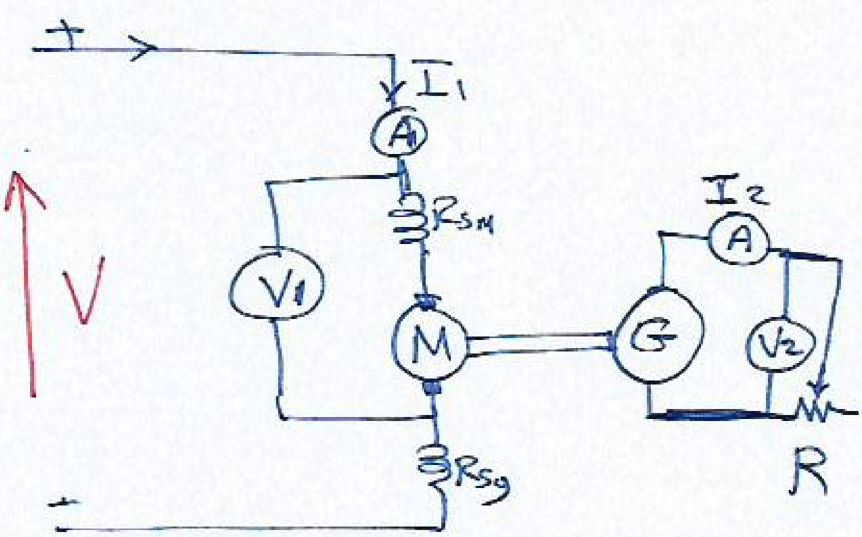


fig: 31.5

Armature and field Cu losses :-

Not $R_{seM} = R_{se_g} = R_{se}$

$$W_{cu} = (R_a + 2R_{se}) I_1^2 + I_2^2 R_a$$

$\therefore$ W_t = total losses, W_{cu} = Cu losses

$$W_s = \text{stray Losses} = W_t - W_{cu} \Rightarrow \underset{\text{Machine}}{\text{for each}} = \frac{W_t - W_{cu}}{2}$$

Efficiency η

Motor η

Motor i/P $= V_1 I_1$, Motor Losses $= (R_a + 2R_{se}) I_1^2 + W_s = W_M$

$$\boxed{\therefore \eta_m = \frac{V_1 I_1 - W_m}{V_1 I_1}}$$

Generator η

Generator O/P $= V_2 I_2$

field Cu losses $= I_1^2 R_{se}$

Armature Cu losse $= I_2^2 R_a$

$\therefore$ Total Losses $= I_1^2 R_{se} + I_2^2 R_a + W_s = W_g$

$$\boxed{\therefore \eta_g \% = \frac{V_2 I_2}{V_2 I_2 + W_g}}$$