EXP. No.(6)

Speed Control of Wound Rotor I.M

Theory:

At the instant of start, resistance in the rotor circuit prevents a large current inrush. The price you pay for that is a reduced torque. This is compensated for by the fact that you get more torque per ampere of starting current. Resistance accomplishes this by making the rotor field closer to being in phase with the stator field. In other words, it improves the power factor of the rotor.

The reason that the rotor has such a poor power factor at start is that the induced rotor frequency is at a maximum……Equal to the frequency of the incoming power. Once the rotor starts turning, however, this rotor frequency starts going down. With a wound rotor motor running without load, the induced rotor frequency may be only 5 Hertz or so. At that frequency, the rotor windings have practically no inductive reactance. If you had resistance in series with the rotor windings, it would not improve rotor power factor. All it would do is increase the losses in the rotor circuit.

Here is what happens: The motor, itself, automatically picks out the mount of slip it needs to produce the rotor current that will drive the load at speed. Now you add rotor resistance now that the rotor is losing some of its power to the resistance, it needs more slip so it can produce more current from a higher induced rotor voltage.

That makes the rotor slow down. But the load has not changed. Therefore, the rotor draws enough current so it can produce extra torque. The load remember, is proportional to torque times speed. If the speed goes down, the torque has to go up since the load is constant. Rotor resistance, then, can provide speed control of a wound rotor motor. It is not absolutely accurate, however, because speed changes with load.

This experiment is more or less similar to load test on phase wound motor except with a difference that some additional resistance is added to its rotor circuit. The torque in a slip-ring following relation

$$Torque \; \alpha \; \frac{SR_2}{(SX_2)^2}$$

Where: X2= Leakage reactance per phase of rotor winding at stand still.
R2= Resistance per phase of rotor winding.
S= Slip

Since X2 is constant for a given motor that is the torque is inversely proportional to the slip and directly proportional rotor resistance.

It is obvious from the above relation that when R2 is small compared with SX2, the torque for a given slip is directly proportional to the value of R2. At the od starting S=1, the motor having a low rotor resistance, the starting torque is small compared with the maximum torque available.

When a motor is required to exact its maximum torque at starting, the usual practice is to insert extra resistance in to the rotor circuit and to reduce this resistance as the motor accelerates. I^2R losses in the rotor winding would be high, fall in efficiency and increase in slip.

Procedure:

1- Make circuit connections as shown in the circuit diagram fig. (1).
2- Start the I.M either with the help of starter or reduced voltage method.
3- Suitable external resistance are to be selected after seeing the ratings of the motor.
4- Now load test is to be performance for different value of the external rotor resistance.
5- Set a particular value of rotor resistance, say R1, external resistance must same in all the phases.
6- Excite the D.C. generator which is load for motor and adjust the speed such that it gives rated no load terminal voltage.
7- Switch ‘ON’ the load switch.
8- Note down the readings of instruments placed on motor side and D.C. generator side.
9- Repeat twice the step No.8 for another values of external rotor resistances R2 and R3.
10- Put the values in observation table.

Calculation:

Calculate output power in H.P., slip, power factor, torque and efficiency. See the effects of increasing resistances in the rotor circuit on the performance of the motor.

Report:

Draw the graph of output power versus slip in each case.

Question:

1- What is the value of no load current in relation to the rated value of current?
2- What are the advantages & disadvantages of the wound rotor I.M.?

Case1 $R_{ex}=R_1$	V_i	I_i	P_i	N	T	V_G	I_G
	380	I rated					
Case2 $R_{ex}=R_2$	V_i	I_i	P_i	N	T	V_G	I_G
	380	I rated					
Case3 $R_{ex}=R_3$	V_i	I_i	P_i	N	T	V_G	I_G
	380	I rated					

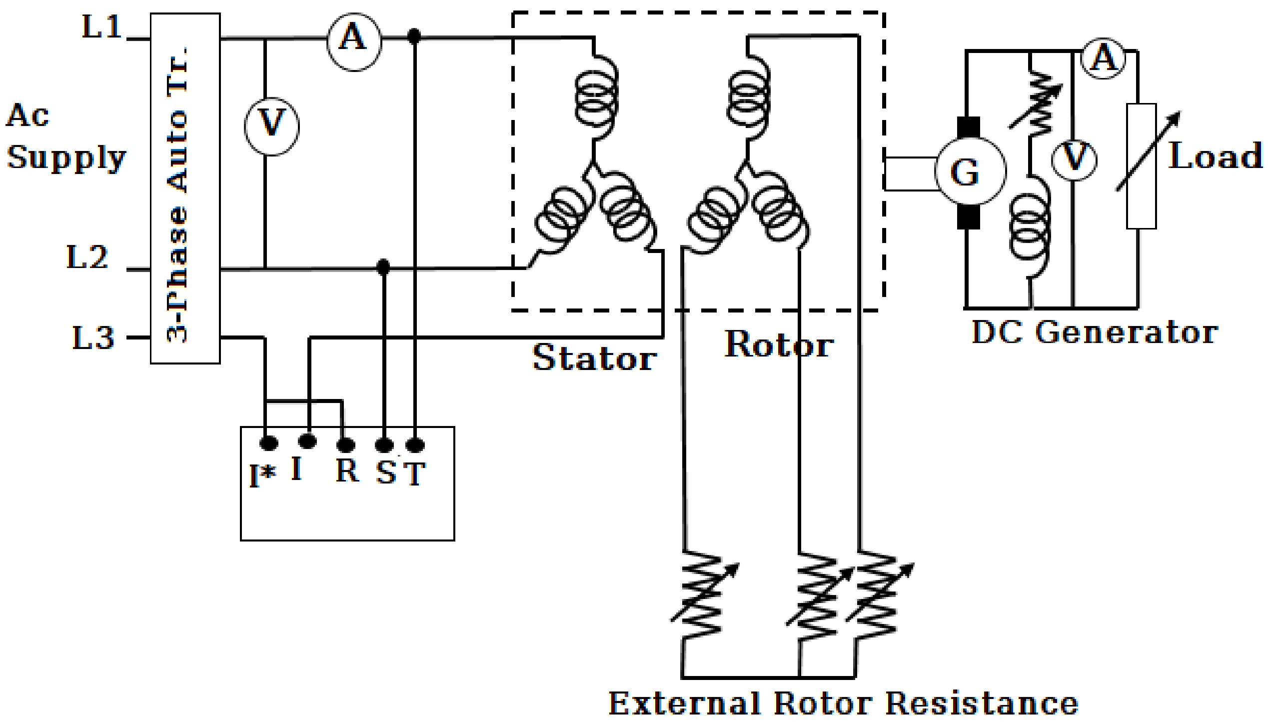
L1
Ac
Supply
L2
L3
3-Phase Auto Tr.
A
V
I* I R S T
Stator
Rotor
G
A
V
Load
DC Generator
External Rotor Resistance

Fig.(1)