STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR

INTRODUCTION

In a three phase induction motor, the magnitude of an induced e.m.f. in the rotor circuit depends on the slip of the induction motor. This induced e.m.f. effectively decides the magnitude of the rotor current. The rotor current in the running condition is given by,

$$I_{2r} = \frac{sE_2}{\sqrt{R_2^2 + (sX_2)^2}}$$

But at start, the speed of the motor is zero and slip is at its maximum i.e. unity. So magnitude of rotor induced e.m.f. is very large at start. As rotor conductors are short circuited, the large induced e.m.f. circulates very high current through rotor at start.

The condition is exactly similar to a transformer with short circuited secondary. Such a transformer when excited by a rated voltage, circulates very high current through short circuited secondary. As secondary current is large, the primary also draws very high current from the supply.

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Due to such heavy inrush current at start there is possibility of damage of the motor winding. Similarly such sudden inrush of current causes large line voltage drop. Thus other appliances connected to the same line may be subjected to voltage spikes which may affect their working. To avoid such effects, it is necessary to limit the current drawn by the motor at start. The starter is a device which is basically used to limit high starting current by supplying reduced voltage to the motor at the limit of

starting. Such a reduced voltage is applied only for short period and once rotor gets accelerated, full normal rated voltage is applied.

Not only the starter limits the starting current but also provides the protection to the induction motor against overloading loading and low voltage situations. The protection against single phasing is also provided by the starter. The induction motor having rating below 5 h.p. can withstand starting currents hence such motors can be started directly on line. But such motors also need overload, single phasing and low voltage protection which is provided by a starter.

Thus all the three phase induction motors need some or the other type of starter.

Types of Starters

From the expression of rotor current it can be seen that the current at start can be controlled by reducing E_2 which is possible by supplying reduced voltage at start or by increasing the rotor resistance R_2 at start. The second method is possible only on case of slip ring induction motors. The various types of starters based on the above two methods of reducing the starting current are,

1. Stator resistance starter
2. Autotransfomer starter
3. Star-delta starter
4. Rotor resistance starter
5. Direct on line starter