General Motor Knowledge
Part 38

The Induction Rotor

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We constructed a stator by laminating several thin layers of steel. Around the poles are wound many turns of wire. Alternating electric current flowing through the wire creates an alternating magnetic field. An auxiliary winding, be it a single turn shading coil or many turns in series with a capacitor, causes a phase shift in the magnetic field. The magnetic field can now be described as revolving around the stator from pole to pole. Laminated steel stator poles concentrate and direct the revolving magnetic field toward an air gap and beyond to the rotor. The rotor turns with the revolving field. Why?

Drop a rotor in the right type of acid and it will eat away the steel leaving only the die cast aluminum. The remaining aluminum will look like two rings connected by 22 bars, like an exercise wheel in a hamster cage. Aluminum is an electrical conductor. It has formed single turn coils around the 22 rotor poles.

Remember that current moving through a conductor will produce a magnetic field around the conductor. The opposite is also true. When a conductor is placed in a magnetic field, if the conductor moves or if the magnetic field changes, current will be generated or induced in the conductor. Furthermore, the current will be induced in such a was as to produce a magnetic field opposing the field that induced it. Our shaded pole and PSC motors belong to a class of motors known as "induction motors" because the magnet field in the rotor is induced by the stator.

Our revolving magnetic field in the stator induces current in the rotor bars. Current induced in the rotor bars produces an opposite magnetic field around the bars. Opposites attract. The rotor turns to align with the revolving stator field.   With our usual 60 cycle AC voltage the stator field is revolving between 2 poles 60 times a second or 3600 time a minute or 3600 RPM. Since our current motors are 4 pole motors the field is revolving only half as fast or 1800 RPM. If the rotor were to turn exactly as fast as the stator field revolves, the rotor bars would not be moving relative to the stator magnetic field and no current would be induced. Therefore the rotor would slow down. There must be a speed difference between the stator field and the rotor. This is commonly known as slip. This is why our notors run at about 1750 RPM with no load. Keep an eye out - we'll be building some 2 pole 3600 RPM motors soon.

This process establishing a rotating stator magnetic field and inducing a current in the rotor to establish a magnetic field is not very energy efficient and is limited to a narrow range of operating speeds. Next month we will begin to look at an entirely different way to get this done.