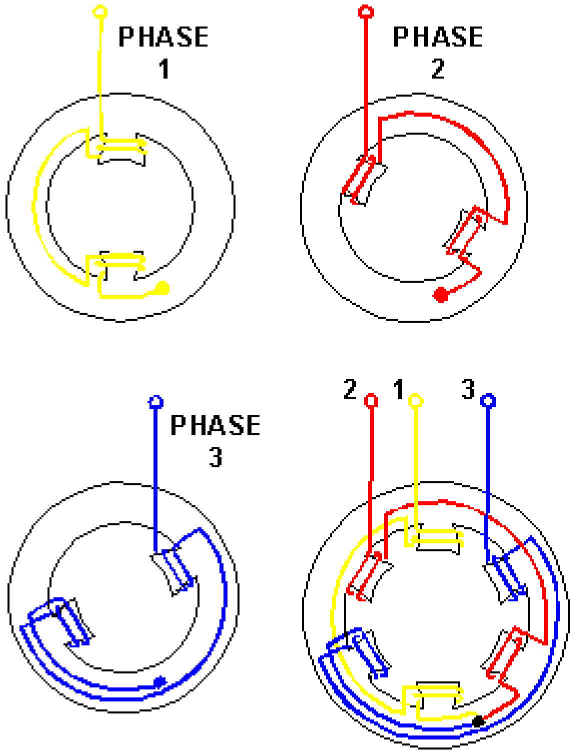
The Three-Phase Ac Induction Motor

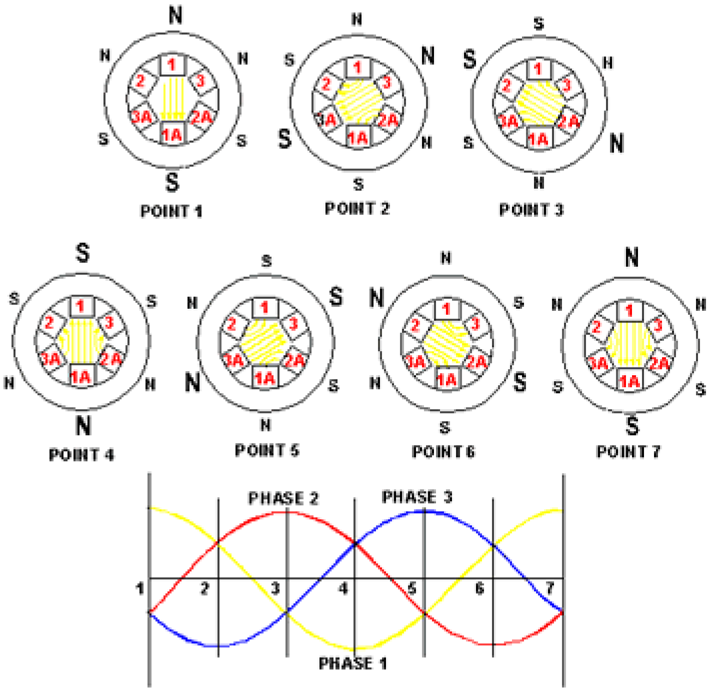
In a three-phase induction motor the stator windings are connected in a 'Y' configuration (Figure 1), the two windings in each phase being wound in the same direction. The currents in the three windings are 120 electrical degrees out of phase, so the magnetic fields produced will also be 120 degrees out of phase.



At the end of one cycle of alternating current, the stator magnetic field will have shifted through 360° or one revolution. This magnetic field produced by the stator will induce in the rotor a magnetic field of opposite polarity. Therefore, as the magnetic field in the stator rotates, the rotor will also rotate to maintain its alignment with the stator's magnetic field. Therefore, at the end of one cycle of alternating current the rotor will also have rotated through one revolution. This is illustrated in Figure 2, where the position of the stator's magnetic field is developed at intervals of 60 electrical degrees on the sine waves representing the current flowing in the three phases.

At Point 1 the current in phase 1 is at its maximum positive value. At the same instance, the currents in phases 2 and 3 are at half of the maximum negative value. The resulting magnetic field will be established vertically downward with the maximum field strength developed across coils 1-1A, with polarities as shown. At the same time weaker magnetic fields across phases 2 and 3 tend to aid the 1-1A field.

At Point 2, the current in phase 3 has increased to its maximum negative value. The current in phases 1 and 2 are at half of their maximum positive value. The resulting magnetic field is established downward to the left, with the maximum field strength developed across coils 3-3A, with polarities as shown. This magnetic field is aided by the weaker fields developed across phases 1 and 2. The magnetic field within the stator of the motor has physically rotated 60 degrees.



At Point 3 the current in phase 2 has increased to its maximum positive value. The currents in phases 1 and 3 are at half of their maximum negative value. The resulting magnetic field is established upward to the left, with the maximum field strength developed across coils 2-2A. This magnetic field is aided by the weaker fields developed across phases 1 and 3. Thus the magnetic field on the stator has rotated another 60 degrees for a total rotation of 120 degrees.

At Point 4, the current sine waves have rotated 180 electrical degrees from Point 1 so that the relationship of the phase currents is identical to Point 1 except that the polarity has reversed. Since phase 1 is again at a maximum value, the resulting magnetic field developed across phase C will be of maximum field strength. However, with current flow reversed in phase C the magnetic field is established vertically upward between poles. As can be seen, the magnetic field has now physically rotated a total of 180 degrees from the start.

At Point 5, phase 3 is at its maximum positive value, which establishes a magnetic field upward to the right. Again, the magnetic field has physically rotated 60 degrees from the previous point for a total rotation of 240 degrees. At Point 6, phase 2 is at its maximum negative value, which will establish a magnetic field downward to the right. The magnetic field has again rotated 60 degrees from point 5 for a total rotation of 300 degrees. Finally, at Point 7, the current has returned to the same polarity and values as that of Point 1. Therefore, the magnetic field established at this instance, will be identical to that established at Point 1. So, for one complete revolution of the electrical sine wave (360 degrees), the magnetic field developed in the stator of a motor has also rotated one complete revolution.

Reference:

http://www.dpaonthenet.net/drives/drives_20040803.html