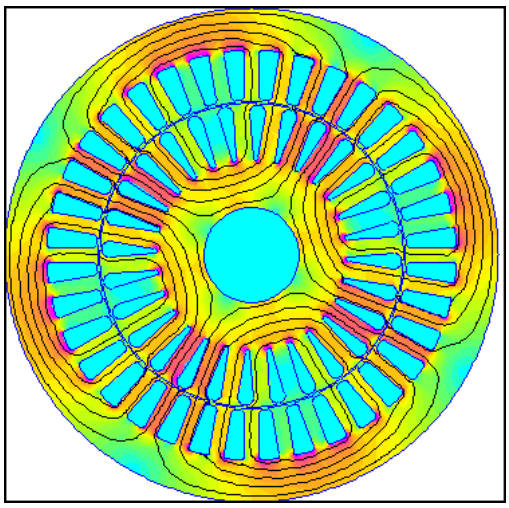
Shop Tech Talk July 2009

What is meant by poles on a 3 phase induction motor ?



The picture to the left shows a representation of the magnetic flux inside a 4-pole induction motor.

For a MUCH BETTER animated view of this , showing the rotor and flux rotation see this link http://bit.ly/mXuoF4

For a 3 phase motor:
No. of Poles x No. of Phases = No. of Groups. so
for a 3 phase 2 pole motor it has 6 groups and
for a 3 phase 4 pole motor it has 12 groups and
for a 3 phase 6 pole motor it has 18 groups,and so on.

The stator, where the wire is placed, consists of wound 'poles' that carry the supply current to induce a magnetic field that penetrates the rotor.
The rotating magnetic field rotates at what is called synchronous speed.

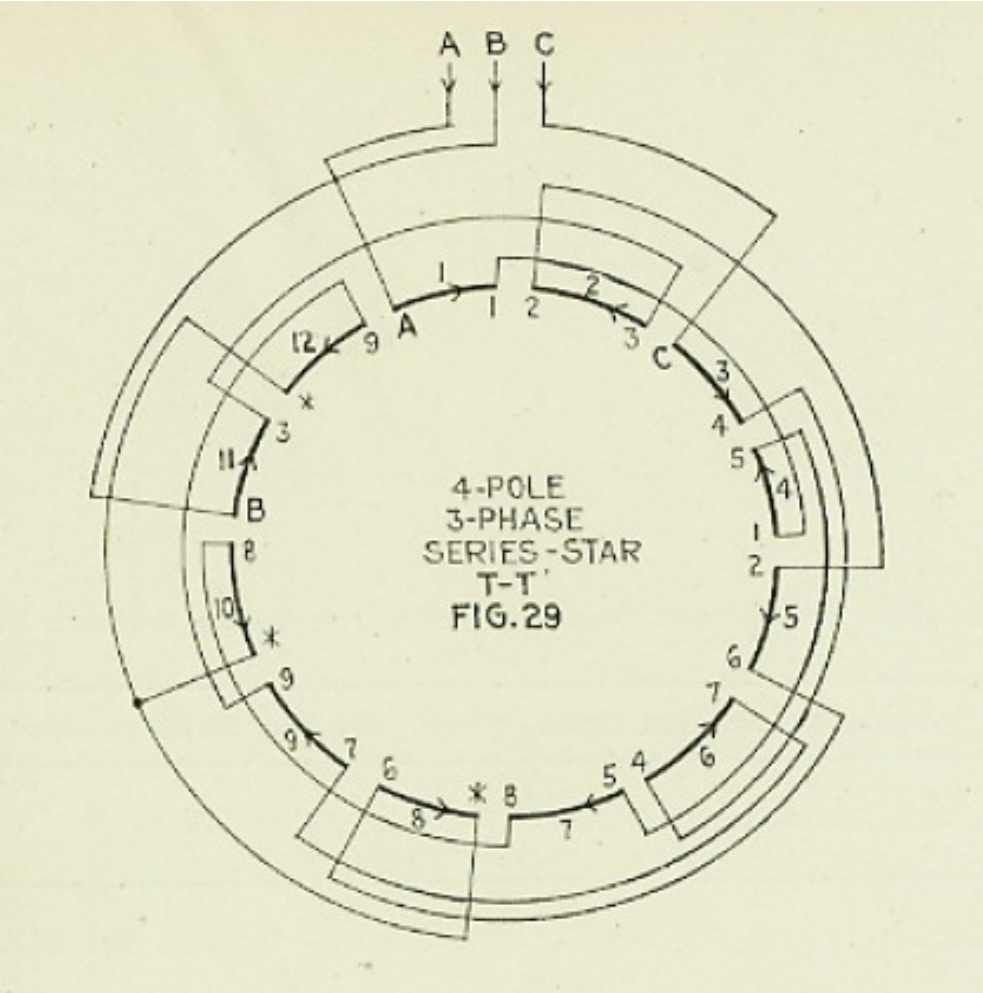
The synchronous speed, $N_s = \frac{60 \times f}{p}$ where f = the frequency of the ac supply

and p is the number of magnetic pole pairs per phase. So for a 2 pole motor, we have 1 pole pair,
$N_s = 60 \times 60 / 1 = 3600$ rpm
and for a 4 pole motor, 2 pole pairs
$N_s = 60 \times 60 / 2 = 1800$ rpm
and for a 6 pole motor, 3 pole pairs
$N_s = 60 \times 60 / 3 = 1200$ rpm
The above formula can also be expressed as :
The synchronous speed, $N_s = \frac{120 \times f}{p}$ where f = the frequency of the ac supply

and p is the number of magnetic poles per phase. So for example a 2 pole motor, we have 2 poles.

The actual rotor in the motor does not rotate at this synchronous speed but rotates at a slightly slower speed. This difference between the speed of the rotor and speed of the rotating magnetic field in the stator is called slip.
This slip varies as the motor is loaded. On different motor nameplates showing the rpm you will see that a 4 pole motor (1800 rpm synchronous) can have full load speeds of 1720, 1770 and 1725 rpm. The speed shown is always that measured when the motor is running at full load. Different designs will produce different full load speeds even though they may all be 4 pole motors. The amount of slip is usually shown as a Percentage of Slip and is equal to $\frac{\text{Synchronous Speed} - \text{Shaft Speed}}{\text{Synchronous Speed}}$

So for a 1720 rpm motor, % Slip = $\frac{1800-1720}{1800} \times 100 = 4.4$ % Slip



This picture shows a connection diagram for a simple 4 pole (1800 rpm sync. speed) , 12 group, 3 phase motor, with a 1 Wye (series star) connection.

.The 12 groups are numbered 1 through 12

A,B and C are the 3 line phases fed to the motor.

If the stator has 36 slots, then there will be 36 coils and each group will consist of 3 coils.

Holland Industrial, 518 West Montgomery Street, Henderson, NC., 27536
Tel: 1-800-232-7541,Fax 1-252-492-2444, E-Mail: sales @ hollandindustrial.com