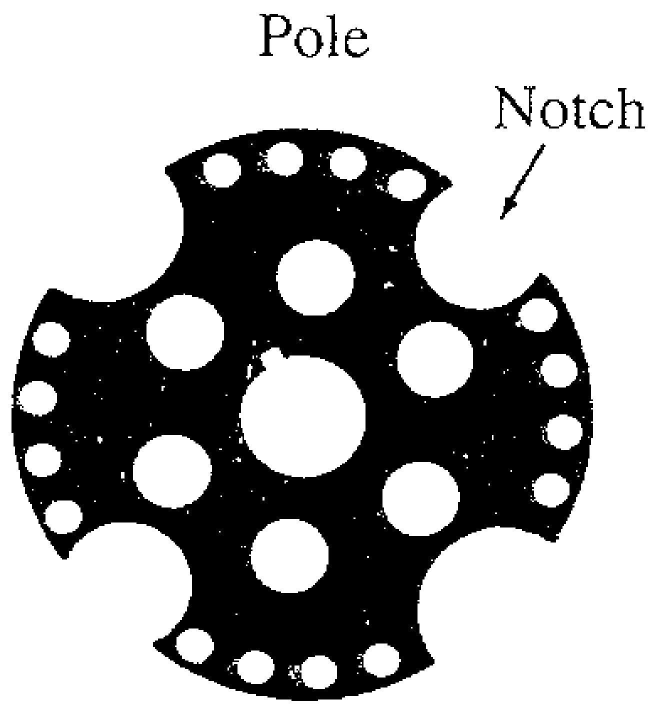
Special Electrical Machines

Reluctance Motors

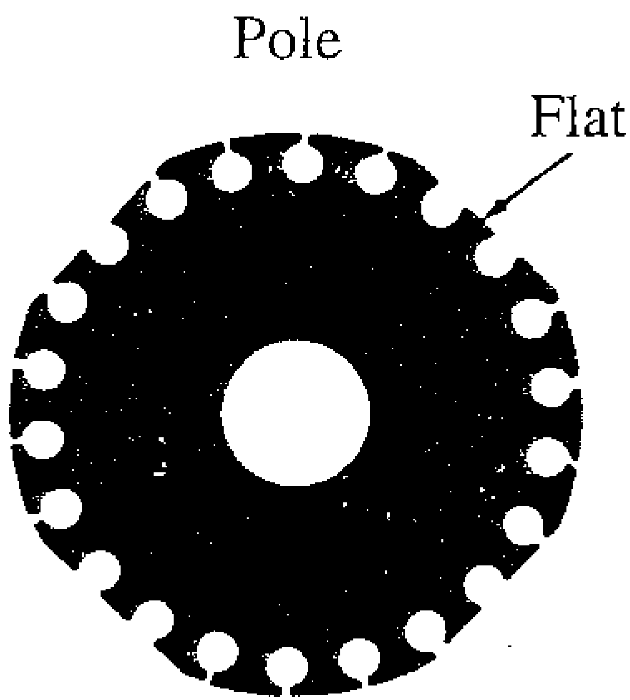
- An induction motor with a modified squirrel-cage rotor
  - Single-phase or Three-phase
  - rotor turns in synchronism with the rotating magnetic flux

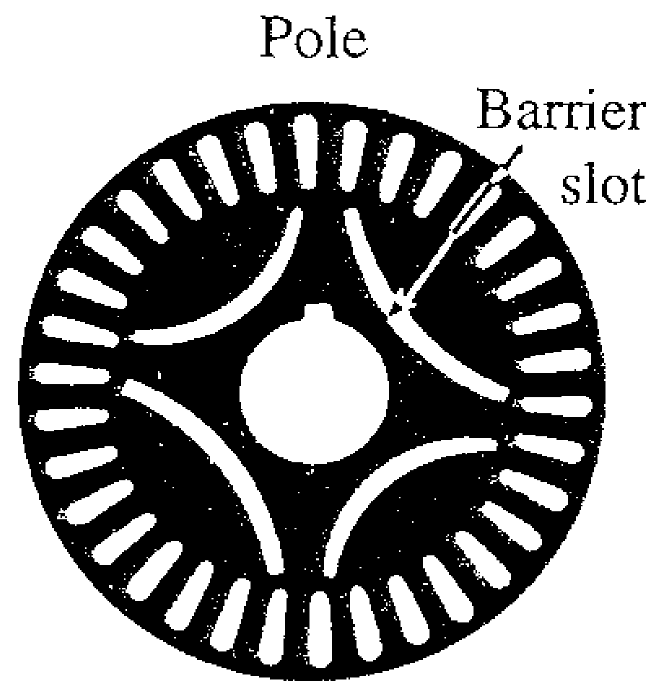
Notch-Type Rotor

- "Notch" areas are "High-Reluctance"
- "Pole" areas are known as "Salient" Poles
  - Number of salient poles must match the number of stator poles



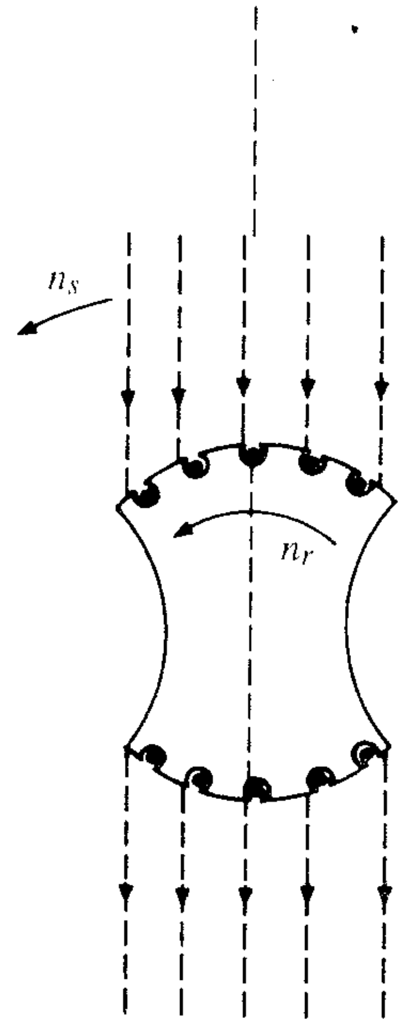
Flat and Barrier Slot Rotors





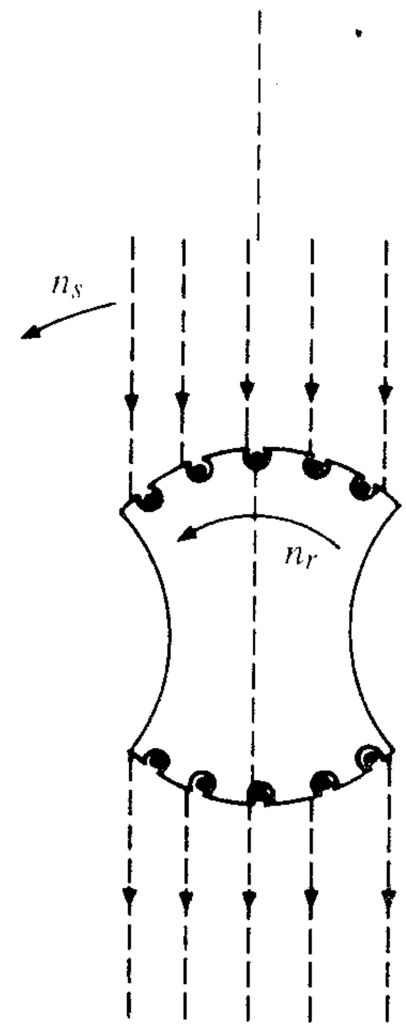
Operation

- Rotor accelerates towards synchronous speed
- At a “critical” speed, the low-reluctance paths provided by the salient poles will cause them to “snap” into synchronism with the rotating flux.



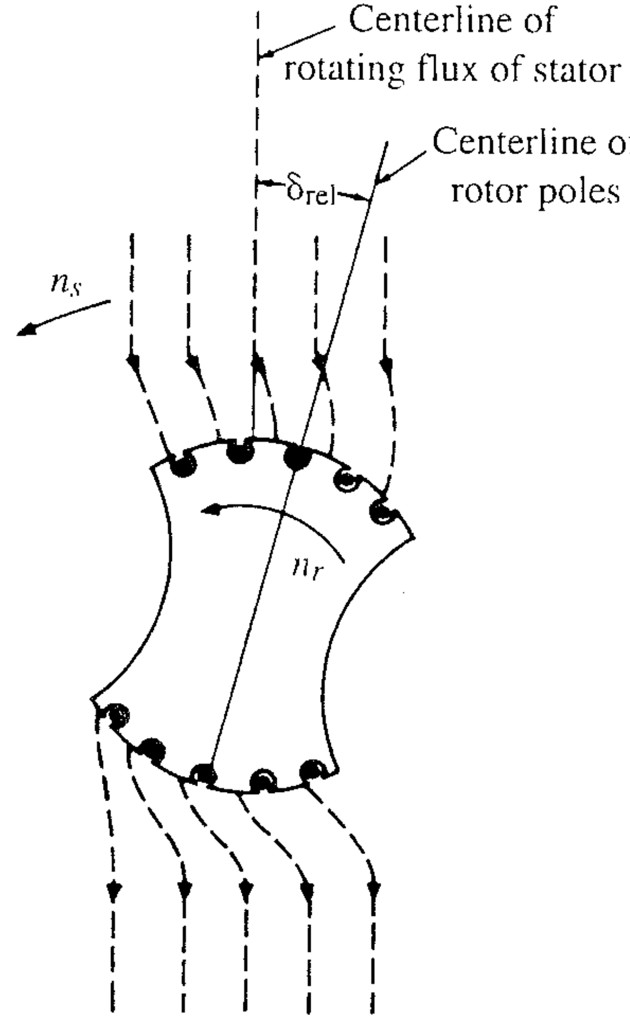
Operation (continued)

- When the rotor synchronizes, slip is equal to zero
- Rotor pulled around by "reluctance torque"
- Figure at right shows the rotor synchronized at no load



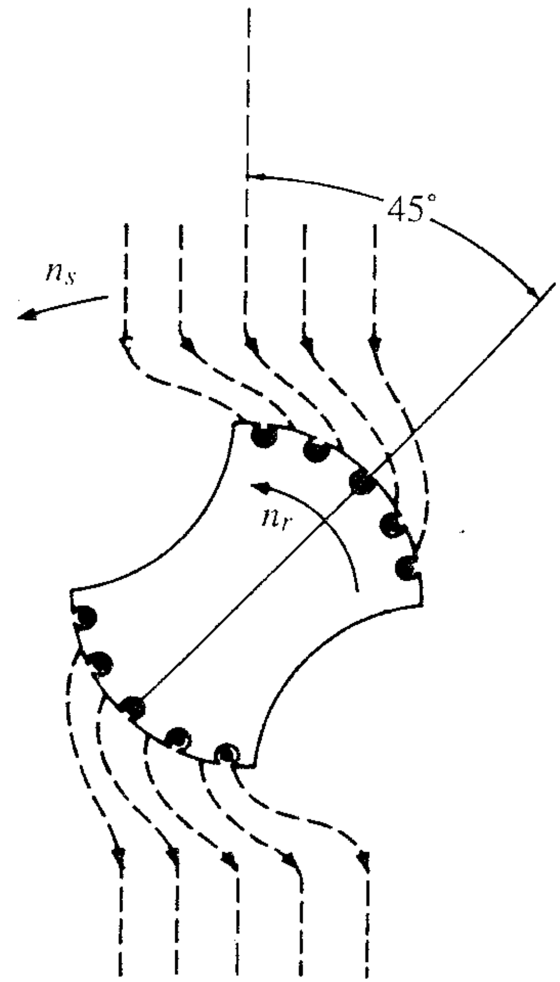
Operation (continued)

- A "step" increase in load slows the rotor down, and the rotor poles "lag" the stator poles.
- The angle of lag, δ, is called the "torque angle".
- The maximum torque angle, δ_{max} = 45°.



Operation at maximum load

- Maximum load is when δ = 45°.
- If load increases so that δ>45°, the flux path is "over stretched" and the rotor falls out of synchronism.
- Motor runs at slip speed



Reluctance torque, T_{rel}

$$T_{rel_{s=0}} = K\left(\frac{V}{f}\right)^2 \times \sin(2\delta_{rel})$$

T_{rel} = average value of reluctance torque

V = applied voltage (V)

f = line frequency (Hz)

δ_{rel} = torque angle (electrical degrees)

K = motor constant

Reluctance torque, T_{rel}

- Maximum reluctance torque, T_{relmax} occurs at $\delta_{rel} = 45°$

THANKS….

Queries Please…