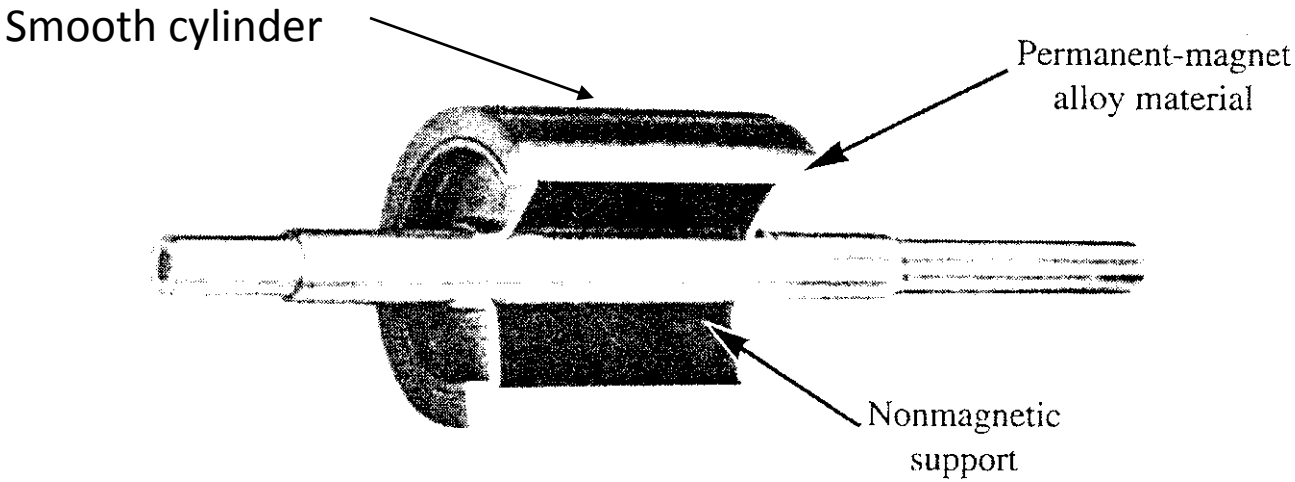
Special Electrical Machines

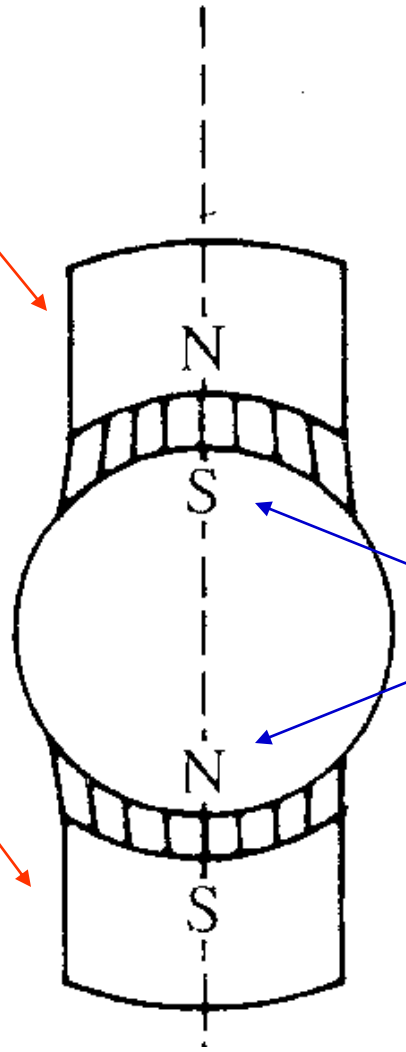
Hysteresis Motors

- Stator
  - same as for induction motor
- Rotor



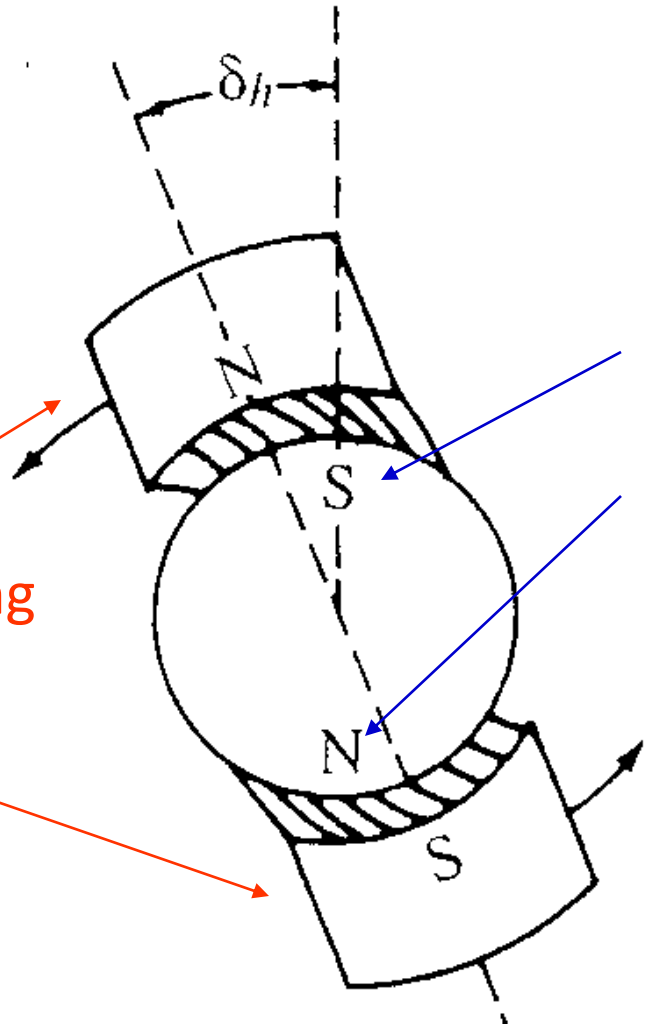
Principle of Operation

Stator Flux establishes these magnetic poles



Rotor poles "induced" by Stator Flux

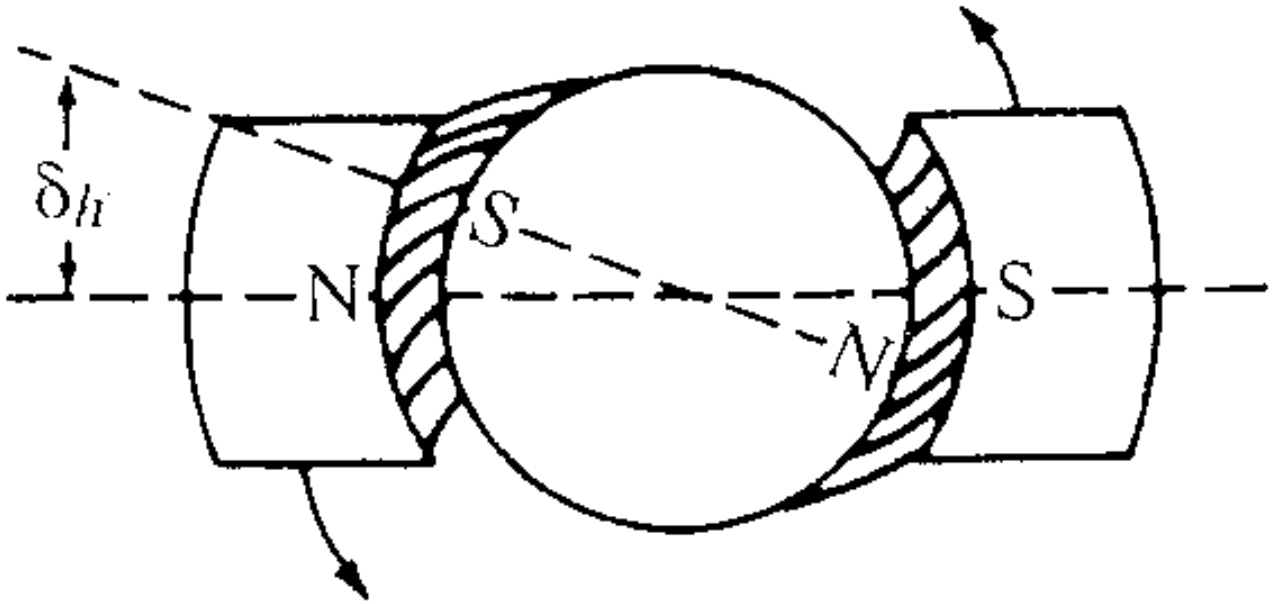
Spin the stator poles with the rotor blocked



Rotor poles follow the rotating flux, but lag behind by angle δ_h

Stator poles moving CCW

Spin the stator poles with the rotor blocked



If the rotor is released, it will accelerate to synchronous speed

Hysteresis Power Loss, P_h

$$P_h = k_h f_r B_{\max}^n$$

where

f_r = frequency of flux reversal in the rotor (Hz)

B_{max} = maximum value of flux density in the air gap (T)

P_h = heat-power loss due to hysteresis (W)

k_h = constant

Mechanical Power developed

$$P_{mech} = P_h \left(\frac{1-s}{s} \right)$$

$$P_h = k_h \cdot f \cdot B_{\max}^n$$

$$\frac{T_h n_r}{5252} = k_h \cdot f \cdot B_{\max}^n \left(\frac{1-s}{s} \right)$$

$$n_r = n_s (1-s)$$

$$f_r = s f_s$$

Mechanical Power Developed (cont)

$$T_h = \left(\frac{5252 k_h f_s B_{\max}^n}{n_s} \right)$$

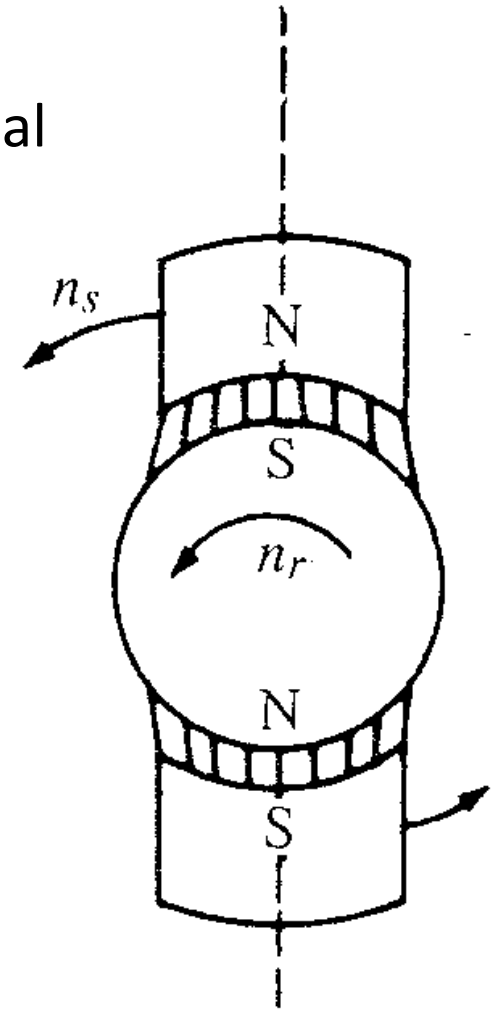
$$n_s = \frac{120 \cdot f_s}{P}$$

$$T_h = \frac{5252 k_h B_{\max}^n}{\frac{120}{P}}$$

Independent of frequency and speed!

Hysteresis Motor at Synchronous Speed

No load and
negligible rotational
losses



Induced rotor magnets remain locked with the rotating poles produced by the stator

THANKS….

Queries Please…