

HYBRID STEPPER MOTOR.

Hybrid ~~no~~ stepper motor is operated with the combined principle of the permanent magnet and variable reluctance motors in order to achieve small step length and high torque in spite of motor size. Standard HSM have 20 rotary teeth and rotate at 1.8 degree per step.

The figure on the overleaf page shows the cross-section and cut-view of the two phase HSM.

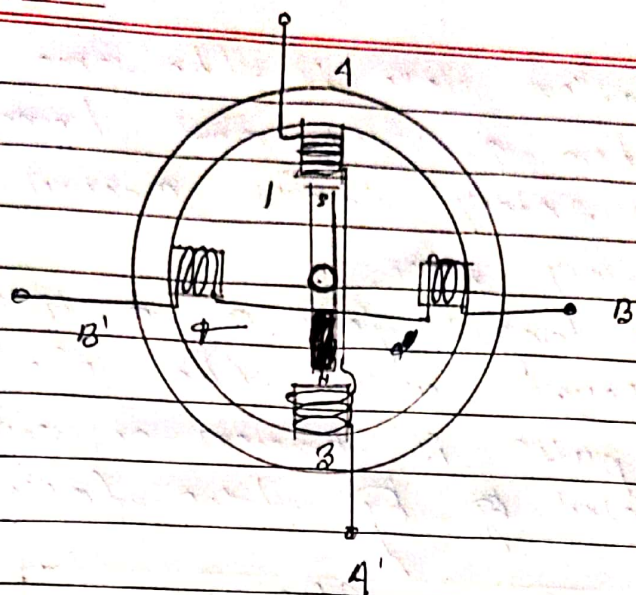


Fig: Cross-sectional view of HSM.

The windings are placed on the rotary stator poles and a PM is mounted on the rotor. A cylindrical or disc-shaped core is in the rotary core. Stator and rotary end-caps are toothed. The coil in the pole 1 and pole 3 are connected in series consisting of phase A and pole 2 and 4 are for phase B. If the stator phase 1 is excited pole 1 acquires north polarity while pole 3 acquires south polarity pole 1 attracts the rotor's south pole while pole 3 aligns with the rotor's north pole. When the excitation is shifted from phase A to phase-B then in which this case pole 2 becomes the north pole (N-pole) and stator pole 4 becomes south pole, that would cause the rotor to turn 90° in clockwise direction and so on.

A complete excitation cycle of HSM consists of four stator and precisely 4 steps of rotary movements.



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The excitation state is the same before and after these 7 steps and hence the alignment of stator/rotor teeth occurs under the same stator poles.

The step length for a 48M and the angle through which the rotor moves for each step pulse is known as step angle which is calculated by the following equation

$$\theta = \frac{360}{m \times N_r}$$

$$\text{or } \theta = \frac{360 (N_s - N_r)}{N_s \times N_r}$$

where

θ = Step angle in degree.

N_s = No. of stator teeth.

N_r = No. of rotor teeth.

m = No. of phases.

HSM material properties are listed below.

S.No.	Motor part	Material.
1	shaft	Non-magnetic material
2	Magnet	Neodymium Iron Boron (NdFe) Samarium Cobalt (SmCo5)
3	Rotor core	Steel sheet
4	stator core	Steel sheet
5	Coil	Copper.



Hybrid Advantages of stepper motor

- 1) Step angle is very small and non-cumulative.
- 2) Rapid response to starting, stopping and reversing.
- 3) Brushless design for reliability and simplicity.
- 4) High torque per package size.
- 5) Holding torque ~~at~~ at standstill.
- 6) Can be stalled and indefinitely without damage.
- 7) No external feedback component is required.

Disadvantages:

- i) Resonance obtained
- ii) Vibration obtained
- iii) Torque ripple obtained.