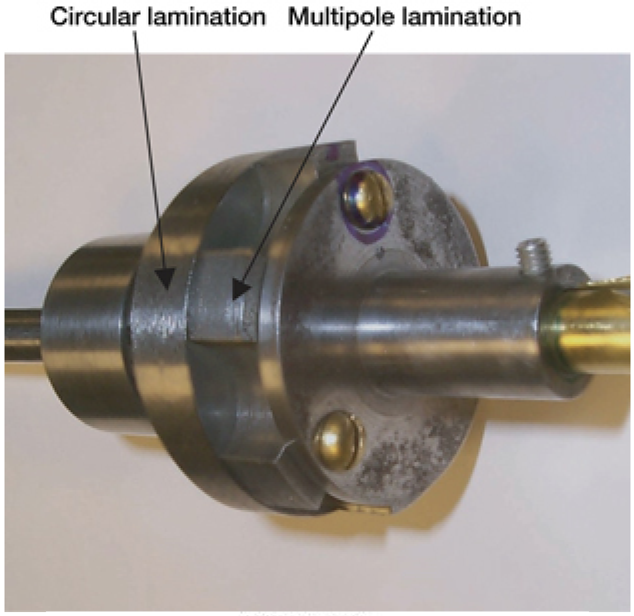
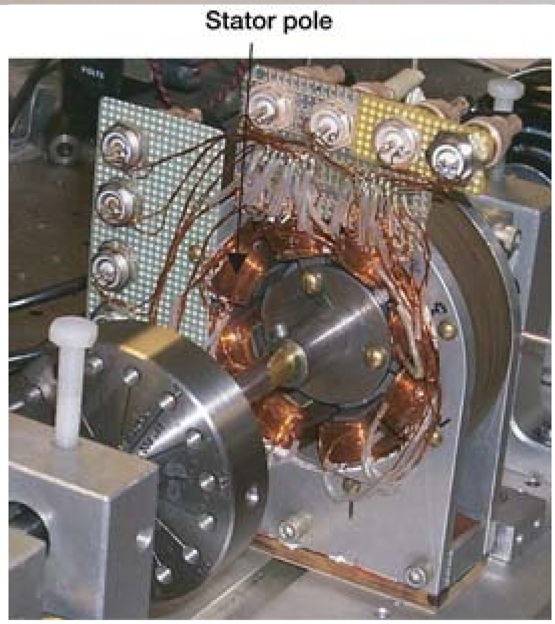
Bearingless Switched-Reluctance Motor Improved

The Morrison rotor, named after its inventor, is a hybrid rotor for use in a switched-reluctance electric motor. The motor is characterized as bearingless in the sense that it does not rely on conventional mechanical bearings: instead, it functions as both a magnetic bearing and a motor. Bearingless switched-reluctance motors are attractive for use in situations in which large variations in temperatures and/or other extreme conditions preclude the use of conventional electric motors and mechanical bearings.

In the Morrison motor, as in prior bearingless switched-reluctance motors, a multipole rotor is simultaneously levitated and rotated. In the prior motors, simultaneous levitation and rotation are achieved by means of two kinds of stator windings: (1) main motor windings and (2) windings that exert levitating forces on a multipole rotor. The multipole geometry is suboptimum for levitation because it presents a discontinuous surface to the stator pole faces, thereby degrading the vibration suppression capability of the magnetic bearing.

The Morrison rotor simplifies the stator design in that it contains only one type of winding. The rotor is a hybrid that includes both (1) a circular lamination stack for levitation and (2) a multipole lamination stack for rotation. Simultaneous levitation and rotation at 6000 rpm were achieved with a prototype that included six rotor poles and eight stator poles (see the following photographs). During normal operation, two of the four pairs of opposing stator poles (each pair at right angles to the other pair) levitate the rotor. The remaining two pairs of stator poles exert torque on the six-pole rotor lamination stack to produce rotation.





Left: Prototype hybrid rotor. Right: Rotor/stator ensemble.

The relative length of the circular and multipole lamination stacks on the rotor can be chosen to tailor the performance of the motor for a specific application. For a given overall length, increasing the length of the multipole stack relative to the circular stack results in an increase in torque relative to the levitation load capacity and vice versa.

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