Modification of Induction Motor Designs for Higher Efficiency and Starting Torque

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Squirrel cage induction motors are the most widely used electric motor design, especially for industrial purposes such as AC compressors and fans. However, they lack the high starting torque needed for demanding applications like elevators, cranes, and printing presses. In these applications, slip-ring induction motors are used. These motors use slip-rings to connect resistors to the rotor coils externally, boosting the startup torque. However, these slip rings create friction and wear out with use, compromising the efficiency of this design. This study aims to create a new induction motor design similar to the slip-ring induction motor without this key source of inefficiency. The squirrel cage and slip-ring induction motor designs were constructed and tested for operating speed and slip at different frequencies, dynamic torque, and efficiency. Tests were conducted using a variable frequency drive to represent applications requiring precise speed control and with a rotary phase converter to simulate more common industrial uses. Rotor speed was measured with a tachometer, and an eddy-current brake was constructed for measuring torque. The data proved that the squirrel cage rotor had a slightly higher operating efficiency than the slip-ring design. However, the slip-ring rotor performed better on the dynamic torque test than the squirrel cage design by a greater margin. The third motor design currently being developed utilizes a mechanism based on the centripetal acceleration of the rotation to connect the resistors to the rotor coils on startup and short them after the rotor approaches its normal operating speed. The performance gain this research promises can improve motors found in cranes, elevators, air compressors, and electric vehicles.

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Fourth Award of $500