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NASA TECH BRIEF

Brushless Direct-Current Motor with Stationary Armature and Field

An improved electronically commutated dc motor has an active fixed field winding, an active fixed armature winding, and a passive rotor. By using the well-known brushless-dc-motor switching technique, the motor provides a continuous controllable and reversible torque without the use of sliding contacts. Because no power is dissipated in the rotating assembly, bearing life is prolonged and thermal limitations are reduced.

The rotor, made of a material with high magnetic permeability, has a number of salient poles or teeth and is rotatably mounted near the field winding

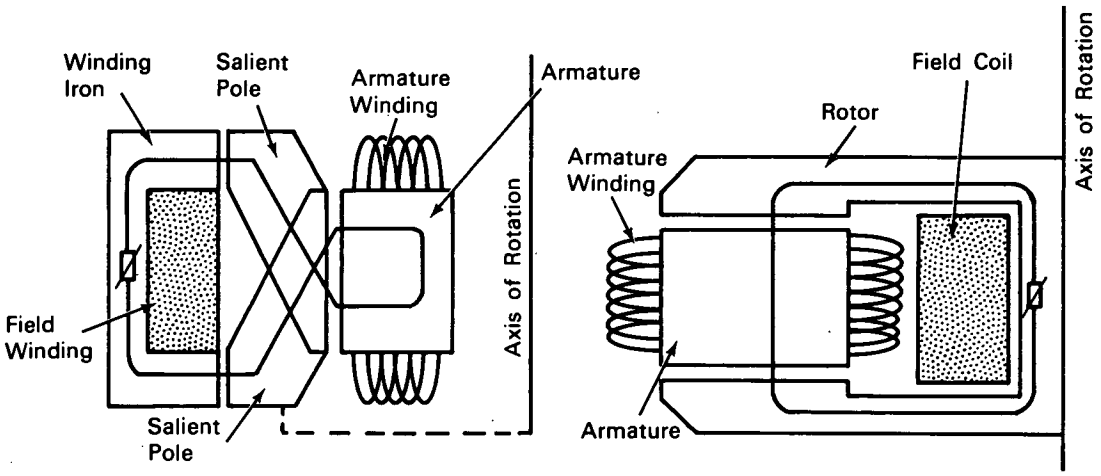

Figure 1. Cross-Sectional Magnetic-Circuit Diagrams of Halves of Two Forms of the Motor

Unlike a permanent-magnet motor which has a single linear speed-torque characteristic and a unique peak efficiency operating point, the new motor can be controlled to shift the peak of its efficiency curve to match the instantaneous load condition over a wide range of speeds. High starting torque is provided by less power, and magnetic losses at high speeds are minimized by a simple control scheme such as connected all or part of the field winding in series with the armature. Stationary mounting of the field results in a rotor structure that may have less mass than earlier brushless dc motors. so that the winding electromagnetically induces magnetic flux in the poles. The armature windings are also mounted near the rotor. In operation, the magnetic flux induced in the poles interacts with the current passing through the armature windings. This current flow is controlled by a solid-state commutator (Fig. 2) as in a brushless dc motor. The magnitude of the current supplied to the field windings controls the motor's speed. The windings can be connected in a series, shunt, or compound configuration as desired.

Wear-prone elements are eliminated, and mechanical

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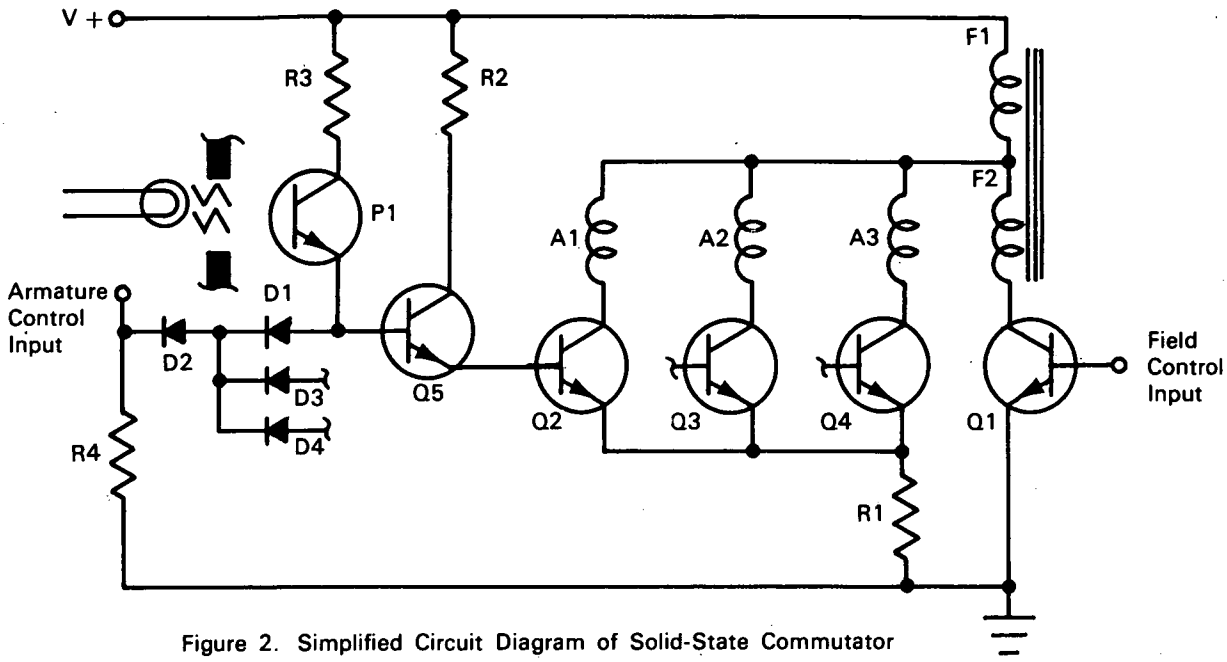

Figure 2. Simplified Circuit Diagram of Solid-State Commutator

and magnetic losses in the rotating structure are reduced. The motor's inertia is reduced, its response time is improved, and its dynamic braking and acceleration torques may be controlled. The new motor is electrically, magnetically, and mechanically inexpensive and uncomplicated. The fact that the field flux can be connected in various configurations makes the invention flexible.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: TSP70-10691

Patent status:

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Patent Counsel
Mail Code 204
Goddard Space Flight Center
Greenbelt, Maryland 20771

Source: P. Studer
Goddard Space Flight Center
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