A Brushless D.C. Spin Motor
for Momentum Exchange Altitude Control

The problem:
Conventional ac induction motors, when used in
conjunction with a static inverter momentum wheel, have
several deficiencies. The system is bulky; it requires too
many watt-hours to accelerate the momentum wheel;
and once running, consumes excessive power to keep
the wheel in motion.

The solution:
A brushless dc spin motor (see figure) has been
designed to use Hall effect probes as a means of resolving
rotor position and controlling motor winding currents.
This results in a 3 to 1 reduction in watt-hours required
for wheel acceleration, a 2 to 1 reduction in power to
run the wheel, and a 10 to 1 reduction in the electronics
size and weight.

How it's done:
The motor uses a stator (either two- or three-phase
winding), a main permanent magnet rotor, a flux return
path ring for the sensing rotor, and two Hall effect
probes located in the air gap of the sensing rotor.

Two armature windings, electrically displaced by 90°,
are provided on the stator. The motor is energized by two
power amplifiers which are controlled by two Hall probes
that sense the magnetic flux of the auxiliary sensing rotor.

The sensing rotor is aligned with the main rotor so
that the voltages of the Hall effect probes are proportional
to the magnetic flux from the main rotor. By suitably
magnetizing the rotors, the flux density around the
periphery of both rotors can be made to vary sinusodially.
The probe voltages are the inputs to the power amplifiers
that provide the currents to the armature windings.

This motor has a normal operating speed of 8,000 rpm
and an operating life of 9,000 hours. It has a nominal
torque of 1590 gm-cm and a peak output power of 133
watts.

Notes:
1. This innovation may be of interest to designers of
   high speed, high efficiency motors and the aerospace
   industry in general.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&TS-TU
   Huntsville, Alabama 35812
   Reference: B72-10448

Patent status:
No patent action is contemplated by NASA.

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