CORE
Metadata, citation and similar papers at core.ac.uk
Provided by NASA Technical Reports Server

NASA TECH BRIEF
Goddard Space Flight Center

NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

An Electric Motor with Magnetic Bearings: A Concept

The problem:

The rotors of electric motors and generators are supported by mechanical bearings and bushings. These bearings have a limited life, can operate only at limited speeds, and require frequent lubrication.

The solution:

A new concept in electric motors that uses the magnetic fluxes that drive the rotor as a rotor bearing.

How it's done:

A sectional view of a dc motor with magnetic bearings is shown in Figure 1. The motor has four parallel magnetic pole pieces centered on two mutually perpendicular axes. Two of these are shown in the illustration. The armature is a circular iron core with teeth and is attached to the pole piece by a nonmagnetic insulating material. The rotor consists of two toothed iron rings that are connected by a nonmagnetic binder, but are otherwise separated by an air gap. Figure 2 is a view of the rotor, armature, and pole piece.

The legs of the pole pieces and the armatures are each wound with copper wire. The flux flow is determined by the width of the air gaps in the motor. As shown in Figure 2, the flux out of the first rotor segment and into the second rotor segment interacts with the current in the armature to produce a torque that drives the rotor.

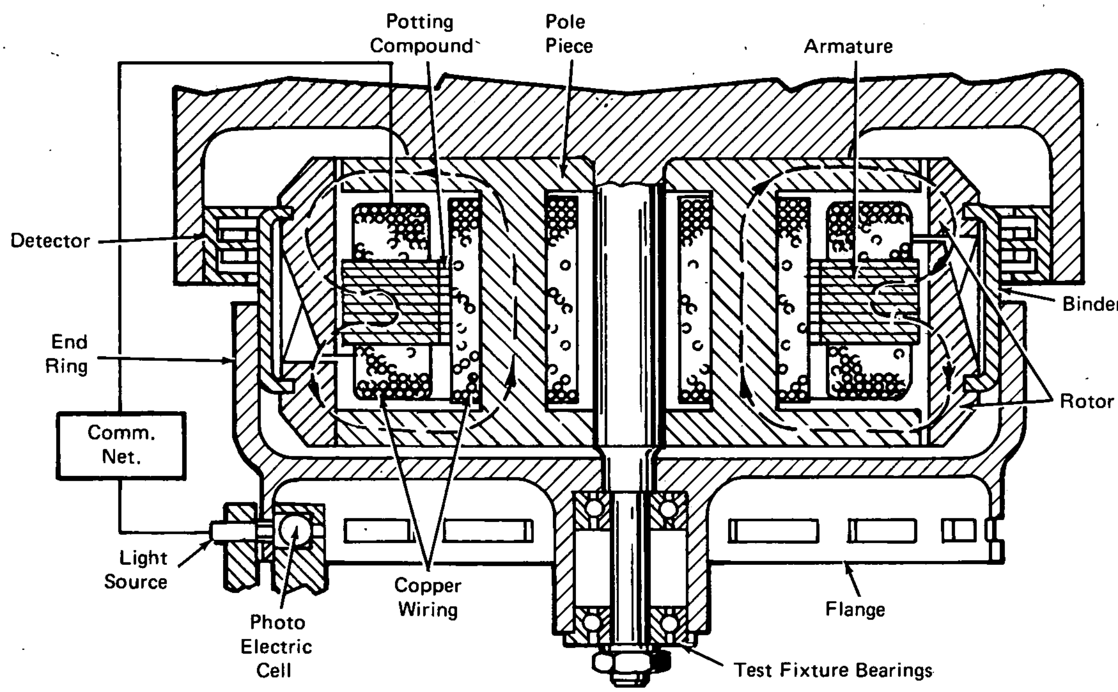

Figure 1. Cross Sectional View of Motor Showing Two of Four Pole Pieces.

(continued overleaf)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.

The brushless photoelectric commutator is triggered by slots in a flange attached to the end ring (which is attached to the rotor binders). As the slots rotate between the fixed light source and photo detector, switching voltages are fed to an electronic network that controls the current direction in the armature coils.

The rotor is kept properly aligned by the driving magnetic forces, rather than by mechanical bearings. Axial motion of the rotor is automatically prevented by the magnetic reluctance. The flux tends to follow the path of least magnetic reluctance, and the motor is designed so that any axial motion of the rotor would lengthen this path. Thus the magnetic force opposes the motion. The transverse motion of the rotor (lateral motion in the drawings) is maintained by varying the current in the windings around the pole pieces. Detectors that determine the position of the rotor are connected to a control network that adjusts the current to center the rotor. Torsional stability, or resistance to tilt, requires either a motor with a large diameter or two units axially spaced on the same shaft.

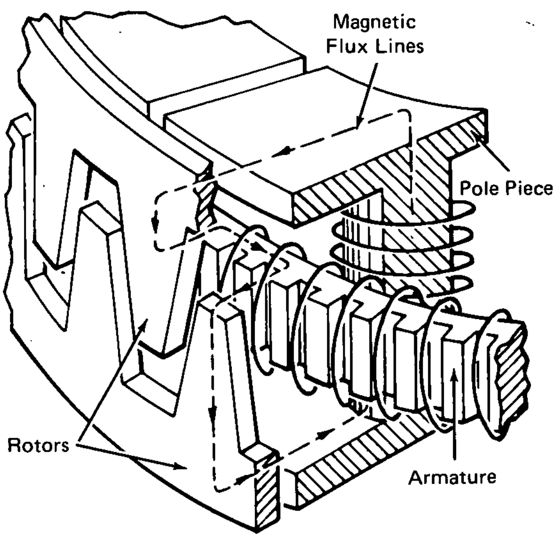

Figure 2. Detailed View of Rotor Armature and a Pole Piece Showing Magnetic Flux Lines.

Because the same magnetic flux is used to control the rotor as to drive it, the size, weight, and power required are minimized. The constant total current keeps the motor torque invarient, and the absence of mechanical bearings eliminates wear and reduces frictional power loss.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: TSP73-10304

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,694,041). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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

Source: Philip A. Studer
Goddard Space Flight Center
(XGS-07805)