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NASA TECH BRIEF

Goddard Space Flight Center

Improved Magnetic Suspension Technique

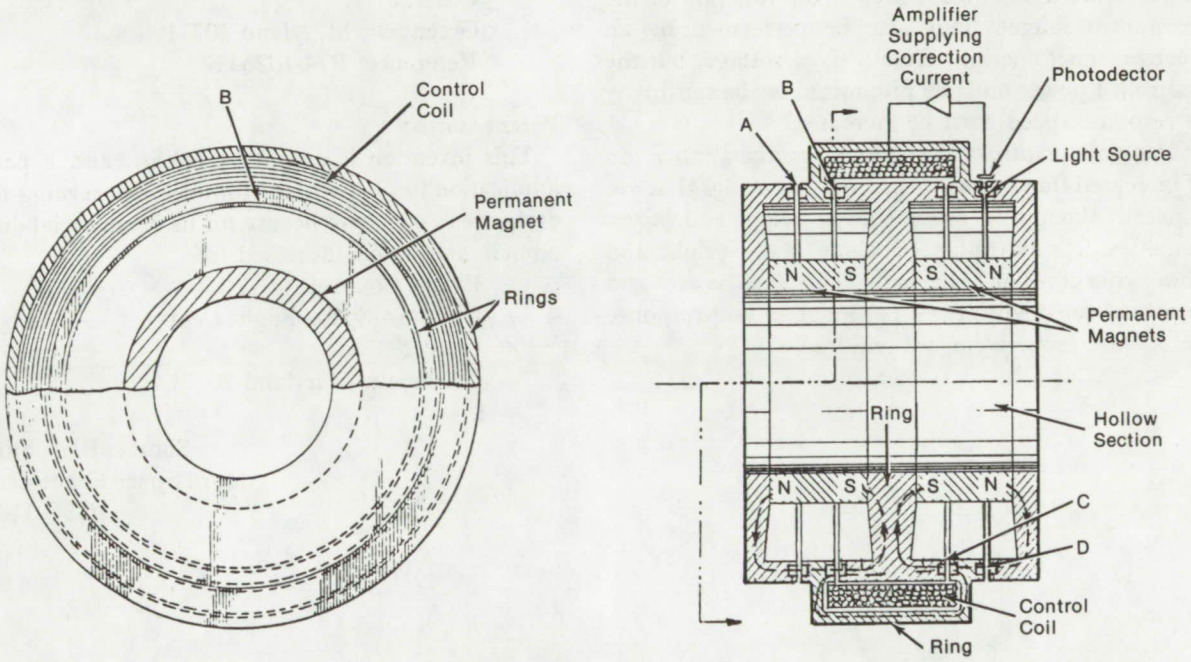

Figure 1. Magnetic Suspension

An improved polarized-magnet suspension technique can be used for magnetic flotation bearings and dc motors that have magnetically supported rotors. The technique combines an electromagnetic coil with polarized permanent magnets. This reduces the power consumption of electromagnetic units and improves the response of magnetic suspension systems, by increasing their sensitivity to changes in the current controlling the electromagnet.

The new technique provides a parallel path for the permanent magnet flux so that this path and that of the electromagnetic flux coincide over only a portion of their respective circuits. Thus, the flux generated by the electromagnet adds to and/or subtracts from that of the permanent magnet. The net force developed is proportional to the square of the total flux density. The function of the permanent magnet is to raise the average flux density to a high level. The effective force of the control current is therefore amplified by the magnetic level supplied by the permanent magnet.

One arrangement (see Figure 1) has two permanent magnets and four airgaps. The flux direction due to the respective permanent magnets is opposite in airgaps A and B relative to C and D, while that of the control coil is the same in both central airgaps. Thus, for one direction of current flow, the control current tends to increase the flux and force in one airgap (B) and to decrease it in the other (C); for the opposite direction of flow, this condition is reversed. Therefore, a single control coil can effect a net force in either direction.

(continued overleaf)

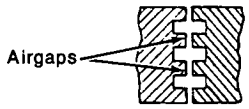

Figure 2. Four Airgaps

Alternate arrangements can be devised. Figure 2 shows four airgaps where only two are essential, but any number of pairs may be used. The uncontrolled airgap or airgaps may serve to increase the stiffness of the bearing normal to the controlled axis. Where power is not a significant factor, the function of the permanent magnet may also be performed by an electromagnet operated from a fixed voltage, but the controlled power must be minimized or the sensitivity or response speed must be increased.

The main feature of the technique is the application of increased flux density to magnetic bearings that are generally thought to present large weight and power penalties. The advantages include lower weight and power consumption (especially controlled power) and improved sensitivity (force per ampere) and response time, since fewer turns are required.

Note:

Requests for further information may be directed to:

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Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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