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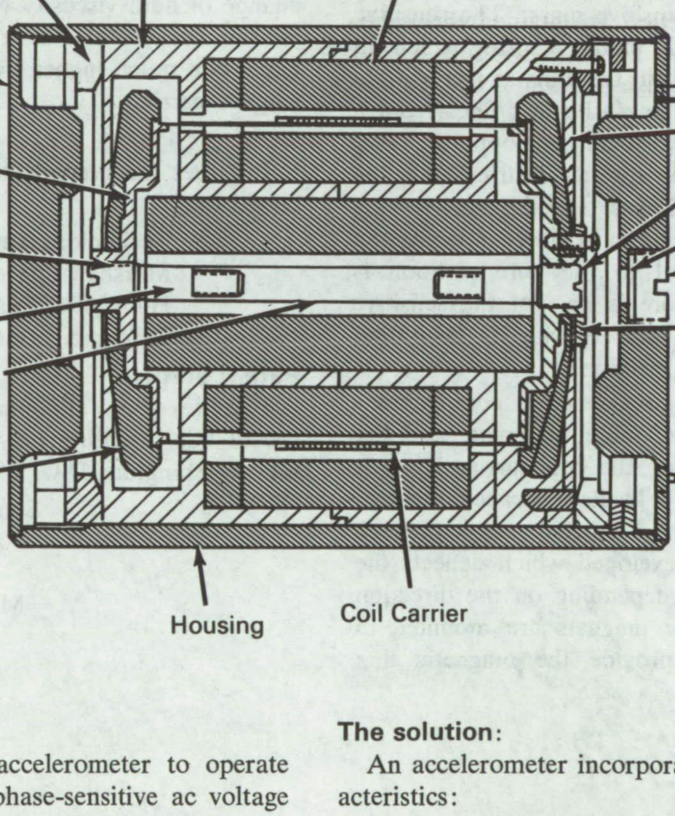
NASA TECH BRIEF

Rectilinear Accelerometer Possesses Self-Calibration Feature



The problem:

To design a rectilinear accelerometer to operate from an ac source with a phase-sensitive ac voltage output proportional to the applied accelerations. In addition, the unit must include an independent circuit for self-test which will provide a sensor output simulating an acceleration applied to the sensitive axis of the accelerometer.

The solution:

An accelerometer incorporating the following characteristics:

Range: ±10 meters/sec/sec
Output: 0.5 volt rms/meter/sec/sec
Output Load: 20,000 ohms
Output Impedance: 2,000 ohms max (as a voltage generator)

(continued overleaf)

Null Voltage: <15 mv at 75° (<25 millivolts max)

Static Accuracy: ±½% to ±1½% (depending upon operating temperatures).

With an acceleration applied to the sensitive axis, the acceleration sensitive mass will deflect until the acceleration force on the sensitive mass is equalled by the deflection force on the S-springs. This deflection is measured by an output from the linear variable differential transformer, which is a phase-sensitive differential transformer. For self-test capabilities, a series-wound coil is mounted on the self-test coil carrier and the winding is positioned between the two permanent magnets.

How it's done:

The sensitive mass of the rectilinear accelerometer consists of nylon damping rings, coil carrier supports, and a coil carrier with its winding. In addition, the core of the transducer and its null adjustments are also included in the sensitive mass. Two S-springs are used in the assembly and are symmetrically mounted, one on each end of the sensitive mass. The sensitive mass is mounted to the ID of the S-spring which, in turn, is securely positioned to the magnet carrier.

In operation, the core links the flux lines from a primary winding into two balanced opposing secondary windings. With the core at electrical null, the in-phase signal and out-of-phase signal cancel leaving an electrical zero. With motion in either direction, an output signal proportional to the core position is achieved. Because the core is part of the sensitive mass and thus travels or deflects with it, the output signal indicates the mass position.

The self-test forcer comprises three components: the forcer coil carrier, the forcer magnets, and the magnet carriers. In design, the coil carrier is positioned within the flux gap located between the two permanent magnets. When a current passes through the winding, a force is developed which deflects the forcer in either direction depending on the direction of the current flow. The magnets are mounted in magnet carriers, which provide the magnetic flux path around the two permanent magnets. The forcer coil carrier is an aluminum drum of very thin cross section. On the OD of the aluminum drums are two ribs within which the series wound self-test coil is mounted. The two forcer magnets, inner and outer, are of a plastic permanent magnet material, which is easily formed into any cylindrical shape, and are encased in aluminum shells which mount on the ID of the outside magnet and the OD of the inside magnet to provide the necessary mechanical support. In addition, the aluminum shell also forms spacers at the end of the magnets so that they cannot come into physical contact with the magnet carriers, thus preventing the shorting-out of the magnetic fields.

The stainless steel coil supports mount on the ID of the S-springs. In addition, the coil supports also carry the coil carrier, the null adjustment of the linear variable differential transformer, and the nylon damping pistons. The dashpot damping leakage gap is between the ID of the magnet carriers and the OD of the nylon damping rings. To compensate for the change of fluid viscosity with temperature, nylon was chosen because it has a temperature coefficient of expansion much higher than the material used in the magnet carriers.

Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B66-10452

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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