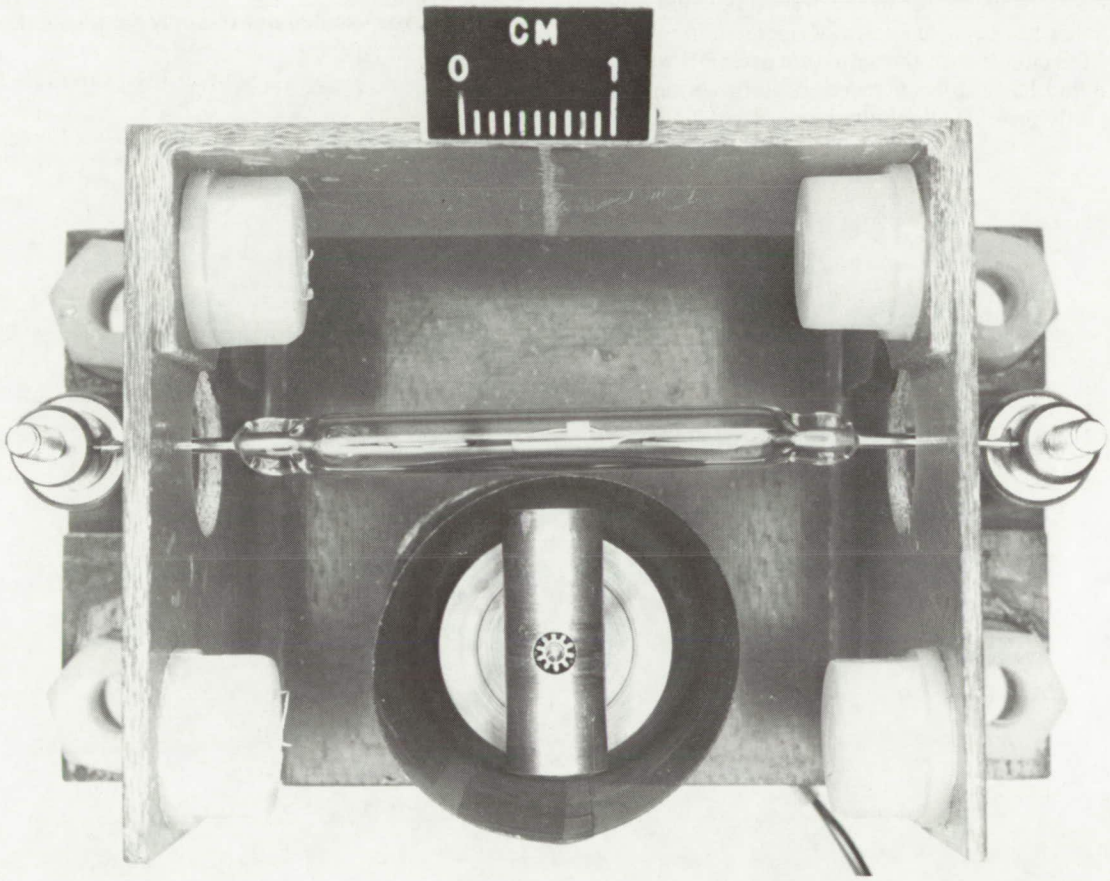
NASA TECH BRIEF

Lewis Research Center

Very High Voltage Latching Relay



The Problem:

To design a high voltage (20 KV DC) relay circuit that will hold in a latched position without the continuous application of electrical power or mechanical locking devices, and that operates with very low current leakage and will survive in a severe vibration environment.

The Solution:

A high voltage latching relay consisting of a high voltage reed switch actuated by a rotating permanent magnet mounted on the shaft of a stepper motor, with the actuation assembly isolated from the high voltage circuit.

How It's Done:

The high voltage latching relay consists of a single pole, normally open, high voltage reed switch, and an actuation assembly (see photograph). The switch is mounted on 38.1 mm (1½ in) long by 6.35 mm (¼ in) diameter insulators attached to a fiberglas base plate. The actuation assembly, mounted on the baseplate beneath the switch, consists of a samarium-cobalt permanent magnet mounted on the shaft of a small 90° stepper motor. The actuation assembly is electrically isolated from the high voltage circuitry by ceramic insulators, the fiberglas baseplate,

(continued overleaf)

and a polyimide plastic shield. The ceramic and fiberglas contribute high bulk and surface resistivities and comparatively long conductivity paths. The plastic shield effectively increases the spacing between the motor and the high voltage circuitry by increasing the gaseous conduction path length in air.

The relay is closed by stepping the motor 90° which aligns the permanent magnet perpendicular to the switch. The switch resistance to ground is greater than 10^{16} ohms and the power required to latch or unlatch the relay is peculiar to the stepper motor, e.g., 4.9 watts at .16 amps for actuation times up to ½ second. The switch is opened by stepping the motor back 90° to remove the magnetic field and allow the switch to return to its normally open position. The detent torque in the stepper motor holds the magnet in position so that the only power required is that which steps the motor to the desired position.

This relay has been successfully operated in vacuum in a 20 KV DC circuit with the actuation assembly at ground potential and has also been successfully flown on a space mission, fully meeting all requirements.

Notes:

1. The unit can be modified for use as a double pole or double pole double throw latching relay.
2. The latching relay can be used in either air or vacuum.
3. This item should be of interest to manufacturers of ionized gas plasma equipment, medical electronic equipment, and communications equipment.
4. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B74-10079

Patent Status:

NASA has decided not to apply for a patent.

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(LEW-12265)