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NASA TECH BRIEF

NASA Headquarters

Sputter Etching of Hemispherical Bearings

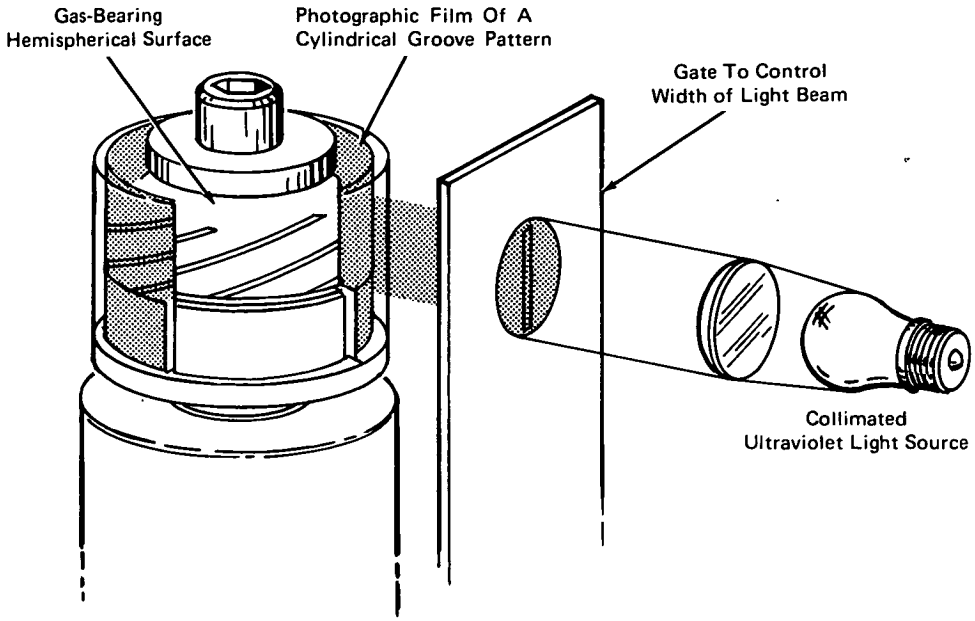

Figure 1. Application Of Photo-Resist Pattern Of Groove On Hemispherical Surface

The problem:

Presently, fabrication techniques used to produce three dimensional grooving patterns on hemispherical gas bearings cannot provide sufficient groove uniformity.

The solution:

A method has been developed for fabricating three dimensional pumping grooves on gas bearings by sputter etching. This technique eliminates problems such as groove nonuniformity, profile, and finish, which are associated with normal grooving methods.

How it's done:

The bearing is covered with a mask that has been cut-out to expose that part of the bearing to be etched. The masked bearing is bombarded with high energy gas ions (usually argon) which etch the cut-out pattern in the bearing. This process is called sputtering. The sputtered finish will generally be the same as the original finish in uniform materials; however, composite materials such as tungsten carbide in a cobalt matrix will have rougher finishes.

Flat masks for sputter etching are easily made and used, but three dimensional masks such as the hemispherical masks needed for bearing etching are more difficult to make. To make the mask for the bearings, a hemispherical, aluminum form is plated with about 0.0075 cm (0.003 in.) of nickel. The nickel plating is then coated with photo-resist and exposed to UV light through a cylindrical mask in a rotating fixture (see Figure 1). The pattern is developed, and the nickel is acid etched through. Alternatively the pattern may be

(continued overleaf)

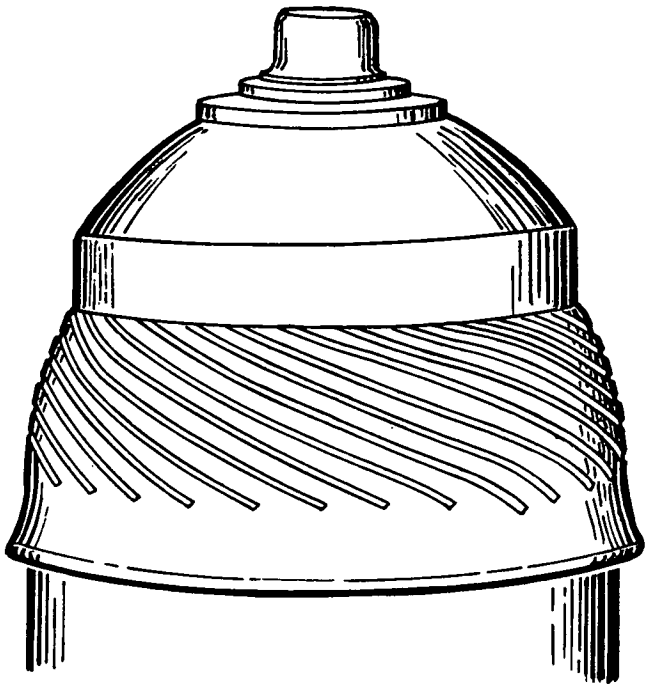

Figure 2. Mask Mounted On Bearing Ready For Sputter Etching

machined on the nickel with a conventional end mill and indexing device.

The finished mask is mounted on the bearing (see Figure 2) which is then etched in a sputtering machine. The uniformity and quality of the grooving depend upon the power levels and the positioning of the bearing in the field of bombarding gas ions. Properly done, the mask pattern will be perfectly reproduced on the bearing surface with groove depths uniform to 0.013 cm (0.005 in.).

Etching through a mask by sputtering has distinct advantages over acid etching. The etching action of acid results in sloping side walls, while sputter etching (etching by line of slight) eliminates this problem and produces well defined, reproducible groove patterns.

Note:

Requests for further information may be directed to:
Technology Utilization Officer
NASA Headquarters
Code KT
Washington, D.C. 20546
Reference: TSP72-10534

Patent status:

NASA has decided not to apply for a patent.

Source: R. J. Schiesser of
Massachusetts Institute of Technology
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NASA Headquarters
(HQN-10712)