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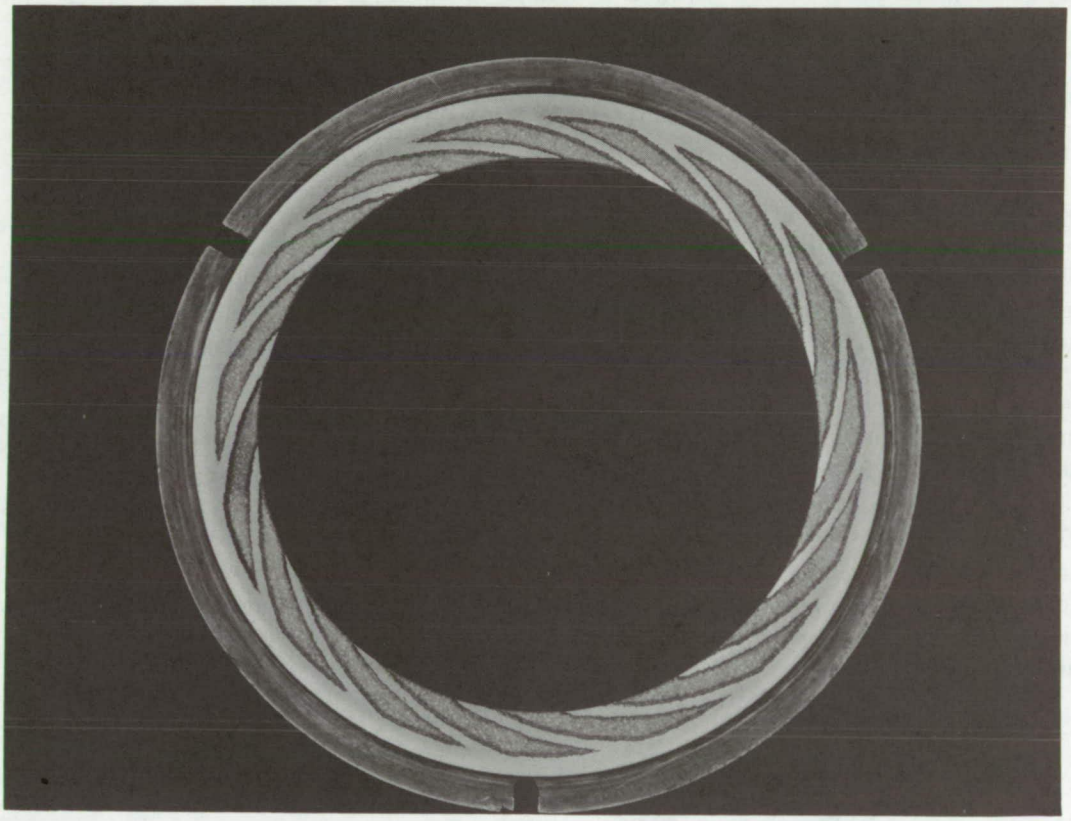
Spiral-Grooved Shaft Seals Substantially Reduce Leakage and Wear



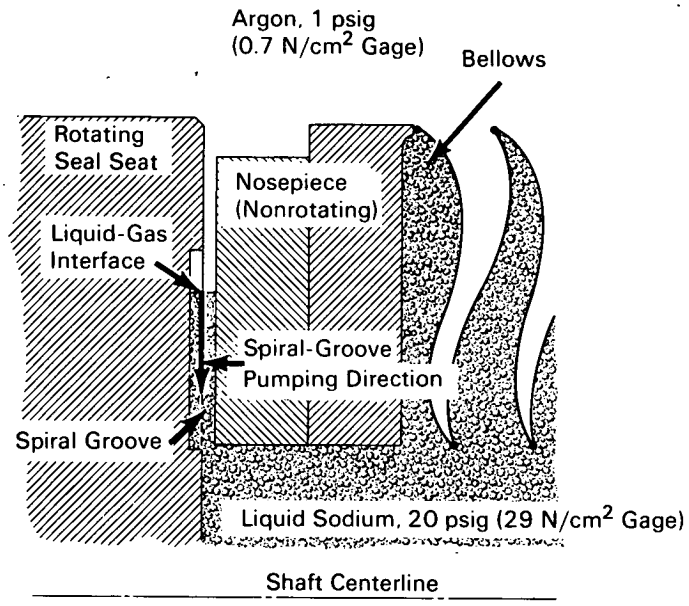
Rotating shaft seals for use in space power systems must operate reliably for periods of several years without maintenance or attention. Leakage and wear must be minimized. In addition, they must be suitable for use at extreme temperatures, simple and light in weight, and capable of containing pumped fluids such as liquid sodium or potassium.

Conventional shaft seals are not adequate. Leakage rates are too high; thermal and pressure distortions cause rubbing contact which results in wear, scoring, and increased leakage rates.

To overcome these problems, seals have been developed which incorporate spiral grooves, as shown above, in one or both of the opposing seal faces. These grooves induce a pumping action which displaces the intervening fluid radially inward toward the shaft and counters the centrifugal forces which tend to displace the fluid outward. The net effect maintains hydrodynamic separation of the seal faces, thus preventing seal face contact and wear (see the figure overleaf).

Spirally-grooved seals have been tested against comparable conventional seals for use in a liquid sodium

(continued overleaf)



pump operating at over 1300°F and 20 psig. The results showed that:

1. The spirally-grooved seals leaked at a rate less than the detectable limit of 0.02 cubic inch per hour with generally no detectable increase in leakage after prolonged operation. Comparatively, the conventional seals had initial leakage rates up to 27 cubic inches per hour which increased to as much as 57 cubic inches per hour with prolonged operation.
2. The spirally-grooved seals showed negligible wear at the completion of the test run.
3. Static leakage of the spirally-grooved seals was comparable to that of the conventional seals.

Notes:

1. This technique of machining rotating shaft seals with spirally-grooved faces appears applicable to a wide variety of uses.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B68-10270

Patent status:

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

Source: T. N. Strom, L.P. Ludwig, G. P. Allen, and R. L. Johnson (LEW-10397)