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NASA TECH BRIEF

Lewis Research Center

Improved Circumferential Shaft Seal

The Problem:

Conventional shaft seals as used on some aircraft and accessory transmissions tend to leak excessively at the higher rotational speeds. Elastomeric lip seals are usually satisfactory at sliding speeds below 1219 m/min (4000 ft/min); however, at higher speeds, the temperature of the lubricating film exceeds the useful temperature limit of the elastomer causing elastomer degradation and leakage of the lubricant out of the transmission. Segmented carbon ring seals have suitable high temperature operating capability, but at high speeds the carbon rings tend to lift up and hydroplane on the lubricant, a thick film of lubricant develops and the seals leak even at low pressure differentials.

The Solution:

Add helical grooves to conventional segmented carbon ring seals to counter the lubricant build-up and prevent leakage. Comparative tests of modified and unmodified carbon ring seals showed that addition of the helical grooves reduced leakage significantly, and that the modified seals gave equivalent performance in other respects such as wear life.

How It's Done:

A conventional segmented carbon ring seal, shown in Figure 1, is modified by adding helical grooves to the bore of the side cover ring, as shown in Figure 2. The helical grooves are oriented to pump against the leakage tendency.

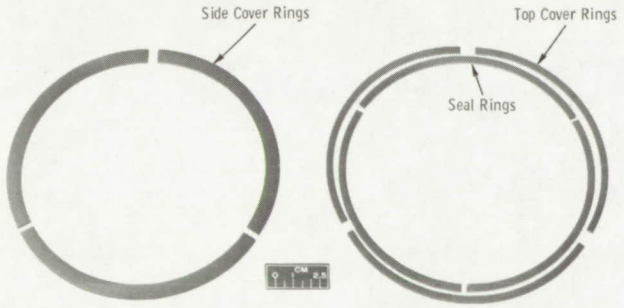

Figure 1. - Carbon rings for conventional circumferential seal.

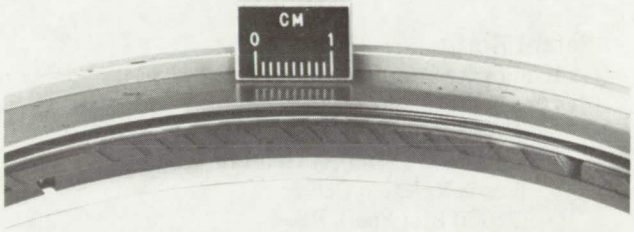

Figure 2. - Modified (helix grooved) circumferential seal.

Bench tests were run with both modified and unmodified segmented carbon ring seals to determine comparative performance with respect to: (a) leakage, (b) torque and heat generation, and (c) operation under shaft runout conditions to 0.254 mm (0.010 in) total indicated runout. The seals were mounted on a 11.258 cm (5.481 in) diameter shaft operated at 6600 rpm which provided a seal sliding speed of 2880 m/min (9450 ft/min). Pressure differential across the seals was varied from zero to 1.38 N/cm^2 (2 psi), and the seals were tested in both partially flooded and fully flooded conditions.

Test results showed that:

1. Leakage through the modified seal was significantly lower than through the unmodified seal.
2. Torque of the modified seal was comparable to that of the unmodified seal.
3. The modified seal was insensitive to shaft runout whereas the unmodified seal leaked excessively with shaft runout.
4. The modified seal was insensitive to flooding by the lubricant; whereas, leakage through the unmodified seal increased with flooding.

Notes:

1. This innovation illustrates the use of helical grooves to reduce leakage and otherwise improve shaft seal performance. Both the modified seal described herein and the concept of adding helical grooves to other conventional seals may be advantageously employed in other applications.

(continued overleaf)

2. Further information is available in the following report:

   NASA TN-D-7130 (N74-14138), Improved Circumferential Shaft Seal for Aircraft Gear Transmission

   Copies may be obtained at cost from:

   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B74-10062

3. Specific technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B74-10062

Patent Status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

NASA Patent Counsel
Mail Stop 500-113
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135

Source: L.P. Ludwig and T.N. Strom
Lewis Research Center
(LEW-11873)