NASA TECH BRIEF
Lewis Research Center

Improved Lip Seal for Rotating Shafts

An improved lip seal has been designed which is simpler and less expensive than conventional lip seals. Both axial and radial seal loading is provided by an axial spring, eliminating the separate radial loading ring conventionally required. The seal can be used in very small or inaccessible areas without limitation as to the size of the loading spring which can be utilized. A wide range of seal loading is available by selective design of the components.

As shown in Figures 1 and 2, the axial spring forces the seal loading ring of the spacer into the formed cavity of the seal so that a controllable lip seal pressure can be maintained. The ring height is designed so that the flat portion of the spacer bottoms on the seal body when a predetermined seal load is obtained, and potential overloading of the seal is prevented. Varying amounts of seal-loading spring force can be applied to the sealing lip by changing the nose radius of the loading ring or the contour of the flank portions of the spacer or both.

Additional control of the seal-loading forces can be obtained by varying the angle of the seal recess in the seal which receives the loading from the spacer. Additionally, the stand-off height of the spacer loading section can be varied to provide different limits in seal radial loading due to the fact that the base of the spacer will bottom on the flat portion of the inner seal under predetermined spring-loading conditions, and additional spring loading beyond this level will be absorbed in compressing the body of the inner seal. By matching the modulus of elasticity of the inner seal material (plastics such as polytetrafluoroethylene, polyimide, etc.) with the axial loading provided by the external spring, a fixed limit in seal radial loading is obtained. This feature allows the designer to select the desired seal radial loading regardless of the size of the external spring. It is possible to design the seal such that the same seal load can be obtained with a very heavy spring or a light spring; however, different inner seal and spacer configurations will be required if the spring loading variations are very large. The normal considerations of sealing efficiency, service life, and seal loading limits apply to this seal design; however, a much broader range of loading is possible within the same space limitations.

Since the seal radial forces are generated through the use of an external spring instead of the conventional internal spring, a larger selection of spring-loading rates is possible. This is particularly important where the size of the seal cavity is limited to small sizes, but where relatively large seal radial loading is desired.

This seal is easier to install than a conventional seal due to the fact that the seal is not spring loaded when installed, but is loaded after the return spring is installed. Less seal damage will occur to the sealing surface of the seal during installation with this design. The seal and spacer are both installed in the same manner as a plain flat washer and then loaded after installation.

The following are specific advantages of this seal:

1. This design is less expensive than conventional seals due to the fact that the internal seal expansion spring is eliminated and the return spring serves this function.
2. This seal can be loaded to a higher sealing load without danger of overloading due to the design arrangement of the spacer.
3. This seal provides for the compensation of seal wear during service like that of spring loaded seals without requiring a special spring for this service.
4. The seal can be used on any shaft and housing point where a return spring exists, such as the intake valves on an automotive internal combustion engine.
5. This seal arrangement provides a much greater range in lip sealing forces than can be obtained with conventional type of lip seals. This will provide better sealing on all small sizes of seals.

(continued overleaf)

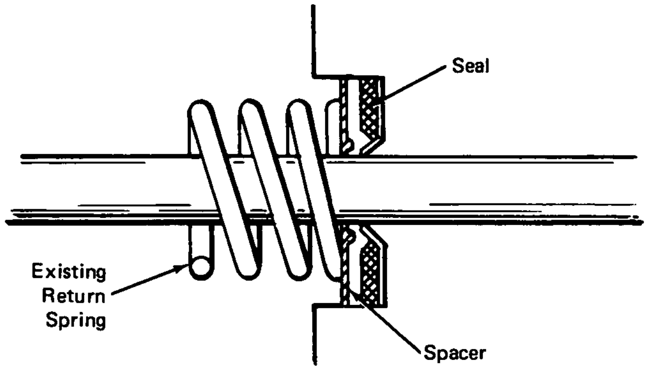

Figure 1.

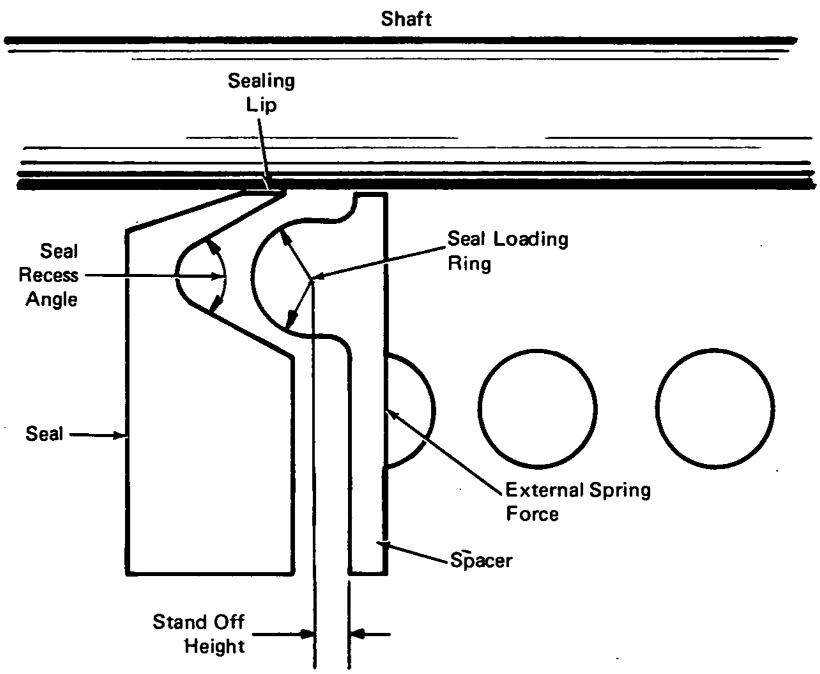

Figure 2.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)], to McDonnell Douglas Corporation, 3000 Ocean Park Boulevard, Santa Monica, California 90406 (Attention: Mr. Donald Royer).

Source: Donald L. Endicott of
McDonnell Douglas Corp.
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