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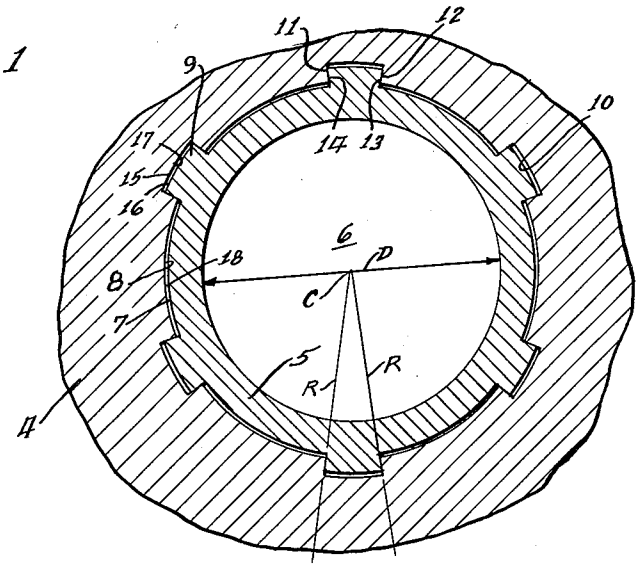
PRESS FITTED SLEEVES

Filed April 7, 1961

Fig. 1



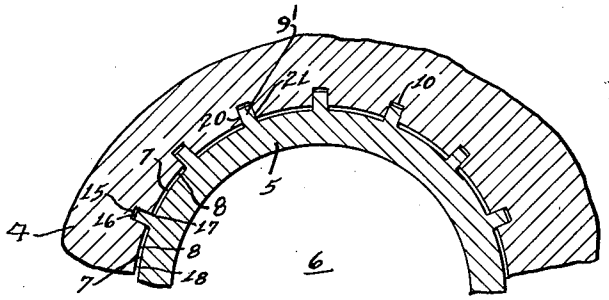


Fig. 2

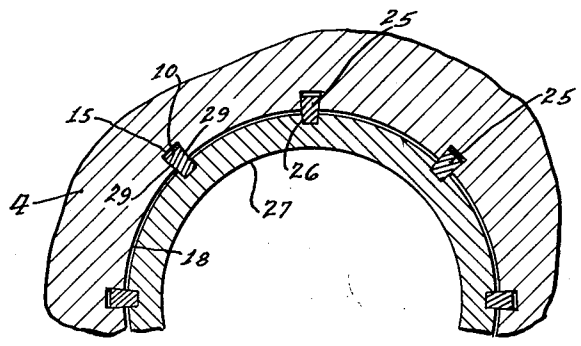


Fig. 3

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PRESS FITTED SLEEVES

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This invention relates to rockets, missiles and related air and space borne vehicles, and is more particularly concerned with improved bearings, seals, liners and the like which may be employed over wide temperature ranges.

Aircraft and missile components have to operate over wide temperature ranges, and heretofore means for retaining bearings, seals, piston liners, and the like which had limited applicability over these wide temperature ranges were employed.

Normally, standard procedure involves shrinking or press fitting a liner, having the desired wear properties or strength properties into a lightweight housing. The weight problem is, it will be appreciated, of great importance with respect to flight vehicles since each pound of additional weight sacrifices mileage. The importance of these features are easily recognized in other applications, such as in the automotive field.

In press fitting such assemblies, difficulties have heretofore been encountered under operating conditions as the assembly temperature rises since the press or shrink fit which exists at room temperature may be lost at higher or lower temperatures. The lightweight housing, will shrink down normally faster than the liners, and stresses will gradually increase in the lightweight housing to the point where they may reach the yield point and permanently deform. Thus, when the unit returns to a higher temperature or lower temperature, the initial press or shrink fit is no longer present.

With the present invention, we substantially overcome the problems and difficulties of the prior art and provide press fitted liners or sleeves for environments involving wide temperature ranges.

It is therefore an object of the present invention to provide press fitted sleeves for environments involving wide temperature ranges.

It is another object of the present invention to provide press fitted sleeves which will expand and contract due to temperature change over wide temperature limits without imposing undue stresses on the housing with which employed.

Still another object of the present invention is to provide press fitted retaining members which do not impose stresses in the assemblies with which they are employed to an extent sufficient to permanently deform the assembly.

Another object of the present invention is to provide an improved method of press fitting retaining members in assemblies in such a manner that operation of the assemblies over wide temperature ranges does not affect the initial press or shrink fit of the retaining members.

These and other objects, features and advantages of the present invention will become readily apparent from a careful consideration of the following detailed description, when considered in conjunction with the accompanying drawing illustrating preferred embodiments of the present invention and wherein like reference numerals and characters refer to like and corresponding parts throughout the several views.

On the drawings:

FIGURE 1 is an enlarged fragmentary view in cross section of a liner or sleeve constructed in accordance with the principles of the present invention.

FIGURE 2 is an enlarged fragmentary view of an alternative embodiment of the liner or sleeve of FIGURE 1.

FIGURE 3 is a further embodiment of the present invention wherein a plurality of spaced keys are employed.

As shown on the drawings:

Although the present invention has a variety of applications, one such application appears in FIGURE 1 wherein a lightweight housing 4 is provided with a liner 5 having a smooth bore, generally indicated by the numeral 6, and a splined outer surface 7 adjacent the inner wall 8 of the housing 4.

The liner 5 may be constructed of a material heavier in weight than the housing and the housing 4 may have a different coefficient of thermal expansion than the sleeve or liner 5. The liner or sleeve 5 may be employed as a cylinder liner in sleeve bearings or sleeve bearing supports in piston engines.

When the material defining a hole or a plug expands or contracts due to temperature change, all growth of the material occurs along radial lines so that, in effect, there is no circumferential movement of a particle or molecule on the surface of the material defining the hole or plug. Thus, growth always takes place radially inward or outward. The realization of the application of this principle provides an important feature of the present invention as next explained.

The outer periphery of the surface 7 of the liner 5 is provided with a plurality of projections or splines 9. The splines 9 extend into grooves 10 formed in the housing 4 to maintain the liner in fixed position relative to the housing 4. Thus, a male and female type cooperation is provided.

If the side walls 11 and 12 of the projection 9 are divergently tapered from the surface 7 of the liner and are radially aligned with or follow the same radial lines R from the center C or axis of the liner 5, as the complementary surfaces 13 and 14 of the housing 4 against which the projections or splines 9 are press or shrink fitted, crushing of these complementary surfaces will not occur due to temperature change regardless of the differences in coefficient of expansion of the material of construction of the housing 4 and projections 9, within predetermined temperature limits.

The differences in the coefficients of expansion between the housing 4 and spline 5 will have an effect on the diameter of the housing and sleeve 5 during a temperature change. To compensate for the differences in the change in diameters, a clearance space 15 is provided between the outer peripheral edge 16 of each projection 9 and the complementary bottom wall or surface 17 of the grooves 10. The outer peripheral edge 16 of the projection 9 is preferably shaped to the surface 17 and thus may be arcuate as shown in FIGURE 1.

The clearance space 15 is of predetermined dimension so that over the total temperature range, contact between the surface 16 and surface 17 does not occur.

A similar effect is provided between the sections between the projections 9. A clearance 18 of predetermined dimension is maintained between the inner surface 8 of the housing 4 and outer surface 7 of the liner 5. Thus contact between the liner and the housing is limited to the side walls of the spline or projections 9 over the predetermined temperature range in which the assembly is required to operate.

The overall effect of a liner constructed in accordance with the present invention is that the bore diameter D of the liner is affected only by the coefficient of expansion of the liner itself and is not affected by shrinkage or enlargement of the housing 4. Thus stresses are not applied to the liner by the housing and its coefficient of expansion remains the same. Similarly, the liner does

not apply stresses to the housing and its coefficient of expansion remains the same.

In FIGURE 2 an alternative embodiment of FIGURE 1 is disclosed wherein the side walls of the spline 9' are parallel. These side walls are indicated by the numerals 20 and 21. In this embodiment, wherein the splines 9' are relatively thin in cross section, the effect of thermal expansion is thus relatively small on the cross section that is not following expansion along radial lines. In this embodiment the space 15 between the surfaces 17 and 16 is maintained as well as the spacing between surfaces 7 and 8. The manufacturing errors in producing these thin cross section projections 9' will be compensated for in the smaller width thereof and, therefore, in principle, these projections 9' follow the radial line expansion and contraction concept but any deviation thereof is compensated for by the small cross section of the spline 9', when press fitted in the groove 10.

In FIGURE 3 an alternative embodiment of the present invention is disclosed wherein the splines are independent retaining members 25 seated in grooves 26 formed in the liner 27. With this embodiment the retaining members 25 have opposed divergingly tapered sides 29 which are press fitted into the liner groove 26 and into the groove 10 defined by the housing 4. The predetermined space 15 is provided as well as the space 18. This embodiment finds applicability where the housing has a long use life and the temperature ranges to which it may be exposed in different applications may vary. With the separate retaining members 25 and separate sleeves of different dimension, the spaces 15 and 18 may be varied for the different temperature range applications.

The principles of the present invention may also be employed in applications wherein a pin is fitted into a hole, such as a key and slot (not shown) and a specified clearance must be maintained therebetween over the entire operating temperature range.

Although various minor modifications of the present invention will become readily apparent to those skilled in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of our appended claims.

We claim as our invention:

1. An assembly adapted for use as a bearing housing and the like over a wide operating temperature range comprising: a housing having a liner receiving bore, a plurality of spaced grooves in the bore defining surface of the housing and said housing grooves having parallel sides, a liner in the bore, and spaced thin cross section projections carried by the liner extending beyond the outer surface of the liner, each of said projections having in cross section parallel side walls sized for press fitted engagement with complementary side walls of the grooves formed in the housing, the projections and outside diameter of the liner being of predetermined dimension relative to the housing grooves and to the housing respectively to provide spaces therebetween of a dimension sufficient to permit thermal expansion and contraction of the liner and housing over a predetermined temperature range.

2. A member adapted for use as a press fitted liner for bearing housings and the like over a wide operating temperature range comprising: a bored liner sized for insertion in a housing, a plurality of grooves formed in the outer surface of the liner and a plurality of grooves formed in the inner surface of the housing, the housing grooves and the liner grooves being radially aligned, and a plurality of separate retaining members seated in said grooves formed in the outer surface of the liner having the base of the retaining members engaging the base of the liner groove, and said retaining members projecting beyond the outer surface of the liner, each of said retaining members having side walls divergingly tapered in cross section to the outer peripheral edge of the retaining member along lines radially aligned with the axis of the liner, said side walls being sized for press fitted engagement with complementary side walls of a groove formed in the housing, the retaining members and the outside diameter of the liner being of predetermined dimension relative to the grooves of the housing and to the housing respectively to provide spaces therebetween of a dimension to permit thermal expansion and contraction of the member and housing over a predetermined temperature range.

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