investigated. This is a particularly important factor because the difference between the hoop stress and the high compressive radial stress represents an extremely large shear stress.

The effect of a brittle-ductile transition in high-strength steels on the fatigue behavior near and above the transition temperature is another factor which may need to be considered.

RECOMMENDATIONS

Proposed Materials Study

The possible material limitations discussed in the preceding section suggests that a materials study be conducted. The biaxial and triaxial fatigue behavior of high-strength steels under compressive mean stress should be investigated. The objective of the study would be to establish a fatigue criterion for these materials under combined-stress states. The effect of large transverse compressive stresses of magnitudes one to three times the ultimate tensile strength, upon the flow and fracture characteristics of high-strength steels should also be studied. Moreover, a brittle-ductile transition in high-strength steels may influence fatigue behavior at elevated temperatures – an investigation of this factor may also be worthwhile.

Suggested High-Pressure Container

The results of the investigations on various containers have shown that fluid-pressure support is beneficial and that prestress is also beneficial in increasing the predicted fatigue strength under cyclic pressure loading. Use of high-strength steels for the liners of the containers was also found necessary. Although the controlled fluid-fill design, Figure 27, uses the fluid-support principle, the required size and complexity of the fluid-fill apparatus for fatigue application makes the design impracticable. Use of shrink-fits to provide compressive prestress can reduce the required size and the number of pressure annuli as the ring-fluid-segment design indicates. Although the latter design has the benefit of prestress from shrink-fitting it requires large interferences because of large deformations of the segments and large outer cylinders because the segments offer no hoop support.

A suggested design which appears to minimize the problems introduced by segments is shown in Figure 28. It is made up of two multi-ring units and a fluid-pressure support annulus. Three rings are shown in each part of Figure 28, but the number of rings can be varied to give the best design. For example, for containers having small bores, one ring is sufficient in the inner part. It is easily shown (using the tensile fatigue criterion for the inner ring) that a cyclic bore pressure of 450,000 psi is possible with one inner ring of wall ratio, $k_1 = 1.65$ and a support pressure p_1 of 250,000 psi. A multi-ring container for the outer part can be designed for 10^4 to 10^5 cycles at 250,000 psi as shown in this study.

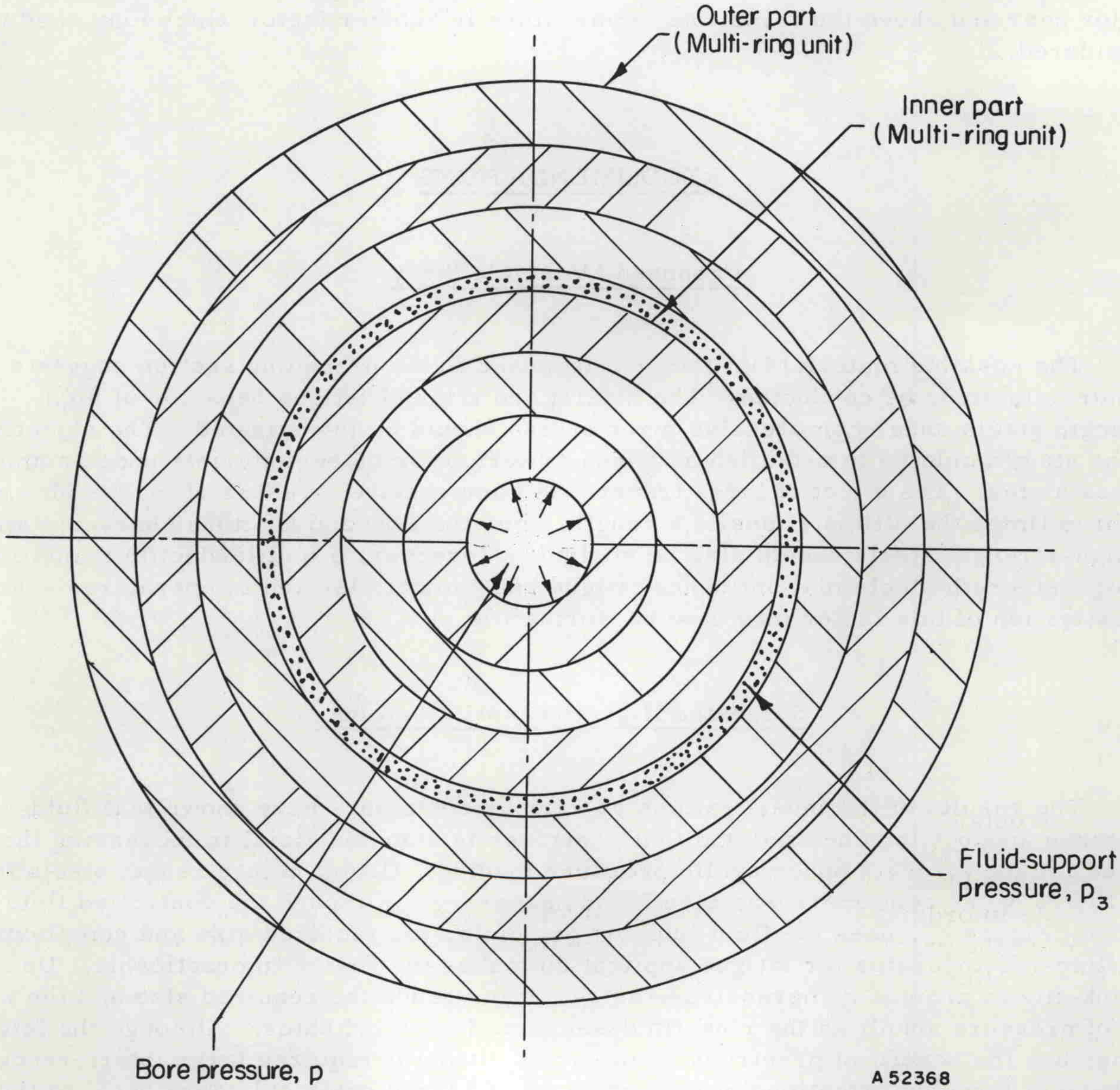

FIGURE 28. SUGGESTED FLUID-SUPPORT MULTI-RING CONTAINER FOR HIGH PRESSURE

The design involves the combined use of interference-fit multi-ring construction with fluid-pressure support.