It is considered noteworthy that the breakthrough pressures for the compound-angle die are about 10 percent lower than those obtained with the single-angle design. This is particularly significant in view of fact that the machining of the compound-angle die is less expensive and presents fewer technical problems than the single-angle design. Moreover, the compound-angle-die concept is more amenable to segmented construction.

In the study of stem speed, it was found that, with both die designs, a stem speed of 80 ipm eliminated the stick-slip during runout experienced at the lower speeds. Further, the results in Table 5, coupled with previous observations made with solid round extrusions, suggest that the range of billet-surface finishes evaluated had no appreciable effect on pressure requirements.

In a single attempt to extrude an AISI 4340 T-section at a ratio of 3:1, breakthrough was not achieved at 244,000 psi, at which point the trial was stopped. On disassembly, the die was found to be cracked. In view of the pressure reductions obtained with the compound-angle die with 7075-0 aluminum, future trials will be made with this die design. Furthermore, dies of segmented construction will be used with the aim of alleviating the die-cracking problem.

EVALUATION OF SYSTEM VARIABLES FOR HYDROSTATIC EXTRUSION AT 500 F

Two modifications of the hydrostatic system were made for extrusion at 500 F. These were: (1) replacement of the manganin gage used for cold hydrostatic fluid-pressure measurements, and (2) redesigning of the stem seal. The reason for the modifications and their influence on the results obtained in hot hydrostatic extrusion are discussed below.

FLUID PRESSURE MEASUREMENT

The resistance of manganin wire is sensitive to small changes in pressure and large changes in temperature, and thus is unsuitable for high-pressure measurement when temperature variations are large. In order to measure the hydrostatic fluid pressure at elevated temperatures, a gage was designed and constructed on this program. Details of the gage will be included in a subsequent report.

For trials carried out during this interim report period, the new gage was calibrated against a manganin gage with both gages at room temperature. The calibration curve obtained with the new gage compared very well with that of the manganin gage from the standpoint of sensitivity and reproducibility. Initial experiments with fluid under under pressure at 500 F indicated some hysteresis effects, but these appeared to diminish in later trials, indicating stabilization of the gage at temperature and pressure.

STEM-SEAL DETAILS

In designing a new stem to incorporate the high-temperature, high-pressure gage, the stem-seal angle (Figure 4) was increased to 65 degrees from 45 degrees with the existing design, with the aim of reducing the stem pressure by decreasing the friction between seal and container. The modification was made as a result of the stem-seal experience of Fuchs[6] with this design. In room-temperature calibration trials, it was found that the stem pressure/fluid pressure difference was reduced by approximately 25 percent when using the 65 degree stem-seal angle.

During the warm trials, three O-ring arrangements were used in the investigation as a result of leakage problems. Three combinations were used:

(1) A single PTFE O-ring
(2) A PTFE O-ring plus a Buna-N rubber O-ring
(3) Two PTFE O-rings.