to the back surface of the mandrel. Figure 2B presents a typical hydraulic swaging assembly. The specimen was counterbored to a diameter slightly smaller than the mandrel and deep enough to admit the mandrel and the end packing through which the fluid was passed. The mandrel was pressed into the position shown to obtain an initial seal; thereafter, contact with the cylinder walls provided a continuous forward seal. Pressure was recorded by means of a Manganin wire pressure cell and a Foxboro Dynalog recorder.

Mechanical-push Swaging

A hydraulic press was used to mechanically force the mandrel through the cylinders while a simple fixture supported the specimen and guided the ram and mandrel. The mandrel moved at constant velocity since the required force was, in general, much less than the 75-ton capacity of the press.

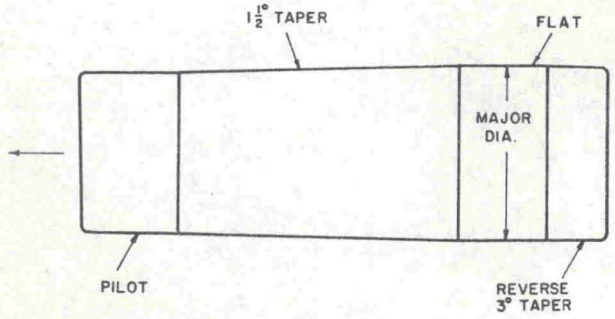

Fig. 1—Typical swaging mandrel

SR-4 strain gages, Types AX-5 and A-7, were placed on some specimens at the mid-length section on the exterior surface to record the tangential strains during the swaging process. In this way the maximum strains which occurred, the residual strains, and the effects of the cylinder ends on the strain at the mid-length section were recorded. Brush and Edin continuous strain recorders were utilized for these measurements.

Radial elastic recovery and permanent enlargement at the bore were determined by measuring the bore diameter before and after test using a dial bore indicator. The change in average surface finish was evaluated with a Profilometer using rms values.

To provide data for evaluating the longitudinal, tangential and radial residual stresses in the cylinder walls, SR-4 Type A-5 and/or A-7 strain gages were placed diametrically opposite and oriented in the longitudinal and transverse directions at the mid-length section. These data were obtained by successively removing material from the bore and noting the accompanying change in strain.

A special jig was designed to facilitate the machining of the specimens. This fixture permitted the specimen to be removed from the lathe and jig during the period required for the specimen temperature to return to its initial value. In this way, the jig was used continuously in the machining of other cylinders. Certain specimens were strain gaged very completely to evaluate the effects of the ends on the residual strains. A cylinder with strain gages is shown in the jig in Fig. 3.

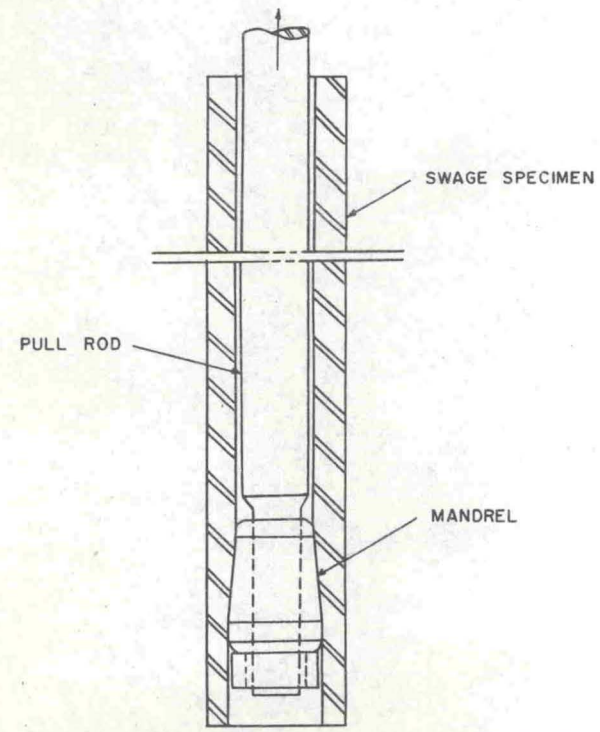

Fig. 2A—Mechanical-pull swaging assembly

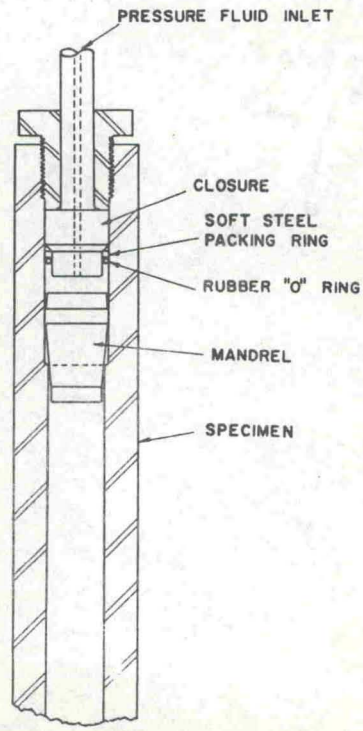

Fig. 2B—Hydraulic-push swaging assembly