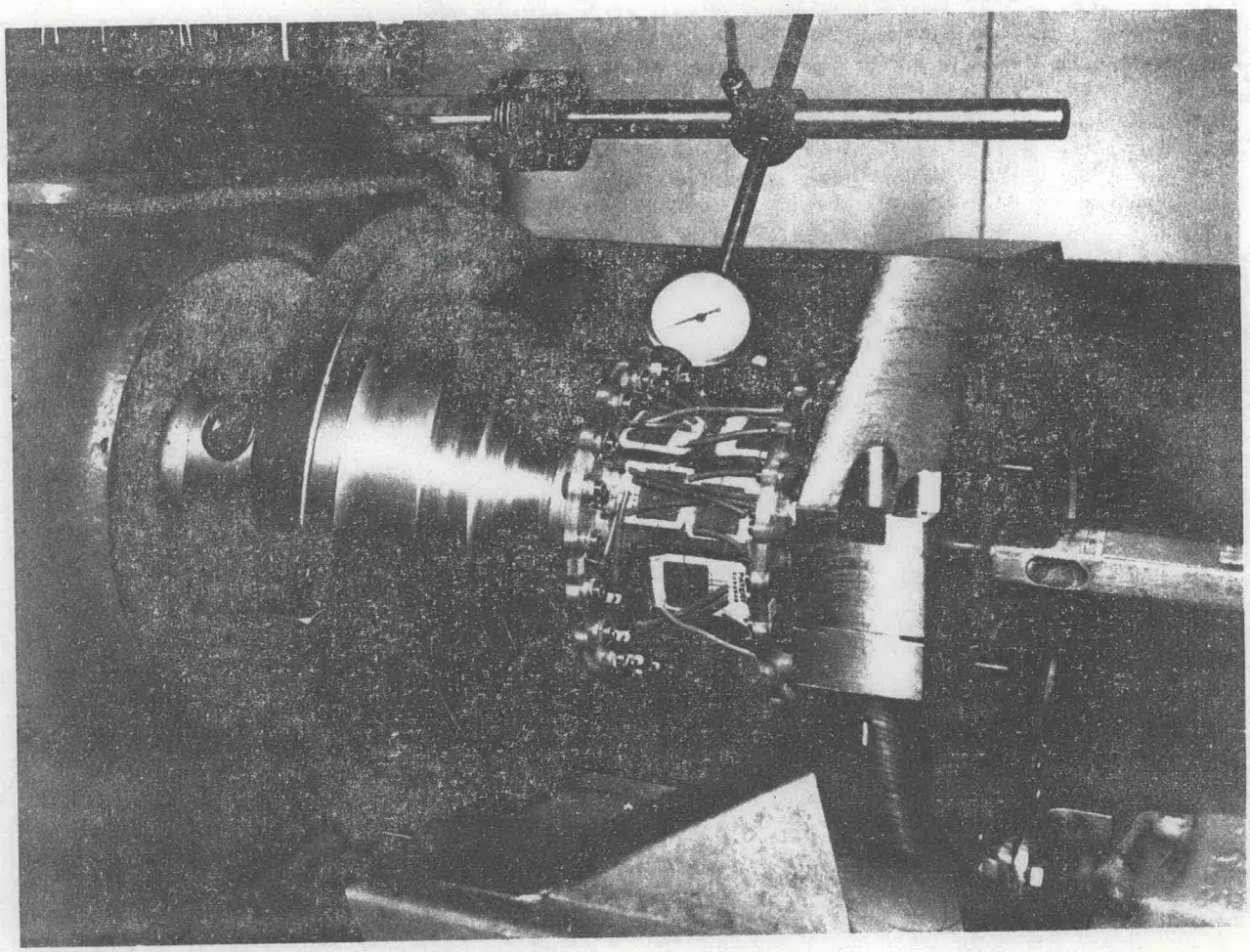

Fig. 3—Residual-stress evaluation fixture and specimen

Results and Discussion

Lubrication and Surface Finish

The greatest amount of plastic flow during the swaging process occurred in the bore of the tube where the radial pressure and the longitudinal forces were applied by the mandrel. Photomicrographs on transverse sections at 100 and 500 times enlargement were made comparing swaged and non-swaged cylinders. No evidence of structural change or damage was found.

The basic mandrel configuration was found to be, in general, satisfactory for all percent enlargements at the bore and for all yield-strength values. Slight changes were made from time to time to alleviate minor difficulties encountered. The velocity of the mandrel was constant at approximately 17 21 ipm which was established by the particular press used.

The need of dimensional control before swaging in order to measure accurately percent enlargement and elastic recovery at the bore required good initial bore finishes. These initial ground finishes averaged 27.6 rms microinches for all tested specimens before swaging, and 13.2 after swaging. This yielded an average finish improvement in the bore of 52%.

The data showed that rougher initial bore surfaces resulted in correspondingly larger improvement in surface finish than did the relatively smoother initial bore surfaces. In general, the finish before swaging was too smooth to permit the maximum improvement in finish to be realized. This was unavoidable due to the dimensional-control requirements. The data revealed no correlation of finish with percent bore enlargement and wall ratio for any mandrel and yield strength.

A study of suitable lubricants was carried only far enough to make possible the use of existing facilities to mechanically push the mandrel through the shorter cylinders. A molybdenum disulfide suspension in oil and copper plating were tried as lubricants, first separately and, then, in combination. The best lubrication as determined from the least force required to swage was obtained from using the two in combination. However, the basic lubricant was apparently supplied by the copper in the form of a film of relatively soft material between the two sliding surfaces.

Force Requirements

In order to describe the force requirements of the