DISCUSSION

John K. Liu

I wish to commend the authors on their significant contribution to the understanding of the complex subject of metal cutting. My comments that follow are not meant to be critical and I hope they are not taken as such; they are merely meant to suggest to the authors lines along which they might extend the research in which they have made such an excellent start.

As I see it, there are three significant effects that are not covered in the present investigation. It would certainly be of interest to determine the results of:

1. Cutting strain-hardening materials. Most engineering materials are strain-hardening, and the tool stresses resulting therefrom would be of practical interest. The authors mention the difficulty of obtaining photoelastic material hard enough to cut strain-hardening materials. The birefringent plastic coating developed by the French (and marketed in this country by Tatnall Measuring Systems Co., Phoenixville, Pa.) which lends itself to direct spraying on metals would seem to be a solution to this problem.

2. Addition of cutting fluids. Most commercial cutting on ferrous materials is done with the addition of cutting fluids, which probably significantly alter the tangential and normal stress magnitude and distribution. A connected problem is the influence of cutting fluid on the thermal stress picture in the tool but it is realized that the experimental setup used by the authors may not lend itself to generating cutting speeds high enough to produce thermal stresses.

3. Different tool geometry. Most popular cutting tools today are of the mechanically inserted carbide bit variety, which offer both a tool geometry and gross geometry differing from that of the tool used by the authors. It would be of great interest to find the effect of these different geometries, and especially that of the different modulus of elasticity of the tool holder from that of the bit itself, on the stresses.

The authors have in effect used a plane stress approach to the three-dimensional stress problem occurring in most cutting, and I, for one, most anxiously await the results they will get if they try cutting strain-hardening materials with a truly three-dimensional cutting tool.

Authors' Closure

The authors are indebted to Mr. Liu for his helpful suggestions. His proposal to use the birefringent plastic coating offers interesting possibilities. The coating will be applicable to both the side of two-dimensional cutting tool made of tool steel instead of photoelastic material and the side of workpiece. Such an approach is now in progress in the authors' laboratory and it is expected to bring about helpful information for the understanding of the machining stresses.

The authors are also quite interested in inquiring about the effect of cutting fluids on the tool-face friction. Using the same setup described in this paper, it was found by applying a mineral oil that the tool-chip contact length is greatly reduced and the normal stress on the rake face is increased very steeply toward the cutting edge and it reaches a higher value than that in dry cutting. Because most cutting fluids are not so effective for lead, as is well known, the authors are checking the results in cutting of babbit which was also found to be machinable by the resin tool.