Metal Cutting Tools Without Clearance*

Tool to Cut Without Clearance, Consisting of a Cutter and a Holder so Constructed as to Allow the Cutter Slight Oscillatory Freedom in the Holder. Object is to Make Use of More Acute Cutting Edges in Order to Reduce the Cutting Stresses, to Equalize the Unbalanced Side Pressure on Cutting Edge and to Prevent Lateral Quivering.

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This paper sets forth a turning tool that is intended to cut without clearance.

It consists of a cutter and a holder so constructed as to allow the cutter a slight oscillatory freedom in the holder. The center line on which the cutter oscillates is substantially coincident with the cutting edge. The oscillation of the cutter about the center line does not affect the position of the edge, but it does allow the face of the cutter to swing around to conform to the face of the metal from which the chip is being severed.

The objects of this construction are to make possible the use of more accurate cutting edges in order to reduce the cutting stresses; to equalize wholly or partly the unbalanced side pressure on the cutting edge; and to obtain a rubbing contact to prevent lateral quivering.

In order to bring out these objects it is necessary to analyze briefly some of the conditions under which metal is worked in a lathe, dealing particularly with cutting angles, clearance of cutting edges, and the importance of minimizing the tendency of the work and tool to separate under cutting stresses.

No attempt is made to discuss the forms of cutting edges for withstanding the heat of high speed service. High speed tool forms have been ably and perhaps conclusively treated in the paper by Mr. Fred. W. Taylor and its discussion, and in the papers of Dr. Nicolson before this Society and before the Manchester Association of Engineers.

The generally accepted cutting angle of greatest endurance under high speed is about 75 degrees, and the angle of least resistance, according to some of Dr. Nicolson's tests, is about 60 degrees, with an increase below as well as above that angle.

The cutting angles of the tool described in the present paper may be varied from the present orthodox angles down to 30 degrees or less, according to the nature of the work.

The results obtained by Dr. Nicolson, which showed an increase in cutting stress for tools more acute than 60 degrees, may have been due to the cuts having been run without cutting oil or suitable cutting lubricant. Furthermore, the comparative lack of durability of the more acute edge below 70 degrees, may have been due either to heat or lateral quivering or both. The heat would have been greatly reduced by a liquid cooling medium, especially one having some suitable lubricating qualities, and the lateral quivering may now be eliminated by means explained in this paper. The thin edge of an acute tool is obviously the least suited to carry off heat or to withstand the quivering incident to cutting.

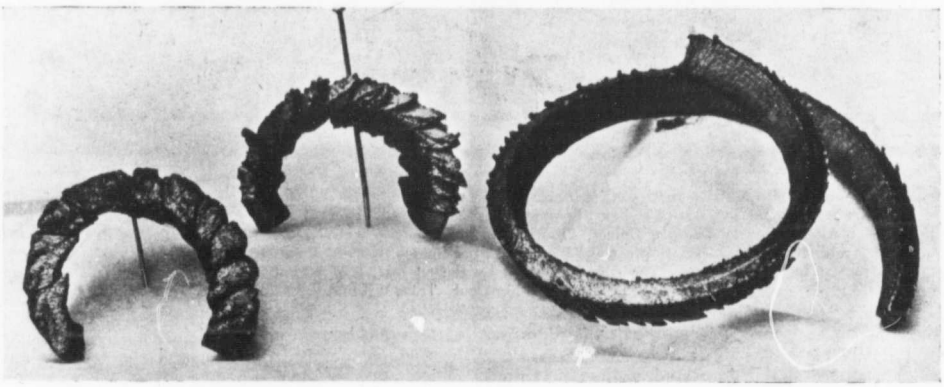

Fig. 1.—Characteristic Chips (about double size). Chips at the Left made by Diamond Point Tool having 70 Deg. Cutting Angle. Chips at the Right made by No-Clearance Tool, 45 Deg. Cutting Angle.

Having mentioned the great work of Mr. Taylor and coworkers and of Dr. Nicolson, it is necessary at once to disclaim any pretension at contributing valuable data, such as are found in the papers of these truly scientific researchers. Nothing of the kind is possible at this time. All that is attempted is to suggest a scheme for widening the field of investigation.

Instead of approaching the subject as a scientist bent on getting exact data regarding performance of certain existing forms of tools and machines, the writer's line of approach has been from the standpoint of a designer and manufacturer of lathes, and particularly lathes of the character of the flat turret lathe.

The Class of Work Here Considered.

The means for cutting set forth should be considered from the standpoint of one who sees nothing but lathe

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References mentioned: Dr. J. T. Nicolson's papers in Transactions of Manchester Association of Engineers, 1903, and in Transactions of this Society, p. 637, vol. 25, 1904; Mr. Fred. W. Taylor's paper, vol. 28, 1907; also cuts on p. 333 in Dr. Nicolson's discussion of Mr. Taylor's paper.