CHAPTER V

Grinding the Chip Breaker on Carbide Tools

When machining steel at high speeds with tools of the usual shapes, a continuous chip is normally produced. This continuous chip is not only hazardous to the operator, but also difficult to handle. One of the means of controlling the chip is the ground-in chip breaker, which, essentially, is a step ground into the tool's top surface so as to curl or break off the chip. Both depth and width of the breaker vary with the depth of cut, feed, type of metal being machined and cutting speed.

Types of Ground Chip Breakers

Three types of ground-in chip breakers, sometimes referred to as the "angular," "parallel" and "groove" types, are recommended by the carbide tool manufacturers. These are illustrated on the following page.

The ease with which the chip can be broken depends upon the chip cross-section or area, the nose radius and the physical characteristics of the material being cut. A thin, springy chip is hard to break but can be coiled, whereas a thicker chip with some stiffness can usually be broken.

Whether a chip can be stressed to the point of breakage, for a given feed, depth of cut and type of steel, will depend upon the depth and width of the breaker, or (D) and (W) respectively on each sketch. It is also possible to stress the chip to the breaking point, when using a tool with a given

depth and width of chip breaker, by varying the speed or feed in order to obtain a chip of sufficiently stiff cross section.

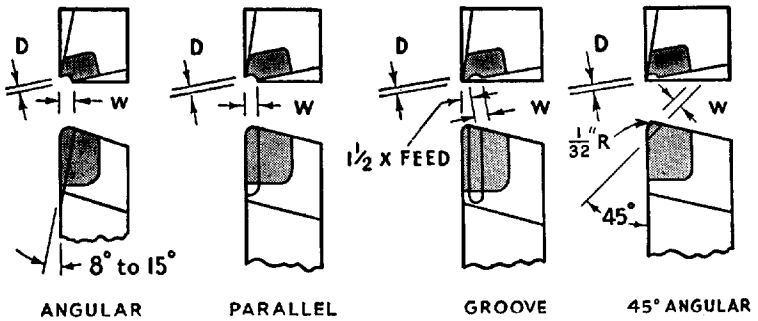
In the following table are listed the recommended dimensions for the angular and parallel types of chip breakers.

Recommended Width of Chip Breaker (W)

Depth of Cut (Inches)	*Width (W) for Feeds (Inches per Rev.) of:*			
	.006 to .012	.013 to .017	.018 to .027	.028 to .035
1/64 to 3/64	1/16	5/64	7/64	1/8
1/16 to 1/4	3/32	1/8	5/32	3/16
5/16 to 1/2	1/8	3/32	3/16	3/16
9/16 to 3/4	5/32	3/16	3/16	3/16

A Chip Breaker Depth (D) of .020" is satisfactory for most types of steel. It should never be less than 1/64" nor more than .030".

The angular type of ground-in breaker is satisfactory for the majority of jobs and is the easiest to grind. The chip is deflected back against the uncut portion of the work where it is broken without any damage to the tool. By varying the depth and width of the step, this style of the breaker can be adapted to practically any set of conditions. An angle of 8° to



Common types of ground-in chip breakers

15° will be found generally satisfactory. On cuts $\frac{1}{32}$" or less, the angular type of breaker is usually more effective when a nose radius of $\frac{1}{32}$" or less is used.

For light, fast finishing cuts, not exceeding $\frac{1}{32}$", an angular type chip breaker ground at 45° will give good results. This style of breaker forces the light chip either into a spiral coil or a small ball that can be easily handled. Usually the width of the step does not exceed $\frac{1}{16}$".

The parallel type of chip breaker is also widely used, particularly where the cuts extend to the shoulder or where it is desired to force the chip against the work and cause it to break.

The groove type of chip breaker resembles a high-speed steel tool that has been allowed to wear its own chip breaker. This type has been successfully applied where the depth of cut varies and cutter speeds are relatively low. The land between the cutting edge and the groove is parallel to the top face and should be one to one and one-half times the feed. A 2° negative rake on this land will strengthen the cutting edge. The width of the groove should be three to four times the feed to be used and the depth, not over .010".

Wheels for Chip Breaker Grinding

Chip breakers may be ground on a:

1. Universal Tool and Cutter Grinder.
2. Small surface grinder equipped with a universal vise.
3. Special chip breaker grinder.

The machine should be equipped with a straight (type D1A1 (D1T) diamond wheel, either resinoid or vitrified bonded, depending upon the width of the wheel. Recommended grit sizes for average tools are 150 for resinoid; 150 and 220 for vitrified bonded wheels. Metal bonded diamond

wheels are recommended for plunge grinding chip breakers in one pass, using flood coolant.

Select a width of diamond wheel slightly greater than the width of the chip breaker so that when the wheel is reversed on its spindle, there is no portion of the wheel face that does not engage the work. If a diamond wheel as thick as $\frac{1}{4}$" can be used, a vitrified bonded type, SD150-N100V$\frac{1}{8}$ or SD220-N100V$\frac{1}{8}$, is recommended for average tools. If a wheel less than $\frac{1}{4}$" thick is called for, use a relatively hard grade resinoid bonded diamond wheel, such as SD150-R100 B11$\frac{1}{8}$.

Grinding Procedure

The grinding machine should be equipped with a universal vise for quick positioning of the tool. The first step in the grinding procedure, after clamping the tool in the vise, is to tilt the tool so that the top of the carbide tip is horizontal. Next, swivel the top of the vise until the side cutting edge of the tool lines up parallel to the side of the diamond wheel and, after raising the wheel, check the horizontal alignment. Finally, swivel the vise on its base to the desired chip breaker angle.

To set up for the desired chip breaker width, bring the tool in, very carefully, until it just touches the flat side of the wheel as it is rotated slowly by hand. Note the reading on the graduated cross-feed handwheel and use this as a starting point for measuring the breaker width. Back the tool away and raise the grinding wheel clear of the tool. Advance the tool under the wheel to the full width of the chip breaker desired, as measured on the handwheel.

Start the diamond wheel. The direction of the wheel rotation should be from the cutting edge toward the shank. Turn on the coolant to keep the wheel face wet. This coolant

preferably should be water with just enough soluble grinding oil or compound to prevent rusting. If the grinding machine is not equipped for wet grinding, lubricate the diamond wheel with a kerosene-moistened felt wick attached to the machine so as to have a wiping contact with the wheel or use a mist spray.

To measure the desired depth of chip breaker, lower the diamond wheel until it just touches the top of the tip. Note the reading on the downfeed handwheel and make a chalk mark on it to indicate when the breaker has been ground to .020" or other desired depth.

Now start grinding. Traverse the table lengthwise along the breaker, using moderate table speed. The downfeed of the wheel should not exceed .0005" per pass. Continue alternate traverse and downfeed until the desired depth has been reached. Let the cut sound out (spark out) on the final passes to get the best possible finish.

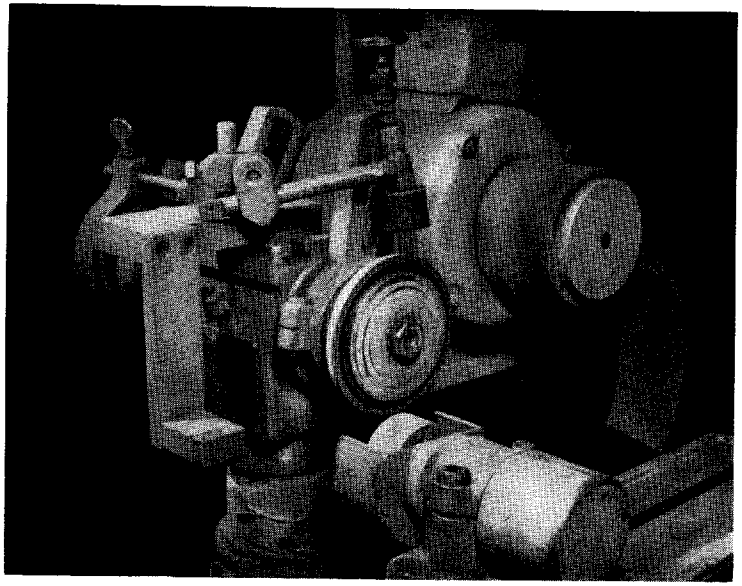
Truing and Dressing the Diamond Wheel

After extended use, the corner of the diamond wheel will round over to the point where the radius is too large to grind an effective chip breaker. When this occurs, and the other side of the wheel is still sharp, reverse the wheel on its spindle. When both corners have worn to an excessively large radius, it is necessary to true the wheel to square up the face.

One method of doing this is to remove the wheel from the machine and grind it in a cylindrical grinder with a Crystolon vitrified wheel of medium grit size and soft grade, such as 37C60-JVK. Rotate the diamond wheel very slowly while the Crystolon wheel runs at normal grinding speed. Continue grinding, taking light cuts, until a flat face has been restored on the diamond wheel.

This truing operation can be facilitated by mounting the diamond wheel on a collet which fits tightly on the spindle. After the wheel has been put in running truth, it should be left on its collet until worn out. When it becomes necessary to reverse the wheel or to transfer it to another grinding machine for truing, the wheel and collet should be removed from the spindle as a unit.

The cutting face of the diamond wheel, if of the vitrified bonded type, must be dressed or opened up after truing. This can best be done with a ½" square stick, about 37C150-KV, pointed at one end. Apply it to the underside of the wheel and roll it from the middle of the periphery, first to one side and



Truing and squaring up face of diamond chip breaker wheel, using a Norton brake-controlled truing device

Opening up the cutting face of a vitrified bonded diamond wheel with a Crystolon stick after truing

then to the other, in a manner to avoid rounding the corners of the wheel, until the wheel, when stationary, feels sharp to the touch. Never force the Crystolon stick straight into the wheel with the full width of the stick as this will tend to break down the sharp corners of the wheel left by the cylindrical grinding operation.

It is good practice to touch up the wheel in this manner with the Crystolon stick every few chip breakers that are ground.

CHAPTER VI

Hand Honing of Carbide Tools

The life of carbide tools between regrinds can often be prolonged by touching them up with a diamond hand hone at the first signs of dulling, without removal from the lathe or other machine tool. Care must be taken, of course, to hold the hone flat against the surface being honed so as not to round over the cutting edge or change the relief angle. To be sure, this hand stoning cannot be continued indefinitely; after a time the tool will have lost its original cutting angle and will require regrinding with a wheel.

While most shops today are finish grinding their carbide tools on fine grit diamond wheels, where suitable equipment for diamond wheels may not be available, the use of a fine grit diamond hone is recommended for stoning the cutting edge to remove any slight burr or surface roughness that may have been left by the silicon carbide wheel. A few light strokes with this hone will produce a keener, firmer and more durable edge.

Still another use for diamond hones is for supplementing diamond wheels in shaping out special contours on carbide form tools. They can be made in suitably small sizes for this work.

Diamond Vitrified Hand Hones

The Norton vitrified bonded diamond hand hone has proved to be up to 50% faster cutting than ordinary resinoid