# *Ian Bradley talks about*

# *Lathe Tools*

THE NUMBER OF tools necessary to perform work satisfactorily in the lathe is really very few. At one time very comprehensive sets of tools were offered for sale, many if not most of which the eventual purchaser never used. These sets also had the disadvantage that the shanks of the tools themselves were left in the rough forged condition, and not ground flat on their underside which is generally accepted as being best for ensuring a firm mounting in the toolpost.

Today, however, one can buy tool bits that are ground all over and, as they are bodily shaped, may be used as they are, or clamped in a holder if need be, the firmness of their mounting is assured, provided of course that the machine tool itself has no shortcomings in this respect.

Varying types of steel are used in the making of lathe and shaping machine tools. Originally carbon steel was the main source of material but with the advent of more difficult machining problems, and the need from the commercial aspect to carry them out rapidly with the minimum of resharpening, high-speed steels were introduced. Tools made from this material are obtainable in the forged condition if needed, in addition the tool bits already referred to are made from high-speed steel and are well worth the inevitable extra cost involved.

In view of the advantages to be obtained from the use of high-speed steel, it is perhaps not surprising that tools made from carbon steel are losing their favour even in the amateur workshop. One form of carbon steel still fmds a use, however, this is silver steel, available in round bright bar of varying diameters each 13 in. long. The material finds an application in the making of cutters for various purposes, since in the annealed state it is readily machined and subsequently hardened and tempered by quite primitive means. On the other hand, the hardening and tempering of high-speed steel calls for the employment of equipment most unlikely to be found in the average small workshop, so tool forming there is by a grinding process only.

As stainless steel is now often found **in** the small workshop, the employment **of tools made from** high-speed steel is virtually essential. It **is** possible to machine stainless material with **carbon steel tools,** but their durability is then **much reduced** and they rapidly lose their shape.

**Carbide-tipped tools**

The amateur workshop for the most part cannot make the best use of carbide tools with one exception, that is the tool used for machining cast-iron. The reason for their failure, when used on the light type of lathe possessed by most amateurs, is that the carbide tip itself has little mechanical strength, so, when it is not possible to take a heavy cut, the chip produced by the turning operation impinges directly on the cutting edge, causing it to crumble.

When turning cast-iron, these conditions do not apply. The chip produced breaks up immediately on impact with the cutting edge and has then no ill effect upon it. Carbide tools suitable for use in the small workshop will be discussed later.

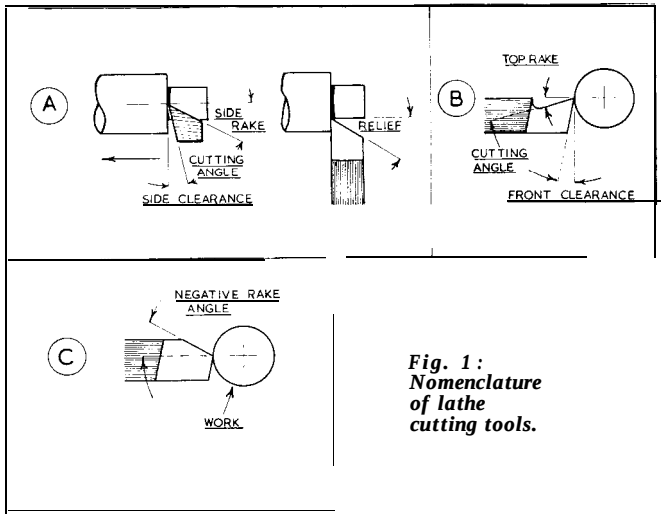



***Fig. 1: Nomenclature of lathe cutting tools.***

Before dealing with specific tool shapes the terms commonly applied to their angles must be considered. These are shown in Fig. 1. From this illustration, where the tool is depicted in sections, it will be seen that, in order to allow the tool to cut in the direction shown in the diagram A, ***side clearance*** must be given or the tool will rub on the work. Additionally to provide the correct cutting ***angle*** for the material being machined, ***side rake*** must be given to the tool point. Where viewed from above the point of the tool will be seen to have an angle of ***relief;*** this is needed to prevent " chatter " or vibration of the tool, the frontal area of the tool in contact with the work being reduced to the minimum consistent with obtaining a good finish to the work surface. ***Front clearance*** must also be given to the tool as shown at B, in order to provide a satisfactory cutting angle.

Before leaving the subject of tool angle terminology, one further condition needs to be considered. This is the provision of negative ***rake*** **to the tool** point as illustrated in Fig. 1 at C.

From this diagram it will be seen that the top surface of the tool is inclined at an angle above the centre-line of the work. This practice is often adopted industrially, but in the small workshop can be employed with success when machining the harder bronze alloys.

**Tool shapes for external work**

The basic tool shapes required are not many but the few there are can be applied to a variety of tools for both internal and external work. The first of these is the roughing tool which probably needs less power (despite its ability to take heavy cuts) than any other. As an example of its effectiveness Fig. 3 shows a roughing tool removing 7/16 in. from a 3 in. billet of stainless steel. This machining operation was carried out at a mandrel speed of 60 r.p.m. taking a cut of 0.005 in. per revolution using a copious flow of neat cutting oil (Gulf Metsil E) as a coolant. The lathe used was a 4 in. Myford, now some 40 years old, and the driving motor fitted was a 1/3 h.p. machine of a standard commercial type.

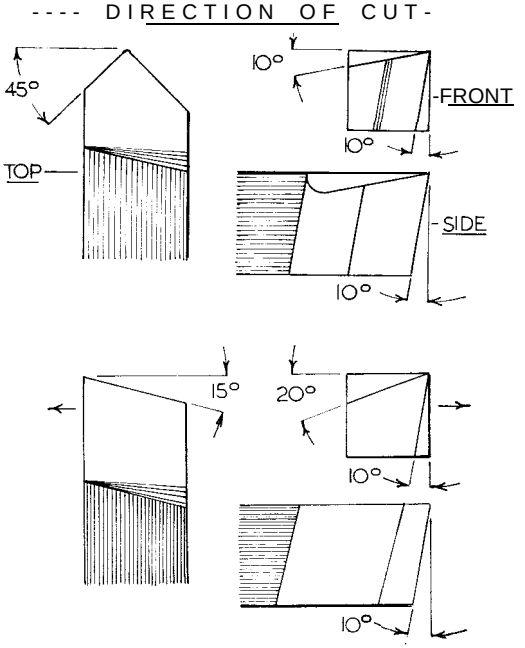



*Fig. 2 : Roughing and knife tools.*

**The knife tool**

The most important weapon in the turner's armoury is the knife tool. It is found in both right-handed and left-handed forms. The right-handed knife tool cuts from right to left, that is to say it is fed towards the headstock of the lathe, whilst its counterpart the left-handed tool cuts in the opposite direction. Fig. 2 depicts the salient characteristics of a right-handed knife tool.

It is usual to grind a small flat land at the tip of the tool. This area is at right-angles to the cutting edge, helping to promote a good finish to the work. As it is sometimes necessary to form a rounded comer on shoulders machined by the knife tool, the flat land can be replaced by a radial point, For the amateur worker the radius of this point can probably be standardised at some convenient figure and it will therefore be convenient to have two right-hncded knife tools to avoid the wastage of material and the time involved in altering the point of a single tool. An enlarged view of both forms of point is seen in Fig. 4.

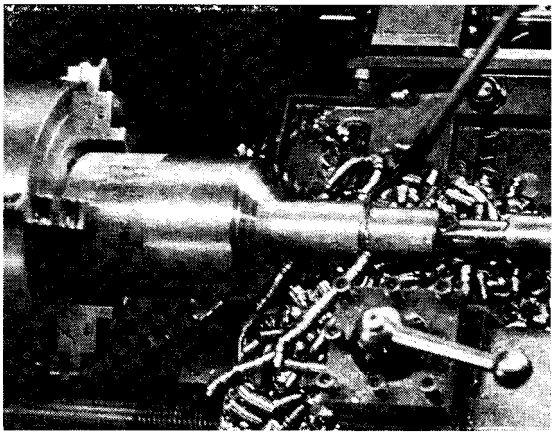


**Fig. 3.**

**The parting tool**

Once the worker has completed the turning of a component he will need to sever it from the stock material. This he does with the parting tool, shown in Fig. 4. This is the form usually supplied in sets of turning tools, but experienced workers modify the point to ensure that the work is removed cleanly and this alteration is shown at A. This is the tool point commonly used in automatic lathes where, of course, it is absolutely essential that the parts produced are parted off cleanly.

Where much bar material turning is undertaken the parting tool is best mounted in a toolpost set on the cross-slide behind the work, thus leaving the top-slide itself for holding outer turning tools either singly or in a capstan head that may be indexed accurately to bring a succession of tools to bear on the work as required. It is perhaps worth emphasising that the back toolpost, as it is called, is the ideal holder for parting tools in a light lathe because the forces then acting tend to force the faces of the cross-slide into closer contact. In this way vibration sometimes encountered in the front-of-work placing of the tool can usually be elimin-

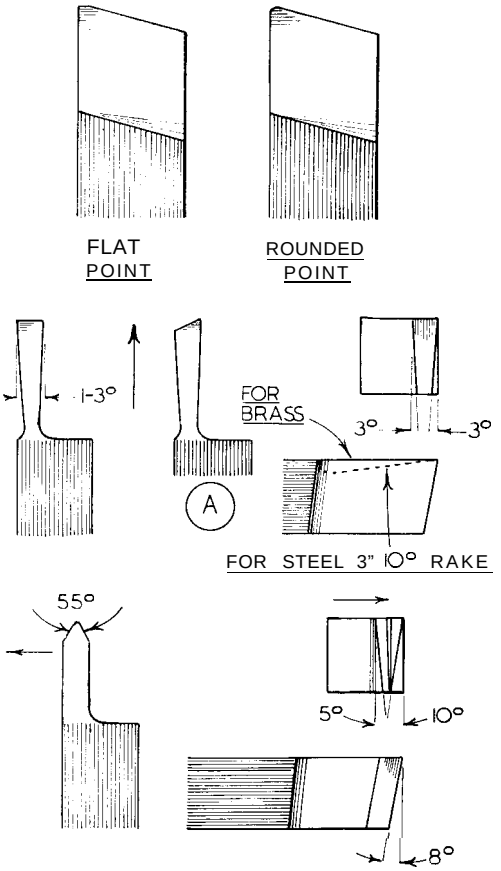


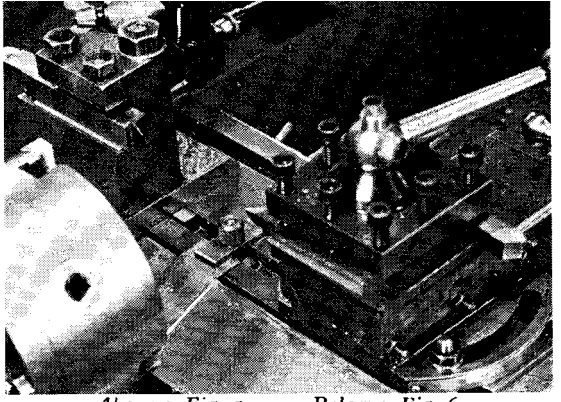

*Fig.* 4.

ated. Long ago "Duplex" advocated this position and designed a toolpost that itself possessed a capstan-head. carrying a pair of tools, one for chamfering and one for parting-off, two operations regularly needed. A typical set-up embracing front and rear tool placings in capstan-heads is illustrated in Fig. 5.

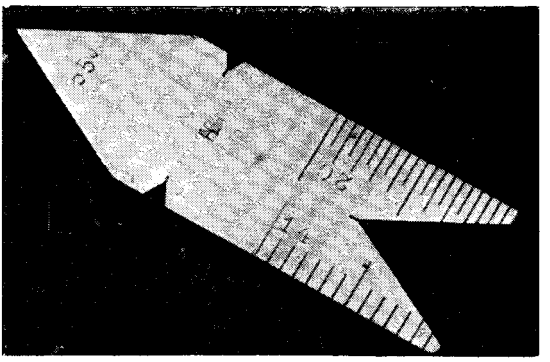
**The screwcutting tool**

**The** last of the basic tools needed for external work is the screwcutting tool whose salient features are seen in Fig. 4 above.

The point angle depends upon the thread form to be cut. In this context the handbook " Screw Threads and Twist Drills" published by Model & Allied Publications may be consulted. It should be noted however that as supplied, commercial single-point threading tools are not necessarily ground to any particular angle. One must be careful, therefore, to check this angle using the appropriate setting gauge for the purpose. This gauge, illustrated in Fig. 6, is provided with male and female cones of the **correct** angle so that the accur-



*Above : Fig. 5.* *Below : Fig. 6.*



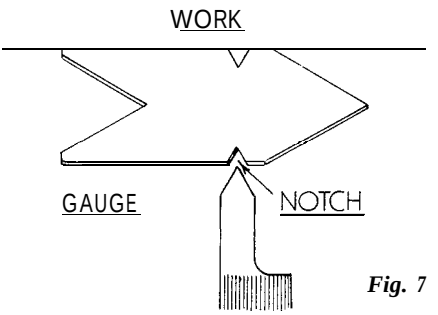
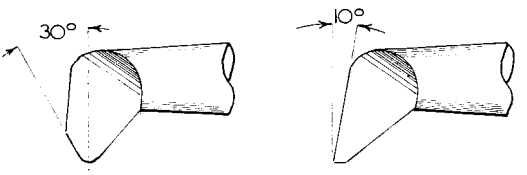



*Fig. 7*




acy of the tool point can be checked. In addition the sides of the device have angular notches, again of the correct angle, machined in them to enable the turner to set the threading tool squarely with the work. This he does by placing the gauge against the side of the part and engaging the tool point with one of the notches in the manner shown by the illustration Fig. 7.

A piece of white paper or card placed below the tool point will enable the correct engagement of the tool point with the notch to be observed more easily.

***To be continued.***