Stroke		Belt Position			
		A	B	C	D
1 in.	..	4	6	8	14
2 in.	..	6	12	18	28
3 in.	..	10	16	26	42
4 in.	..	14	24	34	56
5 in.	..	16	28	42	72
6 in.	..	20	34	52	86
7 in.	..	24	38	60	100

The cutting speeds available are expressed in feet per minute and are given in the four vertical columns of the list. Suitable cutting speeds for various materials are listed below:

Aluminium	100 to 116	feet per minute
Brass	100 to 116	,, ,, ,,
Bronze	80 to 100	,, ,, ,,
Zinc	80 to 100	,, ,, ,,
Cast Iron	40 to 50	,, ,, ,,
Mild Steel	40 to 50	,, ,, ,,
Carbon Steel	30 to 40	,, ,, ,,
Plastics	100 to 116	,, ,, ,,

However, in order to avoid vibration some compromise is essential particularly when long ram strokes are involved. In the interests of comfortable working, therefore, it is best to considerably reduce speed unless commercial considerations make it necessary to work fast. The amateur need never hurry in his work so perhaps for him, as for the author, the best general belt setting is "A" in the list. Nevertheless, if any increase in speed seems desirable it is suggested that this is only set when the ram strokes are short.

The belt-and-pulley layout for the Acorn Tools shaper is illustrated in Fig. 9.

The pulley "X" is an extra component provided to accommodate a brake pad attached to the control lever. When this is lowered the brake pad comes into contact with the pulley and stops the machine.

CHAPTER 4

Shaping Machine Tools

BEFORE WE CONSIDER the various tools that can be used in a shaping machine it is necessary to understand the principle on which these tools should operate. If we take a swan-necked tool of the type illustrated in Fig. 1 and mount its point on the centre line of work in a lathe, any spring in the tool itself will tend to unwind the tool when load is applied. But in the lathe this effect is not detrimental since the point of the tool will back away from the work surface and no "dig in" will occur.

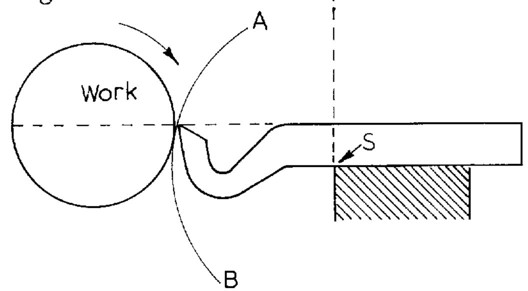


Fig. 1
Swan-neck tool mounted on the lathe top slide

In the case of the shaper, however, the reverse is the case if a cranked lathe tool is used.

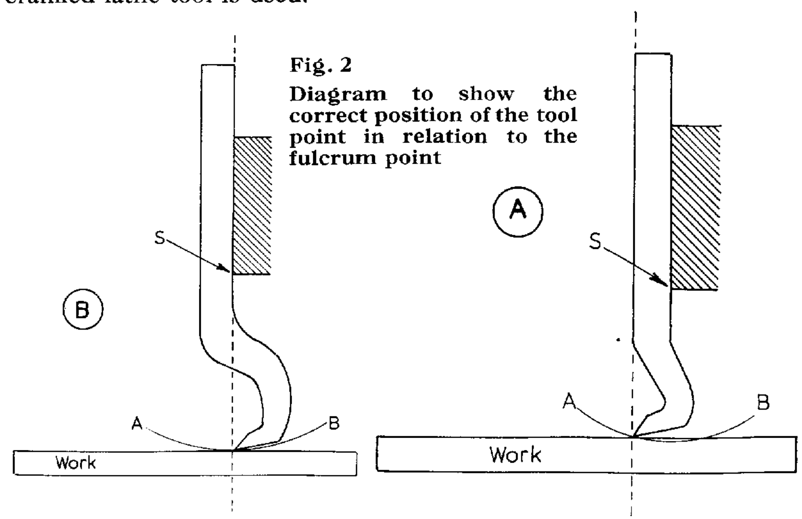


Fig. 2
Diagram to show the correct position of the tool point in relation to the fulcrum point

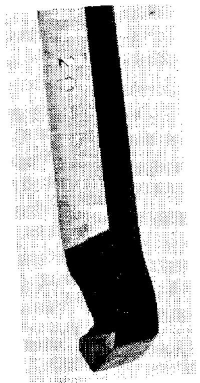


Fig. 3 Tool for Roughing out

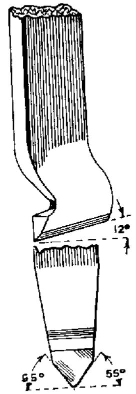


Fig. 4 Tool for Roughing out

If we look at the diagram "A" in Fig. 2, which illustrates a cranked lathe tool set on the tool slide, we see that the point is well in front of the fulcrum centre "S". Thus, when load is applied to it the point of the tool will tend to describe the arc "AB" and will "dig in". If, on the other hand, the tool is shaped as seen at "B" no digging in can take place because its point will describe an arc "AB" lifting the cutting edge away from the work surface.

Therefore, when the use of swan-necked or cranked tools is contemplated these points should be borne in mind. In any event such tools must be made amply strong, in which case, when lightly loaded, the position of the tool point is not of such great significance. This being so it is possible to make use of many of the cutting tools normally employed in the lathe. In practice, for normal work, a very few basic tool shapes will suffice. These are a tool for roughing out, a pair of knife tools left-hand and right-hand, that will serve for the machining of shoulders and any overhung work such as machine slides, a tool for cutting keyways and finally a spring tool for surface finishing.

The Roughing Out Tool

The type of tool the author prefers to use for this work is illustrated in Fig. 3 and also in Fig. 4 where the angles for a general purpose tool are given.

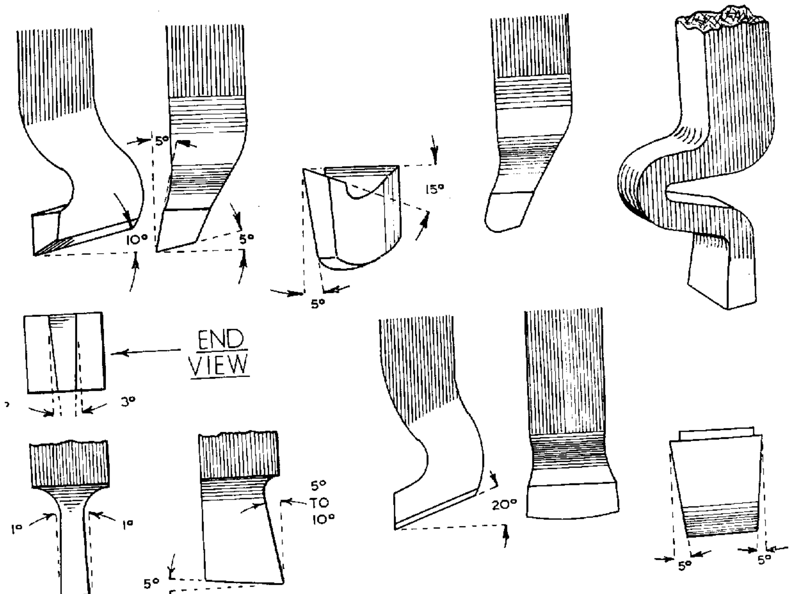
A similar tool, but one that it is offset so that it is able to machine a vertical surface without the shank fouling the work, is illustrated in Fig. 5. Tools of this nature can be obtained either right or left handed and may well take the place of the knife tools previously mentioned; unless, of course, the work in hand is the machining of

slideways. In this case the nose of the tool is not well fitted to clear the base of the slide when at the bottom of the slideway. The tool shown will cut a sharp corner. If, however, a rounded base to the cut is needed then the point of the tool can be ground to the form depicted in Fig. 6.

Keyway Cutting Tool

The form of tool used for cutting an external keyway is akin to the parting tool employed in a lathe. It is ground to the shape shown in the illustration Fig. 7, the width being controlled to some extent by the size of the keyway to be cut and the rigidity or otherwise of the machine it is proposed to employ for the purpose. When the keyway is wide and the shaping machine somewhat lacking in robustness then it pays to form the keyway in two cuts. For internal cutting the same tool form suffices, but the procedure is a little specialised and will be dealt with in a later chapter where the subject of cutting keyways both external and internal will be fully covered.

Fig. 5 Offset tool for Roughing out
Fig. 6 Offset Roughing Tool for round corners
Fig. 7 Tool for cutting external keyways
Fig. 8 Tool for finishing surfaces
Fig. 9 Tool for finishing surfaces

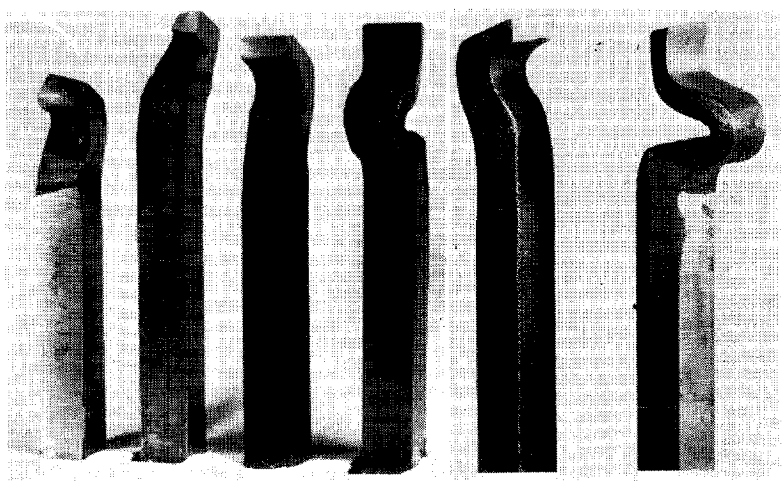


Surface Finishing Tools

The surface finish produced by a roughing tool may well suffice for much of the work undertaken in the shaper. On the other hand there are times when a smooth finish must be produced and it is then that the tools illustrated in Fig. 8 and Fig. 9 can be used with advantage. Both are scraping tools, intended for taking off no more than 0.002 in. to 0.003 in. of metal at a pass. The first tool depicted is similar to a spring tool sometimes used for finishing work in the lathe. In fact that is just what it is. When used in the shaping machine however, the cutting edge needs to be very slightly curved in the manner seen in the diagram Fig. 9. Some consider that the clapper box should be locked when a finishing tool is in use. As this is a provision advisable in other shaping operations, the various ways of locking the clapper box will be described in a later chapter.

Clearance and rake angles given for the various tools described are suitable for general purposes in the machining of cast iron and steel including stainless steel. For brass, of course, no top rake is needed but the clearances can be retained as shown in all cases. Light alloys will take considerably more top rake than the general tools depicted, but even these have been found to give good service. For those readers who wish for more advice on this subject perhaps we may recommend "Lathe and Shaping Machine Tools" published by Model and Allied Publications Ltd. where full information may be obtained.

Fig. 9A Group of Shaping Machine Tools



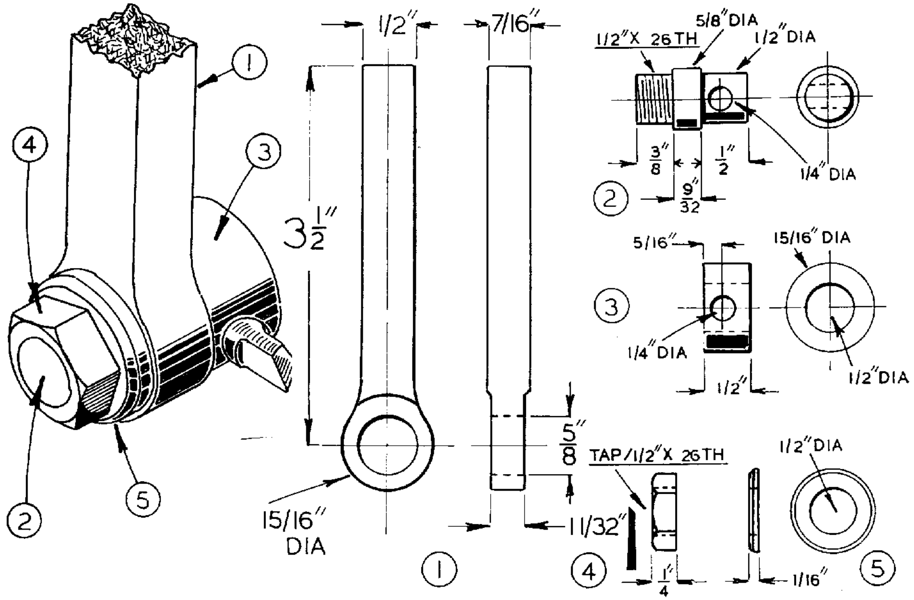


Fig. 10 Tool for holding round tool bits

Special Purpose Tools

So far we have considered one-piece tools, that is tools having the cutting portion and the shank made from a single piece of tool steel. It is, however, quite possible to make a simple shank fitted with a head that will accept round tool steel; this can be ground to the shape required, and held in the finished tool at any angle desired.

The device illustrated in Fig. 10 is an example, it consists of a shank (1) carrying a drawbolt (2) that passes through the sleeve (3). The tool bit seen in the illustration passes through both the sleeve and the draw bolt and is gripped between them by the tension applied by the nut (4). In the interests of good design a washer (5) is interposed between the face of the shank and the nut. The shank of the particular tool illustrated in Fig. 11 at "A" was made from an old bicycle crank machined to the dimensions given in the accompanying detailed drawings. Many of those readers interested in making this tool will, no doubt, be able to do so without further instruction. Those who do need further help will find it in the book already referred to.

In passing it may be worth noting that the tool in question carries its cutter bit well behind the point of spring referred to at the beginning of the chapter. To this end the shank is mounted in the

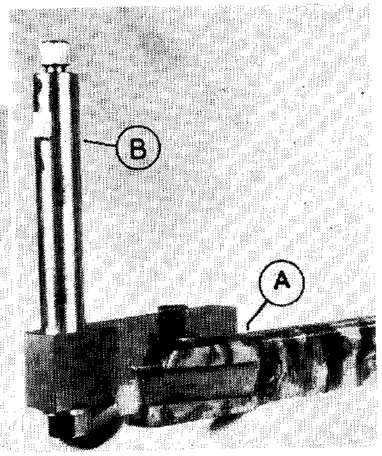


Fig. 12 (A) Parting Tool Holder
(B) Tool for cutting internal keyways

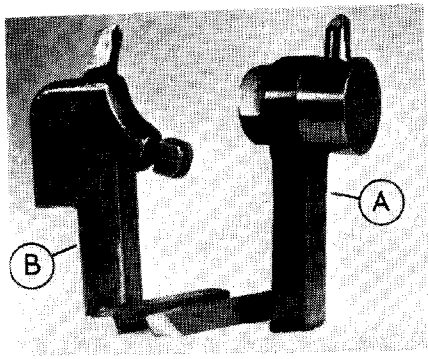


Fig. 11 (A) Tool Holder made from a cycle crank
(B) Holder for small square tool bits

clapper box with the lock nut of the cutter head facing forwards.

For those whose work is of a somewhat delicate nature the tool holder seen at "B" in Fig. 11 may be used with advantage. It accommodates standard tool bits such as may be bought at reputable tool merchants. So half-a-dozen such bits ground to forms suitable for the work normally undertaken, may likely fill the requirements of the user.

Such tool holders are substantial, being made from steel forgings and are easily adapted to fit into the clapper box of the shaping machine. If modification to the holder is needed this should not involve cutting its shank to less than half-an-inch, in cross section or the device as a whole may be unduly weakened.

Tool for External Keyway Cutting

The tool illustrated in Fig. 12 is in fact a lathe parting tool provided with a detachable blade. Such a tool is useful for cutting external keyways but the blade itself must not be extended too far or the lack of rigidity possessed by it will probably spoil the work. The method of centring such a tool in relation to the work itself will be explained in a later chapter.

Tool for Cutting Internal Keyways

The shaping machine is well fitted to cut internal keyways provided that suitable tools are provided for the purpose. One such device is illustrated in Fig. 13. It consists of a shank "A" to which is attached a circular cutter bar "B". The cutter itself is ground to

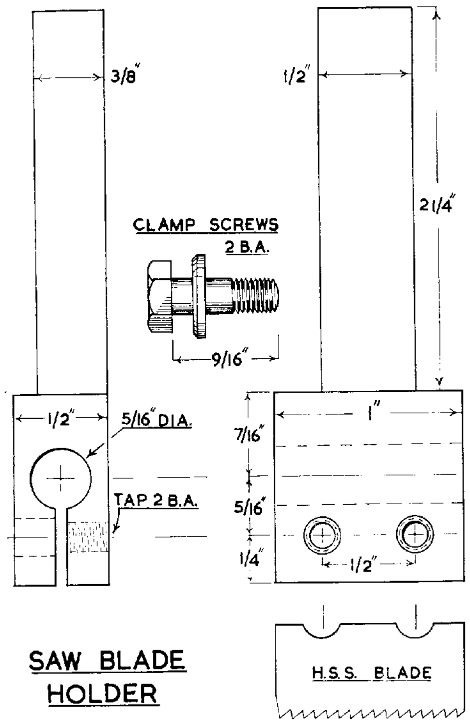
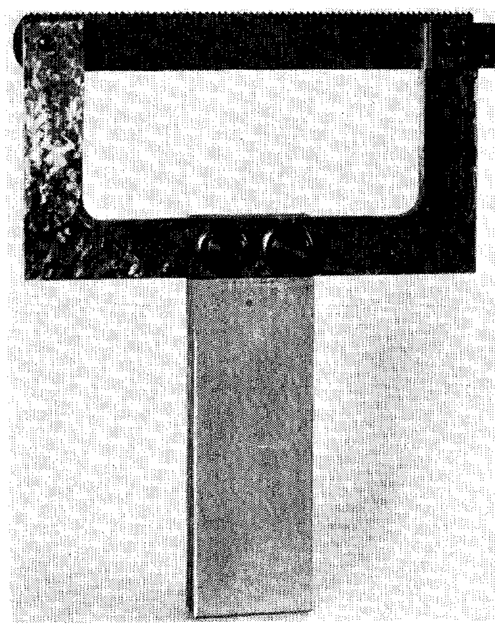
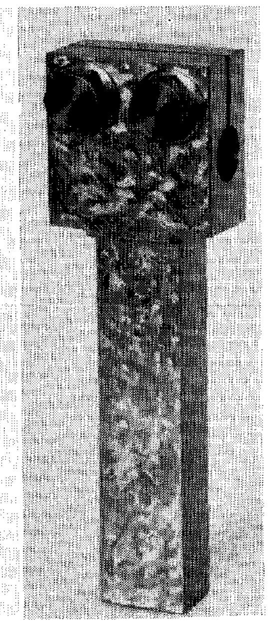


Fig. 14A Details of Small Sawing Tool

Fig. 14 Small Sawing Tool

Fig. 15 Large Tool for Sawing



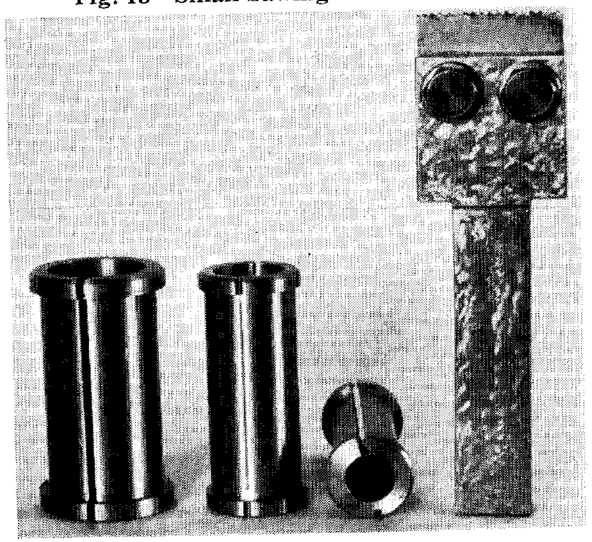


the form shown in the diagram Fig. 7 and is held in place by the set screw seen at the right-hand end of the bar. The lock nut at the opposite end permits the bar to be turned so that the cutter may approach the work at any angle desired. In the illustration the cutter is seen facing forwards. In use this is not so since the device needs to be *pulled* through the work on the back stroke of the shaping machine. This action requires the clapper box to be locked in order to prevent the tool from lifting in the normal manner on the return stroke.

Tools for Sawing

Many years ago, in the course of making certain components, a sawing operation was required. At the time, and with the equipment then available, the shaping machine was considered to be the best medium for carrying out the work in a simple manner. Accordingly, the simple small tool depicted in Fig. 14 was evolved. The body of the device is the holder for boring tools used in the lathe. This holder is split axially by a saw cut and is fitted with a pair of pinch screws which normally serve to make the holder grip the boring tool. The sawcut, however, can be used to grip a short length of hacksaw blade that may be applied to the work once the holder has been set in the clapper box and the machine set in motion. This device was found to be quite successful in practice. So much so, in fact, that the enlarged version illustrated in Fig. 15 was developed to deal with work needing a tool with rather greater capacity.

Fig. 13 Small Sawing Tool with work



CHAPTER 5

Additions to the Machine

AS A RESULT of keeping a machine tool specifically designed for the amateur to an acceptable price level, there are often a few, perhaps minor, shortcomings that are usually within the capabilities of its owner to put right. The shaping machine is no exception. Here some of the improvements that can be carried out concern the tool slide itself.

In Fig. 1 the tool slide of the Acorn Tools shaper in the author's workshop is illustrated. Three modifications have been made to it, and these will serve as examples that may be applied to other makes of machine.

Fig. 1 Acorn Tools Shaper Tool Slide