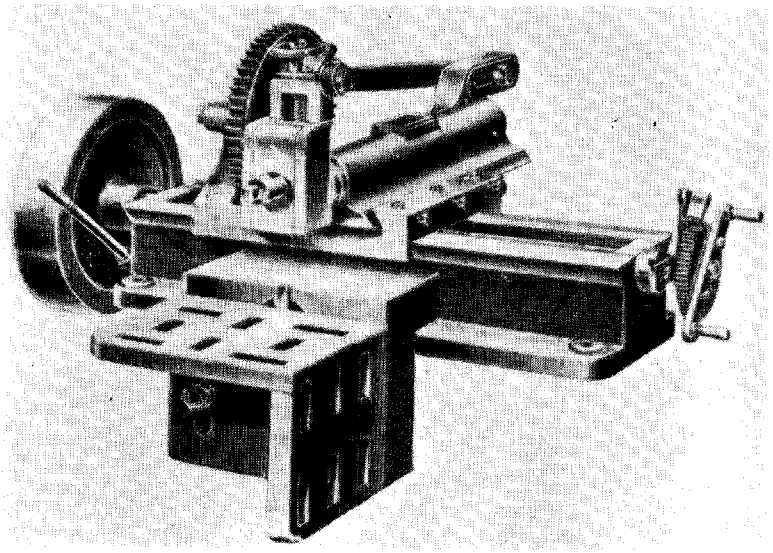
CHAPTER 3

Power-Driven Machines

WHILST HAND-POWERED shapers may suffice for many operations in the small workshop, there is little doubt that an electrically-driven machine has many advantages. Apart from doing away with muscular energy, it enables the user to set the machine in motion so that it can proceed with a shaping operation while he, if necessary, gets on with other work about the shop. In the past there have been several small powered bench machines available. Today, however, their numbers are much reduced so at least one of the machines to be reviewed is only likely to be found on the second-hand market.

The shaping machine depicted in Fig. 1 appeared in several tool merchants' catalogues during the period 1910-1912. It was intended for use on the bench in fitting shops, or anywhere else if thought convenient, as a rather more rapid and accurate means of carrying

Fig. 1 Powered Shaping Machines 1900-1912



out work usually performed with a hand file. It is of a type in which the ram slides are in a saddle moving along a box bed similar to that used in the Cowell and Perfecto hand shapers. The machine was intended to be driven from lineshafting, the flywheel to the left of the bed acting as a pulley. The drive through a dog-clutch could be engaged or dis-engaged at will be means of the lever, also seen at the left of the bed. Automatic reversible feed was provided and both the stroke of the ram and its position in relation to the work itself could be adjusted in order to secure the most efficient working.

The Perfecto Automatic Feed Power Shaper

This machine, in common with the company's hand-operated shapers is made in two sizes, namely 5 in. and 7 in. Indeed the powered version was developed directly from the hand-operated machines, as will be appreciated when examining Fig. 2 and Fig. 3. These show opposite sides of the 5 in. and 7 in. machines respectively. Many of the components used are common to both the hand and power-driven shapers, but the latter have a somewhat different automatic feed which is variable and can be adjusted to suit the work in hand.

The ram is driven from a disc crank formed from the large gear wheel seen in the second illustration. This wheel is carried by the cast gear case in which it has a bearing and is driven by a pinion housed in the case and sliding along the drive shaft mounted behind the bed of the machine. This shaft has a keyway running its full length and imparts the drive to the pinion through a key engaging this keyway.

The gear case itself is secured to the saddle of the ram which is provided with a T-slotted member attached to its left-hand side. The connecting rod is secured at one end to a gudgeon pin positionally adjustable in the T-slot and at the other to a crank pin, also adjustable for position, in the large gear wheel. In this way not only can the stroke of the ram be regulated, but the position of the tool point itself can be set suitably in relation to the work.

The Automatic Feed

In contradistinction to the hand-powered machines made by Perfecto the self-act or automatic feed is variable. It is operated by an eccentric forming part of the spindle supporting the large gear wheel. The necessary movement to the self-act mechanism, located in the well of the box bed, is by means of a cranked connecting rod attached to the eccentric and the self-act quadrant arm respectively.

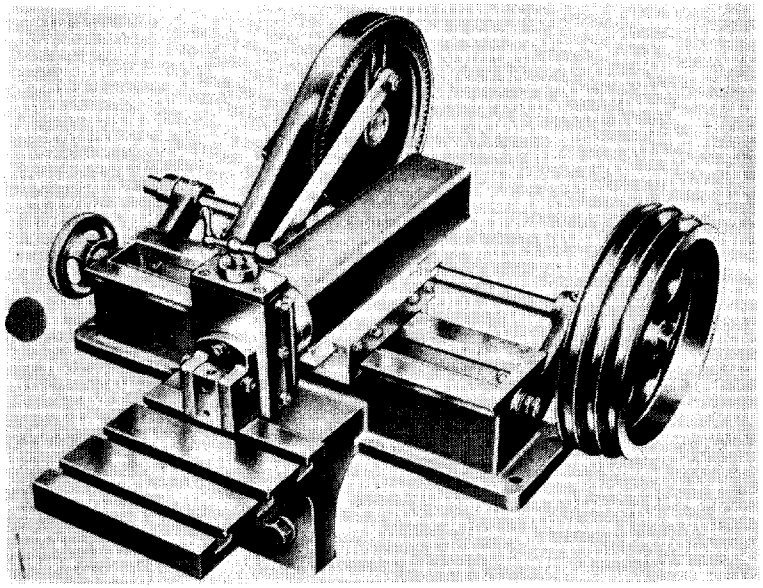
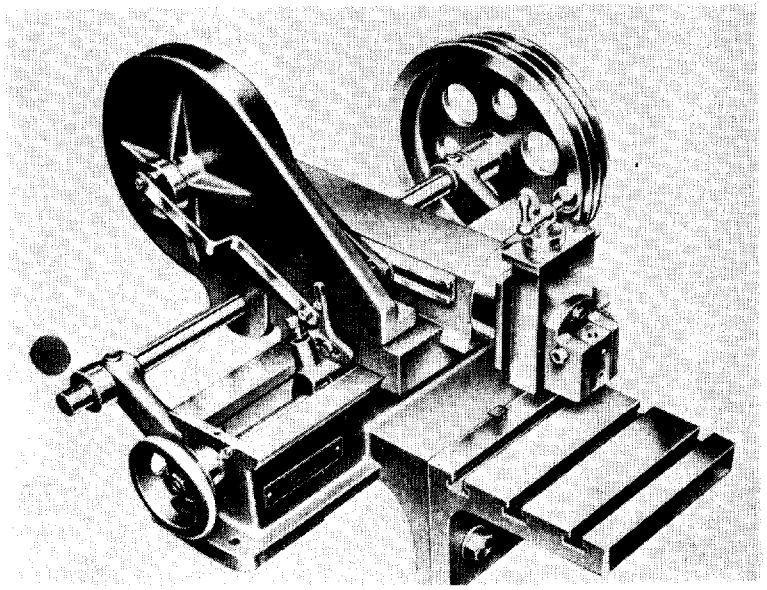


Fig. 2 5″ Perfecto Powered Machine

Fig. 3 7″ Perfecto Powered Machine



Operating Speeds

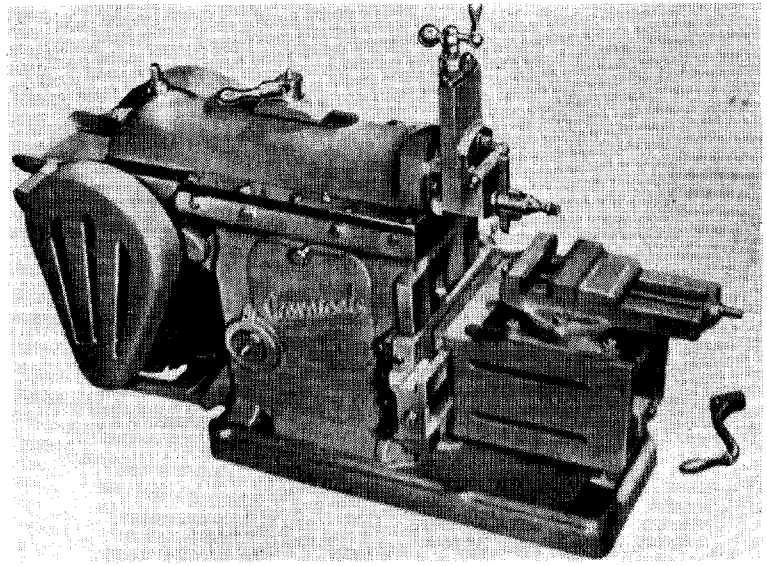
Three rates of speed are available. These are 60, 70 and 80 strokes per minute derived from a three-step V-belt pulley connected by belting to a pulley attached to the shaft of an electric motor running at 1,425 r.p.m. A suitable pulley for the motor would seem to be $2\frac{1}{2}$ in. diameter.

The Acorn Tools 7-in. Shaping Machine

The operators' Handbook supplied with the machine in a foreword to the general operating instructions says: "This 7 in. shaper has been introduced in response to an insistent demand for a small precision-built machine. It is suitable for both high output with arduous production runs, and for precision work in the tool room".

It is on this last criterion that the author can speak, for not only has he an Acorn Tools shaper himself, but many years ago he specified one of these tools for inclusion in the plant required for the specialist workshop which was run by him in one of our larger aircraft factories. It was used by qualified tradesmen and apprentices alike, and the millwrights dropped the machine when the author moved it to another shop under his control; but, despite working under conditions sometimes not of the best, this tool has never given any mechanical trouble and, so far as is known, still continues to preserve its accuracy.

Fig. 4 Acorn Tools 7″ Powered Shaper



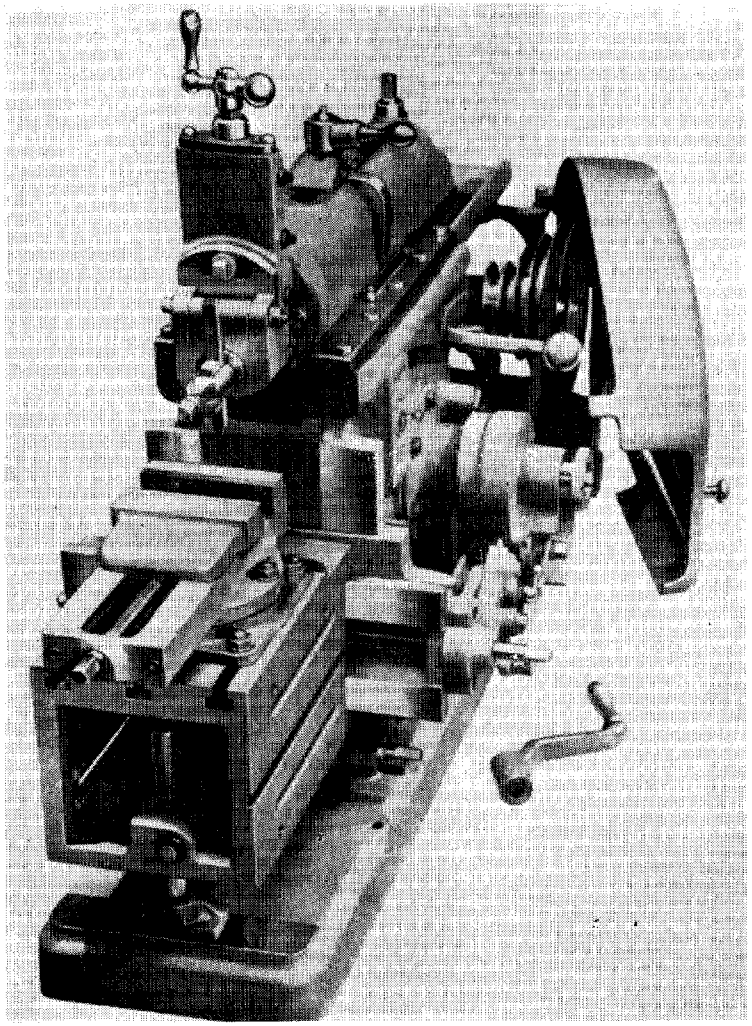


Fig. 4A Acorn Tools 7″ Powered Shaper

The machine itself is virtually a scaled down model of a shaper of the type illustrated in the Frontispiece of this book. With the exception of automatic feed to the tool slide, and this has since been added by the author, the Acorn Tools shaping machine illustrated in Fig. 4, has all the facilities offered by a large shaper.

The mechanism of the Acorn Tools shaper follows the basic lines laid down long ago for machines having a fixed ram slide and a moving work table.

The ram is driven by what amounts to a disc crank operating a rocking lever attached at one end to the main casting of the machine and at the other end to the ram itself. The disc crank has a ring gear machined on its periphery so that it can be driven from a layshaft set at the rear of the machine and carried in bearings in its main frame. Attached to the layshaft is a 4-step pulley driven through belting by the electric motor carried on a mounting behind the shaper.

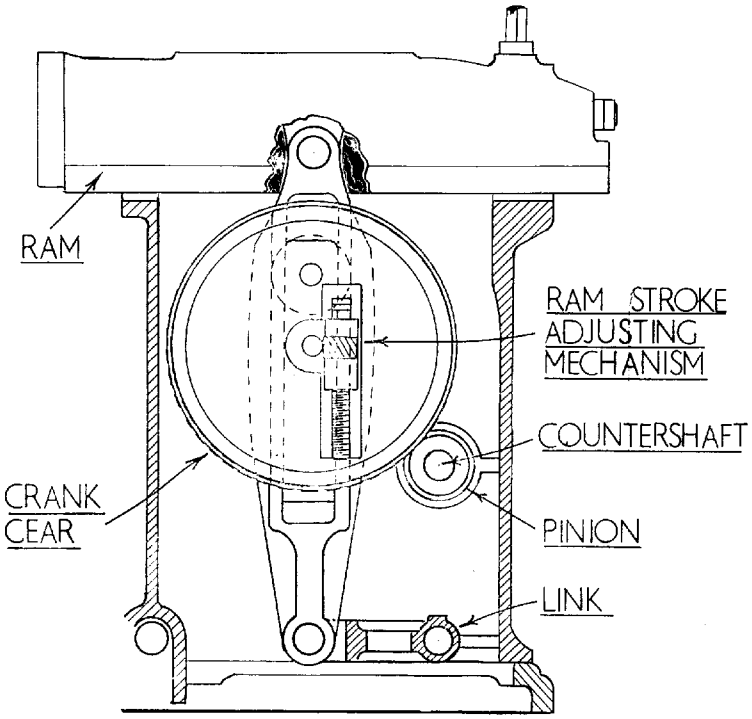


Fig. 5 Acorn Tools Ram Drive

Adjusting the Ram Stroke

The parts referred to can be seen in the diagram Fig. 5. The crank is overhung with its hub supported in tapered roller bearings, and is provided with a sliding block and pin, the latter engaging a thrust block in the ram lever. The sliding block is adjustable for position from outside the machine by turning the ram adjusting shaft that passes through the hub supporting the crank. This shaft carries a skew gear that engages a corresponding gear mounted on

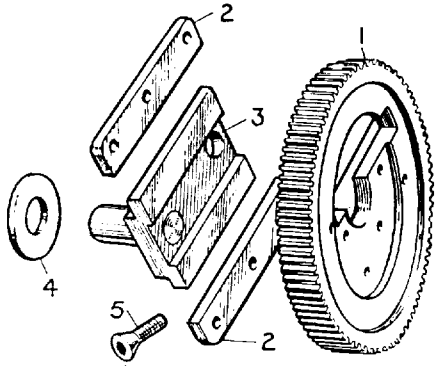


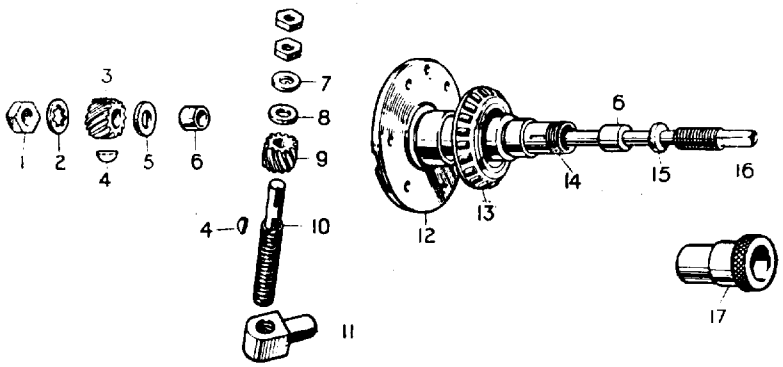
Fig. 6 Acorn Tools Disc Crank

the ram adjusting screw. The screw passes into a nut with pin set in the sliding block, so any movement of the adjusting screw is reflected in a corresponding re-positioning of the block and thus the stroke of the ram.

Adjusting the Position of the Ram

As well as being in a position to adjust the length of the ram stroke, it must also be possible to set the position of the ram, and with it the toolpoint, in relation to the work itself. In the Acorn Tools shaper this adjustment is effected by the mechanism depicted in the illustration Fig. 8. The block attached to the ram drive lever, and abutting the ram itself, has a female square thread machined in it. This thread accommodates the ram adjusting feed screw which

Fig. 7 Acorn Tools Crankshaft



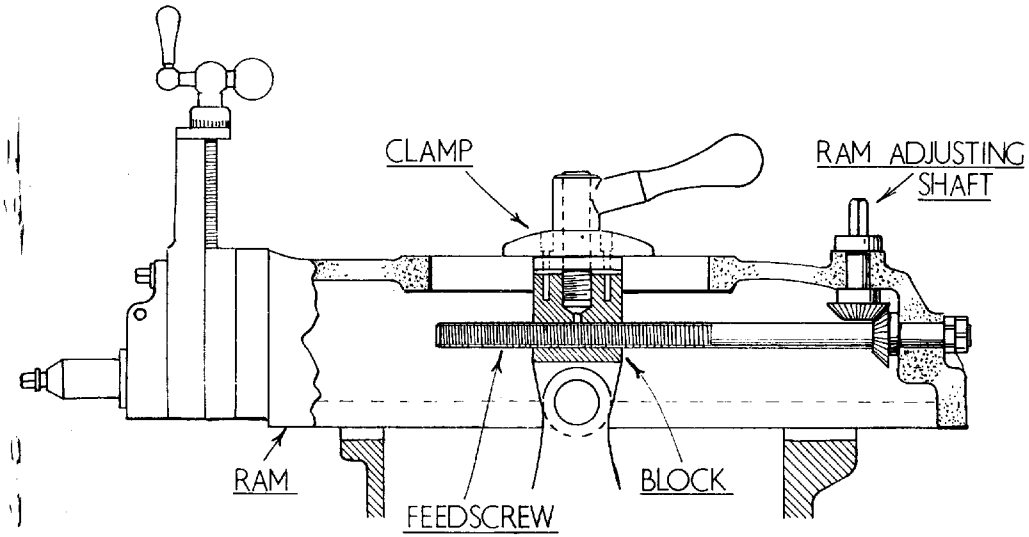
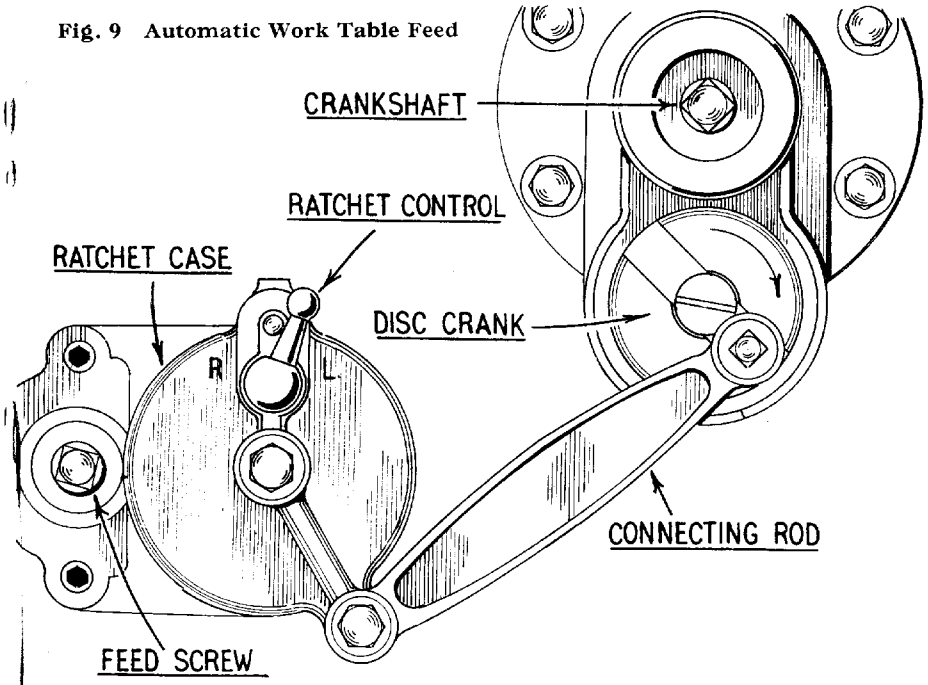


Fig. 8 Acorn Tools Ram Adjustment

Fig. 9 Automatic Work Table Feed



passes into this thread and is supported at its outer end by a bearing formed in the tail of the ram.

The feedscrew has a bevel gear mounted upon it, this engages a corresponding gear machined on a stub shaft passing through the ram. So, when a handle is applied to the stub shaft, and is turned after the block has been unclamped, the tool point position can be adjusted to suit the work in hand.

In practice the stroke of the ram is so adjusted that the point of the tool bridges or covers the work in hand, whilst the position of the tool point itself is set so that it clears the work by about a quarter of an inch at each end of the ram's stroke.

Automatic Work Table Feed

In common with most small shaping machines the ratchet feed for the work table is driven directly from the shaper's crankshaft. In the case of the Acorn Tools machine the mechanism is contained in two small gearboxes, one forming part of the crankshaft bearing housing the other being attached to the horizontal cross rail upon which the work table slides. The reversible ratchet is located in this gearbox and is driven from the disc crank projecting from the box on the crankshaft bearing housing. The stroke of this crank can be adjusted by altering the position of the crank pin. The pin takes the form of a stud passing through a T-slot machined in the crank and engaging a block that slides in the slot. When the stud is slackened the block may be moved along the slot thus altering the stroke and so adjusting the feed of the work table. The parts of the mechanism are seen in the illustration Fig. 9.

In use, as the disc crank turns, the connecting rod pulls the ratchet case backwards and forwards so turning a ratchet wheel inside the case. There is a gear attached to the ratchet wheel; this engages a pinion mounted on the cross slide feed screw which turns either clockwise or anti-clockwise according to the direction set by the ratchet control lever.

Work Table Adjustment

In addition to the down feed for the tool point provided by the tool slide itself, it is sometimes advisable to make use of the work table elevating gear in order to set the work itself in the best possible position for machining. The elevator fitted to the Acorn Tools shaper is a vertical feed screw actuated from a short shaft projecting from the side of the machine by means of skew gears affixed to the shafts themselves. A key is used common to the vice, the ram position

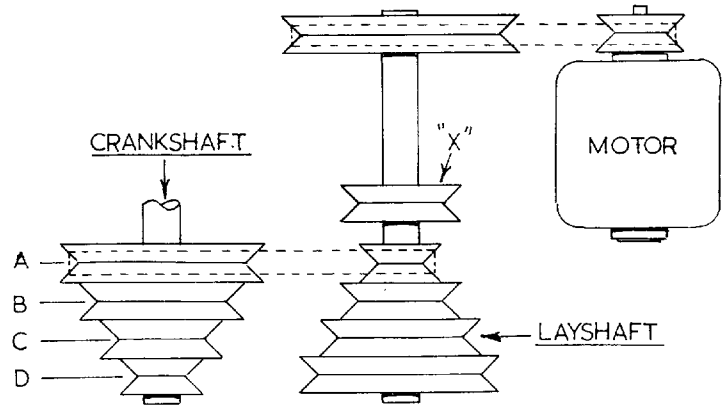
adjustment and the elevator itself. At all times after any adjustment has been made the thrust jack affixed to the work table must be re-set. The jack slides in a lug cast at the front of the box form work table and is secured by a collar lock in the lug. The jack has a cast iron foot that rests on a machined surface formed on the base plate of the shaping machine, and on this the foot slides as the work table moves along under the tool point. The jack and its location can be seen in the illustration Fig. 4A.

Electric Motor Drive

The motor that drives the Acorn Tools shaper is mounted on a bracket assembly bolted to the back of the machines main frame. The platform to which the motor is fastened swings in this bracket enabling belt tension between the motor and the countershaft, also secured to the back of the main frame, to be adjusted.

The countershaft itself is carried in a pair of roller races mounted in a hanger that swings in the hinge member at the back of the frame. The hanger is controlled by a lever. Lifting the lever allows the whole countershaft to swing upward and put tension on the belts between the motor and the countershaft and the countershaft and shaper crankshaft respectively. The countershaft and the layshaft transmitting power to the crankshaft are each provided with a 4-step pulley. This combination gives the approximate cutting speeds set out in the accompanying table:

Fig. 10 Acorn Tools Shaper Belt Layout



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.

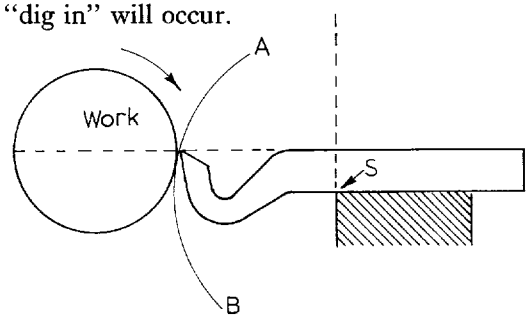


Fig. 1
Swan-neck tool mounted on the lathe top slide

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

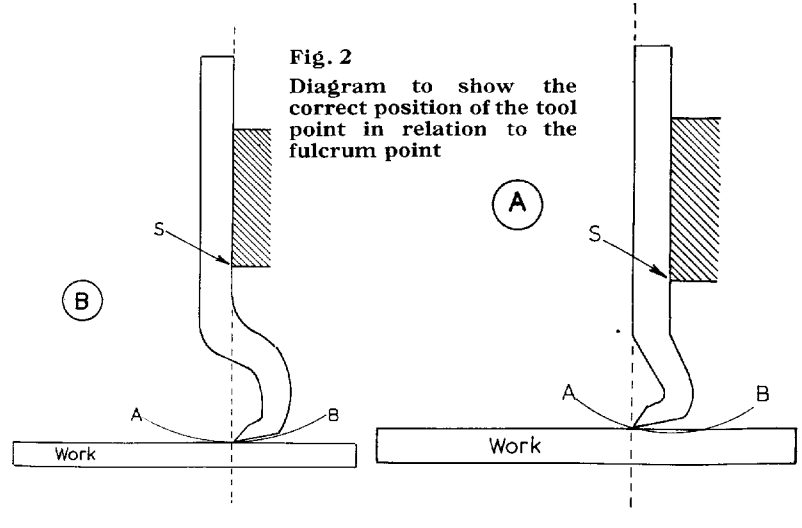


Fig. 2
Diagram to show the correct position of the tool point in relation to the fulcrum point