OPERATOR'S HANDBOOK

for the

WARCO VARIABLE SPEED SUPER MINI LATHE

Metric and Imperial Models

Warren Machine Tools Ltd
Warco House, Fisher Lane, CHIDDINGFOLD, Surrey GU8 4TD
Tel: 01428 682929
e-mail: sales@warco.co.uk
web: www.warco.co.uk

NOTE

The information contained in this handbook is intended as a guide to the operation of the machine and does not form part of any contract. The data it contains has been obtained from the machine manufacturer and from other sources. Whilst every effort has been made to ensure the accuracy of these transcriptions it would be impracticable to verify each and every item. Furthermore, development of the machine may mean that the equipment supplied may differ in detail from the descriptions herein. The responsibility therefore lies with the user to satisfy himself that the equipment or process described is suitable for the purpose intended.

Emphasis is placed on the metric version of the lathe throughout the handbook but the information may be deemed to apply in general to the imperial version. Any specific differences are detailed where necessary.

LIMITED WARRANTY

Warren Machine Tools Ltd. (WARCO) makes every effort to assure that its products meet high quality and durability standards and warrants to the original retail consumer/purchaser of our products that each product be free from defects in materials and workmanship as follows: ONE YEAR LIMITED WARRANTY ON ALL PRODUCTS UNLESS SPECIFIED OTHERWISE. This Warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence or accidents, normal wear-and tear, repair or alterations outside WARCO facilities, or to a lack of maintenance.

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The manufacturers reserve the right to change specifications at any time as they continually strive to achieve better quality equipment.

The WARCO VARIABLE SPEED SUPER MINI LATHE

OPERATOR'S HANDBOOK

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SAFETY AND ACCIDENT PREVENTION

This is the SAFETY ALERT SYMBOL. Throughout the handbook this symbol is used to draw your attention to items or operations that could present a hazard to the operator, or to other persons nearby. Please read these messages carefully. Ensure that you have a full understanding of their importance and always abide by their requirements.

Figure 1 The Variable Speed Super Mini Lathe

INTRODUCTION

Your new Variable Speed Super Mini Lathe is a robust and highly accurate machine tool. It is very compact and modern in design yet it is still a traditional type of lathe and is used in the conventional manner.

With proper maintenance, correct operation and use this machine can provide you with years of accurate service.

Some purchasers of the machine will be experienced in the use of similar but larger equipment, others may not be at all familiar with the processes involved in the operation of a lathe. This manual seeks to offer advice, both to those whose knowledge is limited and to the experienced operator, to give details of methods that can be used to obtain the best from this particular machine.

Before attempting to use the machine please read this manual carefully and familiarise yourself with all the controls, their purpose, and especially with safety of operation in mind.

Figure 2 Tools and Equipment

INSTALLATION

These instructions describe the recommended installation procedure. However, before you attempt to install your machine, please read these instructions carefully.

As delivered, the lathe weighs 38 kg (84 lb). Although single-handed lifting may be considered, great care should be taken when handling the machine to minimise the risk of injury. **The aid of an assistant when lifting or moving the machine is strongly advised**.

Unpacking

The lathe is supplied securely packed in a light wooden crate for transit. Carefully unpack the machine by releasing the tabs at the base of the crate to separate the upper section from the base. Check for any possible damage that may have occurred. Some smaller components, such as handles, are packed separately to minimise any risk of damage during transit. These items are included in the list below that also covers the components and accessories supplied as standard equipment (Figure 2). Check against the list that all items are present. Should there be any discrepancies then please contact the supplier immediately.

Remove all packaging clear of the work area before proceeding.

The following list details the items that are supplied with the lathe:

- Set of four rubber mounting feet, with M6 screws
- Chuck guard, with M4 screws, washers and nuts
- Toolpost guard
- Handle for leadscrew hand-wheel
- Tailstock centre, No.2MT
- Set of three external jaws for three-jaw chuck
- Chuck key
- Two open-end spanners, 8 + 10mm and 14 + 17mm
- Set of six hexagon key wrenches
- Set of change gears, comprising 30, 35, 40 (x2), 45, 50, 55, 57*, 60 (x2) and 65* teeth (* imperial only)
- Two pinions (metric only) for thread dial indicator, 14T and 15T
- Oil container (plastic)
- Spare fuse, 2A cartridge (in plastic bag with documentation)

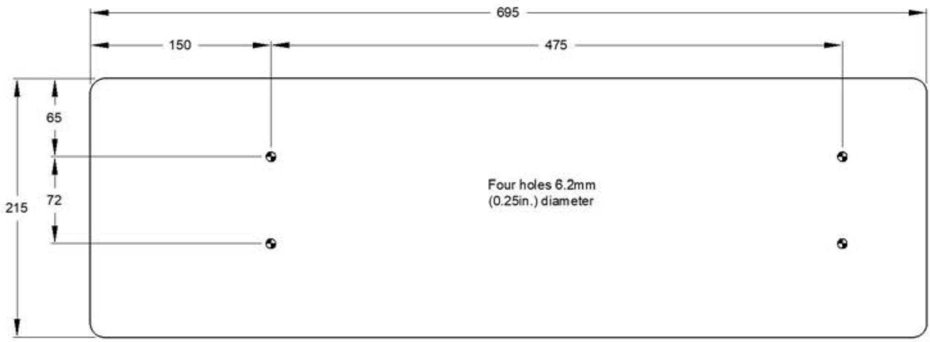


Figure 3 Worktop or Baseboard Drilling Diagram

Assembly and Positioning the Lathe

Attach the handle to the leadscrew hand-wheel by its slotted screw.

Although the construction of the machine is such that normal levelling procedures are rendered unnecessary, every effort should be made to keep the base as level as is possible.

The machine may be mounted on a rigid wooden bench; however, the top of the bench must have sufficient strength to support the machine.

Determine the position for mounting the lathe, allowing sufficient working space around the machine, and drill four holes 6.2mm (¼in.) diameter through the bench top to the dimensions shown (Figure 3). If the bench is of softwood construction, it is advisable to place a metal plate, or large diameter washers, under the bench to prevent the mounting screws drawing through into the woodwork as they are tightened. Although not essential, the plates or washers could with advantage be fixed to the wood surface using a suitable adhesive once their exact positions have been determined. Extra rigidity may be obtained by bolting the bench to the wall, although this is usually considered to be entirely non-essential.

An oil resistant surface to the top of a wooden work bench, such as a plastic laminate, should be provided to minimise the ingress of cutting fluids and other oils into the wood itself.

Should a permanent installation not be required and in most cases where relatively light machining operations are contemplated, the lathe is sufficiently stable when resting on its rubber feet, thus obviating the need for it to be bolted to the worktop. It would be advantageous, however, to secure the lathe to a rigid board base, such as 20mm plywood; it may then be clamped to a suitable workbench or table.

Initial Cleaning and Oiling

When the lathe is supplied its bright surfaces are covered by a grease-like material; this has been applied to protect the surfaces during transit and storage. Before installing and operating the machine it is necessary to remove completely all this protective material. It is usually sufficient to use a dry cloth or paper towel to remove this grease but in some rare cases a solvent may be needed.

A water dispersant liquid, such as WD40, may be used to assist cleaning, while white spirit is also an effective solvent for the grease. Paraffin (kerosene) may also be used, but the use of petrol (gasoline) or other highly volatile substances is NOT recommended. Clean lint-free rags used with the solvent will remove grease from the accessible surfaces but a small brush will be found to give better cleaning in the more awkward corners and crevices. The parts inside the guard covers should also receive attention as any preservative left in situ will attract foreign matter and could cause premature wear. It may be necessary to remove the chuck, saddle, etc from the lathe in order to achieve complete de-greasing.

Abide by all the usual precautions when using solvents and ensure that there is no solvent left on the machine when cleaning is complete.

Caution: Avoid getting any solvent on to the drive belt or other rubber based parts. The action of the solvent will rapidly decrease the life of the component.

Apply a thin coat of lubricating oil to all exposed bright surfaces, paying particular attention to the tailstock barrel and slide-ways. Apply lubricating oil to the oil ways of both lead-screw bearings. Note that it will be necessary to remove the change gear cover to gain access to the left hand bearing.

ELECTRICAL INSTALLATION

Your machine is supplied already fitted with a moulded fused plug and is ready for connection to a suitable outlet having a rating of at least 13 amps. A normal domestic socket of this rating is suitable, but it is preferable that this socket should also be switched. If the machine is to be operated from a different type of supply connector it will be necessary to fit a suitable connector to the power lead on the machine to permit connection to your mains supply. Ensure that the colour coding of the cables complies with the convention:

Live	Brown or Red
Neutral	Blue or Black
Earth	Green or Green/Yellow.

Should a change of connector be necessary, the displaced moulded plug must be disposed of and not placed into a live socket at any time.

Do not switch on the supply to operate the machine until after the preceding cleaning and oiling sequence has been completed.

Electrical Control System

A theoretical wiring diagram for the control system is shown at Figure 4.

Each machine is supplied with an electrical control box mounted at the headstock end and this carries controls located on its front and top surfaces (Figure 5).

A guarded push-button switch for STOP (red top, yellow body) is located on the right of the top panel. When closed, the cover prevents access to the start/stop push-buttons and holds the stop button in the ‘off’ position, thus inhibiting operation of the machine. Releasing the latch by pressing the red centre of the switch towards the rear of the machine enables the cover to be raised to reveal the START (green) and STOP (red) buttons.

Selecting FORWARD or REVERSE on the semi-rotary switch (left front) determines the direction of rotation of the motor. Then rotation of the speed control knob (right of front panel) clockwise from the 0 (OFF) position to the I (RUN) position determines the running speed, which is continuously variable between zero and maximum.

A four-digit display window on the top left of the panel gives a continuous indication of the speed of rotation of the spindle. This information is derived from a toothed wheel and photo-electric sensor located at the rear of the spindle housing.

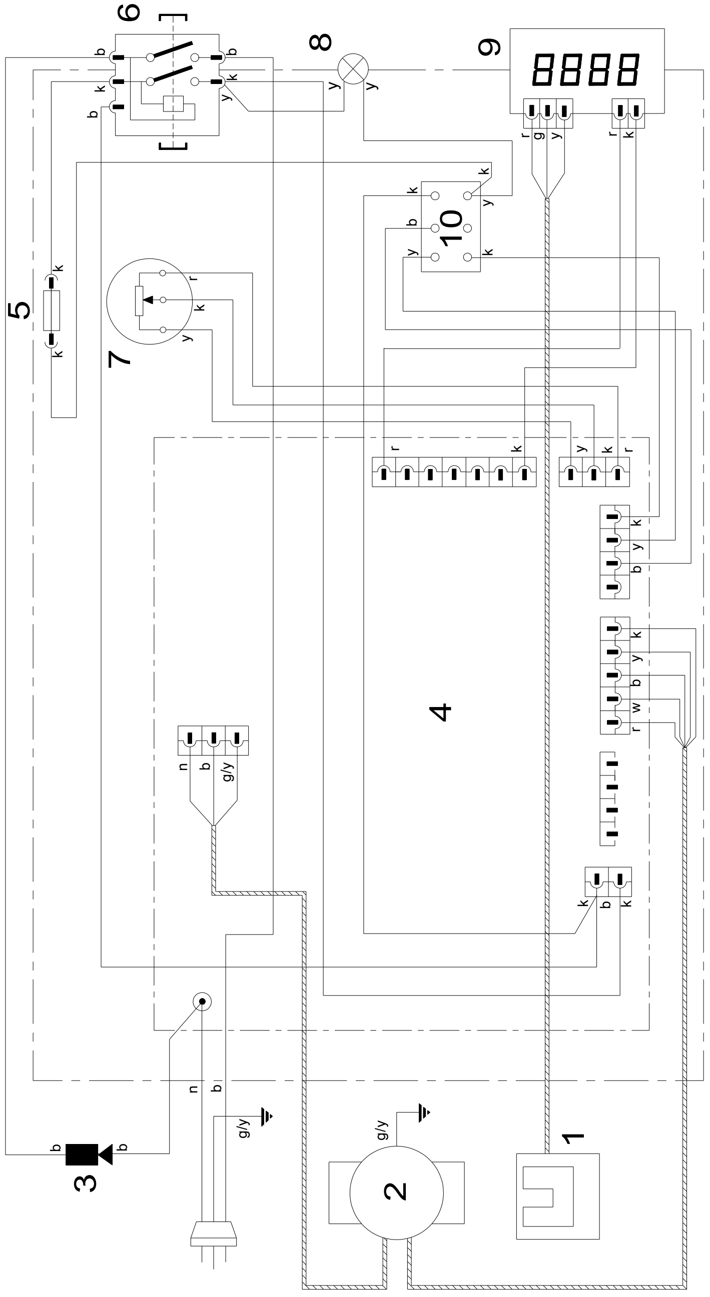


Figure 4 Wiring Diagram

Key to Figure 4 (opposite)

1	Spindle speed sensor	2	Drive motor
3	Chuck guard interlock switch	4	Circuit board
5	Fuse	6	Magnetic switch
7	Power indicator lamp	8	Spindle speed indicator
9	Speed control potentiometer	10	Forward/Reverse run switch

Wire colour coding

b = blue g = green
k = black n = brown
r = red w = white
y = yellow

Figure 5 Control Panel

Figure 6 Master Stop Switch and Speed Indicator

Figure 7 START/STOP Switch Selection

Figure 8 High and Low Speed Selector Lever, Tumbler Reverse Lever and Spindle Speed Detector

A transparent chuck guard is pivoted at the top rear of the headstock housing. This guard acts on a microswitch that inhibits operation of the motor when the guard is open.

SPEEDS AND FEEDS

The drive from the motor to the spindle is totally enclosed and employs a toothed belt and pulley system. A sliding gear set, which is controlled through a handle at the rear of the headstock, gives a choice of HIGH or LOW speed ranges.

Power feed to the lead-screw, in either direction, is derived through a gear train from the spindle to the lead-screw. This gear train incorporates a tumbler reverse gear, operated through a spring-loaded detent lever at the rear of the headstock, and is set to produce a fine feed of approximately 0.1mm (0.004in.) per revolution of the spindle.

Good machining results depend to some extent on the correct rotational speed for the lathe spindle according to the type of metal being machined and its effective cutting diameter. The larger the diameter of the material then the slower the spindle speed should be.

Similarly if a harder material is to be turned then this too will require a slower speed. For example, if mild steel of 50mm (2in.) diameter is being turned then this will require a slower speed than if the diameter were 12mm (½in.) diameter. However, brass of 50mm diameter will require a spindle speed higher than that used for the equivalent piece of steel.

The complete range of speeds and feeds available, giving the amount of feed per revolution of the spindle, is shown later (Tables 1 to 6) and this varies according to the configuration of the change wheels selected. Similar charts and diagrams are also displayed on the drive covers to the machine. The most suitable rate of feed for the material being machined will probably best be found by trial and error. A smoother finish is more generally obtained with a finer feed but again, with the softer metals, a faster feed can often be used.

HEADSTOCK

The headstock spindle, or mandrel, runs in two ball-race bearings; these are pre-tensioned on manufacture and packed with heavy-duty grease; in normal use it will not require any attention.

The mandrel nose is flanged for location of chucks and faceplate; each of these items is secured to its mounting by three headless socket screws with locknuts. This method of fixing provides a very secure type of fitting which prevents the chuck from unscrewing when the machine is operated in reverse drive.

At the left of the headstock the pick-off gear for the screw cutting gear train is keyed to the mandrel.

The spindle is bored through 20mm (0.79in.) to accommodate long bars up to this diameter and there is a No.3 Morse taper socket at the mandrel nose for centres and other accessories.

TAILSTOCK

The tailstock provides a means for holding work and tooling at the opposite end of the lathe to the headstock and may be positioned anywhere between the saddle and the bed end; at its extreme position it provides a between centres distance of 350mm (13.8in.). Unlike the headstock, however, its centre member (the quill) is non-rotating.

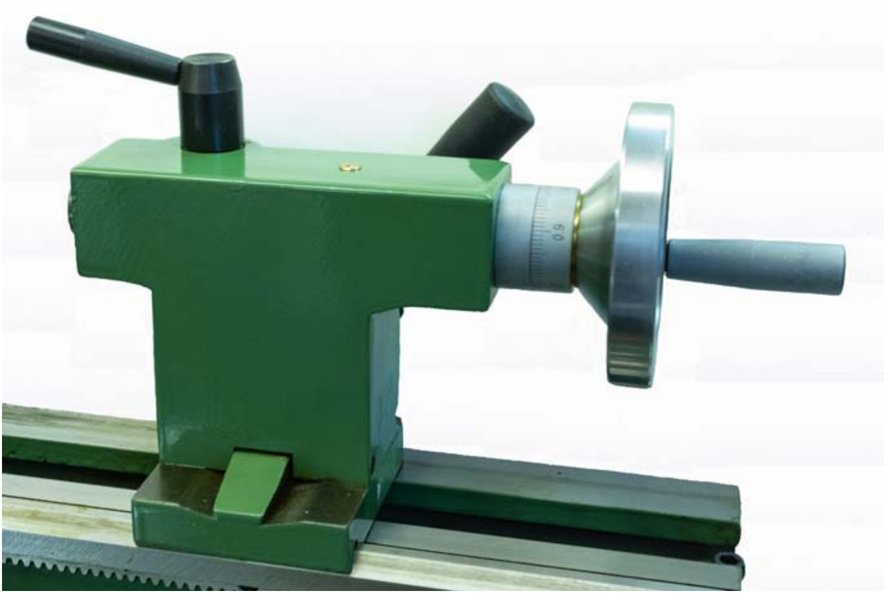


Figure 9 Tailstock

The major feature of the tailstock is the locking lever, which provides a means for rapidly changing the position of the tailstock on the lathe bed. It has two other controls; a lever that locks the quill in position when using a centre or for a similar operation and a hand-wheel, which drives a screw acting on the quill to extend and retract it; the locking lever also prevents the quill from rotating as the wheel is turned. The quill has a No.2 Morse taper socket to receive centres, drill chucks, drills and other accessories. When the quill is fully retracted these items are self-ejected by the action of the end of the taper shank of the tool coming into contact with the drive screw. This obviates the need to use a drift or similar tool when changing tapered tooling.

A further feature of the tailstock is that it may be set over by a small amount when there is a requirement to turn a long shallow taper between centres. First slacken by a small amount the clamping screw on the under side of the tailstock base, along with two further screws, located at the rear of the body. The body is then adjusted for the required amount of set over and the clamping screws re-tightened. After set over has been used be sure to return the tailstock to its true centre setting before resuming any parallel turning or other tailstock operation. A quick check of the setting may be achieved by lightly pinching a steel rule (or similar) between centres, when any misalignment will be evident from the viewed angle of the rule relative to the lathe bed. However, the use of a setting bar between centres and a dial test indicator (DTI) will be required for accurate realignment.

Figure 10 Carriage Controls

CARRIAGE (Figure 10)

The carriage assembly comprises three slides, the lower of which has a sliding movement along the lathe bed that is activated through a hand-wheel located on the apron at lower left. The hand-wheel drives through a pinion acting on a rack attached to the lathe bed. In screw cutting and automatic fine feed operations the carriage movement is effected through a clasp nut driven from the rotating lead-screw. A much finer control of carriage movement is obtained by use of the lead-screw hand-wheel after first disengaging the drive to the lead-screw.

The cross slide has a range of movement of 70mm (2.76in.); it has manual feed only via a hand-wheel and feed screw. The hand-wheel dial is calibrated for both metric and imperial units. Slide adjustment is provided by means of a moveable dovetail strip.

The step on the cross slide nearest the headstock is drilled and threaded at its rear end to accept the optional travelling steady.

The top (or compound) slide is located on a centre pivot on the cross slide to give a range of movement of 90º, that is 45º either side of zero, its base being clamped to the cross slide through a graduated clamping ring.

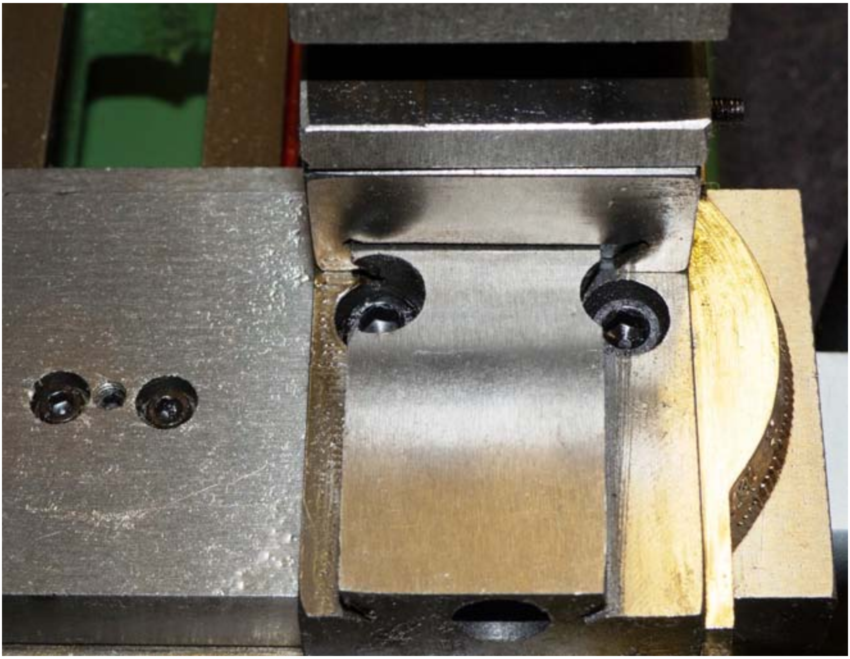


Figure 11 Top Slide Clamping Screws

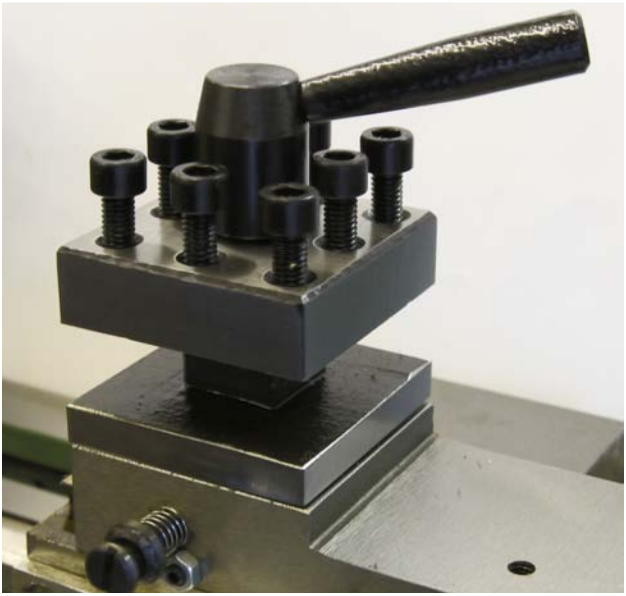


Figure 12 Tool Post

At the front of the top slide is a transparent guard. This guard pivots on a projecting screw at the handle end and its movement is damped by a spring; a similar screw and spring at the opposite end secures the 'in use' position. Clockwise rotation of the guard gives clearance for tool changing.

The clamping screws (Figure 11) are concealed by the top slide itself and the slide needs to be retracted to provide access. The slide travel is 45mm (1.77in.) through a manual feed, similar to the cross slide and having similar slide adjustment.

A four-way indexing tool post (Figure 12) is attached to the top slide; this can be set in any required position and is held by a single locking lever.

STANDARD EQUIPMENT

A range of equipment is supplied with each machine and the major features are described in detail. The range is complemented by a number of additional accessory items, some of which are described later.

Caution: When changing a chuck or faceplate care should be taken to ensure that it does not drop on to the lathe bed, or on to the operator, during removal or refitting. A piece of thin wood placed over the bed will help to prevent damage should the chuck be allowed to fall.

Three-Jaw Chuck

The three-jaw chuck is conventional in style and operation and can hold round or hexagon stock accurately and firmly. Hand tightening only, using the chuck key supplied, is all that is required to exert sufficient force to secure the work. Under no circumstances should additional leverage be applied to the chuck key or any other means used to obtain additional tightness from the chuck jaws.

The chuck is secured to the mandrel with three hexagon head screws. When removing the chuck it is advisable to mark the chuck and mandrel flange in some way to ensure that the original relationship is regained when they are re-assembled.

The set of jaws may be removed completely from the chuck body and replaced by a set of outside jaws for holding larger diameter work. It should be noted that the outside jaws have a reduced gripping surface and therefore should only be used when the work diameter is outside the range of adjustment of the normal jaw set. Both sets have the individual jaws numbered to correspond to the markings on the chuck body and must always be replaced in their correct locations and in the correct sequence. Start with jaw No.1 and observe the action of the scroll screw through the jaw slide-way when the chuck key is turned. When the lead-in for the screw appears for No.1 jaw, turn the key back about a quarter of a turn, lightly press the No.1 jaw down to the screw to engage the jaw then continue turning until the lead-in is observed at the No.2 slot. Similarly fit jaws No.2 and No.3.

From time to time the jaws should be removed and cleaned and at the same time the threads in the scroll screw should also be cleaned. The locating recess in the backplate must be wiped clean, preferably each time the chuck is removed, as small particles of swarf will tend to get trapped and these will cause rapid wear and lack of concentricity.

OPTIONAL EQUIPMENT AND ACCESSORIES

Four-Jaw Independent Chuck

Caution: When changing a chuck or faceplate care should be taken to ensure that it does not drop on to the lathe bed, or on to the operator, during removal or refitting. A piece of thin wood placed over the bed will help to prevent damage should the chuck be allowed to fall.

Unlike the three-jaw chuck the jaws on the four-jaw chuck have individual adjusting screws and each jaw is set independently of the others; thus it is not self-centring but makes it possible to hold square and rectangular bar stock, as well as irregularly shaped work pieces. Because of the individual action of the jaw setting screws it is possible for the jaw to exert more pressure on the work piece. Also unlike the three-jaw, which has a substitute jaw set for large diameter work, any or all of the jaws of the four-jaw may be reversed in their slides.

Due to the independent action of the jaws some initial difficulty may be experienced in setting the work to run true. This is usually overcome quite readily with just a small amount of practice setting. A simple approach is to set the work as accurately as possible by eye, referring to the steps on the chuck jaw in relation to the engraved rings on the face of the chuck body. Having thus achieved an initial setting the lathe spindle is then rotated by hand with the work revolving close to, but not actually touching, a scriber point, lathe tool, or similar pointer held in the tool post. As the work is rotated it will be readily seen where the work passes closest to the pointer. By loosening the jaw immediately opposite the closest point by a small amount, and tightening the jaw nearest, the work piece will be moved bodily towards the centre. It may be necessary to do this a number of times, at any or all of the jaw positions, in order to achieve maximum

Figure 13 Fixed Steady

accuracy. Where the work piece already features a smooth cylindrical reference surface, a much greater accuracy can be obtained by using a dial test indicator (DTI) against the work to detect the out-of-centre errors. The DTI indications will be found much easier to observe in addition to providing the enhanced accuracy.

With the feature of the jaws on a four-jaw chuck being reversible, a wide combination of settings is possible, whether all internal, all external or a mixture of any. This is particularly useful when it is necessary to hold irregular shapes. Another aspect of the feature is that work may be deliberately set off centre if required. It should be noted in these applications, however, that an off-centre setting will usually result in the work being out of balance and vibration will result, particularly if a higher speed is required. It is usual in this case to reduce the spindle speed slightly from the normal desired cutting speed for the material in order to reduce the vibration induced.

The method of fitting the four-jaw chuck to the lathe spindle nose is identical to that of the three-jaw, using a dedicated backplate with headless screws and locknuts. Similarly, attention to cleanliness should be given when removing and refitting the chuck. The jaw setting screws should be kept lightly oiled.

Faceplate

The faceplate is used for machining large and awkward shapes, such as castings, and items that may be too large for the chuck. It is attached to the lathe spindle with screws and locknuts in a similar manner to the chucks. It is checked for accuracy and balance before leaving the factory and no built-in adjustment is provided.

The work piece to be machined is attached to the faceplate through the tee-slots. For reasons of safety, it is essential that the work be secured in at least three places, preferably equally spaced over the work area. Obviously, the shape and size of the work piece in relation to the slots and the desired centre will dictate the actual clamping positions. Always use correctly made tee-bolts in the tee-slots for clamping. The use of ordinary bolts could cause the casting to fracture due to the bolt heads not providing a sufficient load spread.

The faceplate can also be used as a driving plate, when work is needed to be turned between centres, by fitting an extended bolt firmly in one of the slots to engage with a projection or dog clamp attached to the work.

Fixed Steady

Where the work piece is long and overhangs the chuck jaws by a considerable amount, it is necessary to have some form of support to the free end of the work. It is not always practicable or desirable to provide a centre recess for tailstock support and an alternative is provided by the three-point, or fixed, steady (Figure 13). This device clamps to the bed ways of the lathe and should be located as close as is practical to the point where the actual cutting is to take place.

The top of the steady is hinged at the rear and may be swung back, or removed completely, for easy insertion of the work piece. The capacity of the steady ranges from a minimum diameter of 6mm (¼in.) to a maximum of 75mm (3in.). Adjustment of the jaws to take up the diameter of the work is made by releasing the clamp screws and turning the knurled ends of the jaw screws; re-tighten the clamp screws when the required adjustment has been made. The jaws have replaceable bronze tips to give minimum friction when correctly adjusted. Care must be taken not to over-tighten the screws as undue friction will be generated and the work may be distorted. A light smear of oil should be placed on the work where the jaws make contact to prevent overheating and/or damage to the material.

Travelling Steady

The travelling steady performs a similar function to that of the fixed steady. It is, however, attached to the rear of the front step of the carriage

Figure 14 Travelling Steady

assembly (Figure 14) to provide a stop to counter the thrust imparted by the cutting tool. It is eminently suitable when turning long slender shafts. As only two adjustable fingers are provided it is not necessary to swing part of the assembly clear of the work when removing the work from the machine. The two screws that are used to mount the steady should be kept in their sockets when the steady is not attached to prevent swarf from entering the screw holes and damaging the threads.

Vertical Slide

The vertical slide provides an additional range of movements, thus extending the lathe's versatility. Bolted to the top of the cross slide it may be swivelled vertically to present a wide range of angles relative to the lathe axes. A feed-screw with handle and indicator dial, similar to those on the carriage assembly, control the movement of the integral sliding clamp. Three socket cap screws are used to secure the work piece within the clamp.

The vertical slide is located on the swivel disc of the cross slide in place of the top slide assembly. To fit the vertical slide it is first necessary to withdraw the top slide fully, then remove the two cap screws that secure it to the disc; these screws are then used to secure the vertical slide in place.

Depending on the type of work to be undertaken on the vertical slide it may be advisable to remove the tailstock from the lathe. Removal of the thread dial indicator will also permit a slightly greater range of carriage movement. Removed items should be carefully stored for refitting for later use.

OPERATING THE MACHINE

A machine of this type is perfectly safe provided it is used with reasonable care. However, there are a number of safety precautions - common to most workshop operations - that need to be taken. Therefore, before carrying out any form of machining operation the following safety considerations must be observed.

Wear protective goggles or shatterproof spectacles to protect the eyes from particles of swarf and dust that will be generated. In the event of any foreign matter entering the eye, stop the machine immediately and do not delay seeking first aid.

Do not wear loose items of clothing that could become entangled with the machine. Similarly, long hair should be tied back and any items of jewellery or other adornment removed. Long sleeved garments are preferred to provide some protection for the lower arms.

Do not wear light shoes or slippers when operating the machine. Wear boots or shoes, preferably with hard toecaps, which will protect against injury if heavy metal objects are dropped.

Always ensure that chuck keys are removed from chucks before starting the lathe.

Check that the work piece or cutters are securely mounted in the chuck or collet.

Check that the tool holder and cutter or work piece is securely clamped to the table or machine vice.

Do not leave pieces of metal, tools etc laying on the bed of the lathe in such a position that they can move into a rotating work piece, or be allowed to fall on to the operator's foot.

Avoid reaching over the lathe when the work or cutter is revolving; where filing or hand turning operations are necessary take the utmost care to prevent accidents. NEVER use a file or other hand tool without a properly fitted handle.

Be aware of and, as far as possible, keep hands clear of sharp cutting tools that are held in the tool post. The tool post will hold up to four tools at one time and when so fitted it is inevitable that cutting edges will protrude at awkward angles. It is recommended that safety caps be made for cutting tools and those tools fitted but not in immediate use be covered to minimise the risk of injury. Modelling clay or masking/insulating tape make effective covers.

Ensure that the working area around and over the lathe bed is adequately lit to prevent accidents through being unable to see.

Always wash after using any machine tool, particularly where cutting oils have been used, to avoid any danger of skin diseases. The use of a barrier cream before starting work is recommended.

GENERAL OPERATING DETAILS

At the start of each day's use apply the oil gun to all the lubricating points and ensure that the table and slide ways are clean.

Observe all the safety requirements detailed above and select the drive configuration to give the rotational speed required for the material being worked and for the cutting tool being used.

After completing operations for the day, disconnect the electricity supply to the machine and remove and store any cutting tools that have been used. Remove the work piece from the chuck, or clamps or machine vice (unless further operations need to be performed at the same settings on the following day, when it may be left in position). Remove all swarf from the machine, check that all cutting fluid has been drained, and then thoroughly clean the working areas. Apply a thin film of oil to the working surfaces, and then cover the machine to keep out dust.

TURNING OPERATIONS

Most turning operations will require the cutting tool to be mounted in the tool post and traversed along the work through the motion of the saddle. This motion may be achieved either directly through the hand wheel or by using one of the automatic feeds. Rotation of the hand wheel in a clockwise direction moves the carriage from left to right along the lathe bed.

A suitable cutting tool must be clamped securely in the tool post and it must be set so that the tip of the tool is at exactly centre height. A quick check of tool cutting height can be made by comparing it with a lathe centre held in either the mandrel or the tailstock. The experienced operator will probably make his own setting gauge to determine tool setting height. The following simple procedure will also be found to be effective:

1. With the lathe power switched off, position the tool tip close to the work but not touching it.

2. Insert a small steel rule vertically between the work and the tool tip, adjusting the cross slide as necessary until the rule is *very lightly* trapped.
3. Observe the angle taken up by the rule; it should be vertical when the tool tip is exactly at centre height. If the tool tip is above centre height the top of the rule will lean towards the rear of the lathe, or to the front if the tip height is too low.

Usually the error will be on the low side and packing or shims will be required to bring the tip up to correct working height. In the unlikely event that an unpacked cutting tool is above centre height at the tip, it will be necessary to re-grind the tool and repeat the procedure.

Care should be taken when re-grinding lathe tools to maintain the correct angles on the tool faces. These angles are derived to obtain the maximum efficiency of cut and for clearance of swarf and chips from the work. It is not practical to describe here the various shapes and angles required for different cutting actions and materials; if the operator is unsure of the cutting tool required then reference should be made to a suitable textbook or wall chart. Ready shaped tools are widely available should the operator not wish to attempt making his own.

Longitudinal feed may be made directly through the hand wheel on the carriage assembly; rotating the hand wheel counter-clockwise moves the carriage towards the headstock. Clockwise rotation moves the carriage towards the tailstock. A more sensitive method of carriage movement is available by means of the leadscrew hand wheel, after first ensuring that the power feed to the lead-screw is disengaged.

Both directions of cut are available under power to give a steady cut of fine feed. The lathe is supplied set up to produce this fine feed through a set of change wheels between the spindle and the lead-screw. The arrangement comprises two 20T and two 80T wheels and this is shown in Figure 15. These wheels are removable and interchangeable with others in the set to produce a wide range of feeds for screw-cutting.

Short lengths of cut can also be achieved by using the top slide, which is also referred to as the compound slide, but this needs to be set parallel with the lathe axis to ensure a parallel cut. In most cases the graduated dial on the base of the top slide, when set to zero, will produce an alignment of sufficient accuracy. Setting over the top slide to any of the graduations will produce a tapered cut at the indicated angle.

Where more precise cutting is required, for example against a known taper, then the use of a DTI clamped in the tool post will be required. This method is also useful for ensuring true parallelism for straight turning.

For machining across the work, known as facing operations, only the cross slide is used to traverse the tool - the other movements should be inhibited by locking the saddle and top slide. Tool settings will be generally the same as for longitudinal turning.

Both the cross slide and top slide have graduated dials concentric with their feed screws and these are marked in both metric and imperial measurements. Each graduation on the cross slide dial represents one-fortieth (0.025) of a millimetre or one-thousandth of an inch according to the scale used; it follows that the larger markings represent multiples of these figures. One complete revolution of the dial represents a total slide movement of 1mm (0.04in.). These graduations allow accurate work to be accomplished without continual reference to other measuring facilities.

Note: Remember that in the case of advancing the cross slide each graduation on the dial represents the amount being machined from one side of the work only and the actual metal removed is *double* the amount indicated. For example, assume that a bar has been turned to a diameter of 20mm then, if the dial is advanced by 1mm, the resulting cut diameter will be 18mm.

A similar but more complex effect will be experienced when using the top slide for anything other than longitudinal machining. The amount of metal removed is proportional to the dial setting but is also related to the angle of set-over that has been made. The actual depth of cut could be determined by calculation or reference to mathematical tables, but in this case it is often more practical to proceed slowly and measure the result after each cut.

DRILLING AND BORING

In addition to the external turning and facing of material the generation of bores and recesses can be readily accomplished on the lathe. Small holes will normally be made using drill bits while the larger holes would usually be bored. Regardless of the diameter of the hole it will be found that boring operations will give a greater accuracy than if a drill bit alone were used.

Centre Drilling

Prior to any drilling or boring operation taking place a deep centre recess is usually required. For this purpose a centre drill, or 'slocombe' drill as it is otherwise known, will be required. This type of drill bit is usually double ended with a narrow pilot tip and a main body of larger diameter. This configuration makes for a drill bit of exceptional stiffness and provides the best possible accuracy. The drills are available in a range of sizes.

The more common usage will be when the work is to be held in the chuck or on the faceplate and the drill is to be held in a chuck at the tailstock. The position of the tailstock is adjusted along the lathe bed as required and locked by the clamp nut and quick release lever. Rotating the hand wheel at the rear of the tailstock moves the quill or chuck towards or away from the work.

With the work accurately set to the required centre, the centre drill is brought up to the work and carefully fed into it until the pilot tip is completely recessed in the work. Continue drilling until the cone on the main body is in the work to approximately a third or half its diameter. The actual depth will depend on the required diameter of the following drill bit, although it is permissible to go to the full diameter of the body. Do not go any further as the centre drill has only very short flutes for the clearance of swarf. A breakage of the drill will damage the work and the broken tip may prove difficult to remove. Furthermore, any deeper drilling with the centre drill will leave a shoulder at its junction with the face of the work and, if the work is to be supported on a centre, the bearing surface will be greatly reduced.

Drilling

Drilling in the lathe is usually undertaken by mounting the drill bit in the tailstock. Drills up to 10mm (0.375in.) diameter can be accommodated in a tailstock chuck but larger drills, with straight reduced shanks (generally known as 'blacksmith's drills') may also be used with care. Larger drills having taper shanks would be fitted direct in the No.2 Morse taper recess in the tailstock quill. Drill sleeve adapters may be used to allow for the use of drills having No.1 Morse taper shanks. It should be borne in mind that the drilling action of larger tools involves a greater load on the machine and they should preferably be used only for opening out smaller drillings.

Once the centre has been made, work can commence with the required size of drill bit. As with turning operations it must be remembered that speeds and feeds are proportional to the diameter and material being worked. With the larger sizes of drill it is often easier and advisable to start with a smaller sized drill, experience and convenience will dictate the size to be used, then follow with the larger size. It may be advantageous to use a series of drills of increasing size, particularly where holes of greater depth are required; for instance, should a 12mm diameter hole be required it may be prudent to start with a 6mm drill, followed by 9mm and then 12mm. When using drills to enlarge through holes, particular care should be taken with the feed pressure as the drill nears the point of breaking through to prevent the drill from snatching: damage to the work piece or drill could result should the drill be allowed to snatch. This applies particularly to the drilling of non-ferrous metals such as aluminium, brass, copper and bronze.

Cutting fluids should be used with drilling operations in the same manner as in turning operations.

Reaming

Where greater accuracy of a hole size is required the use of a reamer becomes necessary. The hole is first drilled slightly under size, preferably leaving only about a tenth of a millimetre (a few thousandths of an inch) of metal to be removed by the reamer, though the final choice may be dictated by the sizes of drills available. The correct type of machine reamer should be used and the lathe must be run at a slow speed for the operation to be wholly successful. Plenty of cutting fluid should be used if the material demands its use.

Boring

During drilling there is often a tendency for the drill to wander off line. The effect may be due to a number of factors but the initial use of a centre drill will help to alleviate this to some extent. It may be more noticeable where a series of drills are used to open out to a larger size, when the pressure on the less rigid lead drill may cause it to flex and wander. Subsequent larger drills will then tend to follow the pilot bore and in consequence increase the amount of error.

To obtain really accurate holes then boring operations are called for. The hole is started in the normal way by drilling and opening out to a reasonable size. A boring tool of suitable size is then mounted in the tool post and metal is removed from the inside of the hole in a similar manner to a normal turning operation. The difference in this case is that the handle for the cross slide is wound out to increase the depth of cut and to take further cuts. As before the dials on the cross slide handle can be used to indicate the amount of metal being removed. Generally it is better to use a slightly slower rotational speed than when external turning and cutting fluids are applied as necessary.

Where the work piece is of an awkward weight or shape such that it cannot be mounted satisfactorily either in the chuck or on the faceplate, it can be bolted to the cross slide for boring. This may be effected either by a cutting tool or boring head mounted on the lathe spindle or, if a through hole is required, by a between centres boring bar. As its name suggests, this type of boring bar is mounted between the lathe centres and driven from the lathe headstock and is a very accurate method. It has the disadvantage, though, that the tool bit must be adjusted accurately to obtain the required depth of cut and no built-in indication of depth is available. Once the correct settings for the tool and work are achieved, the cross slide should be locked for this operation and the cut is made by traversing the saddle along the lathe bed.

The boring head referred to above is not part of the lathe standard equipment or accessory range and therefore its detailed use is outside the scope of these instructions.

THREADING

It is often necessary to undertake threading operations in the lathe for which two standard methods are available. The first is similar to hand threading in that taps and dies are used, although more accurately aligned, and the second method is known as screw-cutting - where the thread is generated by a cutting tool held in the tool post. Both methods require some knowledge of threads to be cut as they vary in pitch (the number of threads over a given length), depth and flank angles. It is necessary therefore to refer to one of the many available thread charts that give this information.

Using Dies

Where a male thread is required, that is a thread on the outside diameter of the component, the use of a thread-cutting die is the most common method. The die is mounted in a special sliding die holder, which is located in the tailstock taper. The tailstock is positioned so that the die is just clear of the work and the lathe spindle rotated very slowly, preferably by hand - especially for the smaller, finer threads. As the die contacts the work it will engage and start to cut; it will then be pulled along the work by its own cutting action and must not be pushed with the tailstock feed. As with hand threading it is advisable to proceed slowly, stopping the cut after two or three rotations, and reversing a part of a turn to break any chips that form before proceeding. Removal of the die from the work is a simple matter of reversing the rotation to cause the die to unscrew from the thread it has generated.

When using this method it is worth remembering two factors, the correct diameter for the thread and the tendency for soft metals to clog the die and damage the thread being cut. The first factor is easy to remember, as generally the quoted diameter of the thread will be the diameter to which the component will first be machined. However, where a thread such as British Association (BA) or pipe (BSP) is required, for instance, such a thread does not conform to the rule and the correct diameter will have to be obtained by reference to a suitable chart. When cutting the softer metals, such as soft bronze and some grades of aluminium, the effect of metal build-up on the die can be minimised to a degree. This may be accomplished by reducing the diameter of the work very slightly, perhaps no more than 5% of the thread depth - the actual amount being calculated from the relevant thread chart. When threading any metal other than cast iron a suitable thread cutting compound should be used.

Using Taps

A tap is used to make internal threads in a component, which it does by cutting into a pre-drilled hole of the correct size. There are three standard types of tap, of any thread form, and they are taper, second and plug (or bottoming) and refer to the sequence in which they are used. In most cases, starting with the taper tap it is possible to go straight to the plug tap to finish the thread. Similarly, where the hole may not be very deep, it is equally possible to start with the second cut rather than the taper.

The internal, or root, diameter of the thread is the one to be considered when selecting the size of drill required to prepare the hole. Reference to the appropriate thread chart will provide the recommended drill size for the particular thread. Note that this is a recommended size and that the actual size used may be varied slightly to allow for type of material being worked and for ease of cutting. It is not uncommon to increase the diameter of the hole to give an effective thread depth of 70% of the tabled value where circumstances demand.

The tap is usually held in the tailstock chuck with the work rotating on the lathe spindle, or a sliding tap holder similar in principle to the die holder may be used if preferred. It is also possible to reverse the situation with the work at the tailstock and the tap held in the headstock chuck. Again the work may be bolted to the cross slide and tapped from the headstock if the work lends itself to this method.

Once the hole is correctly drilled the point of the tap is brought up to the work until it is felt to be just touching. If the tailstock chuck is to be used, then it is left loose and not clamped to the lathe bed; this is to enable the tailstock to be slid bodily but gently by hand to follow the thread of the tap as it cuts into the work. The lathe spindle should again be rotated very slowly, preferably by hand, and the procedure of reversing by part of a turn at frequent intervals to clear chips is essential. It is worth noting that a degree of caution is required during this operation as a broken tap in the work is almost impossible to remove! Once the full depth of the hole has been reached by the tap it may be withdrawn by reversing the direction of lathe rotation. The next or final depth tap can then be used in a similar manner.

Figure 15 Change Wheel Gear Train - Shown Set for Fine Feed

The flutes of the tap must at all times be kept free of swarf and a good cutting compound should always be used, both to ease the cutting action and to help with the clearance of swarf.

An alternative method of holding a tap, especially when greater sensitivity of feel is required, is to hold the tap in an ordinary tap wrench with the work remaining stationary. To ensure that the tap is correctly lined up with the work it should be held against a centre in the tailstock and a very light pressure maintained to keep the alignment. A similar method may be used with a standard diestock if a suitable holder is not available for use in the lathe; in this case the open end of the tailstock quill can provide the backing for the diestock.

Screw-cutting

The term screw-cutting generally refers to the use of a specially shaped single-point tool held in the tool post to do the thread forming. The correct thread pitch is derived from the amount of movement of the lathe carriage relative to the rotation of the lathe mandrel, which is in turn determined by a selection of gears on the quadrant (Figure 16). The depth of thread cut is obtained by advancing the cutting tool by the required amount. This process will generally involve making a number of passes with the tool to achieve the required depth of thread.

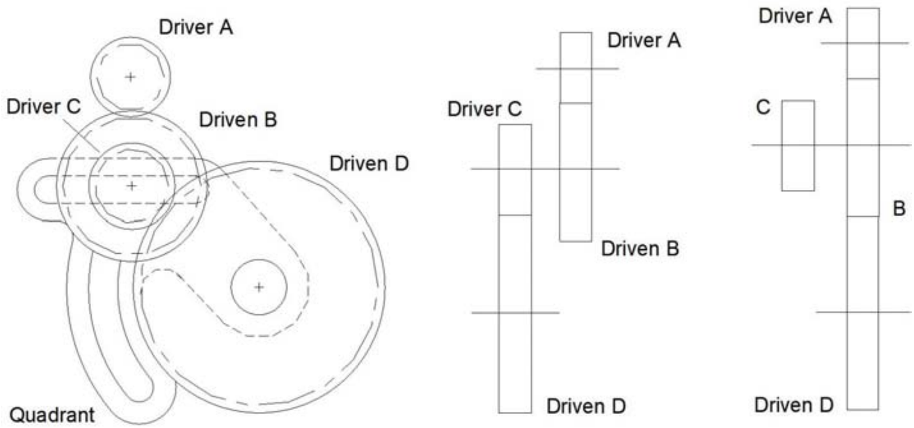
As supplied the lathe will be configured for the accurate cutting of either imperial or metric screw threads. It is assumed that the metric version will be more commonly in use and this will be detailed first. However, it should be noted that it is possible to achieve a close approximation of some metric threads on an imperial machine and vice versa. Such approximations may be quite satisfactory for many of the thread cutting applications, particularly if only short lengths of thread are required, but for more extensive use and to meet more exacting demands of the alternative thread standards then the appropriate machine will be required.

Listed in Tables 1 to 6 is a wide range of thread pitches that may be required. If the tables do not cover the desired thread pitch, however, then recourse to individual calculation will be necessary. For the metric machine, which has a 1.5mm pitch lead-screw, divide the required pitch in millimetres by 1.5. For the imperial machine, which has a 16tpi lead-screw, multiply the required pitch by 16 and determine which gear combinations match this figure.

For instance, to cut a 4BA thread, with a 0.66mm/0.0259842in. pitch, the equivalent factors will be 0.44 and 0.4157472. The change wheels that are required to approximate to these figures are 20/35 x 50/65 for the former and 35/60 x 57/80 for the latter, for a derived feed rate of 0.6593404mm and 0.0259765in. respectively. Note that these figures are only an approximation, although they are very close to those required, and the operator must decide whether they are sufficiently accurate for the purpose.

Imperial and Metric Specification Machines

The gears are set up to the pitch required according to the chart on the lathe quadrant cover or as listed in Tables 1 to 6 and shown in Figure 16. The range of pitches covered in the chart will be found to apply to most normal applications. The recommended set-ups are by no means exhaustive, however, and the range of pitches may be extended by applying alternative gear combinations. These may be derived from reference to published tables or by calculation from the available change wheel sizes. The positions of the chosen gears should be determined with care to ensure adequate meshing and clearances as appropriate.



Note: 1. Unspecified idler gears may be of any suitable size and posi tioned as convenient.

2. The combinations given are theoretical and in some cases only a close approximation is achievable. Not all combinations have been verified on the machine and thus may not be physically possible to achieve.

3. Pitches marked with an asterisk (*) in the tables require an additional idler gear in the train in order to achieve meshing.

Figure 16 Screw-cutting Gear Train

Table 1

Screw-cutting Data – Metric Pitches on Metric Machine

Target Pitch (mm)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (mm)	Error (mm)
0.25	20	55	35	80	0.2526	0.0026
0.40	20	65	45	55	0.3997	-0.0003
0.45	30	57	35	65	0.4499	-0.0001
0.50	20	57	45	50	0.5013	0.0013
0.70	35	55	45	65	0.6994	-0.0006
0.75	35	57	50	65	0.7498	-0.0002
0.80	40	55	45	65	0.7993	-0.0007
1.00	45	55	50	65	0.9991	-0.0009
1.25	35	50	45	40	1.2502	0.0002
1.50	40	55	65	50	1.5009	0.0009
1.75	40	57	55	35	1.7506	0.0006
2.00	40	50	55	35	1.9957	-0.0043
2.50	35	50	45	20	2.5003	0.0003
3.00	35	40	65	30	3.0096	0.0096

Table 2

Screw-cutting Data – Imperial Pitches on Metric Machine

tpi	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
6	0.1667	40	57	80	20	0.1754	0.0088
7	0.1429	50	55	80	30	0.1515	0.0087
8	0.1250	50	20	55	65	0.1322	0.0072
9	0.1111	60	20	50	80	0.1172	0.0061
10	0.1000	40	20	55	65	0.1058	0.0058
11	0.0909	50	65	60	30	0.0962	0.0052
12	0.0833	50	65	55	30	0.0881	0.0048
13	0.0769	40	50	57	35	0.0814	0.0045
14	0.0714	35	55	57	30	0.0756	0.0041
15	0.0667	40	65	55	30	0.0705	0.0038
16	0.0625	50	65	55	40	0.0661	0.0036
17	0.0588	35	40	57	50	0.0623	0.0035

Table 2 (continued)

tpi	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
18	0.0556	50	65	55	45	0.0588	0.0032
19	0.0526	55	57	60	65	0.0557	0.0030
20	0.0500	55	-	idler -	65	0.0529	0.0029
21	0.0476	35	45	57	55	0.0504	0.0028
22	0.0455	40	65	50	40	0.0481	0.0026
23	0.0435	35	57	60	50	0.0461	0.0026
24	0.0417	50	65	55	60	0.0441	0.0024
25	0.0400	50	80	65	60	0.0423	0.0023
26	0.0385	20	50	57	35	0.0407	0.0023
27	0.0370	20	50	55	35	0.0393	0.0022
28	0.0357	35	60	57	55	0.0378	0.0021
29	0.0345	35	-	idler -	60	0.0365	0.0020
30	0.0333	30	65	55	45	0.0353	0.0019
31	0.0323	35	40	50	80	0.0342	0.0019
32	0.0313	50	65	55	80	0.0331	0.0018
33	0.0303	40	60	50	65	0.0321	0.0017
34	0.0294	35	50	57	80	0.0312	0.0018
35	0.0286	20	65	55	35	0.0302	0.0016
36	0.0278	45	60	50	80	0.0293	0.0015
37	0.0270	20	50	40	35	0.0286	0.0015
38	0.0263	30	57	55	65	0.0278	0.0015
39	0.0256	20	60	65	50	0.0271	0.0014
40	0.0250	40	65	55	80	0.0264	0.0014
41	0.0244	30	50	55	80	0.0258	0.0014
42	0.0238	30	65	35	40	0.0252	0.0014
43	0.0233	35	50	45	80	0.0246	0.0014
44	0.0227	20	40	50	65	0.0240	0.0013
45	0.0222	20	65	55	45	0.0235	0.0013
46	0.0217	30	50	35	57	0.0230	0.0013
47	0.0213	20	80	65	45	0.0226	0.0013
48	0.0208	20	65	40	35	0.0220	0.0011
49	0.0204	20	55	57	60	0.0216	0.0012
50	0.0200	20	65	55	50	0.0212	0.0012
51	0.0196	20	-	idler -	60	0.0208	0.0012

Table 2 (continued)

tpi	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
52	0.0192	20	80	65	50	0.0203	0.0011
53	0.0189	20	57	50	55	0.0199	0.0011
54	0.0185	30	60	50	80	0.0195	0.0010
55	0.0182	20	- idler -		65	0.0192	0.0010
56	0.0179	35	65	45	80	0.0189	0.0011
57	0.0175	20	57	55	65	0.0186	0.0010
58	0.0172	35	60	40	80	0.0182	0.0010
59	0.0169	20	55	45	57	0.0179	0.0010
60	0.0167	20	60	55	65	0.0176	0.0010
64	0.0156	20	35	30	65	0.0165	0.0009
72	0.0139	20	60	40	57	0.0146	0.0007
76	0.0132	20	55	35	57	0.0140	0.0008
80	0.0125	20	65	55	80	0.0132	0.0007
88	0.0114	20	65	50	80	0.0120	0.0007
96	0.0104	20	35	20	65	0.0110	0.0006
104	0.0096	20	57	30	65	0.0101	0.0005

Table 3
Screw-cutting Data – BA Threads on Metric Machine

BA	Target Pitch (mm)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (mm)	Error (mm)
0	1.0000	20	45	60	40	1.00	0.00
1	0.9000	20	30	45	50	0.90	0.00
2	0.8100	40	57	50	65	0.81	0.00
3	0.7300	35	45	50	80	0.73	0.00
4	0.6600	20	35	50	65	0.66	0.00
5	0.5900	20	35	55	80	0.59	0.00
6	0.5300	20	35	40	65	0.53	0.00
7	0.4800	20	57	50	55	0.48	0.00
8	0.4300	20	35	30	60	0.43	0.00
9	0.3900	30	80	45	65	0.39	0.00

Table 3
Screw-cutting Data – BA Threads on Metric Machine

BA	Target Pitch (mm)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (mm)	Error (mm)
10	0.3500	20	50	35	60	0.35	0.00
12	0.2800	20	40	30	80	0.28	0.00
14	0.2300	20	57	35	80	0.23	0.00
16	0.1900	20	60	30	80	0.19	0.00

Table 4
Screw-cutting Data – Imperial Pitches on Imperial Machine

Target tpi	Gear Pitch (in.)	Gear A	Gear B	Gear C	Derived D	Pitch (in.)	Error (in.)
6	0.1667	80	- idler	-	30	0.1667	
7	0.1429	80	- idler	-	35	0.1429	
8	0.1250	80	- idler	-	40	0.1250	
9	0.1111	80	- idler	-	45	0.1111	
10	0.1000	80	- idler	-	50	0.1000	
11	0.0909	80	- idler	-	55	0.0909	
12	0.0833	40	- idler	-	30	0.0833	
13	0.0769	40	65	60	30	0.0769	
14	0.0714	40	- idler	-	35	0.0714	
15	0.0667	40	50	60	45	0.0667	
16	0.0625	40	- idler	-	40	0.0625	
17	0.0588	50	45	55	65	0.0588	
18	0.0556	40	- idler	-	45	0.0556	
19	0.0526	40	50	60	57	0.0526	
20	0.0500	40	- idler	-	50	0.0500	
21	0.0476	20	60	80	35	0.0476	
22	0.0455	40	- idler	-	55	0.0455	
23	0.0435	30	80	65	35	0.0435	
24	0.0417	40	- idler	-	60	0.0417	
25	0.0400	45	50	57	80	0.0401	+0.0001
26	0.0385	40	- idler	-	65	0.0385	
27	0.0370	20	60	80	45	0.0370	
28	0.0357	20	- idler	-	35	0.0357	

Table 4 (continued)

tpi	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
29	0.0345	20	57	55	35	0.0345	
30	0.0333	20	50	60	45	0.0333	
31	0.0323	30	40	55	80	0.0322	
32	0.0313	20	-	idler -	40	0.0313	
33	0.0303	30	45	40	55	0.0303	
34	0.0294	35	57	50	65	0.0295	+0.0001
35	0.0286	20	50	40	35	0.0286	
36	0.0278	20	-	idler -	45	0.0278	
37	0.0270	45	65	50	80	0.0270	
38	0.0263	20	57	60	50	0.0263	
39	0.0256	20	65	60	45	0.0256	
40	0.0250	20	-	idler -	50	0.0250	
41	0.0244	20	45	50	57	0.0244	
42	0.0238	20	35	40	60	0.0238	
43	0.0233	20	45	50	60	0.0231	-0.0002
44	0.0227	20	-	idler -	55	0.0227	
45	0.0222	20	45	40	50	0.0222	
46	0.0217	30	65	45	60	0.0216	-0.0001
47	0.0213	30	55	50	80	0.0213	
48	0.0208	20	-	idler -	60	0.0208	
49	0.0204	20	50	45	55	0.0205	+0.0001
50	0.0200	20	55	50	57	0.0199	-0.0001
51	0.0196	20	50	45	57	0.0197	+0.0001
52	0.0192	20	-	idler -	65	0.0192	
53	0.0189	35	65	45	80	0.0189	
54	0.0185	20	45	40	60	0.0185	
55	0.0182	20	50	40	55	0.0182	
56	0.0179	20	35	40	80	0.0179	
57	0.0175	20	50	40	57	0.0175	
58	0.0172	20	50	55	80	0.0172	
59	0.0169	20	80	65	60	0.0169	
60	0.0167	20	50	40	60	0.0167	
64	0.0156	20	-	idler -	80	0.0156	
72	0.0139	20	45	40	80	0.0139	

Table 4 (continued)

tpi	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
76	0.0132	20	50	30	57	0.0132	
80	0.0125	20	50	40	80	0.0125	
88	0.0114	20	55	40	80	0.0114	
96	0.0104	20	60	40	80	0.0104	
104	0.0096	20	60	30	65	0.0096	

Table 5
Screw-cutting Data – Metric Pitches on Imperial Machine

Target Pitch (mm)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (mm)	Error (mm)
0.25	20	55	35	80	0.2526	0.0026
0.40	20	65	45	55	0.3997	-0.0003
0.45	30	57	35	65	0.4499	-0.0001
0.50	20	57	45	50	0.5013	0.0013
0.70	35	55	45	65	0.6994	-0.0006
0.75	35	57	50	65	0.7498	-0.0002
0.80	40	55	45	65	0.7993	-0.0007
1.00	45	55	50	65	0.9991	-0.0009
1.25	35	50	45	40	1.2502	0.0002
1.50	40	55	65	50	1.5009	0.0009
1.75	40	57	55	35	1.7506	0.0006
2.00	40	50	55	35	1.9957	-0.0043
2.50	35	50	45	20	2.5003	0.0003
3.00	35	40	65	30	3.0096	0.0096

Table 6
Screw-cutting Data – BA Threads on Imperial Machine

BA	Target Pitch (in.)	Gear A	Gear B	Gear C	Gear D	Derived Pitch (in.)	Error (in.)
0	0.0394	45	55	50	65	0.0393	0.0000
1	0.0354	35	57	60	65	0.0354	0.0000
2	0.0319	20	55	80	57	0.0319	0.0000
3	0.0287	35	57	45	60	0.0288	0.0000
4	0.0260	35	60	57	80	0.0260	0.0000
5	0.0232	20	45	50	60	0.0231	-0.0001
6	0.0209	20	- idler	-	60	0.0208	0.0000
7	0.0189	35	65	45	80	0.0189	0.0000
8	0.0169	20	80	65	60	0.0169	0.0000
9	0.0154	20	57	35	50	0.0154	0.0000
10	0.0138	20	57	50	80	0.0137	-0.0001
12	0.0110	20	35	20	65	0.0110	0.0000
14	0.0091	20	50	20	55	0.0091	0.0000
16	0.0075	20	55	20	60	0.0076	0.0001

Having selected the range of gears and positions from the chart they are then mounted on their stub axles on the quadrant and lightly brought into mesh with their fixings left slightly loose. The correct mesh should be neither too tight nor too loose and may be readily determined with pieces of very thin aluminium, such as cooking foil. The strip of foil is inserted between the meshing gears and the lathe spindle is then rotated by hand; the foil should deform to the shape of the gear teeth but without any resulting tears or bruising and this will indicate the correct tooth clearance. Ensure any pieces of foil that have been used in this way are discarded after use; they could become caught up in the gears or lead-screw leading to subsequent damage or inaccuracy. Tighten the stub axle retainers and the quadrant locking screws then close the quadrant cover.

As described under Turning Operations, the drive to the lead-screw is controlled through a hand lever at the rear of the headstock. *The lever must not be operated with the lathe running.* Always ensure that the lathe is stopped before engaging the drive.

A cutting tool, shaped to the angle of the thread form to be cut, is mounted in the tool post and is allowed to traverse along the work. The angular setting of the tool is important and may vary with the thread being cut; not all

Figure 17 Clasp Nut Lever

threads have the same angle and again these may be determined by reference to the appropriate thread chart.

Screw-cutting operations should be carried out with the lathe running at a low speed, especially until operator experience is gained. The tool is fed into the work a little at a time, noting the reading on the cross slide dial. The automatic feed can then be engaged, via the clasp nut lever at the lower right of the apron, and the carriage traversed until the required length of thread is obtained. At this point the drive is disengaged, the tool is withdrawn by winding back the cross slide and the lathe is reversed, or the hand-wheel used, to drive the carriage back to the starting position. The tool is then fed back in to its original position plus the extra amount required for the next cut. The operation is repeated until the full thread depth is obtained.

A similar procedure is used when cutting internal threads but in this case the tool is shaped like a miniature boring tool with the correct thread angles ground on. Alternatively a shaped tool bit in a boring bar may be used

Figure 18 Thread Dial Indicator

if the hole diameter is sufficient to allow this. Whatever type of cutter is used it must be remembered that the movement of the cross slide will be in the opposite sense to that used for cutting external threads. If it is possible to do so, it is recommended that an internal thread be chased down with a tap of the correct size to ensure a smooth thread face.

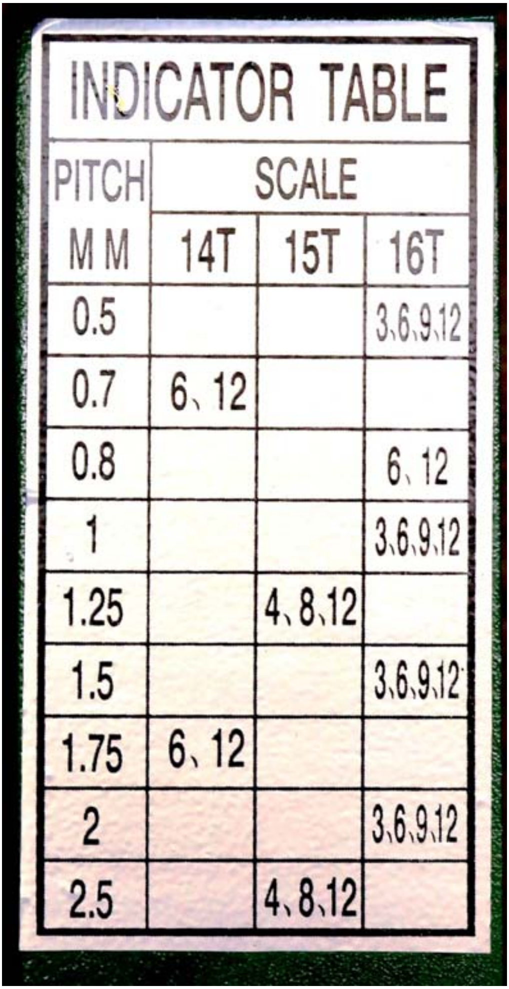
The more experienced operator may prefer to set over the top slide of the lathe to half the thread angle and to advance the tool using the top slide only. This means that the cutting tool will cut only on the leading edge and this generally produces a smoother thread. If using this method then allowance must be made for the angularity of the tool when noting the amount of in-feed.

While the combinations on the chart cover the most commonly used range of thread pitches, it is not exhaustive and other pitches may be calculated and set up.

Cutting left-hand threads of either type is accomplished by reversing the direction of carriage travel in relation to the spindle rotation.

Use of the Thread Dial Indicator (Figure 18)

A feature of the machine is the thread dial indicator, which is located at the right hand side of the carriage assembly and its use greatly simplifies picking up the thread again where a multi-pass cut is required. This item features a twelve-point calibrated dial and pointer, the dial being driven via a small pinion that is set to remain in engagement with the lead-screw. The indicator supplied for imperial applications, however, has a dial calibrated with eight marker points.



INDICATOR TABLE

PITCH MM	SCALE 14T	SCALE 15T	SCALE 16T
0.5			3、6、9、12
0.7	6、12		
0.8			6、12
1			3、6、9、12
1.25		4、8、12	
1.5			3、6、9、12
1.75	6、12		
2			3、6、9、12
2.5		4、8、12	

Figure 19 Thread Dial Indicator Pinion Selection and Engagement Points

Engage the clasp nut by operating the feed lever and the dial rotates as the cut proceeds. At the end of the cut the clasp nut is disengaged, the tool wound clear of the work and the carriage traversed back to the start point. Reset the tool for the next cut and observe the continued rotation of the dial until the required division marker aligns with the zero line, then re-engage the clasp nut. Note that this procedure will ensure a satisfactory pick-up for all normal thread cutting operations.

For many thread pitches the clasp nut may be re-engaged at other division marks on the dial; for metric pitches refer to the following table, where P = thread pitch and *n* = the number of divisions from the start point.

Table 7

Thread Dial Indicator – Metric Pitches

P	**0.25**	**0.4**	**0.45**	**0.5**	**0.7**	**0.75**	**0.8**	**1.0**	**1.25**	**1.5**	**1.75**	**2.0**	**2.5**	**3.0**
n	3	6	*x*	3	*x*	3	6	3	3	*a*	3	3	3	*a*
	6	12		6		6	12	6	6		6	6	6	
	9			9		9		9	9		9	9	9	
	12			12		12		12	12		12	12	12	

The correct drive pinion for the indicator must be fitted before starting to cut a thread; for 0.7 and 1.75 pitches the 14T pinion is required, for 1.25 and 2.5 pitches the 15T pinion is used and remaining pitches make use of the 16T pinion. The label on the left front of the lathe (Figure 19) shows the engagement points on the indicator.

For example, from the table it will be seen that for a thread pitch of 1mm the clasp nut can be engaged at position 12 (0) and three, or a multiple of three, divisions later, i.e. 3, 6 or 9. Where *n* = *a* the thread pitch is a direct multiple of the lead-screw pitch and the thread may be picked up at any point on the indicator dial. Where *n* = *x* the thread can only be picked up at position 1, assuming that position 1 was the point chosen to start the first cut.

Imperial pitches require a slightly different approach since they are calculated on a number of threads per inch rather than the actual pitch distance. Any intended thread that is a direct multiple of the lead-screw pitch, for example 32 tpi, may be picked up at any point on the dial rotation. Threads divisible by 8 are picked up on any of the dial markers, while those divisible by 4 (but not by 8) are picked up on any of the numbered markers or any of the plain markers but not in combination. Those divisible by 2 (but not by 4 or 8) are picked up on opposite numbered markers, that is 1 or 5 and 3 or 7 or on their equivalent plain markers. Odd numbered threads are picked up each time on the same pointer on the dial. For instance a 26tpi thread can be picked up at positions 1 and 5, 3 and 7 etc. The recommended pick-up pointers for a typical range of threads are defined in Table 7. Similar information is given on a label on the front of the machine.

For threads that do not represent whole numbers, for example on most BA threads, then the clasp nut should be left in engagement and, after withdrawing the cutting tool, the carriage is moved back to the start by means of the lead-screw drive or by the hand-wheel.

Gib Strip Adjustment

Both slide movements incorporate tapered gib strips that are adjustable to compensate for wear on the slides. Their use is described later in the Maintenance section of this handbook.

Taper Shank Drills

Taper shank drills rely on the friction of the taper to retain them in the shaft socket. Inserting the drill shank into the socket and hand pressing the drill against the taper is usually sufficient to establish the lock. If this is unsuccessful, however, further pressure may be obtained by placing a small block of wood against the point of the drill and applying pressure via the quill feed. *Do not use more force than is necessary to achieve the lock*.

Release the lock on the taper by retracting the quill until the tool impinges on the feed screw, thus releasing the drill.

MAINTENANCE

Regular maintenance will ensure that the machine will continue to perform at its best and maintain its accuracy. There is not a great deal of maintenance required on the lathe but it is important to keep it clean. Swarf should be brushed off using a brush with hairs of a medium hardness, after which all surfaces should be rubbed over with a clean dry cloth. Painted surfaces can be cleaned by rubbing with a cloth moistened with neat washing-up liquid followed by wiping with a dry cloth. Bright surfaces can be wiped with a dry cloth to which is added a small amount of light oil. If the machine is to be out of service for any length of time then a spray of Duck Oil or WD40 is recommended.

Note: Cleaning the machine by means of compressed air is not recommended as such use can drive small particles of swarf and other debris into the slide ways and cause premature and unnecessary wear.

The following procedures should be undertaken by the operator at the suggested intervals.

Daily

1. Apply the oil gun to all the oiling points before starting work each day.
2. Keep the work area clean, especially the bed and slide ways, and remove all swarf and cutting fluid at the end of the day's work. If the machine is located in an area where condensation and rust are a problem, apply a moisture repellent oil to the exposed surfaces.

Weekly

1. Clean the feed screws and apply a fresh coating of oil.
2. Check the sliding surfaces for any abrasions; clean and apply a fresh coating of oil.

Monthly

1. Check the slide ways for smooth operation. Remove any slackness by adjusting the gib strip screws.

Yearly

Check general condition, paying particular attention to electric cables, connectors and switches, which should be free from damage, wear or insecurity.

Note: The foregoing schedule is based on the assumption that the machine is in regular use throughout the year. If use is intermittent, the schedule may be varied at the discretion of the operator and the service attentions postponed or combined. However, they should not be overlooked.

Slide Adjustment

The slides can be adjusted to compensate for wear by means of the gib strips; the adjustment procedure is the same for each of the slides. Loosen the locknuts on each of the adjusting screws on the slide requiring adjustment. With the slide set at its approximate central position and starting at the screw nearest the centre and working outwards, turn the screws to increase slightly the pressure on the gib strips. Only very small amounts of adjustment will be required; the slides should move smoothly with no evident slackness or resistance at any point. When the correct setting is achieved, re-tighten the locknuts ensuring that the settings of the screws are not disturbed.

If at any time when adjusting or working an extra resistance is felt on any of the slides it should be investigated. The most likely cause is the presence of swarf or some other foreign body in the slide and this should be removed and the settings re-checked.

Spindle Bearings

The spindle main bearings are adjusted before the lathe leaves the factory and no further adjustment should be required. Only after extensive use or bearing failure necessitating replacement will it be necessary to disturb the spindle settings. Similarly there is no adjustment to any of the lead-screws; if excessive wear is experienced on any of these components they are easily replaced.

Lubrication

Lubrication can be considered to be general oiling and greasing and any light machine oil or medium grease will suffice.

The frequency of carrying out any of the lubrication procedures will depend to a large extent on the amount and type of use to which the machine is put. Consequently much may be left to the discretion of the owner/ operator as to when lubrication is effected. However, on no account should the attentions be ignored.

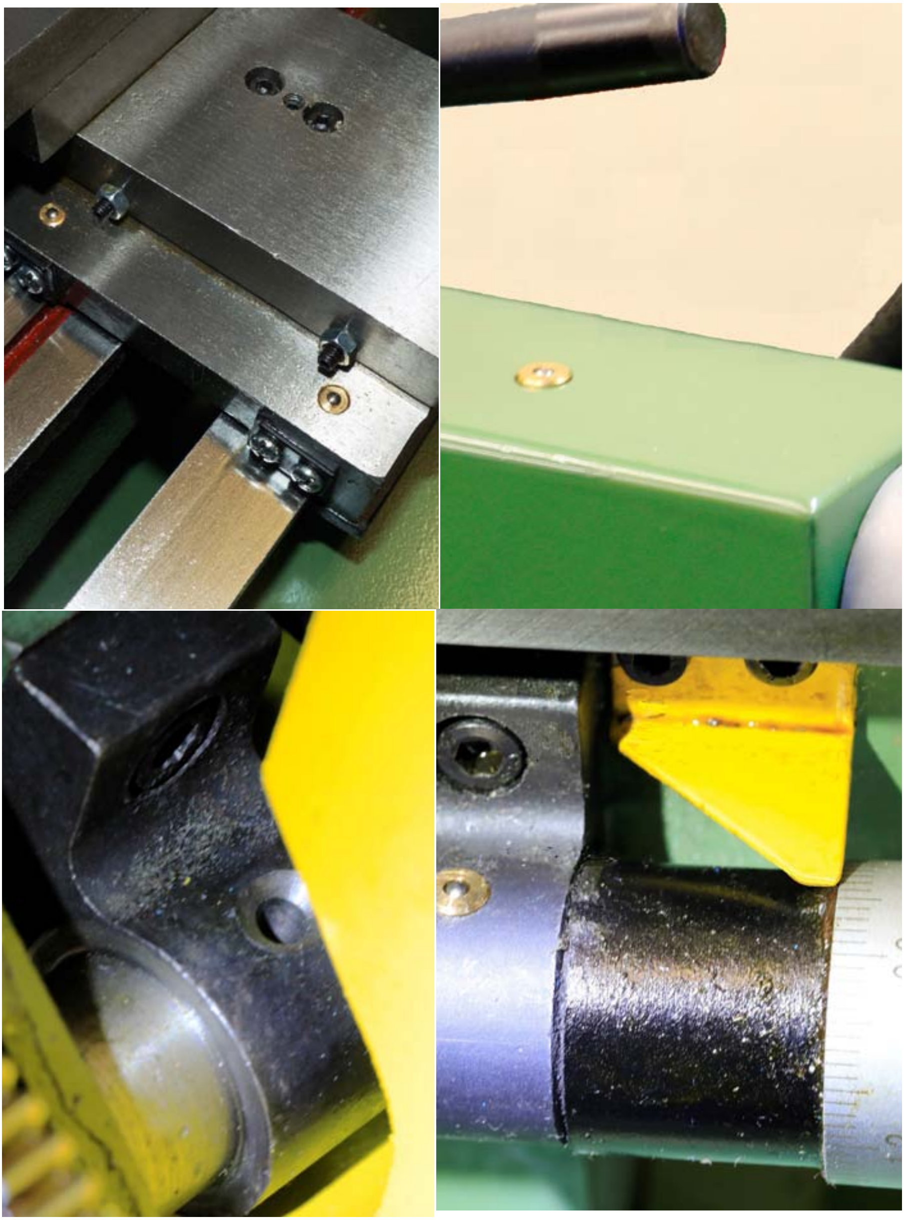


Figure 20 Lubrication Points

Upper left - Carriage Assembly   Upper right - Tailstock
Lower left - Leadscrew (headstock end)
Lower right - Leadscrew (tailstock end)

FAULT FINDING

Any malfunction should be investigated immediately and the fault rectified. Any overheating or unusual noises from any source will indicate that some fault condition exists. The following details the most likely problems that may be experienced and the suggested remedy. Any faults not covered here should be referred to your dealer or direct to the distributor and advice sought.

Motor does not run when switched on

Supply fuse blown - check and replace if necessary.

Faulty connection at socket or junction box - check and re-make connection.

Supply voltage incorrect - check and adjust (if applicable).

Motor overheats, produces diminished or no power

An overload condition exists - reduce the rate of feed, depth of cut or cutting speed.

Supply voltage too high - adjust.

Incorrect power fuse allowing excess current to motor - switch off and replace with correct fuse.

Magnetic switch contacts eroded - renew.

Overload relay inoperative or is open circuit - re-connect or renew.

Motor unserviceable - renew.

Spindle bearings becoming hot

Prolonged use at high speed - allow to cool and resume with light cuts.

Spindle bearings too tight (tightness of rotation may be felt by hand) - refer to dealer.

Main spindle revolves but lacks power

Motor faulty - renew.

Carriage movement erratic, producing chatter marks

Check rate of feed and depth of cut and adjust.

Check tension on gib strip adjustment screws - tighten if necessary.

Chatter marks other than through carriage movement

Spindle bearings – check clearance and adjust if necessary - refer to dealer.

Bearing covers – check for security.

Taper slides – check tension on gib strip adjustment screws and tighten if necessary.

Cutter arbor or chuck insecure in drive socket - tighten.

Cutter damaged or in need of sharpening - renew or re-sharpen.

Work piece insecurely held - tighten or rearrange clamp bolts.

Lack of accuracy in cut

Work piece out of balance or insecurely held - re-clamp to give more secure work holding.

Incorrect setting of gib strips on slide movement - check and reset correct movement.

Use of hammer to reposition work piece on table, thus transferring blows through work piece to table and feed-screw - DO NOT USE A HAMMER TO POSITION THE WORK.

PARTS
IDENTIFICATION

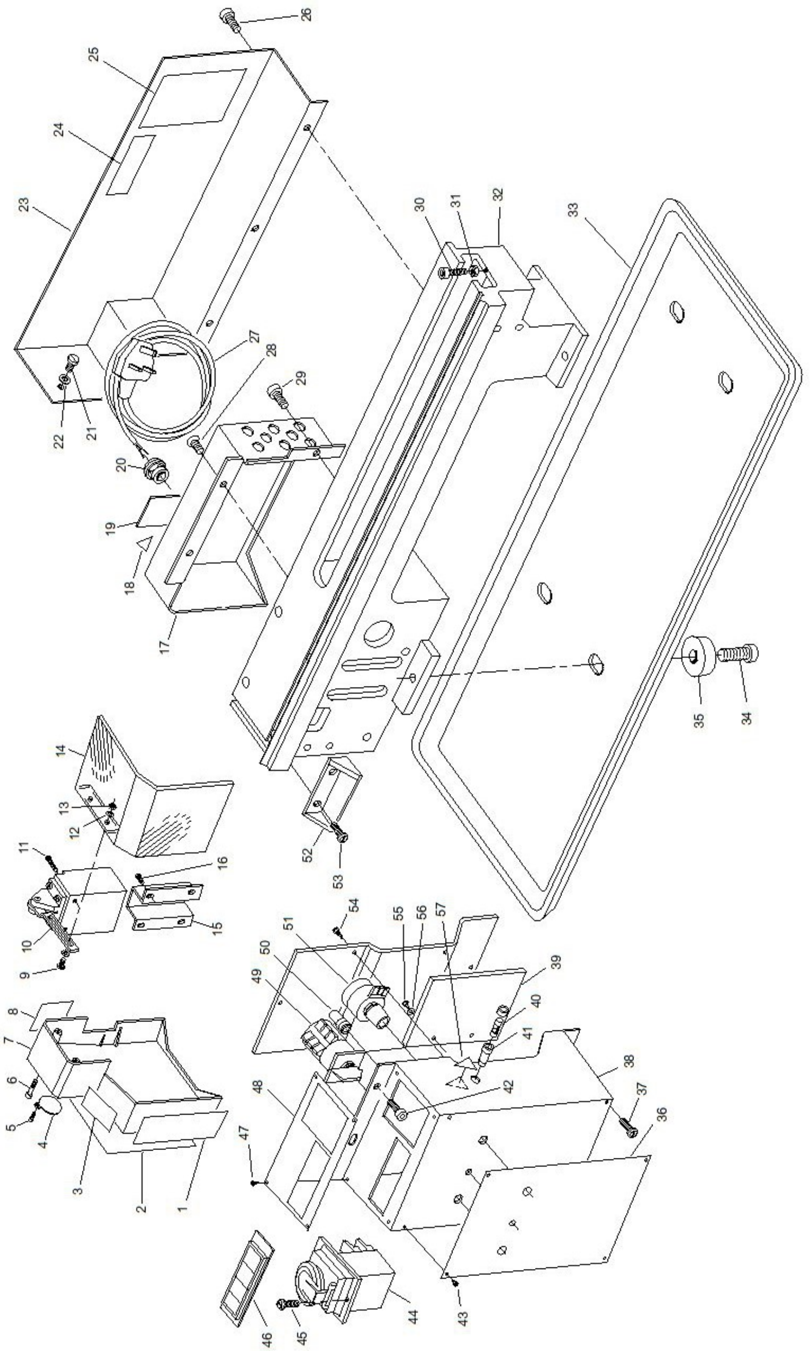


Figure 21 Bed, Chip Tray and Covers

Figure 21 Bed, Chip Tray and Covers - Parts List

Ref. No.	Description	Quantity (per machine)
1	Thread indicator label	1
2	Change gear setting chart	1
3	Forward/Reverse warning label	1
4	Spindle bore access cover	1
5	Screw, M3 x 6	1
6	Screw, M5 x 40	2
7	Gear train cover	1
8	Feed direction warning label	1
9	Screw, M4 x 10	2
10	Guard operation microswitch	1
11	Screw, M4 x 30	2
12	Washer, M4	2
13	Nut, M4	2
14	Chuck chip guard	1
15	Cable channel	1
16	Screw, M4 x 6	4
17	Motor cover	1
18	Warning label, electrical hazard	1
19	Label, machine data	1
20	Cable retainer	1
21	Screw, M5 x 8	1
22	Washer, M5	1
23	Rear splash guard	1
24	Label, hand protection	1
25	Label, general safety notes	1
26	Screw, M5 x 8	4
27	Plug and cable, 13A	1
28	Screw, countersunk, M5 x 8	1
29	Screw, M5 x 8	2
30	Screw, M6 x 16	1
31	Nut, M6	1
32	Bed way	1
33	Chip tray	1
34	Screw, M6 x 16	4
35	Rubber pad	4
36	Model label	1
37	Screw, M5 x 12	2
38	Control box	1
39	Circuit board assembly	1
40	Fuse link	1
41	Fuse holder	1
42	Screw, plated, M5 x 12	2
43	Screw, self-tapping, 3 x 6	4

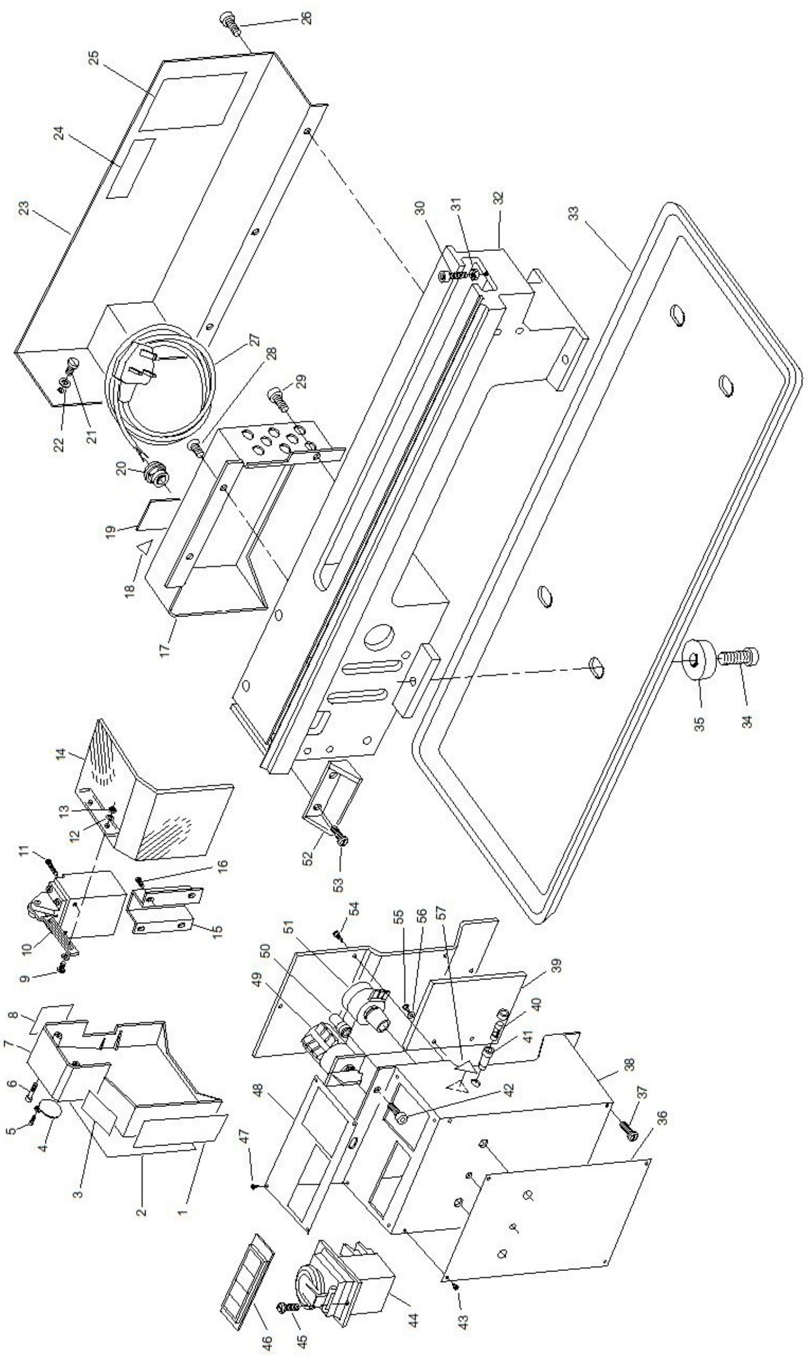


Figure 21 Bed, Chip Tray and Covers

Figure 21 Bed, Chip Tray and Covers - Parts List (continued)

Ref. No.	Description	Quantity (per machine)
44	Start/Stop and Emergency Stop switch	1
45	Screw, self-tapping, 4 x 12	2
46	Digital spindle speed indicator	1
47	Screw, self-tapping, 3 x 6	4
48	Speed indication label	1
49	Forward/Off/Reverse switch	1
50	Indicator lamp	1
51	Variable speed control potentiometer	1
52	Bracket, cable guard	1
53	Screw, M5 x 8	2
54	Screw, self-tapping, 4 x 15	6
55	Screw, self-tapping, 5 x 8	2
56	Washer, M5	2
57	Warning label, electrical hazard	1

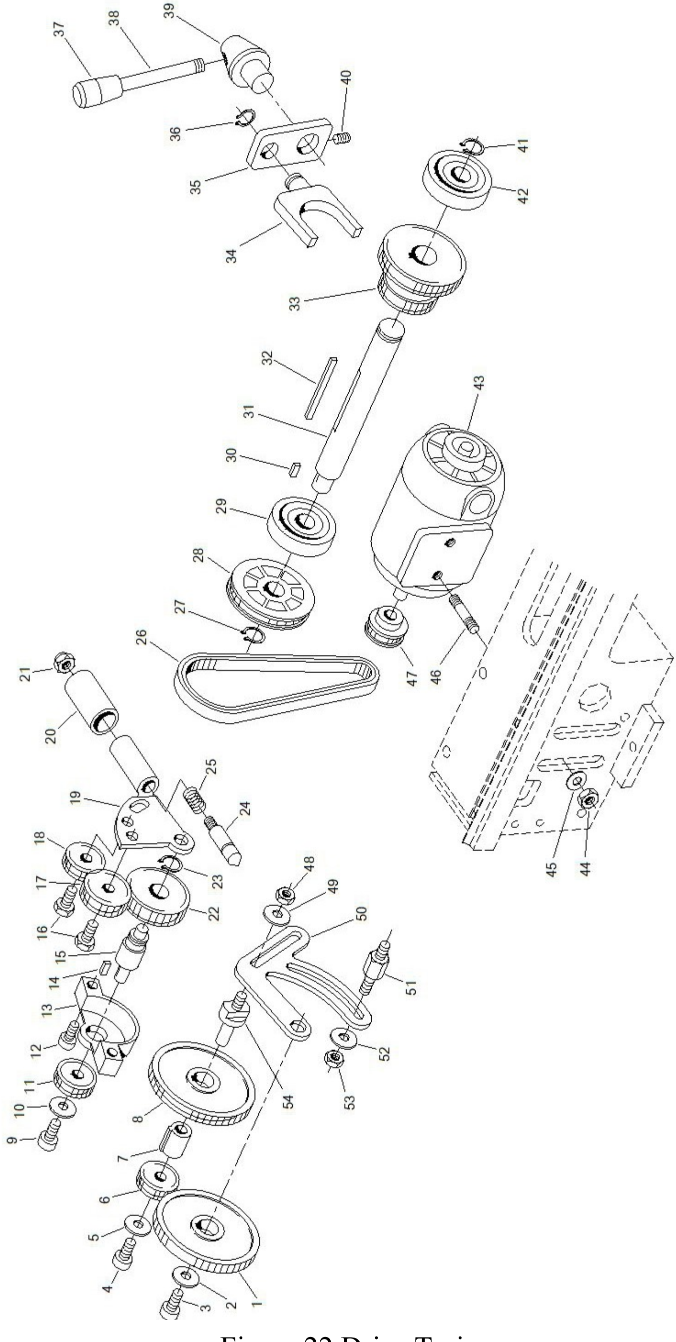


Figure 22 Drive Train

Figure 22 Drive Train - Parts List

Ref. No.	Description	Quantity (per machine)
1	Gear, 80T	1
2	Washer, M6	1
3	Screw, M6 x 10	1
4	Screw, M5 x 10	1
5	Washer, M6	1
6	Pinion, 20T	1
7	Bush, with key	1
8	Gear, 80T	1
9	Screw, M5 x 10	1
10	Washer, M5	1
11	Pinion, 20T	1
12	Screw, M5 x 15	3
13	Gear casing	1
14	Parallel key, 4 x 8	1
15	Shaft	1
16	Support screw	2
17	Pinion, 25T	1
18	Pinion, 20T	1
19	Changeover lever	1
20	Handle	1
21	Dome nut, M6	1
22	Gear, 45T	1
23	Retaining ring, 12 dia	1
24	Detent pin	1
25	Compression spring	1
26	Drive belt	1
27	Retaining ring, 10 dia	1
28	Pulley	1
29	Ball bearing, 6201ZZ	1
30	Key, 4 x 8	1
31	Hi/Lo gear shaft	1
32	Parallel key, 4 x 45	1
33	Duplex gear, 12T/20T	1
34	Speed change fork	1
35	Speed change arm	1
36	Retaining ring, 10 dia	1
37	Speed change lever knob	1
38	Speed change lever shaft	1
39	Speed change lever hub	1
40	Screw, M5 x 8	1
41	Retaining ring, 12 dia	1
42	Ball bearing, 6201ZZ	1
43	Motor	1

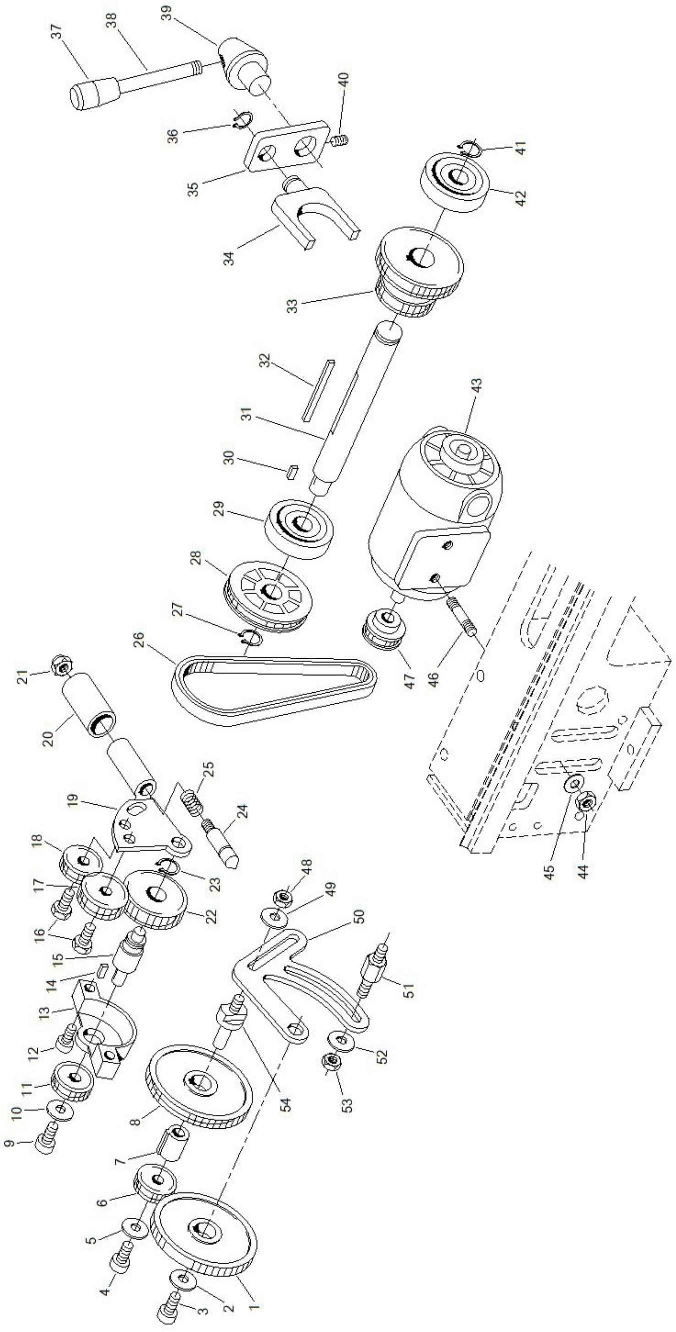


Figure 22 Drive Train

Figure 22 Drive Train - Parts List (continued)

Ref. No.	Description	Quantity (per machine)
44	Nut, M6	2
45	Washer, M6	2
46	Stud, M6 x 16	2
47	Pulley	1
48	Nut, M8	1
49	Washer, M8	1
50	Change wheel quadrant	1
51	Shaft, quadrant guide	1
52	Washer, M8	1
53	Nut, M8	1
54	Shaft, change gear	1
*55	Change gear, 30T	1
*56	Change gear, 35T	1
*57	Change gear, 40T	2
*58	Change gear, 45T	1
*59	Change gear, 50T	1
*60	Change gear, 55T	1
*61	Change gear, 57T	1
*62	Change gear, 60T	2
*63	Change gear, 65T	1

*Item not illustrated

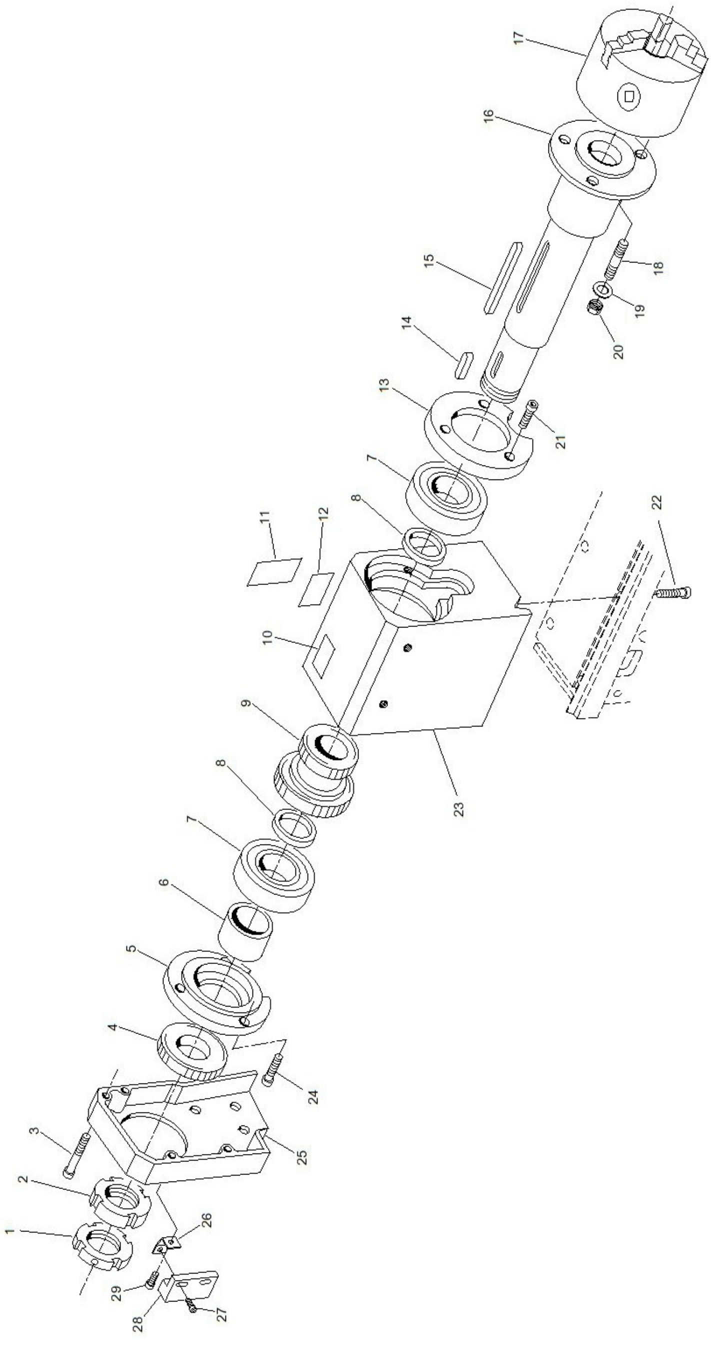


Figure 23 Headstock and Mandrel

Figure 23 Headstock and Mandrel - Parts List

Ref. No.	Description	Quantity (per machine)
1	Spindle speed drive nut	1
2	Nut	2
3	Screw, M6 x 20	2
4	Spur gear, 45T	1
5	Bearing cover	1
6	Spacer	1
7	Ball bearing, 6206ZZ	2
8	Spacer	2
9	Duplex gear, 21T/29T	1
10	Eye protection warning label	1
11	Feed direction label	1
12	High/Low label	1
13	Bearing cover	1
14	Key, 4 x 8	1
15	Key, 5 x 40	1
16	Spindle	1
17	Chuck, 3-jaw	1
18	Stud, M6 x 16	3
19	Washer, M6	3
20	Nut, M6	3
21	Screw, M5 x 10	3
22	Screw, M8 x 25	4
23	Headstock casting	1
24	Screw, M5 x 10	3
25	Fixed cover	1
26	Sensor mounting bracket	1
27	Screw, M3 x 7	2
28	Spindle speed sensor	1
29	Screw, M5 x 8	1
*30	External jaws, set of 3	1
*31	Chuck key	1

* Item not illustrated

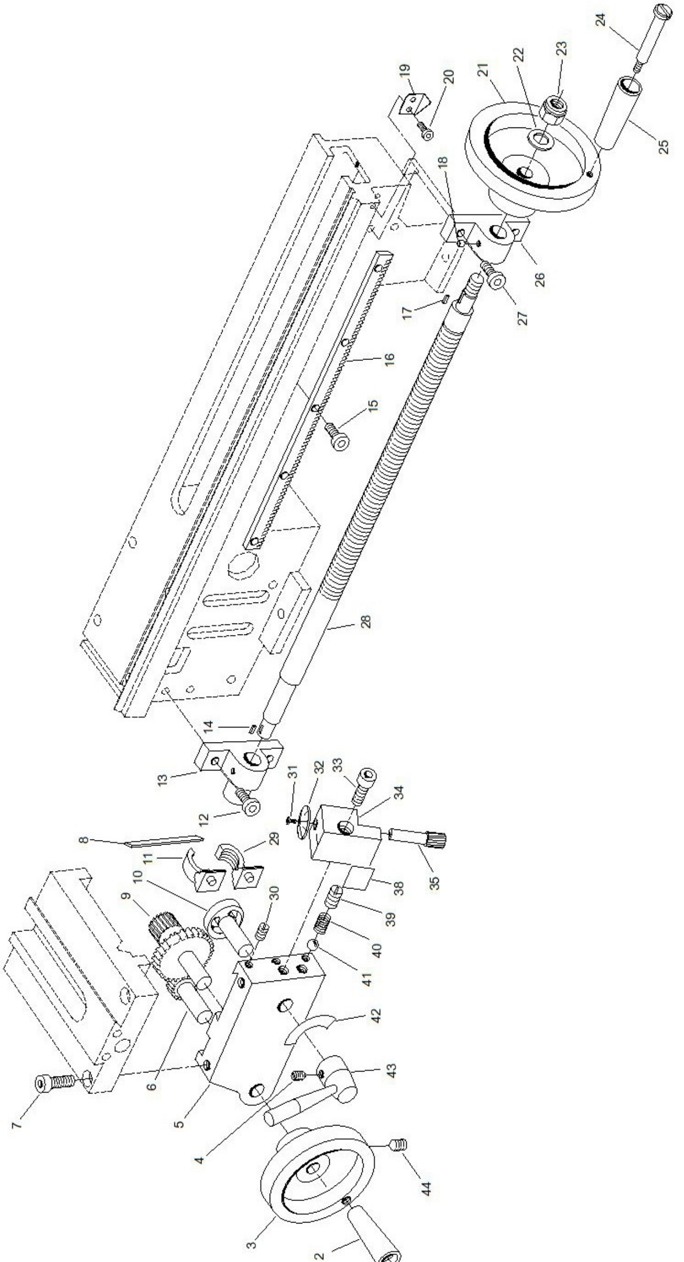


Figure 24 Lead Screw and Apron

Figure 24 Lead Screw and Apron - Parts List

Ref. No.	Description	Quantity (per machine)
1	Bolt, shouldered, M6 x 46	1
2	Knob	2
3	Wheel	2
4	Screw, M6 x 6	1
5	Apron	1
6	Feed gear (B), 24T	1
7	Screw, M8 x 20	2
8	Gib Strip	1
9	Feed gear (A), 11T/54T	1
10	Groove cam	1
11	Half nut, upper, with shaft	1
12	Screw, M6 x 16	2
13	Bracket, leadscrew, left	1
14	Key, B4 x 8	1
15	Screw, M3 x 10	4
16	Rack	1
17	Key, 3.5 x 12	1
18	Oil cup	1
19	Pointer plate	1
20	Screw, M4 x 6	2
21	Feed wheel	1
22	Washer, M6	1
23	Nut, self-locking, M6	1
24	Bolt, shouldered, M6 x 45	1
25	Feed wheel handle	1
26	Bracket, leadscrew, right	1
27	Screw, M6 x 16	2
28	Lead-screw	1
29	Half nut, lower, with shaft	1
30	Screw, M4 x 10	3
31	Set screw, M4 x 10	1
32	Thread indicator dial, 16T	1
33	Screw, M6 x 16	1
34	Dial indicator body	1
35	Pinion shaft, 16T	1
*36	Pinion shaft, 15T	1
*37	Pinion shaft, 14T	1
38	Label, leadscrew pitch	1
39	Set screw, M6 x 6	1
40	Compression spring, 4 x 9	1
41	Steel ball, 5 dia	1
42	Label, engage/disengage	1
43	Handle	1
44	Screw, M6 x 12	1

* Item not illustrated – metric machine only

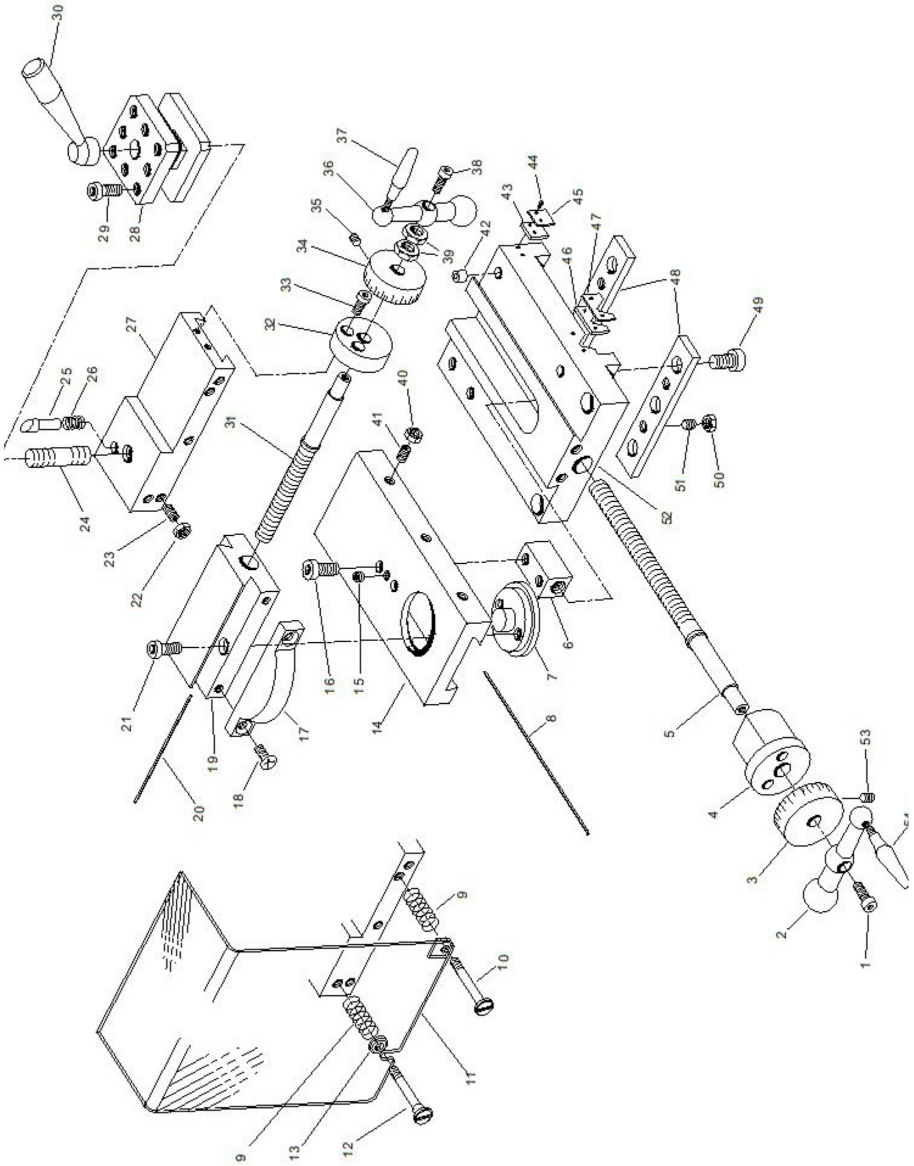


Figure 25 Cross and Compound Slides

Figure 25 Cross and Compound Slides - Parts List

Ref. No.	Description	Quantity (per machine)
1	Screw, M6 x 10	1
2	Handle body	1
3	Dial	1
4	Bracket	1
5	Feed screw	1
6	Feed nut	1
7	Swivel disk	1
8	Gib strip	1
9	Compression spring	2
10	Bolt, plain, M5 x 25	1
11	Chip guard	1
12	Bolt, shouldered, M5 x 25	1
13	Washer, bevel	1
14	Cross slide	1
15	Screw, M4 x 10	1
16	Screw, M8 x 20	2
17	Angled setting block	1
18	Screw, M4 x 10	2
19	Compound slide, lower	1
20	Gib strip	1
21	Screw, M6 x 16	2
22	Nut, M4	3
23	Screw, M4 x 16	3
24	Stud, M10 x 50	1
25	Positioning pin	1
26	Compression spring, 4 x 9	1
27	Compound slide, upper	1
28	Tool post	1
29	Screw, M8 x 25	8
30	Clamping lever	1
31	Cross feed screw	1
32	Bracket	1
33	Screw, M4 x 14	2
34	Dial	1
35	Screw, cup point, M6 x 10	1
36	Handle body	1
37	Handle	1
38	Screw, M6 x 10	1
39	Nut, M10	2
40	Nut, M4	3
41	Screw, M4 x 16	3
42	Oil cup	2
43	Bed way wiper, rear	2

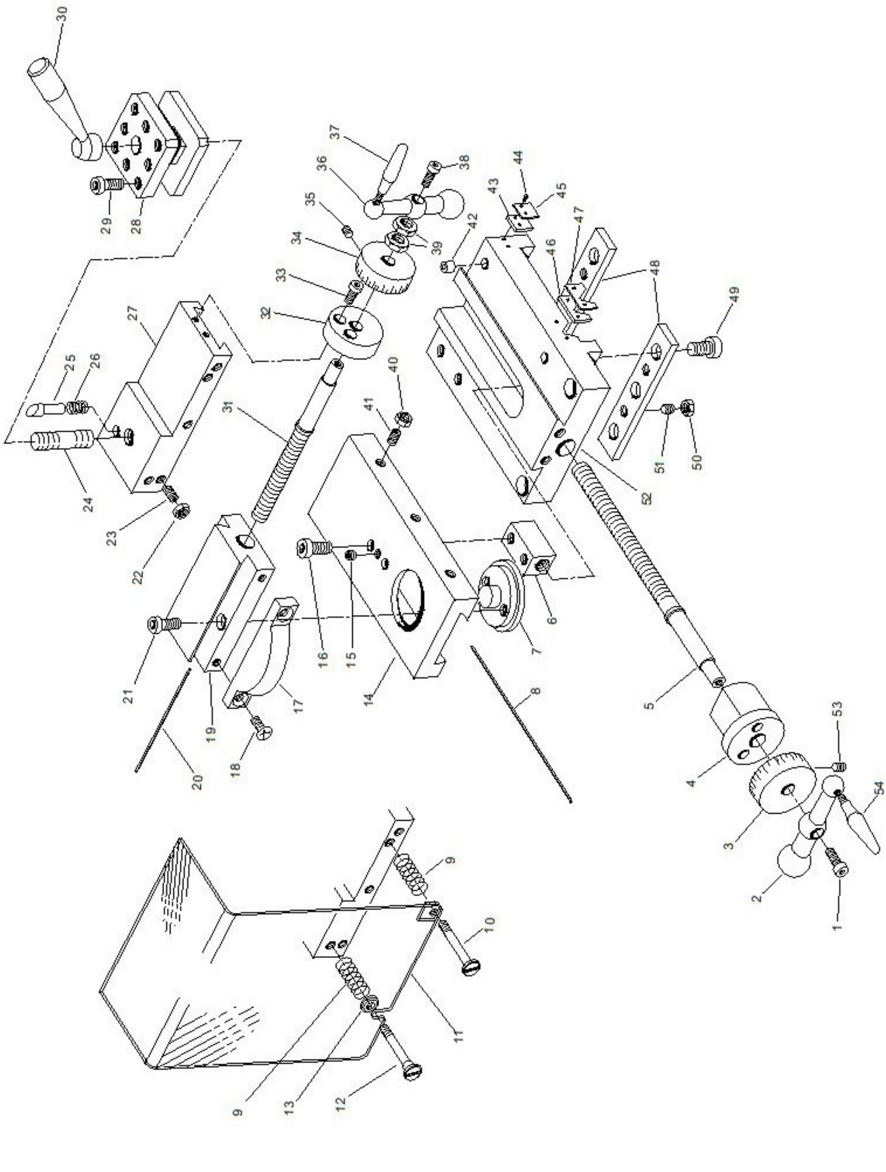


Figure 25 Cross and Compound Slides

Figure 25 Cross and Compound Slides - Parts List (continued)

Ref. No.	Description	Quantity (per machine)
44	Screw, M4 x 6	8
45	Plate, rear wiper	2
46	Bed way wiper, front	2
47	Plate, front wiper	2
48	Slide plate	2
49	Screw, M6 x 12	6
50	Nut, M5	4
51	Screw, M5 x 8	4
52	Saddle	1
53	Screw, cup point, M6 x 10	1
54	Handle	1

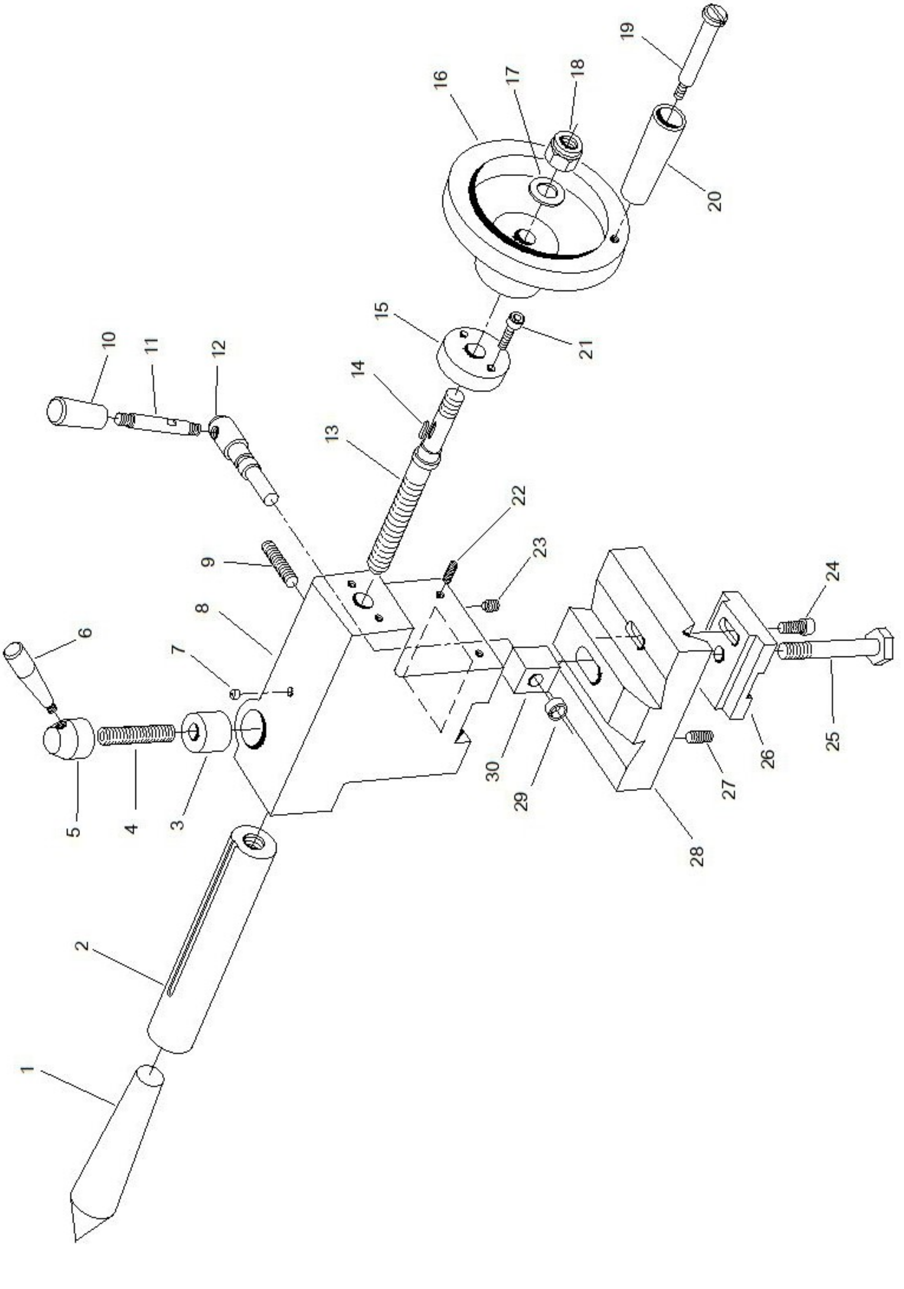


Figure 26 Tailstock Assembly

Figure 26 Tailstock Assembly - Parts List

Ref. No.	Description	Quantity (per machine)
1	Centre	1
2	Tailstock quill	1
3	Clamp collar	1
4	Stud, M8 x 35	1
5	Clamp shaft	1
6	Handle	1
7	Oil cup	1
8	Tailstock casting	1
9	Screw, M6 x 30	1
10	Knob, release lever	1
11	Release lever	1
12	Eccentric shaft	1
13	Tailstock feed screw	1
14	Key, 3.5 x 12	1
15	Bracket	1
16	Feed wheel	1
17	Washer, M6	1
18	Nut, self-locking, M6	1
19	Bolt, shouldered, M6 x 45	1
20	Feed wheel handle	1
21	Screw, M3 x 10	2
22	Screw, cup point, M5 x 15	2
23	Screw, dog point, M5 x 8	2
24	Screw, M5 x 14	1
25	Bolt, hexagon, M8 x 50	1
26	Clamp plate	1
27	Screw, M6 x 20	1
28	Base	1
29	Bearing sleeve	1
30	Clamping block	1

APPENDIX 1

SPECIFICATIONS AND FEATURES

Motor	½ HP, single phase	
CAPACITY – TURNING	mm	in.
Swing over bed	180	7
Swing over cross slide	100	3.94
Height of centre	90	3.5
Distance between centres	350	13.78
HEADSTOCK		
Spindle bore ... ... …	20	0.79
Spindle taper in nose	No.3 MT	
Spindle speeds, infinitely variable ... …	range 50 to 2900rpm	
CARRIAGE AND COMPOUND SLIDE		
Cross slide travel...	70	2.76
Compound slide travel	45	1.77
Cutting tool (max section)	10	0.375
THREADS AND FEEDS		
Imperial pitches (26)	range 12 to 52 per inch	
Metric pitches (12)	range 0.5mm to 2.5mm	
TAILSTOCK		
Internal taper	No.2 MT	
Quill travel...	50	2
WEIGHTS AND MEASUREMENTS		
Overall length	820	32.28
Overall width	254	10
Overall height	260	10.25
Net weight (approx)	38kg (84 lb)	

APPENDIX 2

STANDARD EQUIPMENT

Change gear set and lead-screw for either metric or imperial screw-cutting

Chuck guard

Tool post guard

Dual graduated friction dials, metric or imperial

Four-way indexable tool post

Full electrics, including no volt release push button ON/OFF switch, emergency stop switch

Induction hardened and ground bedway

No. 2MT dead centre

Three-jaw self-centring chuck with inside and outside jaws

Tool kit, including open end and hexagon key wrenches and oil container

OPTIONAL ACCESSORIES

Faceplate

Four-jaw independent chuck

Drill chuck and arbor

Set of TCT and indexable lathe tools

Quick change tool and holders

Fixed steady

Travelling steady

Vertical slide

Live centres

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