

B. R. PERRIS
Machine Tools
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The Perris SL90 lathe was the direct antecedent of the first Cowells lathe, and was produced as a kit in Norwich, England by Mr B.R. Perris. On his death, Cowells took over the design, and initially the only change they made was to put their name on the casting. These are Mr Perris's notes on assembling his kits.

For further historical information, including photos, see the machine tool archive at lathes.co.uk under both Perris and Cowells.

INTRODUCTION

A great deal of care has been taken to ensure that anyone who has an interest in mechanical matters can, by following the instructions carefully, assemble the parts supplied and, at the end, have a high quality Lathe capable of producing all the many parts needed when making models, clocks, or instruments.

Produced in a small works by a team of highly skilled craftsmen, whose enthusiasm is evident by the standard of accuracy and workmanship to be seen in every last detail.

It is hoped that the section dealing with the use of the Lathe will assist those who are not too familiar with machines, and enable them to get the maximum advantage from it.

WITH any project of this nature, it pays to approach it in a logical manner; to this end the assembly has been divided into sections. This method has been found by experience to be the easiest in practice.

We suggest opening each parcel in turn, these are marked with a reference number corresponding to the assembly drawings in this Manual. This will help you to become familiar with the job. Take care not to mix the parts and screws with other parcels, especially if you are not too mechanically inclined. It is, of course, fairly straightforward to sort them out by referring to the drawings but there is no point in making extra work.

All the machined areas of the parts will be found to have a coating of anti-rust fluid, this is easily removed with a rag moistened with paraffin or white spirit. Do this only on the parts as they are to be used. The cast surfaces should be wire-brushed to remove any sand on the surface, this will result in a better finish when they are painted.

Finally, we suggest reading this manual through before commencing work. This makes you more familiar and will lead to a confident approach.

(i)

(ii)

TOOLS REQUIRED

Most people will already have all that is required, but this list covers the basic essential tools.

- One - small flat smooth file.
- One - medium size screwdriver.
- One - set of Allen keys.

Emery cloth - medium and fine grades.

- One - $\frac{1}{2}$ " wide paint brush.
- Small hammer.

A verdict indicator and an 0-1" micrometer, or a vernier calliper are extremely useful, but not essential unless you intend working to very close limit work. The use of these tools is covered in this manual.

ASSEMBLY 'A' : BED AND SADDLE.

Refer to exploded drawing Plate No.1.

Remove all parts from the wrappings, clean with paraffin or white spirit and lay out on your work area. The first job is the bed, Det.No.1. An examination will show that the top surface is machined with an angle on the long edges and a central slot which has an undercut area forming an inverted 'T' section.

Use the small flat file, fitted with a wooden handle and lightly file the sharp edges to give a small flat or radius, do not overdo this, a glance at the sketch fig.1. will show what is required. Clean the bed to remove the dust caused by the file.

Next take the saddle, Det.No.2. and, using the same file, treat in a similar fashion. The Gib strip Det. No. 3. should also have the sharp edges filed off.

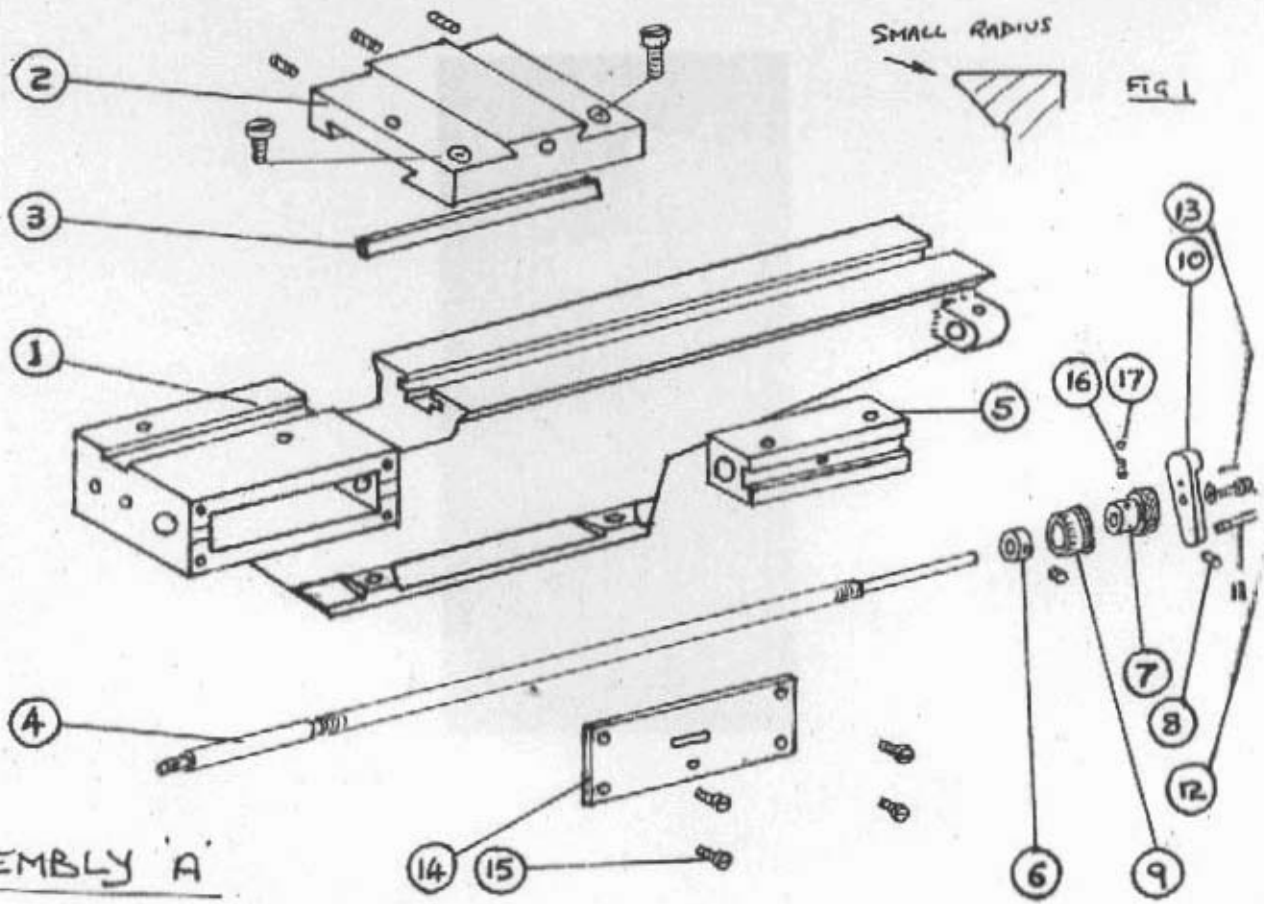
Slide the saddle on to the bed slides, making sure that it is correctly positioned with the two counterbored holes at the front of the bed.

Slide the saddle up and down the bed a few times, holding the front edge in contact with the angle of the bed. Push the gib strip between the rear angle of the bed and the saddle, fit the three grub screws in the threaded holes in the rear face of saddle, adjust the screws with an Allen key to grip the gib strip lightly, try sliding the saddle along the bed after smearing oil on the edges and top of the slides.

Aim now to adjust the screws to give a nice firm sliding fit between the saddle and bed. There should be no tightness at any point along the bed, nor should there be any play or looseness.

If the slide is stiffer at one end than the other, note which end it is and remove the saddle and Gib strip.

Using the Flat file lightly rub it along the front angled face of the bed, keep the file flat with the face and do not attempt to file more off one end than the other, just aim to polish the surface without altering the angle, wrap emery cloth round the file to finish the surface.



ASSEMBLY 'A'

PLATE 1

Do the same on the rear angled face of the bed, wipe clean and re-fit saddle and gib strip, adjust and test as before, if the tightness is still apparent, move the saddle away from this spot, rub the file on the tight area on the rear angle of bed only. Keep the file flat and work gently, any tightness will be caused by a difference of half a thousandth of an inch or so, wipe clean and slide the saddle along to test the fit, do this frequently, adjust the screws securing gib strip each time.

Having got the slides working smoothly, the gib strip should have 'dimples' formed for the tips of the screws to locate in. The way to do this is to remove one screw at a time, starting with the centre one, lock the two outer ones and using a hand drill (not electric) with a small twist drill which enters the hole, rotate a few times to cut a dimple with the tip of the drill, clean the hole replace the screw and do the same with each of the other holes in turn.

The assembly should now be stripped and cleaned again, re-fit after oiling the slides.

The leadscrew, Det.No.4. and nut, Det. No.5. are required for the next operation, clean both items and test that the thread on the leadscrew will screw easily into the nut. NOTE : THIS THREAD IS LEFTHANDED - the screw must be turned anti-clockwise to screw into thread. Remove the nut and slide the leadscrew through the holes in the box at the left hand end of the bed, test that it will enter the bearing lug at the right hand end of the bed and revolve freely. Withdraw the leadscrew far enough to allow the nut to be fitted, check the drawing to ensure the nut is correctly positioned with the two threaded holes uppermost and the groove at the front. Oil the screw and screw the leadscrew through the nut so that about one third of the leadscrew is projecting from the nut. Take the small collar, Det. No. 6. and fit it on the right hand end of the leadscrew, do not tighten the screw yet. Slide the leadscrew into the bearing lug.

Position the saddle by sliding it along the bed until the two counterbored holes line up with the threaded holes in top face of nut. Use the two cheeschead screws to fit the saddle to the nut but do not tighten fully.

Fit the knob, Det.No.7. on to the projecting end of leadscrew, do not bother to fit the index ring or handle at this stage. Lock the knob to the leadscrew with the grub screw, Det.No.8. ensuring that the leadscrew is flush with the face of knob. The small collar, Det. No. 6. can now be pushed against the inner face of bearing lug and the screw locked.

Turn the knob in an anti-clockwise direction, this will move the saddle towards the knob. Stop when the nut is about $\frac{1}{4}$ " clear of collar.

Loosen the cheese head screws, holding saddle and nut together, and allow the nut to find its own position. Tighten the screws and test the saddle movement by using the knob to turn the leadscrew. The action should be smooth and if the method outlined has been used, this will be the case.

The knob should now be removed and can be assembled with the index ring Det. No.9. Clean both items and test that the ring fits on the plain part of knob. The spring and ball, Det.Nos.16-17. should now be fitted in the hole drilled in the knob, insert the spring first and slide the index ring until it just touches the side of the spring, the ball can now be placed on the spring, a small blob of grease will stop it falling off. Use a flat strip of wood to push the ball against the spring into the hole, and slide the index ring along over it. The spring pressure against the ball creates sufficient friction to hold the ring from turning on the knob under working conditions, but allows it to be moved by the user when required. The advantage of this feature will be apparent when the section on using the lathe is read.

The cast handle, Det.No.10. should be filed and polished with emery cloth, the steel handle, Det.No.11. can then be screwed on the threaded hole of handle. At this point, fit the knob on the leadscrew, it will not be necessary to remove the index ring. Tighten the screw in the knob to lock it to the leadscrew, the tip of which should be just below the surface of the knob. Use the screw and washer Det.No.12. and fix the handle to the knob, the spring dowel pin, Det.No.13. should now be tapped lightly into the hole in handle, the tip should be lined up with the hole in the face of the knob. Tighten the screw and drive the pin home. The collar, Det.No.6. should now be moved up to the inner face of the bearing lug and fixed with the grub screw.

Remove the sharp edges on the cover plate, Det.No.1 and fit to the bed with the cheese head screws, Det. an 'O' is stamped on the lower front face of this i and should be visible when plate is in place.

This completes the work of Assembly 'A'. It is not desirable to dismantle the assembly and paint the c surfaces. See the chapter on painting.

It is not necessary or desirable to strip the knob assembly, leave the index ring and handle in place. remove by loosening the grub screw in knob and the s in the end of leadscrew; this allows the knob to be removed in one piece. The leadscrew collar, Det.No will, of course, have to be removed before the lead: can be unscrewed from the nut.

The saddle, Det.No.2. will be required for the next assembly and it is easier to work on this now while the paint dries on the bed.

ASSEMBLY 'B' : CROSS SLIDE

Refer to exploded drawing Plate No.2

The cross-slide, Det.No.16 should have the sharp edge removed with the small flat file, paying particular attention to the edges of the angled sliding surface on the underside.

The Gib strip, Det.No.15 should have the sharp edges removed with the file.

Take the saddle, Det.No.2. from the Assembly 'A' and after cleaning, assemble the cross slide to the saddle vee slides, the gib strip should be slid into position and the socket grub screws tightened lightly.

NOTE: Screws should only be tightened when the gib is in contact with the vee slide of the saddle - move two slides to adjust each screw in turn. If this is done and a screw is tightened on an unsupported area gib strip, this will cause it to bend.

Ensure that the gib strip is flush with the end of the cross slide which has two threaded holes. Dimple the gib strip, using the same method outlined in Assembly Take apart and clean. Re-assemble with a smear of c the slides and gib strip. Adjust to give a nice slide fit.

ASSEMBLY B, CROSS SIDE

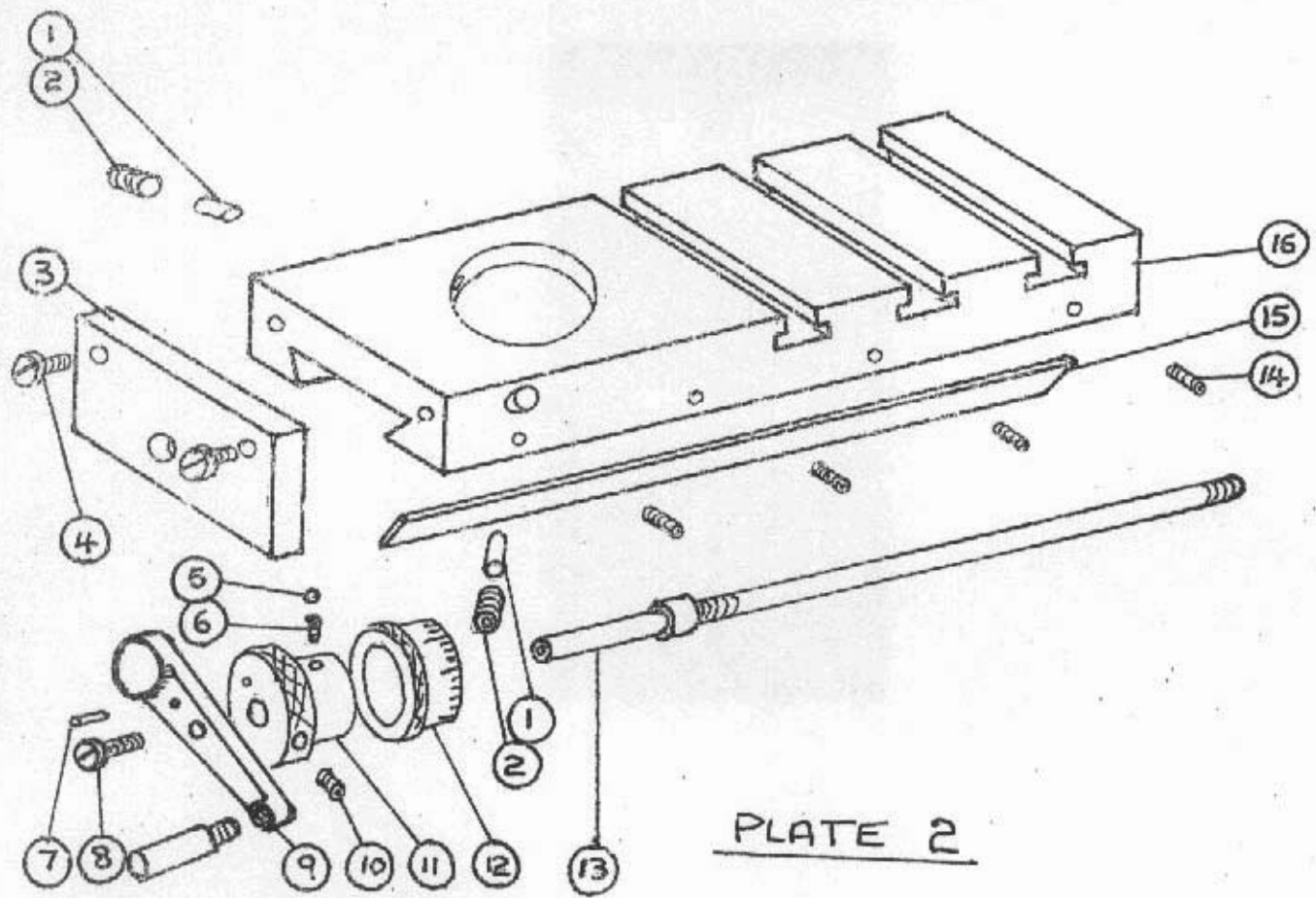


PLATE 2

The END PLATE, Det.No.3. should now have any sharp edges removed, the Feedscrew Det.No.13 is next screwed into the threaded hole in the front face of the saddle until the shoulder of the raised collar is almost touching the face of the saddle.

Using the two cheese leadscrews, Det.No.4 fit the end plate to the front face of cross slide which has two threaded holes for this purpose, do not tighten hard. Push the two slides together until the plain end of the feedscrew enters the hole in the end plate. Tighten the two screws now.

Test that the feedscrew is free to turn. Assemble the knob and index ring with spring and ball as done in Assembly 'A' and fit on the plain end of feedscrew protruding from end plate, the handle Det.No.9 can now be assembled and fitted, using the spring dowel and cheesehead screw with washer.

To adjust the feedscrew movement, loosen the grub screw in the knob, lightly tighten the cheesehead screw, do not lock hard, tighten the grubscrew in the knob and test for freedom of movement by rotating the handle. If it is stiff to turn, repeat the operation until the movement is firm but not tight. If you can achieve a setting which results in being able to turn the knob between thumb and finger and see a movement of two divisions on the index ring before it starts to actually move the slide forwards, this will be just about right.

Remove the slide assembly from the saddle by winding the handle until the feedscrew is disengaged, the slide can then be pulled off.

Return the saddle to Assembly 'A' and put the cross-slide together with screws and angled pins, Det.Nos. 1 and 2 back into a plastic bag for the moment.

ASSEMBLY 'C' : TOPSLIDE

Refer to exploded drawing Plate No.3

The work on this unit is so similar to the previous assembly that it will be easy to follow the procedure outlined. Only a few points need be explained.

ASSEMBLY 'C' TOPSIDE

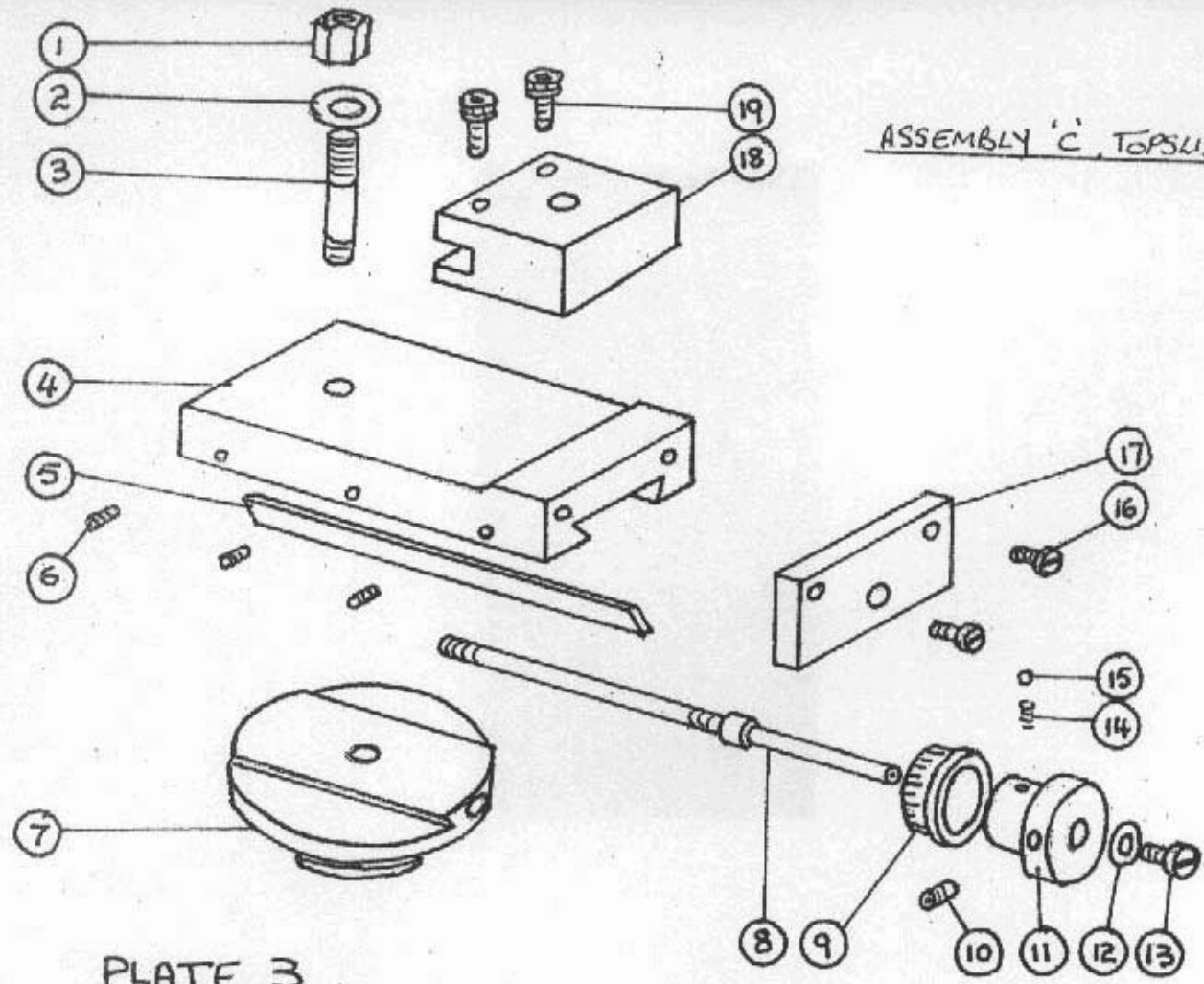


PLATE 3

The circular base, Det.No.7 should be assembled with the threaded end of feedscrew hole facing the endplate it will be seen that the angled slide appears to be offset from the centre of the circular base - this is that when the gib strip is fitted, the upper slide is central on the base.

The Toolpost stud, Det.No.3 should be screwed into the threaded hole in the top of the slide.

Remove the sharp edges from the toolpost block, Det.No. and fit the screws Det.No.19. Fit on to the stud and lock, using nut and washer Det.Nos.1 and 2. Place in a plastic bag until needed later.

ASSEMBLY 'D' : HEADSTOCK

Refer to exploded Drawing Plate No.4

It will be necessary to do this in two stages. The first stage consists of removing sharp edges and surface roughness from the cast surfaces from the body Det.No.1 and also face plate Det.No.10. After this has been done, wash in white spirit and paint the unmachined surfaces as detailed in the chapter on painting.

Leave this assembly now, making sure that all the items are in a plastic bag - except, of course, the body and faceplate, which will have to be left for the paint to dry.

AT THIS POINT return to the bed Assembly 'A'. The paint should be nicely dry. Re-assemble, following the methods used in the instructions previously given. As this will be the final assembly of these components it is worthwhile using 'Loctite' on certain screws, namely, the gib adjustment grub screws and the screw Det.No.12 securing the handle. This will prevent them from working loose and altering the adjustment of the slides.

Fit the Cross-slide Assembly 'B' to the saddle again, using 'Loctite' on the gib adjustment screws and screw securing handle. Adjust to give a nice smooth movement to the slide but avoid any slackness or play in the angled slides.

ASSEMBLY 'D' HEADSTOCK

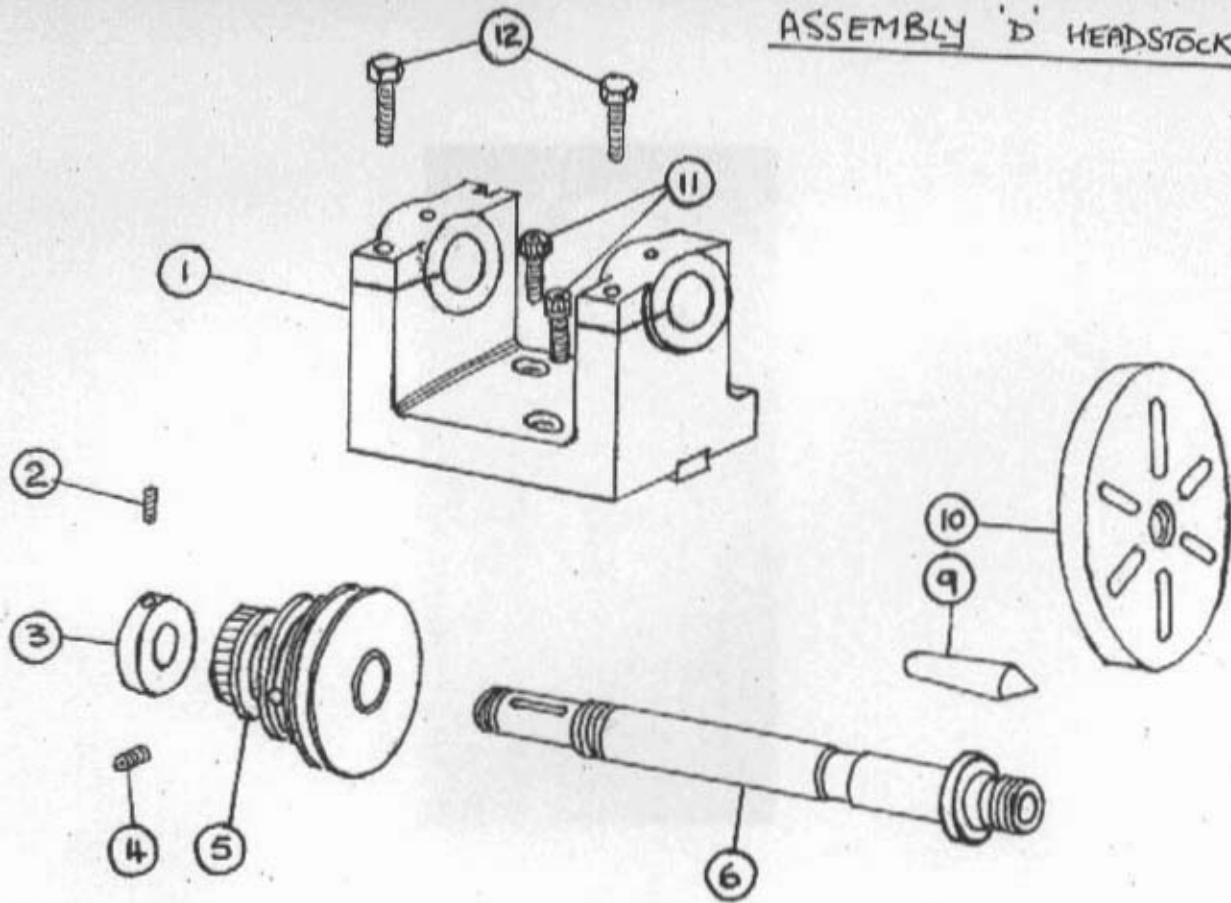


PLATE 4.

Fit the Topslide Assembly 'C' by inserting the spigot of the base into the hole of cross-slide, the angled pins and screws Det.Nos. 1 and 2 (on Assembly 'B' drawing can now be used to lock the Topslide assembly 'C' to Cross-slide assembly 'B'. Insert the angled pins in the holes at the side of cross-slide - ensure that the angle will mate into the angled groove of topline base, push in with a small screwdriver or shank of allen key and try just lifting the topline to ensure the angles are in contact. Fit the allen grub screws and lightly tighten, it should now be possible to rotate the Topslide and, by tightening the grub screws Det.No.1. the topline may be locked at any angular setting relative to the Cross-slide that may be required. How this is of benefit will be apparent in later chapters on using the machine.

We have now reached a stage where assemblies 'A', 'B' and 'C' are complete.

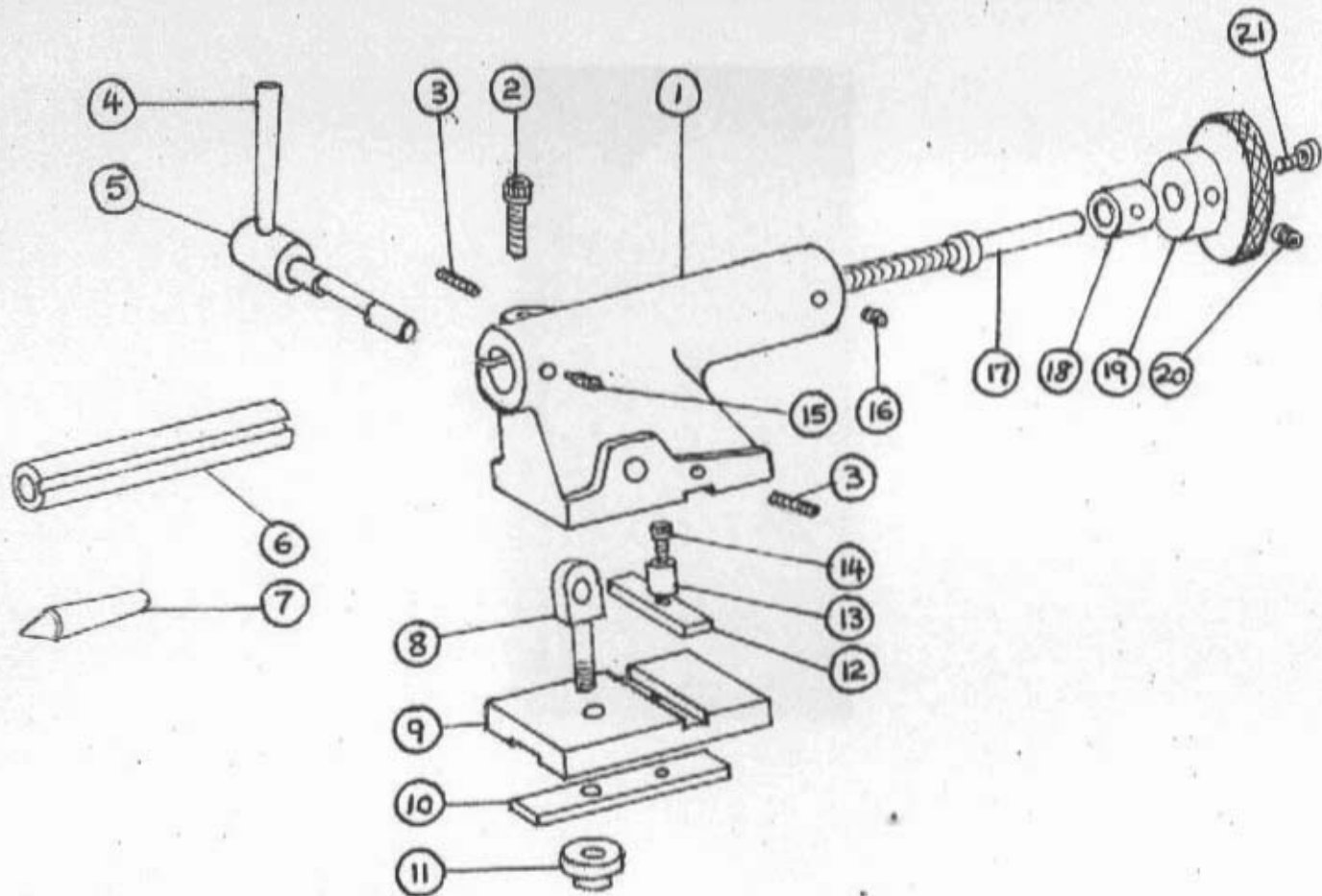
Return to Assembly 'D', the headstock body which was painted earlier should by now be dry and can be fitted to the Bed. The correct way round is as shown in the exploded drawing. Use the two allen cap screws Det.No.11 and, after locating the tenon on the underside of headstock in the groove of the bed, screw the cap screws fully home and tighten.

Clean the bores and Spindle Det.No.6, pulley Det.No.5 and collar Det.No.3, hold the pulley between the bearings and slide the spindle through the front bearing and pulley, fit the collar, behind the pulley and push the spindle fully home.

Press the flange on spindle against the face of the bearing, and tighten the grub screw in the pulley whilst holding it against the inner face of the front bearing.

Test that the spindle revolves freely without tightness, adjust by repeating the operation until this is achieved. The screw in the collar Det.No.3 can now be tightened when collar is in place against the gear fitted to pulley. The two screws Det.No.12 should now be inserted in the holes above the split in bearings. Screw down but do not tighten hard, adjust the front one until a slight drag is felt when spindle is turned and just ease back. Do the same with the rear bearing. Leave this assembly now, placing the faceplate and centre in a plastic bag till required.

ASSEMBLY 'E' TAILSTOCK



ASSEMBLY 'B' : TAILSTOCK

Refer to drawing Plate No.5

As received, the body will be attached to the base, separate the two parts by loosening the screws, Det.1 in the side of the tailstock body; the base will then come away from the body. Use the file to remove sharp edges and surface roughness on cast areas. Clean both items.

Insert the eyebolt Det.No.8 into the hole in the base. Fit the base to the body but do not tighten the screws Det.No.3 yet.

Insert the cam lever Det.No.5 into the side of tailstock body and twiddle the eyebolt to align the hole with the cam lever, a spot of grease on the cam lever spur is needed before finally pushing completely through the body.

The clamp nut Det.No.11 should now be screwed on the projecting thread of the eye bolt. The small boss of the nut faces away from the tailstock base.

Assemble the unit to the lathe bed by sliding the key of the base into the central slot of the bed, the nut will locate in the undercut groove, by screwing the nut further on the thread or off, as the case may be, it will be found that the cam lever can be made to lock or unlock the tailstock body to the bed. The screws Det.No.3 can now be adjusted to bring the sides of the body level with the base and can be tightened to hold the two items together. Do this when the cam lever is in the locked position but not excessively so as you need a little movement.

Turn now to the other items and select Details 17, 18, 19, 20, and 21.

Take the feedscrew Det.No.17 and slide the bush Det.No.18 up to the shoulder, the knob Det.No.19 is next pushed on up to the bush and held in place with grub screw Det.No.20. Fit the screw Det.No.21 into the thread at the end of feedscrew.

The feedscrew should be screwed into the thread of the tailstock barrel Det.No.6.

NOTE: This is a left hand thread and is turned anti-clockwise to effect this operation.

Make sure that no sharp edge or burrs are present along the groove in the barrel. Remove with file if there are.

Insert the assembly into the tailstock body from the rear end and ensure the dimple in the bush Det.No.18 is in line with the screw hole of body, fit screw Det.No.16 and tighten to hold the bush.

The barrel should now be turned until the slot is in line with the screw hole at the front of tailstock body, fit the screw Det.No.15, this screw has a plain unthreaded end which acts as a key to prevent the barrel rotating. It does not need to be locked hard, screw in until it contacts the base of groove and retract half a turn.

Adjust the movement of the knob to turn freely without binding or tight spots and, by rotating the knob it will be found that the barrel will travel forwards or backwards depending on which way the knob is turned.

The clamp screw Det.No.2 can now be fitted to the split boss of the body.

This completes Assembly 'E'. So this can be stripped down and painted after washing in white spirit.

Re-assemble when the paint is dry and use 'Loctite' on screws Det.Nos.15 and 21 and the clamp nut. Fit the centre in the taper of barrel and check, by retracting the barrel, that the centre is pushed out.

Whilst the paint is drying on the tailstock, the next assembly can be fitted.

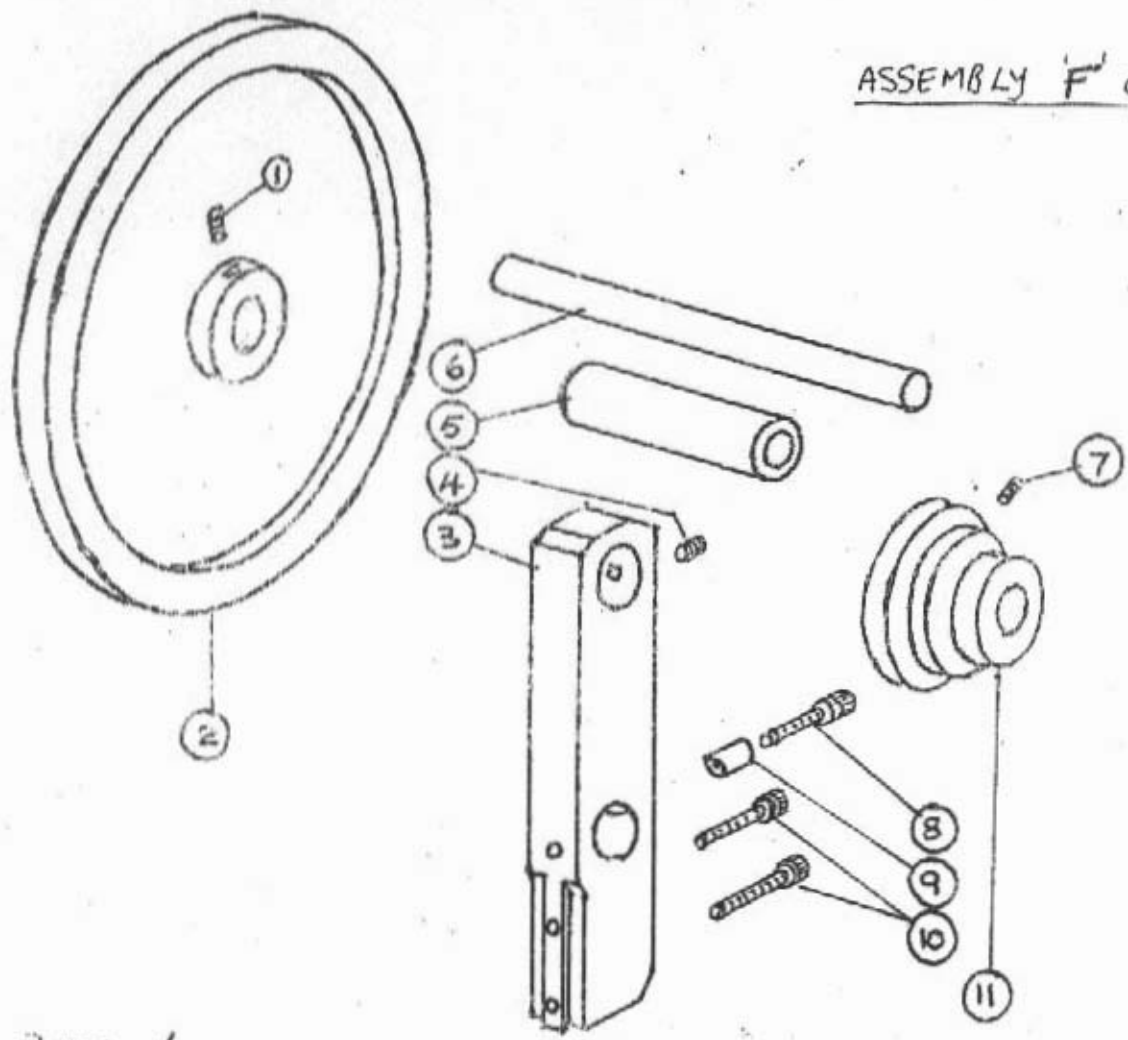
ASSEMBLY 'F' : COUNTERSHAFT

Refer to exploded drawing Plate No.6

Take the column Det.No.3 in hand first and remove sharp edges with a small file. Test that the bearing with bronze bushes fitted Det.No.5 will enter the hole at the top end of column.

The screw and clamp bush Det.Nos.8 and 9, and the hole halfway down the column, are provided for the backgear attachment, this is covered in detail in a separate section and can be ignored at this point.

ASSEMBLY 'F' COUNTERSHAFT



Fit the column to the rear of headstock casting where it will be found that a vertical groove is machined to receive the column. Two threaded holes will be seen, and the screws Det.No.10 are used to secure the two parts together.

Fit the three step vee pulley, Det.No.11 to the spindle Det.No.6, allow the spindle to just protrude so that the full chamfer is visible, enter the spindle from the largest side of the pulley. Lock with the grub screw Det.No.7.

Slide the spindle into the bearing Det.No.5, and fit into column, check that the pulley grooves are in line with the grooves of the pulley on the headstock spindle. Adjust by moving the bearing in column until satisfied and lock bearing with screw Det.No.4.

The large pulley can now be fitted to the spindle. Fix so that there is no side movement but the spindle should be free to spin easily.

The bronze bushes fitted to the bearing are porous, oil retaining types, it is best to soak the bearing in a tin of light oil overnight. This will then absorb sufficient oil to last for a long time.

Sufficient belt is supplied in the form of a circular section plastic material with a hole running through the centre. Thread under the pulley on the headstock and over the pulley on the countershaft, get the length by pulling it into the centre groove of each pulley and marking, cut the belt $\frac{1}{2}$ " less than this so that tension is applied when the joint is fitted. The fastener supplied is pushed into one end of the belt, using thin nose pliers to hold the fastener, thread the belt round the pulleys and fix by pushing the belt onto the projecting fastener.

If the belt is too slack, then cut another $\frac{1}{2}$ " off the length until a satisfactory drive is obtained.

Once the length has been established, the belt can be butt welded together, dispensing with the fastener if desired. A hot knife blade (an old one!) is used. Press both ends of belt simultaneously on the knife and when the ends are soft, slide knife away and press ends together, hold until set, trim off the "flash" with a razor blade or scissors.

This plastic belting is of a special type and once the tension is applied initially it will not stretch unduly.

Return to the tailstock assembly and fit the centre in the headstock spindle.

Slide the tailstock up to the headstock and extend the barrel so that the two centres are almost touching, align the tailstock body sideways by adjusting the screws Det. No.3 in the sides. When it looks as if the centres are in line, lock the screws. The final adjustment of this will be done later to a greater degree of accuracy, this is dealt with in the section dealing with the use of the lathe.

The standard lathe is now complete.

If you have purchased the backgearing attachment and/or autotraverse attachment, you can now tackle these. If not, you can go straight on to the section on setting up the lathe for use.

DRIVING THE LATHE

Having completed the assembly of your machine, you will need to fit it to a bench or, if you want a portable unit, to a baseboard.

The area required will depend on the physical size of the electric motor available. The sketch shows the layout if using a baseboard.

If you use the special plastic belt we supply there is no need to allow for moving the motor and this can be fixed using bolts and nuts or woodscrews.

The Lathe should be fixed with small bolts and nuts.

If plastic faced plywood of about $\frac{1}{2}$ " - $\frac{3}{8}$ " thick is used - and often this is available as offcuts from D.I.Y. and Handyman Stores, it will be found easier to clean as the oil will not penetrate the surface.

Fit rubber feet at the corners of the underside of the base, this will prevent scratching the surface of the table it is rested on in use.

Where motors are bought from us we will supply a diagram so that it can be wired to give forward - off - and reverse. If you already have a motor we will be pleased to advise on wiring.

SPEEDS

The best average speed range will be obtained if the countershaft Spindle is running at 750-800 revolutions per minute. The Speed range will then be as the chart shows.

If your motor speed is 1450 r.p.m. the pulley size will need to be 2" diameter. If you buy one of our motors the belt and pulley will be supplied.

FITTING THE BACKGEARING ATTACHMENT.

Refer to drawing Plate No. 7.

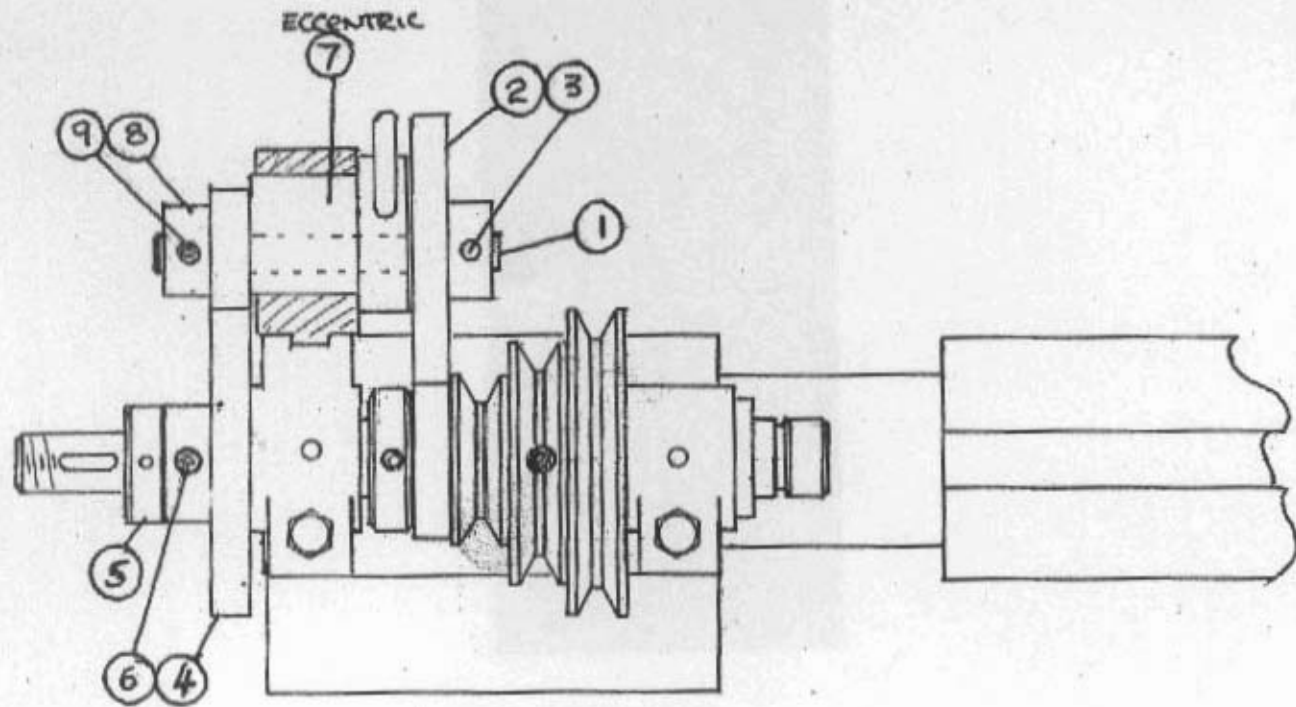
Clean all gears by washing in white spirit, paraffin or kerosene. Remove the countershaft column bodily. The eccentric bearing is fitted to the countershaft in the large hole provided, the screw and clamp should be loosened sufficiently to allow this. Fit the spindle Det.No.1 to the gear Det.No.2 this is the larger of the two gears with small holes in the centre. Note from the drawings that the flat face of the gear is against the eccentric bearing. The small gear is now fitted to the other end of the spindle and locked in position, test for free rotation without end play.

The large gear Det.No.4 is now pushed onto the tail of the headstock spindle and the circular nut, Det.No.5 is screwed on the thread, which will be visible in front of the gear. Screw up finger tight and lock the gear with the grubscrew Det.No.6, test that headstock spindle is free to revolve without stiffness; after getting this satisfactory, remove the circular nut, treat with 'Loctite' and replace.

The countershaft can now be refitted, loosen the grub screw in the headstock pulley and engage the gears by moving the eccentric by the lever towards the front of the machine, if the screw Det.No.8 in countershaft is tightened lightly the clamp will stiffen up the movement and help get the best setting of the gears. Aim to get the gears running sweetly together without tightness and lock the screw to clamp eccentric.

The action of the gear reduction will now be clearly seen, if the pulley on the headstock is rotated it will not turn the spindle directly as we have loosened the screw which locked the two together, but the gear fixed to the pulley will drive the large gear on the eccentric spindle, but because of the difference in size of gears, the speed will be reduced. The large pulley is solidly connected by the eccentric spindle to the small gear which is meshed with the large gear on the tail of the spindle, so we again get a further reduction in speed. The large gear is fixed to the spindle and thus, although the headstock pulley revolves at say 100 revolutions per minute, the spindle revolves at only 25 r.p.m.

BACKGEARING ATTACHMENT



To disengage the gearing and get direct drive to the spindle, we must loosen the clamp screw and take the gears out of engagement by moving the lever to the rear, relock the clamp screw.

The grubscrew in headstock pulley should now be tightened. The drive to the spindle is now once more directly from the pulley. Details of speeds that can be obtained by using the pulleys with gears in and out of engagement will be found in the section dealing with lathe use.

AUTOMATIC TRAVERSE ATTACHMENT

Refer to drawings Plate Nos. 8 and 9.

Remove the cover plate from the front of the bed. Fit the bearing bracket, Det.No.26 on drawing, to the end of the bed using the screws, Det.No.27. Do not tighten fully. Slip the clutch bobbin, Det.No.23 on to the end of the leadscrew projecting inside the box under the headstock. Insert the leadscrew extension shaft Det.No.13 into the bearing bracket and into the clutch bobbin. Align the shaft by tapping the bearing bracket until the bobbin slides easily along both shaft and leadscrew. Tighten screws, Det.No.27. Withdraw the shaft from the bobbin and fit the retaining collar Det.No.25, push the shaft along to engage in the bobbin and until the raised shoulder contacts the outer face of bearing bracket; the collar is now pushed against the inner face of bearing bracket and locked with the grubscrew. The shaft should be free to turn without tightness. The two screws Det.No.14 are located in the threaded holes in leadscrew and extension shaft, these are specially prepared after cap screws and should be screwed fully in the holes. The bobbin should be slid along and will engage with both screws at its extreme right hand position. Test that the bobbin moves each way without excessive tightness.

Det. No.21, the slide bar can now be tried in position. It will be seen that a pin fitted through this bar, one end of the pin is larger in diameter than the other, it is the larger end that engages the groove in the side of bobbin. Fit the slide bar to the bed locating it in the grooves machined in the ends of the box. The pin should engage in the groove of bobbin, there should be a clearance between the end of the pin and the inner diameter of the groove of bobbin - about 1/64th of an inch. File the end of the pin if this is too long.

The operating knob, Det.No.16, should now be fitted to the front face of the bed cover plate, using the screw and spring washer provided. The spring washer is slipped on the screw, insert screw into knob and fix to cover plate, tighten screw until knob can be moved, but with the spring causing a small amount of friction.

Position the slot in knob so that it is at the top and fix coverplate to bed making sure that the pin of slide bar engages the groove of bobbin and the slot in knob.

Test the action by turning the knob to the left, this should disengage the bobbin from the screw fitted to leadscrew. Turn the leadscrew handle and see that the extension shaft does not revolve.

Turn the knob to the right and at the same time revolve the leadscrew to bring the pin in line with the slot in bobbin, the knob will then push the bobbin along and engage both screws, Det.No.14, this effectively connects leadscrew with extension shaft and can be checked by turning the leadscrew handle. The extension shaft will be seen to revolve also.

A key must now be fitted to the extension shaft, a length of steel is supplied for this purpose, cut a piece to the same length as the keyway or groove in the extension shaft. Remove the sharp edges and place in keyway. The gear, Det.No.11, should now be tried on the extension shaft, it may be found that the key will need easing with a file on the top or sides to allow the gear to fit firmly, but not so tight that a hammer needs to be used.

Test that the collar, Det.No.9, will fit on the projecting end next to the gear. Now remove these items.

Take the slotted arm, Det.No.15, and fit on the projecting boss of the bearing bracket. The capscrew, Det.No.29, should allow the arm to be locked in any position.

Re-fit the gear with key and collar, push the gear fully home against the shoulder of the shaft and lock the collar with grub screw.

Insert one screw, Det.No.28, from the rear face of slotted arm and slip the shouldered bush, Det.No.7 over the screw with the shoulder against the arm. The double gear Det.No.8 (which is the larger of the two double gears) should be fitted on the bush with the small gear facing the arm, the washer and nut Det.Nos. 5 and 6 are screwed on the thread projecting.

Slide the assembly down the slot so that the small gear engages with the gear on extension shaft, a small amount of backlash or movement is needed. Test that the gears revolve together easily, the clutch should be disengaged when doing this.

The remaining double gear can now be fitted, assemble the bush, Det.No.7A, into the gear, the flange of bush against the larger gear face. Locate on slotted arm and slide the larger gear behind the other double gear Det.No.8, fit the screw, Det.No.28, through the slot into the bush, using screw and washer, Det.Nos. 5 and 6. Lock this gear to the slotted arm, the small gear of this assembly to be engaged in the large gear, Det.No.8. Test for free movement of the gears.

This now leaves the small gear to be fitted to the headstock spindle. Use the remaining piece of steel to make a key to fit the keyway or groove machined in headstock spindle. The gear, Det.No.2 is now tried on the spindle, adjust the key until the gear can be pushed on by hand. The reduced boss of the gear fits against the shoulder of spindle. The knurled knob, Det.No.3, is screwed on the projecting thread to lock the gear to the spindle.

Move the slotted arm up to engage the teeth of the gear just fitted, with the large gear of Det.No.4, again adjust the backlash. Lock the slotted arm in this position with screw, Det. No.29.

The slotted trip bar, Det.No.30, can now be fitted to the groove in the leadscrew nut, using the screw and washer to lock it in place. Set the bar to project to the left hand end of nut.

The action of the Autotraverse assembly is as follows - as the headstock spindle revolves, the gear on the tail end drives the other gears, transmitting a rotary movement to the extension shaft - the speed is greatly reduced by the gears fitted. If, as the gear train is in motion, the knob Det.No.16 is turned to the right, the bobbin will move to engage the screw Det.No.14 in leadscrew. At this point, the leadscrew will also be driven, causing the saddle and slides to move towards the left.

As the saddle travels along the bed, the trip bar will eventually meet the protruding end of slide bar and push it along, thus disengaging the bobbin and disconnecting the drive to leadscrew which will then cease to turn.

The advantages are many, and are described in the section dealing with lathe use.

It is advantageous to paint grease on all moving parts, including those inside the box.

MAINTENANCE

To get the best results from your Lathe, it is necessary to look after it.

Always clean the slides after use as dust and swarf can cause wear to the working surfaces. If the Lathe is in use daily then oil all moving parts daily. Otherwise, oil before using.

It is a good idea to cover the Lathe when not in use - a fitted cover is easily made from heavy gauge polythene sheet, or even a thick quality plastic bag.

USING THE LATHE

The following notes have been prepared in the hope that they will prove of value and enable you to get the best results from the Lathe and, by properly caring for it, ensuring the longest, trouble-free working life.

Although it is possible to look in reference works and find optimum speeds and feeds for any given material and diameter, with tool shapes for maximum metal removal, I would firmly advise against this. The recommendations, whilst being necessary where mass production is concerned, are of no benefit to the small Lathe user.

The tool shapes shown have been found, by actual use, to be the best for most purposes.

Where speeds are concerned, start with the slowest speeds and work up. It will soon be apparent when the best speed for any particular job has been reached as the metal will be removed cleanly and easily without undue noise.

Once past this point, it will be obvious as the tool may overheat, the swarf will no longer slide cleanly past the tool and the noise level will rise, "chatter" may start (this sounds like teeth chattering only much louder). The surface of the work will look very uneven. When this happens reduce the speed. As a general guide, the larger the diameter the slower the speed. Cast iron should be worked on slow speeds, preferably with a tool tipped with carbide. Do not use any cutting fluid.

Steel, mild and freecutting.

Use a sharp tool and apply cutting fluid with a small brush to get the best finish.

Brass and Bronzes.

Very sharp tools with very little or no top rake to tool. Do not use cutting fluid. It is advisable to use safety glasses or fit a Perspex Shield over toolpost, as the swarf from this material does fly about and is very sharp and hot when it leaves the tool.

Personally, I wear safety glasses whatever material I am turning - having hot swarf in the eyes is no joke!

Aluminium and Dural.

Plenty of top rake to the tool. This material is best machined at speeds higher than steel but lower than brass. If too high speeds are used the material will build up on the tool and look as if it is welded on. It helps to use either paraffin or white spirit (Kerosene or Turpentine) - apply with brush.

Alloy steels and special proprietary materials are best machined on a trial and error basis using the shapes shown for steel as a starting point. Experience comes with practice and often by trying various shapes and angles on tools the job can be completed satisfactorily.

Tools.

Tools are best ground to shape from high speed steel toolbit blanks. These are obtainable at most good tool merchants and are available in various lengths. They are ground flat on all four sides. The sizes suitable for this machine are either $\frac{1}{4}$ " square or $\frac{3}{16}$ " square. (6 mm or 4 mm).

The carbide tipped tool, mentioned as being the best for cast iron, can be supplied by us, $\frac{1}{2}$ " square shank tipped tools are used and available in two or three shapes. If you get these they will do all the work you may want to do. The biggest drawback to using tipped tools is the sharpening - it is possible to grind them using a green grit grinding wheel specially made for this purpose, but it really needs a diamond lap to finish the edge properly. In spite of this, the need for re-sharpening will not arise often and it is sometimes possible to approach a local engineering works and get it done in their toolroom.

Another material for making tools which is somewhat neglected these days is Silver steel - this is available in precision ground round stock in lengths of 13". Also Square Section and flat precision ground stock which is termed "Gauge Plate".

This is supplied in a soft or annealed condition and can be filed to the shape required and can be hardened quite easily.

Although it has limitations it is very useful and is especially good for working brass as a much keener edge can be given to a tool than is possible with high speed steel.

Screwcutting Tools.

These are single point tools and require grinding to the angle of the thread to be cut, as American threads and Metric threads have an included angle of 60° and English threads have an angle of 55° . It pays to have one tool for each rather than re-shaping a single tool. B.A. (British Association) threads have an angle of $47\frac{1}{2}^\circ$ but these cannot be screwcut on this machine due to the odd pitches of this range and are best cut with Button dies using a Tailstock dieholder to get a true thread. NOTE that screwcutting tools are not usually given toprake as this alters the shape of the angle. INTERNAL THREADS are cut using a boring bar with the end ground to the thread angle.

Boring Bars.

These are used when holes need to be machined and shapes are given suitable for various jobs. The diagram shows how clearance is needed under the cutting edge to prevent rubbing. This is considerably more than the clearance on an external tool.

Workholding.

There are various methods of holding work to be machined. The simplest is that of drilling a centre hole at each end of the work - in the case of a Bar, and attaching a carrier or dog to the end nearest the headstock. This dog is driven by a pin in the Faceplate.

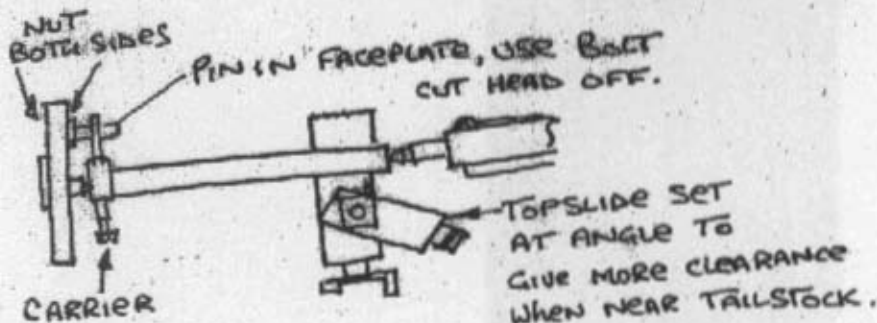
Although simple, there are points to watch. If the headstock centre is not absolutely true then it will not be possible to turn an accurate workpiece and this is the reason that all headstock or live centres are left in a soft condition, so that the point may be turned true whilst in position. This is not difficult and is explained in the text on taper turning.

A further point to watch is that the tailstock centre is kept lubricated and is adjusted during working, as due to heat causing expansion of the work being turned, this could, if not done, lead to burning out the hard centre of the tailstock and scrapping the workpiece. A revolving centre incorporating Ball races to take the thrust is very useful in the roughing out stages, but for the most accurate work, always finish using a fixed centre. In any turning operation it is better to rough turn all over, leaving about 10 to 20 thou. oversize and then change the tool for a sharp one to finish - this has two advantages. Firstly, most bar steel, brass dural, etc., is rolled to size rather than machined. This has the effect of stressing the skin or surface of the bar and, when machined away, the stresses are relieved causing slight distortion. It will be clear then that if you finish the work completely to size at one end and then turn the work round and machine the opposite end as soon as the skin is removed with the tool, the end finished to size will be distorted. This also applies to Cast bar such as iron and bronze - unless it is bought with the skin already turned or ground away and left 10 - 20 thou oversize (as is commercially available in a range of sizes). The second advantage is that by using two tools - one to rough out and a second to finish the work, a higher surface finish is obtained, with more accurate results, than if a single tool had been used.

To centre drill the end of the work is not difficult and can be done in various ways. First, roughly trim the ends of the bar with a file to get them reasonably flat, using marking fluid - either copper sulphate solution or a proprietary layout fluid - or a heavy type of felt marking pen will give quite good results.



STAGES IN CENTRING BAR.

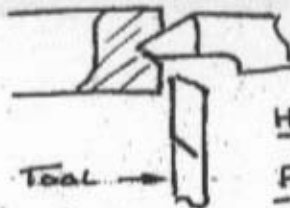


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CENTRE DRILL



FIG. 1.



HALF CENTRE

FIG 2

To mark the centre use a centre square - this is a standard accessory with the combination set. Oddleg calipers can also be used - this is a caliper with one curved leg and a point on the other, by setting it to roughly half the diameter of the work and then using the point to scratch across the bar end, from four places it will leave a small boxed area in the centre which will be enough to guide you, when marking with a centrepunch. A punch must, of course, be used whatever means are used to mark the centre.

To drill the centre hole, a special type of drill is required. These are made in various sizes and are quite cheap. Consisting of a short body, it is shaped to the same angle (60° inclusive) as the Lathe centres, with a further and much smaller drill at the point. Two flutes machined in the ends give the cutting edge. Known as a combination centre drill, it has a twofold purpose, it cuts a recess, tapered to suit the centre, and leaves the extreme point of the centre clear - the smaller drill point ensures this and also gives a reservoir for lubrication. The sketch shows clearly what is meant. Fig.1. Plate No.10.

Hold the bar in a vice and use the drill in a hand drill, keeping it as square to the axis of the bar as possible. Do not drill deeper than the conical end of the drill as this would leave a ridge which defeats the whole object.

The carrier may now be attached and work mounted between the Lathe centres. Tighten the Tailstock centre by using the handwheel after clamping tailstock to the bed. Do not over tighten, but take up all looseness - this is easily felt, by rotating the bar between finger and thumb - lubricate tailstock centre only, before doing this.

The carrier should be positioned so that the pin in the faceplate drives against the leg of the carrier and not on the screw.

The tool can now be fitted to the toolpost. As it is always more difficult to get the tool to the end of the bar when doing work between centres, it helps if the tool is mounted in the righthand side of the toolpost rather than the left as usual - rotate toolpost to bring the correct side to this position.

It will also be helpful to set the topslide at an angle to the axis of the Lathe as this gives greater clearance from the tailstock body.

Use a bar turning tool and ensure it is set with the cutting edge on the centre height of the machine. Pack under the tool with strips of tin to adjust this.

It is not possible to retain the original height of the tool, as each time it is sharpened it will lower the cutting edge slightly.

We are now prepared to set the tailstock accurately in line with the Headstock.

Position the tool just clear of the bar end supported by the tailstock and just clear of the bar surface. Switch on the machine. If a loud squeaking noise is apparent, either you have forgotten to oil the tailstock centre or have too much pressure exerted on it. Adjust if this is the case. **STOP MACHINE FIRST.**

If all is well, advance the tool by turning the cross-slide knob until tool is just scraping the surface - it will most likely only scrape on one side, as the bar may run more or less out of true. This is why it is not wise to set the tool to touch the bar before switching on, as if it was touching on the low side, when the spindle rotated the high side would more than likely jam on the tool due to the shock of impact - this could also chip the cutting edge and mean regrinding the tool.

Having got the tool scraping, move the saddle clear of the work by using the leadscrew handwheel and turning it anti-clockwise.

Note the index graduations on the cross-slide knob. Use a fibre tip pen or pencil to mark the line which is opposite the fixed mark on the cross-slide.

Each division on the knob equals 1 thousandth of an inch (or .025 mm) **ACTUAL MOVEMENT**. This means that if it is advanced one division the work will be reduced by double this amount, as the tool will take a cut all round the bar. Therefore, when measured across the work diameter it has reduced it at each point from the axis of the bar.

Take a cut of 5 thou (or .125 mm) by turning the cross-slide knob 5 divisions. Traverse the tool along the bar by rotating the leadscrew knob clockwise. When you have a 2" length of the bar machined, return the tool to the start, and take further cuts of 5 thou deep until the surface of the bar is running truly.

Measure the diameter of bar at each end of the part machined. It is likely that an error will show.

If the bar is smaller at the tailstock end, then adjust the tailstock body by loosening the grub screw in the near side and tighten the grub screw in the rear. This will move the body (and the end of bar) away from the tool. This should be done in stages, moving the body a minute amount, taking further cuts along the bar, re-checking and repeating until both ends of turned area are identical. This will have the result that the tailstock is absolutely in line with headstock and useful practice will have been gained.

If the diameter at tailstock end of bar is larger, the body needs moving nearer to the tool.

The bar can now be used for further practice as follows.

Assume, for the purpose of this exercise, that you are going to make a spindle with a diameter of $9/16$ " over the centre and with both ends reduced to a diameter of $3/8$ " for a length of $1\frac{1}{2}$ ".

It will be necessary to measure the distance on the work that it is required to reduce, this can be done with a 6" rule and a pencil at this stage. The mark will show up when the work is revolving - mark to leave the length about $1/32$ " under what is required finally. Most experienced turners would, no doubt, hold a rule just clear of the work whilst actually turning it, but I am assuming no previous knowledge and there is quite enough to watch without adding further to it, if you are a novice. In any case, the final length will be faced, using the graduations on the leadscrew knob.

Change to a side cutting tool, setting to centre height. Position clear of the bar end, you will have previously marked the length to be turned, as described earlier, using a rule and pencil.

Take a cut of 5 thou (or .125 mm) by turning the knob through five divisions in a clockwise direction.

Traverse the saddle along the work by using the leadscrew knob until the pencil mark is reached. Bring the tool back to the starting point and switch off machine. Check again that the bar is not sloppy on the centres and measure the length to see if it is just under the final measurement required.

Start the machine again and take further cuts until the area being turned is running true. It is advisable to check the fit of bar on centres after every two or three cuts, when it will be found that adjustment may be needed. This is due to the surfaces of centres and centreholes bedding together. They will soon settle down, however.

Having trued the surface, use a micrometer to measure the diameter. Make a note of the figure and take away from this the size finally required. Assume as an example that the figure obtained is .605" dia. The size we want it to be is $3/8$ " dia. plus 10 thou. which is .375" plus .010, or .385", take this from the first figure :-

.605
<u>.385</u>
<u>.220</u>

This is the total amount to be removed but as we saw earlier, we must divide this by two in order to get the amount to be removed by the actual reading on the Knob Graduations. So the figure will be .110" or 110 divisions, as the Knob has 40 divisions it will be seen that two full turns of the Knob and a further 30 divisions are required to bring the bar to size.

By this time you will have become more used to the machine and can take deeper cuts with the tool.

Do not just rely on the dial being absolutely accurate for this amount, however, but when halfway through make another measurement of the work and before taking the final cut test for size again. The reason that it will not be 100% accurate is that wear of the tool edge will take place, and it has been known for a mis-calculation to occur!

When this end of the bar is machined, reverse the bar in the Lathe and fit the carrier to the end you have just machined. Use a small piece of soft metal - either brass, copper or aluminium - under the screw point to avoid making a nasty scar in the surface.

The procedure is now to repeat the operations on the second end of the bar that you have done on the first.

Having done this the tool can be removed from toolpost and a newly sharpened one fitted.

The workpiece can now be finished to size, give a smooth even feed to the tool by rotating the leadscrew handwheel in a continuous manner.

Use cutting fluid applied by a small paintbrush to give the best finish to the surface. The exact length from the end of the bar to the shoulder can be easily determined by using the graduations on leadscrew handwheel. This gives 40 thou. (or 1 mm) traverse to the saddle for each revolution of the wheel. It is not difficult to work out how many turns are needed to give a precise length.

Having finished to size all over, remove sharp edges with a tool set to 45° approximately or use a tool with a cutting edge ground to this angle.

The extreme ends of the Spindle can be best faced by using a narrow knife tool with the front ground to an angle greater than the centre angle. Even with this tool it is not possible to machine the end completely but will leave a ring of metal around the centre hole. To overcome this, a special type of centre is best used. This is one in which the point is ground away at one side until just over half the diameter is left. This is set in tailstock with the flat facing the tool and it leaves a gap just large enough to allow the tool to clear to the centre hole. This is known as a 'half centre' - see Sketch. Fig.No.2.

Although I have taken some space to describe this basic operation, you will find that it will take far less time to actually perform than it took me to write out.

There are many easier ways to approach the job just described but all of these need more equipment in the way of chucks, steadies, etc. I have tried to show that it is possible to turn out good work with the basic equipment and it is the best way of gaining experience.

Using a Four Jaw Chuck.

This is a most useful accessory and the most versatile type of chuck. It is possible to hold irregular shaped articles, such as Castings and square bar, as well as give absolute accuracy in holding round work.

It takes practice to use it to best advantage, but once you get the hang of adjusting the jaws it takes very little time to set a job in it.

It helps if an indicator is available. There are many of these on the market, but I would recommend that one of the low cost type such as the Verdict Junior be obtained - they are very robust and of a size easily managed on the Lathe.

The method of setting is to open each jaw in turn until the work will enter. Now tighten each jaw - equally. Rotate the chuck by hand. Any major error in truth will be very obvious and can be corrected by loosening the jaw on the low side as near as can be estimated by half the error. The opposite jaw is then tightened to take up the slack. Note, it may be necessary to slightly loosen the other jaws to enable the workpiece to move. After this has been done, rotate the chuck and check again. If the work runs more truly, you can now fit the indicator to the toolpost using a bar to hold it in a convenient position. Set the stylus of the indicator to a point where the hand registers a mid position on the scale. Now by turning the chuck until one of the jaws is directly in line with the stylus, note the reading on the dial, without altering the position of the indicator turn the chuck until the jaw opposite the one just checked is in line with the stylus. The dial will indicate the error. This can be rectified by loosening one jaw, the low reading one, and tightening the high reading one, the reading should then be the same on both jaw positions, turn your attention to the other jaws and repeat the process until the work runs truly and shows no perceptible movement on the indicator.

It is a very quick operation after a few attempts. The jaws can be reversed to hold larger objects, or just one or two can be reversed and the others left. When, for instance, rectangular objects need to be held. To reverse the jaws, withdraw completely and remove the screw from its recessed tongue seating on the jaw. Turn the jaw over and replace the screw, refit in body.

Always keep the threads in the chuck body clean as swarf can get embedded in the roots preventing correct fitting to Spindle nose. Also, clean the register diameter and face of both chuck and Spindle before fitting. Any swarf here could cause the chuck to run out of true. Where it is necessary to either turn a boss or bore a hole offset from the middle of a casting or block, the method is to measure the position of required centre and use a centre punch to mark. Set in chuck as near as can be seen by eye then use a centre finder and by using indicator on this the work can be set to run truly.

Details for making this useful accessory are given elsewhere.

The 3 Jaw Self Centering Chuck.

This is useful for holding round and hexagonal material. It is quick and easy to operate and is favoured by many users. Its main disadvantage is that it is rarely accurate, an error of 3 to 7 thou. is usual, even if it is true when new, it does not remain so - and the error can vary on different diameters of workpieces. Having said this, I should, perhaps, add that the larger industrial chucks are better in this respect but the cost is obviously much greater. This does not detract from the usefulness of this accessory as long as the user is aware of its limitations. Some chucks have jaws which can be reversed - in this case when the jaws have been completely removed, turn the scroll plate - that is the ring at the rear face of the chuck, until the start of the thread is in position to engage the teeth of jaw (1) but when used in the reverse position jaw number (3) should be used in Slot (1), jaw (2) fits slot 2 and jaw (1) is used in slot (3). If this is not done the jaws will not run true.

Other chucks are supplied with a separate set of jaws and, in this case, the correct numbers should be used. Again, it is necessary to maintain cleanliness and lightly oil the moving parts.

The Faceplate.

This is useful for objects which are too awkward to hold in the chuck or for discs which are too large to swing over the bed.

Another use is turning such things as locomotive wheels - the best method for these is to hold in a chuck, face the back and bore the hole for axle. Do this on all the wheels.

Then make a dummy centre to fit the Spindle with an extension suitable for the wheel boros. This should be machined to size after fitting in position. The wheels can then be mounted on this spigot and small bolts used between the spokes to clamp to Faceplate. The wheels, when finished in this manner, will all run true.

Collets and Collet Adaptor.

Collets are used to hold bars of metal which are reasonably accurate in size. They will only hold the size of metal that they are supplied for.

The advantages are that the metal is gripped on its entire diameter and does not get marked. Due to this it is possible to turn, say, an axle, by using a stock diameter and reducing one end to fit the wheel. The bar is then parted off or cut to length and can be reversed in the collet to turn the other end.

The nose taper of adaptor needs to be trued in Lathe to ensure accuracy.

Maintain scrupulous cleanliness at all times with collets. Wipe the nose socket clean of chips and swarf before inserting - the collet should be rotated by hand in the socket until the Keyway is in line with the Key then it will go fully home. The nosepiece can then be screwed in position. Do not tighten until you have pushed the bar into the collet. Always wipe the bar clean before using collets and check that no bumps or burrs are marring the surface. Anything of this nature will ruin a collet for accurate work.

Drill Chuck.

The use of this item is obvious. The shank tapered to fit the tailstock barrel and holds drills, roammers and taps when making holes in work held in lathe chuck.

The drill chuck will also fit the headstock spindle taper.

Tailstock Dieholder.

This accessory is used to hold Button Dies of 13/16" O.D. They are called Button Dies because with the four holes around the centre, they do resemble a button. They are available to cut all B.A. (British Association) threads. B.S.F. (British Standard Fine) and B.S.W. (British Standard Whitworth). Also many other fine threads up to 1/4" diameter. American National Fine (A.N.F.) and American National Coarse (A.N.C.) and number sizes are also available in this size of Die.

The die is loaded into the recess of the dieholder making sure it is clean and seats to the flat face. The dies usually have one side that is more tapered at the thread end - this is the side to face outwards. Use the screws in a manner that does not distort the die. Screw home the centre screw of the three into the split of the die. Use hand pressure only. Now screw home the two outer screws to engage in the Dimples of the die. It will be seen that if the centre screw is tightened so that it opens the split of the die, the thread will be cut slightly larger than the Standard and again if the two outer screws are tightened more than the centre one, the die will be closed slightly and cut a smaller thread than Standard. NOTE: that this adjustment is very limited. Do not overdo this or the die will break opposite the split.

If you wish to cut a thread up to a shoulder and do not want an undercut position at this point, thread the screw with the die fitted as above and then reverse the die in the holder - the taper lead is much less at this side and can be compared with taper taps and plug taps.

The body of the dieholder is machined to a sliding fit over the Tailstock Barrel and to use, extend the barrel so that about 1/2" to 1" is sticking out. Lock the barrel with the clamp screw.

Slide the body over the barrel with the die fitted.

It has been assumed that the work is turned to the size to be threaded. It is best to have the work a couple of thou. small on diameter as the action of threading will bring up the metal to size. Note that if a bolt of 1/4" B.S.F. thread is being made the shank should be made 1/4" minus a couple of thou. We do not allow any metal for threads as is the case when threading a hole.

Chamfer the end of the work so that the die has a good start.

Place the lever of the dieholder against the bed or cross slide, ensuring that it has enough clearance in front to allow movement of the length to be threaded.

Until you have enough experience to use a slow speed on the threading operations, I would strongly advise turning the Spindle by hand to cut the thread. Use either Tallow or a tapping compound, such as R.T.D. compound, to assist getting a clean thread.

It will be found quite easy to do after a little practice and because the die is guided by the tailstock barrel true threads will be cut.

Where holes need to be threaded, a tap is used. These are available in a wide range of sizes and come in taper, second and plug. For most purposes the second tap alone can be used. This is lighter on the pocket than three of each size. The plug is, of course, essential where a blind hole needs to be threaded - (this is a hole that does not go through the work). When threading holes, allowance has to be made for twice the depth of thread, but it is not necessary to work this out, as many tables give tapping size drills to use for any given thread.

Hold the tap in the drill chuck and rotate spindle by hand but, in this case, leave the Tailstock Body free to slide along the bed and as the tap screws into the hole it pulls the body with it - if you do not do this the hole will be just milled larger with the tap shearing its own threads away. Do not screw with a continuous action but give a half turn back occasionally to veer the chips. Holes tapped by this method will be true as long as the hole drilled was true. It makes a much neater job if the first thread is removed by countersinking with a drill of a diameter equal to the screw diameter as a burr is always raised when tapping.

Drilling and Reaming in the Lathe.

Most people, even if not associated with engineering, know what a drill looks like.

When used on the Lathe, it pays to have the short jobber lengths as these are stiffer in use and do not take up too much length, especially where the distance between centres is limited.

You will find that if you hold a drill in the tailstock chuck and feed it to work held in the Lathe chuck, that when the drill touches the work it will wobble. The best way to start a hole truly is to use a centre drill first - as it is much stiffer than a twist drill. Drill the metal until the countersink is fairly deep and then change it for the size of twist drill required.

If you want a hole to be drilled to size use a smaller drill first and follow with the final one required. This is because most drills, except when new, have points which are very slightly off centre. This causes the drill to oscillate and drill a larger hole than its body

size.

If, however, you drill a smaller hole first the metal which the point would cut, is not there and so the flutes will cut evenly.

Where a hole needs to be an exact size and also smooth, a REAMER must be used. This is a tool with a number of flutes cut along the length. Two main types are available - hand reamers, which usually have a square machined on the end opposite the flutes so that a tap wrench can be used to turn it through the work. This type is normally slightly tapered for the first third of their flute length to assist using the tool. Because of this, parallel holes which are blind cannot be reamed.

The other type is called a machine reamer. This type is usually provided with a Morse tapered shank and as these are all larger than our Lathe taper they are not much good to us unless the shanks are machined parallel so that we can hold in a drill chuck.

For most holes the hand reamers will be suitable. Use a slow speed and feed smoothly through the work using cutting fluid. Note that the reamer should be withdrawn frequently to clear the metal swarf which otherwise will build up in the flutes and cause a badly finished and scored hole. It helps to leave the tailstock body unclamped and slide the body along the bed instead of using the Handwheel to traverse barrel. The hole to be reamed should be about 5 thou smaller than the reamer size. A reamer will not true a hole that is out of true - where extreme accuracy is required the hole should be bored using a boring bar in the toolpost before the reaming size drill is used.

The type of cross-slide fitted to the Lathe with tee slots increases the usefulness of the Lathe by allowing various odd-shaped castings to be machined. These can be bolted down on top of the slide or clamped against an angle plate mounted on the slide. The work can then be machined by using a boring bar between the Lathe centres or milling can be done by using a cutter in the headstock spindle.

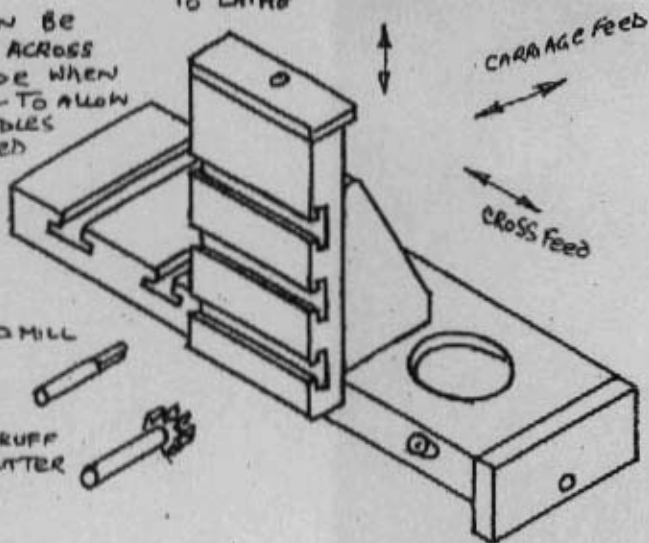
Vertical Milling Slide.

By adding a third movement to the Lathe, this accessory enables many milling jobs to be done; slots, keyways, steam ports in model cylinders, to mention just a few.

USING SOME ACCESSORIES.

VERTICAL SLIDE
ADDS THIRD MOVEMENT
TO LATHE

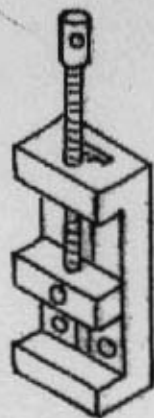
SLIDE CAN BE MOUNTED ACROSS CROSS SLIDE WHEN REQUIRED - TO ALLOW LONG SPINDLES TO BE MILLED AT END. ETC.



CUTTERS ARE HELD IN CHUCK.

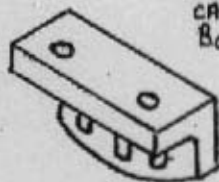
END MILL

WOODRUFF TYPE CUTTER



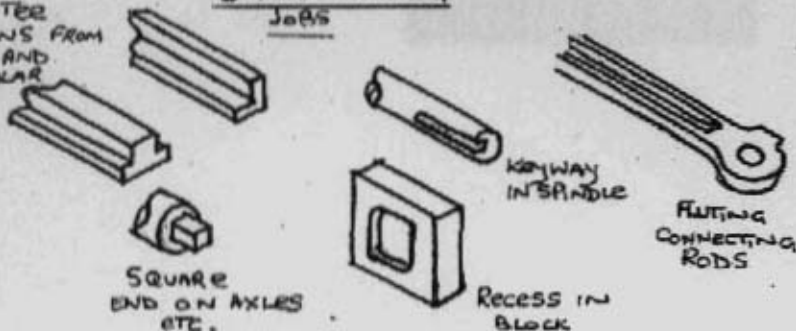
MACHINE VICE
CAN BE BOLTED TO VERTICAL SLIDE AS SHOWN UPRIGHT OR SIDEWAYS.

ANGLE PLATE
CAN BE BOLTED TO VERTICAL SLIDE.



ANGLE AND TEE SECTIONS FROM SQUARE AND RECTANGULAR BAR.

TYPICAL MILLING JOBS



SQUARE END ON AXLES ETC.

KEYWAY IN SPINDLE

FLUTING CONNECTING RODS

RECESS IN BLOCK

Again, the work can either be clamped directly onto the slide table or an angle plate can be used and the work held on this. Where a long object is to be machined, such as coupling rod fluting operations, a long angle plate is very useful and these are easily made using either Bright Steel Angle Section or the more common black variety which does not need much work with a file to clean the flat surfaces. Holes can be drilled and tapped in it to suit the job.

It will be seen that as you have movement in a cross direct and vertical, plus a horizontal movement with the leadscrew and all these have knobs with graduations, the spacing of holes to exact and repeatable dimensions apart, the making of identical mating parts is possible without difficulty.

The Machine Vice.

A very useful accessory and can be used on cross slide or Vertical Slide. It makes the holding of work much easier especially Round Spindles and Square Steel sections. The sliding jaw can be moved to clamp the work and after tightening the adjusting screw, if the Hexagonal screw in the centre of jaw is locked, this will ensure that the work is held flat against the base. Most machine vices suffer from the disadvantage that the moving jaw, when clamped, lifts slightly due to the working clearance necessary for the jaw to slide. This obviously gets worse as the vice wears. So by simplifying the design we have overcome this. Admittedly, you have to push the loose jaw back by hand when opening the jaws, but this is a small price to pay for having a vice which will always clamp the work flat.

Dividing Unit.

This is designed to fit in various attitudes on the Lathe - it can be clamped through the various holes provided, either on the boring table or on the vertical slide.

The Spring Loaded Plunger is used to engage in the index plate.

The work can be held in collets or lathe chucks which will all fit the nose of the dividing unit spindle. Or a special arbor can be made to take such things as gear wheel blanks.

Holes can be drilled on pre-determined pitch circle diameters.

If an index plate with 24 divisions is fitted to the unit and you want 6 holes in your work - say a cylinder cover bolt holes, the way to proceed is to line up the centre of the dividing unit with the centre of the lathe spindle. The easiest method is to have a centre in both and adjust the slides until the points coincide. Now, without touching the vertical or cross-slide, withdraw using the leadscrew knob. Remove centres and fit the work to dividing unit and a drill chuck to Headstock spindle. Use a centre drill to start the holes true before drilling with bolt size.

Having decided on pitch circle diameter of the bolt holes, move the cross-slide using the index graduations to a distance exactly half the pitch circle diameter - back or forward, whichever is most convenient. Centre drill and then drill to size the first hole. As we decided on six holes and the index plate has 24 divisions, withdraw the plunger and let it just touch the index plate so that when you turn the work you can hear it click. Count four clicks and engage the plunger. This is because $6 \times 4 = 24$. If 4 holes were required 6 clicks would be needed and so on. Carry on in this manner until all holes are drilled. With practice in its use, you will be able to think of many jobs you can use it for.

Circular Saw Table Attachment.

Is used to cut flat and square metal or plastic to the size required. It will surprise you how easily it is to cut, for instance, a piece of $\frac{1}{4}$ " x $\frac{1}{4}$ " section steel and how smooth the cut is.

To fit to the machine, first remove the topslide, fit the column of the attachment in the bore of cross-slide - it is clamped in exactly the same manner as the topslide. Ensure that the screw in the column is at the front. Then screw saw arbor onto spindle. Fit the saw onto the arbor with washer and screw. Now fit the table by moving the saddle until table pillar can be fitted into column and the slot is in line with saw. Position the table to the height required but in any case make certain that clearance exists between the table and arbor.

Note that it is necessary to skim the arbor true, so that the saw does not wobble.

The 3 Point Steady

This is used to support long slender work whilst drilling and turning operations are carried out. It is also very useful when facing and centring work.

The work is held by a chuck in Spindle and supported at its extreme end by the steady. It is easy then to face with a knife tool and centre drill the end.

To adjust the 3 support arms move the steady along the bed as close to chuck as possible and clamp to bed and move the arms inward to touch the work, clamp them. Then move steady to extreme end of work and lock to bed. If the arms are adjusted whilst away from the chuck it is possible to deflect the work which can lead to inaccuracy. Oil the arms whilst in use.

Screwcutting in the Lathe.

This is not a difficult operation, but care and patience are required, especially when you have no previous experience.

I do not propose to enter into calculations for working out the change wheels required for any particular thread. The chart supplied with the gears will give all the details required for a range of pitches.

All that you need to do is to find how many threads per inch are required for your particular job.

Look on the change wheel chart and find the required TPI in the first column. Now by following across the line you will be able to select the gears necessary and the last column will indicate which of the set up diagrams to use when fitting these to the machine.

Ensure that the gears have just a small amount of clearance where the teeth are meshed together. The best procedure to follow is to fit the gear to the leadscrew position then the next one above and, to ensure clearance, run a cigarette paper between the gears and after tightening the stud, rotate the gears to remove the paper. Now fit the twin gear and do the same between these gears.

Bring the quadrant up to mesh the idler gear and spindle gear and lock the quadrant screw.

If you are cutting a British thread, a tool with a 55° inclusive angle should be fitted to the toolpost. Ensure that the axis of the point is at the right angles to the work, otherwise the thread will have a sideways tilt and will not fit a nut. American and metric threads have a 60° angle.

A gauge can be bought quite cheaply, which has all the usual thread angles cut in the form of Vee notches in its side - this is very useful, not only for checking the angle of the tool, but also for setting the tool in relationship to the work. All you need to do is hold on the tool with one of the notches on the point and line up the opposite side with the work - adjusting the toolpost to achieve this.

The work will, of course, have been turned to the size required previous to the above procedure.

Set the tool point to just scrape the diameter of the work and mark the graduation opposite the index line with a felt pen or a pencil.

Find the depth of thread required. This will be shown in the tables. This gives us the amount in thousandths of an inch that the tool must be advanced into the work. However, this must be done in stages of 2-3 thou cuts until experience is gained and even then it is usual to finish the last cuts with no more than this amount. Use the lowest speed available.

Before starting the Lathe, ensure that the tool is just to the right of the work and feed in two thou. Switch on and engage clutch with lever below headstock. The tool will immediately start to move to the left and it should be noted that the coarser the thread the faster will the movement be.

When the tool has reached to a point just before the end of the length required, stop the Lathe. Do not disengage clutch. Return the tool to starting point AFTER HAVING WITHDRAWN THE TOOL by reversing the motor. Reset the tool to the previous depth plus another two thou (making a total of 4 thou from the original setting). Take this cut and then repeat until the total thread depth is reached.

The thread may now be checked for fit. To do this, move the tailstock clear and try the nut on the thread. Chances are it will not fit. Because Whitworth form threads should have a rounded crest and root and we with our single point tool cannot reproduce this, the only way to finish the thread to the correct form is either to finish off with a button die, if it is a standard thread, or by means of a hand thread chasing tool of the correct number of threads per inch. This does not apply to Metric or American threads which do not have a rounded crest.

These useful tools are available for either internal or external threads. They are not expensive. They are made with a tang at one end to fit a file handle and the other end, which is about $\frac{1}{2}$ " wide, has a number of teeth of the correct form. In use, a bar of metal is held in the toolpost to act as a rest. The chaser is then held with one hand on the handle and the other is used to guide and steady it. If the tool is pushed lightly onto the thread it will traverse along, shave off the metal and correct the form. It also gives a good finish. Do not go too far before checking the fit of screw as it is quite surprising how quickly it cuts.

It should be noted that many jobs, such as lense mountings, etc., which have a large diameter can be cut with a fine thread and finally fitted to each other using chasers.

It pays to make the nut part first and use this as a gauge to fit the external thread.

When cutting internal threads a boring bar with the thread form on the end is used. The procedure is the same but in this case the hole should be bored to outside diameter of the external thread MINUS two depths of thread. More care is needed when cutting internal threads.

Wherever possible, it helps to have a recess at the end of the threaded part to the root diameter of the thread and two or three threads long. This gives you a chance to end the thread neatly.

GENERAL INFORMATION.



ALLEN CAP HEAD SCREW.



ALLEN KEY

ALLEN SCREWS ARE HIGH TENSILE STEEL AND MUCH TOUGHER THAN ORDINARY SCREWS



ALLEN GRUB SCREW.



CHEESE HEAD SCREW.



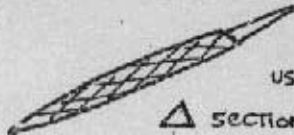
HEXAGONAL HEAD SET SCREW



NYLOC NUT. HAS NYLON RING INSERT, WILL NOT UNSCREW WITH VIBRATION



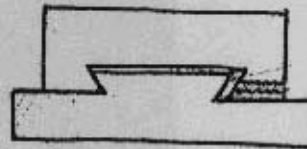
TEE NUT SPECIALLY MADE TO FIT IN TEE SLOTS OF CROSS-SLIDE.



SECTION

USE WOODEN HANDLE ON TANG.

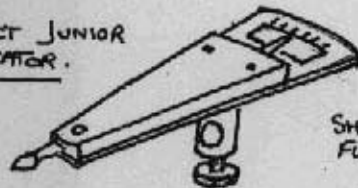
THREE SQUARE FILE
USEFUL FOR REMOVING HIGH SPOTS ON DOVETAIL SLIDES.



GIB STRIP ADJUSTING SCREW

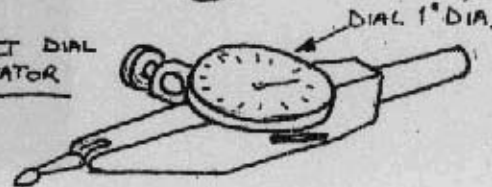
GIB STRIPS ARE USED TO ENSURE A GOOD SLIDING FIT BETWEEN TWO SLIDES AND ALLOW WEAR TO BE COMPENSATED FOR.

VERDICT JUNIOR INDICATOR.



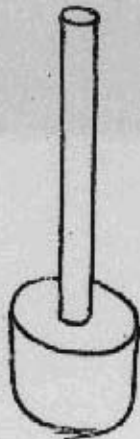
THESE ARE SHOWN APPROX. FULL SIZE.

VERDICT DIAL INDICATOR



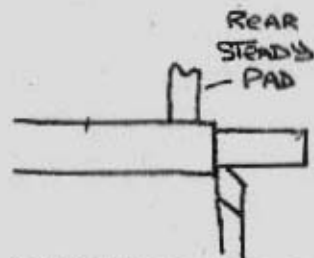
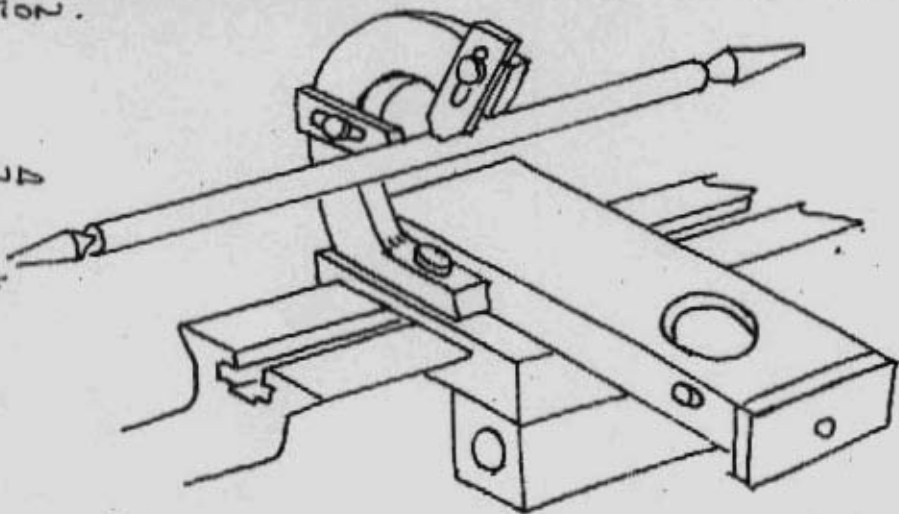
DIAL 1" DIA.

USEFUL MAGNETIC INDICATOR STAND MADE FROM 'ECLIPSE' POT MAGNET ABOUT 1" DIA. THESE HAVE A THREADED HOLE. WE CAN SUPPLY A ROD WITH THE MATCHING THREAD AT ONE END.

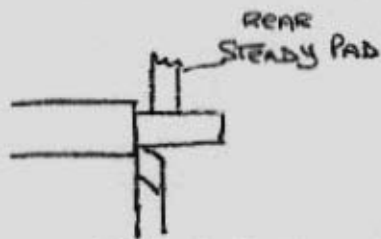


TRAVELLING STEADY. USED TO SUPPORT LONG SLENDER WORK. THE PADS SUPPORT WORK CLOSE TO TOOL TO PREVENT DEFLECTION.

THIS END
CAN BE
HELD IN
CHUCK IF
EASIER.



IF BAR IS TRUE AND
ROUND, PAD RESTS AS
SHOWN IN FIG. 13A

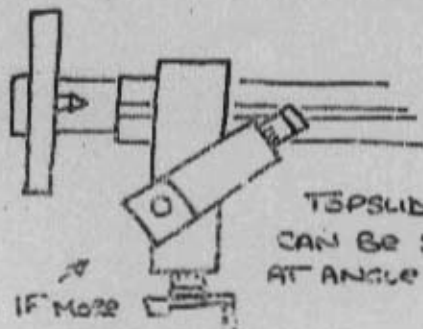


IF BAR IS ROUGH OR
OUT OF TRUE, PAD FOLLOWS TOOL

TOOLPOST
OMITTED FOR
CLARITY.

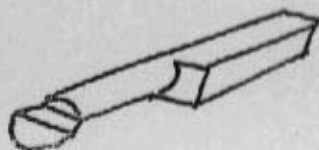
PLATE 13

TURNING TAPERS



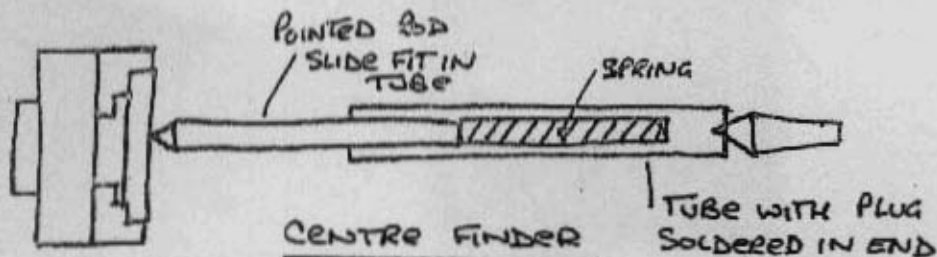
IF MORE
CONVENIENT
KNOB CAN BE
AT THIS POSITION

TOP SLIDE
CAN BE SET
AT ANGLE REQUIRED



BORING TOOLS

NEED MORE CLEARANCE
AS SHOWN.



BY ADJUSTING JAWS, WORK CAN BE SET
UNTIL NO WOBBLE IS APPARENT ON
FINDER.