IN THE WORKSHOP

by "Duplex"

*45—Graduating the Lathe Tailstock Barrel

THE practice of graduating the tailstock barrel as an aid to drilling to a required depth has been adopted by some lathe manufacturers; but where this has not been done by the makers the work can readily be carried out by the owner, and both the utility and the appearance of the tailstock will be enhanced thereby if a little trouble is taken to work methodically.

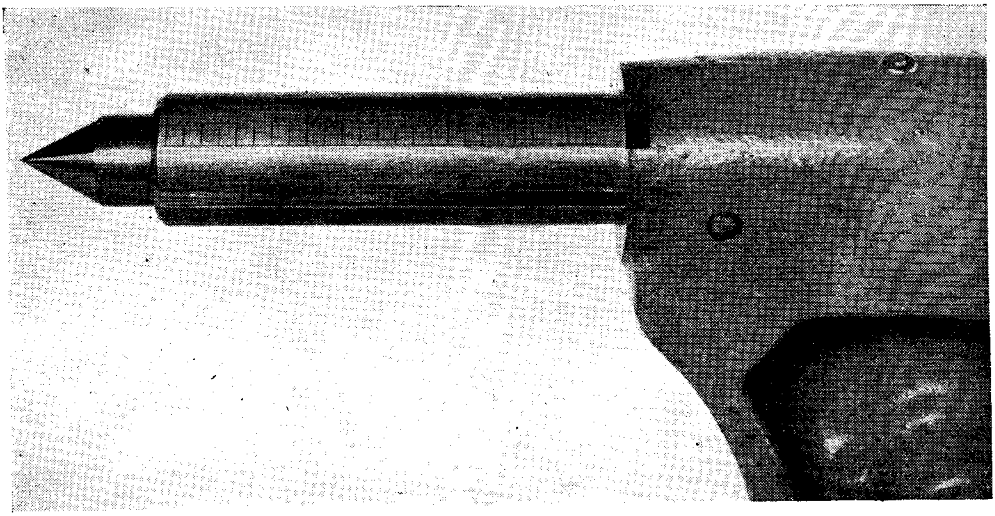

Fig. 1. *The graduated tailstock barrel*

The photograph, Fig. 1, shows the tailstock of the Myford M.L.7 lathe graduated in our own workshop by the method here described.

Clearly, the tailstock barrel could quite well be graduated, at a price, if sent to an engineering firm, but this would deprive the owner of the satisfaction gained from doing the work himself and at the same time carrying it out exactly as he wishes.

Now, the main purpose of graduating the tailstock is to enable drills and other tools, such as D-bits and counterbores, to be fed into the work for an exact distance. For the most part, this work will comprise entering a drill, mounted in the tailstock chuck, for a specified distance under the control of the tailstock feed mechanism. Under these circumstances, however, it will be difficult or even hardly possible to estimate exactly what is the zero position of the drill in relation to the work, or precisely at what point the drill begins to cut to its full diameter; for in the first instance the drill point usually engages a hole previously drilled with a centre drill, and in the second case it only becomes apparent that the full diameter has been reached when the parallel portion of the drill has entered for some distance. From what has been said, it will be evident that advantage can seldom be taken of any very fine graduation of the tailstock; nevertheless, the tailstock itself has all the essential features of a micrometer, for single turns of the feed wheel correspond with the major divisions of the scale, and subdivisions on the rim of the feed wheel are comparable with the minor graduations on the micrometer thimble.

In the present instance, as the pitch of the tailstock feedscrew is $\frac{1}{8}$ in., each revolution of the feed wheel will advance the barrel exactly $\frac{1}{8}$ in. and, as the wheel has four spokes, the registration of these with a fixed mark will indicate 1/32 in. of feed. If the tailstock feed mechanism is utilised in this way, $\frac{1}{8}$-in. divisions are inscribed on the barrel and any finer readings are taken from the position of the feed wheel itself. By this means, the scale lines on the tailstock barrel are widely spaced and easily read, whereas, were subdivisions of $\frac{1}{16}$ in. and 1/32 in. inscribed in this situation, quick and precise reading would be more difficult and confusion might easily arise.

It has been suggested that, as in a micrometer, the feed wheel should be graduated to enable measurements of a thousandth of an inch to be made, but it is not readily apparent when and how such fine readings could be utilised.

The method here suggested for indexing the feed wheel is illustrated in Fig. 2. A flat or other mark is made at the centre of one of the spokes, and the screw securing the thrust tongue in the barrel is used as the fixed index mark.

As will be seen later, when these two marks are set to correspond, the $\frac{1}{8}$-in. graduations of the barrel will at the same time register with an index face formed on the nose of the tailstock casting.

Now, in the present instance, the diameter of

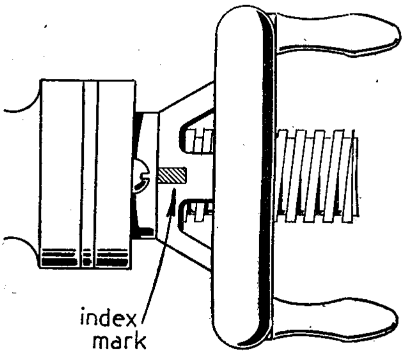

Fig. 2. View of tailstock, showing index mark on hand wheel

the feed wheel at the site of the index mark is $1\frac{3}{4}$ in. and the width of the spoke is $\frac{5}{8}$ in.; it follows, therefore, that, by turning the wheel to bring the edge of the spoke, instead of the index mark, opposite the screw-head, the tailstock barrel will advance approximately 7 thousandths of an inch. This goes to show that, with ordinary care, the depth of drilling can be regulated very accurately when increments of 1/32 in. are required; and beyond this, decimal parts of an inch can be estimated with reasonable exactitude by reference to the position of the feed wheel

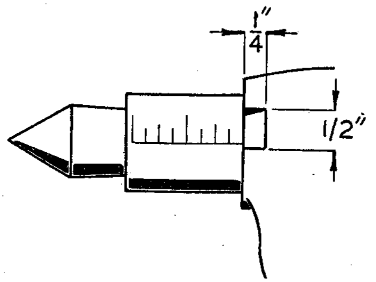

Fig. 3. Showing position of graduations and index bevel

spokes in relation to the [fixed index mark.

Now that the underlying principles involved have been considered, the next step is to apply them in carrying out the necessary work on the tailstock.

Marking the Hand Wheel

Any one spoke is selected to carry the zero index mark, and for this purpose its surface over a small area is filed to a good finish. The mark itself may take the form of a line, or a small countersunk hole drilled with a centre drill having an $\frac{1}{8}$-in. diameter body will give a good appearance to the work and can also be easily read.

If a line is preferred, some difficulty may be experienced in forming it neatly in this rather awkward situation, but it can quite well be engraved with acid in the manner previously described for marking hardened steel gear-cutters.

Graduating the Barrel

To ensure that the divisions cut on the tailstock barrel are in step with the zero marked on the wheel spoke, the feed wheel is turned to bring its index marks into line and, at the same time, the barrel should project some $\frac{1}{16}$ in. from its housing. A line is then lightly scribed on the barrel against the nose of the casting to denote the position of the first graduation line, as shown in Fig. 3; this scribed line will be referred to later when the actual machining operation is described.

At this stage, it is advisable to mark-out with a grease pencil the position of the base line for the graduations, and also to indicate that these graduations are cut above the base line; the importance of this is that workers, being misled by the inverted position of the barrel during the machining operation, have cut the scale lines upside-down. The grease pencil mentioned is the kind commonly used in the laboratory for writing on glassware, but these will equally well mark metal surfaces and are far superior in this respect to ordinary chalk.

Although grease pencils can be obtained in several different colours, the blue marking shows up best on most metals.

The next step is to mount the barrel in the lathe so that the leadscrew feed with the aid of its index can be used to space the graduations accurately. For this purpose, the barrel is withdrawn from its housing, and the register peg

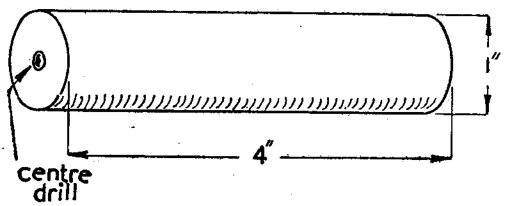

Fig. 4. Dummy tailstock barrel

fitted to the bore is also removed. A length of round brass or steel, which fits the bore of the tailstock casting, is then gripped to run truly in the four-jaw chuck and, after it has been faced, a centre is formed in its end with a centre drill, as illustrated in Fig. 4. This component is inserted in the tailstock, where it can be clamped in place to form a guide centre for the ordinary coned centre now fitted to the tailstock barrel.

The barrel is next secured by its threaded end to run truly in the four-jaw chuck and, at the same time, the improvised back centre is engaged and firmly clamped in position. The situation at this stage is represented in Fig. 5.

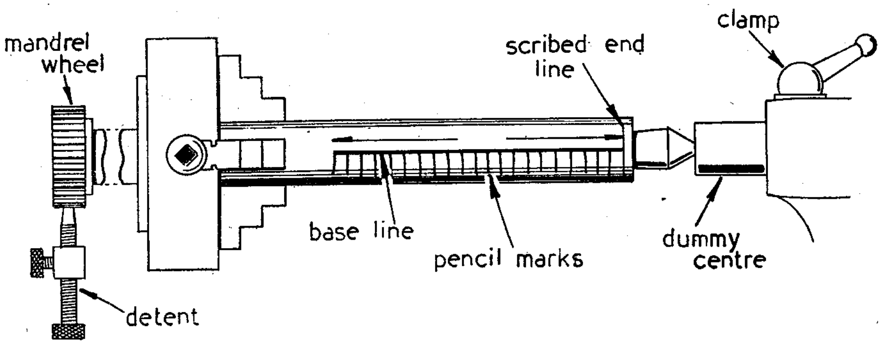

Fig. 5. Tailstock barrel mounted in the lathe for machining

The correct centring of the barrel by means of the test indicator is of the greatest importance, for, if this is omitted, the graduation lines when cut may be of unequal depth and width throughout their length, and they may also vary in these respects from end to end of the scale.

For cutting both the base and the graduation lines, a V-tool is used when mounted at centre height in the lathe toolpost.

If the included angle of the V is made equal to about 45 deg., deep but narrow lines will be cut, thus making for easy reading and giving a pleasing appearance to the work.

The sharp edge at the tip of the V should be removed with a few strokes of an oilstone slip to give greater strength to the cutting edges, but in doing this, care must be taken to preserve the clearance angle at the front of the tool.

When cutting the base line, the tool is clamped on its side at centre height and with the cutting edge facing the tailstock.

To locate and fix the barrel while cutting the base line, some form of mandrel lock is required, and the arrangement previously described of securing a change wheel to the tail of the mandrel, and locating it with a detent, will serve this purpose well.

The lathe mandrel is rotated to bring the base line, drawn on the barrel, level with the tool point, and it is then locked in this position.

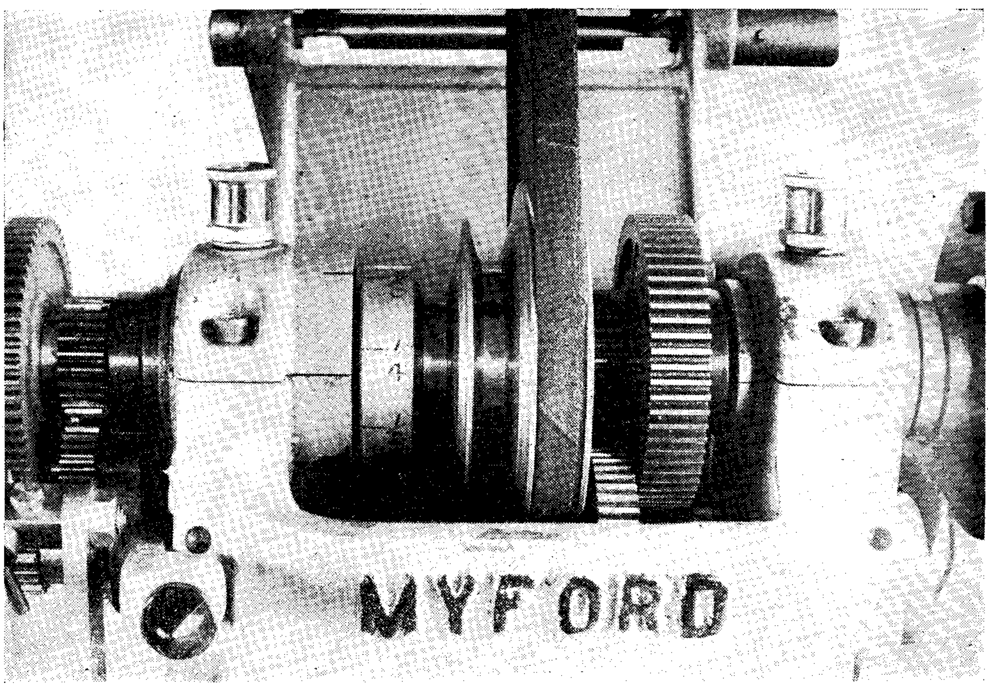

Fig. 6. Showing the method of marking the zero and index lines

Although it will be sufficient to make the scale itself 3 in. in length, the base line must be started farther back to enable it to be machined correctly. This is done by feeding the tool up to the barrel at its left end and then setting the cross-slide index to zero ; the tool is now fed in gradually for a distance of two thousandths of an inch as it is traversed towards the right, so that the full depth is cut by the time the beginning of the scale is reached. The tool must be stopped in a position some 5 thousandths of an inch beyond the limit line previously scribed on the barrel ; this is to allow the tool to enter the base line correctly when the vertical scale lines are later machined.

This procedure is then twice repeated, with an in-feed of 1 thousandth of an inch each time, to bring the total depth to 4 thousandths and thus complete the machining of the base line.

Before the vertical scale lines are cut, their length must be decided upon either by reference to a standard rule, or by setting out the graduations on the drawing board, to obtain an easily-read scale of good appearance.

The following dimensions have been found to fulfil these requirements :—

Dimension denoted	Length of line	Distance on pulley
$\frac{1}{8}$ in.	$\frac{1}{8}$ in.	$1\frac{3}{4}$ in.
$\frac{1}{4}$,,	$\frac{3}{16}$,,	$2\frac{5}{8}$,,
$\frac{1}{2}$,,	$\frac{1}{4}$,,	$3\frac{1}{2}$,,
1 ,,	$\frac{5}{16}$,,	$4\frac{3}{8}$,,

The lines are cut by mounting the tool with its cutting edge facing downwards, and then rotating the lathe mandrel for an angular distance corresponding with the length of each line.

Although this can be readily carried out by employing a mandrel dividing-head, a simpler method is to rotate the mandrel for the requisite distance by means of the back gear. The latter method gives a drive reduction of approximately 6 : 1, so that not only is very little operating pressure required, but any errors made in the amount of rotation are reduced in the same ratio.

To put this method into practice, the mandrel remains locked by its detent, and, as illustrated in Fig. 6, zero lines are drawn with the grease pencil on both the headstock casting and the cone pulley. From the zero line on the cone pulley the distances given in the third column of the Table are then marked off with the aid of a flexible rule.

These distances are calculated by dividing the diameter of the cone pulley by the diameter of the barrel, and then multiplying the dividend by both the drive ratio and the length of the line required.

In the present instance :—

Diameter of cone pulley flange $= 2\frac{5}{16}$ in.
Diameter of tailstock barrel $= 1$ in.
Back gear ratio $= 6$ (5.96)

Therefore, the distance the pulley is turned to mark the $\frac{1}{8}$-in. line

$$= \frac{2\frac{5}{16}}{1} \times \frac{6}{1} \times \frac{1}{8} = 1\ 47/64 \text{ in.}$$

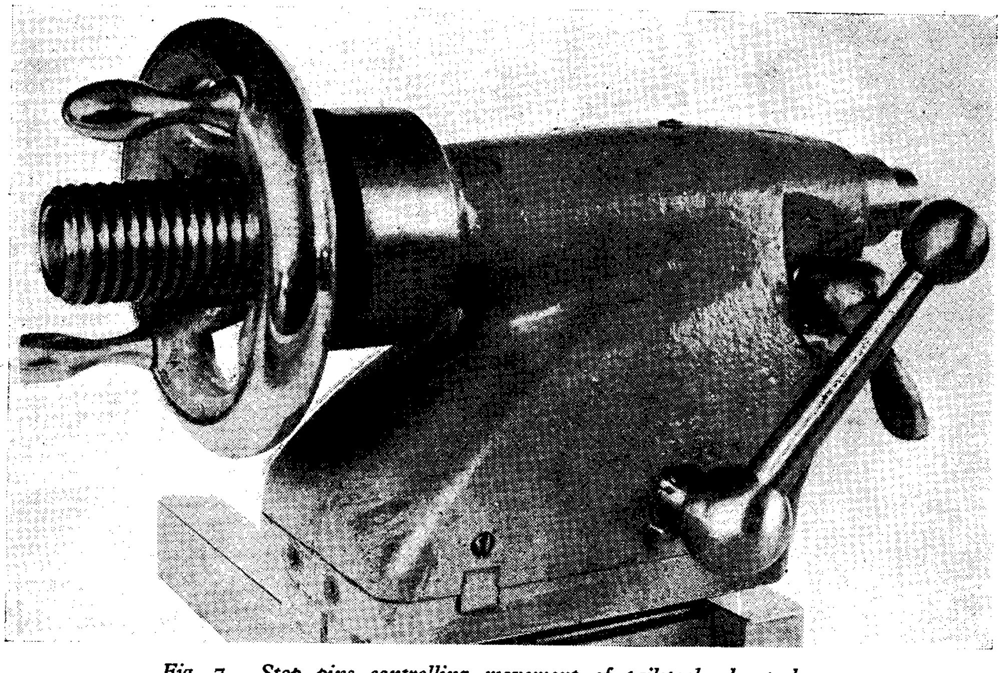

Fig. 7. Stop pins controlling movement of tailstock clamp lever

This figure is corrected to the nearest 1/64 in., making $1\frac{3}{4}$ in.

It will be apparent that, as the distance the cone pulley has to be rotated is very much greater than the length of the scale line, the possibility of making any material error in operation is considerably reduced.

To cut the graduation lines, the tool is first fed against the work and the cross-slide index is set to zero. The mandrel detent is then engaged in its former position and, with the lead-screw index turned to zero, the point of the tool is engaged exactly in the right-hand end of the base line. This is done by adjusting the setting of both the top- and the cross-slide.

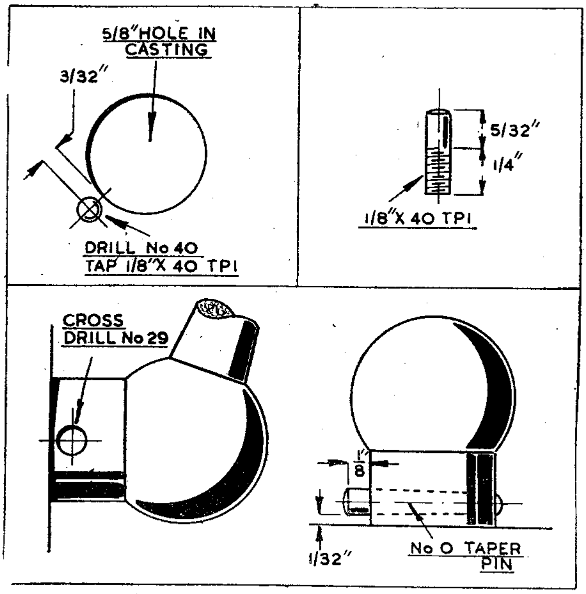

Fig. 8. Details of clamp lever stop pins

Next, a cut of 2 thousandths is put on with the cross-slide, that is to say, its index is turned this amount beyond the zero mark.

The mandrel detent is then freed and the cone pulley is rotated with the fingers until its 1-in. pencil mark registers with the zero line on the headstock casting. This procedure is twice repeated with an added in-feed of 1 thousandth inch in each case to complete the cutting of the first line.

The tool is now withdrawn, the leadscrew is turned through an exact revolution, and, when the detent has been engaged, the tool point is entered in the base line to enable the next graduation line to be cut in a similar manner.

When cutting the lines, it will be found that, owing to the low drive ratio, very little finger pressure is required to turn the cone pulley or to stop it at exactly the right point.

On completion of the machining, the burrs set up by the tool should be broken off with a piece of brass and the work surface smoothed with an oilstone slip; finally a strip of worn abrasive cloth may be used to restore the appearance of the barrel. If the work has been carefully carried out, inspection, even with a hand lens, should not bring any faults to light. To enable the graduations to be easily read close to the nose of the tailstock, a flat or bevel is formed on the casting as shown in Figs. 1 and 3.

The flat should be marked-out with the barrel in place so that the bevel is sited directly opposite the scale lines. The surplus metal can be cut away with a small hacksaw, leaving the surface to be brought to a good finish with a fine file.

A Stop Pin for the Tailstock Clamp Lever

It may be found that when the tailstock clamp lever is released, it tends to fall below the surface of the lathe bed, and at times this may mean groping for its recovery.

This can be readily overcome, as shown in Figs. 7 and 8, by fitting pins to limit the movement of the lever, for the distance the lever has to travel to free the tailstock is quite small. A small taper pin fitted in a cross-drilled hole will serve for the peg at the base of the lever, but the pin fitted to the casting should be threaded and screwed into place ; this form of construction allows either peg to be easily removed if required, which would not be the case were the pins driven into blind holes.

The exact location of the stop pin fitted to the casting is immaterial, for within limits the travel of the clamp lever can be varied by adjusting the thrust-nut, bearing on the clamp-piece fitted between the bed shears. This nut should be adjusted so that the tailstock is just free to slide when the clamp lever is in contact with its stop pin

Traction Engine Drawings and Castings

Mr. A. J. Every, 33, Williams Road, Ealing, London, W.13, has designed a $1\frac{1}{2}$-in. scale Burrell single-crank compound traction engine for which he can supply blueprints and castings. We have inspected a set of blueprints which consist of four sheets giving the general arrangement in side and end elevations and half-plan, as well as the principal details for a very handsome engine. The castings are excellent.

The design has been worked out in such a manner as to keep all machining operations as simple and straightforward as possible while preserving the external appearance of the prototype.

We think that there are many traction engine enthusiasts who will welcome the opportunity of being able to build a not-too-elaborate but very good-looking engine.