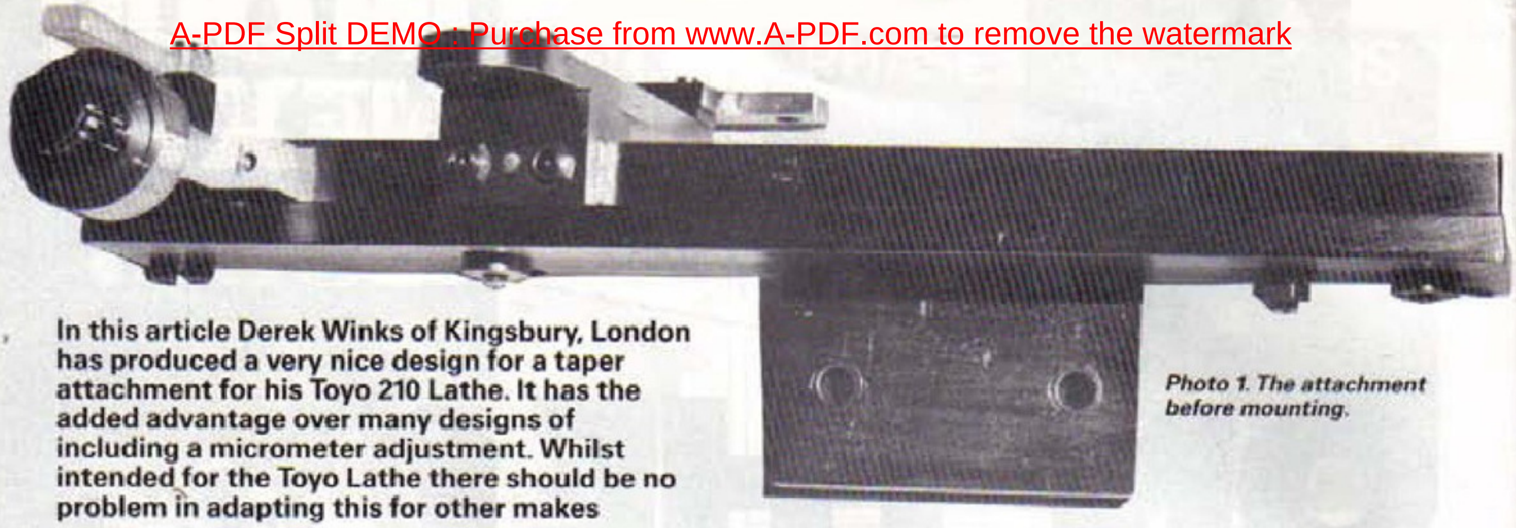


Photo 1. The attachment before mounting.

In this article Derek Winks of Kingsbury, London has produced a very nice design for a taper attachment for his Toyo 210 Lathe. It has the added advantage over many designs of including a micrometer adjustment. Whilst intended for the Toyo Lathe there should be no problem in adapting this for other makes

TAPERS ON A TOYO

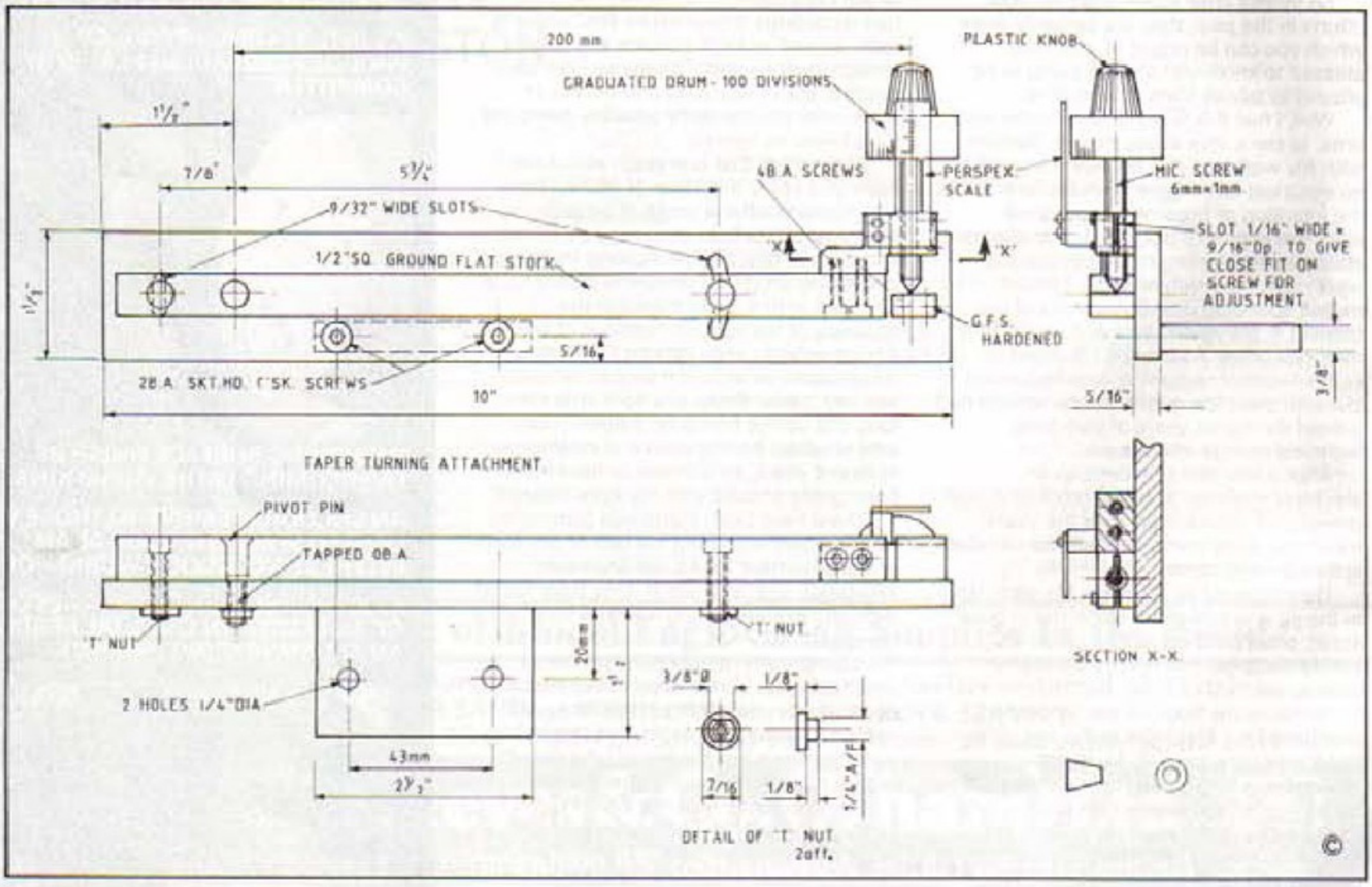
The Toyo ML210 lathe is not provided with a set-over tailstock, so the only means of turning tapers is by the use of the top-slide. This is limited to a length of 45mm. Also, as the smallest angular division is 5 degrees, setting a slow taper is very much a matter of guesswork. This attachment was designed to provide a means of setting up a taper accurately at first go, without need to resort to tedious cut-and-try methods.

It takes the usual form of a guide bar mounted behind the lathe bed which controls the movement of the cross-slide, which has of course been disconnected from its usual feed-screw.

The construction can be seen in **Photos 1 & 2.** The base is a length of flat steel 1.5in. x ⅜in. x 10in. long. A bracket projecting from the underside of this can be bolted to a machined surface on the rear of the lathe bed. The upper side carries the guide bar which is a length of ½in. square ground flat stock. This must of course be straight. I checked the bar against a good quality straight-edge, selecting the best portion. The bar is pivoted 1½in. from its left-hand end on a ¼in dia. pin which must be a close fit in its reamed hole. Two Allen screws with their heads recessed into the guide bar go through slots in the base and serve to clamp the bar firmly to the base after the angle has been set.

Geometry of the device

The diagram illustrates the geometry of the device – with the angles exaggerated for clarity. The line OA represents the centre line of the guide bar with the pivot at O. The line AC is the centre line of the micrometer screw which has a pitch of 1mm. AC is at right angles to OA. OC is a line parallel to the lathe axis. The point of the micrometer screw bears on a steel block, the face of which falls on the line OC. The distance OA = 200mm. The distance AB represents the travel of the cross-slide as the saddle is transversed from B to O. H is the half-angle of the taper to be turned. S is the setting of the micrometer, which is



set to zero with the guide bar parallel to the lathe axis. As the triangles OAC and OAB are similar,

$$\frac{S}{200} = \frac{AB}{OB} = \tan H$$

Thus if the taper to be produced is specified by the included angle A, then the setting required on the micrometer is

$$S = 200 \tan(A/2) \text{ mm.}$$

If the taper required is specified as inches per foot on diameter, divide by 12 to convert to inches per inch. As this is a ratio it is independent of units. Let this = R, then

$$R = \frac{2 \times AB}{OB} = \frac{2S}{200} = \frac{S}{100}$$

thus the setting required $S = 100R$ mm.

The Micrometer setting device

The details of the micrometer setter can be seen in **Photo 3**. The screw is 6mm dia. x 1mm pitch which is a standard size so that a tap for the nut is easily available. The screw was made from ¼in. free-cutting silver steel, obtainable from Chronos. One end of a 60mm length was turned to a 60 degree point, the other end centre-drilled, the piece mounted between the centres with a female centre in the tailstock and the portion to be threaded 40mm long reduced to 6mm dia. and a screwcut using the screwcutting attachment also added to this lathe. *[For those without this facility, an M6 die should give adequate results. Ed].* The nut should be made first so that a good fit can be obtained, taking care to get a good finish on the thread. It is best to use the top-slide, set over to half the thread angle so that the tool cuts on one side only.

The micrometer dial is about 28mm dia. with 100 divisions. These were marked using the division plate set up in a larger lathe, with a pointed tool set sideways in the toolpost using the top slide index for controlling the length of the lines. Each 5th and 10th line was extended in the usual way. Each 10th division was marked 0.1 to 0.9 with number stamps using a simple jig as seen in **Photo 5** to place the stamp accurately. A grub screw was fitted for securing the drum to the screw.

The nut portion of the micrometer was cut from [illegible]in. flat mild steel. After tapping the thread the piece was slotted and two 4BA adjusting screws fitted as shown so that any shake of the micrometer screw could be eliminated. The nut is fixed to the guide bar with two 4BA screws. The micrometer screw must be at right angles to the bar. A Perspex scale graduated in millimetres is attached to the nut so that it just clears the micrometer dial; it indicates

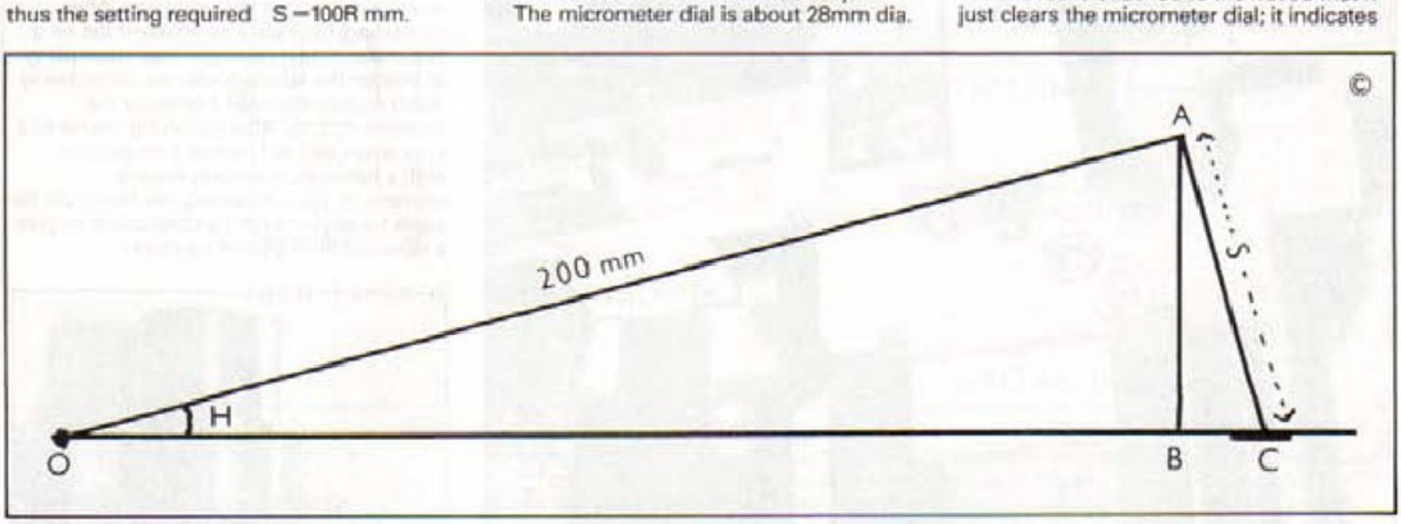
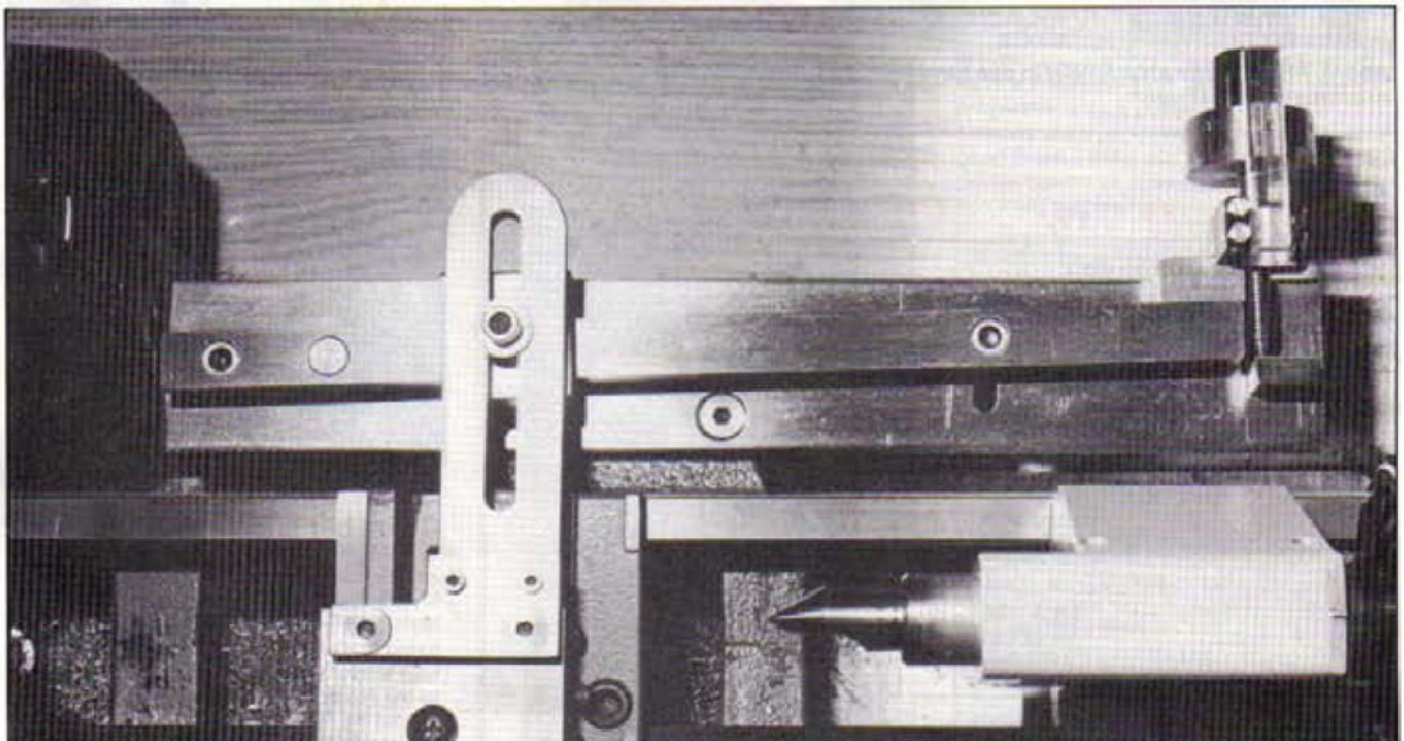
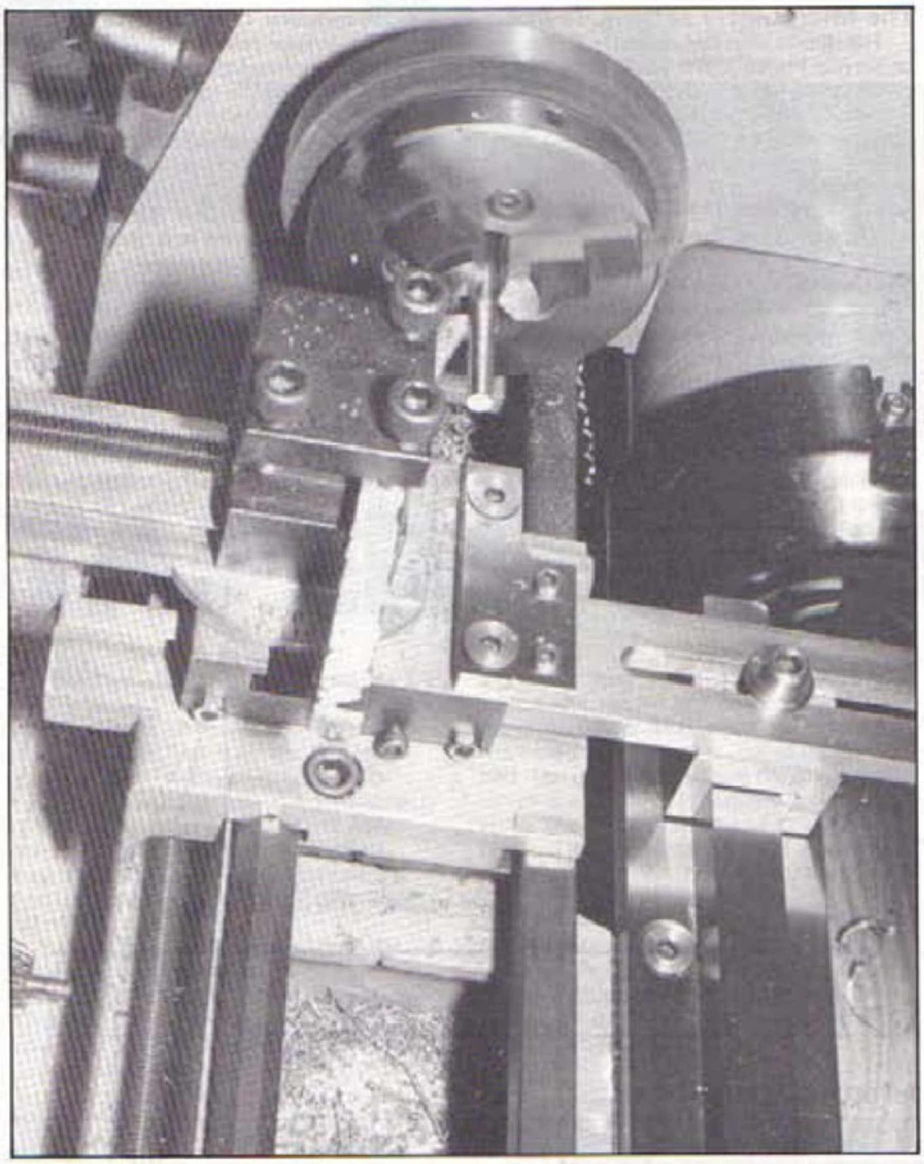
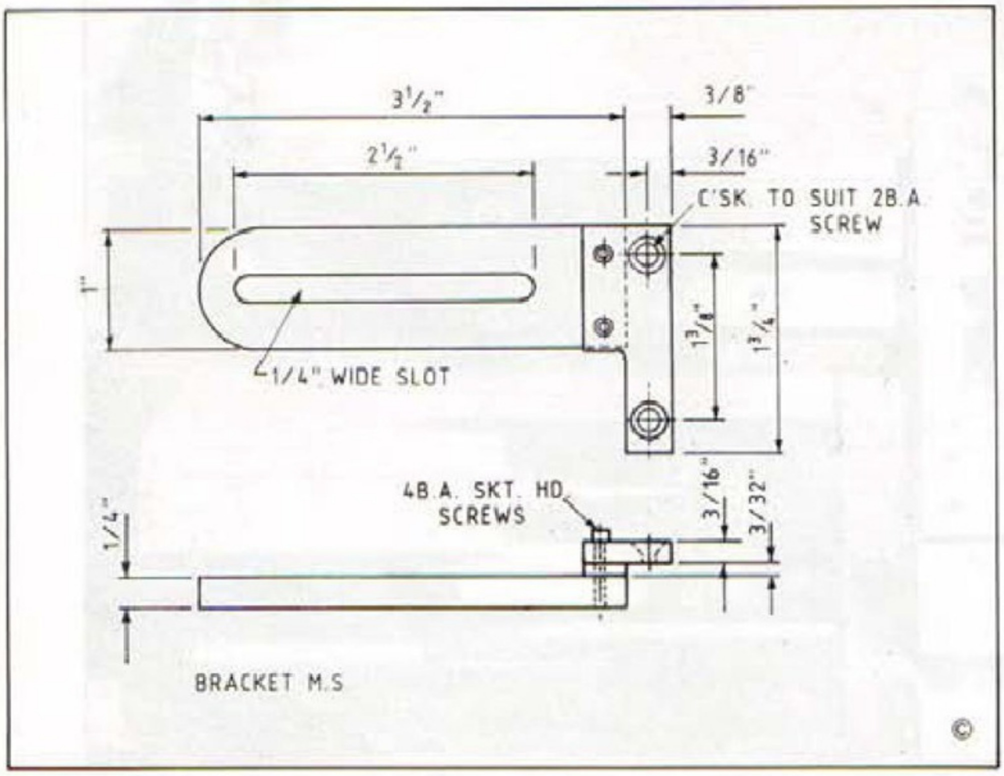


Photo 2. The attachment fitted to the author's Toyo ML 210, ready for use.





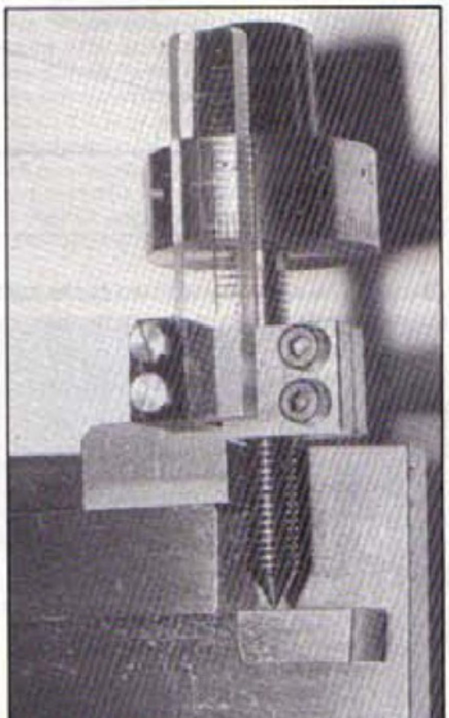
Above, Photo 4. The attachment in use turning a taper pin. Right, Photo 3, the micrometer adjustment.



the number of full turns of the screw, and carries the index line for the dial graduations. The graduation lines on the dial and scale were filled with black paint to improve legibility. The knob is a plastic collet-type knob 15mm dia. obtainable from electronic component suppliers.

The distance between the centre lines of the pivot and the micrometer screw must be as near as possible 200mm. The method of achieving this will depend on the equipment available; I used the table feed screw of the Emco miller as the measuring device.

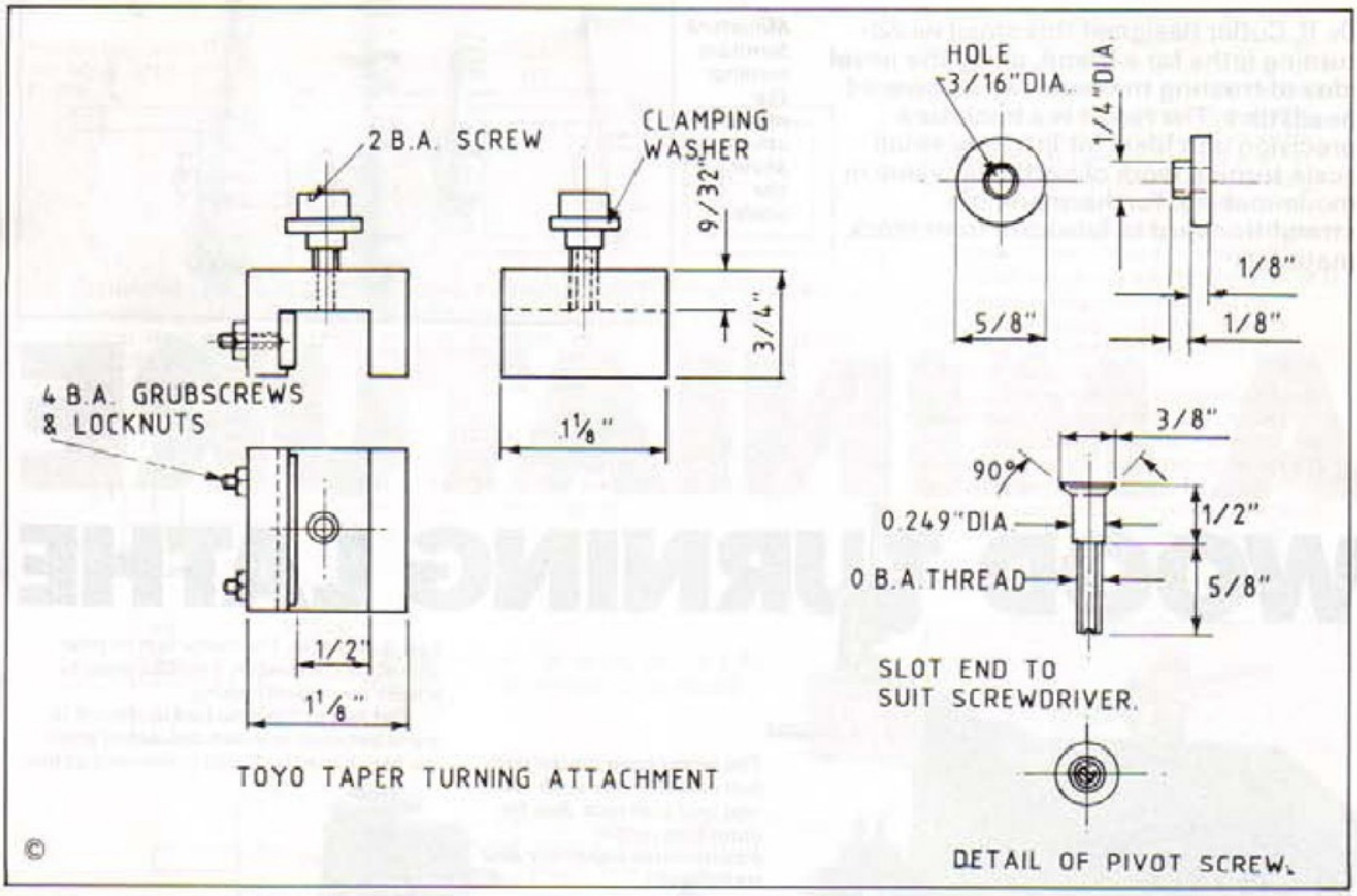
The steel block of which the point of the micrometer screw bears was made from a scrap of ¼in. ground flat stock; it was attached to the base with 4BA Allen screws in a position so that the face is on the centre line of the base bar. The block was hardened by heating to redness and quenching in oil in the usual way. After hardening, the face was polished flat on a fine water stone. I thought that attempting to harden the whole screw would probably result in distortion so I hardened the extreme tip only. After polishing the tip to a very small radius, I heated it to redness with a flame from an oxypropane microtorch; after removing the flame the tip cools rapidly enough by conduction to give a reasonable degree of hardness.



Guide bar connections

The guide bar is connected to the lathe cross-slide by a slotted bracket as shown. It is necessary to remove the slide from the lathe to drill and tap two 2BA holes for the fixing screws; there is plenty of metal to take these. The rear of the bracket is bolted to the block which slides along the bar guide.

The block is fitted with a gib strip with the usual adjusting screws at the back. There should be a good clearance between the top of the bar and the block to prevent binding. The gib strip should be adjusted so that the block slides freely along the bar;



any tightness here could cause the saddle to twist on the lathe bed.

Cross-slide disconnection

The cross-slide feed screw must of course be disconnected before the attachment can be used. This is most easily done by removing the handwheel so that the screw can slide freely through its bearing; this is done by using a thin-walled spanner, then unscrewing the wheel. This also gives clearance to fit the top-slide at right angles to the lathe axis to act as temporary cross-slide.

Setting the device

The micrometer must be set to zero before the device can be used. The guide bar was set parallel to the lathe as nearly as possible by eye, then clampled. A light cut taken along a bar between centres indicates any error, which was corrected until the test bar became parallel. The micrometer screw was then advanced to contact its block and the drum set to read zero, then secured with its grub screw and carefully rechecked.

For a simple test I used the device to make a taper pin. This can be seen in **Photo 4**. The standard taper on these is ¼in. per foot which equals 0.0208 inches per inch so using the formula given previously the micrometer was set at 2.08mm, the tip pressed firmly into contact with the block and the bar clamped. As with all taper turning, the tool must be at centre height. The tool was fed in with the top-slide screw, the autofeed engaged and the pin turned in the usual way. The resulting pin appeared to be a good fit in a hole reamed with a standard pin reamer, which was encouraging so I went on to make an arbor for an old drill chuck I had.

A piece of ¾in. dia. EN8 free-cutting steel was centred and roughed down in the larger lathe to the size of the large ends of the tapers which were Jacobs No. 33 and No. 2 Morse. Reference to the invaluable *Model Engineers' Handbook* (Argus Books £6.95 plus 75p p&p) gives the taper for No. 2 Morse as 0.04995in. per inch and for Jacobs 33 as 0.76194in. per foot which equals 0.0635 in per inch. The micrometer was set to 4.99mm, the blank mounted between centres and the Morse end turned. The blank was reversed, the micrometer reset to 6.35mm and the other end completed. A guide bar must of course be clamped firmly after each adjustment; the screw is for setting only, not resisting cutting forces.

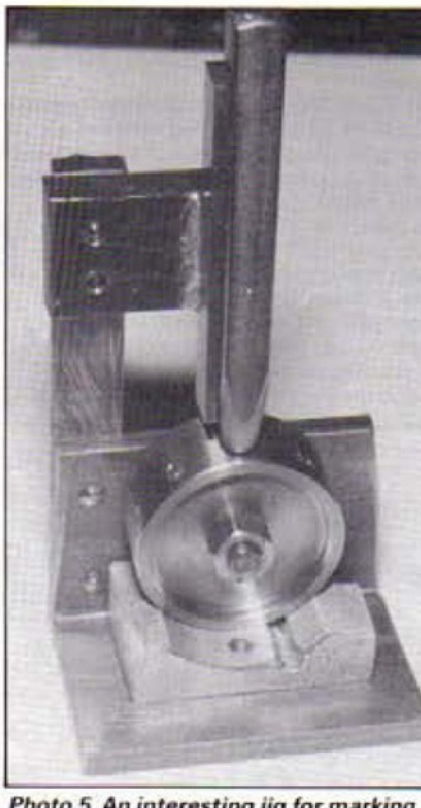


Photo 5. An interesting jig for marking the dial.

The resulting arbor was an acceptable fit in both tapers without any further fiddling. As this steel has good machining properties, only a polish with fine carborundum paper was necessary for a good finish. I think this test shows that the device can be an answer to an awkward machining problem.

LIST OF SUPPLIERS

Note — The author has no connection with any firm mentioned here.

AKRON TOOLS
11, Hawthorn Court, 46 Rickmansworth Road, Pinner Middx. HA5 3UN
Ground Flat Stock.

BOND'S o'Euston Road, Ltd.
Arundel House, Rumbolds Hill, Midhurst, Sussex GU29 9NE.
Worm Gears.

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Toothed pulleys and belt.

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SHESTO
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