AN UNUSUAL TURNING TOOL-HOLDER FOR
SLENDER WORK-PIECES
by W.M.H.

Describing a very interesting type of lathe tool-holder employed with much success for guiding and supporting rods of very small size whilst reducing them to a very slender diameter.

Very often the engineer is called upon to reduce (by turning) the diameter of rods, pins, or studs, etc. for a certain length, when the outside diameter of such parts is already very small in size. If the depth of cut to be taken on such components has to be of substantial magnitude it may be found that considerable difficulties will arise during the turning operation in respect of the following points.

(i) Errors, Faults, and Delays Associated with Customary Methods, and Tooling

For example, with components of such slender proportions it will often be impracticable to employ the customary centre-hole up the end of the rod being turned, owing to the smallness of the diameter of the original rod, or the size it is desired to reduce such a part. Consequently, the ordinary centre-bit cannot be used in the lathe tailstock to support and steady the rod against deflection whilst under the cut.

Should a piece be turned without such a centre-bit support there will be considerable tendency for the workpiece to deflect and bend due to the lateral pressure arising from contact with the cutting tool. Three major forms of error would therefore accrue. These are:-

(a) In the first place the turned portion would not be concentric with the original unturned diameter of the rod.

(b) The machined portion may not be turned perfectly cylindrical.

(c) Thirdly in respect of the parallelism of the slender turned portion it may be found that serious errors would arise, again partly due to the deflections of the rod, and the inability to take a substantial depth of cut.

Ovality, taper, and eccentricity of the above character would of course be most liable to spoil the whole workpiece. On the other hand, the turner in his efforts to avoid such faults might have to expend a very considerable amount of time, attention and effort in performing such delicate turning operations. It would in practice be necessary for him to take a large number of passes along the turned portion of the rod, each one being of a very small depth of cut so as to obviate placing any undue load upon the slender unsupported portion of the rod.

(2) Construction of a Special Supporting Tool-holder

To overcome the aforementioned kind of difficulties, when having to deal with a large number of small diameter pins requiring reducing at one end for about half the overall length, down to a very slender size, the author developed and used a most interesting type of tool-holder having a supporting guide provision for the rod. This was found invaluable for avoiding the troubles just enumerated in connection with usual turning methods.

The diagram, Fig. 1, depicts two views of the complete tool-holder. Referring to the right-hand front elevation view, it will be noted that the holder consists of a stiff rectangular shaped steel bar A. This member is reduced to less than half thickness and a slight amount in width for about half its overall length in order to provide a gripping shank B, by means of which the tool-holder may be fastened in the lathe tool-post.

The full thickness portion is slotted centrally for a given depth in the manner shown. The left-hand side portion is drilled and reamed to take the hardened and ground guide bush C.

This member should be made a tight press fit within the bearing hole in the holder. A similar smaller bush as shown at D is situated in like manner in a drilled and reamed hole passing through the right-hand side of the slotted portion.

The respective holes in which these two bushings are housed should be machined perfectly in axial alignment in both planes, in order that the bores of the bushes, when mounted, shall in turn lie exactly in line with each other. A rod component when turned to the requisite size should be capable of revolving freely within the bush members without tightness or interference.

Element E is the cutting tool which should be made from the usual standard size rectangular tool-steel. This is situated within a parallel rectangular slot machined into the top face of the tool-holder A as shown. This slot should be located exactly at right angles to the horizontal centre line passing through the bushings C and D, or in other words at right-angles to the rod component held in the chuck. The tool should be made a very snug sliding fit within its slot.

The tool is capable of being locked in any desired position within the capacity of the slot length by means of the square-headed set screw F situated in a tapped hole machined through the right-hand side wall of the slot.

To prevent the tool from lifting out of the slot a mild-steel keep-plate G is employed. This member is secured down to the top face.
of the holder by four vee-head screws \( H \). With this keep-plate thus fastened in place, the tool should be capable of moving smartly within the slot with a minimum of working clearance, when set screw \( F \) is released, and pressure is applied to the rear end face of the tool in a manner now to be described.

A well-fitted tool in this fashion will greatly promote the reproduction of high quality finish and close accuracy on the finished workpiece by reason of the elimination of tool vibrations.

Construction of the tool its method of usc and action will have been made clear.

This can best be described briefly by selecting an actual example. Suppose for instance it is desired to reduce a 3/16 in. diameter silver-steel rod down to 1/8 in. diameter for a length of say 3 in.

It will first be necessary to grip the rod in the ordinary self-centring three-jaw chuck, taking care to have the rod running exactly true.

Two suitable guide bushings would then be

or deflection out of the proper cutting position, which vibrations etc. would be transmitted to the turned portion of the bar.

To provide a simple means for adjusting the tool relative to depth of cut required, a small endplate \( I \) is fastened permanently to the step formed at the junction of the shank portion \( B \). Threaded through a tapped hole in this plate is the adjusting screw \( J \). As will be noted this member is located so that it will bear centrally against the rear endface of the tool.

By rotating this screw \( J \) in a clockwise direction the tool will be advanced closer to the work, thus causing a deeper cut to be taken. Conversely, by releasing the screw a slight amount the tool may easily be retracted away from the work to allow for increasing the diameter on the turned portion.

For preference, this screw \( J \) should be of very fine pitch to enable fine degrees of adjustment of the foregoing kind to be effected.

(3) Application and Use of the Tool

From this description of the design and required, one having a bore diameter of 3/16 in. for mounting in the left hand side of the holder nearest to the chuck, through which the rod should pass freely but with a minimum amount of working clearance. A second bush would be mounted in the right-hand wall of the slotted part of the holder, having a bore diameter of 1/8 in.

The rod would next be carefully turned down for a short length to the required size, this operation of course, being performed with the member running within the left-hand bush \( C \).

It would be necessary to adjust the lathe cross-slide laterally in order to bring the leading bush \( C \) exactly in axial alignment with the rod, before commencing a cut.

After the necessary trial cuts have been taken to determine the correct size of turned portion on the rod, cutting operations proper may be commenced. When a very short length of cut has been taken along the rod the reduced portion will be long enough to enter into the bush whereupon still additional guidance and support will be presented to it.
The finished turned portion formed in this manner should then be free from ovality, taper or eccentricity with the original outside diameter of the rod.

Practical Advantages

A number of valuable advantages are to be derived from the use of a tool-holder of this design. Briefly these advantages will be as follows:

(u) Use of such a holder will greatly reduce the risk of error, particularly on small diameter work.

(b) If the holes in the slotted portion of the holder, required as housings for the guide bushes, are machined to the correct standard size to receive ordinary hardened and ground drill guide bushes, very considerable economies will be obtained. Bushings of this well-known type are easily obtainable in a wide variety of bore sizes, from specialist manufacturers, at very economical prices. Moreover, the sizing of bores with such components will be to guaranteed limits.

These items may be bought at much lower prices than the cost of manufacturing same in one's own works, unless very large quantities can be produced as a batch.

Headed bushes of the kind illustrated in the finished cylinder casting. If the chassis is laid on its side, the cylinder rests on it by its own weight, and adjustment is just a piece of cake. When you get it right, put a big toolmaker's cramp over the cylinder and frame; then check with a piece of sewing cotton, same as young Curly used to do when setting his little toy oscillating cylinders. Pull out the piston-rod as far as it will go; the piece of cotton, about 1 ft. long, is stretched taut, and held exactly over the centre-line of piston-rod, at one end. If the other end passes exactly over the centre of driving axle in its new position, the cylinder is set O.K. If not, it is a simple matter to adjust it until it is correct. Tighten cramp, and locate the screw-holes on the bolting face by aid of a long drill poked through the holes in both frames, as described and illustrated in the notes on Tich; drill No. 40, and tap 1/8 in. or 5 B.A.

Give the second cylinder a dose of the same medicine; then, if you haven't already done it, screw the guide-bars on, put the crosshead between, with the boss just sufficiently over the piston-rod to prevent it falling off, and put the guide-bar brackets over the bars. Put each assembly in place, securing the cylinders temporarily by two or three screws, just enough to stop them from shifting. Set the guide-bar brackets in their correct position, that is, the front edge of the channels at 2-1/8 in. from the cylinder cover. This gives ample clearance for the wheel flanges. Set the crossheads exactly between the jaws of the brackets; then put a toolmaker's cramp over the flange of each bracket, and the frame. Now see if the crossheads move up and down between the bars easily; if they do, the location of the brackets is correct. You can attach the brackets to the frame by drilling No. 34 holes through it, using those in the bracket flanges as guides, and fixing with 6-B.A. bolts; or make No. 34 countersinks on the frame, drill No. 44, tap 6-B.A., and use set-screws.

Still keeping the crossheads between the jaws of the brackets, poke a No. 30 drill down the holes in the channels, and make countersinks on the guide-bars. Shift the crossheads out of the way, drill the bars No. 40 at the marked spots, tap 1/8 in. or 5-B.A., and fit set-screws, filling off any threads projecting below the bars. Finally, pin the crossheads to the piston-rods. Push the piston-rods right home, so that the pistons are hard up against the front cylinder covers; then put the crank on front dead centre, the crosshead boss passing over the end of the piston-rod. Scratch a mark on the piston-rod exactly 1/16 in. from the crosshead boss. Take off front cylinder cover, and very carefully drive the piston along, with a hammer and a bit of hard wood, or something similar, until the rod has entered the boss another 1/16 in., and the mark is level with same. Then pin the crosshead boss to the piston rod by drilling two No. 43 holes through the lot, as close together as possible, and squeezing in two pins made from 3/32-in. silver-steel. Don't bother about putting all the cylinder fixing screws in yet, as we shall have to take the cylinders off, to fix the exhaust pipe, this can be the next job.

"PAMELA"

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