QUORN

TOOL AND CUTTER GRINDER

by D. H. Chaddock, C.B.E.

Part II *From page 22*

THE BASE CASTINGS can be quite easily mounted on the saddle of the lathe and the cored holes bored to size by a boring bar between centres. This method also has the advantage that by using the cross-slide to traverse the work from one hole to the next not only will the two holes be exactly parallel but the centre distance between them can be made closely the same for the right and left hand castings. Here it is worth commenting on the fact that although the centre distance is shown as 3.500 in., indicating that it should be worked to as closely as possible, the actual distance is relatively unimportant, all that matters is that both ends should be the same. If therefore before boring the first hole and locking the cross-slide in position the feed screw is carefully turned right-handed and the micrometer index set to zero, the second hole can be accurately positioned by turning the feed screw the requisite number of turns — 35 in the case of a 10 t.p.i. screw — and finishing up again turning right-handed until the micrometer index is again at zero. By this method all backlash is eliminated and one can freely go from one hole to the other and back again. This is convenient with a boring bar between centres because setting the cutter bit to bore a given diameter is always a bit of a fiddle and a little bit uncertain until a trial cut has been taken. So both holes can be rough bored in turn with the same boring bar setting.

The rear hole, which is the less critical, can then be opened out until it is a neat sliding fit for the front bar and this setting immediately used to bring the front hole to size. Thereafter a slight tap on the cutter will give the necessary oversize to bore the rear hole with clearance. Moving the work between cuts and putting it back afterwards sounds all wrong, but if one accepts the fact that work can be accurately positioned by the use of feed-screws, if it can be set right the first time it can be re-set equally accurately any number of times thereafter. There is no magic in the first setting. Any of the subsequent settings will be as equally accurate — or inaccurate — but the greatest care need only be exercised on the final setting when the cuts are light. Of course the centre distance will not be 3.500 in. to N.P.L. standards, but as already explained that does not matter if both ends are alike.

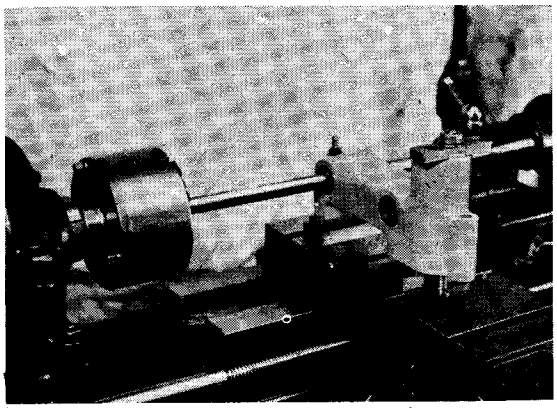
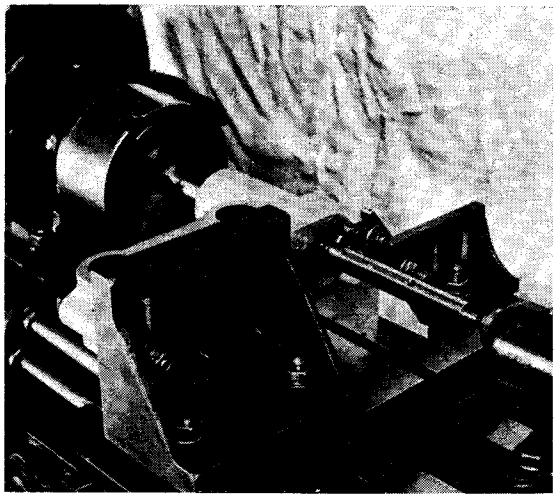


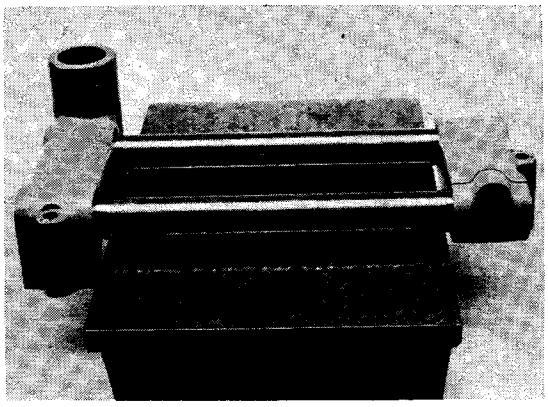
Fig. 5. Base casting bolted to cross-slide.

The castings need little preparation prior to setting up. The under surface should be dressed with a file until the casting sits fair and without rocking on a flat surface. It is convenient too at this stage to drill the holes for the holding-down bolts, which are not critical, as they come in handy for bolting the casting to the saddle — as in Fig. 5. The holes at the back should be a clearance fit for the fixed bar which is going to be "Loctited" into them. The clearance can be checked by inserting a .003 in. feeler along with the test bar. The front holes should be as neat a fit as possible for the front bar which must slide in them without play. If anything it is better to leave them on the tight side because they can always be lapped out afterwords. This will almost certainly be necessary with the right-hand base casting the hole in which may tend to close up after the casting is split for the clamp screw.

The 1¼ in. dia. hole for the vertical column can be bored in exactly the same way with the casting bolted to angle plates on the cross-slide. Because the writer does not own an angle plate big enough to span the length of the casting, nor if he did would he be prepared to bore a hole in it big enough to clear the boring bar, he used two angle plates to support each end of the casting. Although the set-up shown in Fig. 6 looks a bid dodgy it worked perfectly. This hole too should be bored a clearance fit for the vertical column. The other operations, drilling, tapping, sawing etc. are conventional and need no comment although as is standard amateur practice the 4 BA drilled and tapped holes are most conveniently spotted off the mating components.

Here it is to be explained that in this design all dimensions are Imperial and threads BSW,





Left: Fig. 6. The set-up for boring the 1¼ in. hole.
Above: Fig. 7. Using the surface plate to ensure parallelism while the Loctite sets.

BSF, or BA. Owners of suitable screwing tackle can replace them with UN or SI but if this is done the coarse series should be used for threads tapped into cast iron, not the fine.

The front and rear bars should now be tried in both end castings together. The front bar should be a close fit but free to move, the back bar should have appreciable clearance so that the front bar can find its own alignment. If all is well, remove the back bar and thoroughly clean its ends and the holes in which it fits, either with hot strong detergent or preferably with the special cleansing fluid supplied by the makers of Loctite. Don't touch the ends or the holes after they have been cleaned before coating them with Loctite. Reassemble and lay the two bars across a surface plate as in Fig. 7 and leave it thus until the Loctite has hardened. The object of this manoeuvre is to bring the two bars absolutely into the same plane even if there was some residual error in boring the holes in the end castings. After the Loctite has set, it ought to be possible to hold four pieces of cigarette paper between the bars and the surface plate — the toolmaker's traditional test for truth. "Loctiting" the vertical column must be done separately but needs no special precaution. If the end of the column is faced truly square and the job stands upon a surface plate it cannot be other than upright.

Before doing this however a decision must be taken as to whether it is to be screwed or not — once it is in it will never come out again. Those therefore who are opting for a plain column can skip the next section — others read on. Firstly how can you cut a 1 in. pitch thread on a lathe if it is not shown in the screwcutting table? The answer is easy — if it has an 8 t.p.i. lead screw and will cut 64 t.p.i. it will also cut 1 in. pitch. Just put the change wheels on backwards so that the leadscrew is running 8 times faster than the

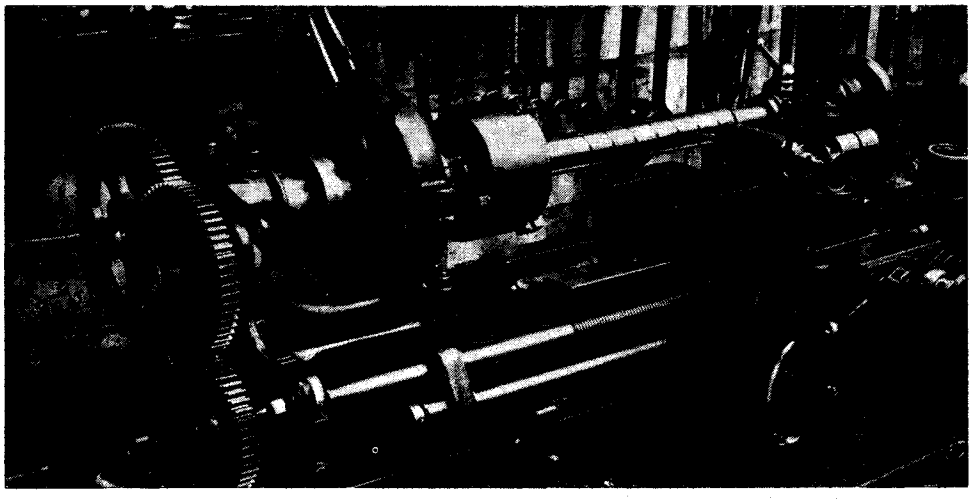


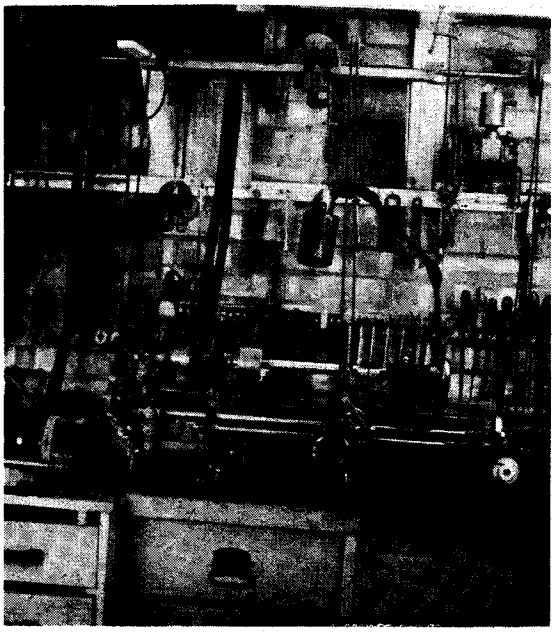
Fig. 8. The set-up used for cutting the quick-start thread in the column.

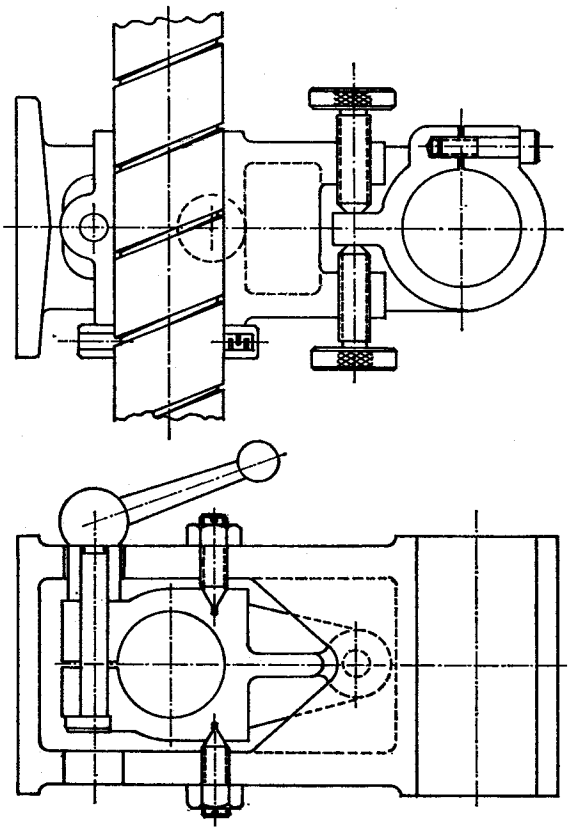
mandrel. The train the writer used was 80/20. 60/30 with a 50 T idler between the 60 T and the 30 T wheels. But there is no magic in 1 in. pitch, anything between ½ in. and 1 in. will do and it does not matter if it is in fractions. So just put the largest wheels you have on as drivers and the smallest on as driven gears. Lucky owners of lathes with Norton boxes are not so lucky here — the best the Norton box can do is 1:1 and they will have to borrow or improvise some transposing gears. If I owned such a lathe I should fit a 45-50 T bicycle sprocket to the lathe mandrel and a home-made 6 T sprocket to the input shaft of the Norton box. Not ideal perhaps but with chains one can get away with a lot and it would work.

Geared this way the lathe cannot of course be driven from the mandrel even with the back gear in. It must be driven from the leadscrew and although this can be done by hand the feed is rather coarse. One turn of the leadscrew handwheel will rotate the work ⅛th of a turn and produce a length of cut of ½ in. on a 1¼ in. dia. bar. Since this is equivalent to a feedscrew of 2 t.p.i. it is rather coarse for a 3/32 in. end mill. For this and similar work the writer has found it well worth while to rig up a worm drive to the leadscrew and many years ago he cut a 14 D.P. worm which meshes with any or all of the lathe change wheels. An additional 50 T wheel was put on the leadscrew stud and the worm engaged with it as shown in Fig. 8.

Having got so far it seemed logical to provide

Fig. 9. The final set-up for cutting the quick-start thread.





WHEELHEAD ASSEMBLY

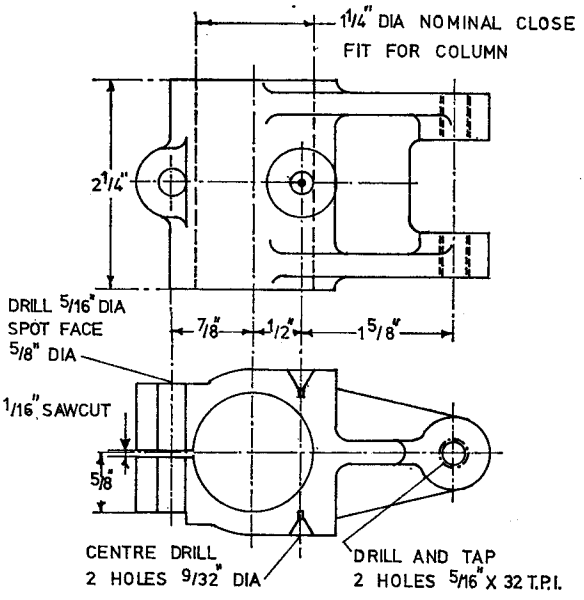
FIG. 10

a power feed since this is much kinder to the cutters and produces better work. Now the recommended depth of cut for a slot drill is ½ of the cutter diameter, which for a 3/32 in. dia. cutter is 0.047 in. and so two passes would be required to produce a slot 3/32 in. deep. Also the recommended speed and feed for a cutter of this size in mild steel is 4278 r.p.m. and 1¼ in. per minute respectively. It was not convenient to drive the cutter at this speed, in fact it was run at 1940 r.p.m. but there is no harm in this provided that the rate of feed is reduced in proportion so that the depth of cut per tooth remains constant. This therefore demanded a feed speed of about ½ in. per minute, that is the work should revolve once in 8 minutes and the total cutting time for each pass of 6½ turns should take about 52 minutes — a clear case for automatic feed! Incidentally this simple calculation shows how wrong one could be in guessing the right feed and then attempting to apply it by hand. One or two trials with rough wooden pulleys and lots of plastic

belt showed that this could indeed be achieved and the final set-up shown in Fig. 9 worked extremely well. After everything was set up it was only necessary to stand by for nearly an hour dabbing on cutting oil while the lathe solemnly completed each pass. Why not automate the oil feed? Well there has to be a limit somewhere!

The milling spindle used in this operation is one that the writer made many years ago and has been used in innumerable milling, drilling and grinding operations. It is very similar to the quill which in due course will be described for use with the QUORN tool and cutter grinder itself. So if you have not a suitable spindle make this up next and discover for yourself what a difference a precision spindle running in pre-loaded bearings can make to seemingly difficult milling operations. I have described this operation at some length to show that with a little ingenuity and some simple figuring to get the numbers right, a seemingly impossible job is not only within the compass of an amateur's workshop but can add considerable interest to his work.

To return however to the main machine, the next group of castings to be machined could well be the wheelhead assembly (Fig. 10) particularly if, as has already been suggested, it is to be used to machine the spiral keyway in the vertical column. The wheel-collar, Fig. 11, will swing in a $3\frac{1}{2}$ in. lathe so that it can be held in a four-jaw chuck, with one jaw reversed, to machine the $1\frac{1}{4}$ in. bore to a neat sliding fit on the vertical



WHEEL HEAD COLLAR 1 OFF C.I.

FIG. 11.

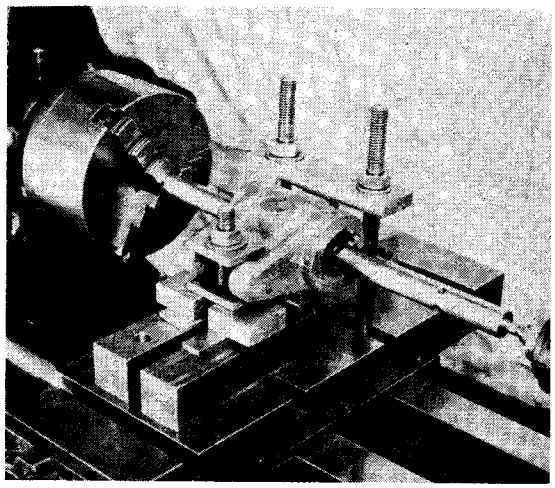


Fig. 12: Machining the wheel-head collar.

column. At this setting one end can be faced but the other end must be faced by mounting the casting on a stub mandrel or on the vertical column itself. Incidentally all these "2nd Ops" of which there a number are very much facilitated if they are deferred until after the castings have been cross drilled for the clamping bolts and split. With a jury bolt through the cross hole they can be firmly and truly clamped to an appropriate bar used as a mandrel between centres. Alternatively the casting can be machined on the lathe saddle as in Fig. 12. In this case both ends can be machined at the same setting by a facing cutter mounted on the boring bar. Cross drilling, tapping and slitting, preferably with a circular saw in lathe or milling machine for neatness, but a hacksaw cut would do, are conventional. Some care needs to be exercised however in planting the 9/32 in. dia. centre holes in which the pivot screws of the wheelhead bracket engage. Unless they are exactly the same height each side the axis of the grinding spindle will be canted and the faces of wheels mounted on it not truly at right angles to the bed bars. Some latitude for adjustment exists in the final assembly, which will be described in due course, but even at this stage it is well to get the work as accurate as possible. Jig drilling would be ideal, using the same jig to drill each side in turn, but hardly worth while for "one off". However if the casting is packed up on the lathe saddle or mounted on a vertical-slide and brought to centre height both sides can be drilled in turn from the chuck without altering the height setting. As a check, clamp a $\frac{1}{4}$ in. dia. steel ball in each centre hole and test its height with a D.T.I. from a surface plate (cheers from Derek Beck!).

To be continued