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On the Editor's Bench



A warm hello to all readers

This is the first issue of *Model Engineers' Workshop* I have edited. I'd like to thank my predecessor, David Clark, for all he has done for *MEW* and for his help in making sure I get off to a good start. I am sure readers will join me in sending David our best wishes for the future, but it's not a final farewell to David. He plans to remain a contributor to *MEW* - initially by continuing his Teach In 2014 beginners' series.

While I am not an engineer by training (I'm an ecologist and environmentalist), as a practising model engineer I was delighted to be invited to edit the magazine. I've long been a subscriber to *MEW* and I have had a workshop (of some description) on and off since I was a teenager, though for much of that time it has been boats, planes and electronics that have had my attention. It was around 1998 that I was given a large pile of *ME* back issues and a spark, kindling since I was a boy, was fanned into flame! Regular readers may be familiar with some of my past articles, both here and in our sister magazine, *Model Engineer* - most recently Norden, a mill engine. I've included two photos, below, as examples of my tool and model making interests. My present workshop activities include putting the finishing touches to VFD drive for my lathe, a tiny four-stroke engine and a queue of stationary steam engines vying for my attention.

Like previous editors, I hope I will be able to stamp my own character on *MEW* without fundamentally changing what the magazine is about. There's no doubt it has evolved considerably since the first issue - Stan Bray's original vision was an occasional special, rather than a regular monthly magazine.



Components of a handwheel dial for my lathe.

My Hudswell Clarke shunter on a visit to Derby SMEE.

Those first issues were more or less quarterly, so serials were problematic, and many of the articles in issue one were very straightforward examples of workshop tooling. One stand out article in issue one comprises two pages on 'engineering of the future'; from the start *MEW* has showcased new technology alongside traditional skills.

MEW has a fair few decades to go to equal the track record of its illustrious companion, *Model Engineer*. Nonetheless, the first issue was in 1990 so next year will mark a quarter century of *MEW*. My predecessors, Stan Bray, Harold Hall, Geoff Sheppard, David Fenner and David Clark have all proven to be talented writers and engineers. I hope I can live up to the standards they have set, and look forward to the challenge.

One thing that has changed since 1990 is the coming of the Internet. Many of you will be reading this on a computer, tablet or smartphone. The forums on www.modelengineer.co.uk are always full of lively debate and are a great source of advice and support for beginners. There is often much discussion around articles in *MEW*, so when something in the magazine sparks your interest, share your thoughts with like-minded readers online. I regularly visit the forum myself, so come and say hello!

As editor, my aim will be to give all readers, both regular subscribers and those who pick up the occasional copy, an engaging, informative and entertaining read. I've been passed a good stock of contributions and can assure readers that you will be seeing a rich and varied selection of topics over the coming months. If you have sent an article in for consideration and would like to make sure it has reached me safely, please get in touch and I will check for you.

A big challenge for the editor is to achieve a good balance throughout the magazine; not just of subject matter but also to encourage new writers to join our established ones. Of course, I can only publish the material I receive from contributors, so if you have ever considered writing for *MEW* contact me with your ideas and I will send you the contributor guidelines to get you off to a good start.

I look forward to hearing from readers and subscribers in my new role, whether you are thinking of writing an article or just want to share your views on the future of the magazine.

I hope you enjoy this and future issues of *Model Engineers' Workshop* and that it continues to be a valuable reference and companion to your workshop activities.

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Coming up...

in the June issue



DESIGN AND CNC MACHINING OF STRAIGHT TOOTH BEVEL GEARS

Andrew Johnston explains how he used his CNC mill to help him produce two sets of bevel gears for a pair of large-scale traction engines.

PLUS A nibbler, a steady for the Hobbymat lathe, tackling rust and much more...

Regulars

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Meet the new editor.

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ON THE COVER



Like his predecessors our new editor, Neil Wyatt, is an active model engineer. The cover shows components of his lathe saddle dial, to Graham Meek's design.



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The Development of Sheet Metal Detail Fittings • 1938 • Townsend • £ 8.45

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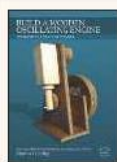
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Grinding Endmills with Radiused Edges



John Pace describes some useful aids and techniques for the Quorn grinder.

The *Quorn* Universal Tool and Cutter grinder may not be familiar to some of our readers. It was designed many years ago, by Professor Dennis Chaddock, as a versatile toolroom machine that was also suited to home construction. It never went into production but very many have been made by hobby engineers. The undeniable versatility of the *Quorn* comes at the cost of some complexity but there are ways to tackle even the most demanding tasks.

Overview

I made my *Quorn* grinder more than 25 years ago, as with any piece of equipment it takes some time to learn how to use. At a visit to the Model engineer exhibition during the mid-80s, I like many others, used to watch the fine engineering demonstrations on the SMEE stand. On one occasion during the time of the *Quorn* build I was in conversation with Ivan Law and I remember this advice that he gave me about the *Quorn*, it was be patient when using it and don't try to take off metal too quickly. This advice has held me in good stead ever since. **Photograph 1** shows my machine, the swing-out drawers underneath are crammed full of various tooling and fixtures made over the years.

Some things are never easy to do

I never was able to get to a point where I was able to grind the sides of end mills to resharpen their edges. This brought about a new machine designed by me that was able to do this and was published in *MEW* issues 143 to 147. It is a CNC cutter-grinder, **photo 2**, seen here grinding a 3-flute endmill. Bench space is at a premium these days, so the screen is top left, mounted on a wall bracket. This machine uses the *Quorn* grinding



My *Quorn* grinder and tooling storage.

head and the rest of the machine is built mostly from scrap material. It is able to sharpen the side flute edges to the same standard as new cutters and in some cases better than some new cutters that I have purchased. In one case new cutters had a clearly visible land of the original blank diameter that had not been ground. Although the edge felt sharp this land had no clearance angle and would therefore rub when cutting. Just because a cutter is new it does not mean that it will be sharp.

Setting up for radius grinding

One other area of cutter grinding that I have always struggled with is grinding cutters with radiused edges, although over the years I have done some it has always been something of a hit and miss result. The grinding is not a problem, it is a matter of accurately setting up in the first place. In Professor Chaddock's book on the *Quorn* grinder (**ref. 1**), the instruction to set up to grind a ball nose cutter is to use two pins that have been ground with a flat that is half the diameter.

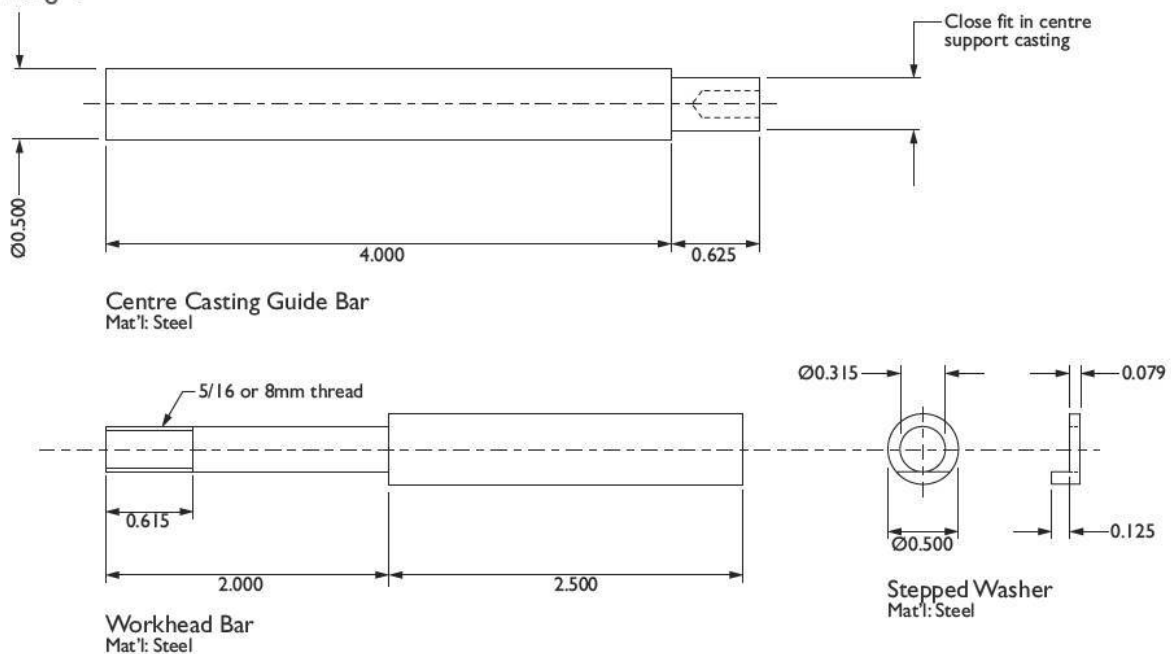


The cnc cutter grinder in action.



Setting the axis of the workhead and rotating base.

Drawing 1



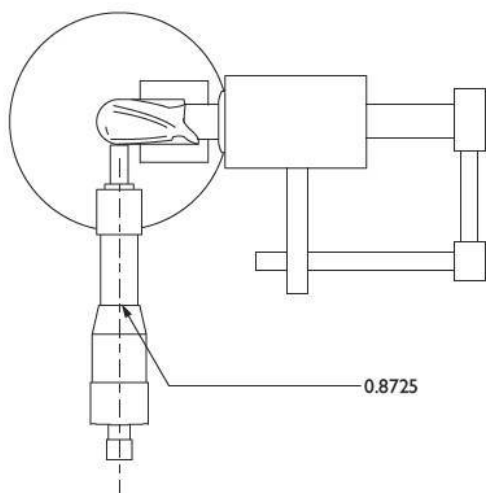
Using these pins one in the hole that is the axis of the rotating base and the other held in a collet, the pins are fitted as in **photo 3**, the flats touching aligning the axis of the work holder and rotating base axis. From here the pins are removed and a cutter fitted in the work head and positioned, quoting from the instruction 'with its nose projecting beyond the face of long setting pin by an equal amount to the radius plus a grinding allowance. This is most conveniently done with a setting micrometer'.

Having made all of these accessories when I built the Quorn, this is how it's done - but if it was only that easy. When the cutter is fitted, just about any size, the work head has to be moved back to allow the cutter to be positioned correctly. As soon as the ball handle is released the work head loses it setting. I had thought about ways of overcoming this over some time (years) but had never really got to grips with it. Over time I had thought of all sorts of

Over time I had thought of all sorts of complicated ideas on how to do this but in the end the solution turned out to be one of the simplest ideas of all and which works every time.

complicated ideas on how to do this but in the end the solution turned out to be one of the simplest ideas of all and which works every time. The mounting for the work head is a round bar that is fitted and clamped into the rotating base, the work head fits on this and is secured by tightening the ball handle which closes up the slot gripping the shaft. This shaft can be as long as required, on my machine the shaft has about 5 inches protruding at the rear. As part of the standard kit of parts with the Quorn this shaft can be changed for a longer mounting that uses the work head and also a casting

used for a centre support. With the head mounted on the short shaft, the centre casting is not normally used for this application. However, by mounting the centre casting on the back of the shaft, as in **photo 3** and making a short length of shafting to fit instead of the centre, it can be positioned to rest against the shaft used for the tooth rest that can be mounted in the hole provided in the workhead casting. These two items are shown in **drawing 1**. The stepped washer is used to bridge the cut out in the casting on the workhead. This simple addition can retain the position in

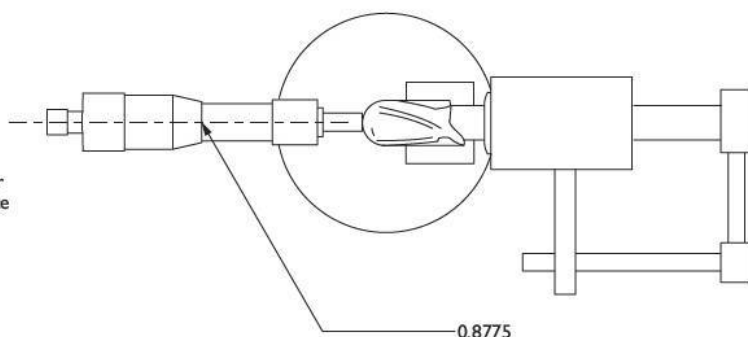


First measure diameter of cutter
e.g. sharpened on sides $\varnothing 0.745$ in

Setting micrometer is set to read zero at 0.500in
so micrometer set to read 0.8725in
($0.745/2 = 0.3725 + 0.500 = 0.8725$)

Adjust cutter so flute edge touching micrometer
Adjust tailstock casting support bar to contact work head bar & secure

Second, back off micrometer, rotate 90°
Reset micrometer to 0.8775
Adjust workhead position to touch micrometer
The difference of 0.005 is the grinding allowance



Setting For Grinding Ball Nose Cutters



Checking the set position of a ball nose cutter.



Setting the grinding allowance of the ball nose cutter.

one direction as the other is adjusted. It is essential that the bar fitted to the centre casting is truly parallel to the workhead support bar.

Safety check

Just a reminder about safety, before any grinding is started. The grinding wheel should be checked for any obvious damage. No one else uses my machine and I always store the grinding wheels in a safe drawer. This is the only way you can be sure of the status of the wheels and machine. The Quorn wheelguard is not shown in the photographs, for clarity. A good pair of safety goggles is essential. When the grinding setup is complete a dummy run of the operation will confirm that there are no clashes with the grinding wheel and

machine and or unwanted contact with any part of the cutter other than the edges being ground. These operations and the grinding should not be done in a hurry and preferably undisturbed.

Setting up to grind a ball nose cutter

The sequence is shown with the aid of some drawings. In **drawing 2** a ball nose cutter is depicted. To get the best result the cutter should have been sharpened along the flutes. The cutter is set as in position 1, **photo 4**, having already set the axis of the work head and rotating base in alignment with the half pins. The micrometer setting is just for checking. A useful check is made by rotating the cutter and checking the reading on the other flute(s). The diameter

of the cutter needs to be measured to be able to set up to grind the radius, as indicated earlier the tailstock casting is fitted and adjusted to position, the cutter and workhead are moved and set with the micrometer. In **drawing 2** this is indicated to be 0.745 inch diameter, the micrometer is adjusted so the end of the cutter is forward to allow a grinding allowance in position 2, I set this at 0.005 inch for a cutter of this size, **photo 5**.

To be continued...

REFERENCE

1. The 'Quorn' Universal Tool and Cutter Grinder, Professor D H Chaddock, 1984.

A Tip for Error Free Indexing



Brian Wood has advice on avoiding unnecessary errors.

Indexing with a dividing head is not a fault free process. If the sector arms are moved accidentally during a sequence, by maybe catching the index pin on one of them during handle rotation, it is a matter of luck whether or not the situation can be recovered without producing a faulty component.

Method

Having produced two useless gears with oversize final teeth in a recent batch, despite the greatest care being taken at the time in attempting to correct just this mistake. I believe I have found a method of recovering from the potential disaster of moving the sector arms inadvertently.

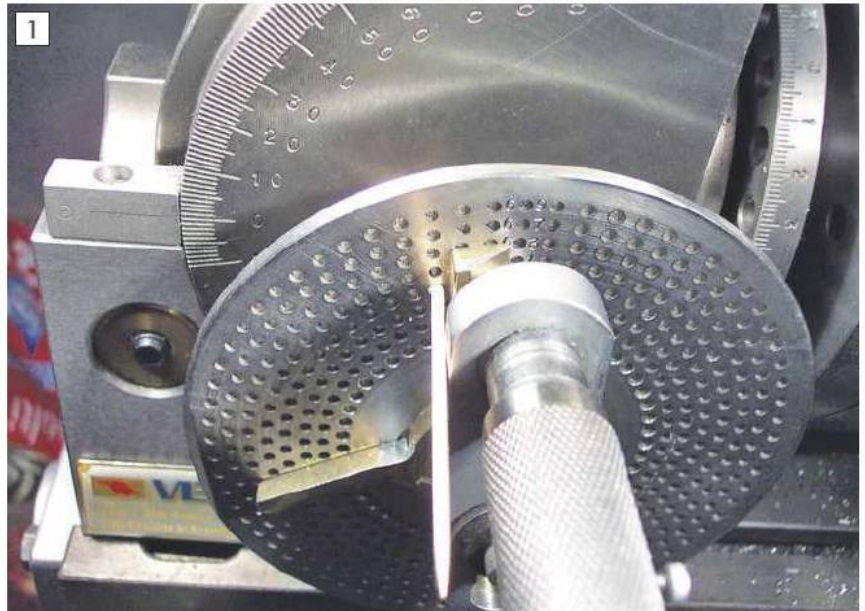
A one hole indexing error on a high number count will have an accumulated error as big as 1mm overall arising from the initial mistake of just $\frac{1}{40}$ mm (0.001 inch) in an example where the error took place 40 holes back. Moreover until, for example, the final teeth in a gear are being cut, it is not at all clear if the whole job is a scrapper.

Any pegs will do, I found cocktail sticks were good for small holes and a pared down golf tee was ideal for the hole sizes used on Vertex index plates.

The photographs show the method much better than any words can.

In **photo 1** any hole for the peg will do, there will always be one in a position that suits. **Photograph 2** shows the sector arm 'secured' on both sides while in **photo 3** the golf tee is fitted in one of the larger diameter holes in a Vertex plate.

It doesn't prevent the mistake from happening of course, but it does give a foolproof reference point of return so that the process can continue satisfactorily.



The general view.

Any pegs will do, I found cocktail sticks were good for small holes and a pared down golf tee was ideal for the hole sizes used on Vertex index plates.

The important thing to be sure of is to butt the peg up to the rear of the sector arm after it has been moved to that position when the indexing pin is secure in its new hole. That way the sector arm position is fixed on the tapered side to prevent movement forward when inserting



The sector arm trapped on both sides.



The golf tee in position.

the peg and thereafter it is secure on both sides to hold the reference for that position.

Apart from any other consideration, using this method confers the comfortable feeling of confidence that comes from knowing the count will still be correct if the reference is lost. An accidental situation becomes recoverable without pressing on in a maybe forlorn hope you were able to correct such a small and barely detectable error successfully.

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Converting a Myford Super 7 Lathe to Poly-V Belt Drive



Alec Payne found careful planning was rewarded by success with this useful modification.

In *Model Engineers' Workshop* April 2011 Ken Willson described a modification to the headstock bearings of the Super 7 lathe to replace the existing angular contact bearings with taper roller bearings. This modification apparently makes the drive run more smoothly and is easier to adjust. I thought about this for some time, being reluctant to alter Myford's design. However, since then I have had two friends who have carried out the modification and think it is well worth while. Accordingly I bought the specified bearings and two new locking rings which I machined to accommodate the new bearings. This enabled me to keep all the original bits in case the modification went pear shaped!

Before starting the work I had seen a kit in the Hemingway Kits (ref. 1) catalogue to modify the belt drive from the countershaft to the spindle from V belt to Poly-V belt, which I understand was a modification that Myford used on their later Super 7 lathes. Again, this is meant to accomplish smoother running and easier belt step changing. The kit is in two parts, one is the drawings and the necessary belt and the other is two spun cast iron blank pulleys. The Hemingway drawings say that an alternative to cast iron would be light alloy pulleys. I was unable to source the correct grade of material with the required diameter, so I ordered the cast iron blanks. One of these is shown in **photo 1**.

At first sight, machining these blanks would seem to be a simple task but in practice great care needs to be taken, as some of the dimensions are quite critical.

The job would be made a lot easier if a second lathe is available but I did not have one, so had to work closely to the drawings. Obviously, once the spindle is dismantled no further turning work can be carried out, so it has to be done correctly before the dismantling takes place! This applies particularly to the bores of the pulleys. It is also worth noting that these blanks weigh about 7lbs each, so it is essential that they are held safely in the chuck as you don't want 7lbs of rotating cast iron running amok in the workshop!

It is also necessary to make a form tool to cut the grooves and I will describe how I made mine later in the article.

I decided to start work on the countershaft pulley as it appeared to be an easier one to hold for machining. The casting has an annular groove in the face at the large end, at the inside of which is a boss which projects about $\frac{3}{8}$ inch beyond

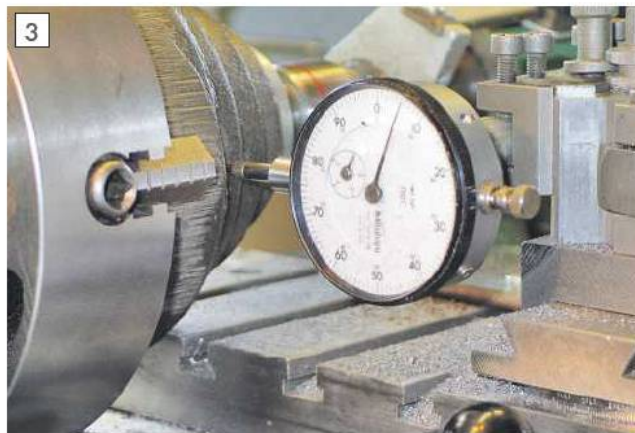


Pulley casting as delivered.

the face. This boss, together with the groove means that the casting can be gripped in the four jaw independent chuck with the small end of the pulley towards the tailstock. The boss, however, being cast, is slightly tapered towards the outer end and it also has a very rough surface, so needs some extra support for machining. I had a piece of scrap aluminium about 2 inches diameter by $\frac{1}{2}$ inch thick with a centre hole, left over from another job, so I used this held against the small end of the pulley by a rotating centre in the tailstock. This set-up is shown in **photo 2**, although this photograph was taken after the steps had been machined. It was then necessary to adjust the 4 jaw to get the outside of the pulley running as true as possible, see **photo 3**. When this was achieved and the chuck tightened, I temporarily removed the tailstock and pad to see what was happening with the



Set-up showing the aluminium support pad.



Setting for best step centring.

cast-in bore. This was not running quite true but as it has to be machined, I reckoned there was enough material left around the hole to achieve this. The pad was then put back and machining could commence. There are precise dimensions on the drawing for the diameter and width of the four steps. It is necessary to check that there is enough width for each of the steps, which are 0.625 inch wide. On my pulley, there was plenty of spare width on the largest step, so I commenced by machining this step to the required diameter but left about 20 thou for finishing. There was a lot of sand in the skin of the casting and I used a standard insert tool at a slow speed to remove this. I used the highest belt ratio with the back gear engaged which seemed about right. If you try to machine it any faster than this, you end up with a shower of sparks and a ruined tool (ask me how do I know?).

Having done this I machined the outer edge of the largest step and then machined the next step to the specified diameter plus the cleaning up allowance. I then machined the outer edge of this step and so on until all the steps were finished. I obviously could not machine the large end as it was against the chuck but I machined the small end and the aluminium pad to just leave a small amount in the centre. When this was done, I checked that the chuck was tight and removed the tailstock and pad. I then very

carefully machined the remaining part of the small end (photo 4).

I was then faced with boring the hole for the countershaft. I wanted to do this while the pulley was in the same position as it was when I machined the outside. I decided that I would very carefully machine it with the outer end unsupported. This bore has to be very accurate as it has to fit on the countershaft which is 0.875 inch diameter. I had a short length of steel rod which was exactly 0.875 inch diameter, so I used this as a gauge. When it was just showing signs of entering the bore, I used a three stone hone on the bore and this cleaned it up so that the test rod was a nice sliding fit. Next I had to cut the keyway in the small end for the Woodruff key. I achieved this by using a boring tool with an $\frac{1}{8}$ inch blade in it and taking fine cuts pushing it in with the saddle control. This works quite well in cast iron if you take small cuts each time (about 5 thou). This pulley also has an annular recess cast in the middle of the bore (how do they do that?), which provides a space for the tool to run into. The keyway is only in the small end.

I was now faced with a dilemma. Should I cut the grooves in the steps, a task I had been dreading, or remove the work from the chuck and clean up the rear face? I decided to cut the grooves first, as that way I knew they would be concentric with the bore, so I had to make the cutting tool.

The included angle of the grooves is 40 degrees but the tool also needs side and top rake of about 5 degrees. Until about a year ago I had a Quorn tool & cutter grinder but I hardly ever used it as it can be quite difficult to set up, so I sold it. It would of course been ideal for this job!

I decided I could make the tool on my bench grinder providing I made a plate with guides at 40 degrees, photo 5. While I was at it, I made guides for both the fine and the coarse wheels. The inner edges of the guides are angled outwards at 5 degree to put on the side rake at the same time as grinding the 40 degree angle. I had a piece of blank HS tool steel, $\frac{3}{16}$ x $\frac{1}{2}$ inch and I used this, grinding it gently with plenty of dips into cooling water. The tool can be seen against the right-hand guide in photo 5. (*Grinding against the side of a grinding wheel is often discouraged, as it can weaken the wheel. Use your judgement – Ed.*) It worked extremely well and I got good angles with clean faces. I put the top rake on by hand and then stoned all the cutting edges. I daresay the purists would say to angle the top slide as in thread cutting but I was worried that I might get it wrong and upset the spacing between the grooves, so I decided to plunge straight in. Further details of this later.

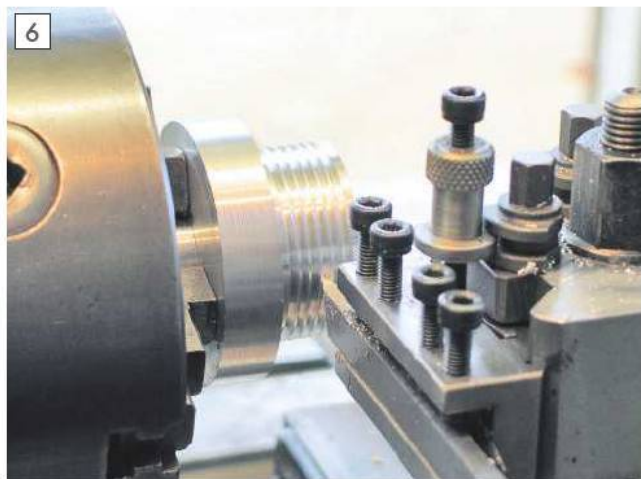
Having made the tool, I decided to make a test piece using a short length of aluminium bar about 2 inch diameter, to see how the groove spacing worked out.



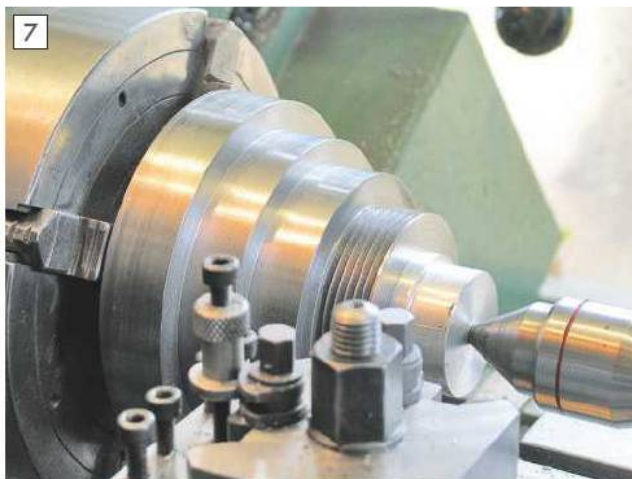
Small end and bore completed.



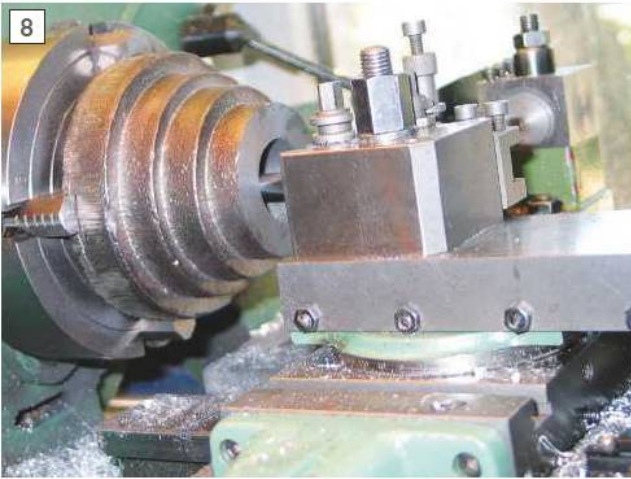
Jig for grinding V tool.



Test piece for Poly V grooves.



First set of grooves completed.



Spindle pulley bored.



The finished pulleys.

This was mounted in another chuck to save taking the workpiece out of the 4 jaw. The test piece was successful so I was happy with the tool (photo 6).

While I had this chuck on the lathe I made an aluminium plug to be a snug fit in the pulley bore. This plug had a centre drilled in the outer end to engage with a rotating centre in the tailstock to support the outer end of the pulley while the grooves were cut.

Having made the tool it was back to the pulley. There are six grooves on each step and the dimensions are given on the Hemingway drawings. I found that I needed about half the speed at which the turning had been done in order to avoid the tool overheating. I started with the smallest (outer) step and worked from the end inwards (photo 7). The first five grooves were no problem but when I got to the sixth groove I found that the left hand side of the tool (the unground part), fouled the shoulder to the next step. I had to relieve the unground part of the left hand edge to avoid this. Had I had a piece of 1/8 inch thick tool steel it would have avoided this complication. The drawings give the dimensions of the grooves from a datum. The grooves are 0.093 inch apart and the first groove is 0.082 inch from the edge of the step. I worked out the dimensions from the step edge and set the tool tip on the edge of the step. I zeroed the top slide and locked the carriage. I then moved the tool in until it just touched the step and zeroed the cross slide. When this was done, I moved the tool into position for the first groove with the top slide. The drawing states that you need to advance the tool 0.126 inch to get the required groove depth. This leaves quite a sharp edge between the grooves. It is then necessary to take a cut of 0.014 inch along the top of the grooves to get the correct profile. When I had done all this, I used a triangular file very lightly to remove any burrs and then polished them with emery cloth. It all finished up very nicely and was then repeated for the other steps. The tool remained sharp throughout.

When all this was done, I reversed the pulley in the chuck, holding it by the smallest step with a piece of aluminium shim to protect it and put the previously mentioned plug in the outer end, again with the rotating centre. Using this I was able to clean up most of the large face and

annular recess, removing the centre at the end to finish it off. I was very pleased with the result.

The spindle pulley was slightly more difficult in that there was no centre boss with which to hold it, so it had to be held on the largest step. This still left some of the step available to be cleaned up. Firstly, it is necessary to get the best centre possible for the steps by adjusting the 4-jaw chuck and then proceeding as with the countershaft pulley. This time I bored the hole through the middle first, again taking care because the outer end was not supported and finished it off with the hone as in the countershaft pulley (photo 8). With the advantage of hindsight, I had already made a plug for this bore. I cleaned up the small end and inserted the

shown in photo 9. (This photo was taken after the bronze bushes had been fitted).

The drawing shows two different sizes for the recess seating the bronze bush flange, depending on the type of bush fitted in the original V pulley. The outer face of the flange should be flush with the large face of the pulley when it is fitted. It is possible to make this recess suitable for either type of flange, which is what I did. It is also possible to see the flange on the V pulley before it is removed but it is difficult to measure it accurately in situ. The flange in my case was the larger dimension given on the drawing. I then had the unenviable task of cleaning up the lathe. Cast iron is a messy substance!

Both pulleys have some holes that need to be drilled. The countershaft pulley has

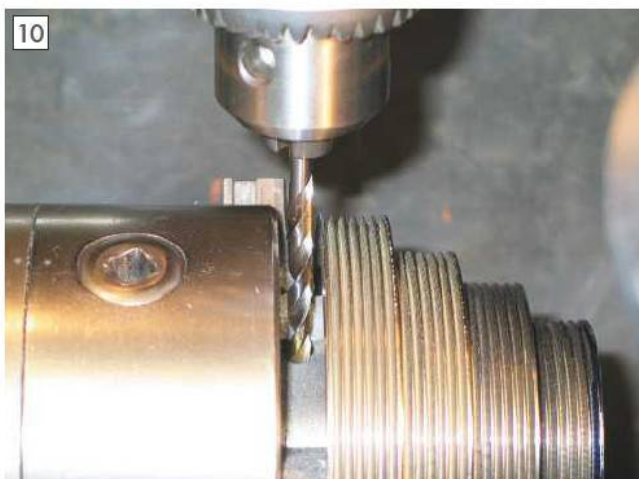
It is worth noting that these blanks weigh about 7lbs each, so it is essential that they are held safely in the chuck as you don't want 7lbs of rotating cast iron running amok in the workshop!

plug. Again I used the plug and rotating centre to hold it in the chuck while the machining took place. When the three smaller steps were all turned to the required diameter and width, I machined the grooves in them as before.

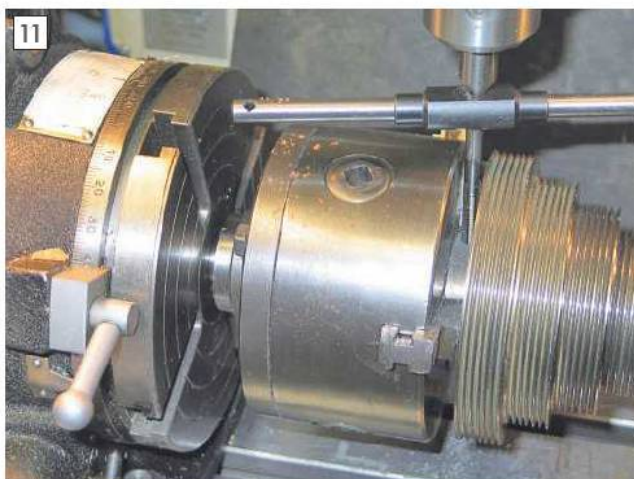
I machined the large step as far as I could without hitting the chuck jaws, then reversed the pulley in the chuck with an aluminium shim as before, using a dial gauge to make sure the partly machined diameter of the large step was running true. I then fitted the plug into the bore at the large end and again used a rotating centre for support. Now I was able to complete the machining of the largest step and most of the large end. I then cut the grooves in the large step. Finally, I took out the plug and carefully machined the rest of the end face. This completed the lathe work on the pulleys. There is one important point to note: The spindle pulley should be kept to the overall length shown on the drawing, as there is very little spare space the headstock (once again, ask me how I know!). The two finished pulleys are

two 1/4 inch BSF tapped holes in the boss 90 degrees apart on the opposite side to the keyway. I don't imagine that there is any great need for accuracy here, as the original pulley had one setscrew in one of the grooves. However, to be on the safe side, I mounted the pulley in its chuck on my rotary table, set vertically on the milling machine. By this means it was easy to position the holes quickly and accurately (photos 10 & 11).

The spindle pulley has a hole drilled in from the large face at an angle of 40 degrees. This is a 0.125 inch diameter hole to allow oil into the centre of the pulley between the bearings. It is opened up to 7/16 inch diameter for 0.5 inch, then drilled and tapped 2 BA for a further 3/8 inch for the oil nipple. The entry point of the hole is detailed on the drawing. I thought of ways to do this and finished up by mounting the pulley on a spigot on the tilting table on the milling machine. Having set the centre accurately under the quill, I bored to the necessary depth for the 7/16 hole using a slot drill. This worked



Drilling the holes in the pulley boss.



Tapping the holes 1/8 inch BSF.



Mounting for the spindle pulley at 40 deg.



Boring the 40 deg. hole.

well and produced a flat-bottomed hole for the oil nipple (photos 12 & 13). There is also a balancing hole on the opposite side of the large face.

When all these holes were bored, the work on the manufacture of the pulleys was complete, so the next job was the fitting. The fitting of the countershaft pulley is straightforward following the Myford Super 7 instructions but I must confess that this aspect of fitting the spindle pulley had been worrying me from the outset. The reason for this is that there are two phosphor bronze bushes, one in each end of the pulley. The one at the large end is a straightforward top hat section bush but the one at the small end is extended to carry the drive gear. Both these bushes are a press fit in the pulley and the one with the gear attached transmits the power from the pulley to the spindle, both in normal drive and back gear. It follows that it must be a very tight fit or slip will occur.

The Hemingway instructions tell you to transfer these bushes from the old V-pulley to the new Poly-V pulley but don't tell you how to do it. Fortunately there is a gap in the centre of the pulley between the two bushes, so it is possible to get a drift in at an angle. Before proceeding, I posted a thread on the ME Forum asking if anyone had done this modification and, if so, how did they do it. I immediately received a reply from a very helpful

engineer saying he had successfully removed the bushes using a shaped drift. This had slightly damaged the edge of the bush but he was able to put that right using a scraper.

I also telephoned Hemingway who said they had not personally done the modification but he would ask someone who had to contact me. My helpful contact said that he had had no serious problems with it. He also said that the new Myford were able to supply replacement bushes although they do not have a Myford part number, being shipped as an integral part of a replacement pulley.

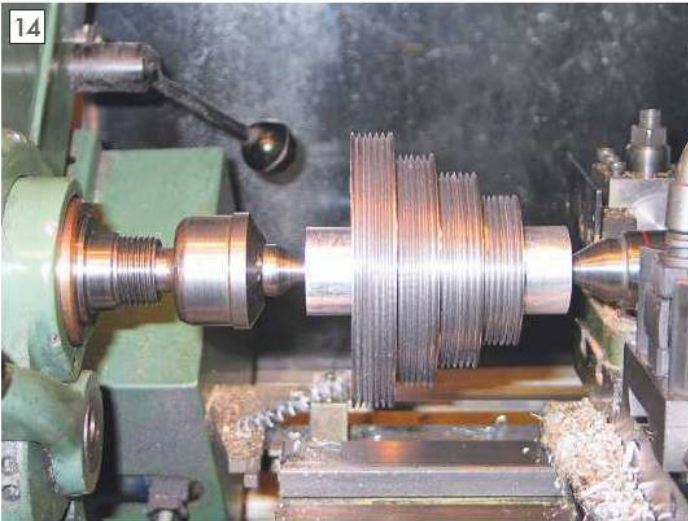
With this knowledge under my belt, I decided to knock out the simple bush first as this was likely to be the cheapest to replace if I damaged it. I made a drift consisting of a brass disc, slightly smaller than the bore and about 1/4 inch thick, attached to a piece of rod, the theory being that the disc would drop down into the gap between the bushes and present a flat surface to the inner end of the bush. I started to hammer it out. When it had moved about 3/16 inch, the flange was clear of the pulley, so I thought I would see if I could lever it out with a couple of screwdrivers under the flange. However, as soon as I applied some pressure, the flange started to bend, so I gave that up and went back to the hammer and drift. Just as it was nearly out it canted slightly then came out. This distorted the bush

slightly so that it would no longer fit on the spindle. I therefore decided that I would purchase a new bush.

Having got this one out, I used my test mandrel to knock out the bush carrying the gear. Because this was a straight fit in the bore I had no problems with this one.

I phoned Myford who said they could supply the bush and would get back to me with a price. They later e-mailed me to say that all their bushes had been fitted to pulleys and they were not likely to have any more in the foreseeable future. A second source was unable to help but gave me another name to try. He also could not help but offered to sell me a complete second-hand pulley. Before following this up I thought I would see if I could sort out the slightly distorted bush. I thought that if I drove it back into the now empty V pulley it would at least ensure the outside profile was correct. Then with a little bit of scraping I finished off with the three stone hone mentioned earlier. This worked and gave a good finish which was a nice fit on the shaft. Because the other end of the pulley was empty I was able to drive the bush out with the mandrel without further problems.

Now came the biggest worry. Because the new pulley had to be machined before the lathe was dismantled, I was not sure whether the bushes would fit. I measured the bore of the old and new



Balancing the pulleys.

pulleys and they appeared to be practically identical and the bushes would just start in the new one.

I have a Myford VM-E milling machine so lined the pulley up centrally under the quill and used the fine drive on the quill to push the bearing in. Probably not the best way to treat a milling machine but it worked! I then reversed the pulley and pushed the bush in the other end. I tried the completed pulley on the spindle and it fitted perfectly. A huge sigh of relief!!

When this was done, I decided to check the balance of each pulley. I had a centred mandrel for each pulley which I mounted between two rotating centres in the head and tailstocks. These were lightly nipped up to prevent any end play but not tight enough to create any noticeable friction. I checked that the pulley did not turn to any particular position that would indicate a heavy spot, **photo 14**. I then spun the pulley several times, noting that it came to rest in

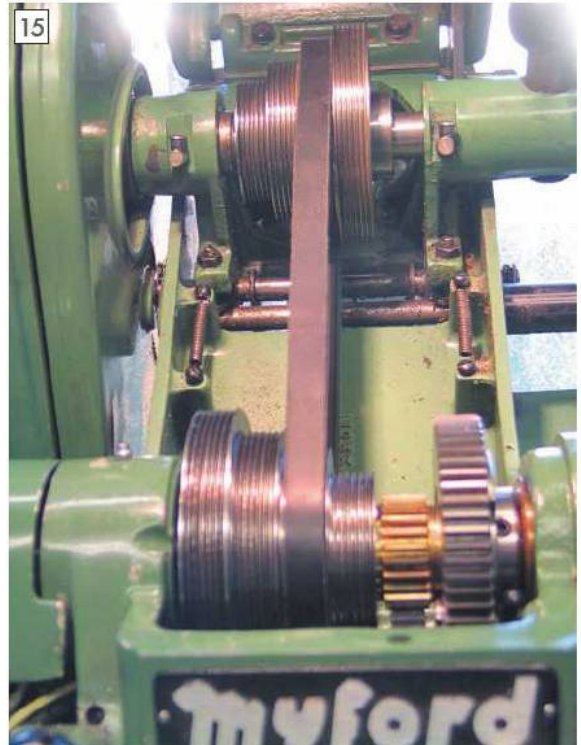
random positions.

Neither pulley appeared to be out of balance, so all that now remained was to refit the pulleys in to the lathe, bearing in mind that I was also fitting the new taper roller bearings mentioned at beginning of this article.

I followed the Myford instructions for this task and everything worked well but I would reiterate what I mentioned earlier – that there is not much spare space for the spindle pulley, so take care to keep it within the length shown on the drawing.

Photograph 15 shows the completed installation.

The lathe now runs very sweetly, even at the highest speed. A contact told me that he had also carried out this modification on the primary drive. I use a link belt for this, which seems quite satisfactory. Hemingway has a



The pulleys and belt installed.

kit for the primary drive conversion but the countershaft pulley is too large to be machined on the Super 7 lathe.

In conclusion, these modifications make for very smooth, quiet running and belt step changing is very easy, so I think it was well worth doing. ■

REFERENCE

1. Hemingway Kits, 01746 767739, www.hemingwaykits.com

Simple gearing for metric threads on Myford ML7 lathes with gearboxes

Corrections to the article published in issues 212-213.

This article by Brian Young has been well received, apparently Myford (RDG) sold out of 34T gears on the day *MEW* was published! Thanks to reader Mike Akehurst who spotted two minor errors. In sketch 1 the pitch of the $\frac{3}{8}$ inch BSF thread on the drop arm should be 20tpi, not 16. The angle of the tommy bar in sketch 2 is not critical, but should be 30 degrees rather than 60 degrees.

Brian has carefully checked the published data by actual measurement, and a number of typographic errors have come to light. All 140 or so of the results have been cross-checked, so the list below should be complete:

Table 1 M3 only, not M3,M5

Table 5 Mod 1.4 is cut with 50-12 combination, not 50-56

Table 7 First three entries are with cluster gear reversed, not as shown
Table 6 9.45 tpi is cut with 33-13 combination, not 33-18

Table 3a 40 DP Better pitch accuracy with 34-18 combination

Table 3b 50 DP is cut with 30-20 combination, not 34-20

Table 3b 30 DP Better pitch accuracy with 20-8 combination

Table 5 Mod 0.50 is cut with 28-19 combination, not 28-16

Table 5 Mod 1.05 is cut with 28-9 combination, not 29-9

Table 6 Holtzapffel pitch 1.940 mm is cut with 33-18 combination, not 32-18

Table 5 Mod 1.1 is cut with 36-11 combination, not the choices listed

Table 5 Mod 0.55 is cut with 31-19 combination, not as listed

The Löwenherz thread angle data should read 53 degrees 8 minutes, not 530 as it was published!

Finally, in the section on errors, reference is made to $1\frac{1}{2}$ as an approximation for $\pi/2$; it should of course be listed as $\frac{1}{2}$.

Brian has supplied me with a fully corrected version of the tables, which I hope to make available on www.model-engineer.co.uk in the near future. ■

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Cranking up your Lathe Chucks



Jock Miller, in New Zealand, updates a tip of his late father's, described in Model Engineer No. 2672 August 7 1952. I'm sure you'll agree it's worth revisiting.

We all find it tedious winding the lathe chuck keys of the plain 'T' design especially when changing the jaws of conventional lathe chucks. The writer found this so when working night-shift many years ago at a large local engineering works. As the day-shift operator wasn't very hygienic regarding swarf and the like in the chuck jaw ways. Changing jaws for 18 inch and 20 inch chucks was a pain.

The photographs illustrate a number of chuck keys that have been suitably modified, and their use.

Procedure:

- 1) Obtain a number of steel balls about $\frac{7}{8}$ or 1 inch diameter, either new or from a large scrap ball race (from your local scrap dealer).
- 2) Drive out Tee handle.
- 3) Face one end, centre drill and countersink to full diameter with a large twist drill (118 degrees).
- 4) Hold in vice by opposite end and with an oxy-acetylene or LPG torch make red hot locally at about one quarter from machined end. With a piece of loose



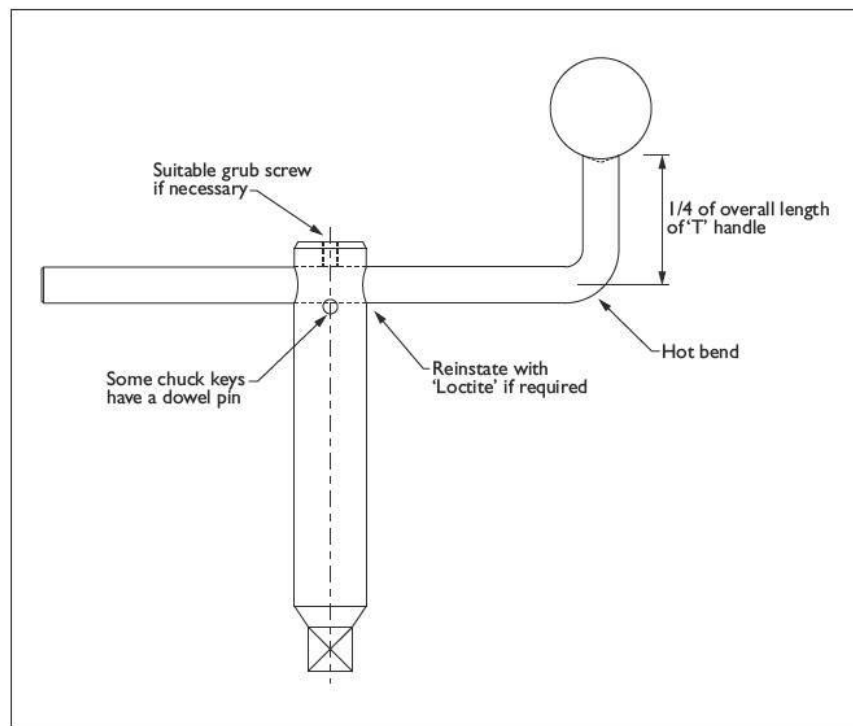
LEFT: A selection of modified chuck keys.
BELOW: A modified chuck key in use.

Photos & diagram courtesy of P. J. King.



fitting tube or drilled rod quickly bend at the red hot position to 90 degrees.

- 5) Once cool carefully degrease the ball and prepared end.
- 6) Hold in vice with cranked end vertical, flux after placing a small piece of 'squashed' Easyflo rod in the countersink, place the ball in the countersink and carefully heat from below until the Easyflo melts and the ball settles down. Add extra Easyflo if required.



Caution: if during the above process the ball falls to the floor and is red hot quick action is required to retrieve it, especially if the floor is combustible. (shades of Lord Nelson's cannon balls!)

- 7) Re-assemble with chuck key body after a clean-up. This may require additional straight knurl at the interface or the fitting of a grub screw and perhaps Loctite (if the non-business end of the key body is case hardened, grind off the case and then drill and tap)

Once complete, changing chuck jaws is a 'breeze'. ■

A footnote: Jaws, jaw ways and screw (independent chucks) and scrolls must always be clean and free from swarf. A late friend who had a small general engineering manufacturing business always advocated complete dismantling of chucks every few years, to clean, lubricate with E.P. moly-grease and re-assemble. Your lathe and other machine chucks are vital to accurate and consistent machining.

Stub Mandrel's Short End

A Saddle Stop for Mini Lathes



Stub Mandrel's aim is to never let anything long enough to hold in the chuck go to waste.

A request for advice on the Model Engineer website was a reminder that, although designs for saddle stops for many types of lathe have been published in this magazine and its sister over the years, I have never seen one for a mini lathe. I was able to assist the enquirer with a short description of the stop I made for my lathe, and I thought that it might be useful to offer the idea to readers.



How the stop bears against the saddle.

The principle of a saddle stop is simple, but it offers a powerful aid to anyone wishing to make several parts of the same size, and has a few other uses too. Basically the stop is a moveable clamp that fits to the lathe bed, with a screwed bar for fine adjustment, that provides a fixed and repeatable location that the lathe saddle can be advanced to (photo 1). If the top slide is used in conjunction with the stop then this sets a datum point that can be used for multiple cuts at repeatable locations.

Stop Body

The challenge with making a reliable stop is to ensure a good fit to the lathe bed, so that it does not slip, yet does not need to be clamped with too much force. Mini

lathes have an 'inverted-V' at the front of the bed that aligns the headstock, saddle and the tailstock. This provides an obvious location for the body of the stop, and the body is just short length of steel bar with a cutout to fit over the V.

The sides of the 'V' are at 90 degrees to each other, and at 45 degrees to the lathe bed (photo 2). The easiest way to machine the stop to fit them is to mount the steel blank for the body at 45 degrees in a milling vice, and mill the cutout using an end mill or slot drill. As the top of the 'V' has a flat on it, it isn't essential to take the slot out of the middle of the cutout, so I haven't shown this on the drawing. I think it looks better with one though. If you lack milling facilities, there is no reason why you can't saw and file the cutout.

Whichever way you choose to do this, take

care to get a good fit and finish so the clamp does not damage the lathe bed.

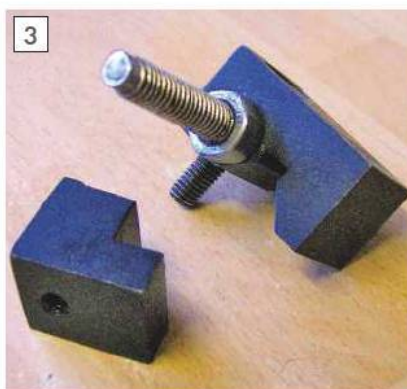
The two holes in the body are straightforward, the one for the stop bar is threaded M6, and the other is M5 clearance, counterbored for the head of an allen screw. The drawings show plenty of clearance between the two holes for simplicity. I overlapped my holes slightly, and turned the thread off a section of the M5 screw, this allows the stop bar to keep the M5 screw captive (photo 3) but this is not really necessary.

Clamp

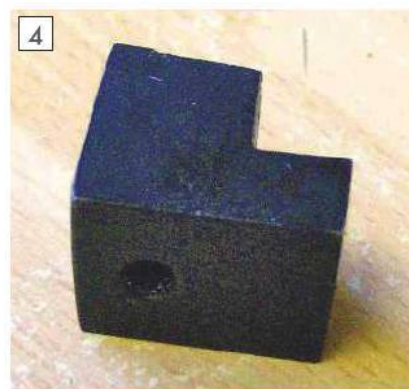
The clamp piece (photo 4) fits below the body, and presses against the lower surface of the bed, where the saddle gib bears. The top of the clamp needs a raised



Clamp off lathe.



The component parts of the saddle stop.



The bottom clamp.

section along its outer edge, as shown in the drawing. This provides a pivot that generates a positive clamping action. The dimensions given worked well on my lathe, but if you do not get adequate clamping with fairly gently tightening of the M5 screw, reduce the height of the clamp raised step slightly.

Stop Bar

The stop bar itself is simply a piece of threaded studding with the 'business end' neatly finished and a locking-nut fitted (photo 5). Try to dome the end of the bar slightly. With the dimensions given it will bear against a flat, machined area on the saddle. Keep it to the specified length and you will not have to fully remove the stop when it is not in use, just loosen it off and slide it to the extreme left of the bed.

In Use

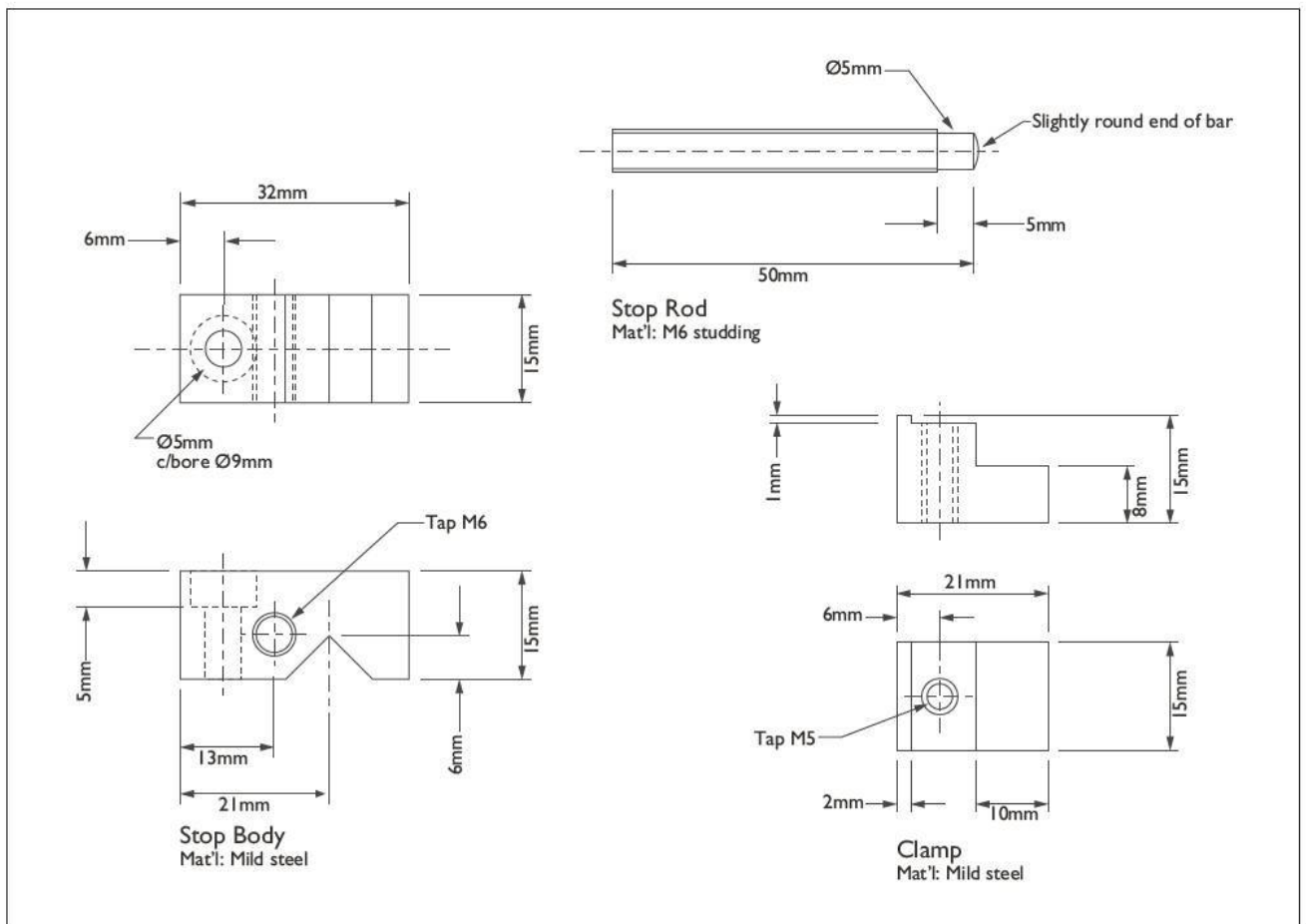
To use the stop, advance the saddle to an appropriate point, and fix the stop with the end of the bar hard against it. You can adjust the rod for different locations, or simply loosen off the clamp and move the whole stop according to your preferences. Make sure the locking nut is done up against the body as this ensures rigidity essential for repeatability. With the saddle in approximate position you can use the top slide to set the tool in an exact position, and zero the index in case you need to make any other cuts relative to this starting datum. Repeatability using a stop like this can easily be accurate to within a thousandth of an inch.



The stop fitted to the bed of the lathe showing the stop bar.

Another use is when boring a blind hole or a flange, ensuring the tool is always advanced to exactly the same point. Instead of nervously listening for chatter as the tool approaches the bottom of the hole, you can just gently wind it in up to the stop and be confident of getting a reasonably flat-bottomed hole. With many designs of boring tool, once you have the hole to size, winding the boring tool in to the centre whilst still at the stop will give a good finish to the bottom of the hole.

Don't rely on the stop as a safety feature, it may help stop you running the saddle into the chuck, but this only works under manual feed - you should not expect it to stop the saddle if it is under power feed. More advanced designs have been made for other lathes that automatically release the leadscrew nut to stop the saddle. I'm sure that these could be adapted to mini lathes, but that's another story. ■



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CNC in the (Model Engineers') Workshop

Part 13



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www.cncintheworkshop.com

Marcus Bowman looks at CNC for the beginner.

Preparing the material

Cut the material for the base, clamp plate and reinforcing bar, leaving at least 3mm extra on the length and the width. Note that the reinforcing bar should be cut to the same length as the other plates at this stage, for convenience (photo 88). We need two securing holes in each piece of material, for the fixture, at 75mm centres, 12.5mm in from what will be the finished edge of the workpiece. Make a small plate 140mm wide (left to right) and 60mm broad (back to front) using aluminium, steel or wood. I used MDF (photo 90). Hold it horizontally in the vice by sitting it on parallels, and set the Work Origin X0 Y0 at the front left corner. The sequence of operations is to clamp each piece of material on the plate, in turn, then drill

and ream the holes. Begin by drilling two clearance holes of at least 5mm diameter, at X38.5 Y12.5, right through the material – but make sure you don't drill into the parallels. I normally use "standard" thickness parallels 8mm thick, but jobs like this suggest thin parallels might be a good idea.

Place the material for the base plate onto the plate in the vice, arranging it so that there is approximately 1mm overhang over the left edge and over the front. Check the other sides overlap, so that when finally machined a cut will take place on all sides, leaving the finished base plate 140mm wide and 60mm broad. Clamp the work securely, making sure the clamps are clear of the hole positions, then centre drill, drill 4.9mm diameter, and ream the two holes. Repeat the process for the material for the clamp plate and the reinforcing bar. There are lots of other ways of doing this job, so feel free to use a method that suits you best.

Preparing the fixture

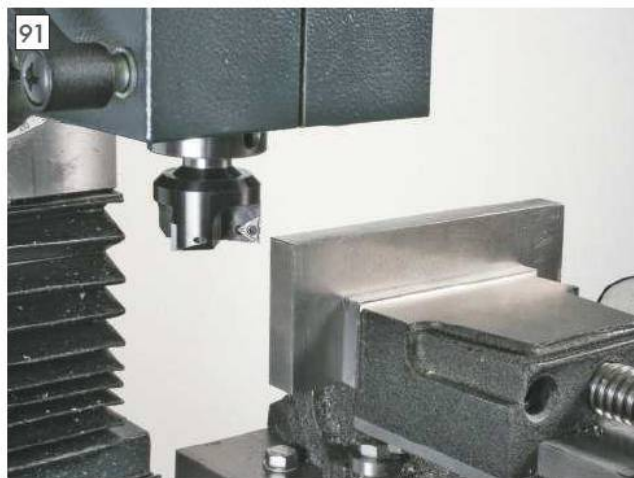
To prepare the fixture plate, cut it a little oversize, select the best long side, and sit the plate down on that side, in the vice (photo 91). Use a facing cutter or large diameter end mill to skim the upper face

(the top edge) level. Then turn the plate over so that the faced edge lies on the base of the vice, and skim the opposite edge. You may wish to check the resulting width (i.e. the distance between the two faced edges) and mill off just enough to bring the plate to a convenient size for your vice. I chose 60mm breadth so that the plate could be gripped easily in my Vertex K4 vice. That may mean the etch folder base plate will overhang the fixture a little, but that is not important.

Sit the fixture plate on parallels, with the top surface just a little clear of the top of the vice jaws and with the ends clear of the sides of the jaws. The next operation is to trim the ends, but it is important that the left end is at right angles to the front face of the plate, so use a lever operated dial test indicator (DTI) to clock the front face parallel to the X axis (photo 92). Get it as parallel as you can, by rotating the vice slightly until there is no more than a tiny change in the DTI reading from one end of the front face to the other. This can be done relatively quickly, but it can also turn out to be a test of your patience, so take your time. Start with the DTI lever at the centre of the face, and move to one end. Note the reading and then swivel the vice to reduce that reading. It works best if you try to pivot the vice around the point



MDF plate in position to support the main parts as the locating holes are drilled and reamed.



Skim the upper face to form the side of the fixture.

where the DTI foot started. Retest, and repeat; until there is no change in the reading from centre to end. Then check the reading from one end to the other.

Once you are happy, nip everything up tight, remove the DTI and trim the ends using the side of a large diameter end mill. Mark the front left corner of the fixture as the reference corner, so that we can locate accurately off the front and left edges of the plate.

Lever-action DTIs tend to have a small range of movement, so if you are not practised in the art of 'clocking', you may find frustration levels can be quite high, at first. My plunge action DTI has a much greater range of movement, but I found it impossible to site it so that it would sit horizontally with its ball foot against the edge of the work. Another way to approach the task is to use a laser centre/edge finder; set the spot to the edge of the work, at the centre of its length, then traverse towards the outer end, watching the red spot as you go. I find it relatively easy to tap the work into alignment with the spot. Any small misalignment which remains will be well within the range of the lever action DTI.

If you made a setting plate for your vice (MEW 207) you can use that to sit the vice in an initial position which locates the jaws very close to parallel to the X axis, but it is worth using the DTI to check the front face of the work to get it dead on. That will, after all, be a reference face for the fixture, and the more accurate its orientation at this stage, the more accurately you can position the machined features of the final workpiece.

Set X0 Y0 at the front left corner, then move to X5 Y0 and set X0 Y0 there. The front left corner will do fine as the Work Origin X0 Y0, but my plate is 150mm end-to-end, while the workpieces are 140mm broad, so it is more convenient to set the Work origin 5mm from the left end, to coincide with what will become the front left corner of two of the finished workpieces. Drill two 4.9mm holes at X32.5 Y12.5 and X107.5 Y12.5 then ream those holes 5mm diameter. Being lazy, I simply used MDI mode to position the Controlled Point (CP) then manually centre drilled, drilled and then reamed each hole. Watch out for the parallels under the plate! Take care, too, that the reamer doesn't bump into the base of the vice. Use a machine reamer if possible, although there is just about enough room to use a hand reamer (mounted in the chuck, of course). Run the reamer at no more than 1/5 of the speed of the equivalent drill, and use copious lubrication.

Make up the two pins (fig 64) and their washers, in the lathe. Make the pins up to 0.5mm shorter than the combined thickness of the fixture and the work. When the sacrificial material is added, that should make the pin 0.5 – 1.5mm shorter than the combined sandwich. Arrange the diameter of the washers so that they just clear the parallels.

Photograph 93 shows the completed fixture.

Machining the base

Assuming the material for the base has been cut to within a few millimetres of the finished size, the basic shape could be machined using four G1 commands



A lever action DTI is used to clock the front edge of the material parallel to the X axis.

to take the cutter along each side to the corner, turn, then travel along the next side. Assuming the Work Origin is at the front left corner, fig 65 shows the path around the shape, taking account of the radius of the cutter. I will assume a 6mm diameter cutter, although a larger diameter would be more rigid and would make light work of aluminium. My 6mm cutter is specifically for machining aluminium and does a terrific job. The flutes are very highly polished to prevent the swarf binding onto the cutter, and the cutting angle of the spiral faces has just the right amount of aggression. Lovely tool; I like it a lot.

Ignoring Z feeds for the moment, the basic path for the CP might be:

```
G0 X-10 Y-3
G1 X143 Y-3
G1 X143 Y63
G1 X-3 Y63
G1 X-3 Y-3
G0 X-10 Y-3
```

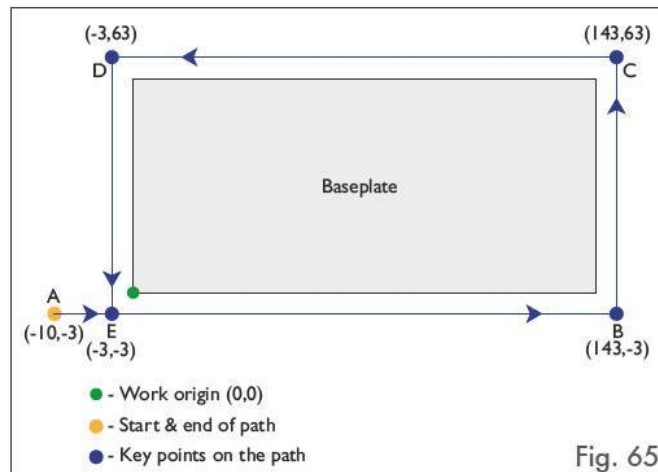
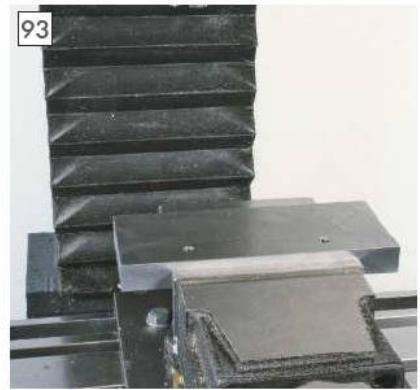


Fig. 65



The completed fixture, mounted in the vice.

But let's be a bit more sophisticated and improve the performance at the corners by eliminating some of the decelerate-accelerate cycle as the CP changes direction abruptly. Instead of simple G1 commands to move in a straight line, add a G3 command to steer the CP around each corner. That way, when the software looks ahead to see where to go next, and whether to stop and change direction, it will see a smooth change, and will not attempt to decelerate to a stop each time. The centre of the arc for the G3 command will be the point of the corner, and the arc will span 90 degrees, so the X and Y co-ordinates of the start and end points will be relatively easy to work out.

Fig 66 (next issue) shows the new path, and the code might look like this:

```
G0 X-10 Y-3
G0 X-3 Y-3
G1 X140 Y-3
G3 X143 Y0 I0 J3
G1 X143 Y60
G3 X140 Y63 I-3 J0
G1 X0 Y63
G3 X-3 Y60 I0 J-3
G1 X-3 Y0
G3 X0 Y-3 I3 J0
G0 X-10 Y-3
```

Now that we have our path, it's just a matter of cutting, lowering the CP (Z), cutting that same path, lowering the CP, and so on. That's what we have been doing up to now, and it is a perfectly workable method. But the smaller the vertical cuts, and the thicker the material, the more we have to repeat the same path

over and over again, with only the Z values changing each time. There is a better way. There are three parts to the solution, and each is a very powerful addition to our programming repertoire, so next month we will take a deep breath and dive straight in. Splash!

To be continued...

Parting Off and Blade Thickness



I found Alan James Aldridge's article on 'Parting off Problems' in the May 2013 issue of *MEW* very much of interest but in his article, in common with previous articles on parting off, there is little mention of the effect of the parting-off tool blade thickness.

Many years ago when I was a novice learning to use my second-hand Myford ML7 lathe parting off was a problem. Initially I was using a $\frac{3}{32}$ inch thick x $\frac{1}{2}$ inch wide HSS blade mounted at the front on the top slide in the tool holder shown on the right of **photo 1**. The result was digging in of the tool.

Thinking about this now as the cross slide and parting-off tool is slowly feed towards the revolving work piece, initially the horizontal force would try to twist the tool and the top slide on its dovetail base away from the work piece requiring further in feed. As the tool bites into the surface of the rotating work piece the downward cutting force on the blade suddenly increases and causes the tool blade and tool mounting on the top slide to tip downwards and twist it forwards further into the work piece. Depending on the relative magnitude of the horizontal force tipping the tool out of the work piece and the downward force tipping the tool into the work piece it can be envisaged that the parting-off tool and its mounting may suddenly flip and dig into the work piece. The downward force will further increase and the horizontal force decrease as the tool digs in causing a potentially escalating catastrophic situation with tool breakage etc. For example in the photo, I suspect that the downward force on the overhanging tool tip presses the left-side of the dovetail on the top slide firmly down on the slide base. On the right side the angle of the dovetail is less rigid and likely to lift from the slide base which means the tool tip will move into the work piece. This effect will add to other deficiencies in the rigidity of the tool mounting and tool overhang.

The magnitude of this downward cutting force on the tool tip must scale and increase with the tool blade thickness.

So the next step was to move to the thinnest blade available and this was $\frac{1}{16}$ inch thick x $\frac{1}{2}$ inch wide. Also to change to a rear-mounted tool holder that is shown on the left of the photo. With rear

No other aspect of turning causes more frustration than parting off. Godfrey Greeves describes his approach to this testing task.



mounting the force on the tool tip is upwards so that any lack of rigidity in the tool holder on the cross slide will cause the tool tip to move backwards out of the work piece. Also the horizontal force is in the same direction causing the tool holder to tip backwards and out of the work piece. This backwards movement will reduce the cut depth and reduce the upwards cutting force. So this rear mounting is self-compensating with much less risk of digging in. Effectively this solved my parting off problems.

The rear-mounted tool holder shown has a cast iron base that is 1.625 inch deep and is bolted to the second-most rear T-slot of the long cross-slide using a single tee-bolt machined from a $\frac{1}{2}$ inch BSW bolt. A slot is machined/shaped at the top of the holder base to suit the parting-tool blade section that has side relief and bevel edges. The tool-holder base clamping-bolt also acts on the top plate that has a slot that clamps the blade on the base slot. This tool holder arrangement gives adequate rigidity. This rear tool holder can be removed or mounted very quickly by slackening the square nut at the top. The blade slot is machined at an angle to give the tool tip positive rake without any need to grind the lower edge of the blade. To sharpen the blade only its front needs to be reground on the off-hand grinder. The height of the angled blade slot in the base is machined so that a projection of the tool tip of 0.75 inch puts the tip at exactly

the centre height of the headstock spindle. This allows parting off for work pieces up to 1.5 inch diameter. For larger diameters parting off can be done for a depth up to 0.75 inch and for these diameters I would usually saw through the remaining depth while supporting the work piece that is being parted/sawn off. The sticky tape is used to maintain the blade protrusion when the holder is unclamped.

The rear tool-post sits just in front of a specially made narrow long-travel vertical-slide and milling spindle. The milling spindle and rear tool post can be used as well as turning tools mounted on the top slide for 90% of the machining operations that I do on the ML7 lathe without removal of any of these 3 tool set-ups.

Also shown in the photo is a very thin parting-off blade made from a piece of broken-off HSS hacksaw blade (blue). This is mounted in the previously used front parting-off blade tool holder on the top slide. The blade thickness is only 0.025 inch and has a very small amount of side clearance ground on the blade sides. The downward cutting force with this thin blade is very small and okay for front mounting. It is used mainly for parting off small items such as pieces of $\frac{1}{8}$ inch wall thickness brass tube. The rear-mounted blade of $\frac{1}{16}$ inch thickness would be quite useless for this operation and cause the stock brass tube to deform and twist out of the 3-jaw chuck in the headstock. ■

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A beginners' guide to Home Metalworking

Part 5



David Clark looks at setting up a home workshop from scratch.

As well as working in engineering, David Clark has set up and operated several home workshops. This regular series offers much sage advice for the beginner.



I have finally assembled the workbenches. The smaller one took about six hours mainly due to me mislaying the instructions. The two larger ones (photo 36) were done in less than two hours each because I knew what to do after assembling the smaller one. I won't go deeply into the assembly details but a couple of things are worth mentioning. Although I purchased these workbenches from Sealey, the Axminster ones are basically the same and are considerably cheaper.

Photograph 37 shows how the back of the cabinet is assembled. Points to note are how the drawer stops (right angle bars) fit between the back upright and the back plate. The holes to take the drawer runners are very close to the top of the partition; the bottom holes are not so close to the bottom edge. This is not very clear from the assembly drawing. Also, the rear square slots are lower than the front two square slots. These slots are to take the drawer runners. I did have one tight drawer but by changing the runners around all fitted freely, eventually. I completely assembled each workbench before finally tightening all of the screws up.

Photograph 38 shows one of the drawer runners. There are three bent out tabs on each runner. Before assembling these,

tweak them out a little with a flat screwdriver blade. This will make assembly far easier. Do this on both the cabinet runners and the drawer runners.

When the workbench is assembled, there are about six empty holes that are not used for fixing parts together. I used some spare roofing bolts to fill the holes for a symmetric appearance. If I had left the holes, they would have irritated me every time I saw the workbench. I also used four 6mm coach bolts to bolt the wooden top to the workbench rather than the short square head wood bolts that were supplied. I also fixed the top flush with the back of the workbench rather than hanging it equally over the edge at the front and back of the workbench. To mark the holes for the worktop, I put the top flush with the front edge of the workbench and marked the two holes. After drilling right through, I turned the worktop round so the two drilled holes were at the back of the worktop and then I drilled the other two holes through the front of the workbench.

The Warco WM 14 milling machine

My new Warco WM14 milling machine turned up this week (photo 39). I was very impressed by it on the front cover of MEW 214. It looked a substantial machine with a solid vertical main column. I don't like the look of the swivelling lower column on some mills; they just don't look rigid enough.





I got as far as removing the outer wooden box before it started raining very heavily so it will be a day or two before it is bolted to the Warco cabinet stand (photo 40). I half expected to have to assemble the stand so I was pleasantly surprised to find that both the mill stand and the lathe stand were substantial welded fabrications. They really do look like quality items.

The bottom of the mill stand has two slots (photo 41) to take Rawl bolts (photo 42) to bolt the stand down to the floor. The stands must be bolted down. I would not consider using them without doing this as they would be too unstable. They will however be perfect when bolted down to the workshop floor.

I also purchased a new 50mm toolmakers type of vice also called a pin vice because the clamping part fits into semi-circular holes under the vice ways (photo 43). I have used a 75mm one of these before and it was very accurate but I decided the Warco WM14 needed a slightly smaller vice, hence the purchase of a 50mm one. As these vices are ground square on all faces, it is possible to mount these vices on their sides allowing you to clamp workpieces vertically in the jaws.

Another useful vice for the larger mill is an Abwood vice, often used in industry. The one in photo 44 is a 4 inch Abwood and it is a very substantial piece of equipment.

Milling machine tools and equipment

Before we can do any milling we need a few pieces of basic equipment. Photograph 45 shows an ER25 collet holder on a No 2 Morse taper shank. ER collets are fine for holding cutters. ER25 allows cutters up to a 16mm shank to be



held securely. The Morse taper shank must be held in with a draw bar through the machine's spindle. If you don't use a draw bar the holder could pull out of the taper with disastrous consequences. Although many people use a drill chuck in a mill for



drilling, never ever hold a milling cutter in a drill chuck. The chuck may come loose from its arbor and start spinning around the workshop. I also prefer to hold drills in the ER collets. The collets are available right down to 1mm diameter and go up in 1mm increments.

You need at least one complete set of drills in the workshop, a set from 1mm up to 6mm by 0.1mm increments will do most of what you need (photo 46). For anything over 6mm, I suggest you purchase them as needed. A set of number drills from No 1 down to No 60 will also be very useful especially if you are making steam engines.

The exception to holding drills in a drill chuck is when you need a sensitive feed on a small drill. For that, I recommend the sensitive drill adaptor and 4mm drill chuck from Arc Euro Trade (photo 47). This little item will be found very useful for many drilling jobs in the mill and indeed it can be used in the lathe as well.

An edge finder/wobbler set will be very useful for finding the edge of a workpiece (photo 48). We will look at edge finders later in the series when we start to use the milling machine.

A dial test indicator (photo 49) will be found very useful, if not indispensable, for clocking up vices and work true on the mill as well as work on the lathe. Some writers recommend using a square to set a vice true on the mill but I don't think you can beat a clock for doing this. You will find that after a few attempts, you can clock the vice true within a thou in a minute or two.

Another useful accessory in the workshop is a rolling workshop cabinet (photo 50). The one pictured here is a Clarke one and I am sure it came from Halfords although they are also available from Machine Mart. The top box is actually an intermediate box from a slightly wider cabinet, the original top box was the one stolen as mentioned in a previous part of this series. I am considering putting this intermediate cabinet onto one of the new workbenches leaving the base unit free to roll around the workshop to the machine that is in use. This would give a useful work surface to store quick-change tools on for the lathe amongst other things. I expect I will chain the rolling cabinet to the workshop wall so it can't be wheeled away if I get burgled again.



For eye protection I have purchased an overall face mask. This is a lot cheaper than proper safety glasses and is ideal when machining brass where the swarf flies as splinters everywhere.

Safety protection

For eye protection I have purchased an overall face mask (photo 51). This is a lot cheaper than proper safety glasses and is ideal when machining brass where the swarf flies as splinters everywhere. Photograph 52 shows a respirator mask. This is an essential item when machining MDF and sawing and filing resin components. You should

wear it when machining plastics as well. It protects your lungs from nasty and abrasive dust.

Turning tools

Some sort of turning tools are required. Photograph 53 shows a grooving tool from J&L Industrial. This one came as a set with five different width tips.

Photograph 54 shows the shape of the tip. It is great for turning and grooving as well as parting off small diameter work. Tips are not cheap but if you are careful they will last a long time and they do have a cutting edge at each end of the tip.

Photograph 55 shows a turning tool that is ideally suited to work being turned between centres. The acute angle allows the tool to get right in to the work without



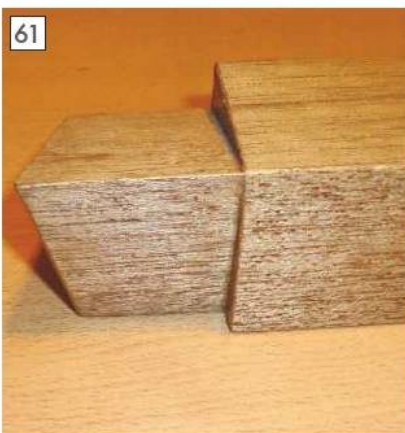
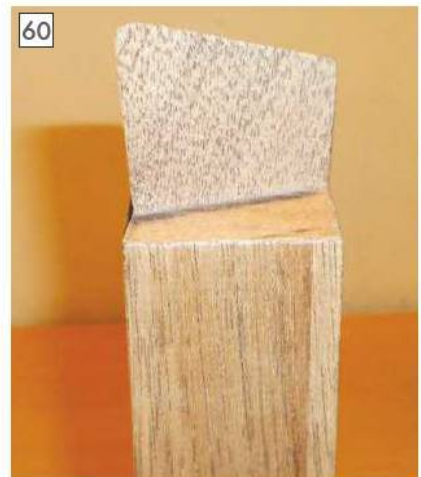
fouling the lathe centre and it can also be used to face the work off in conjunction with a half centre. **Photograph 56** shows another form of turning tool that is more suited to removing large amounts of metal quite quickly. It can also be used for facing as well as turning. **Photograph 57** shows an inserted tip boring tool with a 10mm diameter shank. This tool is ideal for boring holes from about 11mm upwards.

Photograph 58 shows the top rake and front rake of a radiused turning tool (left) and a sharp right angle tool for facing and turning (right). **Photograph 59** shows another view of the top rake. **Photograph 60**

shows the front and back clearance of the same radius turning tool.

Photograph 61 shows the angles on the sharp edged turning tool while **photo 62** shows another view of the sharp edge turning tool. These tools would normally be ground from High Speed Steel to the angles shown. The angles will be about 10 degrees for work on mild steel while tools for brass would be similar but have no top rake. My thanks go to Mike Chrisp for the loan of his large-scale wooden models of turning tools.

To be continued...



COMING UP NEXT TIME

We will start on our first project. This will be a tool height setting gauge for use on the lathe. This simple tool will involve simple turning and milling (although if you don't have a milling machine the milling can be done in the lathe) and I will also show you a simple way to set the height of the setting gauge accurately with nothing more than simple measuring equipment.

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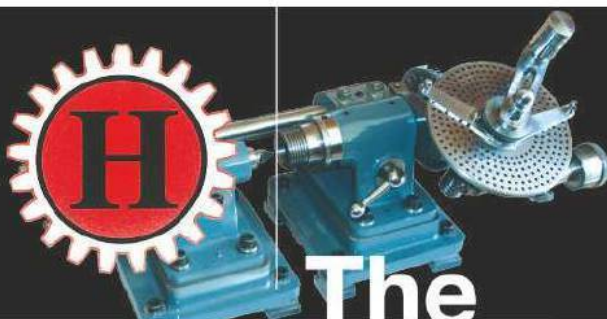
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for issues 201 to 212 of MEW



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MODEL ENGINEERS' WORKSHOP PUBLICATION DATES

We give below the publication dates for issues 201 to 212.

201	April	2013	207	Autumn	2013
202	May	2013	208	October	2013
203	June	2013	209	November	2013
204	July	2013	210	December	2013
205	August	2013	211	January	2014
206	September	2013	212	February	2014



COMPUTERISED INDEX

The index is available on CD in PC Windows format from CAHW at an inclusive cost of £11.00 (non UK orders £13.00) including a full manual. The banks in the UK are following a policy to phase out the use of cheques and in keeping with that trend it is regretted that orders by post can no longer be accepted. To order a copy, please go to www.cahw.co.uk

21st ANNUAL

NATIONAL MODEL ENGINEERING AND MODELLING

EXHIBITION 2014

HARROGATE SHOWGROUND MAY 9th 10th 11th

**Ticket Office
open 10am**

**Exhibition
10am - 5pm
(4.30pm Sunday)**

The National Model Engineering and Modelling Exhibition is one of the largest exhibitions of its kind in the UK and you are invited to look at this impressive list of clubs attending the show. Each stand will be displaying models built by members of the club with up to 60 exhibits on each stand. Members will be on hand to answer any questions you may have and are able to offer advice and give details of how to join your local group.

The National Model Engineering Exhibition is renowned for its huge specialist trade stand section.
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BY RAIL:
Harrogate Railway Station.
Connections to Leeds and York
mainline stations.

BY AIR:
Leeds/Bradford Airport
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BUSES:
A courtesy bus departs from Harrogate Bus and Railway Station on the hour from 9am till 2pm for the Model Engineering Exhibition.
Last bus from the Exhibition into Harrogate departs 5pm. (4.30pm on Sunday).

The National Model Engineering and Modelling Exhibition is one of the biggest exhibitions of its kind in the UK.

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- ☐ Leeds Society of Model and Experimental Engineers
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- ☐ Grimsby and Cleethorpes Model Engineering Society
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- ☐ City of Sunderland Model Engineering Society Ltd
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- ☐ The Tyneside Society of Model and Experimental Engineers
- ☐ Pickering Experimental Engineering and Model Society
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- ☐ Cleveland Association of Model Engineers
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- ☐ The Society of Model and Experimental Engineers
- ☐ Huddersfield Society of Model Engineers
- ☐ Brighouse and Halifax Model Engineers
- ☐ Kelghley and District Model Engineering Society
- ☐ The Stirling Engine Society

RAILWAY

- ☐ Ground Level 5" Gauge Mainline Association
- ☐ Teesside Small Gauge Railway
- ☐ Association of 16mm Narrow Gauge Modellers
- ☐ The Gauge 1 Model Railway Association

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MODELMAKING

- ☐ The Guild of Model Wheelwrights

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Workshop Lighting



Mike Haughton sheds some light on new and old ways of illuminating your workshop.

Recently, I moved both house and home workshop. The new workshop had minimal lighting and unsafe electrics, so a complete rethink was called for. The existing lighting and power points were ripped out and a fresh start made using more suitable modern equipment, selected to make the best of the space available. On the lighting front quite a lot has changed, with the arrival of low energy lighting and especially the arrival of useful Light Emitting Diode (LED) devices that are ideal for some workshop uses.



MEMLO Machine Light.

Traditionally, home workshops made do with unsuitable but inexpensive (i.e. free), cast off domestic lighting. Invariably workshops had fluorescent tubes for overhead lighting and 'warm white' incandescent bulbs for close up lighting. This general approach was followed in my new workshop but some energy and safety improvements were called for.

Photograph 1 shows a low voltage incandescent light fitted to an 'industrial cabinet' Myford Super 7 made in the 1950's. The blue MEMLO unit is a cast iron box containing a pull switch and step

down transformer to 24 or 12 volts and attached adjustable lighting arm. The bulb is unprotected from swarf or coolant and has a very primitive reflector. Mine gives a very yellow-orange light but has a very long bulb life. I have found it useful because the adjustable arm allows the light source to be positioned very close to the work. Both 240V single phase and 440V 3-phase versions of these MEMLO machine lights often turn up in workshop clearances and attached to old machine tools. They work and seem pretty bomb proof but there are more modern solutions that use less power and give a whiter light.

What is Ideal Lighting?

I suppose natural sunlight is the lighting our eyes were designed or evolved to use best. In an ideal world one might aspire to an artist's studio lighting. Studio lighting often had natural lighting provided by a North facing sky light to render colours as natural as possible. Of course, in the Southern Hemisphere it has to be a South-facing skylight. However, northern light in the Northern Hemisphere isn't a constant and varies in hue by location, time of day, month and the weather.

I'm sure very few of our workshops have artist's studio natural lighting and in any case we often work at night, on dull days, in cramped conditions with small windows, etc. Whilst we don't think we need good studio quality workshop lighting most of us notice that as we get older we need more light intensity and in my case whiter lighting is becoming more desirable. Those of us who actually manage to complete a scale model and paint it in authentic colours will find that they need very good studio type lighting to get a really good paint job with an accurate colour match.

Home Workshop activities often involve intricate mechanical and detail drawing work, both of which require more light intensity at the workbench, whatever your age. The lighting has to be in the right place, on the work and not directly into the eye.

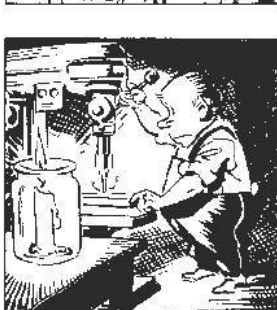
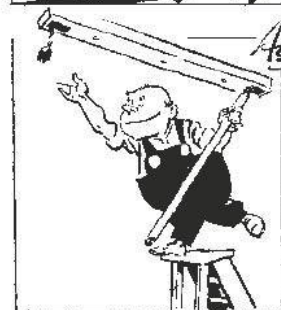
Even in our ideal artist's studio natural lighting isn't constant, and it's worth taking a few minutes to study some of the factors that provide good lighting. The key factors are colour temperature in kelvin, colour rendering index (CRI) and luminosity (brightness).

Colour Temperature

It's called colour temperature because the scale originated from light emitted by carbon, a 'black body', heated to

CHUCK ...

... THE MUDDLE ENGINEER



different temperatures. It's customary to quote colour temperatures in kelvin, K, which is the temperature above absolute zero, -273.85 Celsius. E.g. Carbon heated to 2700 K (2426.85 C) gives a yellowish-white light while carbon heated to 5400 K (5126.85 C) gives a bluish-white light. Paradoxically, the bluer tone of higher colour temperatures is usually interpreted as cool, whilst lower colour temperatures are perceived as 'warm'.

How does this relate to our Artist's North light?

A standard domestic incandescent filament bulb is normally about 2500K, a so-called 'warm white light', frequently found in domestic lighting. Generally domestic warm white lighting has an orange/yellow colour cast. Infinitely better than a candle though!

An office overhead fluorescent light might be 4000 K to 5000 K, a cooler 'white light'. Noon daylight at 5500 K is a good blue-white light. North light, blue sky at 7500 K plus is definitely too harsh a blue-white colour for most workshop purposes.

Relying on kelvin isn't the only consideration for a light source. (These are called luminaires in the UK Building Regulations). Having a cheap light that delivers 5000K but hasn't got the full spectral range or has a distorted spectrum of colours might give pretty disappointing colour rendering results.

CRI, Colour Rendering Index

Normal daylight has a CRI of 100 so that's what would one expect in a lamp that will give excellent colour rendering. In practice a CRI of 90% plus is possible and 98% plus is desirable for some painting and colour matching tasks. A high CRI indicates not too many peaks and blank spaces in the spectral power distribution. Specialist daylight bulbs can achieve a CRI of 98% but these are especially manufactured and probably expensive products. As consumers, our biggest problem is finding any CRI data on luminaires intended for domestic use; so you may have to dig about in the manufacturer's data sheets, search the web and read the fine print on the box. Many domestic luminaires don't exceed a Colour Rendering index of 70 to 85, especially some of the compact fluorescent low energy bulbs. (CFLs)

Remember those greenish high-pressure sodium streetlights that made everybody look ill? One would expect them to have a very low CRI and they do; high-pressure +20% and the yellow low-pressure is even worse at -40%.

Lumens and Light output

How much luminosity or brightness can one expect? Wattage is a measure of how much electrical energy a light uses, not how bright it is. Efficiency of conversion of electrical energy to luminosity is the key and we need to consider how the available luminaires actually work. Energy efficient lighting is more important than it was, due to the escalating cost of electrical energy, and 'save the planet' eco-initiatives. Light output is usually measured in lumens, Lu, and is a measure of all the visible light given out by the luminaire.

Types of Luminaires

In the following discussion of workshop lamp types I have deliberately omitted metal halide or high intensity, high efficiency discharge lamps that have been developed for outdoor sports events, wide area overhead lighting and those very annoyingly bright xenon automotive headlamps.

Tungsten filaments

Incandescent bulbs, coiled coils of tungsten wire in a glass envelope containing an inert gas, tend to give a very soft yellow-orange light of around 2500 K, and have a quite a short life (perhaps 1000 hours if there is little vibration, even less if there is more). They give as little as 16 lumens per watt of input energy or an energy conversion efficiency of less than 5% to light, the rest being heat. Increasing the current through the filament raises the colour temperature but reduces the life of the lamp, as in the old photographic 'flood lamp'. The limit is governed by the melting point of the tungsten filament. For some reason 220 volt filament bulbs are slightly less energy efficient than 110V ones, something to do with the filament thickness, perhaps?

A 40-watt 220/240 volt incandescent lamp might produce as little as 450 lumens. Of course domestic incandescent lamps are now withdrawn from Europe as an energy saving measure. Low voltage and special use 'industrial' bulbs are still available, however. Current UK building regulations apparently state that up to 25% of home lighting can still be energy inefficient. Naughty lighting!

Halogen bulbs still contain a tungsten filament in a 'glass envelope', **photo 2**. They are able to operate at higher colour temperatures by increasing the gas pressure, which raises the filament melting point and the introduction of a halogen, like iodine or bromine, to react with tungsten metal vapour and redeposit tungsten back onto the filament. The outer glass package is usually 'quartz' and gives rise to the name 'quartz halogen bulb'. The colour temperature can be higher than the incandescent lamp and the bulb size is very much reduced for a given wattage.



An eco-halogen bulb.

Sadly halogen bulbs are not a lot more energy efficient than the standard incandescent and they run extremely hot. Typically they give perhaps 29 watts energy input for our 450 lumens light output. Incandescent/halogen bulbs of 3200K can have a CRI close to 100.

My Chester 6x26 vertical mill, around 10 years old, was supplied with a with a low voltage halogen spotlight **photo 3**. The light from this machine light is yellowish but at least the bulb is protected from flying hot metal behind a glass sheet and it can be positioned close to the work with the goose neck support arm. I find I have to remove the protective glass shield and give it a good clean, as oil seems to burn onto the hot glass. A work light like this is very desirable I find and if the mill didn't have one I would have added a more sophisticated quartz halogen spotlight or LED light.

I have, for some years, used ceiling mounted halogen floodlights (security lights) over several of my machines. On moving workshop, I again installed some 140watt weatherproof IP 54 units at ceiling



626 Mill Halogen Light.



Security Down Light.

height above one of my lathes, **photo 4**. Although I have a fluorescent strip light close by, the security light makes a real difference and it is safer because of the IP 54 level of protection.

Whilst not being very energy efficient, these security floodlights do give a comparatively white light and the downward reflected heat is a definite bonus in a cold workshop. I find glare isn't a problem provided the light is mounted above head height. Notice that I have painted the wall behind the lathe white, this helps a lot with the general lighting. These security lights are very cheap units, especially when bought without security features like motion detectors and timed shut down. The units I have use R7S end caps and are rated at 2550 Lumens and 3000K. These units are dimmable but why would you want to? Recommended, if you overlook the electrical input requirements and most designs are IP rated. I.e. enclosed and splash proof.

You may have noticed that 'Eco Halogen' bulbs are now being offered and appear to be halogen bulbs built into a traditional glass envelope (photo 2) with conventional bayonet or screw bases. These units offer slightly superior energy efficiency, using 30% less than an incandescent filament bulb and are energy rated C under EU regulations. It appears that the outer glass envelope has been coated with a heat reflective coating and the gas inside is Xenon. If you are still using incandescent bulbs in your workshop these Eco Halogen bulbs could be a valuable improvement at reasonable cost and modestly lower energy input.

Compact Florescent Lamps (CFL) (Low energy lamps)

These are a miniaturised version of the office overhead fluorescent strip light. Roughly 9 watts input will produce 450 lumens and the light colour can be tailored by manipulation of the phosphor coating



Compact Fluorescent Lights.

inside the glass envelope. **Photograph 5** shows the type of bulb which most will immediately recognise as the 'energy efficient light bulb'. These are available as screw in or push and twist replacements for the old incandescent light bulb. They save energy, last a long time (over 10,000 hours but this is shortened by repeated on/off operation).

Home Workshop activities often involve intricate mechanical and detail drawing work, both of which require more light intensity at the workbench, whatever your age. The lighting has to be in the right place, on the work and not directly into the eye.

Despite all their energy saving performance CFLs annoy many users because they don't achieve full brightness for some seconds; this is especially true in a cold workshop and some designs seem worse than others in this respect. These CFL bulbs contain electronic ballasts, which is one reason why they cost more than filament bulbs.

Millions of these CFLs were distributed 'free' in the UK by electricity supply companies in preparation to the switch over to low energy lights a few years ago. By shopping around one can find 5000K+ CFLs and these give a good white daylight colour temperature and quite acceptable CRI. These are definitely worth searching for, in my opinion. I try to avoid those offering 'warm soft white' 2700K bulbs. Some manufacturers use all sorts of names to avoid quoting kelvin. Colour rendering of about 80% seems common.

Normally a 23-watt CFL is quoted as 100-watt equivalent. CFLs show a huge energy saving over filament bulbs, though some users maintain that the industry exaggerates the quoted wattage equivalent compared to a filament bulb.

Some CFLs can be dimmed, most not, so read the box before purchase. A typical CFL box will have a panel of symbols similar to this that tell you most of what you need to know. Notice that CRI is missing from this particular one. See **photo 6** for the general label and **photo 7** for the efficiency label.

CFLs contain toxic mercury and many countries have collection schemes for end of life units to stop mercury escaping into the environment via landfill. The mercury is recovered and recycled. Without the phosphor coatings the light produced by CFLs would only be the mercury emission lines, which contain a lot of ultra violet. UV is not good for your skin or your eyes. To get the colour temperature required a mix of different phosphors is used as a coating inside the glass envelope. Phosphors absorb UV and re-emit it as visible light.

Because most electronic ballasts in CFLs operate at a much higher frequency than the 50 or 60 Hz mains frequency, combined with the persistence of the phosphors, the risk of stroboscopic effect is apparently quite small. The stroboscopic effect is observed when moving objects appear stationary under a flashing light. Remember the Old John Wayne movie *Stagecoach* where the wheels appeared to turn backwards or were static? There must have been serious industrial accidents in the past with the old fluorescent tubes with mains frequency ballasts.



CFL Package information.



Energy Efficiency Label.

Fluorescent ceiling lights

Surely nothing has changed in these since they were first appeared in the 1930's? I have recently replaced some old and very basic magnetic ballast domestic tubes (the ones with the screw in starter tubes on the side) by modern IP65 weatherproof K8 tubes with electronic ballasts. **Photograph 4** also shows a new 5-foot unit mounted above one of my lathes. I find these lights come on virtually instantly, are quiet, don't flicker, I don't have starters to replace and of course the light has a useful



Indicator LED'S.



LED Spot Light.



LED Strip Light.



LED Cabinet Strip Light.

degree of mechanical protection from its polycarbonate cover. In all, I have now installed 6 of these units in my workshop, in the room above and in the attic.

The electronic ballast also gives slightly better energy efficiency than the magnetic type and tubes are available to provide a range of K values. The tubes supplied with these units were 4000K, 5200Lm (90Lm per watt) cool white. Different manufacturers quote expected life of the tube between 10,000 and 20,000 hours. You can always change the tube for a colour temperature that suits you.

Plug in replacement tubes using light emitting diodes (LEDs) are available for shorter tubes but at the moment look to be uneconomic for home workshop use, at perhaps ten times the price of glass fluorescent tubes and little additional energy saving.

The electronic ballasts operate the tube at a much higher frequency than the old magnetic type and the risk of stroboscopic effects is much reduced. It is said that some electronic ballasts can cause electromagnetic interference but I have no first hand evidence of this. Should you want to dim your lights check before you purchase. Some can be dimmed, some cannot.

Light Emitting Diodes (LEDs)

Light emitting diodes have been around for years as very low power indicators in electronic equipment. **Photograph 8** shows a selection of these indicators.

These are fairly old examples. The actual diode, a junction between two semiconductor alloys isn't visible in this photograph, just its support framework inside the moulded lens. The colours shown here are the plastic protective encapsulations. Early LEDs only gave a red light but gradual development has added more colours by changing the alloys. The requirement for UV emitting LEDs for Blue Ray DVD players finally completed the colour range. Having UV emitters allowed the use of phosphors to give wide spectral range 'super bright' LEDs.

LEDs are very efficient at converting electrical energy to light, at least as efficient as CFLs and they have exceptionally long lives of 25,000 hours plus. They don't contain any mercury so disposal shouldn't be an issue.

Driving LEDs isn't as straightforward as an incandescent filament bulb. They only emit light when current flows through them in one direction and the voltage required to start light emission varies with the alloys used. They should always be used with a DC supply and a series resistor, the value of which depends on the type of LED (*LED plug in replacements for 240V bulbs have recently become widely available, I have found them very effective - Ed.*) These indicator LEDs only consume a few mill-watts of electrical power but are exceptionally useful as internal lights in model trams and trains and the like. They use very little power, last a long time and don't get hot. They are complete

replacements for the old 'grain of rice' miniature filament bulbs.

Photograph 9 shows a fairly recent MR16 LED downlight (spotlight) which is rated at 12volt AC/DC 1.8 watt that claims the performance of a 30 watt halogen. As you can see it's constructed with 30 individual LEDs mounted in a glass reflective envelope. It has colour temperatures of 'day white, 6000-6500K or 'warm white' 3200-3500K. Plugging this into an existing circuit produced a brief flash of light then it extinguished! The existing transformer produced too high a voltage at the new lower current and the internal circuits shut the bulb down. Clearly specialised LED drivers are required.

Photograph 10 shows a LED light strip and its power supply (driver) sold to provide lighting in display cabinets. The strip can be extended by plugging units together. These are examples from the IKEA *Ledberg* range.

The small yellow items are surface mounted LEDs and the even smaller black dots the resistors. The driver is 'intelligent' and can handle different numbers of strips, each being about 0.6 watts from 7 LEDs. Should you have a model display cabinet these strips could be ideal lighting.

Photograph 11 shows a similar 37 SMD LED strip light that I have used on one of my machines for local highlighting and to illuminate a gear hobber at the Midlands ME Show. Quite a number of visitors asked where the light came from. The total power is 3.7 watts maximum and the electronic



IKEA JANSJO LED.

driver is internal to the unit. Again the LED's are the yellow-orange dots.

Photograph 12 shows 2 different versions of IKEA *Jansjö* 3 watt LED desk lamps. Where do IKEA get these names from? These lamps have proved useful in my workshop on the drilling machine and for marking out work. Like all the IKEA LED lamps I have seen they are 'warm white' 2700 K. IKEA quote a very long life and the LEDs are not designed to be replaced.

A friend who operates a small lathe and a mill in a garage with no mains electricity, using a 12 volt car battery and an inverter for all his workshop power, found that two of these mounted either side of his mill column gave excellent results. I have to agree. They contain a single SMD LED and I think represent about the minimum power that is useful for detailed close up work.



LED 10Watt Work Light.

Photograph 13 shows a 10-Watt LED portable work light that has proved invaluable when I was installing T&G wooden flooring in my loft. It is powered by an internal rechargeable battery, that can be recharged from the mains or from a car cigarette lighter socket. It has a single COB LED about the size of a postage stamp. It produces 900 Lm for 3 hours with a CRI of 70+ and a colour temperature of 5500K, 'Cool White'. 90 Lm per watt seems to be the present limit of the LED technology for high powered LEDs. COB stands for 'chips on board' and is a method of mounting multiple chips spread out over a wider area to cut glare.

Since I bought this work light from Screwfix it has had a lot of use on all sorts of jobs around the house and workshop.

The Consumer Association's *Which* reports that in their tests the life of some

LED luminaires isn't as long as some manufacturers claim.

Conclusions

I hope I have caused you to consider what you are using to light your workshop and perhaps to make some changes. Many of the changes I have described are being driven by energy saving demands and safety. In my opinion LED technology has a way to go, it's still developing. I know LED lighting has disappointed some people and the only sensible advice must be to try before you buy.

If you have any comments on this article, you may, as usual, send them to *Scribe a Line*, or Mike Haughton is happy to be contacted by email at mikehaughton@btinternet.com ■

I'm delighted to announce that the well known engineering suppliers **Chester UK** have agreed to send £30 in gift vouchers to each month's 'Top Tip'. Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Every month I'll chose a selection for publication and the one chosen as **Tip of the Month** will win £30 in gift vouchers from Chester Machine Tools. Visit www.chestermachinetools.com to plan how to spend yours!

Readers' Tips

This month's winning tip comes from **Michael Cox** in Cheshire:

When stamping numbers and letters onto metal first print out the required text onto a label, using a CAD program or Word, using a similar font and character size. Stick the label to the metal and clamp a metal straight edge above or below the text to ensure that the stamped numbers are in a straight line. Now use the printed label to guide the position of each punch. This can be pressed gently into the label to check the position using hand pressure. Once satisfied with the position, strike the punch with a hammer to stamp the metal. Doing it this way ensures that the letters and numbers are all properly aligned and spaced.



Set up for stamping.



After stamping.



After cleaning up.



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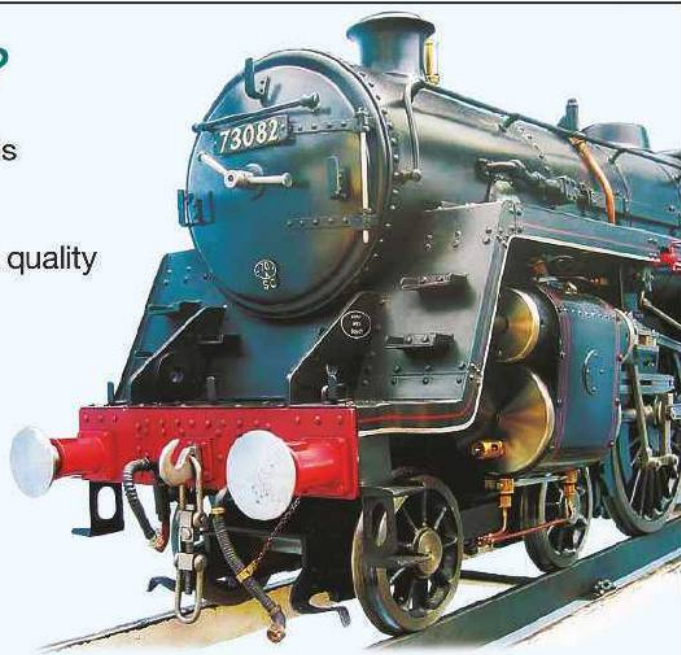
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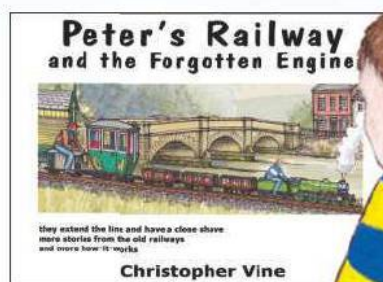
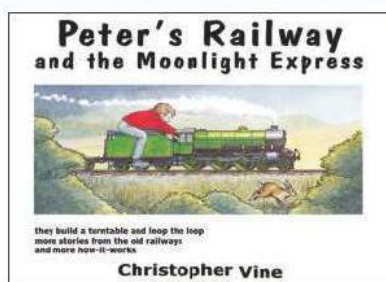
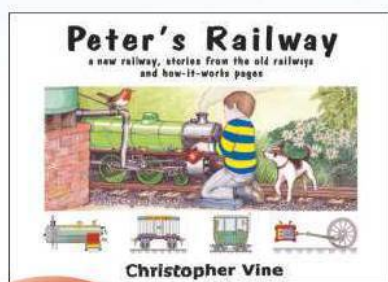
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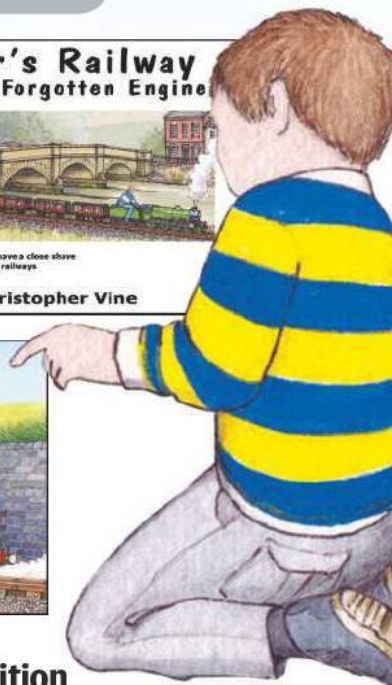
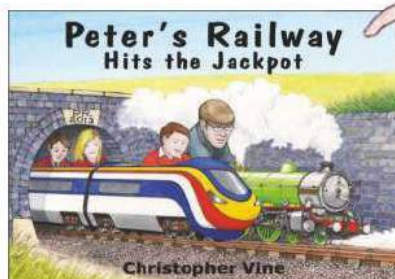
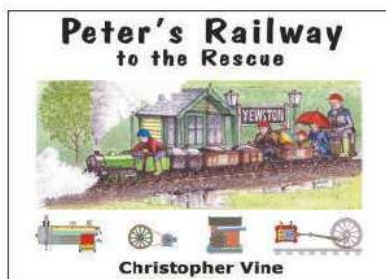
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Polly 2014



Roger Backhouse reminds us that the Society of Model and Experimental Engineers' popular beginners course is running again this spring.

There are still some places available on SMEE's popular 'Polly' or 'Part 2' course, starting on Saturday May 17th 2014 and running monthly until November.

This course has step-by-step demonstrations of making the classic beginner's Polly vertical boiler stationary engine designed by 'Tubal Cain' (T.D. Walshaw.) Techniques demonstrated include marking out, cutting and drilling, boiler making and testing, soft and silver soldering, pipework, sheet metal forming and making cylinders.

Many who've completed this course follow by making larger and more complex models, as it is an excellent introduction to model making.

SMEE has excellent workshop and display facilities with a demonstration lathe generously supplied by ARC Euro Trade. All participants receive a valuable handbook and there's quality 'out of hours' advice available from the volunteer tutors.

The course runs at Marshall House, SMEE's base close to Loughborough Junction station, London, SE24. Participants can buy many materials from SMEE, and a light lunch is provided as part of the course. Previous classes have drawn students from as far afield as Yorkshire! ■



ABOVE: A set of parts for a Polly model made by Allen Berman. Course participants are shown how to make all these parts. Allen made a Polly as a beginner; he's now made many more models and completed restoration of two classic motorbikes, a Triumph Tiger Cub and a Velocette LE200, using skills developed on the course.

ABOVE RIGHT: My own Polly model. Not very elegant but it works!



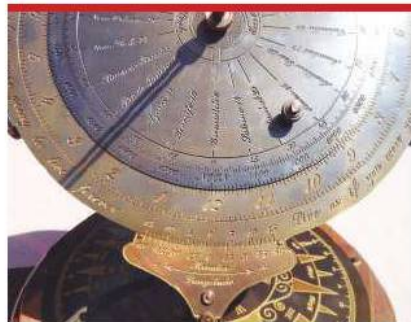
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The digital scale fitted to the tailstock.



Another view of the clamp and scale.

Making a simple digital tailstock scale

Roger Froud made a simple addition to his tailstock from a damaged pair of digital calipers.

Drilling a hole to a precise depth using the dial and graduations on the tailstock barrel can be fiddly and I've always felt there had to be a better way of doing this. This article describes a simple way to use a pair of digital calipers to provide this function (**photo 1**). Obviously, the dimensions of your tailstock are likely to be somewhat different to mine, but the principle is the same for all.

The digital calipers were purchased from eBay and had damaged internal anvils. That was of no consequence because they were going to be removed anyway. I selected a pair of Mitutoyo calipers because they have an extremely long battery life, unlike some of the cheaper alternatives.

The clamp was made from a piece of aluminium alloy bar which was chucked eccentrically in the four jaw chuck. This was faced off and the bore turned to size before parting off over size. The piece was then chucked in the three-jaw chuck and faced to length. The outside details were CNC machined while holding the piece to the table with a central bolt. The tapped holes and other features were added while holding the piece in the milling machine vice.

The tailstock was dismantled and a new peg was made that was closer fitting in the slot in the tailstock barrel. The slot had to be carefully dressed with a file to make it a good sliding fit. Alternatively, this could be done on a mill. Once the tailstock had been reassembled with the new scale clamp fitted to the nose, **photo 2**, the precise position of the scale could be determined. The scale must be aligned to the axis of the tailstock barrel so it doesn't bind.

The anvils of the digital scale must be drilled with a carbide drill because it's very hard. These drills are quite brittle, so be gentle and take your time. Use cutting lubricant to take the heat away. The whole assembly was taken to the milling machine,

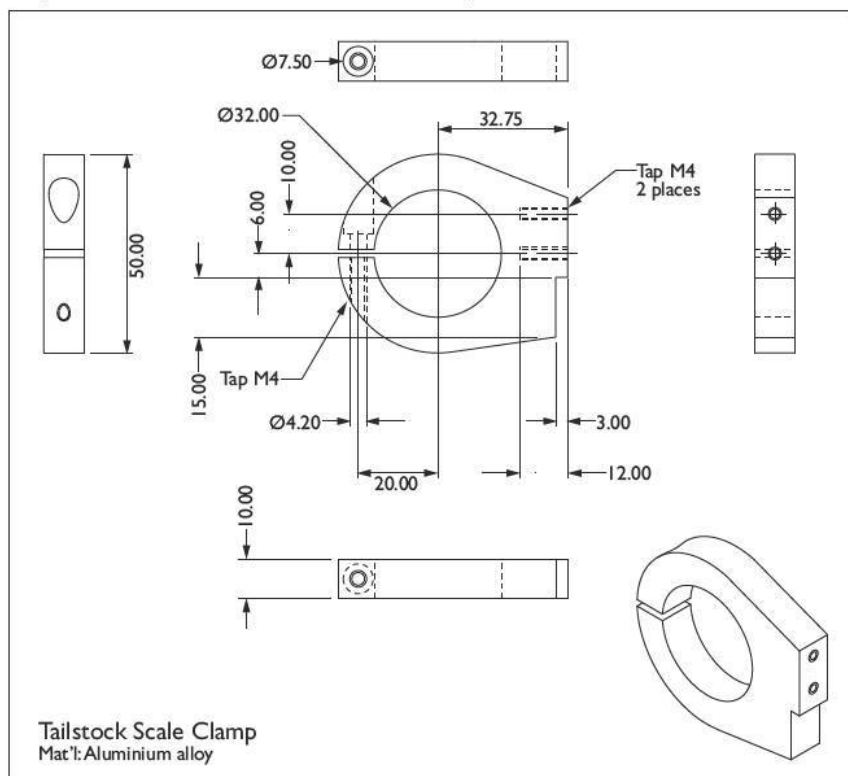
and the final hole attaching the lower anvil to the tailstock was drilled and tapped.

A small spacer was required to bridge the gap between the top of the tailstock and the anvil. You may need to spot face the top of the tailstock where the spacer sits. Once the assembly had been completed, the remaining parts of the anvils were removed using the off hand grinder. Don't let the scale get too hot when you do this. I ground two deep grooves, one each side of the place I wanted to make a cut, and

snapped the anvils off. These were then tidied up on the grinder. Be sure to round the edges on the grinder because these will be very sharp.

The aluminium clamp must only be held very gently on the nose of the tailstock barrel, else it will distort the taper. A little screw lock can be added to make sure it stays in place.

It took so little effort to make that I'm cross with myself for not doing this years ago, it's been so useful. ■



Unimat SL

Lathe Modification ^{Part 5}



Terry Gorin adds back gear to his Unimat lathe.

Fig. 20

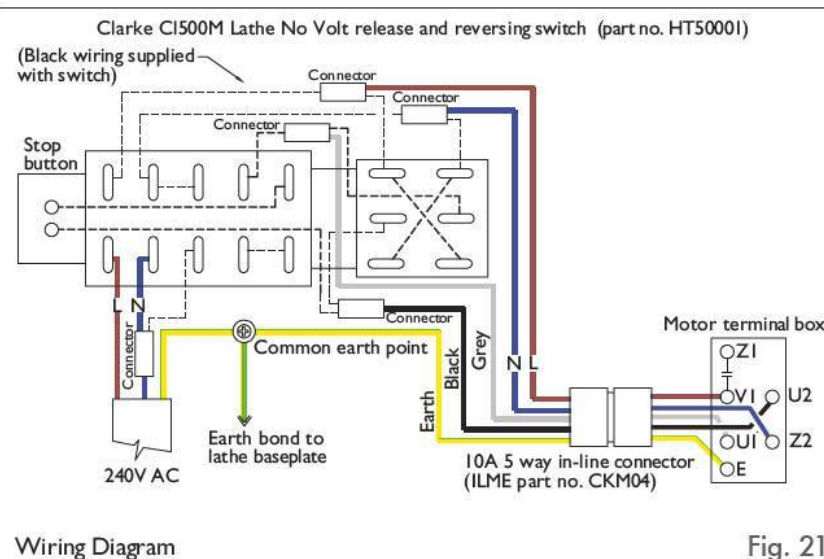
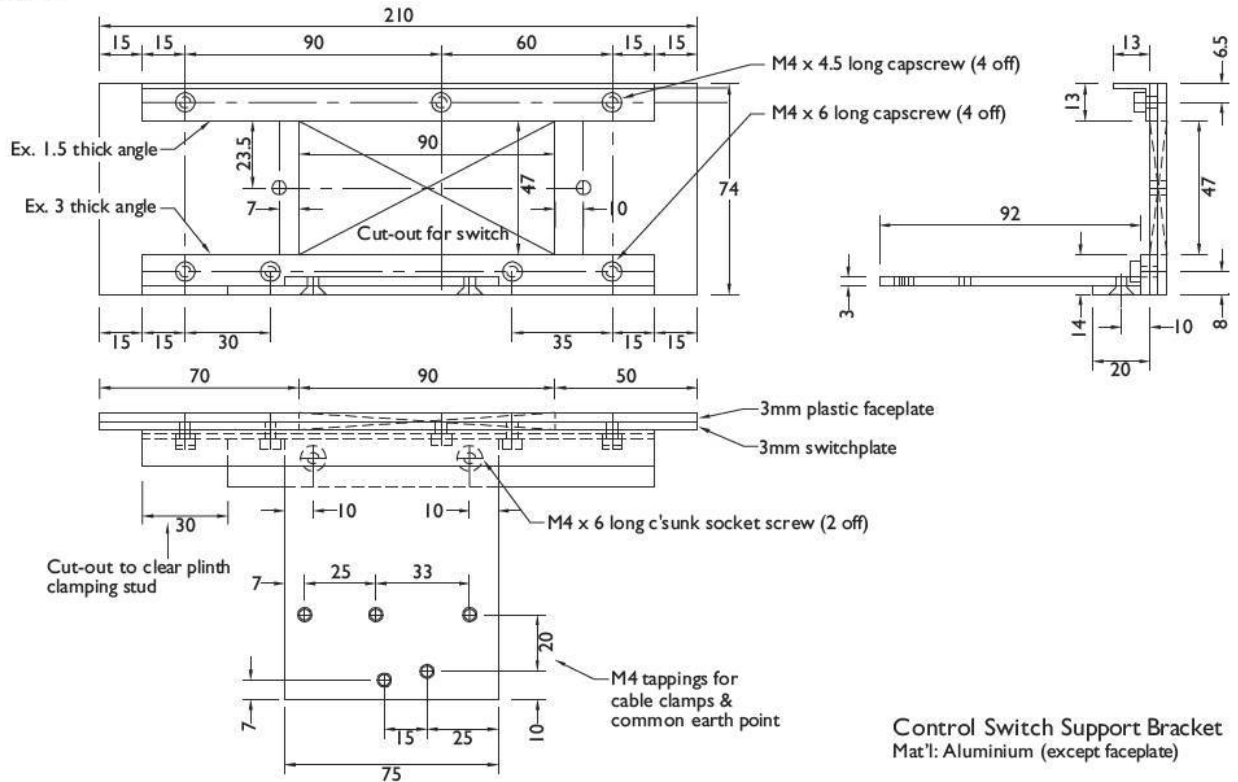
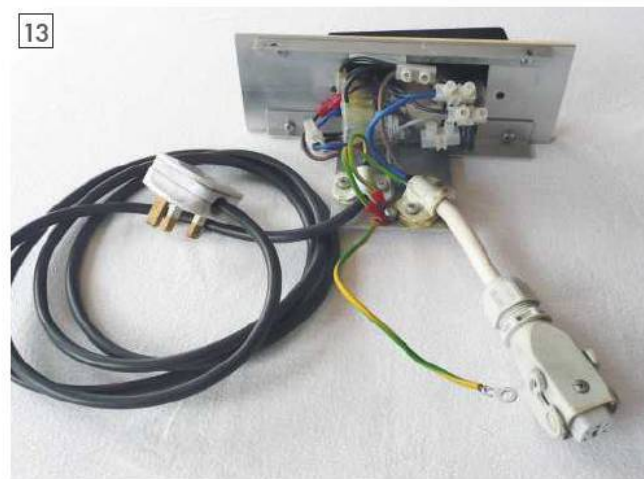
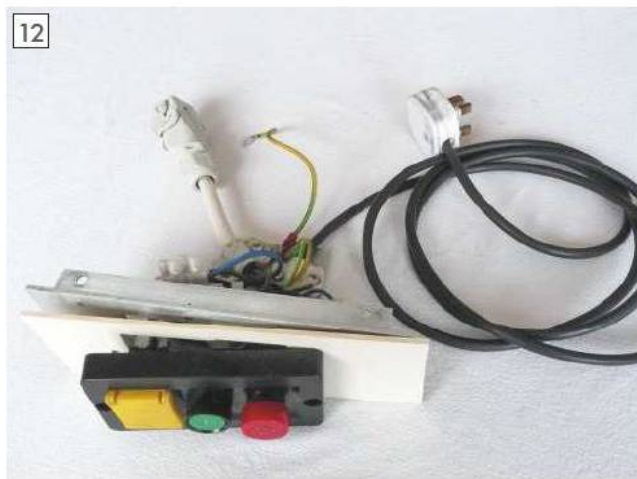
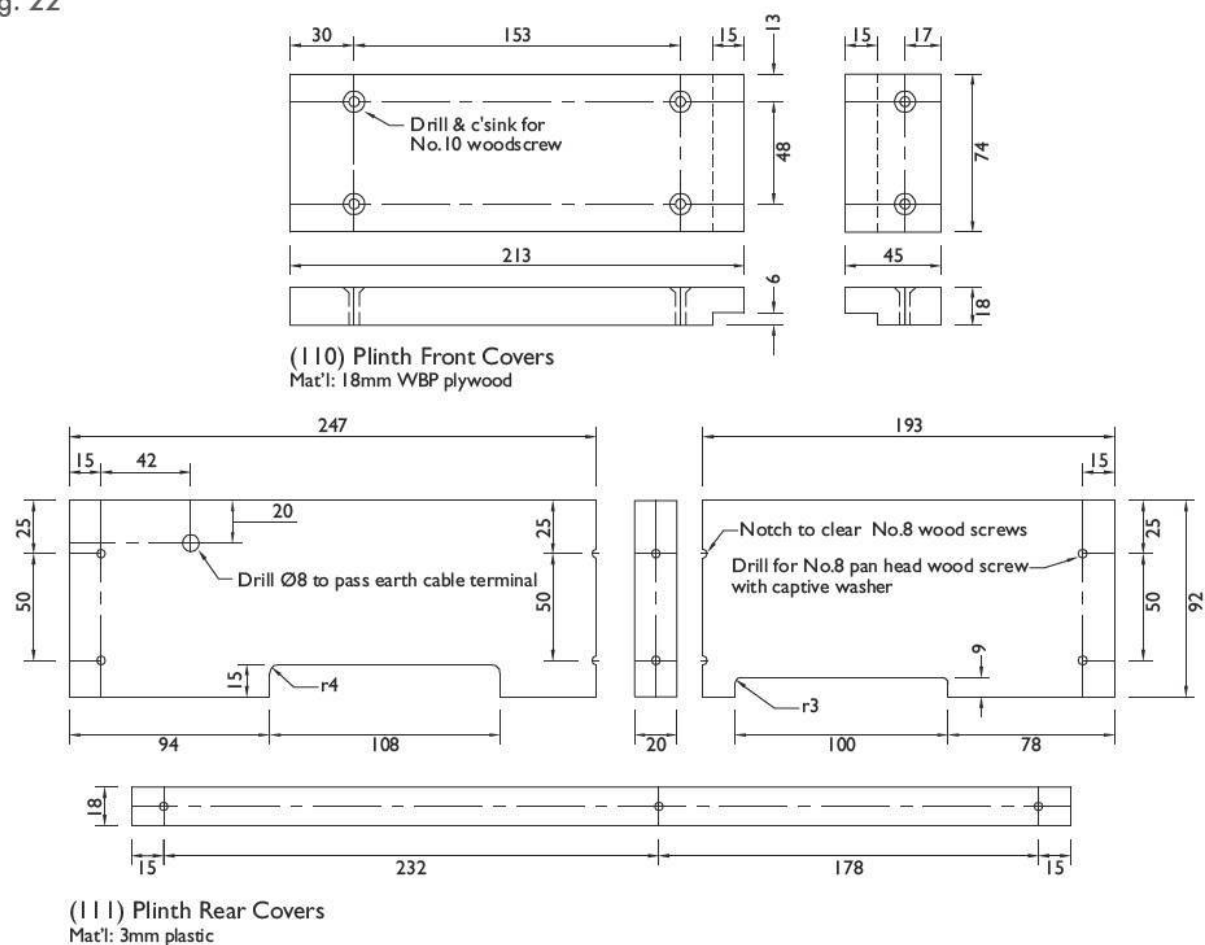


Fig. 21

Following on from my earlier articles, here are details of further improvements to my Unimat SL1000.

Most drilling and screw cutting operations called for on the drawings will be self-evident to readers more experienced than myself and I have only commented on the method and sequence of specific operations.

Fig. 22



Control Switch

The on-off reverse switch, for controlling the single-phase power unit, was chosen and purchased early in the design process. Sourcing a switch with rotary reversing action, my original preference, was proving difficult. The switch fitted to the Cowells lathe would have been expensive and not suitably rated and eventual choice was for the switch fitted to the Clarke CL500M lathe, available as a spare from

Clarke International (ref. 1), but fitted with a rocker switch for reversing. A 0.75 kW motor is fitted to this lathe and therefore the switch is more than adequately rated for the 0.25 kW motor, used for this modification, and not too large to fit within the lathe plinth. Reversing by rocker switch soon proved a non-problem. To enable the motor and countershaft assembly to be completely removed from the baseboard, a five-way inline cable

connector was sourced from ILME UK Limited (ref. 2) and inserted into the cable between switch and motor.

Switch Bracket and Assembly

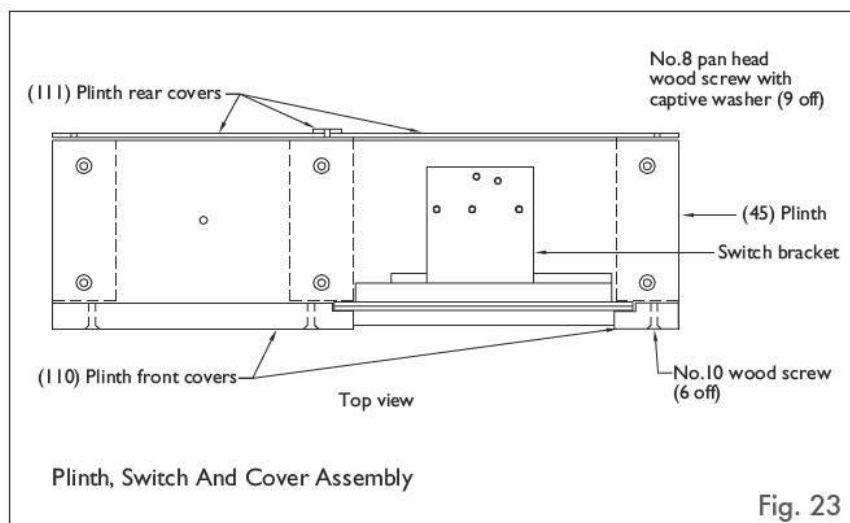
The bracket upon which the switch is mounted was assembled from scrap box oddments. The components and assembly of a bracket detailed in fig 20 would be a tidier version of the prototype fitted, but not likely to be replaced. Figure 21 is a

schematic wiring diagram of connections between switch and motor and **photos 12 and 13** show front and rear views of the switch and cables assembled to the bracket. Both photos indicate the main input cable and the switch end of the in-line cable connector. **Photograph 14** is a rear view of the assembly slid into its plinth slot. As with all electrical devices and wiring connections, great care must be taken to ensure electrical safety. All interfaces between the lathe baseplate, Unimat and modifications detailed in these articles are metal to metal; a flying earth lead is provided to bond to the lathe baseplate. **Figure 22** details front and rear plinth covers with **fig 23** and **photo 15** showing the front plywood covers screwed in place and retaining the switch assembly. **Photograph 16** is a rear view of the plinth, showing plastic plinth covers in place, with the earth bond connected to the lathe and baseplate and the main supply and switch to motor cables and motor sub-base pivot arm protruding through their designated slots. With the headstock, power unit and plinth and baseboard modules assembled (**photo 17**) attention was now turned to construction of the drive shafts and dog clutch.

To be continued...

REFERENCES

1. Clarke International
www.clarkeinternational.com
2. ILME UK Limited www.ilmeuk.co.uk

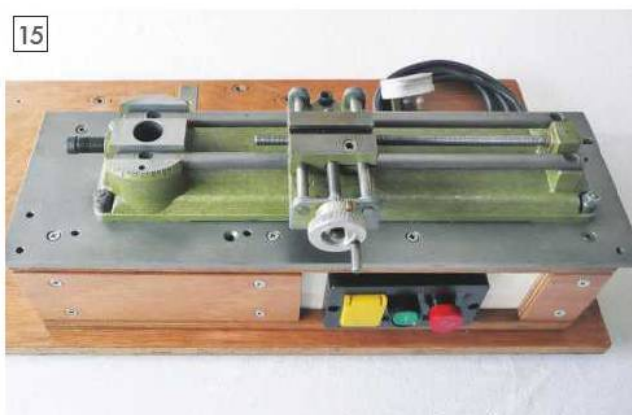


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A Boring Bar for Between Centres



The story of how Peter Shaw's 'MCI' Stores finally came good.

Recently, I had a requirement to bore out a 100mm long piece of tube to an internal diameter of 46mm. I considered mounting the work in the 4-jaw chuck and boring from both ends using a compound slide mounted tool, but thought that I may not be able to accurately match the two bores, so I decided to make a between centres boring bar and use that instead.



The finished boring bar in use on lathe.

When considering the required length of the boring bar, I realised that in order to allow the cutter to clear the work at each end, I would need a little over twice the length of the work - plus sufficient at the headstock end to allow for the driving dog to be attached. This suggested a minimum length of about 220mm. I then reasoned that if I was going to make this device, then why

wrapped in newspaper and placed in the Stores pending a suitable job.

Over the years I kept looking at this bar and then putting it back as I really did not want to cut it up and thus lose this long length, but this time when I got it out, I measured it - 502mm long by 22mm diameter. At last, a suitable project for it! But would it fit in the lathe? And more importantly, how was I going to centre

The column was a long length of solid steel which I thought Might Come In (MCI) some day. This bar was duly oiled, wrapped in newspaper and placed in the Stores pending a suitable job.

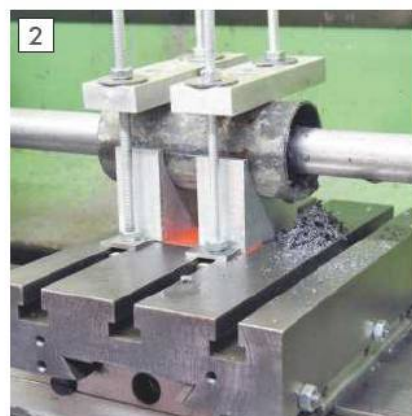
not make it the maximum length I could get into my lathe? As my lathe is specified as having a between centres distance of 500mm then a bar of this length would allow a maximum boring length of around 240mm. I also felt that a diameter of around 25mm would be satisfactory.

Around 17 years ago, I replaced my Black & Decker vertical drill stand with a proper DIY drill press. Most of the B&D stand was aluminium alloy and was duly scrapped, however, the column was a long length of solid steel which I thought Might Come In (MCI) some day. This bar was duly oiled,

drill the ends, given that my drill chuck and centre drill would take up 118mm of the available length between centres?

An initial try holding the bar between two centres showed that it would indeed fit without cutting. **Photograph 1** shows the successful end result, with **photo 2** showing a close-up of the device in operation.

As it happens, my headstock has a MT3 taper. By using the 4-jaw chuck and with the bar entered through the chuck and into the headstock as far as possible, I did indeed find that I had just enough room to centre drill the ends - provided that I



Close-up of the boring bar in use.

could manage with the tailstock overhanging the end of the bed (but see my Post-script). As the tailstock clamp was still over the bed, I decided that it was worthwhile carefully attempting to drill the bar end. This was successful.

Photographs 3 and 4 show respectively the bar setup for drilling and a close-up showing the slight gap available between the centre drill and the end of the bar and the amount of tailstock overhang.

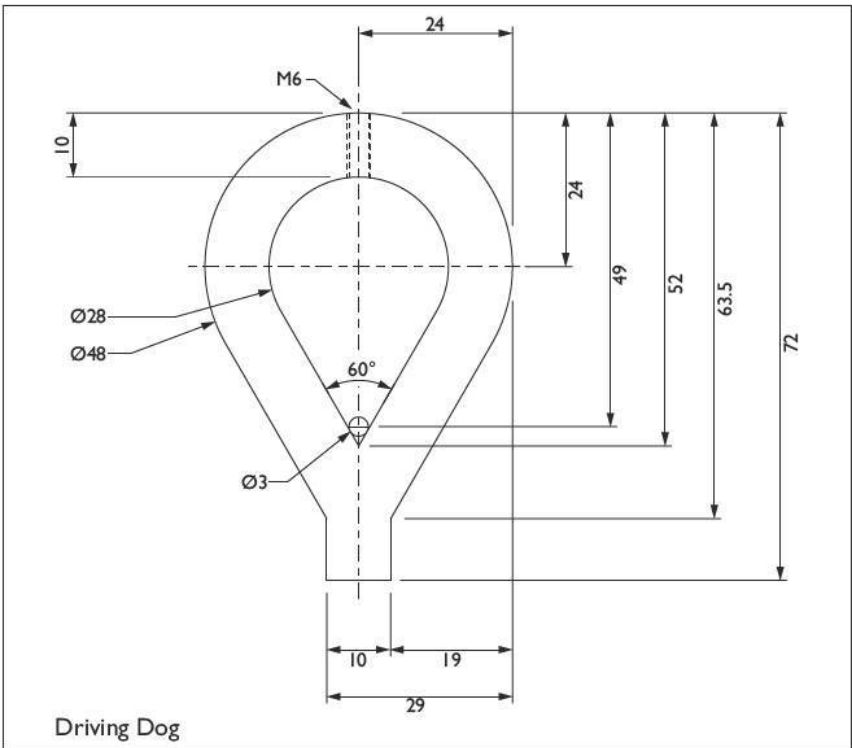
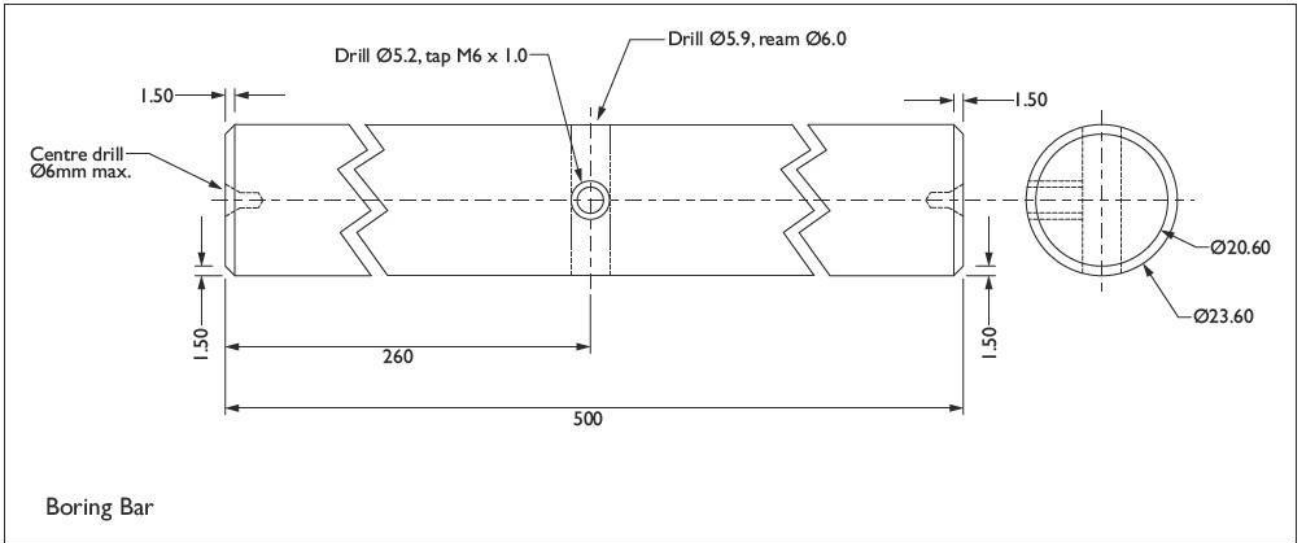
The cutting tool was yet another re-use, this time of an experimental tap made from silver steel. I softened the steel, turned it down to 6mm, filed up a cutting point and then rehardened and tempered to light straw. The bar was centred under the drill press using the age-old method of



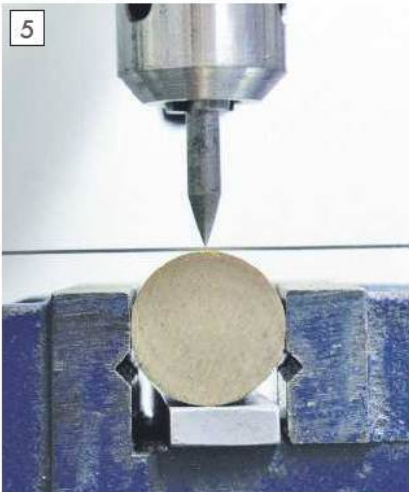
The set-up for centre drilling the ends of the bar.



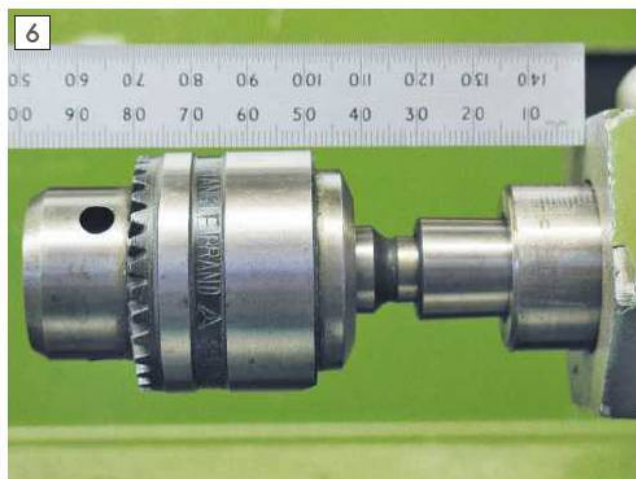
A close up of the centre drilling arrangement.



a balanced ruler with a point pressing down from the drill chuck. **Photograph 5** shows the method. Once centred, the vice was bolted down and then in turn a small end mill used to create a tiny flat, a centre drill to create a starting point for the normal drills which followed and created a through hole. Finally, the hole was reamed



Using a bar to align a drill with the centre of the bar.



The original chuck and tailstock set-up showing overhang.



The improved chuck and tailstock set-up after modifications.

6mm. A similar method was used to create a 6mm tapped hole at right angles to the cutter hole. I used a slotted cheese headed screw to lock the cutter in place, but ideally an Allen headed grub screw should be used.

The driving dog is also home-made, being nothing more than a piece of 10mm thick steel drilled, filed to shape, with a clamping screw fitted at the wide end and a circular extension fitted at the other end. This circular extension fits a slot cut in a piece of 12mm square bar which itself is bolted onto the driving plate normally used for mounting chucks. The parts are painted yellow to improve visibility and hence safety.

Post-script

Shortly after this job was done, I decided that an attempt should be made to reduce the drill chuck overhang on the lathe. Originally, my drill chuck was mounted on a MT1 arbor which was in turn inserted into a MT1-MT2 sleeve to enable it to fit my tailstock. This combination meant that the front face of the chuck was 99mm away from the front face of the tailstock casting, but worse was that the self-eject mechanism of the tailstock prevented the tailstock barrel from fully entering the tailstock before disengaging the MT2 sleeve. This caused the loss of around 9mm of tailstock travel, **photo 6**. I therefore bought a proper MT2 arbor and reduced

the tang. Using the proper arbor reduced the chuck front face distance to 85mm whilst reducing the tailstock travel loss to 7mm. Reducing the tang to the absolute minimum brought the distance between the chuck front face and the tailstock casting front face to 72mm, whilst the front face of the tailstock barrel now became slightly inside the tailstock casting. This gave me a further tailstock travel distance of approximately -6mm i.e. an overall gain of 15mm, **photo 7**. Together these modifications resulted in allowing the chuck to move nearer to the tailstock by 27mm, which, had I done this earlier, would have reduced the tailstock bed overhang on this project to less than 5mm. ■

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A Raising Block for the Warco VMC



Roger Vane's sturdy design could easily be modified to suit some other larger milling machines.

When I bought my Warco VMC milling machine my main concern was the lack of distance between the spindle nose and the table. On my particular machine this is just 12.5 inch, so when a tall vice and keyless chuck are in use with a large workpiece, things can become rather tedious. After 4 years of frustration the time had come to do something about the problem - hence the raising block.



The Raising Block fitted to the VMC Mill.

I decided that a 4 inch raising block would be ideal, but how should it be made? Although a casting would have been nice, the cost, time and effort required to make a pattern, have a casting made, then machine it bore no comparison to fabricating the raising block from solid bar stock.

With the Warco version of the VMC one of the locking nuts is inconveniently sited immediately behind the spindle housing. Even with a stubby spanner it was difficult to gain access without damaging the nuts and my knuckles. The raising

block, as designed, overcomes this problem as the spindle housing is now 4 inch higher, so conflict is avoided. On my machine, and I guess on many others, there is insufficient depth in the pocket to allow a ring spanner to be used - I resolved to make deeper pockets to overcome this particular problem.

The whole project was completed using my Myford S7 and the VMC itself and although I could have borrowed a much larger lathe, that would have involved a 40 mile round trip on each occasion that I needed to use it. Also, I wanted to prove that the job could be done using the Myford and VMC. For anyone wishing to follow my example and make a raising block for their Warco VMC, my machine was built towards the end of 2008, so any machine of a similar vintage should (hopefully) be machined to the same dimensions.

The raising block consists of three main components - a main block, a separate baseplate and a spigot all made from cast iron bar stock supplied by M-Machine (ref. 1). Pockets for the fastening nuts are machined into the bottom of the main block and the baseplate is bolted on to fully enclose the pocket. The main block and baseplate were made from material 160mm diameter so that I could finish

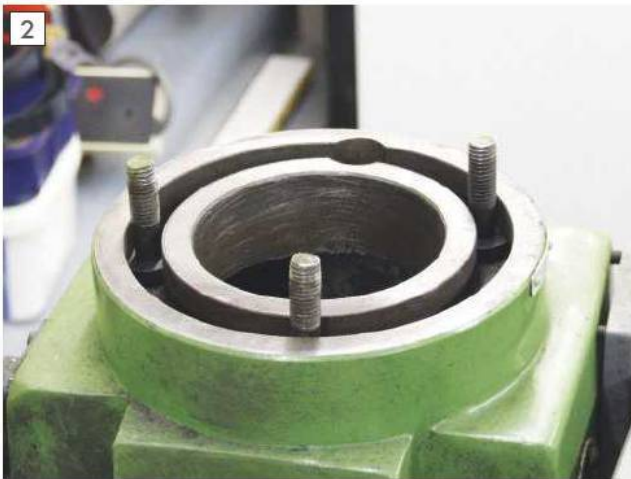
them at 150mm diameter. Had 150mm stock been oversize, then I would have considered using it, but even so there could be no guarantee that it would have cleaned-up all round, to avoid leaving an undesirable surface finish.

The only concession to making the raising block on the Myford is that I made the base plate thicker than the original on the VMC (an additional 7/16 inch) to limit the thickness of the main block to 3 inch. As the pricing policy used by M-Machine is to charge for a unit of 1 inch for any blank less than 1 inch thick, it also made economic sense. On the downside it meant that I would have to make new, longer tee-nuts. I had no problem with this, having had a larger tee-nut supplied with the machine shear-off when I was tightening it. I had no wish to remove the head yet again just to replace a tee-nut. Anyone making this raising block using a larger lathe could easily revise the dimensions to match the flange thickness to that of the original if they wished.

The operation sequence described below is 'process based' rather than based on making individual components and then bringing them together. There is a need to maintain the top and bottom faces of the raising block exactly parallel to one another. I devised a sequence of



The finished raising block - the angular scale would be fitted after assembly onto the machine.



The top of the column.



The underside of the turret.

operations to achieve this, given care and attention to detail. Unfortunately, I do not have access to a surface grinder, which would have made the whole process a bit more straightforward. Throughout the project I aimed for a close fit between components, as I was determined to eliminate all potential sources of movement and loss of rigidity with the finished raising block.

Before going any further, a few words about safety will not come amiss. As always, safety is paramount and with this project I was dealing with large lumps of material, which had they come adrift,

whether the point at which the tee-nuts are inserted into the radial slot would cause any problems over your normal range of rotating the head.

So, this is an account of how I did the job. I have gone into a quite a lot of detail, particularly regarding the initial turning stages, as the sequence in which the operations are carried out is all important if a satisfactory result is to be achieved using the Myford. Those with larger lathes should experience no difficulties. Hopefully this article will inspire others to have a go at improving the capacity of their VMC-style machines.

block and bolted up in the existing 'pockets' then two joints would be loose at the same time. I felt that this was not an ideal situation.

My approach certainly involves more work than a single 4 inch spacer, but I felt that it was worth the additional effort of machining pockets and rings of holes for capscrews - and of course I could complete the job on the Myford.

Measurements and materials

I needed to obtain some measurements prior to designing the raising block, so unfortunately the complete head had to be removed. I have added a few notes regarding this process towards the end of this article under 'Dismantling the machine'.

The major measurements required relate to the circular tee-slot and the spigot. Should anyone making this raising block feel that they can accept my dimensions as a guide, they could always leave the spigot and spigot bore dimensions with some machining allowance and then 'fine tune' these at the fitting stage. This is covered in a few notes under 'Fine tuning' at the end of this article. I have included a couple of photographs showing the top of the column, **photo 2** and the underside of the turret, **photo 3**.

Fig 1 shows the dimensions taken of the circular tee-slot in the top of the column, together with the spacing of the holes in the bottom of the turret.

My main concern at this stage was to establish whether the three holes in the flange were drilled at 120 degrees to each other, or was some other layout used? This would be no problem with the tee-nuts able to move in a circular slot, but of concern as the new studs at the top of the raising block would be fixed in position - I had no great desire to machine another circular tee-slot just to overcome any problems. I checked the hole centres with a digital caliper, measuring between the closest points on two adjacent holes and then adding one hole diameter (2 x radius) to establish centre distance. On the basis of measurements taken, the holes on my machine were not quite equally spaced at 120 degrees, but showed a slight variation to a maximum of about half a degree. Given the fact that my machine

When holding the 160mm diameter blanks the chuck jaws actually pass through the gap in the bed, so the 6 inch 4-jaw chuck used to hold the large blanks MUST be of the threaded body type which has less overhang than the standard backplate mounted variety.

could have inflicted serious damage on operator and equipment. Certain precautions were therefore taken and these will be mentioned in due course.

There is one further consideration before moving on and that is I have stated that the job can be done on the Myford - and yes it can. When holding the 160mm diameter blanks the chuck jaws actually pass through the gap in the bed, so the 6 inch 4-jaw chuck used to hold the large blanks MUST be of the threaded body type which has less overhang than the standard backplate mounted variety. Even with this style of chuck there is only 1/4 inch of clearance between the front of the jaws and the left-hand end of the bed.

I am sure that the same approach could be taken with similar machines such as the Chester 626 and the Myford VMC, although I understand that the Myford version only has two studs holding the head in position. In this case only two pockets would be required, unless of course you decided to 'upgrade' to a three stud fixing at the moving joint. If you were to do this you would need to check

Why did I take this approach?

It might also be helpful to anyone else contemplating this conversion if I said something about why I decided to make the raising block from a 3 inch blank bolted to a 1 inch blank, rather than a single 4 inch blank with holes drilled all the way through for longer studs.

There were a number of reasons for this. Firstly and probably most importantly, I wanted to try to machine the block on my Myford S7. Machining a block of material 3 inch thick would pose enough problems and I believe that it would probably not have been possible to use the Myford to machine a block that was 4 inch thick - bearing in mind that the material used started life at 160mm in diameter.

Secondly, I had doubts as to my ability to drill straight 'stud holes' 4 inch long, given the equipment and tooling available - the longest holes required with this approach are around 2 1/2 inch long, for holding the main block down onto the rotary table.

Also, with this approach there is only a single joint moving when the head is rotated away from its normal position. If long studs were passed right through the

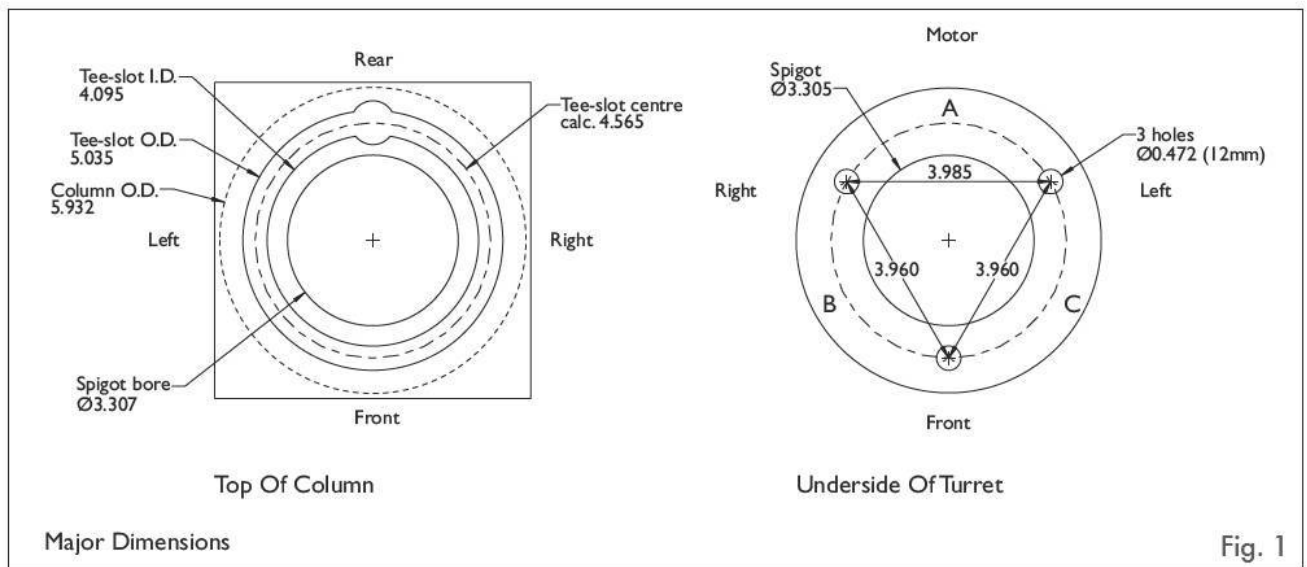


Fig. 1

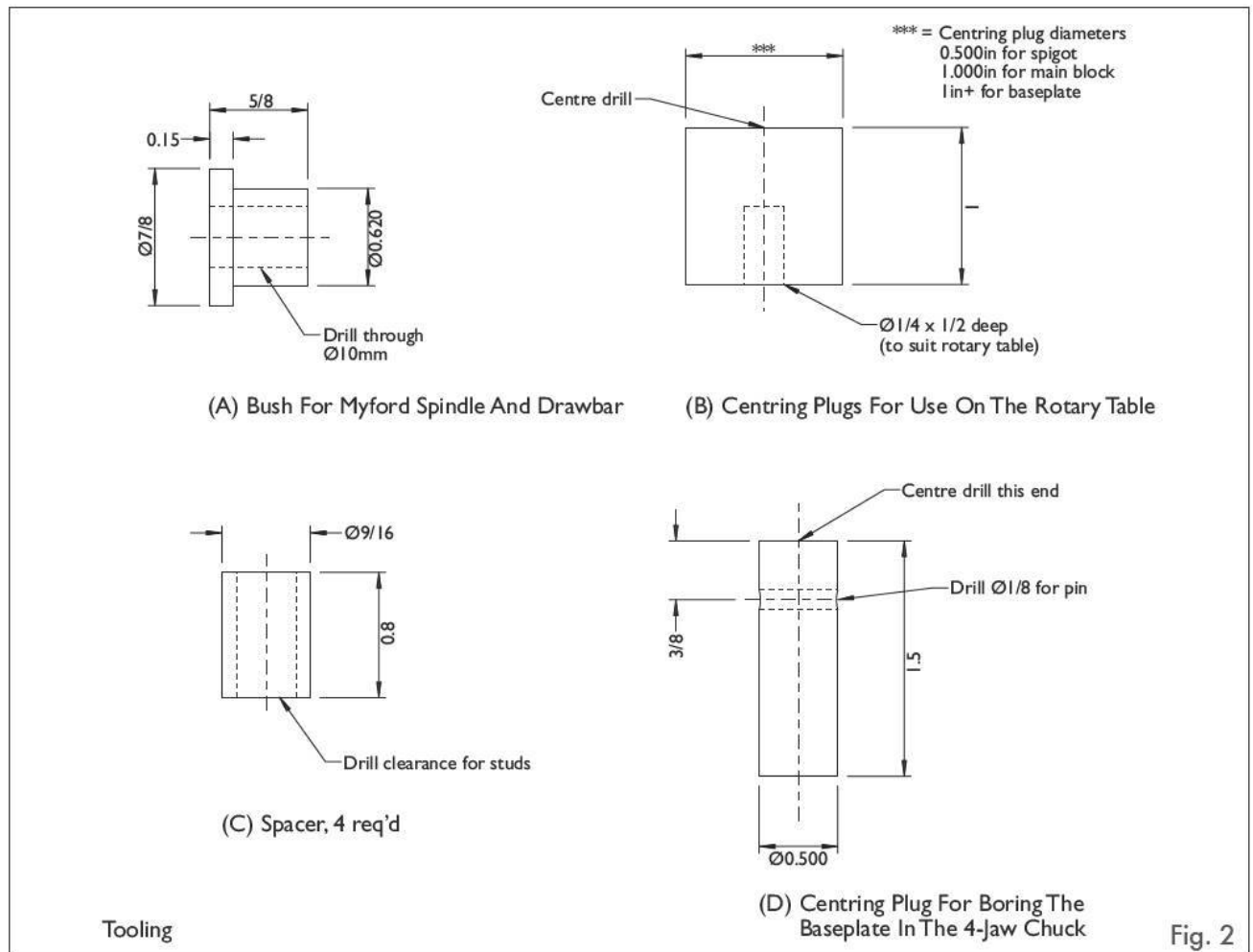


Fig. 2

was fitted with M10 studs in 12mm holes I was quite happy to assume 120 degrees between the fixing studs.

Taking direct measurements of the tee-slots, I found that the centreline PCD for the tee-slot worked out at 4.565 inch, which I took to be an intended dimension of $4\frac{1}{2}$ inch.

Other dimensions taken were spigot diameter and height, which in my case

were 3.305 inch and 0.55 inch respectively. I also measured the tee-slot, tee-nuts and pocket details, all of which were used to produce the appropriate drawings. For the pockets I used the dimensions taken purely as a guide since I redesigned these to be slightly deeper to enable a ring spanner to fit more easily and to be able to use available cutters to produce the large radius.

As for the material requirements, it came down to personal preference and material availability. I used cast iron bar Grade 17, which I understand is now more correctly known as Grade 250. This was lovely material to machine and certainly my sample had no hard spots that I was aware of, even in the skin. The only problem that I had with this material was that, being rather 'soft', tapping holes dry resulted in threads



The starting point - 36 lbs of cast iron.

that could be rather 'slack' compared with say, those in mild steel. However, any potential difficulties were overcome by using a tapping compound and tapping the holes rather deeper than usual. I also used a thread-locking compound to secure the threads on assembly.

I used 160mm diameter blanks for the main block and baseplate (3 inch long and 1 inch long respectively) and a piece 100mm diameter (1 inch long) for the spigot, although 90mm diameter would have been acceptable. Out of interest I weighed the blanks before starting work and found the combined weight to be 36lbs - see photo 4.

Tooling

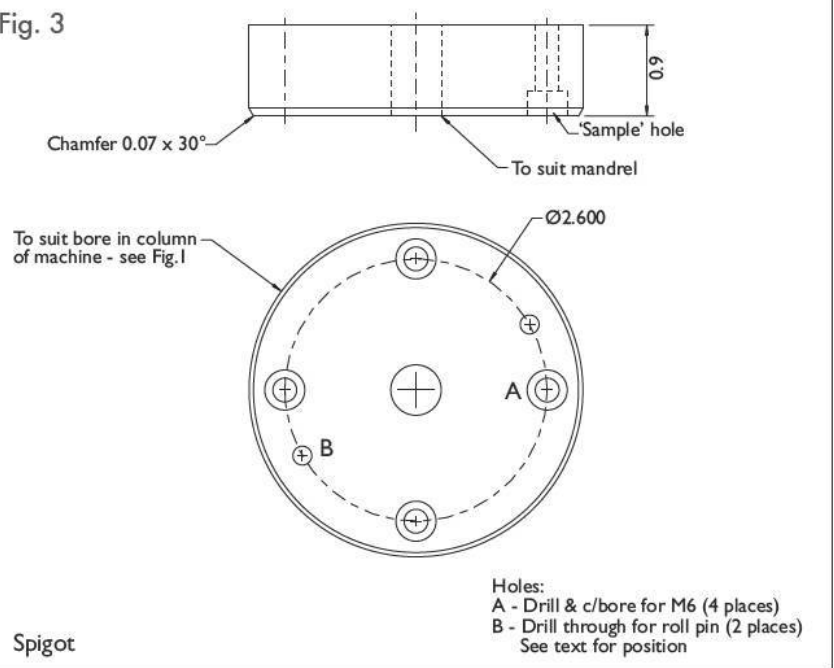
This raising block had been designed to make use of a 1 inch diameter mandrel during the manufacturing process. Correctly known as a 'long milling arbor', it was made by Arrand Engineering, has a number 2 Morse taper at one end and came complete with a number of spacers. It was designed primarily to hold slitting saws and similar cutters. Any substantial mandrel made to your own specifications would be suitable providing the central hole in the main block is machined to suit.

The centre bore in the main block should be made a close sliding fit on the mandrel, whereas the bore in the baseplate should be slightly larger to avoid the possibility of the assembly locking onto the mandrel as the capscrews holding the two parts together are tightened. Yes - I found that out the hard way.

Other simple tooling can be easily made and consists of mainly turned items, some of which are shown in fig 2. They are:

- A bush for the rear of the Myford spindle, required to locate the drawbar central to the spindle bore (fig 2a).
- Centring plugs for use with the rotary table when machining the three components - these have 1/4 inch holes in their bases for a pin that locates in the central hole in my rotary table. The centring plug for the baseplate was made slightly larger than the nominal 1 inch diameter (fig 2b).
- Spacers to fit over the studs within the recess at the top of the main block to hold it down to the rotary table - a small flat may be required on the side of these to clear the spigot bore (fig 2c).
- A centring plug for use with a wobble pin when centring the baseplate in the 4-jaw chuck (fig 2d).
- A plug gauge for use when boring the centre hole through the main block (which had to be a good fit on the mandrel) - I used an odd end of 1 inch diameter silver steel.

Fig. 3



- As the centre hole in the baseplate would be slightly larger I used the centring plug as a plug gauge.
- A length of M10 threaded rod (and nuts) to serve as a drawbar.

In addition to this I have a bedstop, which was invaluable when machining the large diameters on the main block and baseplate, as I wanted to avoid hitting the front of the saddle.

Lathe work

Before starting the description of how I tackled the job it is worth mentioning the red pen marks that you will see from time to time - they mean that this feature is finished, at least for the present and is not to be touched again. Just a small step towards ensuring that the work is not scrapped, which would involve some very expensive material in this case.

I started off by machining the round components all over and also added recesses and through bores as appropriate. The sequence detailed below may seem a little disjointed at times, but it was planned that way to make the best use of the set-ups. It was also 'building-in' accuracy for the future assembly of the main block and baseplate; bearing in mind that both top and bottom faces of the finished assembly needed to be parallel to one another.

The spigot

The first item to be produced was the spigot, which was a nice simple turning job just to get me in the mood. The spigot is shown in fig 3.

I faced both ends, reduced the outside diameter to something just above the measured dimension and then drilled and reamed a 1/2 inch hole to fit onto one of my standard mandrels. There was nothing special about the mandrel size, so any good-sized mandrel that you happen to have to hand would be suitable.

I had measured the bore in the column with a digital caliper (which is not as

accurate as a micrometer). I therefore decided that the use of the mandrel would allow me to check the actual fit of the spigot in the top of the column, then replace it accurately in the lathe as required to achieve the finished diameter - this would be carried out at the final assembly stage.

Luckily I have a 3-4 inch micrometer, so was able to measure the spigot on the turret quite accurately. I then skimmed the very end of the new spigot down to this dimension for use as a plug gauge when boring the recess in the main block.

Although the spigot on my VMC turret is only 0.55 inch high, I could see no reason for reducing my new spigot to this thickness as it fits into a through bored hole in the top of the column and so I left it at 0.9 inch thick.

The main block

This is where things became quite scary, initially at least. The main block is a hefty lump of cast iron and the utmost care was required in turning it. In view of this, before doing anything else I drilled and tapped an M10 hole in the centre of the block - this hole was around 1/2 inch deep and located a length of threaded rod which acted as a drawbar. This can be seen fitted in photo 5, which also shows



The 'drawbar' fitted to the main block, shown together with the reducing bush.

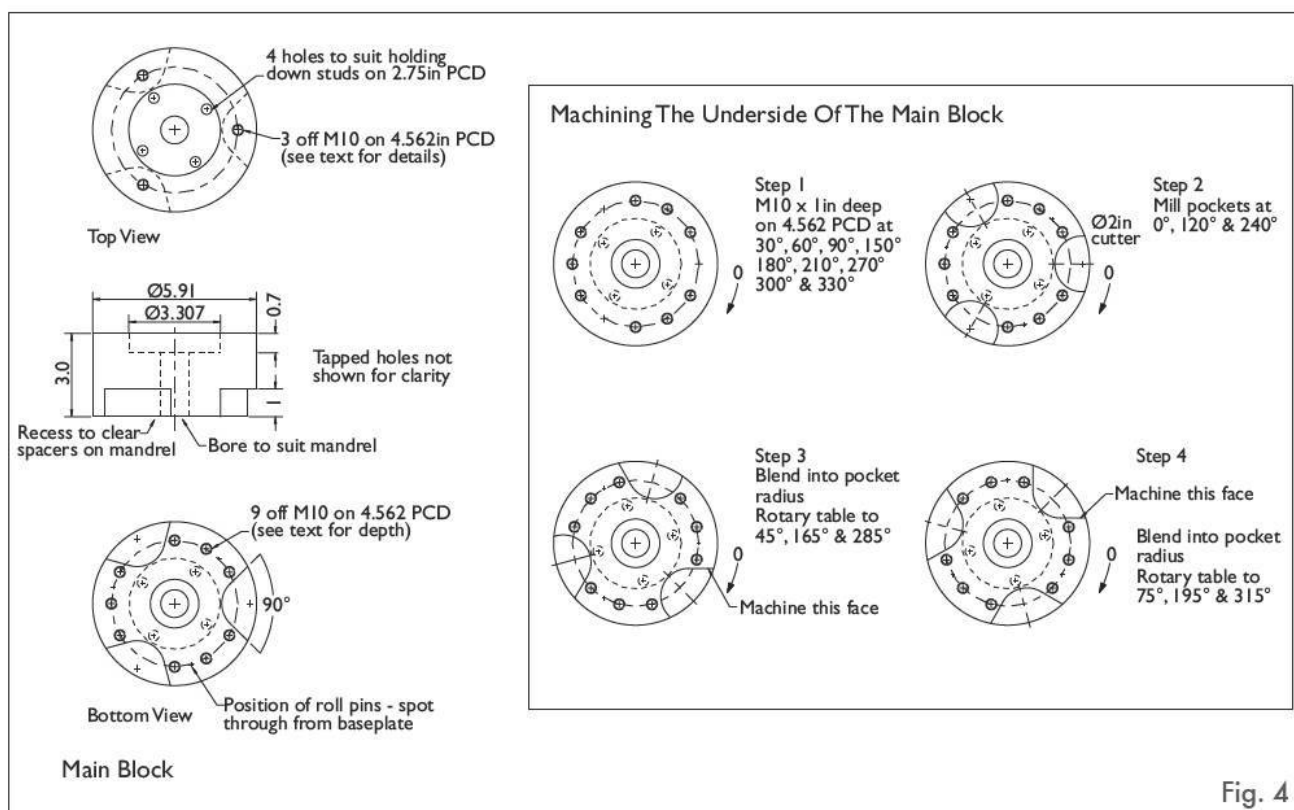


Fig. 4



View at the rear of the Myford spindle showing the reducing bush, M10 stud and nut used to secure the main block blank.



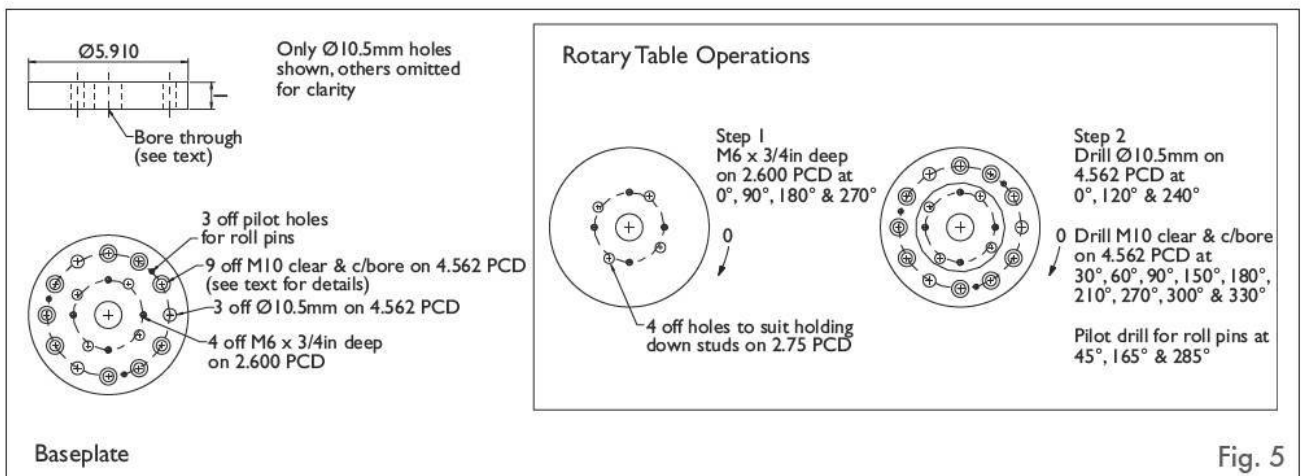
Turning the main block to finished diameter using a left-handed tool. Note the tailstock centre is in use as an additional security measure.



Confidence is increasing - turning a longer second section of the outside diameter.



The first face has now been completed - this is the face in which the pockets will be milled.



the bushing to be fitted into the rear end of the spindle. The drawbar itself was 1½ inch long (for the Myford), which allowed for the addition of a couple of nuts to act as locknuts. The main block is shown in **fig 4**, which also shows details of the later drilling and milling operations. Please note that I have not shown the hidden holes in the side view in the interests of clarity.

The block was then fitted into the 4-jaw chuck with the drawbar passed through the spindle and bushing and fitted with a couple of nuts, as seen in **photo 6**. At the same time the 4-jaw was set to run as truly as possible - while all of this was happening I placed a piece of this plywood under the work to protect the bed, just in case of accidents.

Before doing anything else, I centre drilled the block so that a tailstock centre could be used to provide additional 'support' (peace of mind really) just in the unlikely case that the drawbar came loose.

I then faced the block almost up to the centre - as the design calls for a 1¼ inch recess in the centre at this end of the block facing to the exact centre was unimportant. The recess is for the spacers on the mandrel used for final facing of the main block at the final assembly stage - my spacers are 1½ inch diameter so the recess diameter allows the tool to move into 'fresh air'.

Now to machine the outside of the block - this is where I needed to take care, as at 160mm diameter, the block was too large to fit over the front of the saddle. Having a bedstop proved to be of great benefit in stopping the front of the saddle colliding with the block. Initially, I was understandably a little nervous as this was the largest and certainly the heaviest job that I had tackled on the Myford, so light cuts with a small extension of the topslide were the order of the day. As can be seen in **photo 7**, I used a left-hand tool fitted in the 'boring position' and machined back just enough that the reduced diameter would now pass over the front of the saddle. Confidence was growing, so I now extended the topslide and allowed the segment already machined to pass over the front of the saddle. The resulting extended cut is shown in **photo 8**, with work in progress to turn as far as possible to the finished diameter of 5.91 inch (150mm).

That done, the recess for the spacers was machined and another M10 thread tapped as shown in **photo 9**, ready for the drawbar when the block was turned round

to machine the other end. The rather illegible writing shows that this was to be the 'pocket face' which is the face between this block and the baseplate.

The block could now be removed from the chuck and a sigh of relief allowed as the Myford appeared to be coping well with this large, heavy lump of cast iron. By slackening two adjacent jaws the main block was removed and the 4-jaw could be used to hold the baseplate without any further adjustment, so I decided to use the set-up to advantage and carry on by machining the baseplate.

For information, the machine had the belts set to give a spindle speed of 200 rpm, but with the inverter drive adjusted down to give around 100 rpm for turning the diameter and up to around 230 rpm for facing as the cut moved towards the centre. Initially the cut was interrupted, so the depth of cut was limited to 10 thou, increasing to 15 thou as conditions allowed. Inserted tip tools were used for all of the turning and boring operations without any problems.

The baseplate

The baseplate was essentially just more of the same, although not as scary as with the main block and so I did not feel the need to use the drawbar. Details of the baseplate are shown in **fig 5**.

Again, I used a centre drill and provided tailstock 'support' before either facing or machining the diameter - the tailstock

centre would have stopped the baseplate from coming out of the chuck should anything go wrong.

The next operations were to face towards the centre and then turn the outside diameter back as far as possible, making sure that I avoided hitting the front of the saddle. I decided to leave this diameter slightly up on the finished dimension so that I could blend it into the main block at the final assembly stage. Following this I drilled and reamed a ½ inch diameter hole through the centre of the baseplate.

The baseplate was then reversed in the 4-jaw and the ½ inch centralising plug used to help set it to run true, as shown in **photo 10**. Note the cross-pin which stopped the plug from disappearing through the hole - the use of the pin avoided machining a shoulder on a larger piece of material.

Next on the agenda was to face the other end of the blank and then turn the outside diameter to blend in, although the exact blend was not too important as this diameter was to be skimmed at the final assembly stage.

One last operation before removing the baseplate from the chuck was to open up the bore to suit the centring plug for the rotary table (described earlier).

The baseplate was removed from the chuck, again by releasing two adjacent jaws to assist when mounting the main block, which was then being returned to machine the second end.

To be continued...



REFERENCE

1. M-Machine
www.m-machine-metals.co.uk

Using the centralising plug to centralise the baseplate prior to machining the second face.

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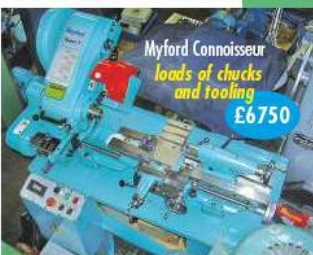
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