No.239

SPECIAL ISSUE

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On the Editor's Bench

This month's issue of Model Engineers' Workshop is a bit of an experiment. Every article this month is wholly self-contained, with a particular bias towards articles that describe items that you can make in your workshop and useful techniques and ideas. I must apologise to those contributors who made an effort to get me articles for this issue that we just weren't able to include. I will endeavour to use these over the coming months so expect plenty more articles covering small builds and workshop techniques.

I hope there's something here to interest every reader, whether experienced in the shop or a raw beginner.

MEX 2016 at Brooklands

I hope you are as excited as I am at the prospect of the next MEX happening at the Brooklands Museum. This issue contains an entry form for MEX 2016, together with all the rules and guidance. Please can I assure prospective entrants that machine tools will be more than welcome! If you have made a tool to a design in *MEW* – at any time over the last twenty-five years – why not enter it? If you don't want to enter a competition class, please consider making a loan entry –new entrants to the hobby are always encouraged and fascinated to see the sort of devices made by 'ordinary' hobbyists!

Chester Lathe Winner

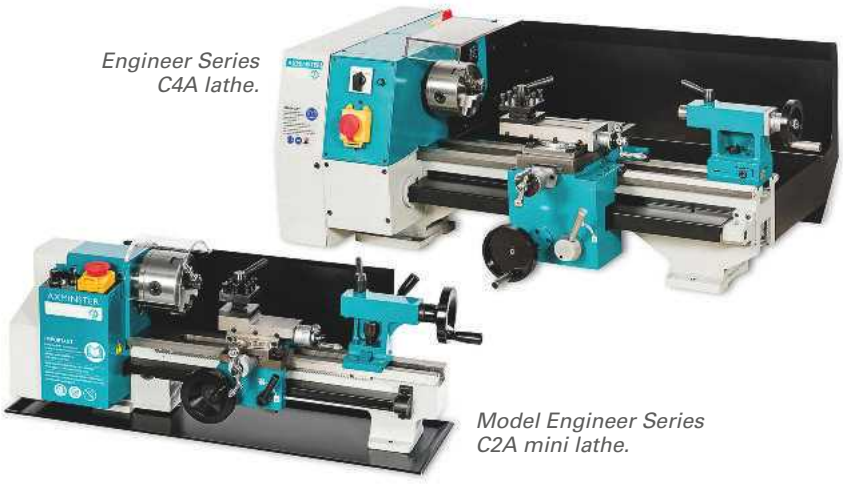
I'm pleased to announce that the winner of our recent competition to win a Conquest Lathe was Dale Smith from Warminster in Wiltshire. He's sent us this photo of his new pride and joy at home in his workshop.

NEW ENGINEER SERIES LATHES FROM AXMINSTER

Axminster have recently announced two new additions to their 'engineer series'. The C2A is a well specified mini-lathe they describe as 'an excellent choice for someone entering the world of model engineering'. It has a 250W reversible motor with variable speed. The C4A is a somewhat larger lathe with six-speed belt drive and an 550W induction motor, making it very quiet running.

The C2A retails at £499.96 and the C4 is £899.96. Both lathes come with an Axminster 3 year warranty, and more details can be found at www.axminster.co.uk

For more information please visit axminster.co.uk or call 0800 371822.



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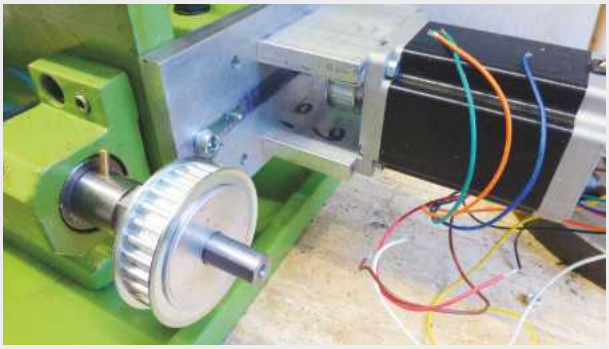
Contents

This month MEW is bulging with things to make and do!

Coming up...

in the April issue

IF YOU ENJOY THIS ISSUE, LOOK OUT FOR THE APRIL EDITION, PACKED FULL OF MORE TOOLS AND TECHNIQUES:



Chris Gabel details an electronic leadscrew controller for his lathe, Bob Rodgerson recounts the first eighteen months with his Tormach CNC Mill, Albert Bishop modifies a vintage cast iron stand to suit a Myford Super 7 and David Piddington offers advice to beginners on using a mill to cut exact lengths.

Regulars

ON THE COVER

Ken Hall's unusual Grimston Mill was in urgent need of protection!

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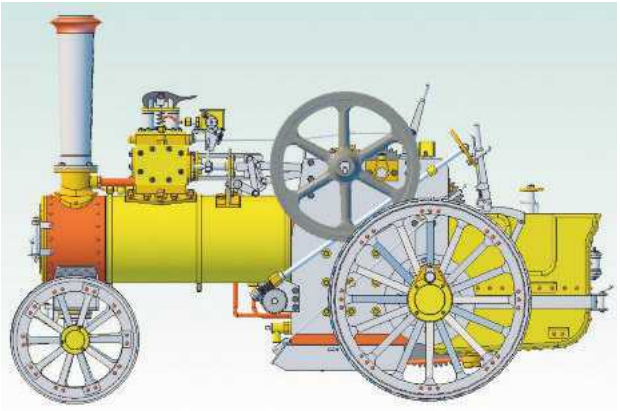
3D CAD Model of a Traction Engine

Following the considerable interest in a 3D model of X3 belt drive, David Thomas has offered us his 3D model of Len Mason's Minnie traction engine design.

You can view the model here:

http://www.model-engineer.co.uk/sites/7/documents/Minnie.pdf



Other hot topics on the forum include:

- **Supercharged V12 2 Stroke**
  They said it couldn't be done...
- **Stirling Engines**
  A lot of hot air...?

AND:

- **Recommendations for workshop Vacuum Cleaners**
  It's time to clean up.

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

A Spring Centre

Ken Jones offers an 'it'll do' version for MT2 lathes.

1 *The original spring centre.*

I have heard it said that an unfortunate employee of Mr Rolls and Mr Royce was heard to say 'it will do' about a component that he had made and was immediately sacked by Mr Rolls (or perhaps Mr Royce) because their motto was 'nothing but perfection will do'. Well, RR certainly made some wonderful cars but their perfection put them well out of the way of the average man in the street.

The spring centre designed by Darren Conway in issue 230 of *MEW* would, I think, get him a commendation from RR for his insistence on precision. I have for some time now been aware that I need a replacement for the primitive version that I have been using since 2006 (**photo 1**) so I was keen to make an MT2 size for my Myford. After reading through his article a couple of times I felt that I could tackle the project using some of the materials laying around the workshop but at the same time I was well aware that a precision device might not be the ultimate result.

I started by considering what the maximum diameter of hole that I could get down an MT2 taper would be so I prepared a CAD drawing of the MT2 angles to scale and decided that 10mm would be okay (**fig. 1**) which was lucky because I knew that I had a 10mm reamer available (more of this later). While I had the CAD on the on the screen I sketched out the other requirements such as the proportions of the spindle centre and the end cap and, having decided that the project was possible I set about searching for materials.

The first item to locate was of course the MT2 taper. I knew that these could be salvaged from old machine drills and quickly found a suitable example donated to me ages ago by a late uncle, it was clearly the stub end of a long since broken drill and unlikely to be of any further use as a drill, the MT2 section had got a bit bruised over the years but it locked in the tail stock quite well so I felt it could be used for my proposed spring centre. The taper end of these drills is not hardened so by carefully locating the transition point between the hard drill and the soft taper it is possible to saw the taper off, but at this

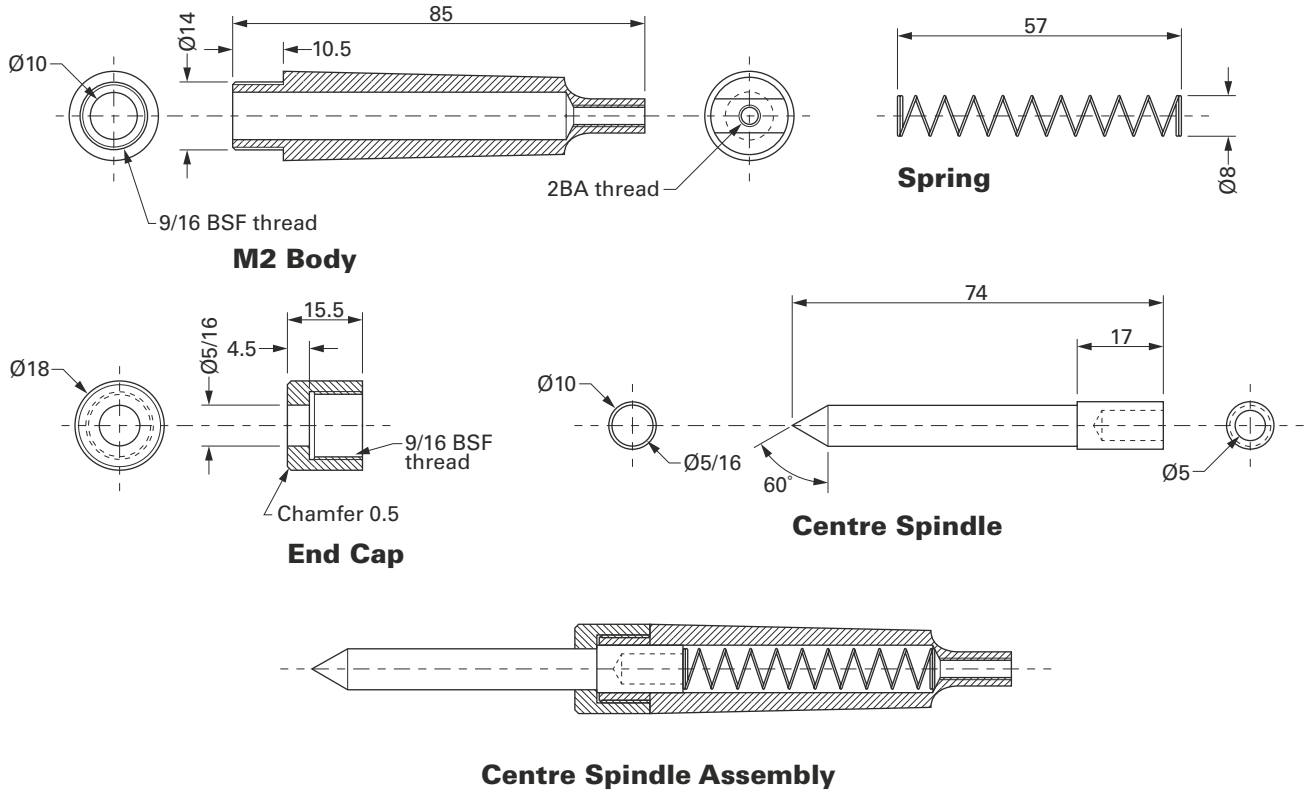


Fig. 1

point I had a flash of inspiration as it occurred to me that I would have to lock the taper in the head stock and I would need some form of draw bar arrangement, -- maybe I should sort this out before cutting off the taper.

The tang on the end of the taper would dictate the maximum diameter of thread that could be used on the drawbar end and this turned out to be 2BA, so by gripping the stub end of the drill in the 3 jaw and using the existing centre drill location in the tang I drilled and tapped the end 2BA. It was a little difficult to get the point running true but I finally got it nearly right so the 'it'll do' policy was put into action and a suitable tapped hole was produced. A length of ¼ inch diameter mild steel rod was quickly turned with a 2BA thread at one end and ¼ inch BSF at the other, a top hat shaped plug for the mandrel end finished the job off and I had a draw bar (**photo 2**). After some careful cleaning of the lathe mandrel to remove swarf etc. I was able to pull up my drill stub onto the lathe and was now ready to cut off the drill end. The actual transition point of the two types of metal was marked by a ring of colour so it was clear where to cut and after placing a suitable block of wood to protect the lathe bed the drill end was duly sawn off (**photo 3**). The sawn end was faced off and centre drilled and preparation made to drill and ream to 10mm.

My CAD sketch was prepared without being sure of the actual length of taper that would become available so I was not sure just how deep a 10mm hole I could produce but I realised that as I was dealing with a Morse taper directly in the headstock I could remove it and replace it and be quite certain that I would still be central, so I was able to measure the part and decide just how deep to go. In fact, I drilled right down until it broke into the recently prepared 2BA hole and the drill tips just touched the flat parts of the tang. This idea has the added advantage of allowing air to escape through the MT2 stock thus avoiding the pressure problem noted by Darren. The 10mm reamer was now applied and pushed right to the bottom of the hole.

I decided my next move would be to locate a suitable material from which to prepare the spindle centre. Many years ago I had retrieved some ground steel bars from a scrap bin somewhere, about 5 inches long and with a diameter of 9.98mm but of an unknown material (sorry about the relaxed mixing of imperial and metric dimensions but I can easily work in

The draw bar assembly.

The original drill stub.

both). After a short search I located one of these and tried it in my newly reamed hole, I was a little disappointed to find that it would not go right to the bottom as I had hoped, clearly my reamer is a hand reamer, (tapered) not a machine reamer. I know that Darren Conway had a similar problem and accepted it as a spring space but I had hoped to get a little more movement than I now had. I considered ways of easing away this taper and experimented with a wooden lapping mandrel (**photo 4**). I think it worked a bit and I might have gained another ¼ inch of depth but I was conscious that I might also be enlarging my 10mm reamed hole so I did not try for a full depth. Any way, the resulting bored taper was knocked out of the lathe mandrel and I was ready for the next stage.

Returning to my CAD sketch, the next component to be considered would be the end cap. I located a piece of steel from the odds and ends box, not sure what the material specification was but it could have been part of an old Ford drive shaft which I had saved many years ago (**photo 5**) dimensions were big enough to match my sketched version of the cap so the material was put in the 3 jaw and faced up true. On the MT2 taper, the diameters between the largest end of the taper and the 10mm hole suggested a suitable thread of 9/16 inch BSF, which is 16 TPI. On reflection I might have been wiser to select a nonstandard size with a TPI of 20 as Darren used but that would have meant some calculation of root size etc. so I stuck to my plan as all the important dimensions were available in my thread tables. I drilled and opened out the hole to the previously mentioned 9/16 inch BSF root size but I took note of Darren's comments and refrained from drilling out the centre hole until the cap was threaded and screwed on to the taper. I searched through my boring tools for a suitable cutter but could not find one small enough, so I had to resort to grinding one by hand (**photo 6**). The resulting tip was inevitably quite small having to work in a small blind hole and certainly not very accurate in terms of angles (should have been 55 degrees) but again the 'it'll do' mantra rang in my head so I proceeded to cut the thread to a reasonable depth. My new 'nut' was parted off leaving plenty of material for finishing, and the 3 jaw chuck removed.

The taper was returned to the lathe and pulled tight with the drawbar. The end was machined to 9/16 inch OD and a shoulder with undercut was created back from the end slightly less than the depth of thread created in the nut in order to ensure a surface for it to butt up against. Another small thread cutting tool tip was shaped (approximately 55 degrees) and fitted to the tool post. After several passes and smoothing off the crests with fine emery cloth (probably not done at RR) I was finally able to screw on my nut right up to the shoulder. This I find is one of the most satisfying moments in model engineering! Now it was possible to machine the nut to size but before starting this I cleaned both male and female threads of any swarf and I made a cardboard washer to fit against the shoulder to provide a bit of resilience which I hoped might help when it was necessary to remove it after machining. So the nut was machined down to match the maximum diameter of the taper and

The unsuccessful wooden lap. INSET: End cap material.

Hand shaped thread tool tips.

Working between centres.

The component parts.

The special collet.

'The Spring Collection'.

faced to provide a nominal amount for the spindle location, I thought 3mm would be enough.

Up to this point I had not actually considered the final diameter if the spindle point but now was the moment. Clearly I needed to drill and ream the final hole so all depended on what reamers were available. I took a look at my old spindle point which had proved adequate up to now and found it to be nearly 8mm dia, this is very near 5/16 inch, so did I have a 5/16 inch reamer?, Well yes, in fact I had five, thanks to that late uncle again. each showed some signs of wear but one looked okay so the cap (while still screwed on to the taper) was drilled and reamed to size.

So, I was now ready to machine the spindle component that I had selected, the material was gripped in the 4 jaw and trued up with a dti. Each end was prepared with a centre drill and set up in the lathe between centres. As the maximum diameter is only a nominal 10mm and final diameter of the reduced section was to be only 5/16 inch I needed to use a half centre and make up a special driving dog (**photo 7**). With a good sharp tool in the tool post I made a tentative first cut and measured it. Now I know that my old Myford is a bit worn but I was a bit disappointed to find the diameters differed by .003 inch over a nominal 2.5 inch distance! I was able to improve this with a minor adjustment of the tail stock so I continued to reduce down to the required diameter and using the completed end cap as a gauge I finally achieved a nice sliding fit by smoothing out the errors with emery cloth. A final undercut at the shoulder completed the first stage of the spindle.

Now I had an almost full set of bits (**photo 8**) a trial assembly was made and the spindle was proved to be a reasonable sliding fit in the taper stock and end cap. I had deliberately left the 10.00mm section rather long to accommodate the centre drill hole and I still needed to add the point, so I now had to consider how to grip the part for this final operation. I tried again with the 4 jaw but the reduced section was now too small to project beyond the face of the jaws, so I considered a homemade split collet. Replacing the 3 jaw chuck in the lathe, I secured a blank of MS nominally 5/8 inch diameter, faced it off and then reduced to approx. 12mm (or just a little larger than the maximum spindle diameter), for a distance of 25mm back from the face and parted off. The resulting blank was then reinserted into the 3 jaw with the face just projecting beyond the jaw tips, again faced and now drilled and reamed to 5/16 inch right through. The position of no. 1 jaw was marked with a centre pop and the space between no. 1 and no. 2 jaw marked with a scriber. The blank was now placed in the bench vice and sawn through between the jaw marks. After cleaning off the burrs the 5/16 inch diameter portion of the spindle was inserted into the now 'C' shaped collet, the assembly refitted into the 3 jaw taking care that no1 jaw was positioned as before and the chuck tightened up (**photo 9**). With the spindle held true in this manner I machined away the excess length from the10mm section. I was interested to see just how true my collet held the spindle so I set up the dti to measure it, it measured less than 0.0005 run out, a great improvement on the bare chuck which is never better than 0.005 inches. RR would have thrown my chuck away ages ago.

Before tackling the point, I thought this would be a good moment to consider the spring. The spring box was turned out and a few possible springs selected to try (**photo 10**) in the end only one was anywhere near suitable, a little too strong perhaps but suitable for a trial run. I again cleaned up all parts and assembled them, I found that my spring compressed sufficiently to give me about 25mm of movement without jamming into the tapered section at the bottom of the 10mm hole and I could now mark exactly where the point could start. Again the spindle was fitted into the collet and tightened into the 3 jaw. With the top slide adjusted to 30 degrees off set, the point was turned to the mark and now with a completed spindle my spring centre was again assembled and tried. Perfect (**photo 11**) well not quite, it needs a softer spring and there is a little slackness in the bore but it's better than the old one, I will look out for a softer spring and I don't think the slackness will bother me so, well, don't tell Mr Rolls or Mr Royce but as far as I am concerned … it'll do. ■

My completed spring centre.

Readers' Tips

WIN £30 worth of Chester Machine Tool Vouchers

Our winning tip from Chris Hilton is as simple as they come – but that doesn't mean it's not a really useful idea. He gets £30 of Chester vouchers.

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for 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. **Don't forget to include your address!** Every month we will choose 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.chesterhobbystore.com** to plan how to spend yours!

Overflowing with Joy

I recently found a quick way for marking out a piece of steel in order to drill the odd hole. Instead of using marking out blue (which I sometimes find messy and seem to get it all over my hands) I use a large black chisel tip marker pen. I have found this to be very quick drying and when scribed the scribing marks can be easily seen.

Chris Hilton, Rochdale

Our runner up is Brett Manners in Australia, who offers us a couple of tips for a tidier workshop. Brett wins a set of ten Shaviv deburring blades with a Mango II handle.

There's Tidy

I have 2 tips for the magazine (Great Magazine by the way). Like most people space is tight in my workshop and I have found that using old metal filing cabinets for storage quite good. They can be found cheap second hand, are strong, store lots of things and even come with a lock/key.

The second tip is to use a rice bag to store the chain from a chain block. I have a chain block hanging from a beam in the workshop roof and when I am not using it I use a small bag to hold the chain up out of the way.

Brett Manners, Bull Creek, W.A.

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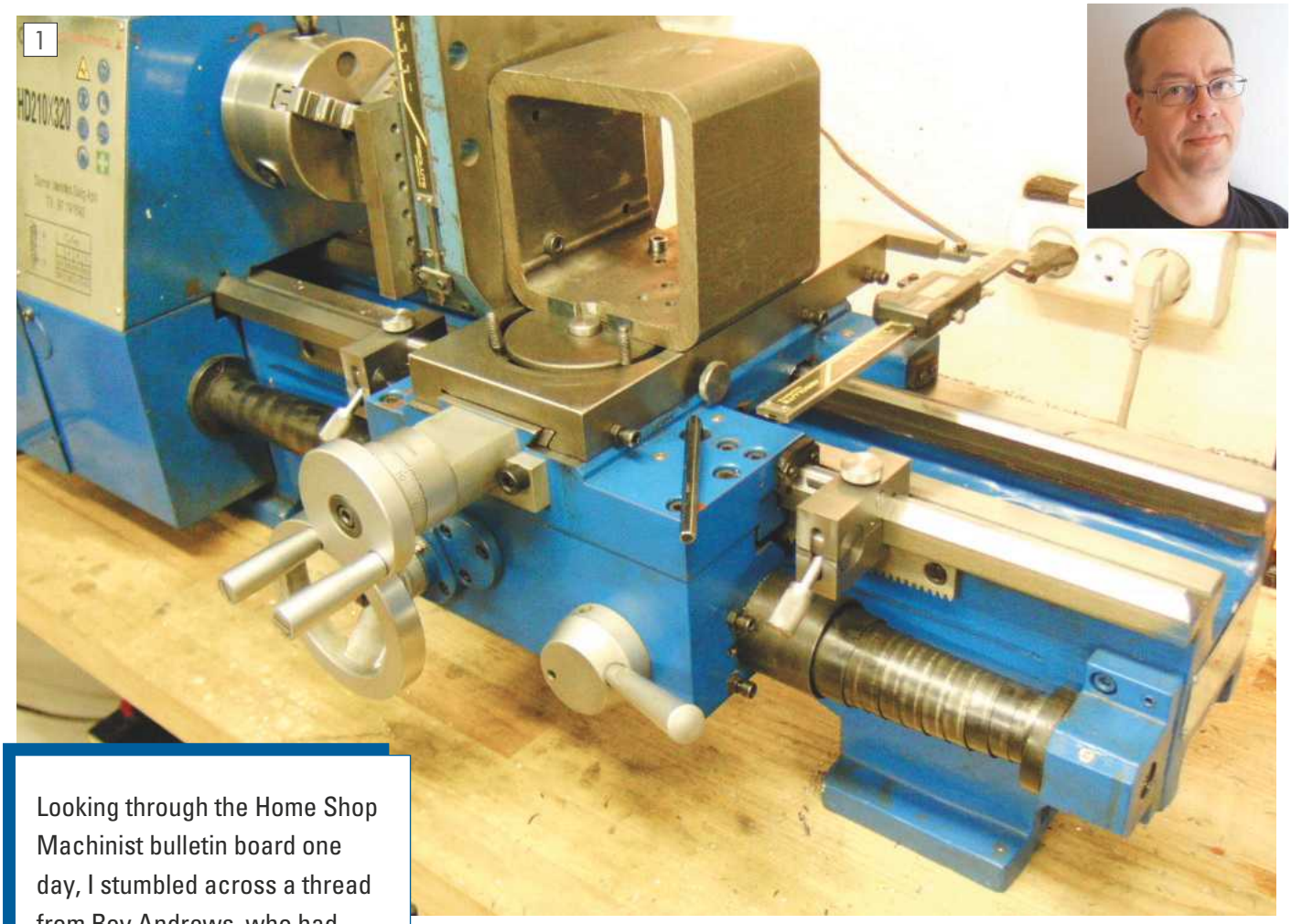


A Lever Operated Carriage Stop

Mogens Kilde makes a carriage stop that can be adjusted without using a tool.

Looking through the Home Shop Machinist bulletin board one day, I stumbled across a thread from Roy Andrews, who had made a tool-less carriage stop. For many years I used a home made stop that was locked in place by means of a hexagon headed bolt. This is a useable solution, and has been made by industry for decades, but Roy's topic made me think there was a much better solution.

This article will describe how I made a carriage stop that is locked in position without using a key or other kind of tool. **Photograph 1** shows the finished carriage stops; I made two of them, as I often need stops on both sides of the lathe carriage when working with my model making. As you might have guessed, the stops are locked by means of lever activated cams.

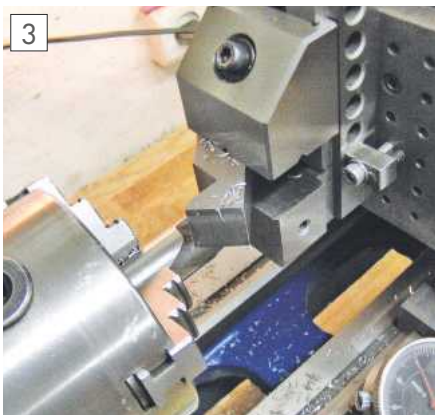
This project describes parts and sizes that fit my lathe, and you may have to adjust different sizes to make a working tool on your lathe. First I made some measurements of my lathe, to know where to begin the design of the tool. The profile of my lathe bed is as shown in **fig. 1**.

Making the upper parts.

The upper part is made from 20 x 20mm cold rolled steel. First the work piece was cut a little oversize - to the dimensions in **fig. 2** plus 10mm, this is important, as you will need the extra 10mm later in the project.

I also cut the blanks for lower part before continuing, you can see the dimensions for this later in the article, and again add 10mm to the drawing dimension – don't forget. After cutting the blanks, they were mounted one by one into the milling attachment, and the final outer length was obtained by using a modified one flute end mill (**photo 2**). The overhang of the upper part looks scary, but all went well.

3



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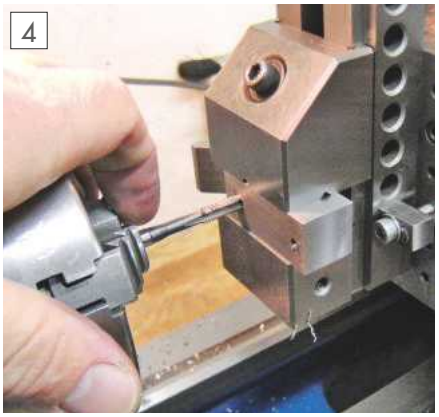

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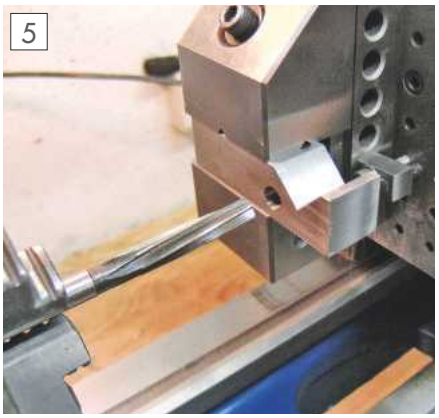


Fig. 1

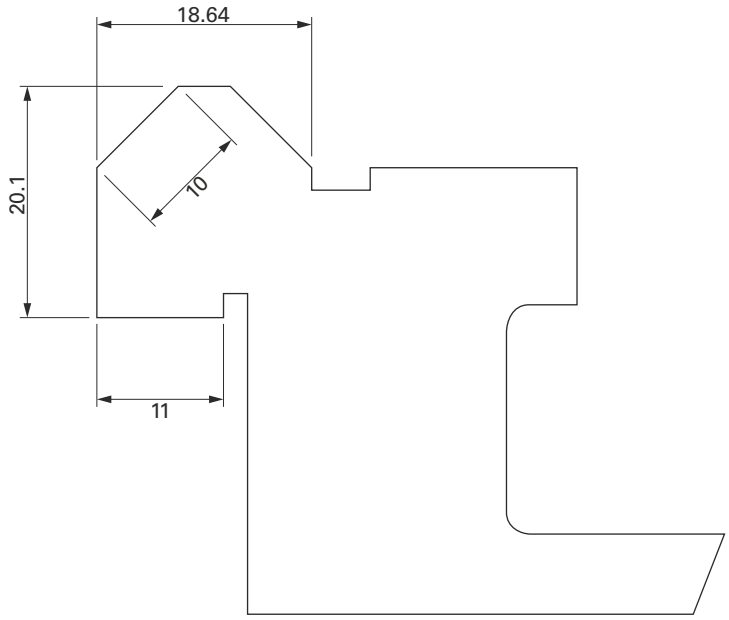
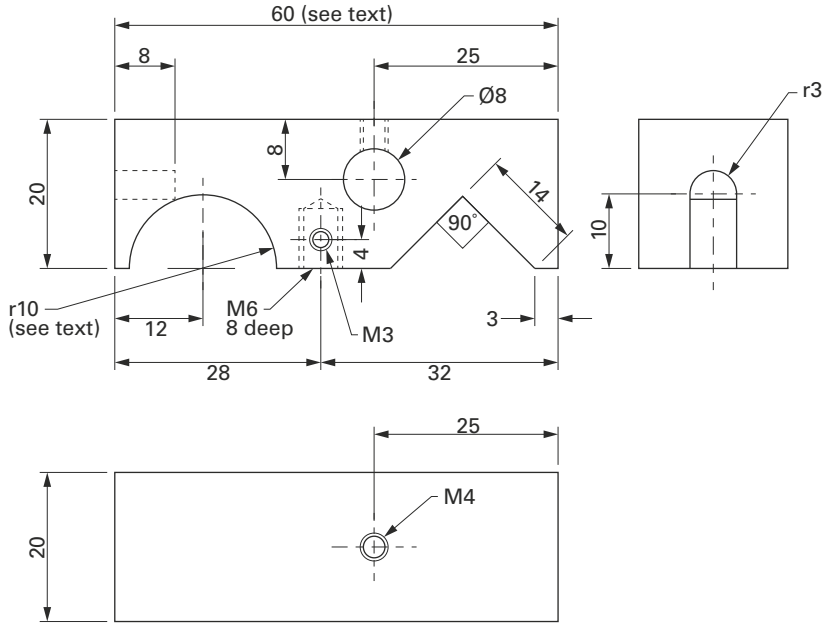


Fig. 2



After all blanks were milled to size according to the drawings, the next step was to mill the square 14mm cutout that will rest on the upper prism of the lathe bed, the part was placed in the milling vice at a 45 degree angle to the face of the cutting tool (**photo 3**).

I milled the shape by light cuts of 0.5mm at a time, it's important to be patient when you have to do your milling work on a lathe with a milling attachment, I'm really looking forward to the day when I can buy myself a milling machine.

Next the work piece is turned over and the M6 hole is drilled 8mm deep and tapped (**photo 4**). Also, a M5 hole is drilled 10mm deep and tapped in centre of the part and 5mm from the face farthest away from the 14mm cutout, this hole is not shown in the drawing, but is vital for machining later in the project. The M5 hole on the upper side of the part was drilled approximately 8mm deep and tapped, Next the 8mm hole is drilled and reamed (**photo 5**) and finally the M3 hole is drilled 10mm deep and tapped.

Making the lower part

The lower part is also made from 20 x 20mm CRS, as stated before the blanks for this parts is also cut oversize by 10mm according to **fig. 3**. The outer length is finished by milling the work piece in the milling attachment.

The next step is the 11x12mm cut out on the right of the drawing (**photo 6**) the drawing says 11.5mm, but that's the size before the final finishing of this part, so you have to allow that the bar is 20x20mm

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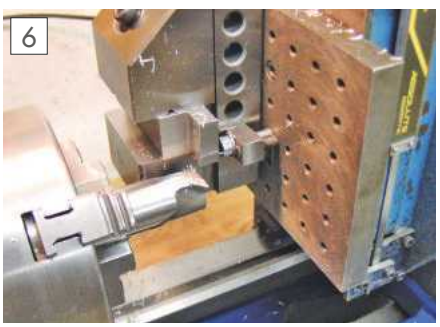
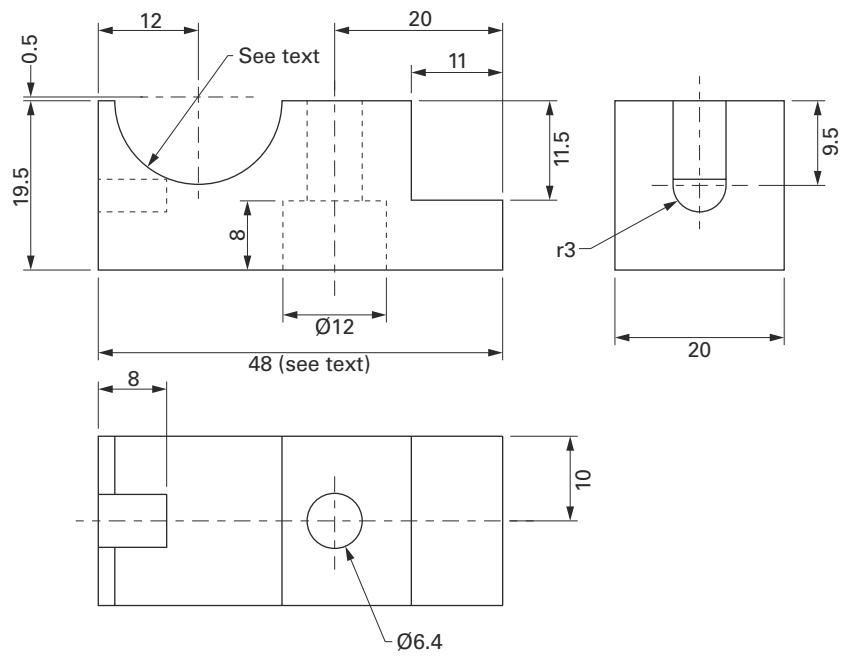


Fig. 3



and not as per the finished drawing (19.5 x 20mm).

Next job is to drill the 6.4mm hole and counter sink this 12mm to a depth of 8mm (**photo 7**). The lower part has a 5.1mm hole drilled with a 9mm countersink, placed at the centre of the part and 5mm from the edge.

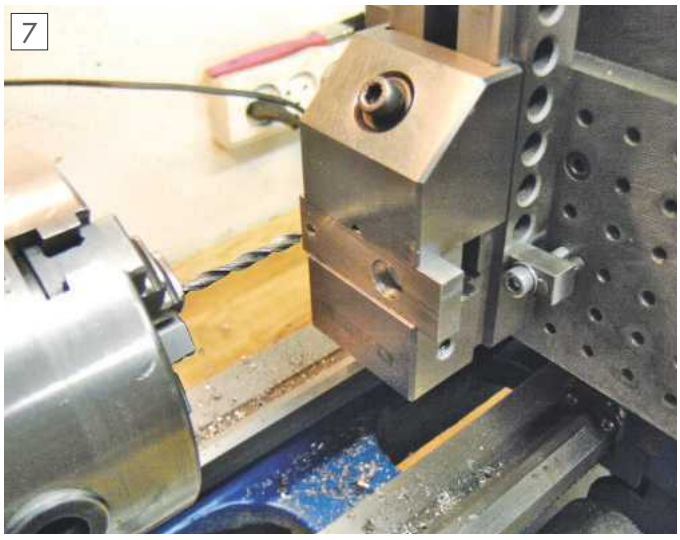
The reason for this rather complicated description should however become clear when looking at **photo 8**, here you see the upper and lower parts screwed together and the making of the 10mm radius bore is taking place.

After screwing the parts together, the centre of the bore is marked out, and the parts located in the 4 jaw chuck by means of a centre placed in the tailstock. First the bore is started using drills and finally the finished dimension is obtained using a boring tool in the lathe tool holder (**photo 9**).

After making the bore, most of the excess 10mm material was cut off, and finally the overall length of the parts cleaned up by milling (**photo 10**).

Making the cams

The cams are made from 20mm diameter free machining steel. Again these parts have to be made in a special order, as it will not be the easiest way to just follow the drawing and make the parts. I started with a 20mm bar in the 4 jaw chuck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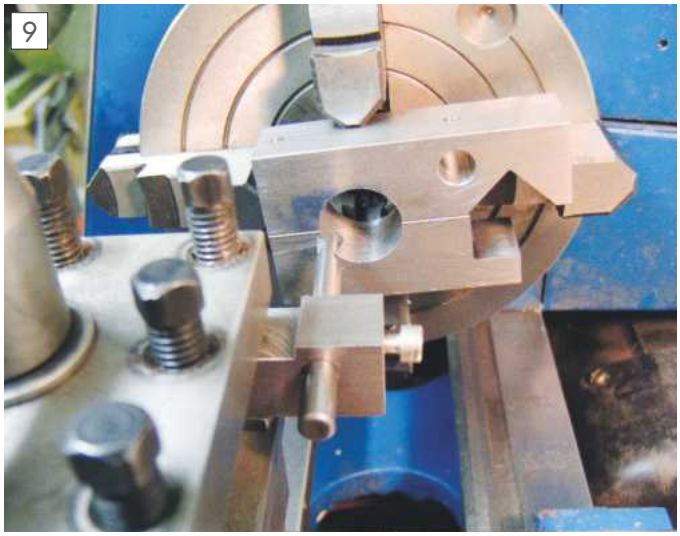
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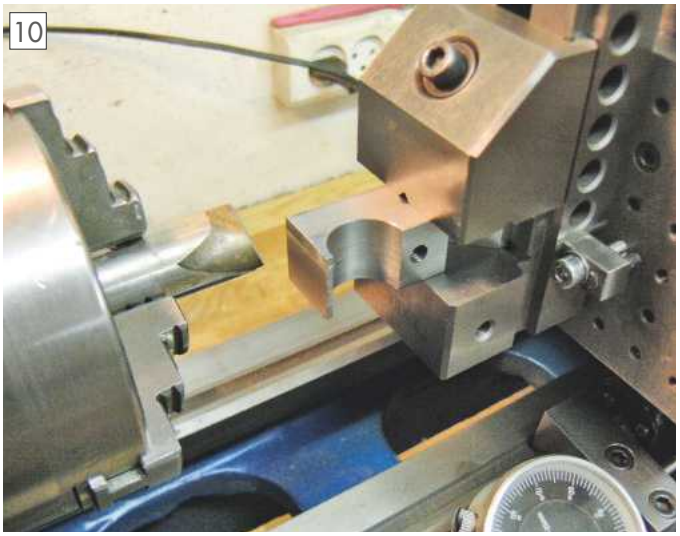
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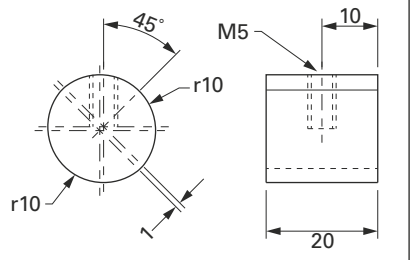
Fig. 4



protruding approximately 30mm from the chuck. The shaft is offset by 1mm from the lathe axis and a 1mm cut taken, making the cross-section of the bar 'lop-sided' (**photo 11**).

The end is faced off, and two cams were cut from the bar a little oversize, and both work pieces faced off to the 20mm length. You might want to make the cams from brass or bronze, but after using a drop of oil when assembling, I have noticed no problem concerning galling of the steel parts.

Next the cams were placed in the R10 bore in the upper/lower part assembly (**photo 12**). I turned the part so that the gap from the 'not so round' part is in the left side of the part, then a line is drawn approximately 45 degree from the centre of the assembly, in this direction I made the M5 hole as described in the drawing, the result should be that the part is lifted apart when the cam is in this position, and thereby forcing the other end to squeeze around the lathe bed, and lock the stop in place.

Next part is placed in the milling attachment and the M5 hole drilled and tapped (**photo 13**) I hope you can just see the blue line, turned parallel to the lathe chuck centre in **photo 14**.

Making the lock screws

These screws, for securing the stop rods (**fig. 5)** are made from 20mm free machining steel. The work is a simple turning job, as the shaft is turned down to 4mm and the thread is made using a die in a holder mounted in the tailstock, the outer diameter is turned down to 18mm and the outer surface is knurled (**photo 15).**

Making the locking levers

The levers are made from 12mm free machining steel (**fig. 6**). Again a simple turning job in the lathe, the shaft is turned down to 5mm and the thread cut by use of a die (**photo 16**). The 6mm shank is turned and next the work is mounted in the 3 jaw chuck and the outer surface of the 12mm is knurled.

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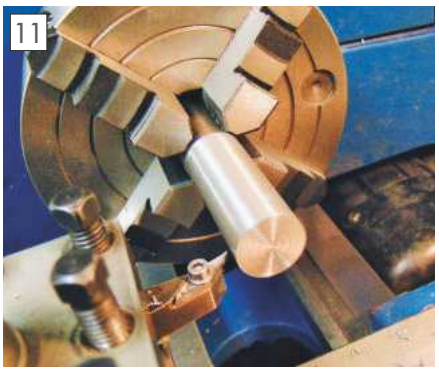

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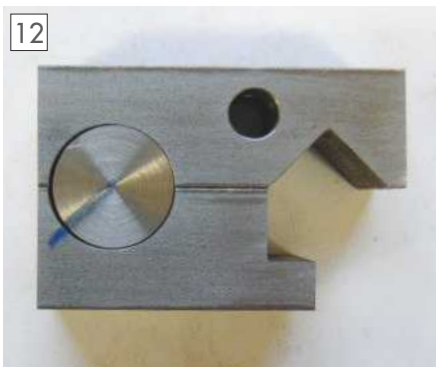

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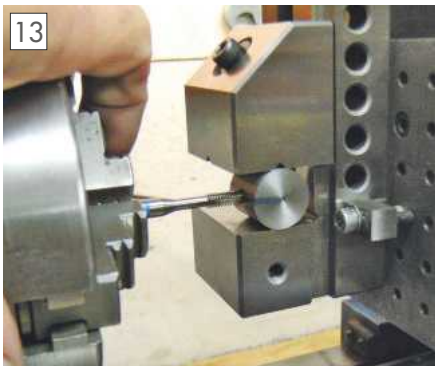

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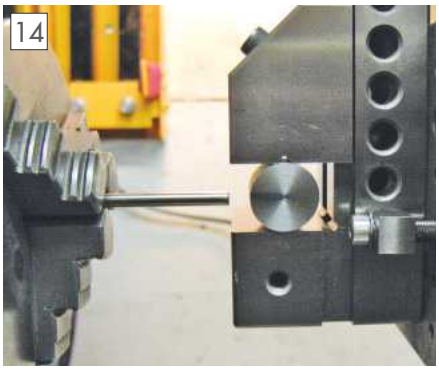

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Fig. 5

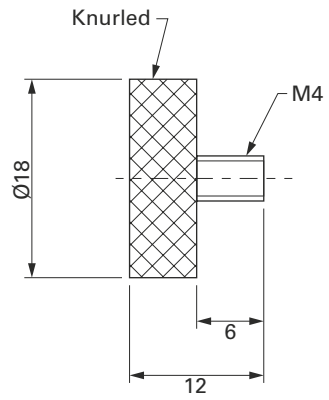
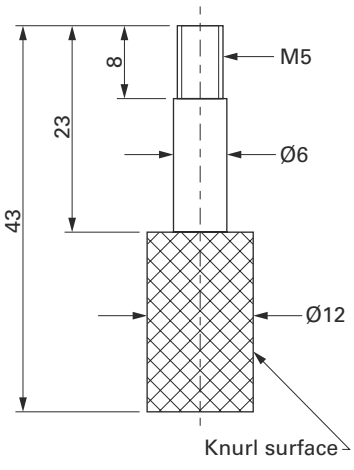


Fig. 6



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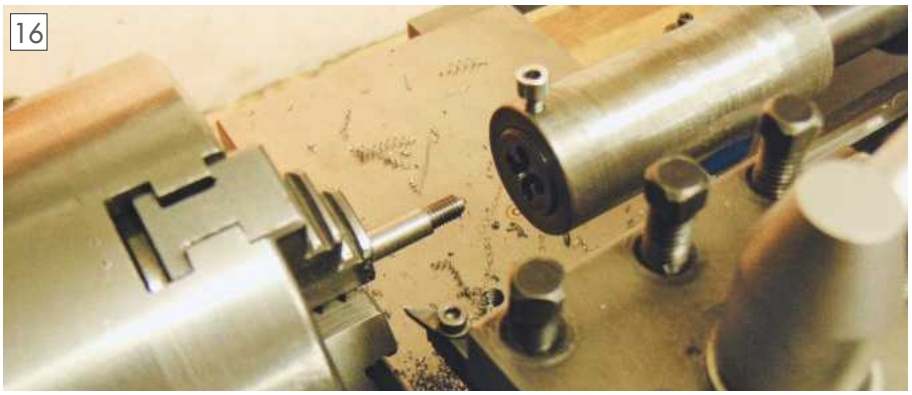


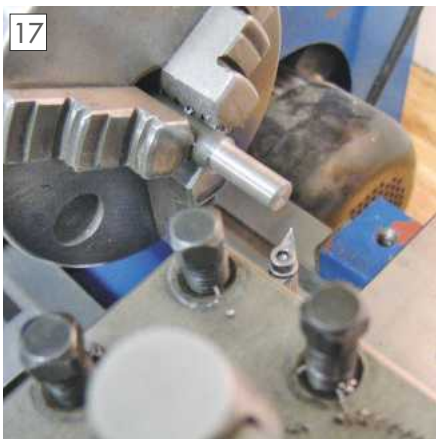
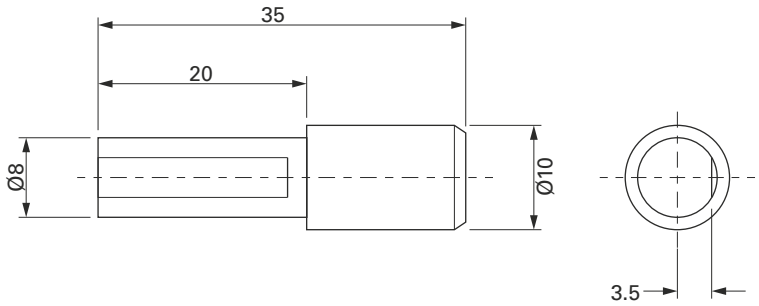


Fig. 7



Making the stop rods

When in use the carriage stop is mounted with a short piece of rod that contacts the lathe carriage. The rods are made from 10mm free machining steel (**fig. 7**).

These are even more simple work in the lathe, the work is turned down to 8mm as per the drawing, and after cutting off and facing off the 10mm end (**photo 17**) the edge is chamfered about 2mm by 45 degree. When locked in the carriage stop, the rod might be scarred by the lock screw; therefore I made a flat on the rods, on which the lock screw can bear.

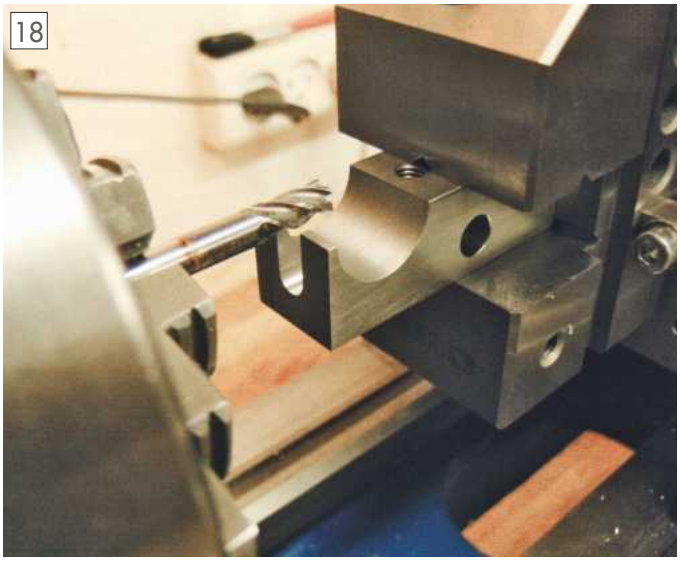
Making the cut out for the locking lever

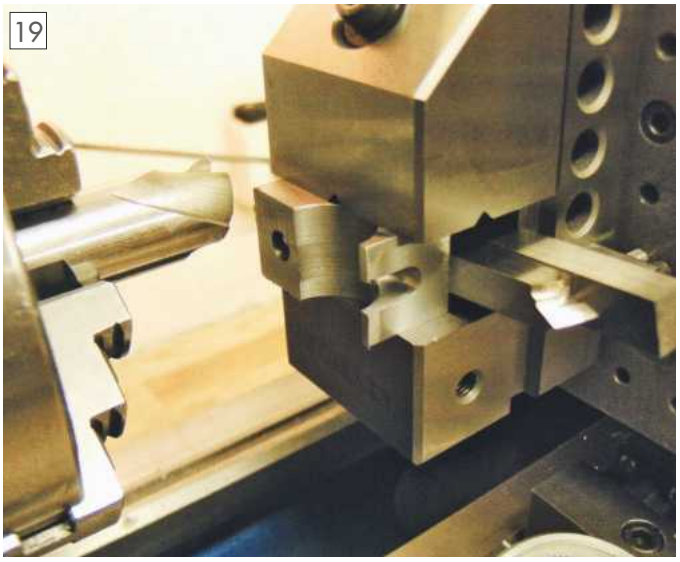
The previously described parts were done while the milling attachment was off the lathe, now it is time to mount this tool again, as the upper and lower parts have to be worked on just a little more.

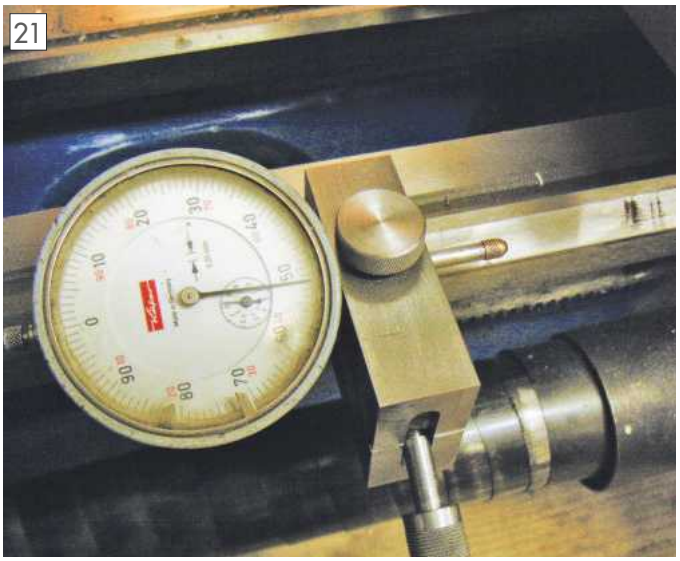
As you might have observed in the project so far, I have not mentioned how I made the 3mm radius cut out in the rear end of the parts, you could do this earlier but in my situation the work was done now (**photo 18**). The reduction of the lower part from 20mm to 19.5mm was also done now (**photo 19**).

Well now you have made all parts, and the next job, after finishing all surfaces, is to assemble the clamps (**photo 20**). I hope you will enjoy using these tools in your workshop.

As a final thought, you can swap the stop rods for a dial indicator as an aid to measuring very small movements of the saddle (**photo 21**). ■







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Playing a Piccolo

Piccolo in action.

A few members of SMEE's Digital Workshop Group have been collaborating in sourcing the materials and building this three-axis, programmable mini device, partly for fun, partly to learn more about using Arduino for controlling our kinds of devices and partly to evaluate it as a possible project for involving younger people in model engineering. This is the story so far.

Peter Edwards describes a novel gadget that provides a painless introduction into the world of Arduino.

How it all started

The word 'Piccolo' conjures up images of military bands or large orchestras and adding the word 'digital' might refer to obtaining the correct fingering to produce a tune. But not in this case. The piccolo in question is a small, 3-axis device which starts off as some bits of mdf and acrylic sheet together with some (not many) electronic components. It is straightforward to assemble, uses just some basic soldering skills, and it provides an introduction to simple programming in order to control its movement along the three axes. It is also fun and attracts interest.

Now I know that not all of you are interested in CNC machining and similar topics but the group of us who are involved in this project are wondering whether Piccolo might provide another way of linking with younger potential model engineers through technology which they would recognise. Increasingly, at school and in their own time, they are learning to experiment with Arduino or Raspberry Pi boards to control things and for some young people (of all ages) the link with tools and machinery might feel like an interesting avenue to explore. So, this article is an account of how we started and what we are planning try out at exhibitions.

The Digital Workshop Group

We are members of SMEE's Digital Workshop Group which is an umbrella label for fifty or so members of the society who are interested in the use of computers as additional tools in the workshop. We collaborate in small groups on a variety of projects from making a CNC router, to designing and building a wire erosion device or making and programming a tachometer to attach to a lathe or mill. There is also a group which is exploring the use of an Arduino programmable circuit board to control a robot. We are fortunate in having some very knowledgeable members who are generous with their time in making this knowhow available to those who are interested through our monthly meetings, online forum and web conferencing. This allows members who live away from London to participate actively such that the group experimenting with Piccolo has members in Aberdeenshire and Yorkshire as well as the South-East of England. If you have visited the SMEE stand at recent exhibitions, you may have come across members of DWG demonstrating some of our projects.

Making a Piccolo

Piccolo, as shown above, has a footprint of about 200mm x 100mm and the pen clipped to the vertical axis gives an impression of the scale. It was designed in America as an open-source exercise so all the plans, build guides and introductory programs are available at no cost. If you want to know more, http://www.piccolo.cc is a good place to begin. What you will not find, however, is a complete kit of parts ready for immediate purchase in UK. There are three main groups of components. First the mdf and acrylic sheet frame, slides and gears; secondly, the printed circuit board on which all the components sit; and thirdly, the three servos, the Pro Micro 5 volt control circuit board and a few electronic components. The approach we used was to look for UK sources of the various components and came up with a full collection for £42 per set. If you were looking to assemble a single example the cost would be a bit more.

1. The Frame, Slides and Gears
These items are made from either 3mm MDF or acrylic sheet (Perspex or similar). They could be produced by traditional methods but lend themselves well to laser cutting and the program files to achieve this are available free for download on the Piccolo website. We found a business in Devon (**ref. 1**) whose proprietor, Dave Neale, not only undertook to produce 20 sets of parts at a very reasonable rate but also assisted with some tweaking of the design to match the slightly different thickness of acrylic sheet available on the UK market. Assembly of these components, which are held together by M3 capscrews and nuts, is a matter of careful fitting at which point the digital stuff goes out of the window and traditional techniques come to the fore. Which is a fancy way of saying 'Get out the abrasive paper and very carefully adjust the clearances'. Fortunately, the laser-cut parts needed only a minimal amount of smoothing and the kit includes two thicknesses of paper shim to adjust the clearances. I also found that a trace of wax polish on the slides, well rubbed in, worked wonders.

2. The Printed Circuit Board
This, like the other components, can be sourced from suppliers in USA which are listed on the Piccolo website. We, however, chose to look elsewhere and used a Chinese company (**ref. 2**) which would make our required twenty boards at a reasonable price using the files provided by Piccolo. The completed boards arrived within a couple of weeks and the quality looked good.

3. The Electronic components
Each of the three axes is driven by a servo motor which is easily available on the hobby market. The control of these motors is achieved by an Arduino board which is programmed by being connected to a computer. The Piccolo uses a Pro Micro 5volt version of the Arduino which is widely available. We chose one of the lower priced examples (**ref. 3**) which so far has done what was expected. All the other components were sourced from UK suppliers such as Farnell or RS except for two which we were only able to find in quantities of 1000 or more! These we had sent from DigiKey in USA (**ref. 4**).

A set of laser cut parts.

Assembling the components on the PCB needed a little careful soldering but was within my limited skills in that area. And then it was a matter of bringing the Piccolo to life which required the programming of the Pro Micro control board.

It is not the purpose of this article to provide details of programming the Arduino but if you follow the guidance on the Piccolo website you will soon have the Piccolo up and running. The website gives basic instructions for setting up a computer to communicate with an Arduino board as well as providing the libraries of routines which the Piccolo requires, and how to download and install them on your computer. At this point you are ready to transfer a set of instructions to the Pro Micro tucked away in the base of the Piccolo. And then, if all is well, a press of the start switch should set the axes in motion with the test drawing which is a spiral. And, believe me, that was quite a satisfying moment!

Then what?

Well, I cannot answer that from experience as this is as far as I have reached but the evidence from other Piccolo users shows that the device can be used for a variety of drawing tasks and some non-drawing roles as well. There is even a 'miniature lathe' illustrated which would be quite challenging, I fancy. What I shall be doing is using this device to learn a bit about simple programming of a three axis device using the language C which is the same language as we have used for other DWG projects. And, I hope, letting some younger members of the family have some fun with it.

In the meantime, we have plans to take a couple of kits to shows and hope to engage young people in assembling them and trying out their Piccolo playing skills. And maybe, just maybe, introduce them to the pleasures (and frustrations) of model engineering from a slightly different angle. If you are there, do come to the SMEE stand and say 'Hello'. And if you have any questions about our experience of Piccolo do contact me at **edwards@fullacott.plus.com** ■

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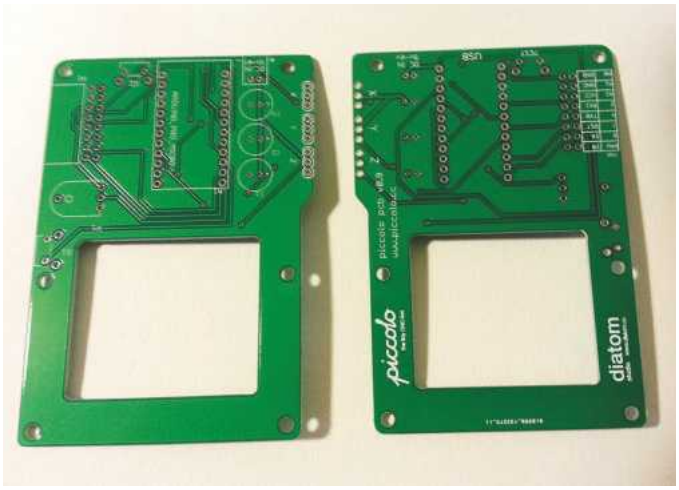
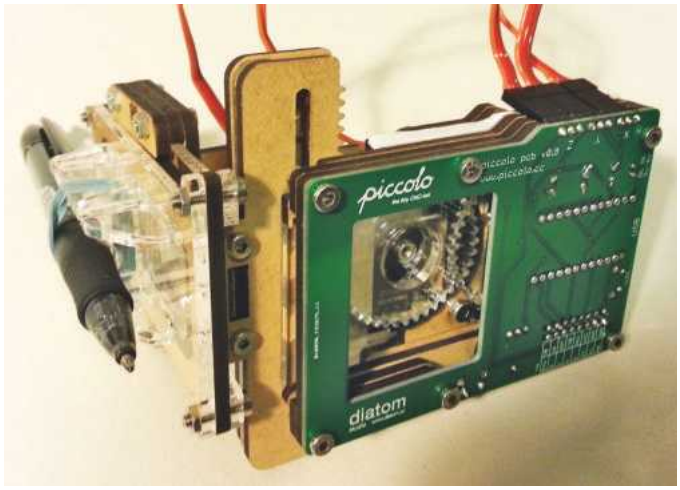
   http://lasercutz.co.uk/
   Email: **shop@lasercutz.co.uk**
2. Seed Studio PCB Fusion, Shenzhen, China
   www.seeedstudio.com
3. Hobby Components.
   Tel: 01246 767060
   http://hobbycomponents.com/
   Email: **sales@hobbycomponents.com**
4. DigiKey USA www.digikey.com



The Printed Circuit Board – front and back.



Completed Piccolo, viewed from below.

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Rotary Table Stops

Jock Miller describes an essential aid to repeat accuracy for manual rotary tables. With photos by Peter King.

Having recently skimmed through the last three or four years of *MEW*. I did not see any reference to simple movement stops on conventional milling machine rotary tables.

For example; when the ends of a model locomotive connecting rod or valve gear part or the like are to be milled to a radius, stopping rotation at the correct place is always a problem. This is especially so when a smooth transition from a radius to the milled shank of the rod without a groove is attempted. Other drilling or milling operations could require stops. My late father, J.O.S. Miller of Timaru, NZ, came up with the idea of two rings with 'stop ears' when he built a 4 inch table in 1949.

The stop rings on all three tables illustrated were cut from the appropriate size pipe (the 8-inch with some difficulty) and the 'stop ears' brazed on. Alternatively, the rings could be cut from small rectangular bright mild steel and rolled to suit.

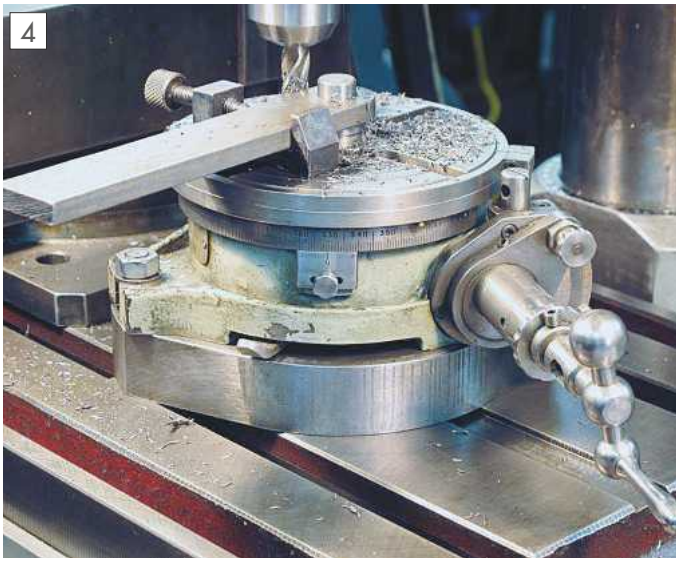
Illustrated are three rotary tables: **photos 1** & **2** show a 3-inch commercial table, modified and fitted with a removable stop pin. Also the centre of table is machined and bushed for a ½ inch central register.

The 4-inch table was home-made in 1982 (**photos 3** & **4**). It's the 'brother' of the unit made by my father in 1949.

A small commercial table fitted with a pair of stop-rings.

The modified table still fits in its box.

Starting rounding a bar end at the first stop.



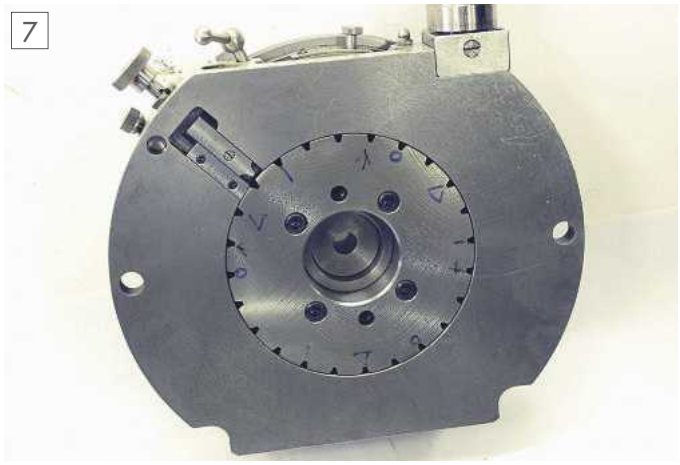
The same operation with the bar rotated a full 180 degrees to the second stop.

A large 8-inch table based on a Tom Senior design.

This close up view of the 8-inch table shows the 'stop ears' clearly.

The big 8-inch home-made table was made in 1993 (**photos 5** & **6**). This unit was generally modelled on the Tom Senior *Major* milling attachment and is only 2 ¼ inches high. This leaves plenty of 'daylight' under the mill spindle. The fixed stop is retractable (see the left hand knurled knob in photo 5). **Photograph 7** illustrates a 24-way index disc on the underside. The detent knob is the right hand knurled knob, see photo 6, giving 2, 3, 4, 6, 8 & 12 divisions. To keep the rings in position, either drill and pin the moving table or pin the base (4 off) ensuring the top surface of the table is not fouled.

This enhancement of a rotary table certainly makes radii and other operations easy and has been used may times over the years. ■



The underside of the 8-inch table showing detents for up to 12 automatic divisions.

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An Electric Power Drawbar for Milling Machines

Mike Stratton describes a novel approach that can be used with any larger mill.

The completed power drawbar.

A couple of years ago I bought a second-hand Warco WM20 turret mill. This is like a ¾ size Bridgeport. I soon found that spindle to table distance was too small when drilling on the rotary table, so I made a 125mm deep riser for the head. This cured the problem but introduced another – I could now only reach the drawbar bolt by using a stepladder!

The solution seemed to be a power drawbar of some sort. Trawling the internet showed that the vast majority of power drawbars were air operated, using an air impact wrench combined with an air cylinder to bring the wrench down onto the drawbar. As I did not have, or want, a noisy compressor in the workshop I started to look for an electrical solution.

A few tests with an old cordless impact wrench showed that it could do the job and it was really only a matter of fabricating a suitable structure to lower the wrench onto the drawbar (**photo 1**). Note that an ordinary electric drill will not work – it will simply spin the mill spindle in its bearings. It is the hammer action of the impact wrench that does the work, without rotating the spindle. The spindle does not need to be locked during operation and it remains perfectly stationary. This means that it is safe to hold the tool being inserted or removed, but a pair of gloves might be a good idea for sharp cutters in collets.

There are no drawings for this project, but the dimensions would need to be altered to fit the mill in question anyway. The photos should convey the basic

›

Baseplate.

Old impact wrench.

Linear bearing.

Spring winding on the lathe.

principle. It should be possible to convert any mill that has room around the top of the drawbar to fit a baseplate to support the guide bars (**photo 2**). My mill has an R8 spindle and the impact wrench easily releases the taper. This would be the case with International tapers as well. I don't know if it would release a Morse taper, and I have not tested this as I don't have a suitable spindle. As a guide to size, my baseplate was a converted 150mm diameter backplate. The guide bars are 20mm diameter x 200mm hardened and ground steel. They are spaced at 125mm centres.

Construction

The assembly consists of a baseplate for the guide bars, a moving plate to support the impact wrench and linear bearings, the 2 guide bars with springs, and an extended handle to pull the wrench down onto the drawbar bolt.

The baseplate could be any shape to suit the mill in question and just needs a central bore for the drawbar and two holes for the guide bars. These two holes need to be a good fit on the bars and at exactly the same spacing as those for the linear bearings in the motor support plate, to prevent binding (**photos 3** & **4**). The bars are retained with grub screws.

I had originally intended to remove the electric motor from its wrench housing but changed my mind when I saw how well it was mounted in the plastic moulded case. I elected to machine a register on the removable aluminium nose of the wrench and use that, with longer screws, to mount the whole wrench including the case on a 16mm aluminium plate. The handle was sawn off the wrench about 10mm proud of the body and the excess material heated with a heat gun and moulded back to fill the hole where the handle had been (**photo 5**).

I was concerned that the twisting effect of an off centre load to pull the wrench down onto the drawbar would cause the bearings to jam, so I chose to use linear ball bearings. I had not used these before, but I was very impressed with their smooth, low friction action (**photo 6**). They run on 20mm hardened steel bar. Both the bearings and bar were purchased from Marchant Dice. The cost of the linear bearings was cheaper than a suitable chunk of bronze and the hardened and ground bar was a similar cost to silver steel. It looks as if the cost of these items has come down considerably as CNC machines have become the industry norm.

The handle extension is made from a piece of rectangular steel tube fitted on the end with a ball handle. The ends were brazed up with steel blocks. By using tube, it is possible to fit the switch and cable inside for neatness. The ball handle should be positioned so that when gripping the ball and pulling downwards, the thumb can be used to press the switch at the same time.

The springs need to be strong enough to support the weight of the impact wrench but still allow it to be pulled down onto the drawbar easily. I found one supplier that sold 22mm bore spring by the metre, but these proved too strong for this job. I eventually made my own springs with 1.8mm spring steel wire on

Profiling the motor support on the rotary table.

the lathe. The pitch needed was approx. 2TPI, which was way outside anything that could be geared from the leadscrew, so I chose to feed manually using the leadscrew handwheel and 25rpm on the spindle. This proved to be very successful and much easier than I had imagined. A 16mm mandrel gave a spring with a 23mm bore (**photo 7**).

The wrench has a ½ inch square drive and I used an ordinary ¾ inch socket from a spare socket set. Impact rated sockets are available but are probably unnecessary for this light duty application. They also are usually hexagon rather than the bi-hexagon of conventional sockets, doubling the chance of the socket not lining up with the drawbar bolt. If the happens just blip the wrench motor to move it to a different position.

Electrical

The impact wrench that I used was rated at 19.2 volts and had a 1.7amp/hr Nicad battery that had failed. It gave a maximum torque of 280N.m, whereas tests with a torque wrench showed that around 30 to 40N.m were all that the drawbar needed. A few experiments showed that if it was connected to a 12-volt car battery the lower voltage limited the torque to the range needed. At 12 volts the current, unloaded, was 5 amps, and hammering under load 19 amps.

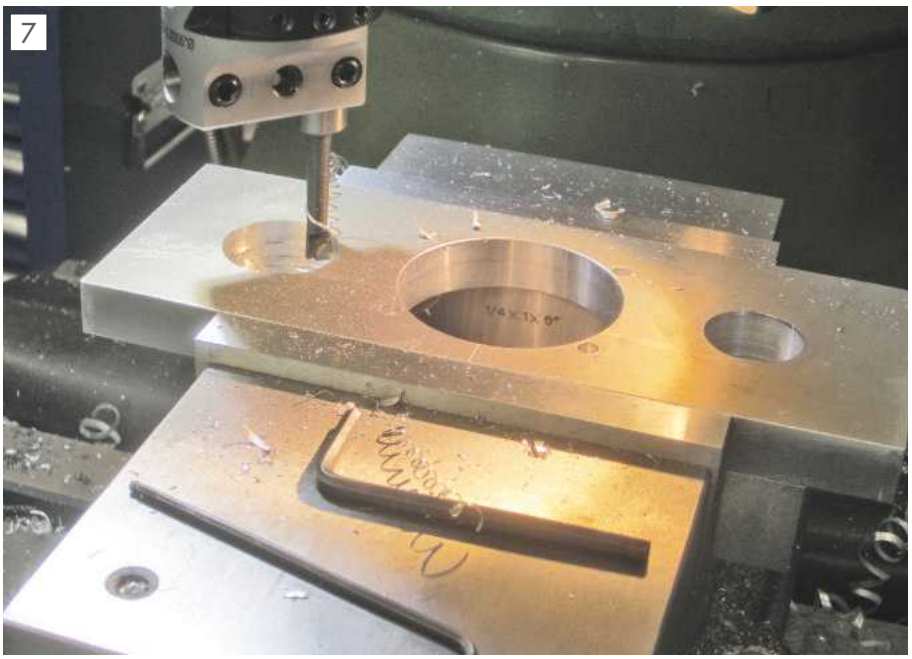
The direction of rotation is changed by merely reversing the polarity of the motor supply. This can easily be done with a DPDT, centre off, momentary contact switch, but I had difficulty locating a switch with a high enough DC current rating. Instead I found that generic car window winder switches are available cheaply that have a 20 amp DC rating. To support the high current a suitable heavy cable is needed and I used some twin core 2.5mm2 that seems to do the job.

I did not want to use a car battery as a power supply as I did not have a spare battery, nor did I want to be recharging one at regular intervals. Instead I used a 10 to 14 volt, 25 amp switch mode power supply that is sold for low voltage LED lighting. This is available on eBay at £17 for the 25 amp version, which is a fraction of the cost of an alternative DIY version using a transformer and bridge rectifier (**photo 8**).

In Use

I have been genuinely surprised how well this powered drawbar works, and how simple it is to construct, having been made from mostly scrap box materials.

In use the handle is just pulled down onto the drawbar bolt, the switch pressed until it hammers 3 or 4 times and then released. The other hand is used to support tool in the spindle. The whole operation takes literally two seconds. I use R8 collets for all my cutters so every cutter change needs the drawbar released. This tool certainly encourages me to change cutters when necessary, rather than carry on using the existing one because of time and effort of a tool change. ■



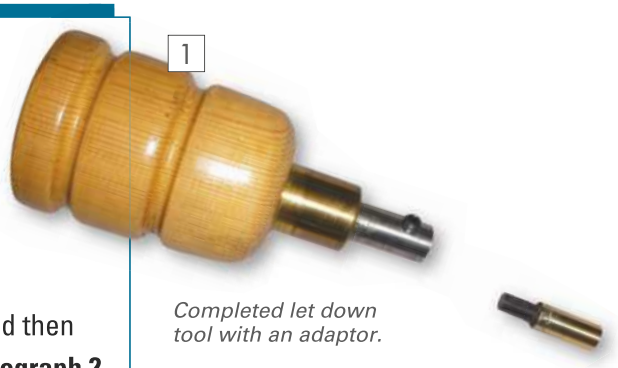
Boring holes for the vertical support columns.

The 25 amp power supply, a suitable outer enclosure is needed for electrical safety.

A Spring Let Down Tool

Henry Hicks describes an essential tool for anyone making or repairing spring driven clocks.

Before trying out any fancy manoeuvres with a spring-driven clock, all residual tension of the main spring must be let down. This is most easily done with a special tool as shown in **photo 1**. The idea is to clamp the movement so that it can not run away across the bench, fit the tool to the square on the mainspring arbour, turn it slightly so that the ratchet just disengages, move the pawl over so that the arbour can rotate and then let it rotate slowly in the hand until all the tension has gone. **Photograph 2** illustrates the final result of all this activity.



1

Completed let down tool with an adaptor.

2

The tool in place after letting down a clock spring.

Since all clocks are different a range of adapters is needed to allow different clocks to be unwound. I made these adapters removable so that for each new size of square to be connected to, only a new adapter need be made.

The tool and one adapter is shown in **figs 1** and **2** giving the necessary dimensions, but these are not critical except for the square hole in the adapter which must fit the barrel arbour fairly closely. If not, then the square will be knocked about by this tool and that is not good for the arbour or for the tool, The handle is wood, as far as the end of the brass banding; then a steel piece is glued (Araldite) into the wooden handle. This piece is drilled to take the adapter which is held in place by a 4BA set screw which fits a hole which is cross-drilled and tapped. This screw comes up against a flat milled 0.05 inches deep by ¼ inch in the tail of the adapter (**photo 3**) and thus locks it in place.

Making an adapter is straightforward. First measure the square on the end of the barrel arbour (**photo 4**). Then using a drawing package draw the square. Note that not all squares are in fact square! You will then have to choose between trying to make a rectangle and making a

Fig. 1

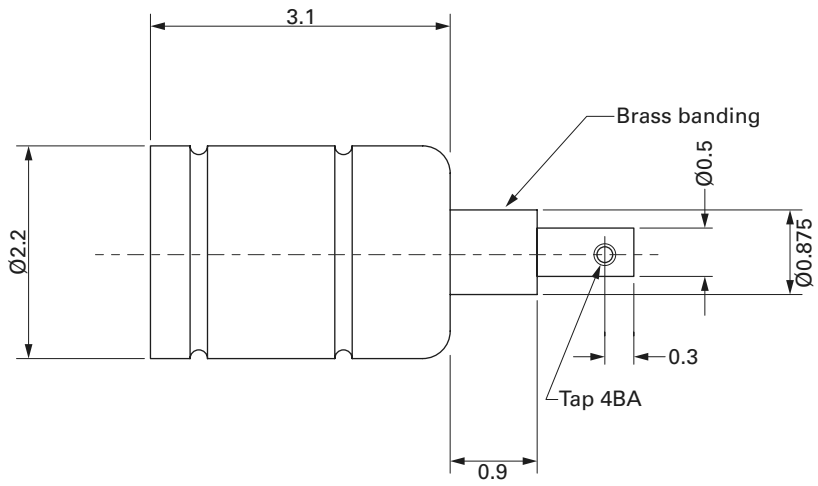
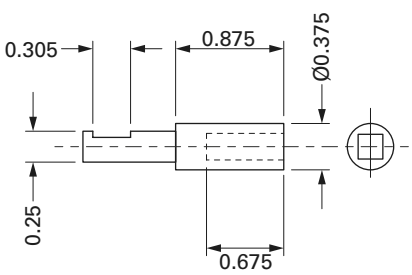


Fig. 2



Machining a flat on the adaptor.

Measuring the square on the clock winder.

Drilling out the corners of the 'square' recess.

Drilling out the centre part.

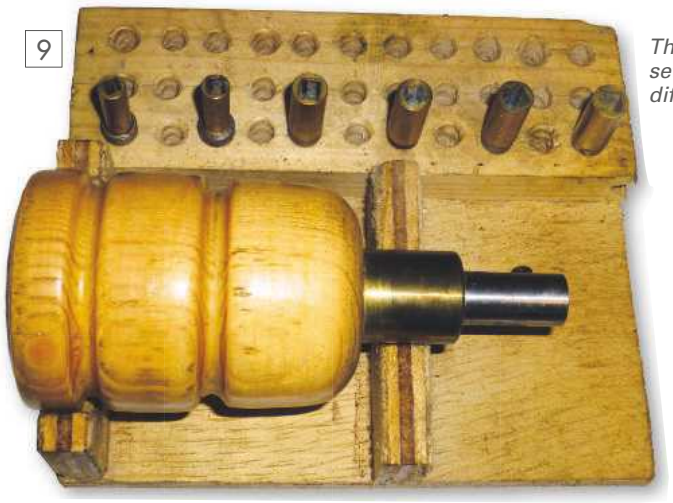
The finished square after filling, note the soft jaws.

Using a DTI to compare the height of a bar and a milling cutter.

square to fit the larger dimension. Now draw a circle tangent to the square and two diagonals as in **fig. 3**. Now centred on where the circle crosses each diagonal draw four small circles tangent to the square (**fig 4**). Now measure the diameter of the small circles and the diameter of the larger one. This latter is the PCD of four holes which will help to form the square. Set up a blank piece of brass with the necessary dimensions for an adapter and with the dividing head attached to the headstock drill these 4 holes all the way through the blank as in **photo 5**. Then drill out the centre material with a drill the same diameter as the PCD as shown in **photo 6**. The final operations are carried out in the vice (fitted with softjaws) and square cross-section files. **Photograph 7** illustrates this process. Remember that some squares may be slightly tapered and the filing of the adapter should take notice of this.

I have described in the past how to set up a Quickstep mill (or other toolpost mounted spindle) so that its centre line is coincident with that of the lathe. Briefly, for those who have only just joined us: set a ground ¼ inch bar in both the lathe headstock and the Quickstep collet and set the Quickstep one to the same height as the lathe's using a DTI (**photo 8**). Now set the Quickstep so that its bar just touches that of the lathe when moved towards you, the operator. Zero the cross-slide

9



The tool with a set of adaptors of different sizes.

thimble at this setting. Now remove the ¼ inch bars and advance the Mill towards you by a distance equal to the sum of the diameters of the bars divided by two. The Mill's centre is now coincident with that of the lathe. The Quickstep is now moved towards you from this centre position by a distance equal to the Pitch Circle Radius discussed above. At this setting the four small holes can be drilled using the dividing head which controls the headstock mandrel.

To complete the adapter a quarter inch of a piece of steel is machined to a suitable OD to fit inside the brass square and the rear part machined to ¼ inch diameter. The steel is then silver soldered into the brass. Now the adapter is held in a collet and the flat milled as in photo 3.

It may be that some adapters would benefit from a collar machined as part of the steel piece in order to prevent it from entering too far into the brass.

Finally, **photo 9** shows the finished device with a number of adapters all held in a make-shift holder to keep them all in one place. ■

Fig. 3

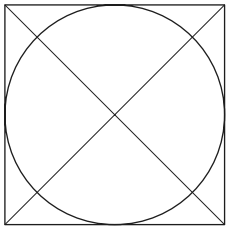
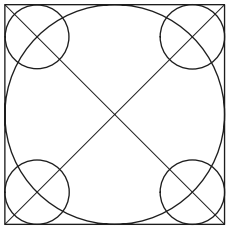


Fig. 4



In our Next Issue

Coming up in issue 240
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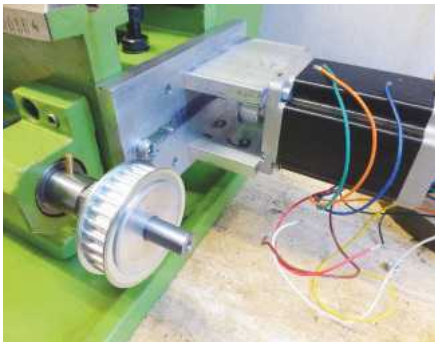
David Piddington offers advice to beginners on using a mill to cut exact lengths

Albert Bishop modifies a vintage cast iron stand to suit a Myford Super 7



Bob Rodgerson recounts the first eighteen months with his Tormach CNC Mill

Chris Gabel details an electronic leadscrew controller for his lathe

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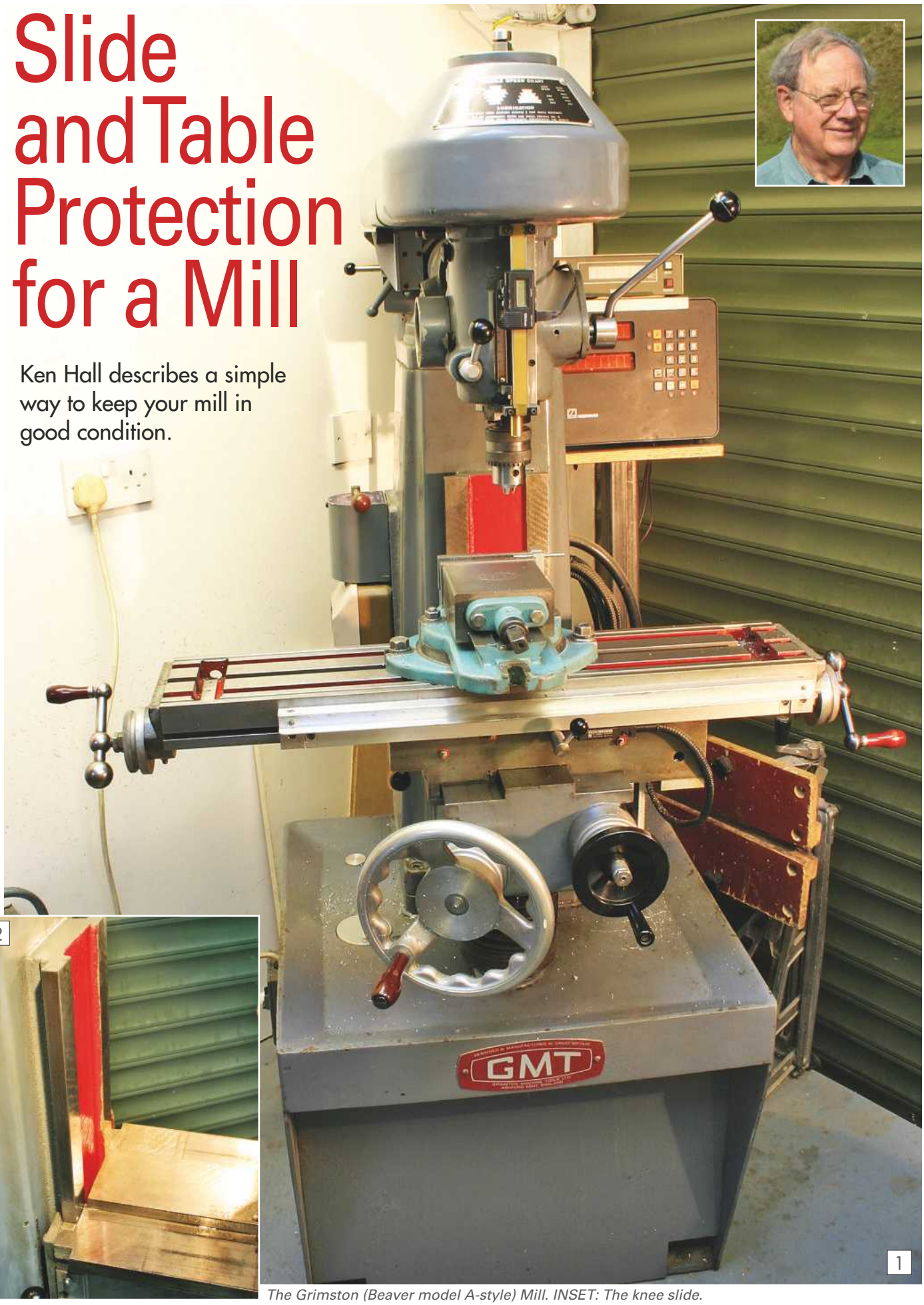
Slide and Table Protection for a Mill

Ken Hall describes a simple way to keep your mill in good condition.



The Grimston (Beaver model A-style) Mill. INSET: The knee slide.

A milling machine is an expensive piece of equipment for any home workshop, so it is sensible to maintain its accuracy for as long as possible.

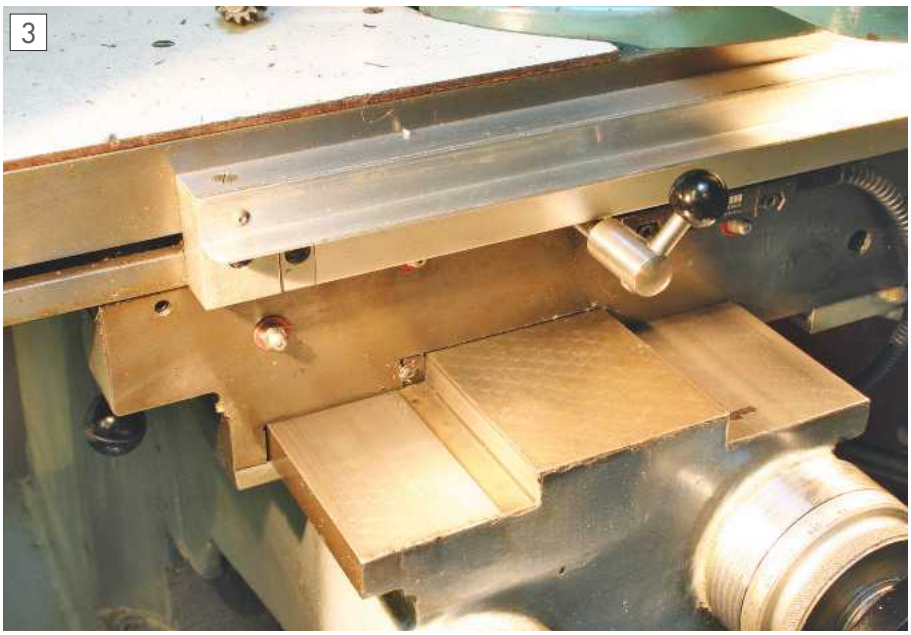
The mill table slide (often a dovetail) is usually under the table, so it is protected from swarf, but often the transverse slide is not, nor is the knee slide (if the mill has one). The table surface itself is not covered, although it can easily become a shelf and a swarf-collecting point, also it is easily damaged accidentally. I have fitted my mill with some cheap, quickly made covers that seem to do the job.

Thoughts on Swarf

To begin with, why is swarf a problem?

Fine swarf particles get into slideways, causing wear if the particles are hard, soaking up or contaminating lubricants and clogging mechanisms. Occasionally I machine wood, some varieties of which are quite abrasive, so wood and other non-metalllic materials can have all the snags of metal swarf.

My machining does not often involve cast iron which produces a fine dusty swarf. When I was an apprentice all the heavy milling was on iron sand castings. At the end of the working day the machinists looked like Victorian chimney sweeps and the machines were heaped with black dust. The state of the machine slideways can be imagined, as no guards were fitted.



The transverse slide.

Slideway Protection

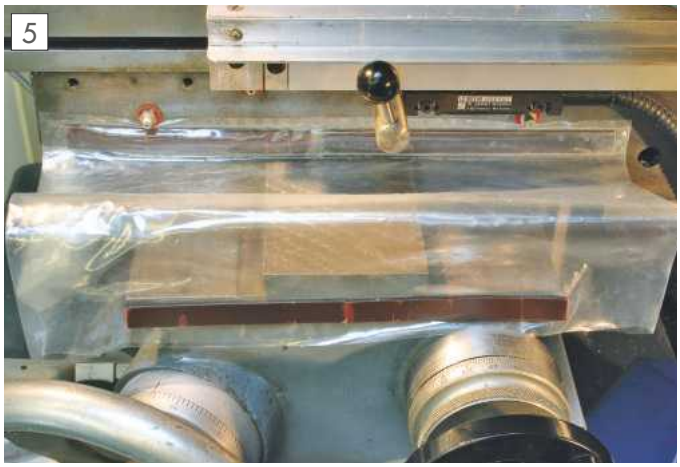
My elderly (like me) mill is a version of the Beaver Model A turret mill but made by Grimston. The Beaver Mill is described on the www.lathes website. The only protected part is the knee adjusting screw which has a bellows. **Photograph 1** shows the machine before the covers were fitted. In **photos 2** and **3** you can see how the uncovered transverse and knee slides are fully exposed to anything that falls off the table.

Photographs 4 and **5** show the covers in place, which are made from large polythene bags. The cover behind the table (photo 4) protects both the knee and transverse slide. It is spread out at the top by a light metal strip (which could also be of wood or plastic), and is held in place by 2 strips of flexible magnet. The magnets are inside the bag so that any ferrous particles attracted to then can be wiped off easily.

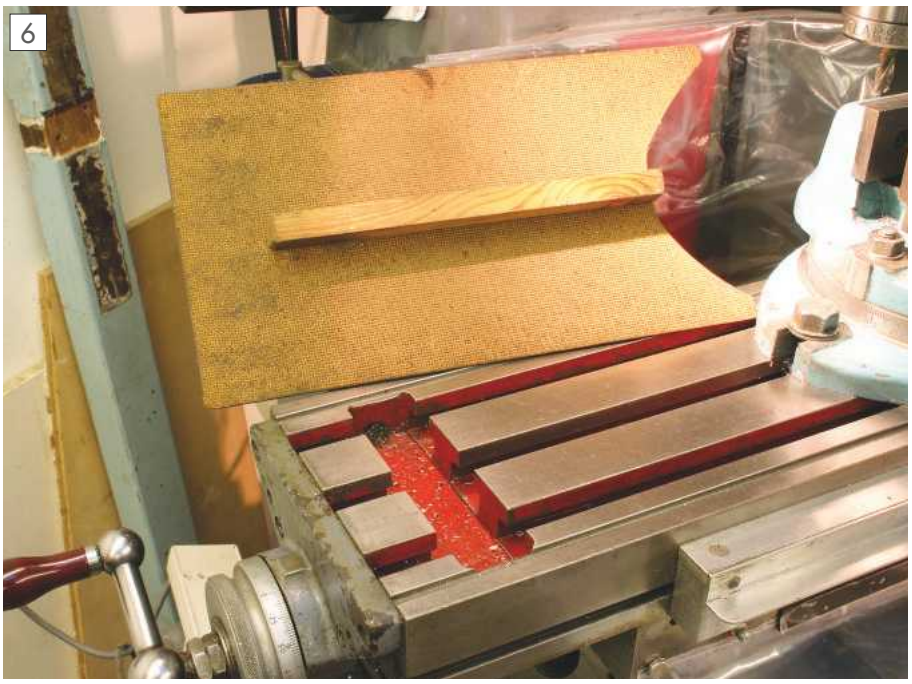
The lower end of the bag is held to the housing carrying the table using one long strip of flexible magnet. This open end of the bag can be sealed with tape or staples once the magnets and spreader strip are inside. In my case the bag is left open with the magnet on the outside, but I don't machine much that would produce magnetic particles. Swarf settles in the lowest part of the cover and can easily be swept out from either side. This needs to be done regularly if a large quantity of heavy swarf is being produced.

These covers will not enhance the look of the mill, so if this matters to you they could be put on only when a nasty type of swarf is being produced. Personally I have found them so useful that they are here to stay.

This simple plastic guard provides ample protection at the back.



This is the arrangement in front of the table.



A simple table protector from hardboard.

A similar arrangement is used at the front of the machine, but with a much shorter bag.

The length of the back cover can be settled by moving the slides to the maximum extent (i.e. knee down, table forward) that the cover must accommodate. Then a piece of string or measuring tape can be used to obtain a length for a cover that will still have a little droop in it, not stretched rigid at the maximum table position, and allowing for the length needed for the magnets.

The length of the front cover and the back cover for a machine without a knee is straightforward, using the full table positions plus some extra length for the magnets however they are to be arranged. The covers need to be as wide as possible to give the maximum protection. Mine are 1.5 times the total slideway width and this seems to work well.

It is important that the covers do not hide lubrication points, although protecting them from dust and swarf is a good idea.

The covers in the photos are new ones specially replaced for illustrating this article. The previous ones were about two years old and were perfectly usable if a bit dirty, and could have lasted another year or so. The bags I use are 'medium duty' which is 250 gauge (0.0025 inches) thick. A single thickness of a heavier gauge with the ends rolled over and stapled or taped to provide pockets for the magnets would be fine. Really it is a matter of using what you have around. There should be no need to buy a load of new bags.

If enthusiastic machining produces very hot swarf, some chips might fuse onto the polythene, but this will not stop the cover working, although it might need replacing sooner.

These covers will not enhance the look of the mill, so if this matters to you they could be put on only when a nasty type of swarf is being produced. The covers can then go in the bin with the swarf. Personally I have found them so useful that they are here to stay.

Table surface protection

Although machine slideways now have protection on better-class mills, the work-table itself is left clear for obvious reasons. It is, of course, vulnerable to accidental damage from things dropped on it and also wear from things slid around when it is used as a convenient shelf.

The tee slots themselves are working parts of the table, so are better not filled with swarf. Fitting tee nuts is impossible in a clogged slot, when time is wasted in the irritating job of clearing it out. Some of us have lost a small drill in a swarf-filled slot and know how annoying this is. For me these are experiences of the past.

Photograph 6 shows one end of the mill table and the underside of a cover fitted with a wooden tenon. **Photograph 7** shows the table used as a shelf with impunity!

Most of the parts I make can be held in the machine vice, which is nearly always left bolted to the middle of the table. This leaves two identical areas of table, which I have covered with hardboard pieces cut to fit round the vice base. When the vice is removed, the covers give an easy guide to replacing it in its normal position.

Now, not only are the tee slots clean if they need to be used, but a convenient area is available for spanners, cutting tools, parallels and all the other things that are involved in setting up the mill, and during the machining process.

Obviously it would not take long to make extra covers to fit round a rotary table, dividing head or anything else that is bolted to the table.

My covers were cut from white-painted hardboard, but they could be painted to match the machine. Underneath the cover a strip of wood is screwed on to locate in the centre tee slot. Beading could be added to the upper surface to stop things rolling or sliding off, but I have not found that necessary during the several years they have been in use.

If condensation in the workshop is a problem, the covers should be packed up to leave an air gap. This will avoid the contact of a water-absorbent material with the cold metal, where rusting could take place unnoticed.

I have not mentioned cutting fluid, as I am a 'squirt in/on as needed' machinist. With cutting oil running over the table, hardboard would not be a good idea, but outdoor quality board, marine ply, rigid plastic or metal sheet could be used instead.

There is a great satisfaction in being able to put anything, however knobbly, small or sharp on the mill table without even a twinge of guilt or worry about where it will all end up!

Materials

I bought my flexible magnetic strip ½ x ⅛ inch section as a roll, quite cheaply on eBay, where there is a choice of suppliers, cross-sections and prices.

All other materials should be available in a normal home or workshop, at no cost. ■

And proof it works.

FREE PLAN

Boring Head

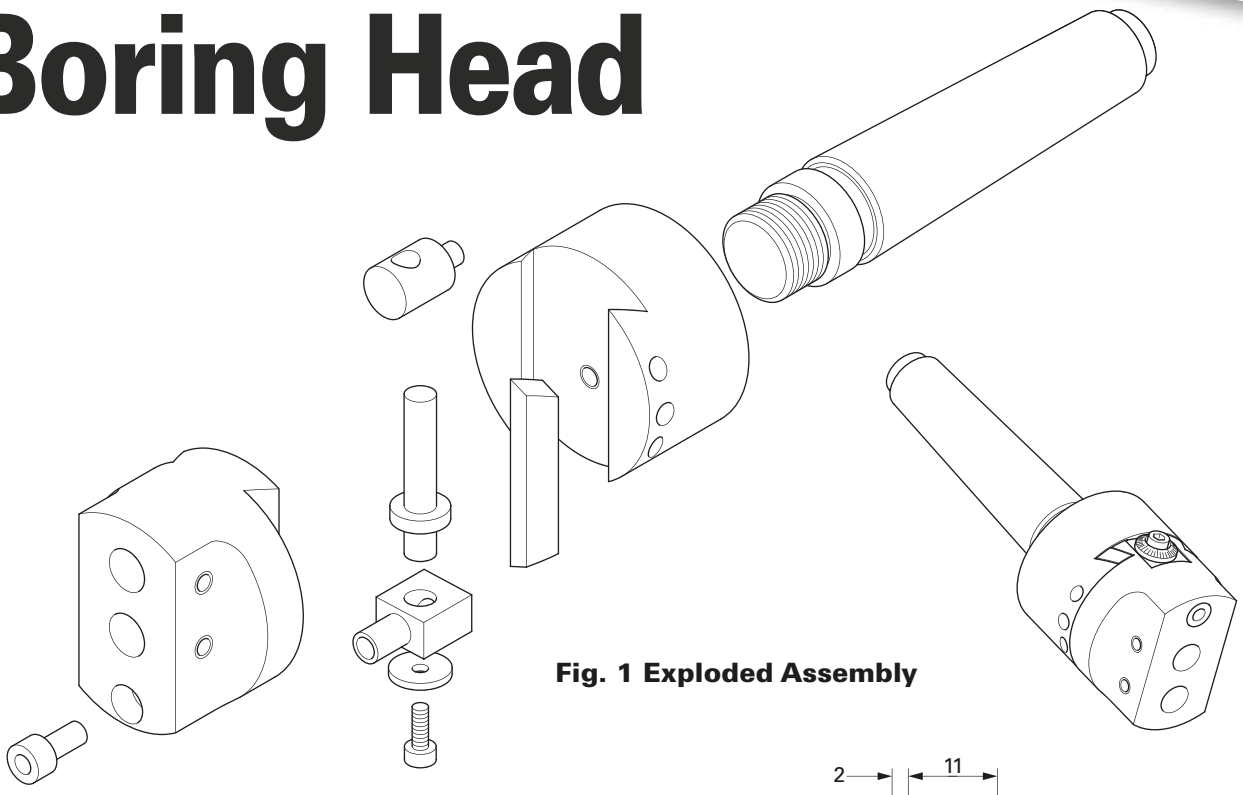


Fig. 1 Exploded Assembly

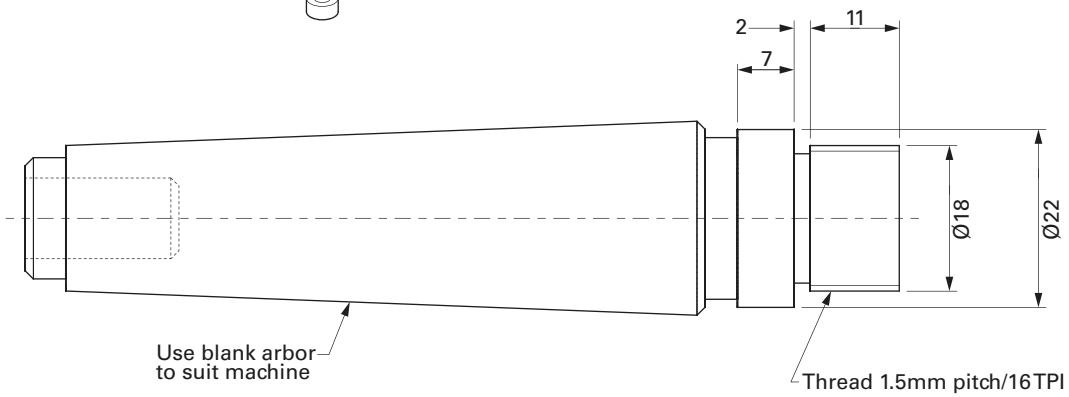


Fig. 2 Arbor

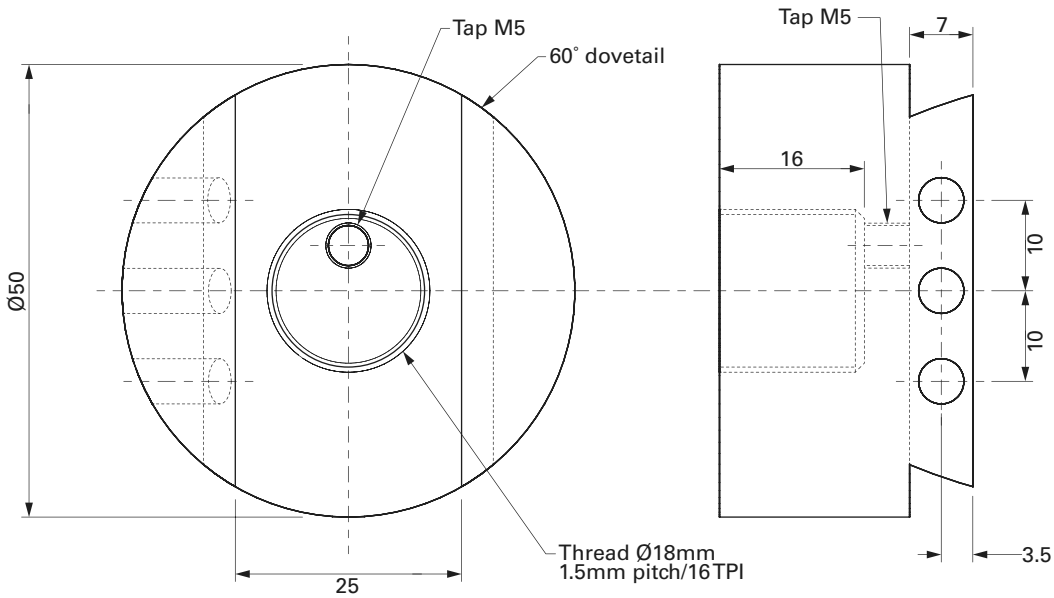


Fig. 3 Body
Mat'l: M.S.
Use Ø2in bar, machine Body & Slide to finished dimension together

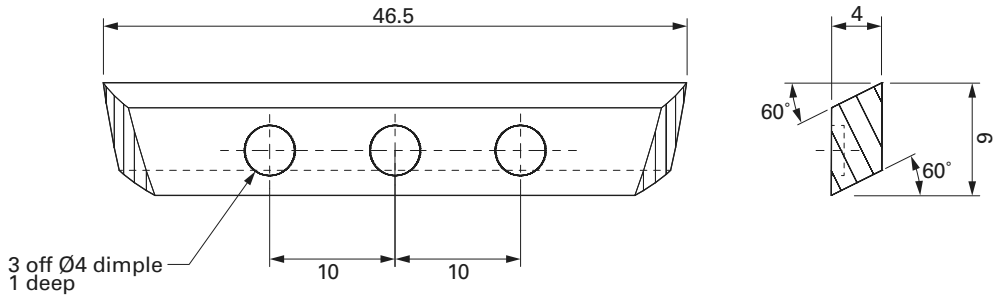


Fig. 4 Gib Strip
Mat'l: Brass or M.S.
Trim ends flush in place

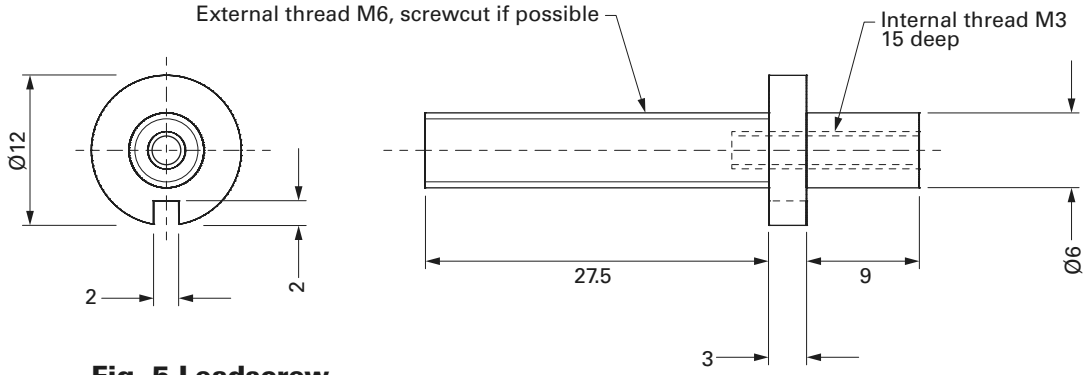


Fig. 5 Leadscrew
Mat'l: M.S.

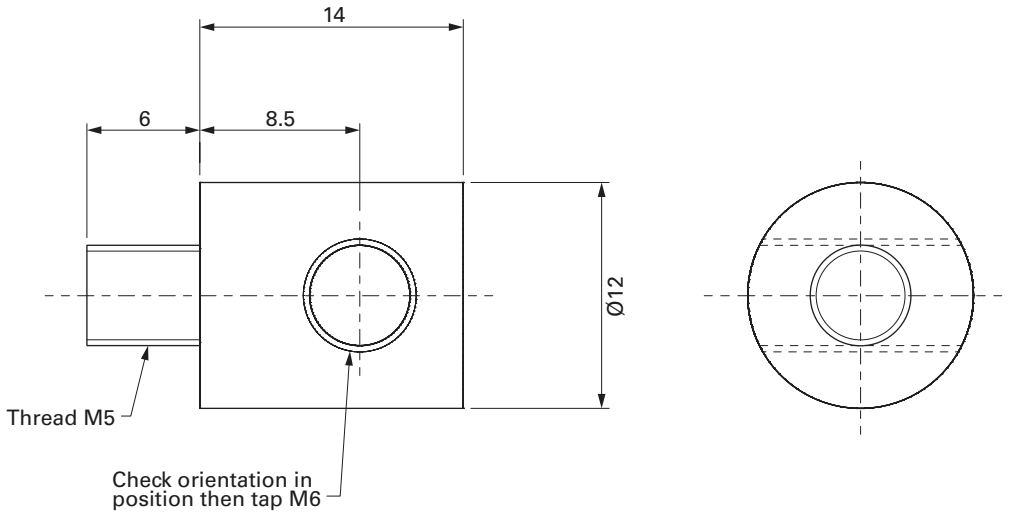


Fig. 6 Leadscrew Nut
Mat'l: M.S. or bronze

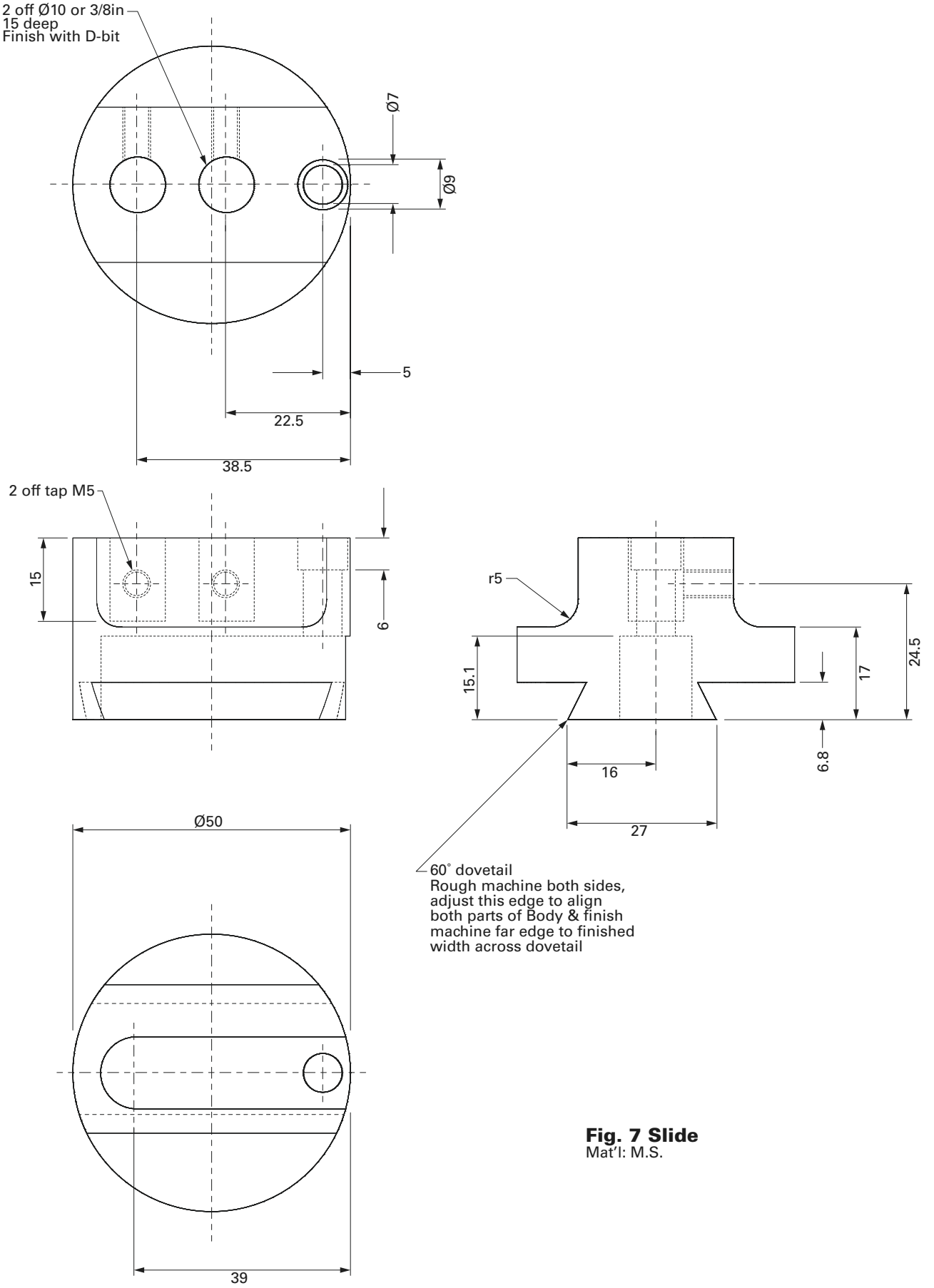


Fig. 7 Slide
Mat'l: M.S.

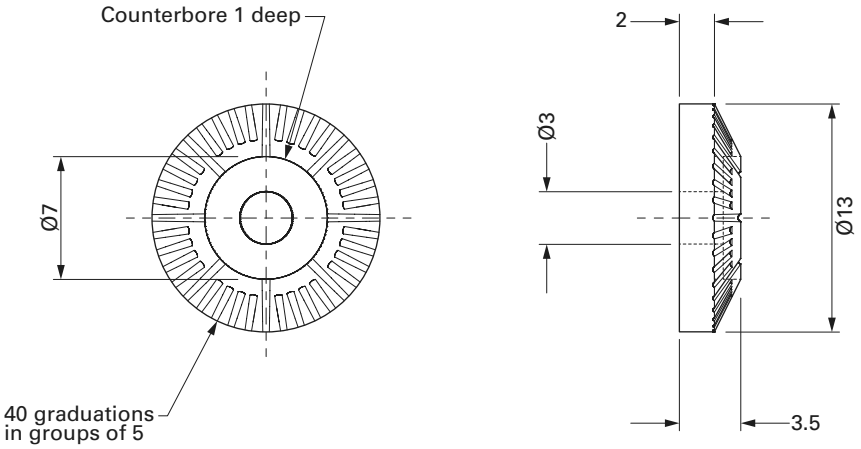


Fig. 8 Index Dial
Mat'l: Brass

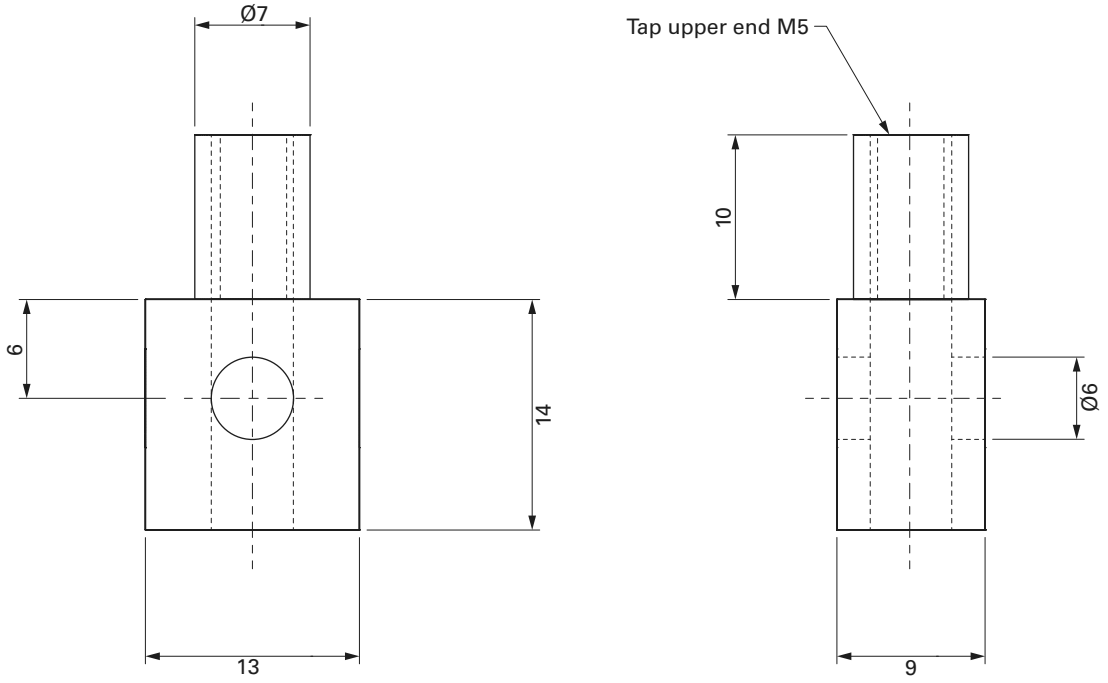


Fig. 9 Leadscrew Support
Mat'l: M.S.

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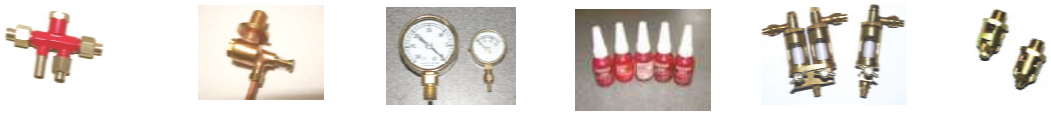

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An HSS Tooltip Holder

Jacques Maurel explains how to make your own holders to suit a range of turning tasks.

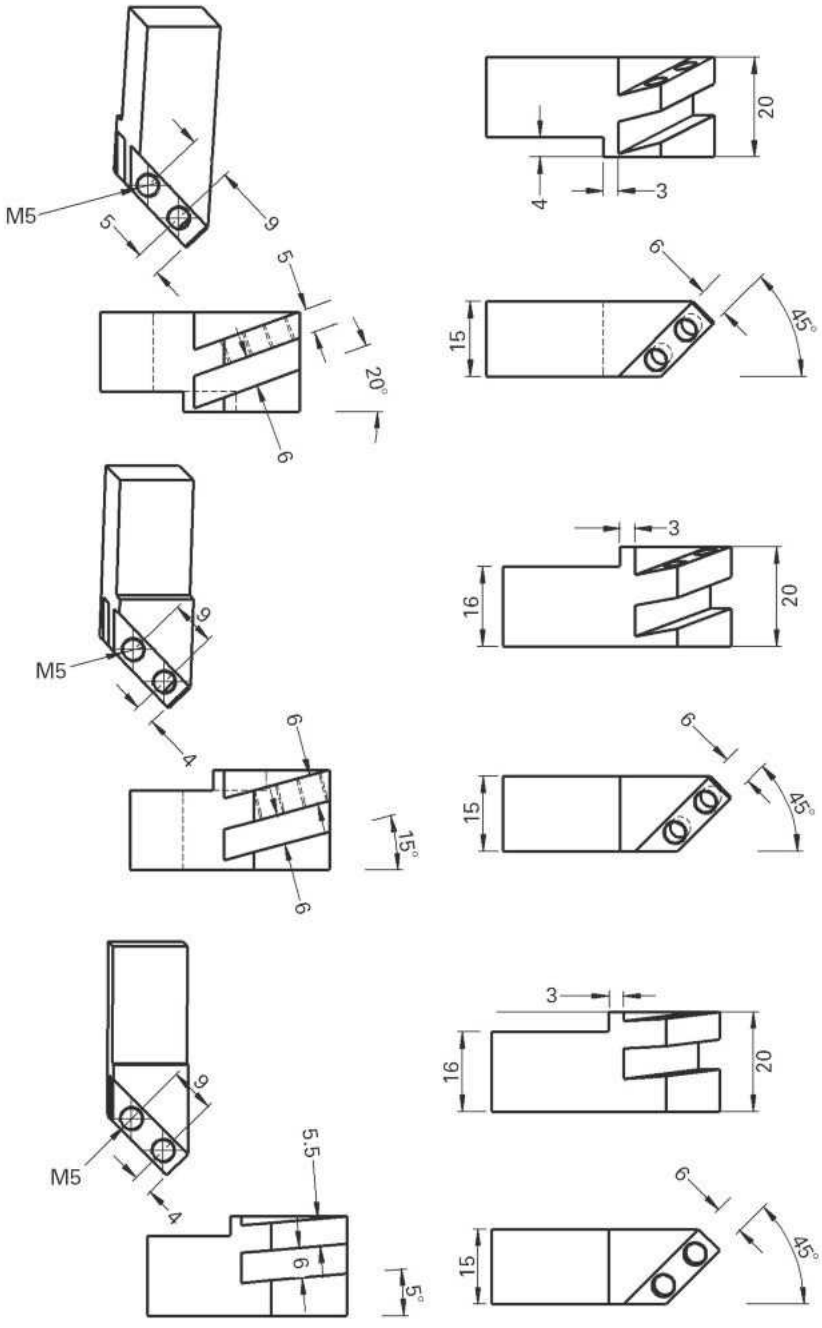
A robust, traditional inserted HSS tip holder.

I have been using for years a home-made tangential tool and found it very convenient for turning and facing, but found the built in clearance quite big (12 degrees). This is good for finishing but too much for roughing. Moreover, diminishing the clearance would make the clamping of the bit almost impossible.

So came the idea of making tooltip holders in which the rake angle should be built in, thus reinventing an old fashioned lathe tool (see **photo 1**) but easier to make for an amateur, avoiding the long square hole that is so difficult to machine.

They are now my most used HSS lathe tools. I have 15 degree rake tools (for steel) and **photo 2** shows 5 degree ones (for brass). **Figure 2** shows the 20 degree rake angle tool.

Fig. 1



The main interests of these tooltip holders are first the easy way of machining them and second the easy method for sharpening the bits.

Machining the tooltip holders

Be aware, the figure is for a 15mm square tool shank and 6mm bit, but can be scaled down for smaller sizes. See **fig. 1** for dimensions (the shank is shortened on these figures).

Use a piece of 15x20 CRS steel, 95 mm long. Machine first the two 45 degree planes (**photo 3**). The angle (45 degree, half a square) is given by a template made of aluminum sheet, but cardboard can be used for this.

Five degree holders for brass.

Start by putting the 45-degree angles on a steel blank.

About to machine the tool tip groove.

Drilling holes for the clamping screws.

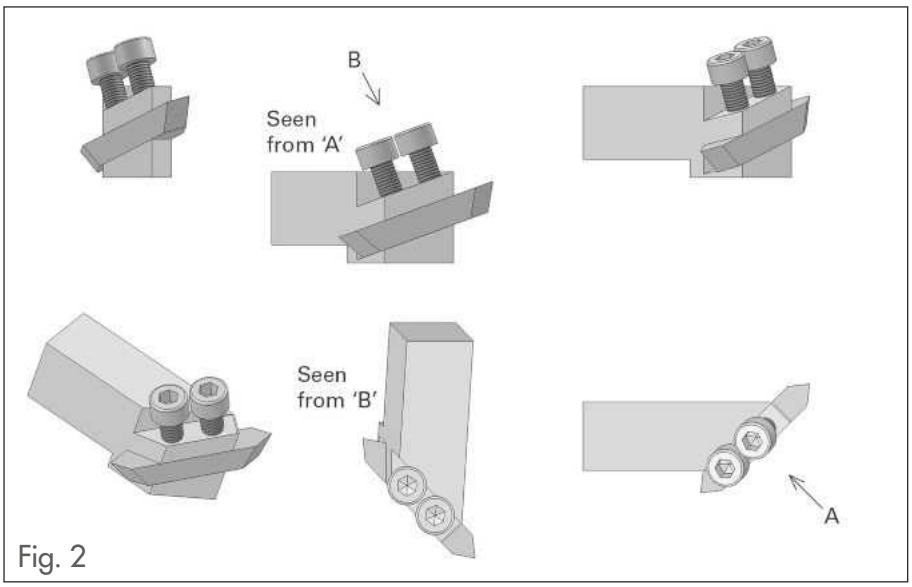


Fig. 2

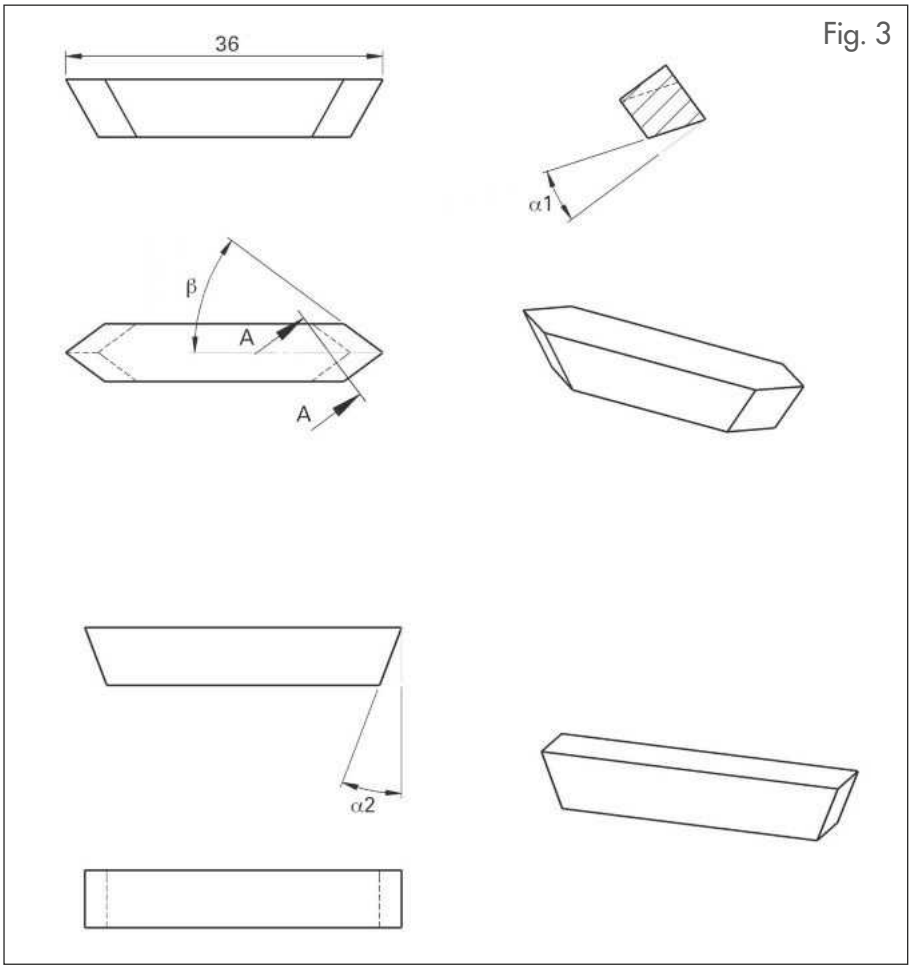


Fig. 3

Turn the vice to give the rake angle (**photo 4**) for machining the tooltip groove with a 6mm end mill; machine next the shoulder with the same end mill.

It's now time to drill and tap the two holes for the setscrews (**photo 5**). Tighten the tool in a toolmaker's clamp set at 45 degrees to the tool shank, put the whole in the drilling machine vice, turn the clamp in the vice for the drilling plane to be horizontal with the help of a parallel and tighten the vice. Drill 4.3mm holes for tapping M5. Use cap head M5-12 screws of quality 8-8 minimum. Smaller screws could be used but for that the shoulder would have to be deeper than 6mm. Grub type screws won't be convenient here due to the small length (5mm) as they must be completely sunk.

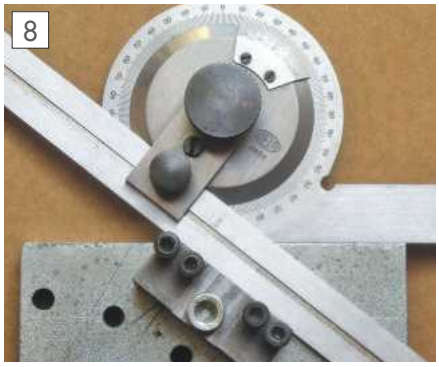
Go back to the milling machine for milling the base, a straightforward job.

Sharpening the tool tips

Two types of tip are to be used, the one with the straight edge for facing and chamfering, the one with an 80 degree point for turning and facing against a shoulder (see **fig. 3**). As the rake angle is given by the tip holder, only the clearance

Grinding tips fitted to a holder risks fouling the wheel.

Setting the clearance angle, a card template could be used.



Setting the point angle.

Fig. 4

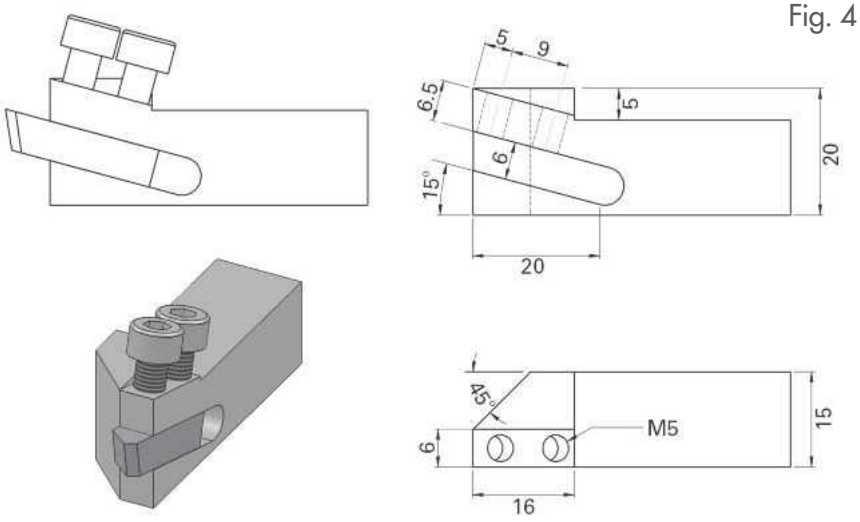
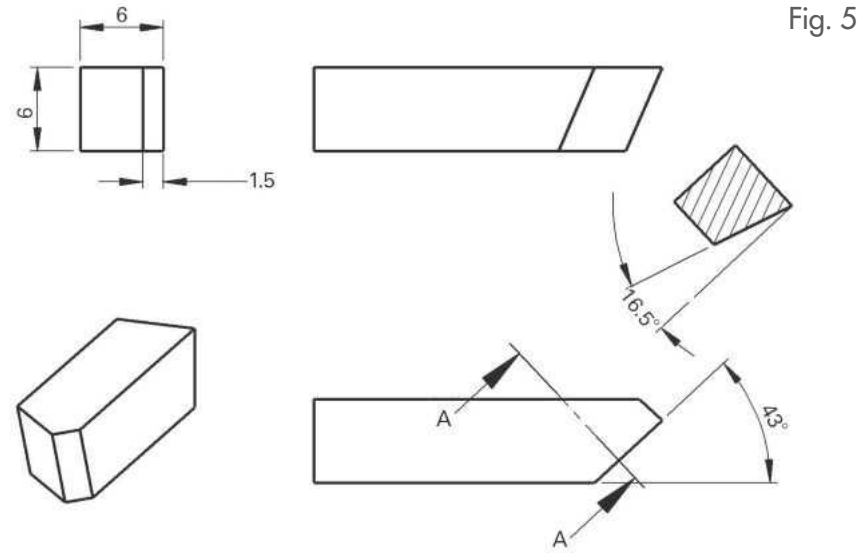


Fig. 5



must be ground. So it's worth polishing the upper face of the tip (by rubbing on a slip-stone or on a felt wheel loaded with polishing paste) before grinding the clearances.

The straight edge tip is easy to sharpen, even if already set on the tip holder, in which case the standard 6 degree clearance must be adjusted on the grinding rest, to suit whatever the rake angle is given by the tip holder.

This is not the case for the 80 degree point tool as when grinding the left side of the point (see the tool in a working situation) the shank of the holder could hit the grinder. For this reason, I prefer grinding the tips out from their holder (**photo 6**), the angle setting will be different on the grinding rest, the values are given in the chart below.

The clearance angle is set with a protractor (**photo 7**) the black line is drawn at the tip height this point must be set tangent with the grinding wheel by adjusting the grinding rest. The point angle is also set with a protractor (**photo 8**).

The two edges can be different in size, a small right edge will be necessary for turning a small diameter between center (for clearing the running center).

Notes

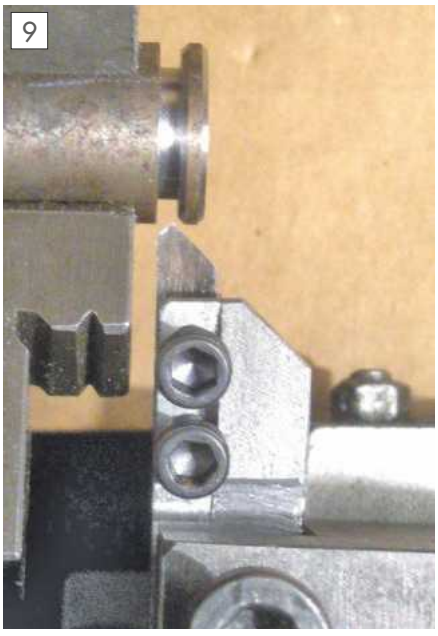
It's worth grinding the both ends of a tip to have two cutting edges.

A well honed 80 degree point tool with rounded tip and small depth of cut working from left to right will give a fine finish.

Chamfering tool

A chamfering tool (45 degrees) can be made in this fashion (see **figs 4** & **5**). This tool can be seen in a working situation in **photo 9**. This explains the short left edge to avoid hitting the chuck when chamfering before finishing the parting-off, while it's possible to chamfer the right side of the washer with the same tool. ■

Angle:	α1	β	α2
5 degree rake	9 degrees	40 degrees	11 degrees
15 degree rake	16 degrees	40 degrees	21 degrees
20 degree rake	19.5 degrees	36.5 degrees	26 degrees

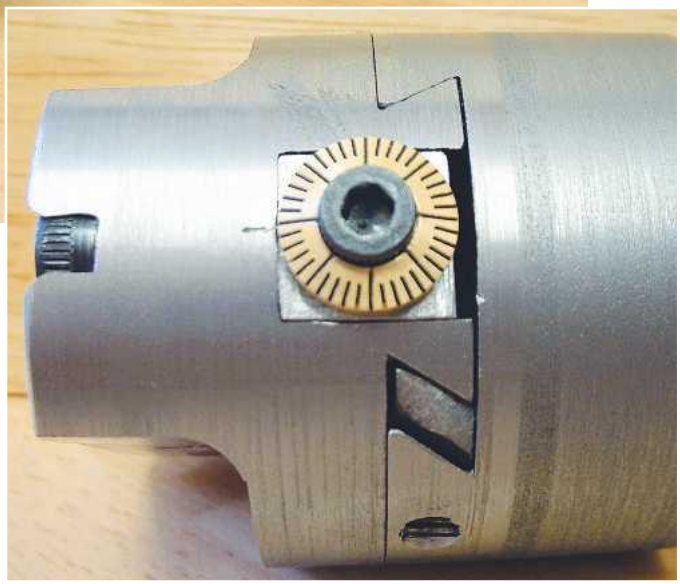


The chamfering tool.

A Micrometer Boring Head

Build this useful accessory from our **FREE PLAN**.

The completed boring head.



A close up showing the graduated dial.

Our boring head demands a certain amount of care in construction, but will reward you with a handy tool that should last a lifetime.

Exploded Assembly Figure 1

This assembly diagram will help you understand how the whole boring head goes together. The sliding head fits in a dovetail on the body, and is moved, over a fairly short range, using the leadscrew.

Arbor Figure 2

This shows the arbor on which the head is mounted. This can be any commercial blank-end arbor, with a suitable thread and register cut on the end.

Body Figure 3

The body of the unit can be made from 2 inch diameter EN1A, which leaves a small allowance for final machining. It should be threaded to be a close fit on the arbor. Take care to get the dovetail central and observe the depth and width of the dovetails as closely as possible.

Gib Figure 4

The gib strip should be left unfinished until the body and slide are completed, but make the 'embryo' strip now as it can be used as a gauge when fitting the two dovetails – the gib should slide freely into the gap between the two parts, without any binding.

Leadscrew Figure 5

The leadscrew is a nice exercise in screwcutting, but will benefit from finishing with a die. Note that M6 is 1mm pitch, but you can use other pitches if they

suit your needs. Note the small slot – this will be needed to lock the leadscrew for final assembly.

Leadscrew Nut Figure 6

The leadscrew nut threads into the body. This means you need to fit it and check its orientation before drilling and tapping it for the leadscrew.

Slide Figure 7

The slide is the most complex part of the boring head. Rough machine the dovetail, then 'tweak' it so that the embryo slide aligns well with the body and use the gib to finish the dovetail to width. Break the corners of the dovetails so they do not bind.

The two holes for the boring bars should be finished with flat-ended d-bits to get a close fit on your bars. Both 10mm and ⅜ inch sets are available so make sure your holes match your bars!

The scallops are not just decorative, they reduce out of balance weight, but the exact radius is not important.

Index Dial Figure 8

This is a nice little job, and it isn't too hard to make the 40 division marks. First angle the top slide to turn the taper and then use it to move a sharp pointed tool across the dial to cut the grooves. Dividing the forty divisions can be done by fitting a 40-tooth change wheel to the back of the lathe spindle, and using a springy strip of brass to improvise a detent.

A set of boring tools, together with allen keys to fit the boring head.

Leadscrew Support Figure 9

This piece should be carefully made so that it fits in the end of the leadscrew groove on the underside of the slide, locating in the 7mm hole. Make some careful measurements and ensure that the 6mm hole aligns exactly with the thread in the leadscrew nut.

The boring head in use.

Assembly

To assemble the head you will need some M5 grub screws for the gib and bar clamp screws. The best type have a short, cylindrical section on the end with a flat, rather than a point.

Before fitting the leadscrew, fully tighten the gib and take a light skim over the whole body and slide to bring them to their finished 50mm dimension.

Fit the leadscrew nut and leadscrew, then over these fit the slide. With the leadscrew wound in a little you should be able to fit the leadscrew support (with an M5 cap screw) then wind the leadscrew out. You may need to make small adjustments until the dial (when fitted with a 10mm long M3 capscrew) gives a shake-free fit for the leadscrew in the support. Use a screwdriver in the notch in the leadscrew collar to stop it turning.

Check everything works, but bear in mind that you will need to use some retainer on the dial fixing screw on final assembly. A little moly grease on the leadscrew and slides is a good idea.

In Use

The boring head should be used with the gib set fairly stiff, and the rpm rather slow. The minimum hole size is about 12mm using the central hole and over 60mm using the outer hole.

The biggest challenge, as with any such head, is setting the boring bars just right, as it is very easy for them to rub. This is not an automatic head, so after each run through a hole, stop the machine and put on the cut. One division is 0.025mm or 0.001 inch on radius, or twice that on diameter. With a little practice you should have no trouble using the head to bore out holes to an accuracy of better than half that. ■

Accurately Formed Threads and Simple Multi-Start Threading

A typical gear cutting train.

Peter Nicolson offers a few ideas on the use of Coventry Dies for achieving more accurate thread forms when screwcutting in the lathe.

For single point threading, most of us would sharpen a HHS tool bit to the correct angle, adjust the speed of the feed screw to give the required thread count in either mm of pitch, or threads per inch (TPI) (**photo 1**), cut a thread and then run a die over the job to clean up the thread.

A much more accurate tool can be made up from a suitable loose Coventry Die Box die. These dies come in sets of four, and if one is lost or broken, the other three can no longer be used in the die box, as a result they are usually scrapped or can be obtained quite cheaply.

Photograph 2 shows a selection of Coventry dies that have been modified for screwcutting in the lathe.

The procedure is to grind away all the teeth except one from a single die of the pitch you require, making sure that a complete tooth remains (including a small part of the root). This ensures that the top and bottom of the thread are of the correct form. The thread is then cut in the normal way, depth of cut becoming much easier to judge, as the root acts as a guide.

The die can then be held in a suitable holder, or can even be stick or MIG welded to a suitable shank.

Multiple start threads become very simple to do. For example, for a two start thread, leave two teeth on the die, and double the speed of the lead. i.e. If a two start 1mm. pitch thread is required, run the lead set for a 2mm.pitch thread. This results in the second thread being started half a turn later by the second tooth on the tool. Similarly, if a three start 12TPI thread is required, leave three teeth on the die and run the lead at 36TPI. ■

A selection of Coventry Dies, some welded to shanks and all ground to leave just the required teeth.

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One Man and his Lathe

Mike Cox and his SEIG Mini Lathe

Over the past twenty years or so, the availability of the Chinese '7x12' mini lathe has proven an affordable route in to the hobby for many thousands of people. Mike Cox has described many useful accessories and mods for these machines in the pages of *MEW*, but now he tells the story of his lathe itself.

My education in the 1950's and 60's was totally devoid of any mechanical arts and my only experience of making things was helping my father with the odd bit of woodwork. However, at an early age I developed an interest in all things electrical and I think I built my first two valve (remember those?) radio set by the time I was 10 years old. I can still remember the thrill of buying my first transistor, an OC71, and experimenting with it. I was also interested in all things scientific and from the age of 11 chemistry dominated my reading and learning. My interests in electronics and chemistry were well served by a publication called 'Hobbies Weekly' that included many other subject areas including woodwork, model making and some metal work. Unfortunately, such magazines no longer exist. I think the subject matter would be considered far too risky and dangerous for modern kids (mains electrics, high voltages, chemicals, sharp tools etc.)

My first encounter with a lathe was at the age of 15 when I took a job during the school holidays at a local engineering firm. I was sat in front of an automatic lathe that was making aluminium rollers and given a piece of bent wire with which to fish out the long streamers of aluminium swarf that were produced during the parting operation. Periodically I had to replace the aluminium bar that was fed into the machine. These were about 3 metres long and 35mm diameter. I can remember being shouted at by the foreman because I caught the wire between the parting tool and the bar one day. This chipped the parting tool and also threw the timing out of sequence. The facing and parting operations were all operated by cams driven from a common shaft and in the jam up the cams had moved on the shaft and the machine was out of action for a few hours whilst the timing was reset. All this for 37 shillings (£1.85) for a 40 hour week.

I left school at the age of 18 with A levels and worked for a well known oil company as a lab assistant in a chemistry laboratory. I quickly realised that to make a career as a chemist I needed a degree so I applied to study Chemistry at Bath University and I was offered a place. I stayed for 11 years doing first a Chemistry degree, then pursuing a Doctorate in Materials Science (aka Metallurgy) and then doing post doctoral research much of which was applied Physics. Eventually after 11 years at University I thought I had better find a proper job in industry!!

I joined a well known consumer products company that had interests in shaving products and in matches. They had a large research and development division. They employed me initially to work on developing razor blades made from exotic metallic glasses but I also worked on a project to develop synthetic match sticks. Two years after joining the company they decided that the R&D division had become too much of an ivory tower and that it would close. I took redundancy but was contacted later by the match division who offered me a job in their R&D department.

I worked in the match industry for the next 30 years developing new production methods and products ending up as the Research and Development director. During this time, I worked very closely with engineers who sort to implement new ideas in production. Very often I would have ideas on how things should be done that were at odds with theirs. This was sometimes frustrating.

As I approached retirement I was looking for a new interest to keep me occupied and I decided that I would like to try my hand at metal working. I looked around for a lathe but the investment in a new Myford was several thousand pounds and even second hand machines were expensive. I was not prepared to invest so much money in something that I did not know whether I would enjoy. I bought a copy of *MEW* and saw the Clark mini-lathe on offer from Chronos for around £400 including some accessories and a set of brazed carbide tools. I decided to take the plunge! The Clark minilathe is a badged version of the Sieg C2 lathe. It has a swing of 7 inches and a between centres distance of 12 inches.

I also bought a copy of *The Amateurs Lathe* by L. H. Sparey and read it several times from cover to cover.

The machine arrived a few days later. I spent some time cleaning it. The splash back was a bit damaged but that was soon straightened out and the machine was ready to go. Then began one of the most frustrating periods of my life.

I had a brand new machine and a set of brand new carbide lathe tools. The first problem was that the tools were too high when in the tool holder. I had read in the L. H. Sparey book that the tool tip must be exactly on centre line. My tools were close to 1mm above the centre line without any shimming. Eventually I bit the bullet and took a file to one of the tools to reduce the tool height to bring the tip on centre. With this tool mounted in the lathe the moment of truth had arrived and I would make my first cut with the lathe.

I mounted a short length of ½ inch hot rolled bar in the machine and made my first cut. This first cut was a very light cut. The finish was awful. I tried many other bits of steel that I had around, as well as different depths of cut and different spindle speeds and the result was always awful. I also tried the lathe on aluminium and on brass. Only the brass produced a good finish. I could not understand what I was doing wrong. New machine, new tools - what could be wrong!

I started to look at the geometry of the supplied carbide tools and it was quite different to the geometry that L. H. Sparey was advocating for HSS tools. I tried to regrind the carbide tooling on my

My first tool, a tailstock die holder.

The lathe as it is now.

small bench grinder with alumina wheels. This did not work because you need silicon carbide wheels to grind tungsten carbide tools. I went out and bought some diamond files but wore these out without significantly changing the geometry of the carbide.

By this time I had had the lathe for about a month (trying to use it only at the weekends) and I had run out of expletives!! I was at the point of giving up and I thought I would have one last try. I ordered some ¼ inch HSS tool blanks and also ordered some EN1A free cutting round steel. When the HSS blanks arrived I quickly ground a knife tool according to the diagrams in Sparey's book. I mounted it in the lathe and shimmed it roughly to centre height and made a cut on the piece of ½ inch hot rolled steel that I started with. Joy of joys the tool cut perfectly and the finish was good. All that frustration and wasted time was just the fault of the brazed carbide tool. I still retain a prejudice against brazed carbide tooling to this day.

The free cutting steel arrived a few days later. In that order was some 10mm round and some 38mm round steel because I had already decided that if I ever had the lathe running well that I would make a tail stock die holder as my first project. This was quickly completed and I was very pleased with the result (**photo 1**). The original version just slid on a 10mm bar held in the tailstock chuck but it was later modified to slide on a bar attached to an MT2 taper to provide more space on the lathe bed.

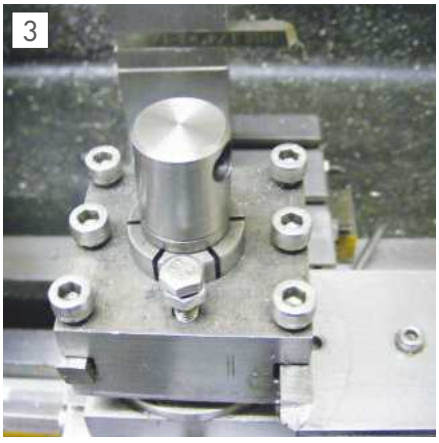
At this stage I came to some important conclusions:

1. A lathe on its own can only be used to make things round or flat. In order to do other operations such as graduating, dividing, ball turning, slotting etc. then modifications and additional tooling would be required.
2. To acquire a comprehensive machining facility was going to be expensive if I bought all the tooling.
3. The best way of learning was by reading and doing. Why not use the lathe to make as much of the tooling as possible? This would save money and advance my skills.

With these thoughts in mind I started buying books from the *Workshop Practice* series and also started trawling the internet for any information on lathe tooling and modifications. There are many good sites devoted to the mini-lathe and the most notable are www.minilathe.com and www.gadgetbuilder.com There is also a yahoo group for mini-lathe users.

Photograph 2 shows my lathe as it is now. Many modifications have been made to improve the accuracy, versatility and ease of use of the machine.

My second project for the mini-lathe was to make a quick change tool post (QCTP). There are many designs of QCTP but most require the use of a mill to cut dovetails. The only type that can be easily made with just a lathe is the simple cylindrical post with a tool holder that clamps in place using a pinch bolt. I considered this type for some time and it occurred to me that maybe rather than clamp the tool holder to the post why not make the post expand to grip the tool holder This simplifies the design of the tool holder and potentially



The quick change tool post.

allows two tools per holder rather than just one. A QCTP was quickly made according to this idea (**photo 3**) and it worked very well. I still use this type of QCTP on my lathe although the design was updated slightly when I reduced the height of the compound slide.

Making the tool holders for the QCTP required much boring and during this much of the swarf migrated along the spindle and dropped out the rear end onto the change gears and this resulted in the change gears jamming. To prevent a repeat problem, the end of the spindle was plugged with a wine cork.

The standard C2 tailstock was clamped to the bed with a nut. This required the use of a spanner every time the tailstock was moved. This became frustrating and I made a simple cam lock mechanism following the ideas of gadgetbuilder

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(**photo 4**). This was much more convenient. At the same time I made a number of other modifications to the tailstock to facilitate alignment with the headstock spindle.

Whilst doing these early projects the need for a carriage lock became apparent as the carriage would tend to move during facing cuts. This was solved by using a small G clamp to prevent movement but a more convenient arrangement attached to the carriage was made at a later date (**photo 5**).

A simple indexing system based on an expanding mandrel that fitted inside the spindle bore and a change gear wheel was quickly cobbled together and this sufficed for quite a time. However, a more comprehensive indexing system using a worm that engaged on the bull gear of the lathe spindle followed (**photo 6**). At a later date a permanently mounted 60-hole indexing disc was added to the spindle to provide instant access to many common divisors (e.g. 3, 4, 5, 6, 10, 12, 15, 20, 30, 60) (**photo 7**).

Very often I have had to make a tool in order to make another tool. To make the indexing disc a tool post drill was needed. Many mini-lathe owners have made an adaptor plate that enables a Dremel type tool to be mounted on the tool post. I considered this option but had misgivings because the run out on my Dremel look alike (from Aldi) was quite large and also the tool was designed to operated at very high speed (20,000 rpm). This speed is much too high for say a 6mm drill and I decided to investigate an alternative route using a flexible drive shaft attached to a normal portable electric drill. I ordered a flexible shaft from Screwfix. This had

The tailstock cam lock.

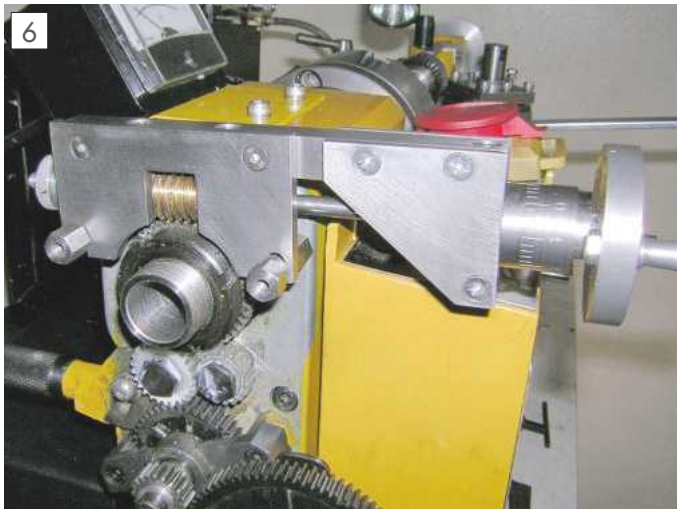
The carriage lock.

some issues because the bearing (if you can call it a bearing) was very loose and the 6mm chuck supplied had a very large run out. The bearing was bored and re-sleeved and the chuck replaced with a precision chuck from ArcEurotrade and the system then worked very well (**photo 8**).

The chuck mount for the minilathe is a flange on the spindle with a register. This is good in many ways because the lathe spindle can be used in both forward and reverse directions without fear of the chuck unscrewing. The downside is that the faceplate has no slots that extend close to the centre and this means that it is sometimes difficult to mount small objects. To overcome this problem, I made a tee slot faceplate. This was fabricated from 5mm steel pieces on a cast iron base because I had no way of cutting tee slots in solid metal (**photo 9**).

At about this stage I decided that I should purchase a milling attachment for the lathe so that I could do simple milling jobs. This was ordered and in the meantime I started to make some milling tools. These involved cutting Morse tapers. My first thoughts were to cut MT3 tapers that would directly fit into the lathe spindle. I quickly realised that this would be very difficult on the mini-lathe because of the limited travel of the top slide. There was just about enough top slide travel to cut a MT2 taper so I purchased an MT3 to MT2 adaptor. My first attempts to cut an MT2 taper were a success but it was not easy. The top slide gibs had to be very tight because the top slide was right on the limit of fitting on the base dovetails and this meant that smooth movement of the top slide was difficult resulting in poor surface finish. Polishing the tapers with fine silicon carbide paper improved the finish and the final fit of the tapers was good. A simple mod to extend the top slide range was made that enabled cutting tapers using an angled top slide much easier (**photo 10**). At a later date I also made an offset for the tailstock (**photo 11**) and a taper attachment (**photo 12**).

The other requirement for milling on the minilathe was a method of advancing the



The headstock indexing unit.

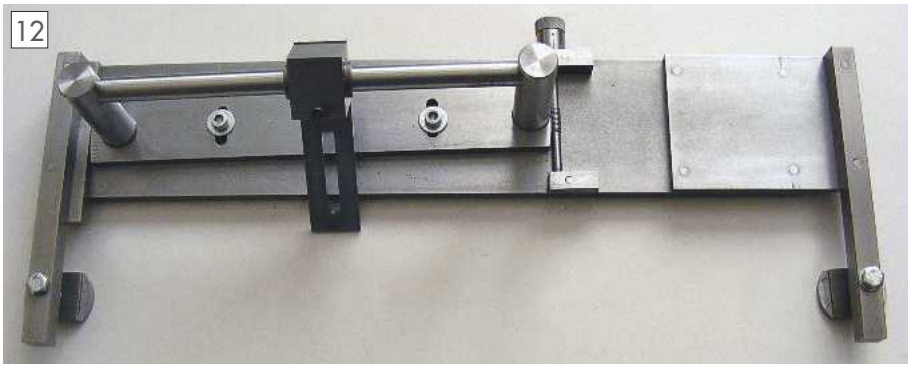
The indexing disc.

The tool post drill.

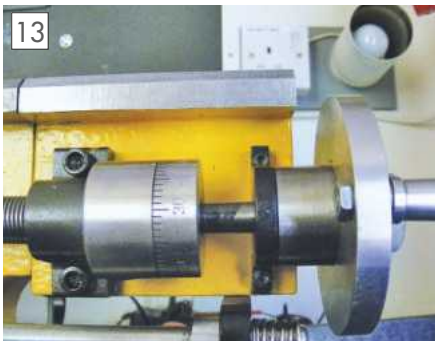
The tee slot face plate.

Modification to extend the top side range.

The tailstock offset.

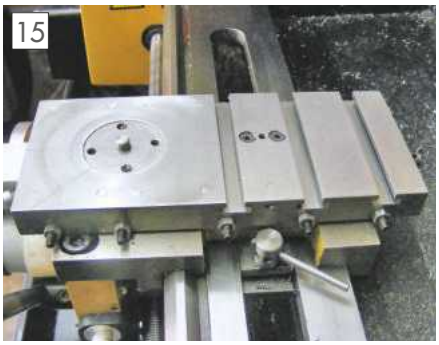


The taper attachment.



The lead screw hand wheel.

Rear spindle extension.



The tee slot cross slide.

carriage by small amounts. The hand wheel on the apron was much too coarse. A handle was made to enable the lead screw to be turned to advance the carriage (**photo 13**). The graduated thimble was made using the indexer described earlier.

The milling attachment arrived. This is not a simple bolt on attachment for the minilathe. An adaptor plate is really needed to attach it to the cross slide and also offset it so as to utilise the travel of the cross slide. The attachment plate was made and some simple milling operations were tried. It is possible to mill with the attachment taking very small cuts but anything more than a 0.1mm in steel caused much chatter. After a few more tries it had convinced me that I needed to buy a dedicated milling machine. I ordered a Sieg X1 milling machine from Arc Eurotrade. The milling attachment has since been recycled as part of a tool and cutter grinder.

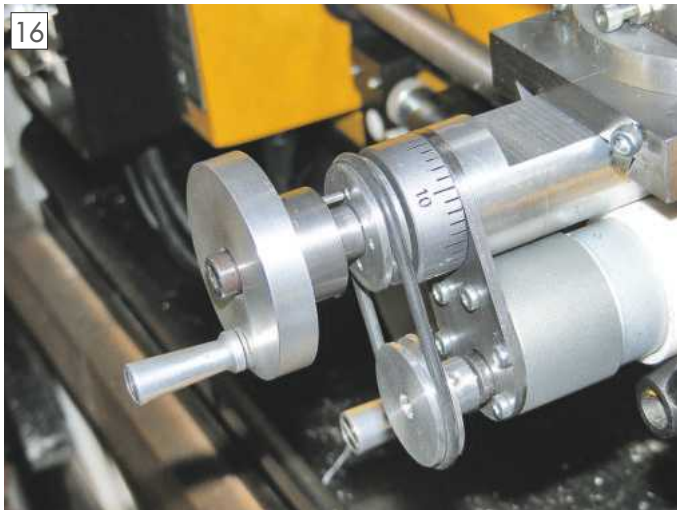
One of the first jobs I used the mill for was to make grooves in a rear extension to the lathe spindle so that chips were channelled outside the cover rather than over the change gears (**photo 14**). This spindle extension was also used to house a magnet that operated a simple tachometer based on a cycle computer.

In his book Sparey lists all the things that he considers essential in a lathe. The Sieg minilathe ticks most of the boxes. The main omissions are the tee slot cross slide and the gap bed. The tee slot cross slide seemed to have many benefits since work can be easily mounted on it for machining, it facilitates having a rear tool post for parting and chamfering and it enables chip guards and splash guards to be easily attached to the cross slide.

I made a tee slot cross slide using the method described by Martin Cleeve in Model Engineer many years ago. This was fabricated by bolting together various sections to build up the form. The cross slide was made longer and wider than the original cross slide (**photo 15**). I also revised the arrangement for setting the top slide at an angle. In the original version it was necessary to wind the topside right back in order to get at the clamp screws that fix the top slide angular position. With the new cross slide, the clamping screw for the topside is accessible without having to wind the top slide back.

To take advantage of the extra length of the cross-slide the cross-slide travel was extended and at a later date a small variable speed dc electric motor was added to provide a power feed (**photo 16**). This is very useful when making facing cuts on large diameter steel.

A variable speed electric motor was also added to the lead screw along with a microswitch to stop the feed when the carriage reaches a certain point. This is very convenient when turning to a shoulder. The same microswitch can also be used to stop the main lathe motor. This is very useful when screw cutting. The feed motors are all controlled from a small box fixed to the front cover of the headstock (**photo 17**).



The cross slide power feed.

The control box for the cross slide, lead screw and lathe motor. Note: CS is cross slide, LS is lead screw and MM is the main lathe motor.

The speed reducer.

The new 100mm flange spindle.

In order to fit the lead screw dc motor under the lathe where it is out of harms way from swarf and oil was necessary to raise the lathe to provide clearance. This was done by fixing some 50 x 50 x 5mm square sections between the lathe and the drip tray.

The main lathe motor is rated at 350 watts and a maximum speed of 2500 rpm. This is fine for small diameter work but it lacks torque at the lower speeds needed for turning large diameters. This situation was greatly improved by adding a lay shaft with pulleys to reduce the speed by a factor of two (**photo 18**).

I had read on various groups that changing the bearings on the lathe from the standard deep groove ball bearing to taper roller bearing greatly improves the rigidity of the spindle permitting easier parting off. At this time Real Bull, an alternative manufacturer to Sieg, introduced a spindle with a flange diameter of 100mm. Their machine is almost identical to the Sieg machine. I knew of an owner of a Real Bull lathe that had changed from the spindle with the 80mm flange to the one with 100mm and I contacted him to compare the dimensions of the Real Bull spindle with the Sieg spindle. They were identical and I ordered a Real Bull spindle with a 100mm flange to fit into my Sieg lathe as well as a set of taper roller bearings. Installation of the new shaft and bearings was straightforward. I have not found any major improvement in rigidity or accuracy by doing this modification but there are some worthwhile benefits. Firstly, there is a big gain in the space behind the spindle flange which make changing chucks much easier (**photo 19**). The second benefit is a small gain in working space since an adaptor plate is not needed to mount the 100mm chuck onto the 100mm flange. Also without the adaptor plate the spindle is better balanced so vibration is reduced.

As time progressed I found that constantly removing the tailstock from the lathe bed became a chore and I wished for a small platform at the end of the lathe to place it on. I started to design such a platform but it began to look more and more like an extension to the lathe bed. At around this time I was also beginning to try my hand a casting aluminium and I decided to try to cast a lathe bed extension and then machine the top and prism to match the existing bed. The resulting casting, after machining, was just bolted to the end of the machine bed (**photo 20**).

Returning to photo 2, it shows a number of other modifications that have been carried out. Above the headstock are a digital tachometer and an ammeter. The digital tachometer is actually a cheap frequency meter bought on eBay. This receives pulses from an optical sensor mounted on the 60-hole indexing ring on the spindle. One revolution per minute generates 60 pulses per minute which equals 1 pulse /second. Hence a frequency meter gives a direct reading in rpm. The ammeter measures the lathe motor current. This in turn indicate how hard the motor is working. It is very useful when turning large diameters, or when taking heavy cuts. Since fitting the ammeter I have only blown one fuse whereas previously I had blown several.

On the cross slide is mounted the quick change tool post and behind it is a rear tool post set up for parting and chamfering

Below the lead screw is a rod and a DRO is attached to it. The DRO can be clamped at any point on the bar. The DRO measures the movement of the carriage. The same rod is also part of the autostop system and it actuates the microswitch housed in the small black box on the left hand end of the bar.

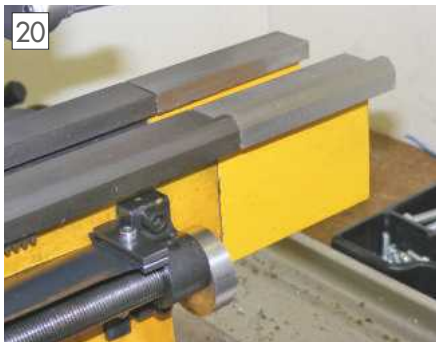
On the right hand side is the tailstock. This has a camlock, and a scale attached to the quill that provide a clear indication of the quill movement (the manufacturers engravings on the quill are almost unreadable). Also on the tailstock note the lever feed mechanism. This was inspired by a discussion started by John Stevenson on the ME website, www.model-engineer.co.uk

This list of modifications and tooling is by no means exhaustive but there are too many to list them all here. I have bought relatively little tooling and whenever I need something new I always try to find a way of making it myself rather than buying it. This approach means that there are always challenges and opportunities to learn new techniques.

One of the good things about the minilathe is that it is not expensive and neither are the spare parts. This encourages experimentation and modification since if the project does not work out you know that the parts can be easily and cheaply replaced. Some spare parts for a Myford cost more than a new mini-lathe!

Machining, development of my skills and my machines, has provided a good outlet for my creativity since retiring. I have enjoyed the journey so far and I hope it will continue into the future.

Further details on all these modifications, and many more, are on my website at http://mikesworkshop.weebly.com/ ■



The lathe bed extension.

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Scribe a line

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Drop us a line and share your advice, questions and opinions with other readers.

Missing Link?

Dear Neil, like David Salter (*MEW* 238 page 10) I replaced my lathe's headstock drive belt with good quality orange link belting to cure a problem with vibration. Although my lathe looks like his Myford Super 7, it is a Far Eastern copy, badged as Warco. I bought it years ago after its original owner had traded it in due to the vibration. I discovered that the width of the cheap drive belt varied along its length such that the belt rose and fell in the pulleys' grooves, tightening and slackening the belt, thereby causing the problem. New belt – no vibration!

Ian Moignard, Jersey

Points Arising

Dear Neil, A couple of points struck me when reading *MEW* 238.

I encountered the same problem as David Salter (Improving a Myford) in that I could not get a low enough adjustment of the quick change toolholders on my ML7 to bring the tool tip on to centre height. There is a cheaper and more easily applicable solution than grinding down each toolholder. It is simply to mill 0.125 inch off the surface of the topslide. (In hindsight, 0.188 inch (3⁄16 inch) would have been even better). Lowering the block in this way allows most TC-tipped tools having shanks of ½ inch/12mm or less to be brought to centre height, while still retaining full rotational freedom for the assembly – see photo. In the unlikely event of needing to fit some attachment that requires the original topslide height (I haven't yet managed to think of one), all that is necessary is to fit a piece of gauge plate of the appropriate thickness.

Tony Hill's article ('Digital Scales') illustrates well the complications of mounting 'Chinese' scales on machines. Rigid and sometimes complicated brackets (e.g. photo 8) place quite severe restraints on the alignment of components. However, I have found that a better way of coupling the reading head to the scale is often to use a short wide piece of 0.005 inch brass sheet with a slight S-bend in it. This allows a modest amount of free movement to compensate for misalignment up-and-down and front-to-back without impairing the accuracy of reading along the scale. The photo of my Unimat lathe illustrates an extreme example of this – normally the linkage can be rather shorter. I used these scales in this way on my mill for several years and the mountings never gave any trouble.

I did find, however, that in winter in a cold and condensation-prone workshop the Chinese scales became erratic and unreliable and I have since replaced them with glass scales.

Best regards, John Garnish

Metric Translation

Dear Neil, articles have appeared from time to time concerning cutting metric threads on an imperial lathe using different combinations of change wheels to produce an approximation of various metric pitches as an alternative to purchasing an expensive 100/127 combination gear. I have never seen mention in *MEW* of using the 63/80 combination which I came across on a South Bend forum.

This can be used in exactly the same way as the 100/127 wheel to produce any metric thread with an error of approximately 1 part in 10,000, so although you would probably not use it to produce a new leadscrew for any of the usual shorter screw cutting jobs the error is completely insignificant. Even over a meter the error would be little more than a tenth of a millimetre.

Now South Bend and Boxford lathes and possibly many others include an 80 tooth idler. John Ward of LatheParts.co.uk made me a 63 tooth wheel which I mounted on the hub of the 80 idler and I had a cheap metric transposer which is less clumsy and easier to work with than the 100/127 alternative, and it can still be used as an idler when metric threads are not required. I hope this may be of interest to some readers.

Anthony Reid, Largs

Thanks Anthony, the topic has come up once or twice before, notably in MEW *204, but the principle of the 63 (or 21-tooth) combinations is a powerful one that everyone who cuts their own threads should know about. – Neil*

We would love to hear your comments, questions and feedback about MEW

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Make your own Parting Off Tool

Peter Shaw makes a useful tool from a worn out file.

Completed tool.

The design presented here is based on Len Mason's design in his book *Using the Small Lathe* but modified by the use of an old 4 x ½ inch file to provide a stiffer tool. **Photograph 1** shows the eventual tool which was the result of much experimentation and has proved extremely satisfactory in use. Unfortunately, all the experimentation resulted in my 4 inch/100mm long old file being reduced to around 55mm in length.

Setting the grinding angle.

Construction

Figure 1 shows the General Arrangement of the tool, albeit with some lines removed for clarity. Specifically, it shows how the toolpost clamp screws are set approximately central over the clamp bar; the relationship between lathe centre height, top of cutting tool, and bottom of the toolholding slot; and finally the positioning of my (shortened) cutting tool. **Figure 2** gives an idea of the shape of the actual cutting tool as ground up from the old file together with dimensions and angles as they apply to my tool.

To convert the file to a parting-off blade, the tang needs to be removed. I did this by holding the body of the file in the vice with just the tang projecting and breaking off the tang by hitting it sideways with a hammer. Because the metal may be brittle, it is recommended that eye protectors be worn whilst doing this, and that the file be wrapped in cloth before clamping and breaking. Afterwards, this end of the file was rounded off smooth by grinding. Alternatively, a small angle grinder fitted with a metal cutting disk could be used.

Before shaping the actual blade, it will be worthwhile gently grinding the cutting faces of the old file to remove the sharp points off the teeth. To shape the actual blade, I first made a wooden setting tool with angles of 87.5 and 92.5 degrees. This was then used to adjust the grinder table to give a 2.5 degree taper on each side of the blade from top to bottom (**photo 2**). I decided that I would use the original safe edge of the file as the top surface of the tool, and so grinding was done with this in mind. The actual grinding was done by clamping the file to a small home-made square and then sliding the blade along the side of the grinding wheel whilst ensuring that the root of the blade was ground slightly more than the tip as shown in **photo 3**. This was done on each side alternately until such time as the blade tip measured between 1.5 and 2.0mm, 1.8mm in my case. Finally, the front face was ground at an angle of 5 degrees to the vertical and at 90 degrees to the centre line of the tool.

Please do remember to use eye protection when using the grinder for these operations. Also, photos 2 & 3 were specially posed to show the principle. Normal safety precautions were applied during operations.

Figures 3 & **4** give the details for the cutter clamp. The two pieces are made from any suitable steel, i.e. from the scrapbox. I used 4BA screws on mine because I have a large quantity of them, but metric screws would be more in keeping with my Warco 220 lathe. It is after all, a metric machine.

Cutting the channel in the back plate needs doing with some care. It is advisable to attempt to keep what will be the upper edge of the channel aligned with the lathe centre height, nominally 105mm in the case of the 220 lathe. Although I have

Grinding the cutting blade.

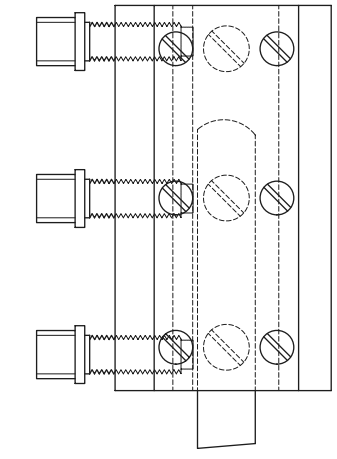
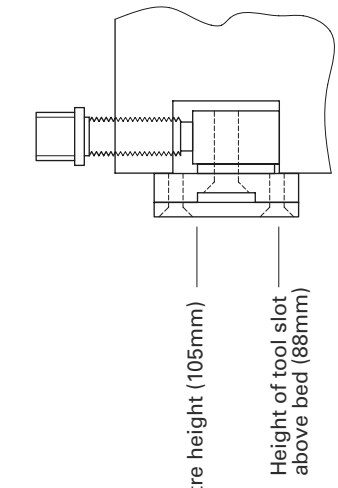


Fig. 1 General Arrangement



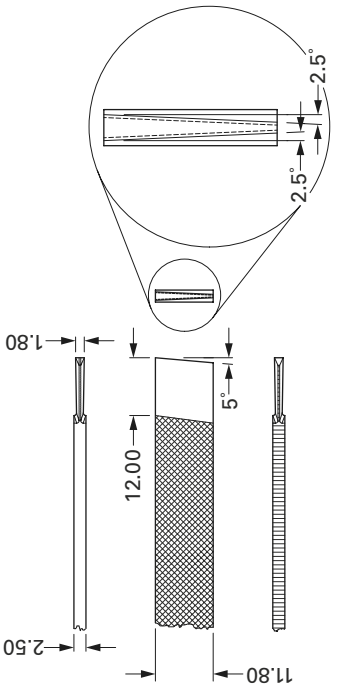


Fig. 2 Shape Of Modified File

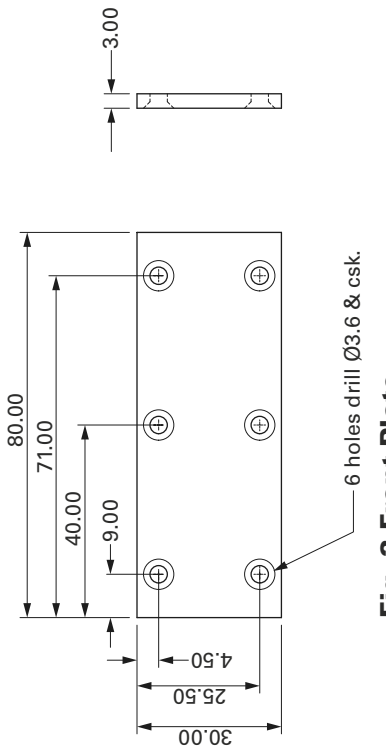


Fig. 3 Front Plate

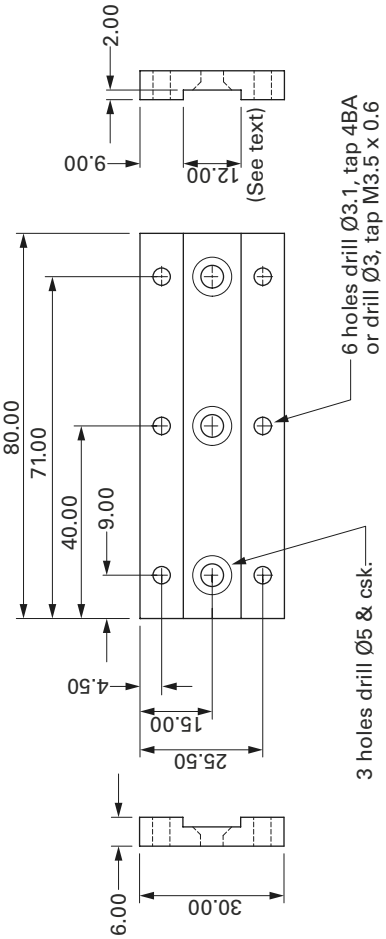


Fig. 4 Back Plate

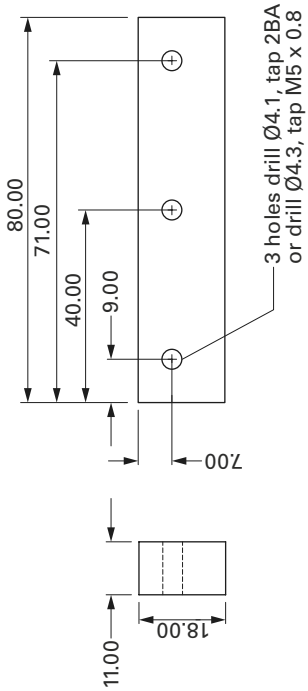


Fig. 6 Clamp Bar

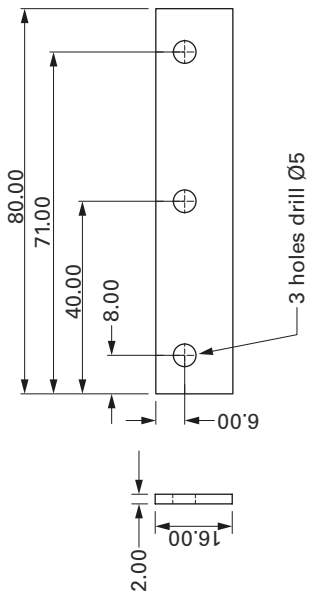


Fig. 5 Packing Plate

shown a width of 12mm, this is a nominal value and depends on the width of the old file. Mine measured 11.8mm whilst two other similar files measured 11.21 and 11.93mm each. Therefore, in order to maintain alignment with the lathe axis, the width of the channel should be adjusted by raising or lowering what will be the bottom edge of the channel as necessary. I cut my channel using the milling machine, but at this length it could be done using a lathe mounted vertical slide.

Figures 5 & **6** respectively show a packing plate and a clamp bar. I have a quantity of nominally ⅜ x ¾ inch bar which means that using this bar on its own, the toolholder clamp screws would be too near the edge of the Clamp Bar. Therefore, I used the Packing Plate, again using scrap box steel, to centralise the Clamp Bar under the clamp screws. There is absolutely no reason why a piece of steel 80mm x 18mm x 13mm or greater should not be used. Here again I used 2BA screws because of their availability. **Photograph 4** shows the component parts of the tool.

Tool components.

Conclusion

Eckhart Hartmann in Scribe a Line, *MEW* 141 said 'I have found that the only tool which works for me is one which has the cutting edge exactly parallel to the machine axis and exactly horizontal and straight. I have tried tools with concave, convex or no ridges along the top and with all sorts of angles at the cutting edge which all produced poor results and normally broken tools. I believe my approach works because there are no side forces generated and therefore no tendency to wander, bind or smear.' As will be noticed, my design uses similar principles and I too now have no trouble taking deep parting off cuts provided I use slow speed (125rpm) and lots of cutting fluid. Indeed, I find it remarkably fast - until the cutting fluid runs out at which point chatter sets in. The procedure then is to flood the cut with fluid, advance the tool firmly, i.e. not too gently, until the cutting fluid runs out, back off the tool, add more fluid, and so the sequence continues until the cutting is complete.

All in all, a worthwhile addition to my set of tools. ■

CarverSaw
Kitchen Utensil to Handy Tool

The completed CarverSaw, adapted from an electric carving knife.

I seem to have inherited a specific gene which induces me to collect and hoard mechanical items in the belief that they will come in use 'sometime later'. Some of my DNA must descend from the Wombles, mythical creatures who inhabited Wimbledon Common and filled their burrows with items discarded by humans. Certainly my burrow has become stuffed to the point that something had to be done to 'Make Good Use of Bad Rubbish', as the Wombles would say. As an example, this article shows how a light, powered hacksaw can easily be created from a disused electric carving knife (**photo 1**).

Mark Noel invites us to consider how discarded electrical appliances can be recycled to create useful workshop tools.

I have always been passionate about recycling and the environment and, yes, I do have a beard and wear sandals, although *MEW's* Editor did insist I shave for that photograph above. After middle age came and went, the next lifetime crisis occurred when our local authority re-located their recycling centre closer to home; so close in fact that the temptation to visit became ever-present and any excuse was found for a diversion to 'Harrods', as it is known locally. Our new Amenity Site has voluminous skips for all manner of waste materials, plus several covered bays displaying items free for the public to collect and recycle. Apart from areas reserved for books, video tapes, plant pots and furniture, one bay is set aside for printers, scanners, TVs and generations of video-CD-DVD players.

Since no-one appears much interested in this stuff, the bay quickly fills up and the contents are then shifted to the Domestic Electricals skip to join other larger items, such as mowers and bicycles, vacuums and computers (**photo 2**). Once this skip is filled to the top, it is crushed down by a digger to make more space for our 21st Century techno-trash. What fuels this appalling waste of raw materials and energy? The foreman tells me that most printers arrive when the ink runs out, bicycles when the children grow, TVs when screens get larger, and toasters when kitchen styles go from silver to white or vice versa. Gazing bewildered into that pile of mangled Domestic Electricals, I instead see an assortment of electric motors, precision shafts, gears, drive belts and pulleys, bearings, power supplies and lasers, all waiting to be up-cycled or re-purposed by our maker and workshop communities. Perhaps all local Amenity Sites should revise their entrance signs to read 'Model Engineers Resource Centre' (MERC), and provide benches and tools for us to salvage the goodies we want.

The Domestic Electricals skip at our local amenity site. What a comment on our wasteful society!

Once you have nurtured the Wombling mindset, you will soon encounter some problems: first, how to find excuses for yet another trip to the MERC and second, how to conceal your loot on returning home? The first problem is easily overcome by making it known to neighbours that you 'often pass by the tip' and would be happy to 'take their rubbish', even if it is only an empty paint tin. The second issue is more problematic and involves careful timing, anticorrelating your return with visits by the Domestic Engineer to the hairdresser, nail bar or supermarket. Why not get her (him?) a dog, particularly an active one that needs to be walked most of the day? Then the time window might expand to permit a second trip to the MERC to collect another load of womble.

Photograph 3 shows a selection of my hoard from twelve months visiting Harrods. In addition to what you see, I have acquired three more sewing machines, another Kenwood mixer, about a dozen printers, ten scanners, several computer monitors and another electric carving knife. Tests in my burrow found all to be in working order and thoughts must now turn to ways in which each can be adapted to create something wizzo in the workshop.

A small selection of unwanted electrical appliances salvaged from my local amenity site. Each was found to be in working order.

I decided to start by exploring alternative uses for one of the electric carving knives, one by Moulinex (**photo 4**) and the other, mechanically identical, but branded Sando. They arrived caked in stale meat juices and bread crumbs, and had fortunately been cast aside by their owners before seeding a global food poisoning epidemic. The heart of these carvers is a 40W, brushed mains motor, which connects to the blade drive via a worm and wheel (**photo 5**). This wheel carries a pair of nylon cranks set 180° apart that propel two nylon sliders back and forth inside a pressed-steel cage, with a throw of about 10mm. Each slider is moulded to house a spring clip that engages with a slot in the stainless blade, thus locking it in place. A button on the sloping front of the carver housing can be depressed to disengage both clips in order to release the blades.

The counter-oscillating, twin-blade design in this type of carver results in negligible vibration being transmitted to the operator, facilitating micron-precision slicing of the Sunday joint. This mass-balanced, inertial stabilisation technology (MBIST) will be embodied as a key feature in the current gadget, although a better acronym is sorely needed. Most significant is the fact that the original carver's blade tang is identical in width to a standard hacksaw blade, simplifying our adaptation for use as a light powered saw.

Dismantling the carver mechanism was a simple task, since the steel shell only clips together, rather than being riveted (**photo 6**). The plastic sliders were thoroughly cleaned in paraffin before re-greasing and re-assembling. Food debris and gravy in the motor and worm wheel assembly were removed by scrubbing in a light spray of paraffin, followed by slow drying on my home-made hot plate at about 30 deg. C (see *MEW* 227). Close inspection of the motor showed that there was plenty of life left in the carbon brushes, and the plain bearings and worm wheel were re-lubricated with a few drops of light oil.

It was obvious that driving a standard 12 inch hacksaw blade back and forth without some form of additional support and guidance would be hazardous, with the risk

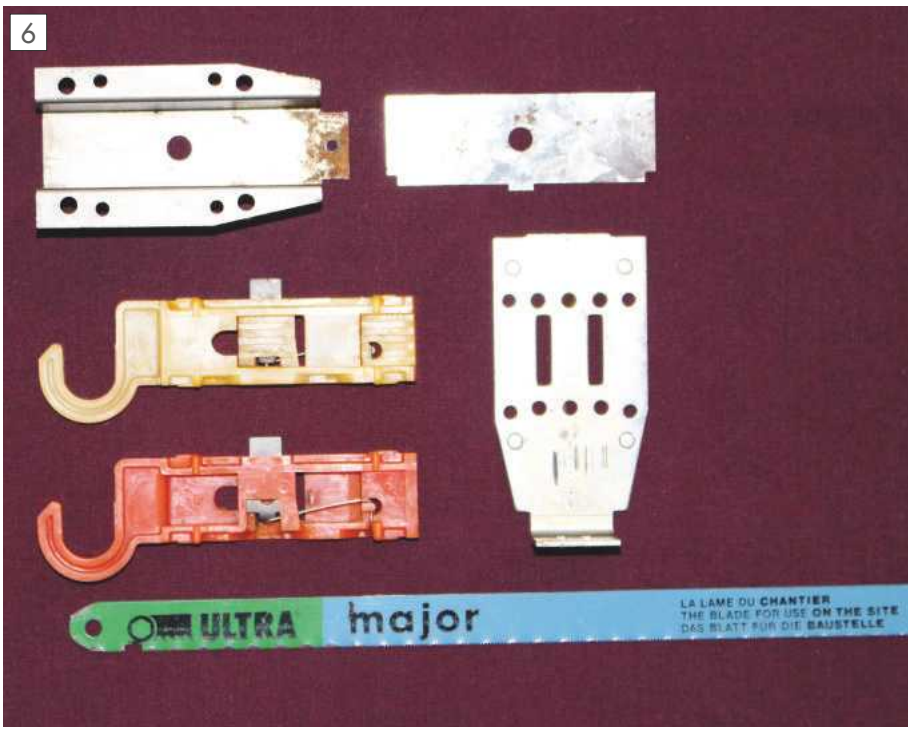
The Moulinex electric carving knife, as found, and used as the basis of the current project.

Inside the Moulinex carver. The 40W mains motor drives two blades in opposition via the wormwheel and cam assembly to the right.

that it might buckle and jam causing damage to the motor, gears and operator. The solution has been to attach an overarm to the CarverSaw body milled from 25 x 15mm aluminium alloy, milling a 10mm wide slot beneath to reduce weight. The end of this arm carries a projecting beam of similar gauge, in the end of which is a 2mm wide slot through which the saw blade passes (**photo 7**). Pairs of opposing 0 BA brass studs with flat polished ends are tapped into the foot of this beam and can be adjusted inwards to act as blade guides. Upward forces on the blade are countered by a 12mm diameter ball bearing housed in a recess above the brass pins; this guidance technique is similar to that used in band saws.

So far the design constrains the untensioned hacksaw blade at both ends, providing guidance and support against modest cutting forces. After all, with only a 40W motor inside, the CarverSaw is unlikely to be asked to slice through 6' girders! However, there is still the risk that as the blade is lifted from the cut it will drop away from the brass gibs and roller bearing, highlighting the need for an additional clasping mechanism. The solution has been to incorporate the revolutionary *MagLok* Technology which is causing a sensation in the model engineering community. A 10 x 5mm rare-earth magnet inside an aluminium housing is epoxied to the guide bar, with a 2mm gap between the face of the magnet and top of the hacksaw blade. This provides a sufficient force of attraction to ensure that the blade is always drawn up against the ball bearing roller, even during withdrawal from a deep saw cut. Complex computer modelling has shown that eddy currents induced by the magnet in the moving, conductive blade raises its temperature sufficiently to facilitate cutting, whilst damping high-frequency vibrational harmonics in the hacksaw blade (only kidding!).

To complete my CarverSaw I ground off a tang from one of the original stainless blades and drilled a 3mm hole to mount a brass bob weight of similar mass to the hacksaw blade. Mounting this assembly in the adjacent slot to the actual cutting blade (**photo 8**) restores the mass-balanced, inertial stabilisation technology (MBIST) seen in the original unit, so that there is negligible vibration during cutting.



Dismantled blade-drive mechanism. The hacksaw blade has been modified to fit, simply by grinding the teeth blunt and cutting a notch for the locking mechanism with a Dremel tool.

Photograph 1 shows the fully assembled CarverSaw, with the new parts and upper casing painted with Plastikote navy blue. A length of 12mm diameter, red PVC rod passes through the aluminium overarm as an extension to the original motor on-off switch in the casing beneath. Also, the blade release button was sprayed Plastikote red to match the general theme.

Despite the modest power available, the CarverSaw has proved a handy unit in my workshop, able to cut thin timber, non-ferrous sections and chocolate biscuits with less effort than required by manual sawing. Since the unit has only a modest stroke, it is necessary to move the blade slowly back and forth to help clear the swarf. Also, it is important to note that the 40W motor is not continuously rated, meaning in practice that there is a risk of overheating if it is asked to work hard for more than a minute or two. Nevertheless, this has been a very satisfying adventure to give a new and novel life to a discarded domestic appliance, moreover at very low cost. I do hope that this article and others that will follow encourage fellow readers to 'Make Good Use of Bad Rubbish' as the Wombles would say. ■

RESOURCES

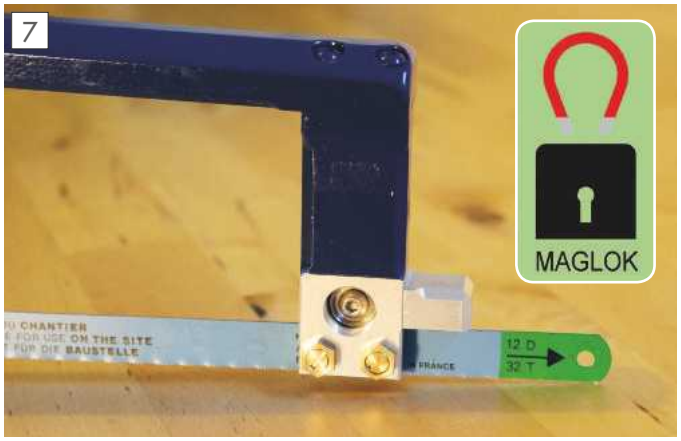
Watch a period Wombles video and be inspired to join in *MEW's* Tools for Free project: www.youtube.com/user/TheWomblesOfficial

Rare earth magnet: www.rapidonline.com Part No. M1219-5

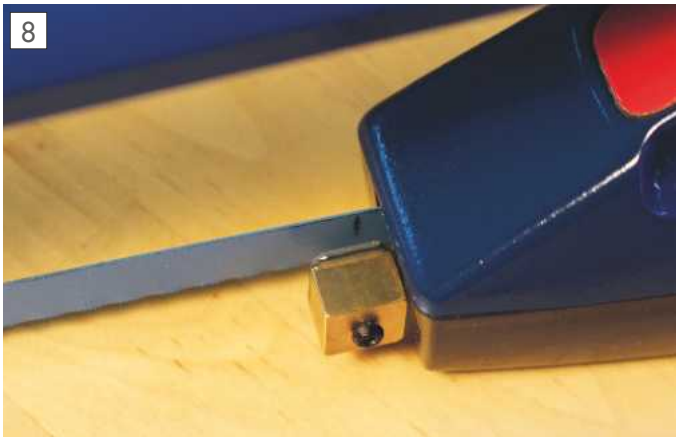
Stainless steel fasteners: www.westfieldfasteners.co.uk

Aluminium alloy stock: www.m-machine-metals.co.uk

Ball bearings of various sizes: www.arceurotrade.co.uk



Close-up of the blade guide, comprising two pairs of opposed 0BA brass studs and a ball bearing salvaged from a printer. To the right is the MagLok blade retainer which pulls the blade upwards against the ball bearing.



Counterweight added to a spare blade tang in the adjacent slot. This eliminates vibration during cutting.

Getting the most from an Arbor Press

Cameron McKeown improves the usability of a basic bench tool.

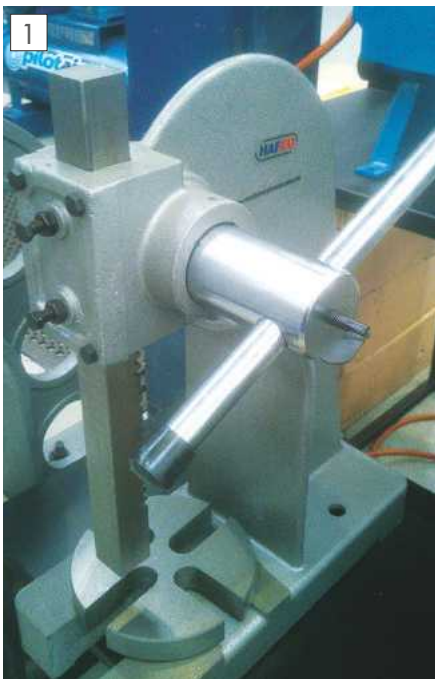
As anyone would have found, having an arbor press in the work shop is a real bonus (**photos 1** & **2**). I have a couple of these on hand, one rated at 1 tonne and a larger one rated at 3 tonne. Although I do have a 10t rated hydraulic press the action of the arbor type press gives a feel that is much easier to work with and control, particularly when fitting bushes or using keyway broaches.

There is however one annoying downside to using an arbor press, the need to pack the work piece to fit the position of the lever handle. This is particularly so with keyway broaching. The lever handle begins at a comfortable height/position but as the lever handle is pulled down, the position can get awkward with the need to start pushing rather than pulling as the required force needs to increase. This sometimes necessitates the need to re-pack the work to enable the lever handles position to be reset to maximize the applied force. In re-packing, the arbor ram needs to be held up clear of the work with one hand while re-packing with the other.

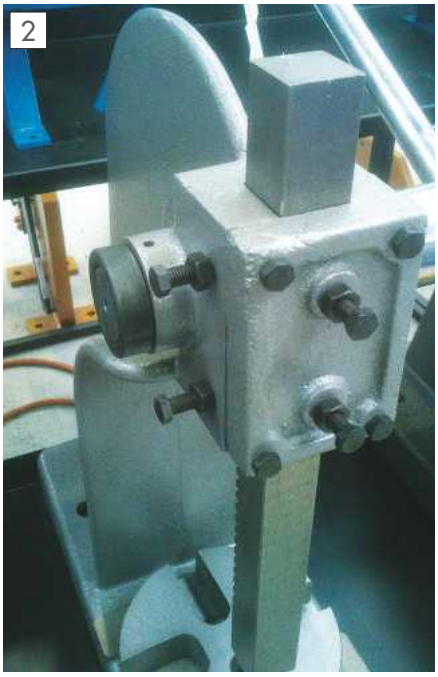
The ideal situation would be a broaching press that utilizes a ratchet on the lever handle on one side and a hand wheel on the other side to retract the ram. These broaching presses often use a band brake arrangement to allow the ram to be held up when positioning the work piece. This is the style of press that would most meet all my needs; however, the purchase price for these benefits is more than I could justify for occasional use.

The only option if I wanted these additional benefits was to look at a way of modifying my existing 3 tonne arbor press to incorporate all the features of a broaching press.

The first step was to design a ratchet system. Sketching up a gear arrangement to drive the ratchet wheel proved difficult given the available envelope space on the arbor body. In the end this became quite complicated with many compromises required to deliver a workable result and there the idea was left.



The arbor press as purchased.



The head of the press.

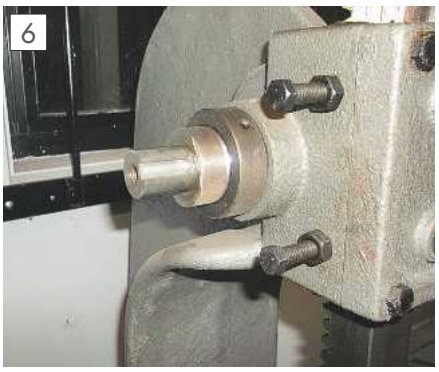
A number of months later I was wondering around one of the local Sunday markets in my area looking at the usual tool stalls for a bargain. At one of the stalls I spotted a ¾ inch drive ratchet with a socket attached, the answer to my arbor ratchet system was solved. Fit the machined down socket onto the arbor pinion shaft and fit the ¾ inch drive ratchet into the socket (**photo 3**). With the beginnings of a ratchet concept in mind the barter started and the deal was done at $90 for the lot. The ratchet head had an extension arm of around 900mm which was only slightly longer than the arbor press lever arm. I remembered being down at my local scrap merchant a couple of weeks before and had spotted a couple of nice hand wheels on some machine components that had just come in. Driving past on the Sunday looking through the fence they were still there. Monday after work the purchase was made for a modest fee and I had all the parts at hand to begin the modification.

Ratchet and socket.

Socket adaptor.

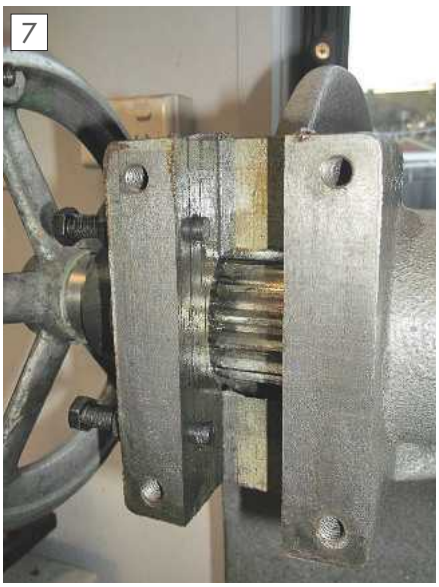
My plan was to keep as much of the original arrangement in place just in case it didn't quite work out, hence an adaptor was made up from some axle material left over from a previous job to fit the machine down ¾ inch socket into (**photo 4**) I wasn't keen on welding the socket into the adaptor due to it being a chrome vanadium steel. This would probably not take and end up cracking around the boundary of the weld circumference. The best option was to secure it in place using a high strength Loctite (**ref 1**). This has been in place for some years now and has shown no sign of movement even though some of the applied loads would well exceed the 3 tonne capacity of the press. The adaptor was then drilled

Adaptor drive.



Adjustment screws and stub shaft.

Adjustment screw and button.



Fitting buttons into position.

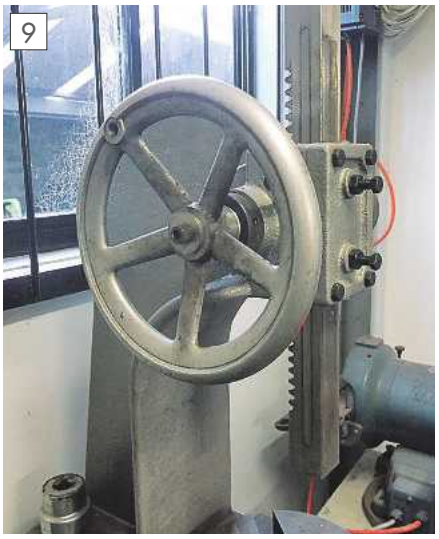
and bored to fit over the arbor's pinion shaft and locked off with a bolt though the hole that was used for the original lever arm (**photo 5**). Note, if I were to do this modification again I would do away with the adaptor and drill and bore the pinion shaft directly to fit the modified ¾ inch drive socket.

One of the unknowns to this modification was how to hold the ram up so it wouldn't fall down under its own weight whilst setting the work up. The unit I had purchased had quite a lot of slop in the ram. The method to reduce this slop was to adjust the 2 side set screws in and lock off with nuts (**photo 6**). Behind these adjustment screws was some thin shim to stop the screws scoring into the square ram. My concern was that if too much pressure was applied with the set screws it would wear through and begin to score the ram faces.

The solution was to machine up and fit Delrin (plastic) buttons to fit in under the adjustment bolts (**photos 7** & **8**). On trying this I found that by tightening the adjustment screw to take out the slop it created enough force against the ram that it would hold up under its own weight, basically doubling as a brake. This worked out well as no further design work to fit in a band brake system was required.

The last step in the modification was to fit the hand wheel. As there is no stub protruding from the arbor pinion shaft to mount the hand wheel on, one has to be added. The simplest way is to counter bore the end of the pinion shaft to allow fitment of a stub extension. Once again I made this a light press fit with the high strength Loctite. The other end was machined for a light sliding fit with a keyway cut to match the existing keyway that was in the hand wheel (**photos 9** & **10**).

The whole show was then assembled and trialled firstly with a keyway broach into a pulley (**photos 11** & **12**) . What a difference, being able to ratchet the handle back to reset allowing the same force to be applied at a comfortable position throughout the cut. Next was a bush into a housing. No packing under the work required and once again being able to reset the handle position to allow a constant force throughout the fitment.



Handwheel fitted.

Handwheel as supplied.

Broaching a keyway into a pulley.

The finished keyway.

In conclusion I have to say that this was a very worthwhile project. For a total cost of around $100 and a few hours of time I now have a broaching press with all the features I required with very little effort. This concept could easily be adapted for any size of arbor press by utilizing different sized drive sockets and ratchet sets. Just remember to keep looking through those trash and treasure market stalls. You never know, that gizmo you're looking at might just turn into a new project or possibly solve a problem for the one you're stuck on now. ■

REFERENCE

1. http://www.loctite.com/

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To help you get the best from The Model Engineer Exhibition

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them. The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achieveable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect. We look forward to seeing a sample of your work at the show!

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits – not covered by the above

Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale)and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.
- B-K1 Working steam locomotives built from a kit.
- B-K2 Working locomotives other than steam powered. (Any model locomotive in class B-K1 and 2, built from a commercial kit, entered into these classes will not be judged in the medal classes but can receive commended certificates and an award from a trade supplier).

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – nonworking.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale, 12in for 1:25 scale, 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medal.

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit,) scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under their own power of any type. Can be either free-running, tethered, radio controlled or slot car, but must represent a reasonable full size replica.

DUKE OF EDINBURGH CHALLENGE TROPHY Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of MyTimeMedia Ltd.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of MyTimeMedia Ltd., in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by MyTimeMedia Ltd
5. A model may be entered more than one year but if the model wins it will be permanently retired.
6. Entry shall be free. Competitors must state on the entry form:
   (a) That exhibits are their own bona-fide work.
   (b) Any parts or kits which were purchased or were not the outcome of their own work.
   (c) That the model has not been structurally altered since winning the qualifying award.
7. MyTimeMedia Ltd. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date. LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.
3. Competitors must state on their form the following:
   (a) Insured value of their model.
   (b) The exhibit is their own work and property.
   (c) Parts or kits purchased.
   (d) Parts not the outcome of their own work.
   (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of MyTimeMedia Ltd.
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by MyTimeMedia Ltd. are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy'.
7. Past winners at any of the exhibitions promoted by MyTimeMedia Ltd. will not be eligible for re-entry into the competition unless the exhibit has been substantially altered in any way.
8. MyTimeMedia Ltd reserve the right to:
   (a) Transfer an entry to a more appropriate class.
   (b) Describe and photograph any models entered for competition or display and to make use of any such photographs and descriptions in any way they may think fit.
   (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
9. Entry into the competition sections is not permitted by:
   (a) Professional model makers.
   (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers prior to the show.

10. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
11. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
12. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

IMPORTANT NOTE: PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS MYTIMEMEDIA LTD WILL NOT ACCEPT LIABILITY FOR ANY LOSS.

CLOSING DATE: 5 AUGUST 2016

Centring a Four-Jaw Chuck

Beginners are often confounded when told a 4-jaw chuck can hold material much more accurately than a self-centring 3-jaw. Jouni Pirttimäki offers a step-by-step guide to achieving concentricity.

Step-by-Step

At the early stage of my model engineer career, centring of a 4-jaw chuck was more guesswork than anything else to me. Using a dial test indicator or not, I moved individual jaws back and forth and the planned centre moved more or less nearer or farther from lathe centre where it supposed to be. I was quite sure that there had to be an easier way and easier way there is indeed. This is a short pictorial article about it.

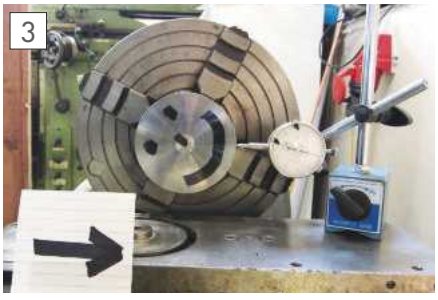
1

For clarity and photographical purposes, I removed the top slide of my lathe as can be seen in the photo . Fasten the workpiece in the 4-jaw chuck as near centred as you can. I exaggerated off-centring so that is possible to see from photographs and there is also parallax error because camera is not on lathe centreline. The face of the workpiece is turned so smooth that it reflects the happy face of the author.

2

Fasten the dial test indicator on lathe centre height. Here the DTI is fastened to the lathe cross slide behind its centreline face towards to the tailstock, but better is DTI fastened to lathe's toolholder DTI face up. The fifteen centimetre rule between workpiece and DTI is vertical and proves that the DTI is on lathe's centre height.

3



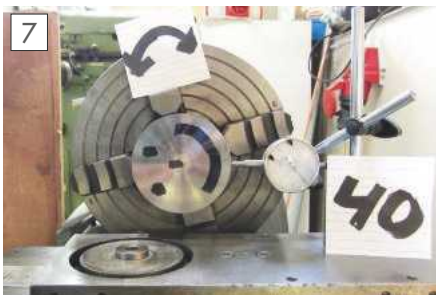
Move cross slide forward until workpiece touches the DTI's contact point.

4

Turn four jaw chuck around by hand until DTI shows its **lowest point**.

Move cross slide backward or forward until the DTI **shows 0**.

Turn chuck by hand again until DTI shows its **highest point**. Record that reading. Let us say that this reading is 80 (hundredths of a millimeter).

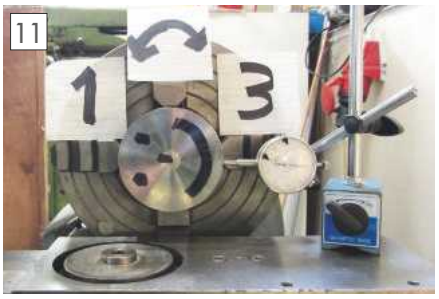


Turn chuck and find **half way** between lowest and highest point. In this example the DTI shows 80/2 = 40.

Move cross slide forward or backward until DTI **shows 0** again.

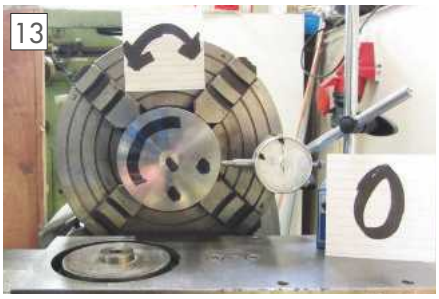
Turn chuck so that chuck jaws 2 and 4 are horizontal.

Move jaws 2 and 4 so that the DTI **shows 0**.



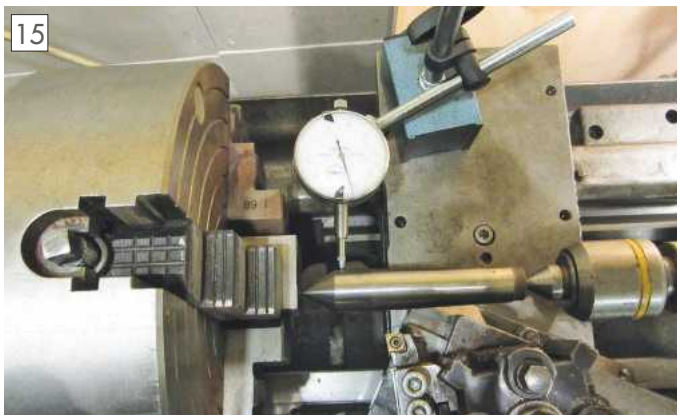
Turn chuck that chuck jaws 1 and 3 are horizontal.

Now move jaws 1 and 3 so that the DTI **shows 0**.



If you now turn the chuck around, the DTI should **show 0 all the time.** If not, repeat procedure from step 4 to step 12.

Centring a square or polygonal item is as easy as centring round bar. First find, mark and centre pop the point you want to centre.



Use a dead centre between centre pop and live centre and centre dead centre as for round bar on the previous example.

The task of centring a 4-jaw chuck that used to be slow and tedious is really a very simple operation. Doing it methodically I can centre a workpiece within about 3 hundredths of a millimetre faster than I can change the 4-jaw chuck to a 3-jaw chuck. centring better than 3 hundredths of a millimetre takes little longer and perhaps two centring rounds.

Making Spherical Washers

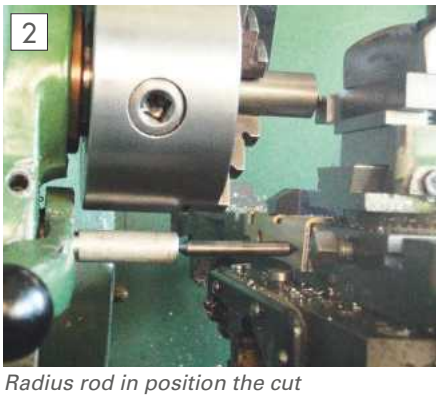
John Pace describes an old machinists' dodge for making two mating spherical faces, whilst making a useful aid to securing parts without disturbing their alignment.

When working on a current project, one machining setup involved boring a through hole in two similar but separate parts. These parts were the headstock and tailstock of a universal grinding machine. When fitted on the grinding machine, these parts use the flat underside and an underhanging fence to locate a ground edge on a sub-table. The bores must be in line with each other, parallel with the ground edge at the rear of the sub table and also parallel to the table surface.

The bored holes are for some parallel to Morse taper sleeves. Since the accuracy of the machine is dependant on the location of these holes to be able to preset the alignment of the centres, the front edge of the sub table on which these parts fit is clocked in alignment with the machine axis. Providing these holes are bored correctly this will be true.

The setup for boring was on the cross-slide of the lathe. Initially I used my Myford vertical slide to mount a ground plate on which to locate the components but this was very flexible, with just light finger pressure 3 to 4 thou movement could be found. This was changed for a more rigid setup but was useful in the first instance for finding a precise measurement for the second setup.

The ground plate was then mounted on a more substantial steel block. This second setup was much more rigid, using the same finger pressure produced no deflection even on a 10th thou clock. The job at this point is only supported on one side and overhangs by about 4 inches. To provide additional support an angle plate is fitted and secured at the other end forming a bridge and increasing the rigidity of the setup (**photo 1**).



Radius rod in position the cut the external washer.

Cast iron tailstock set in position with the aid of a spherical washer.

Unfortunately, this can lead to problems if the second support is not quite in alignment and when tightened down it can distort and displace the set position. When setting up these sort of jobs it can be very useful to position a clock gauge on the job so that any movement can be observed when tightening down and later eliminated. Although the parts in question were ground top and bottom and showed no error, bolting up the angle plate to it has no guarantee that these surfaces will be in perfect alignment.

Spherical Washers

To provide some flexibility in this, a pair of matched spherical washers were made. These simple items are easily made and self adjust when placed between two parts ensuring that when tightening up the securing bolts no unwanted deflection is placed on the job. The washer is between the job and the angle in the place indicated by the arrow. These parts are just two thin steel washers with a matching radius on their mating faces, starting with a piece of ¾ inch diameter steel drilled through ⅜ inch. About 2½ inches long is enough for about four pairs of washers

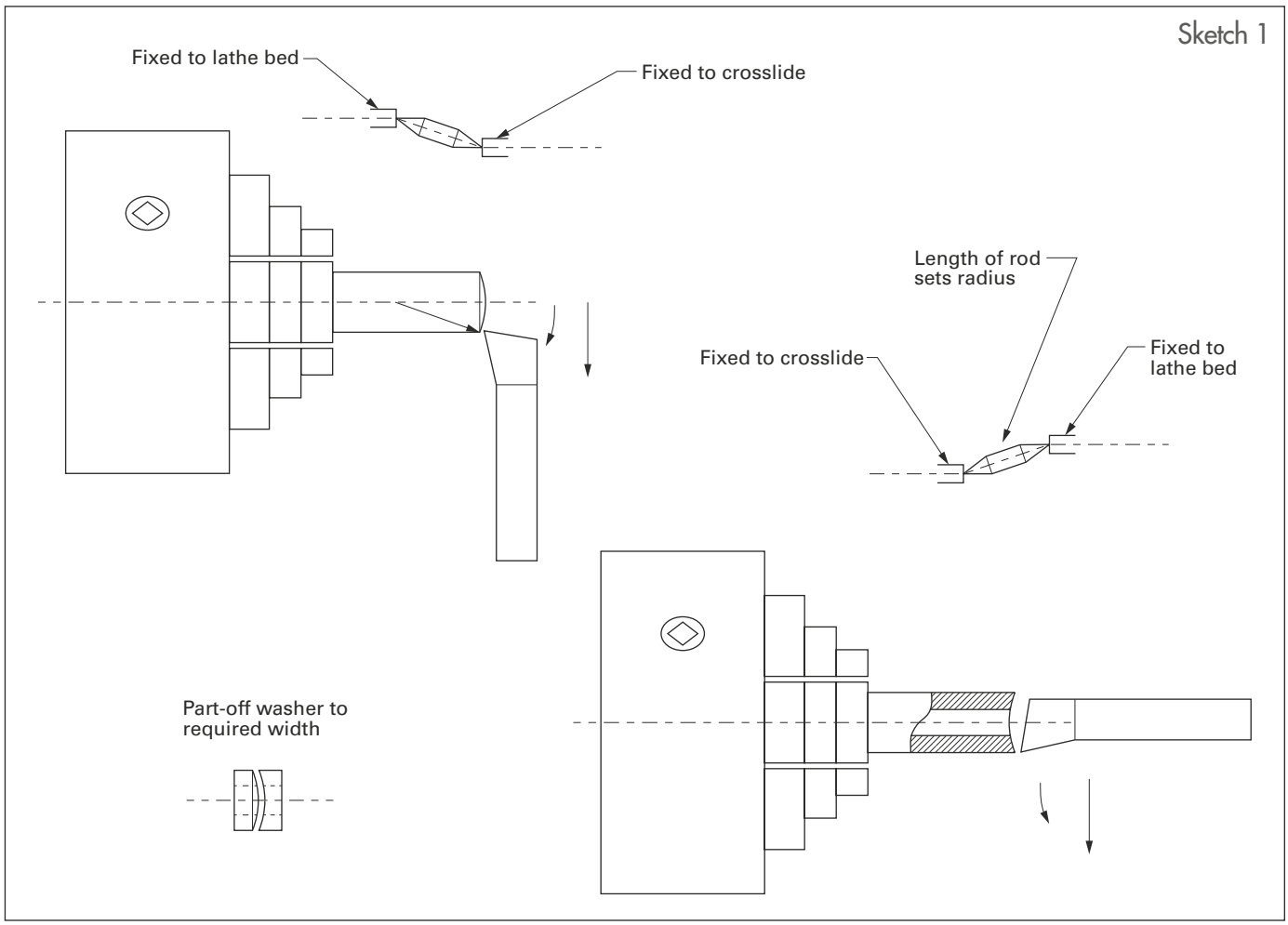
The easy way to make the spherical faces is shown in **photo 2**. Referring to **sketch 1** the principle is that a short rod with a point on each end is trapped between a convenient point on the headstock (or tailstock) and the cross-slide, allowing the easy production of a radiused cut.

In my case a piece of round aluminium is fitted into the lube hole in the backgear lever of the Myford was a convenient support from the headstock. A sharp centre pop mark is made in the end facing out. The tool is mounted in the topslide exactly on centre height and adjusted and set to centre of the lathe axis. A piece of scrap material is folded and attached to the cross-slide as the second support.

A guide rod pointed at both ends, the radius of the one shown is 2 inches long, is placed in the centre pop and held in position parallel in both planes relative to the lathe bedway and the crosslide moved to trap the rod and make a mark on the piece of scrap material. A more positive centre pop make is made at this point.

The top slide is set square to the cross-slide and is used to adjust the cut. By holding the radius rod between the two parts and applying some forward pressure the cross-slide can be moved out and

Sketch 1



3

Setup to cut the internal washer.

4

Providing some additional support on the magnetic chuck.

providing the tool is in the correct position a radius is turned on the work piece.

Photograph 3 shows the reverse cut on the mating washer using the same radius rod but using the tailstock and a bolted together support on the cross-slide. The finished washers are parted off the required thickness and lapped together and polished.

This method is useful for short sections of fairly large radii but not so easy to do for smaller sizes.

The washers seen being used on the grinder in **photo 4**. The fabricated workhead housing only sits on the edge of the magnetic chuck. Even when the chuck was fully energised it was possible to move the work, so the addition of the angle plate increased the contact area, the pair of washers are fitted either side of the angle plate indicated by the arrows.

The chuck is partly energised and the nut secured whilst lightly tapping the washers to seat them, both the job and angle plate are then firmly seated on the chuck and are joined as one making a much safer setup.

These useful washers seen here in **photo 5** along with the radius rod and pivots for the external radius. Making a set of these washers may take little time and effort to make but can save a lot of time when setting up. ■

5

The finished washers and simple parts used to make them.

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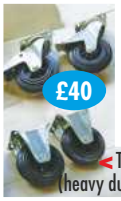

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