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EDITORIAL
Editor: Neil Wyatt
Tel: +44 (0)1689 869 912
Email: neil.wyatt@mytimemedia.com

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching: Brian Vickers
Ad Production: Robin Gray

ADVERTISING
Senior Account Manager: Duncan Armstrong
Email: duncan.armstrong@mytimemedia.com
Tel: 01634 238893

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Kate Hall

MANAGEMENT
Head of Design & Production: Julie Miller
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Tel: 01689 869891
Chief Executive: Owen Davies
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On the Editor's Bench

On My Bench

It's been a 'lots of little jobs' month for me, rather than doing one big project I've tried to finish off a lot of little bits and pieces, including a few more astronomical bits, such as a Pentax screw to 1¼ inch eyepiece tube adaptor. More typical workshop tasks have included a new quick-release mechanism for my tailstock – the old one worked well, but it's short throw made adjustment annoyingly critical. The new one has twice the throw so it needs a bit more force to hold, but is much less fussy. Another was making a bronze spindle for a knurl holder –the HSS drill shank I had been using was quite worn!

Some twenty years ago I was given an old dot-matrix printer, which kept me going until I got an inkjet. It contained lots of nice stepper motors, gears and bits and some very accurately ground square bar. For years I have used two bits of this as rough and ready parallels, but I finally got around to chopping it all into some useful lengths and tidying up the ends on the linisher. About ¼ inch square they are just right for lifting things off the mill table, or dropping between the jaws of a vice to lift up a workpiece.

Another nice little task was 'bricking' the second side of the wall for a model 'house built' engine I am, very slowly, progressing.

Engraving Machines and Die Sinkers

Many readers may not be familiar with these machines. They are relatives of the milling machine, but are often fitted with hefty pantograph arrangements. The working of engraving machines is fairly straightforward as the pattern controls the movement of an engraving tool, usually in two dimensions. Die sinking machines work in three-dimensions, sometimes from a solid pattern, producing cavity moulds for presses, injection moulding or die casting.

Modern engraving machines now tend to be CAD, rather than pantograph, controlled and most die sinking is now carried out using EDM (electrical discharge machining or 'spark erosion'). This means that older, purely mechanical, machines are often available at relatively low cost.

Over the last week the forum at www.model-engineer.co.uk has seen some discussion about engraving and die-sinking machines. This is not a topic that comes up very often, and one of the issues was whether or not such a machine is worth converting into a workshop mill.

By a curious coincidence, this month's Scribe a Line has three letter on related topics. Jurgen Stoltz in South African is hoping for help in identifying his diesinker miller, whilst Charles Woodward tells us how he carried out the conversion of a Taylor Hobson engraving machine by grafting a Deckel milling head on top.

To prove that things really do come in threes, we also hear from Paul Boscott who has a big Krupps die-making machine from the 1930s. Refused by a museum, he would dearly like to find a welcoming home for it rather than see it go to scrap.

Hot Topics

I'm sure that this surge of die sinkers and engraving machines will not become a 'tide', however regular subscribers may well notice that some subjects recur at regular intervals whilst other rarely get a mention. From time readers to get in touch to suggest topics they would like to see covered. I haven't produced a list before, but I think the time has arrived when such a list of topics could be made available to potential authors.

I could write a long list of topics of interest to me that I feel deserve more attention – things such as various handworking techniques come to mind – but it's what you, the readers, want to see more of that I want to know.

If you have a favourite topic that you feel has not been well covered by *MEW*, drop me a line – or join in a thread that I will start on the forum to discuss possible future content. I'm keen to see suggestions from both potential authors and those seeking to fill gaps in their knowledge.

I suggest taking a look at one of the various indexes for *MEW* – I'm looking for topics that have not been covered at all, or no more than once or twice, in the last five years or so.

Dau lawn

A bit of last-minute news has crossed my computer screen. Axminster Tools and Machinery, who have a number of stores across England are opening a new store in Wales. On November 18 the doors will open on their eighth retail outlet at the Valegate Retail Park on Copthorne Way on the West of Cardiff. For satnav users the postcode is CF5 6EH, for locals (and ex-locals like me) it's just off the Culverhouse Cross roundabout!

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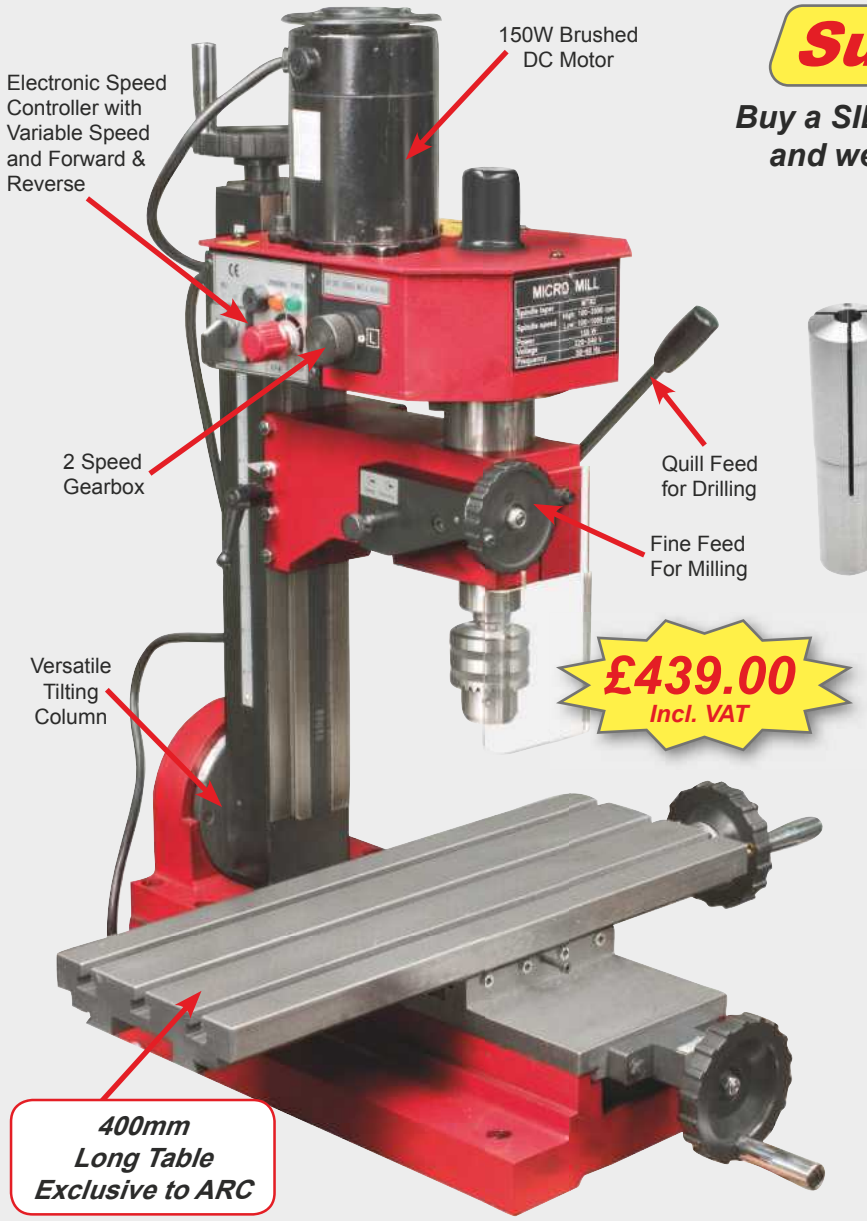

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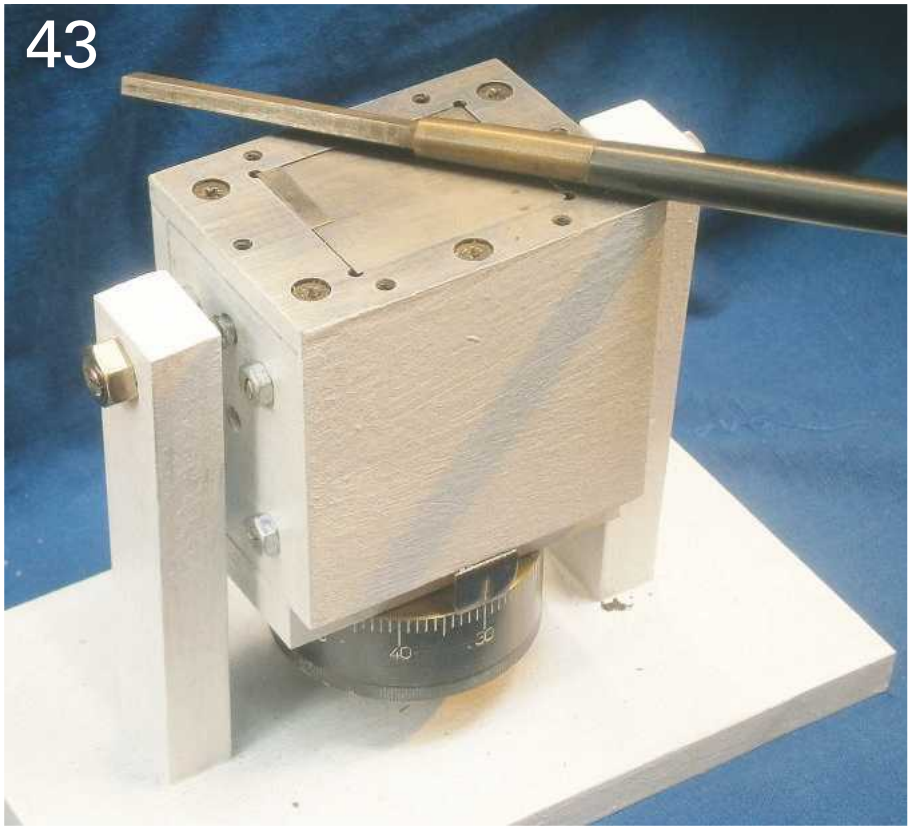


Coming up...

in the October issue

A VINTAGE AMERICAN LATHE

Pete Worden's Hardinge Cataract lathe is nearly a century old and he knows the full history of the machine, which included a short sojourn out in a factory yard. Read the full story in next month's MEW.

PLUS A practical guide to designing springs from Linton Wedlock and Geoff Walker adds rack feed to a vintage Drummond lathe.

Regulars

ON THE COVER

Reader Steve Giles hard at work in his workshop, happy to let the grass keep growing! Steve's photo was one of the runners-up in our recent photo competition.

Visit our Website

for extra content and our online forum

www.model-engineer.co.uk

FREE PLAN:
An Endmill and Slot Drill Sharpening Jig

This handy accessory by A Longworth was first published in MEW 14, December/January 1995. Visit the website to download fully detailed drawings as well as the text and photographs from the original article.

Disposing of a Workshop

We reprint Roger Backhouse's article offering sage advice on this sensitive topic.

Some of the other live topics on the forum include:

- **How Necessary is 3D?**
  Should an aging hobbyist put in the time and effort to get to grips with 3d CAD?
- **Multiple Machines from One Inverter?**
  Practical or Pitfall?
- **The Murad Bormilathe**
  This unique lathe with elevating head and tailstock was an inspiration for J.A. Radford.

A Raising Block for the X1 Milling Machine

Richard Wightman fits a little bit more daylight between his mill's head and table.

The X1 milling machine, in its various guises, is a great little machine with many virtues but suffers from a lack of height. This modification goes someway towards solving the problem.

The X1 milling machine has found its way into many home workshops across the world. I sometimes wonder how many there are out there, hundreds of thousands, a million maybe, who know? They come in many colours from many different suppliers but mostly originate from the same far eastern factory. Mine came from Axminster power tools, (usual disclaimer here), and has been a favourite machine of mine since the day it arrived. There have been many modifications to this little milling machine by many people to increase or enhance its capabilities. The table as supplied is okay at 240mm x 145mm but you soon run out of clamping space if a larger piece of material is to be machined. The first modification I did was to buy and fit a larger table at 400mm x 145mm and longer leadscrew from Arc Eurotrade, (usual disclaimer again). In fact the X1 milling machine from Arc Eurotrade comes with the longer table as standard. The longer table is a real asset and improves the usability many fold.

After that digital readouts were fitted, these transform the machine and I would highly recommend the mod. No more counting turns of the hand wheels and the problem of backlash in the lead screws is eliminated. Another area where the X1 suffers is the height of the column, the Z axis. You could argue that if the machine's not big enough then you need to buy a bigger machine. That's okay if your budget will stretch that far. I'm sure most people try to squeeze that extra little bit out of their machines.

The modification I am going to describe today addresses the problem of the column height, or lack of it, and is a mod that can be completed in a couple of hours. **Photograph 1** shows the milling machine before the mod. I have a rotary table onto which I have fitted a 4 inch 4 jaw independent chuck. You can see that with the spindle at its maximum height

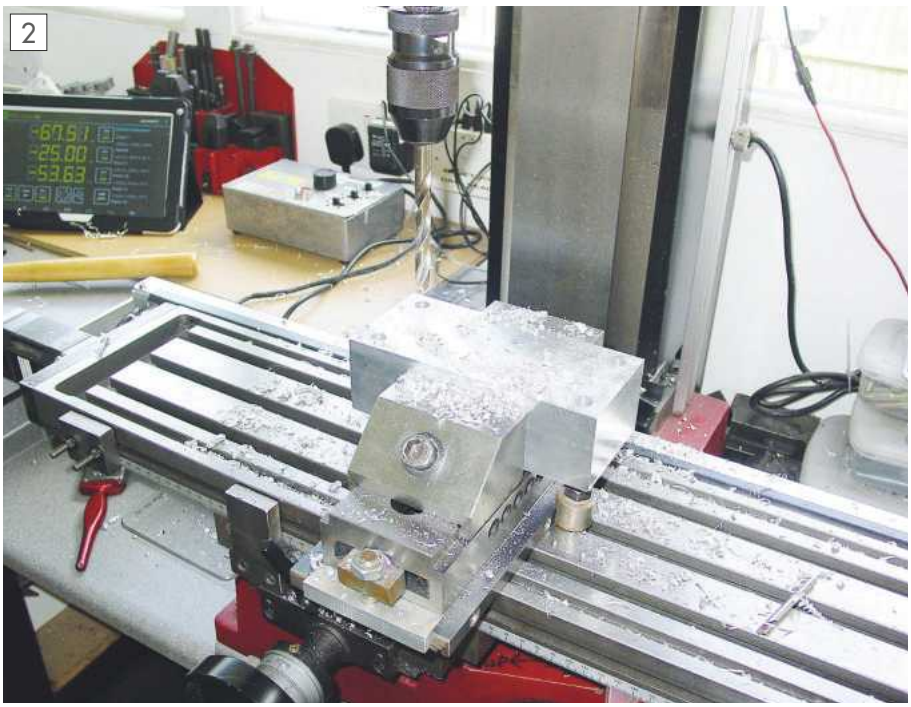
Richard's mill in original condition.

and with a keyless chuck fitted there is barely room for a drill bit let alone the work piece. A little tip here, watch the background when you take photos or you will get the wife's washing as well.

The column of the X1 mill is bolted to the base with 4 X 8mm socket head screws. The modification involves removing the 4 screws, lifting the column and fitting a spacer between the column and the base and bolting it down again with 4 longer screws. This job is manageable on your own; the weight of the column and head is not too excessive but I would recommend the assistance of a friend. If possible support the column and head by rope to

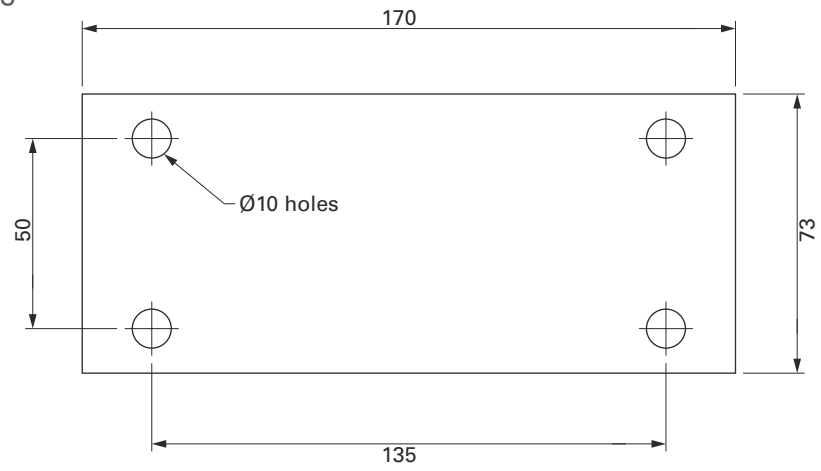
Another area where the X1 suffers is the height of the column, the Z axis. You could argue that if the machine's not big enough then you need to buy a bigger machine. That's okay if your budget will stretch that far.

the roof of the workshop. The first job is to prepare a spacer. I used a block of aluminium that after machining came out at 170 x 73 x 50mm . I used a fly cutter to square up the block. This was carried out on an X3 milling machine but the X1 is more than capable of the task. 4 holes have to be drilled to match the machine. I drilled them to 10mm to give plenty of clearance for the screws (**photo 2**). The drawing (**fig. 1**) shows the measurements but just check your own machine is the same. **Photograph 3** shows the finished block, de-burred, ready to be fitted. **Photograph 4** shows the 4 new screws along side one of the originals. **Photograph 5** shows the raising block



Drilling the raw material for the block.

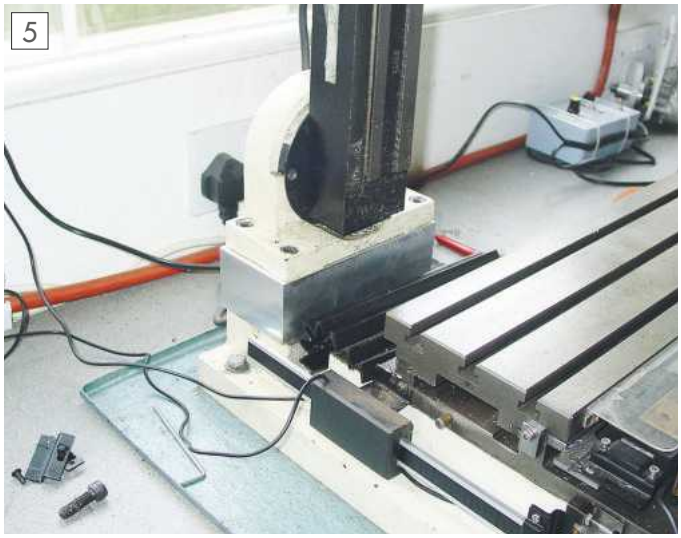
Fig. 1



Hole Pattern For Raising Block

The finished block.

Longer socket screws are needed.



The block fitted.

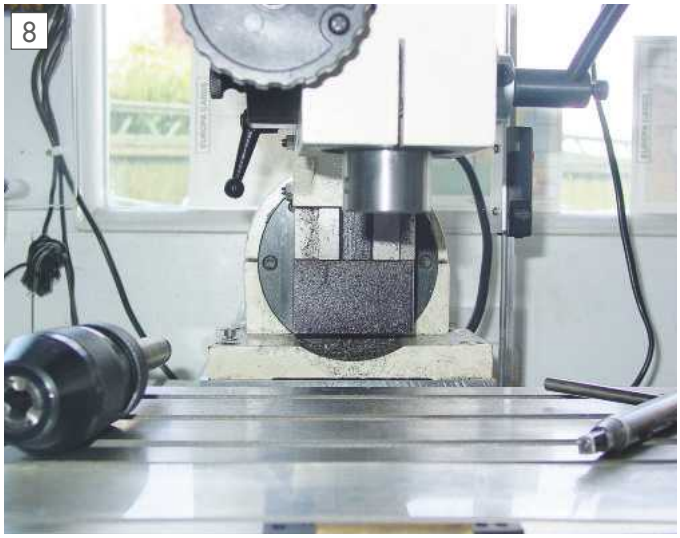
fitted and **photo 6** shows what a difference 50mm makes. **Photograph 7** shows the spindle wound down with a keyless chuck fitted.

Photograph 8 shows the spindle at its lowest point and **photo 9** shows a small vice and end mill fitted in a collet. It's possible that with a thin plate on the table and small cutter in a collet a problem might arise but would be easily overcome by raising the work piece. If absolutely necessary the raising block could be removed in about 5 minutes putting the machine back to its original spec. I took care to machine the raising block to the best tolerances I could get but its not critical as the X1 milling machine has a tilting column, so tramming the machine is just as easy as if there were no raising block fitted.

I did wonder about the rigidity of the column with the extra height but I have not noticed any difference. I used aluminium for the raising block because its what I had in stock, steel or cast iron might be a better choice I suppose, it's a case of use what you have. If you just wanted to raise the column by say 20 – 25mm a couple of steel bars 20 – 25mm square would do, it doesn't have to be a solid block. Well there you are a quick and easy mod that increases the capacity of the machine and requires no modification at all to the machine itself and is easily reversible. I hope you find it useful. ■

The increased headroom.

The spindle can easily reach the table when a keyless chuck is fitted.



The lowest position of the spindle.

All done – perhaps Richard can find time to do his washing now?

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A Tapping Dilemma

John Ashton turns his die stock holder into a tapping head unit.

I am sure many of you are familiar with the thought 'I wish I had an extra hand' when tapping a hole in your latest project, in your lathe. You fit the square shank end of the tap into the tap wrench, place the tap into the hole to be tapped, then slide the tailstock and centre up to the rear of the shank of the tap to locate the whole assembly in line. Then, as soon as you start cutting the thread you need that third hand to wind the tailstock in to synchronise with the pitch of the thread. This usually means you end up playing catch-up with the tailstock. If you are tapping a tough material or your tap is not at its best there is always the thought in the back of your mind that at any moment you might break the tap because you cannot feel it cutting properly.

Another added problem is that very small thread sizes usually have a male centre on the end of the shank, which necessitates the manufacture of a spigot, centre drilled in one end, to fit your tailstock drill chuck and some taps have no centre at all, male or female.

So, after many years of always doing it this way, I decided there had to be a better way. After all I don't have this problem when cutting an external thread with my tailstock die holder, because the die head is mounted on a parallel shank, fitted directly into the tailstock Morse taper. This allows the die head to slide back and forth along the lathe spindle axis eliminating the necessity to have to synchronise the winding in of the tailstock with the pitch of the thread.

I searched the Internet to see if there were any similar systems to my die holder for hand taps. All I could find was a couple of cottage industry manufacturers that would make a tap holder to the specific size of your tap shank diameter that would fit in a drill chuck or auto tapping head, which are primarily designed for vertical use. Some diestock holder manufacturers do supply sleeve inserts to hold taps in the die stock head, but this means you would have to have one for every tap shank size. Unlike dies, which are generally manufactured to standard diameters, hand tap shanks vary in diameter, even for the same size thread. They only seemed to offer 3 or 4 standard sizes, which were either split like a die so that the tap shank was held by friction only or they had threaded cross holes with set screws to clamp the square shank of the tap. The latter give little support for the tap shank. Either way you would probably have to re-machine the bore to suit your tap shank diameter and square spigot size.

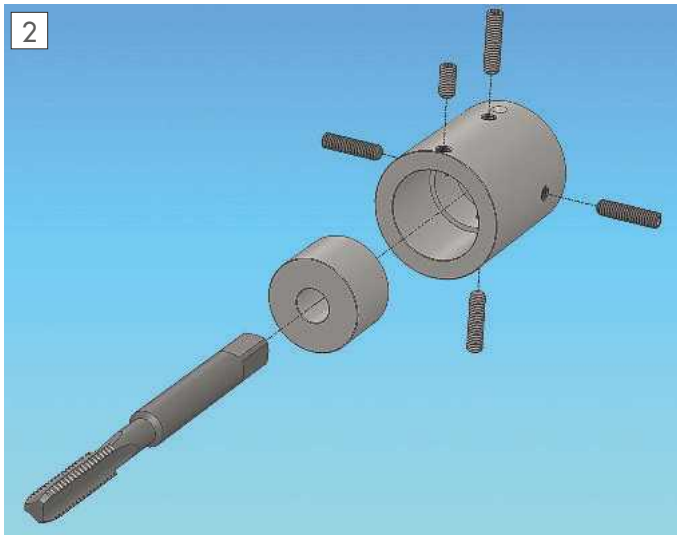
The tapping head.

So I decided to design and manufacture my own tapping head adapter to fit my die stock holder. First I had to decide how the tapping head would accommodate different hand tap shank diameters without having to carry out lots of machining each time I needed to accommodate a new shank diameter.

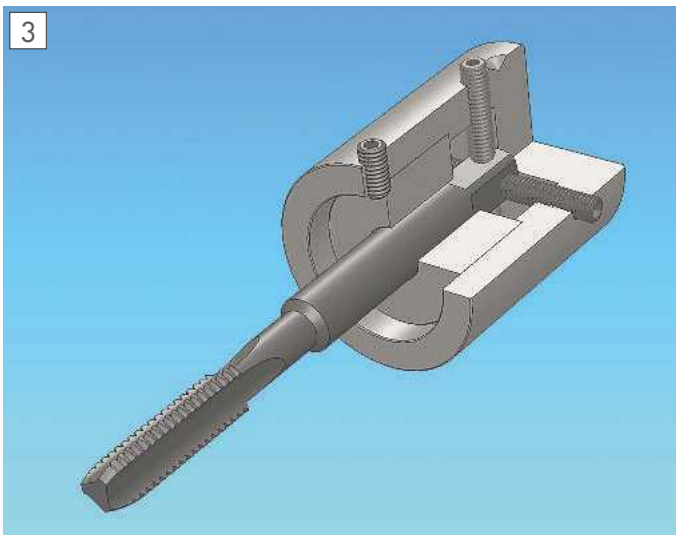
To machine them as the manufacturers supply would mean, after turning the basic blank, setting each one up to either machine a slot through or drilling and tapping cross holes for clamping the square ended tap shank. This would seem to be a lot of work, especially if you are only tapping one hole. So, on with the thinking cap, what I decided on, as a design, is shown in **photo 1**, which shows the tapping head positioned in the die stock holder, ready for action.

Design concept

The design consists of the main tapping head, the outside diameter turned to be a slide fit in an existing die stock holder. A flat-bottomed bore is machined into the face of the tapping head, which is clearance on the largest tap shank diameter the tapping head is expected to take. At the base of the flat bottomed bore are 4 cross holes, at 90 degrees to



Rendered image of the design.



A cutaway view of the tapping head.

each other, drilled and tapped to take 4 set screws which clamp and secure the square section of the hand tap shank. The depth of the flat-bottomed bore acts as the stop for the end of the tap shank, to ensure the square section of the shank is in the correct position for the setscrews to secure and clamp the tap in position. The flat-bottomed bore is counterbored to take the tap shank-retaining sleeve that positions the tap along the lathe spindle axis. The retaining sleeve is a slide fit in the counterbore and on the tap shank and is held in position by a setscrew positioned forward of the retaining sleeve in the tapping head. The design can be scaled up or down to suit a specific range of taps. **Photograph 2** shows an exploded view of the modelled design, while **photo 3** shows a cutaway view of the assembly.

Tightening a clamp screw.

Assembly

With the die stock holder positioned in the lathe tailstock, secure the tapping head in position in the die stock holder using the clamping setscrews that would normally hold the die. Slide the relevant retaining sleeve into the tapping head and secure with the holding setscrew. Ensure the 4 clamp setscrews are retracted enough to clear the faces of the square section of the tap shank. Slide the tap into the tapping head until it contacts the bottom of the flat bottom bore, with the faces of the square shank perpendicular to the clamp screws hand tighten the 4 clamp setscrews. Slide the die stock holder forward so the tap lines up with the hole to be tapped, then tighten the four clamp screws fully, not too tight (**photo 4**). The tapping head is ready for use.

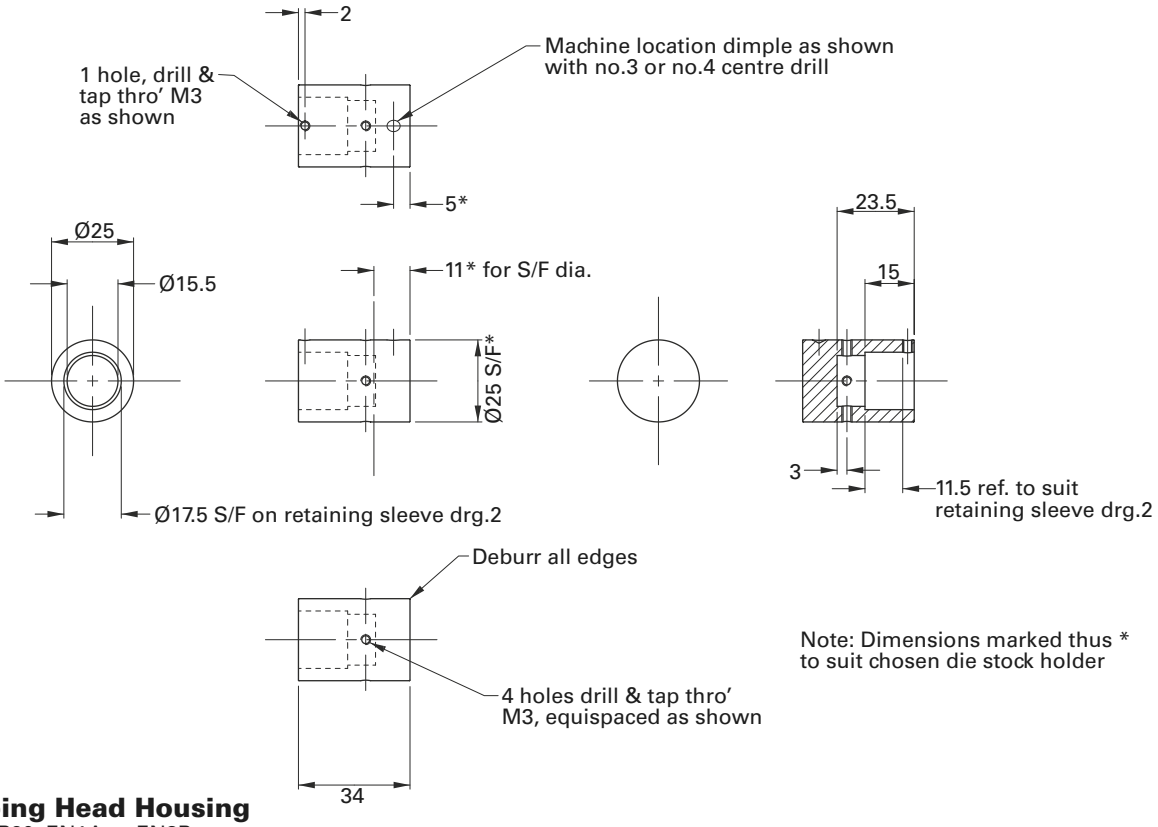
Table 1: Bill of materials

Description	Qty	Size (mm)	Material	Remark
Tapping head housing	1	Ø28 x 40 lg.	en1a or en3b (P20 used by author)	Machine from bar stock
Retaining sleeve	1	Ø18 x 16 lg.	En1a or en3b	One per tap shank size Machine from bar stock
Clamp set screw	4	M3 x 12 lg.	Cs-blacked	Purchased item
Holding set screw	1	M3 x 6 lg.	Cs-blacked	Purchased item

Manufacture

The tapping head system can be fully machined with just a lathe and pedestal drill, or instead of a pedestal drill a milling attachment on your lathe or a vertical milling machine. A full bill of materials is given in **table 1**. The list is based on the tapping head I manufactured; material sizes will vary if you scale the design up or down, or using material stock you have to hand.

Drawing 1



Note: Dimensions marked thus * to suit chosen die stock holder

Tapping Head Housing
Mat'l: P20, EN1A or EN3B

Tapping head housing

Drawing 1 details the tapping head housing I machined to suit my 1 inch (25.4mm) die holder. I machined the tapping head housing from a piece of P20 (tool steel), just because it was a piece I had handy, but EN1a or EN3b (mild steel) would do just as well. To be honest I thought the P20 I picked out of my material rack was a piece of black mild steel, until I started machining it. After facing off I turned the outside diameter to be a slide fit in the chosen die holder, and then machined the flat bottomed bore to 15.5mm diameter by 23.5mm deep, clearance on my largest tap shank diameter of 15mm. I then machined the counterbore for the retaining sleeve, 17.5mm diameter x 15.0mm deep (**photos 5** and **6**). Next I parted off the housing and turned it around in the lathe chuck to face it off to a length of 34mm (**photo 7**). Then before removing it from the chuck I placed the die holder in position and nipped up the centre-clamping setscrew to mark the position for the location dimple (**photos 8** and **9**). To machine the location dimple and cross-holes I used my 5c collet spin indexer on my milling machine. I find the spin indexer a very useful bit of kit, not as sophisticated as a dividing head but just as useful, at a fraction of the price of a dividing head. You can even mount it on an adjustable angle plate to give you similar versatility to a dividing head.

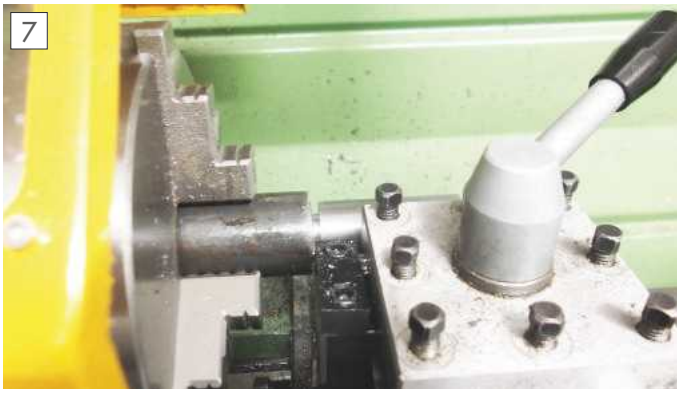
I positioned the tapping head housing in the spin indexer, with the dimple mark uppermost (**photo 10**). It is not important for the dimple mark to be exactly positioned, as it is just an indicator. I then used my edge finder to locate the centreline axis and the edge of the back face of the tapping head housing (**photos 11** and **12**). Once the datums were established, I moved in 5mm from the edge to machine the location dimple using a number 3 centre drill (**photo 13**) I then removed the tapping head housing from the spin indexer. **Photograph 14**

If your only means of holding your work piece is a vice or v-block leave the tapping head attached to the bar stock so you have something to clamp onto, then saw or part it off after you have machined the dimple and cross holes.

A useful tip - if your only means of holding your work piece is a vice or v-block leave the tapping head attached to the bar stock so you have something to clamp onto, then saw or part it off after you have machined the dimple and cross holes.

Machining the head housing.

The counterbore in the housing.

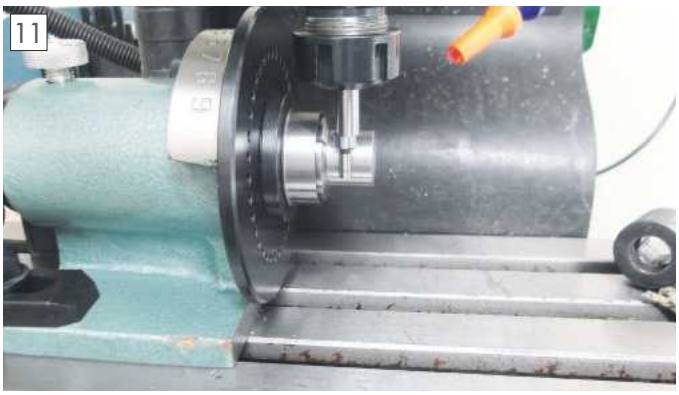


Parting off the housing.

Marking for the location dimple.

The mark on the housing.

Using the spin indexwer.



Using an edge finder on the side of the housing.

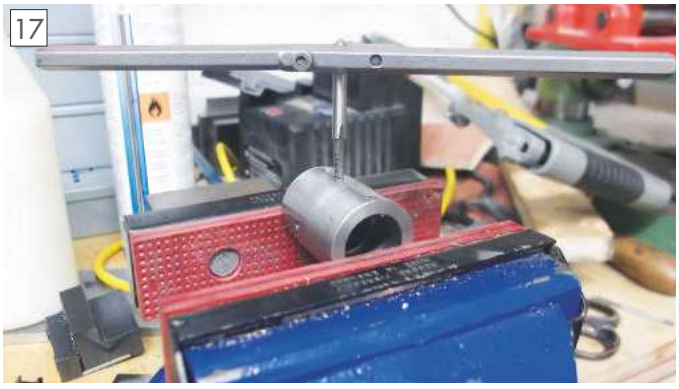
...and again on the end.

Drilling the dimple.

The housing and the die holder.

Drilling the hole for the first clamp screw.

...and the second at 90 degrees.



Tapping the clamp screw holes.

The completed housing.

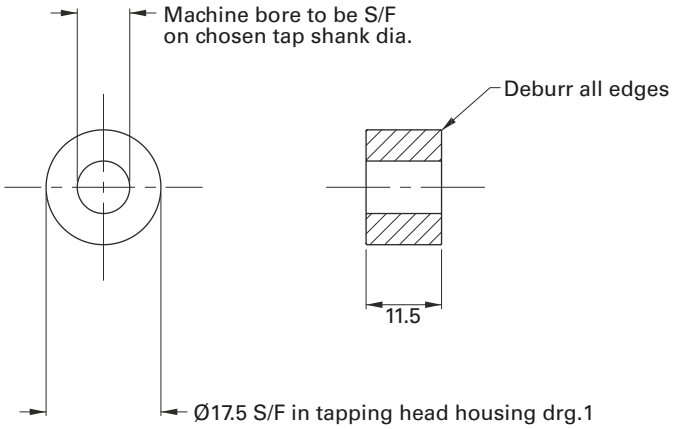
shows the relationship of the machined location dimple to the die stock holder. I turned the tapping head housing around and repositioned it back in the spin indexer leaving enough protruding to machine the cross holes, I then used the edge finder to locate the edge of the face, as before. I moved across 2mm from the face edge, centre drilled and then drilled through 2.5mm, tapping size for an M3 thread, for the retaining sleeve holding screw. I then moved across 20.5mm the face edge to drill M3 tapping size for the first clamp screw position (**photo 15**). I then rotated the spin indexer 90 degreees to the next clamp screw position (**photo 16**) and repeated this until all four positions were drilled. Depending on your setup, you may want to tap in position after drilling each hole. Because of the close proximity of the spin indexer indexing plate to the machine spindle I had to remove the tapping head housing and tap the holes separately (**photo 17**). **Photograph 18** shows the completed tapping head housing with the setscrews fitted.

Retaining sleeve

Drawing 2 shows the details of the retaining sleeve. The retaining sleeve can be machined in a matter of minutes. After facing off, turn the outside diameter to be a close slide fit (s/f) in the tapping head housing. Next machine the bore size required, the bore size can either be drilled, drilled and reamed or bored, depending on size, just remember you need to machine the bore as close to the tap shank size as possible.

You can use a drill bit as a reamer to ensure a close fit to the tap shank. First drill under size as you would for reaming then modify the drill bit you are going to use for the final size as follows: Using an oil stone radius the outer cutting edges of the drill, as shown in **sketch 1**. Then use the drill bit as you would a reamer, you will find that you will end up with a more accurate sized bore.

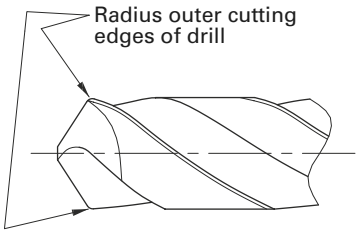
Drawing 2



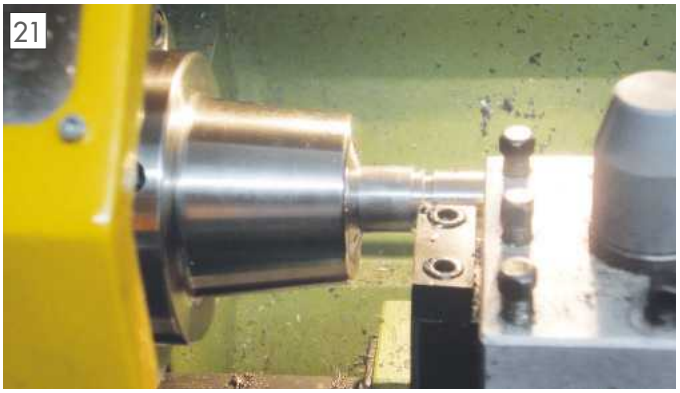
Retaining Sleeve
Mat'l: EN1A or EN3B

A near complete sleeve.

Sketch 1



Setting the parting tool.



Parting off the sleeve.

A selection of retaining sleeves. INSET: The housing fitted with a retaining sleeve.

The tapping head system in use.

Photograph 19 shows a near completed sleeve prior to parting off. Use a depth micrometer or vernier with an end depth gauge to set the parting off tool to 11.5mm (**photo 20**) then part off the finished retaining sleeve, **photo 21** shows the parting off process to complete the retaining sleeve. **Photograph 22** shows some of the retaining sleeves I currently use and **photo 23** shows the tapping head housing fitted with a retaining sleeve. Finally, **photo 24** shows the completed tapping head system in use. ■

Foaming Tools!

Des Bromilow suggests a cure for flimsy plastic trays.

The Problem - modern high quality tools being shipped in good steel cases with cheap vacuum formed inserts to secure the tooling. Over time, and accelerated by solvents, or vibration (e.g. with tools stored in a vehicle), the vacuum formed plastic insert will break down and become useless. This tip adds support to the insert and prolongs its life considerably. **Photograph 1** shows an example with a recently purchased P&N Tap and Die set.

The solution is based on filling the gap behind the insert with a medium - in this case I've used expanding foam, but plaster, silicone, or other media could be used to good effect, albeit at the expense of weight, and curing time.

The insert is placed upside down (so the back of the insert is facing up) and a thin layer of spray foam is prayed in the back of the insert - paying particular attention to try and work the foam into the corners and crevasses (**photo 2**).

A disposable sheet of paper or thin card is placed over the insert, and weighted with a large flat object - Here I have used a damaged suspension file for the disposable card, and a socket set to weight it all down (**photo 3**).

Once cured, any gaps are filled with a second application of foam, any over filled areas are gently cut back with a knife, and the insert can be placed back in the steel case and refilled with the tooling. It is optional if you wish to place a thin card between the foam and the steel case, since some foams may leave a residue.

Some related tips

The Ramset FomoFill (Australian brand) used in these photos can only be used once, that is once the trigger has been pulled, the foam can needs to be emptied within 12 hours, or it will set inside the can. I try and save up all these sorts of jobs and make an event of doing them all from one can to reduce wastage.

The straw nozzle will block easily due to the foam setting inside it between jobs. One solution is to cut the original straw just on the trigger block (**photo 4**) and then slide a straw from a fast food restaurant (McDonalds in my case) over the short section of the original straw (**photo 5**).

In use, I apply the foam where I want it, pull off the disposable straw and toss it in the foaming insert (as a stiffener) and I then only need to clean the short trigger block with a short piece of wire such as a paperclip.

Placing straws, broken hacksaw blades, fencing wire, wood, all manner of 'filler' may be encapsulated inside the foam to add support to the insert if needed. This is of particular use where one tray of tools needs to be removed to gain access to a lower tray of tools (some larger tap and die sets do this). Stiffening the tray insert with hacksaw blades, wire or a thin piece of ply can serve a useful purpose. ■

1

A tap and die set with a typical insert.

2

The back of the insert filled with foam.

3

The 'foamed' insert held down onto some scrap card.

4

How to cut the original straw.

5

A 'fast food' straw fitted to the can.

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On the Wire NEWS from the World of Hobby Engineering

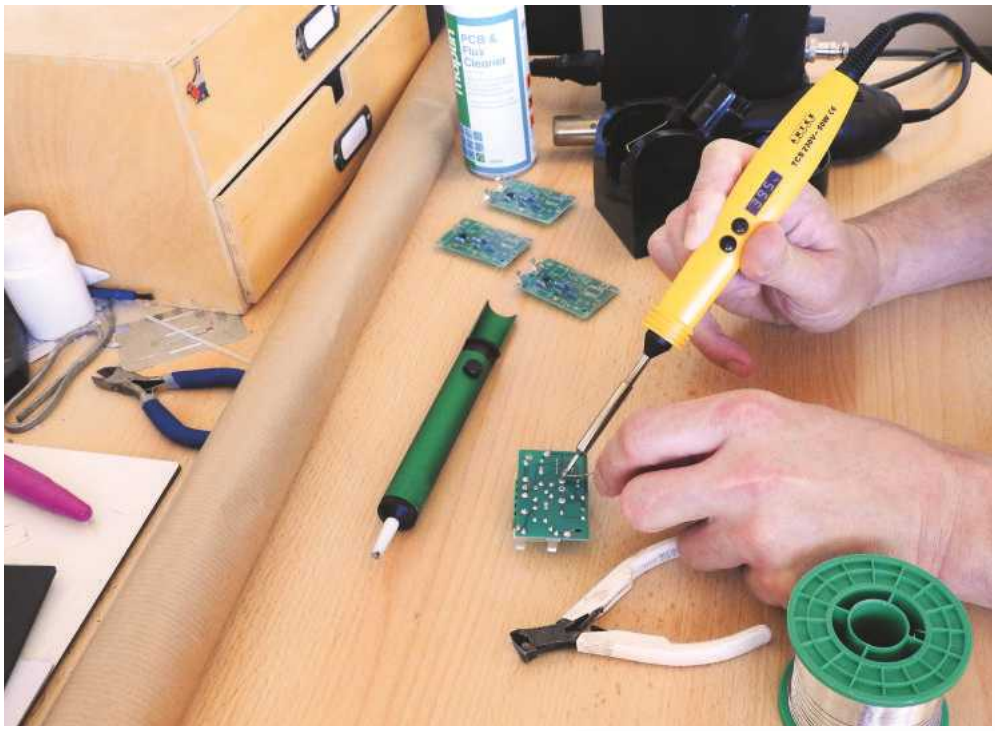
Antex TCS 50W

UK soldering iron specialists, Antex, have introduced the first soldering iron with Temperature Control buttons and, an LCD display built in to the contoured handle.

The usual approach to temperature controlled irons depends on a remote sensor in the iron and a hefty soldering station on the bench. However, this 240V, 50 Watt iron from Antex increases efficiency and saves space by having the controls built directly in to the handle with the current temperature, between 200° to 450°C (392°– 842°F), displayed on a backlit LCD screen.

The TCS 50W also uses elements with the Antex Surefit Tip System, allowing bits to slide-on slide-off. The soldering iron comes with a long life 2.3mm Nickel-plated bit as well as a burn proof silicone cable, improving safety and preventing accidents.

The TCS 50W cost £69.99 and is available from www.antex.co.uk



Look out for a full review of this new soldering iron in our next issue.

Machine Mart

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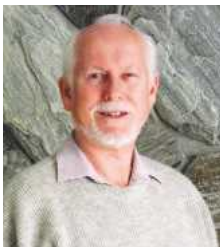
Stiffening Up Loose Screw Threads



John Antliff proposes a cure for 'adjustment creep'.

Most machining operations generate unwanted vibrations which can be detrimental to achieving a good surface finish. In addition, these vibrations may interfere with screw mechanisms used for fine adjustment. The tendency is for them to migrate in the opposite direction to the prevailing pressure. A good example would be the depth setting bobbin on a QCT (Quick Change Toolpost) tool holder. Most tap-cut internal threads and die-cut external threads are designed to produce a loose fit which is not always the result required for the particular application. In this case it can be annoying to find that the bobbin has inadvertently moved since the last time the tool holder was mounted. Most likely, the direction of migration is upwards leaving the tool below the lathe centre line. The discrepancy is usually only discovered after some difficulty has been experienced with a cut soon after re-mounting the QCT tool holder. The discrepancy may not be large enough to be a problem, however, the constant tool height functionality which is one of the beneficial design features of the QCT will be completely negated!

2mm dia. hole being drilled in end of M5 cap screw.

Industry has produced a number of solutions to this problem of shaky screw fittings but most of them are only applicable to static fixings e.g. Nyloc nuts, crinkly or spring washers etc. What is required in this case is an increase in the 'running friction' to stiffen up the thread fit. I have seen some people solve this problem by scoring the male thread or using proprietary stud and nut locking liquids, however these are, at best overkill - too stiff, or, at worst - only temporary as it does not take very many traverses of the screwed item for the thread to loosen up again! Another, more engineered solution, would be to install a grub screw with a suitably soft pad to bear upon the thread radially - this often is not possible due to insufficient space.

My solution is simple (often the best solutions *are* blindingly simple). Just cross drill the male thread and insert a short length of nylon line. Sources of suitable nylon line can be obtained from your local hardware store or fishing equipment supply depot. I use both 1.6 mm and 2 mm nominal diameter nylon line sold as consumables for weed-eater machines (strimmers). In **photo 1** I am drilling a 2 mm diameter cross hole close to the end of an M5 dome-headed cap screw which forms part of a Quorn end mill tooth setting gauge, as described by Keith Johnson in his article *Return to*

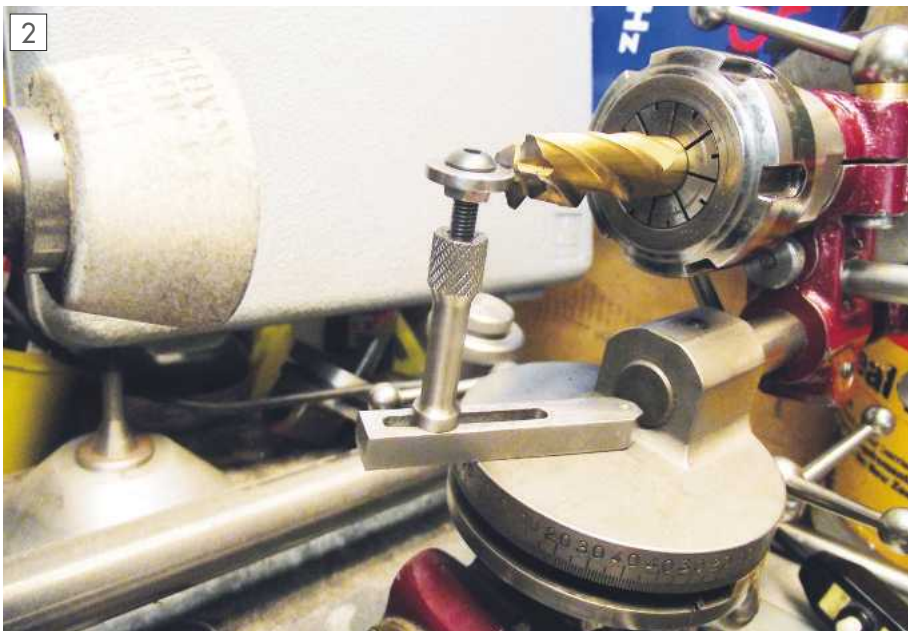
My solution is simple (often the best solutions *are* blindingly simple). Just cross drill the male thread and insert a short length of nylon line. Sources of suitable nylon line can be obtained from your local hardware store or fishing equipment supply depot.

Centre... Dimensions Unknown in *MEW* issue 189. My version is an improvement in that the radial position of the setting disc on the vertical post is adjustable by unscrewing the post and moving it along the slot - see **photo 2**. The height screw (M5) is deterred from moving by inserting a nylon section into the male thread close to the end. Just cut a short length of the nylon line and insert it into the drilled hole and then screw the two parts together - see **photo 3**. The nylon is sheared on both sides as the M5 male thread enters the female part. This small portion of nylon thread will now exert pressure onto the walls of the female thread thus increasing the torque required to screw the parts together.

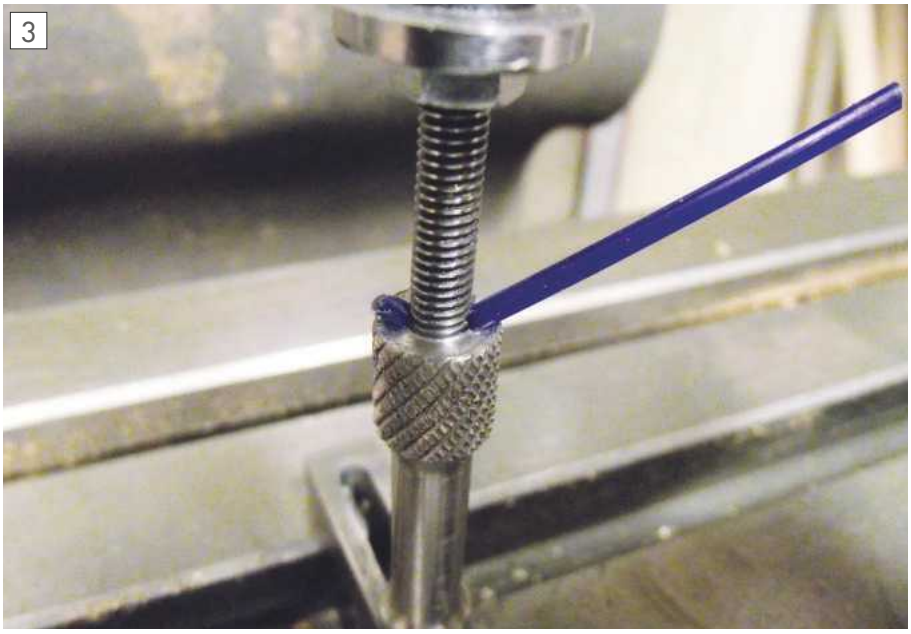
The trapped nylon, being elastic, applies pressure to the female thread for the rest of it's life. Up to now, none of the friction inserts I have used have ever relinquished their hold or had to be replaced! The amount of friction delivered depends on the diameter of the inserted nylon as it is proportional to the nylon's cross sectional area. This simple but effective solution can be scaled to suit any size of screw application. **Photograph 4** shows my home made Dickson type QCT tool holder height adjustment screw (M8) with a nylon insert just visible in threads 3 and 4. It doesn't require the cross drilled hole to be strictly in the centre of the male thread for it to be effective (I'm a bit of a pedant about such things). Care does need to be taken when drilling medium to high tensile components like cap screws and a suitable cutting fluid should be used to avoid blunting, or even worse, breaking the drill bit! Drilling multiple holes and filling with nylon will also increase the friction delivered proportionately. In the grinding jig example this inserted nylon increased the friction to the point of almost needing an Allen key to screw the gauge up or down - just what was required!

The 2mm blue nylon line I used can be seen lying in front of the extended centre drill (another very useful modification) on the top of the milling vice in photo 1.

If you have any 'creepy' handles or loose threads which annoy you during your 'metal mincing' then tighten them up by this 'simple to implement' procedure using this cheap, easily available and durable material. ■



Improved Quorn end mill tooth setting gauge in use.



Quorn tooth setting gauge prior to shearing nylon.

QCT height adjuster nylon insert in threads 3 and 4.

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Readers' Tips

This month's winning tip is from Alastair Sinclair, who wins £30 of Chester gift vouchers for an ingenious approach to making a mandrel handle.

TIP OF THE MONTH WINNER!

Get A Handle On It!

There is perhaps nothing more basic but essential to a lathe than an attachment for a hand operated handle to the headstock mandrel. This has a number of potential uses but principally it is that of facilitating the cutting of screw threads using either a single point tool or a tailstock held tap/die. There can be few who have not noticed the close resemblance of the common expanding anchor used on building sites with the general design of a typical mandrel hand tool that has been designed for the purpose. Such anchors are easily obtained from a builders' merchant but, in this case, it is only the loose bolt type shown in the photograph that is suitable with a slightly larger diameter than the bore of the mandrel. Many readers will also have a vertex type of milling vice which is supplied with a handle having a square drive hole at its business end. Combining these two parts, i.e. the anchor and the vice handle, provides a very cheap and reliable mandrel handle. It is many years since I made use of this approach and the one made then, still serves me well today.

The photo of the upper anchor shows it before machining to size and the lower after completion of machining. In the particular case concerned, very little was required to be turned from the anchor shell to match the bore diameter of the mandrel. It is necessary that the original loose bolt is replaced with a threaded bar to match the thread of the original loose bolt and a square end which matches the dimensions of the hole in the vice handle. A threading and milling exercise is therefore necessary to a piece of round or square stock to obtain this. In addition, the left hand part of the shell of the anchor needs two flats milled on it to allow it to be held by a spanner and prevent it turning during expansion. The second photo shows the assembled tool using the vice handle and the machined anchor together. The most positive way of expanding the anchor shell to grip the bore of the mandrel is to use a spanner on the milled flats of the projecting shell end while tightening the assembly using the handle.

If no suitable vice handle is available for this and only occasional use is anticipated, a ring spanner can be used instead onto the hex head of the original loose bolt. No machining of a special square ended and threaded rod will then be necessary.

Alastair Sinclair

No more than one prize with a value of £30 will be given each month. By entering you agree your entry can be freely published and republished MyTimeMedia on paper or electronically and may be edited before appearing. Unpublished tips may be carried forward to future months. You will be acknowledged as the author of the tip. There is no guarantee that any entry will be published and if no publishable tips are received a prize will not be awarded. The decision of the editor is final.

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!

This month's runner up is Christopher Barnes, with a tip for keeping tiny parts under control. He wins a copy of Chris Vine's *How (Not) to Paint a Railway Locomotive*.

Tiny Trays

I have for many years used the aluminium foil baking trays of pies etc. to hold small parts, but have recently gone one step further in the discovery of the usefulness of used pill strips which generally provide 5 to 14 micro trays, to hold tiny parts screws and the like.

They can also hold a few drops of oil which can be administered in tiny amounts using a piece of wire, or remove one end of a Q-tip for dropping oil or cleaner or WD40 and the remaining cotton wool end for clearing up. Hope this is of some use to somebody once I got started with it, I found I was using it all the time. There are various pill sizes giving you a range of pot sizes, I find the big headache pills the most useful but smaller ones come in sometimes especially where you wish to keep screws in the order they came out to refit each to its own. The only downside is the ease of knocking the strips about but they can be pinned or glued to a piece of wood or the bench if required.

Christopher Barnes

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A book for model engineers. There are many beautifully made miniature locomotives, but very few are well painted. This book tells you how (and how not) to do the job to the highest standard.

This is the book which was written by Chris Vine after he had struggled for nearly two years to paint his locomotive Bongo, an LNER B1. He made a lot of mistakes along the way and found that there was almost nothing written which was of use to model engineers.

After winning a gold medal at the model engineer exhibition in 2004 and also the Charles Kennion Memorial cup for the best finished model in the show, Chris was encouraged by the chief judge to write down what he had found out along the way; this book is the result. It covers choice of equipment, making a spray booth, paint, preparation, spray painting, hand painting, lining, transfers, a list of suppliers and more...

It gives chapter and verse on how to get a great finish on your model. How often have we seen super models spoilt by a poor paint job? It is quite simply the best practical book for model engineers we have seen for decades.

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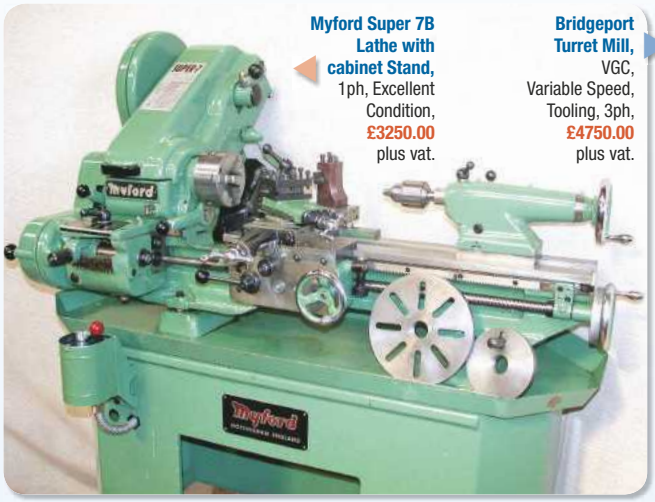

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CNC in the (Model Engineers') Workshop

Part 17

This time Marcus looks at machining complex curves.

Marcus Bowman makes a welcome return with the continuation of this series which started from fundamentals and covers many aspects of CNC programming and machining. The series is not specific to one make or model of machine tool. There is a support website for the series at www.cncintheworkshop.com from where you can download example programs.

Heel guards

On a powerful motorcycle, you will want to keep your heels well away from the fast moving chain or belt drive to the rear wheel. Heel guards (**photo 101)** are often used just aft of the foot pegs, for safety's sake. These are small shaped plates which bolt onto a frame bracket and sit between heel and chain.

Design choices

The initial design of these heel guards was based on a set of verbal instructions: "can you make a pair of heel guards something like the existing guard, but a bit shorter at the ends?"

The most significant aspect of the design is the curved outline. Most straight lines can easily be turned into G code, but flowing curves cannot. What's required is a full CAD/CAM/CNC workflow sequence, beginning with an accurate drawing (**fig 87**).

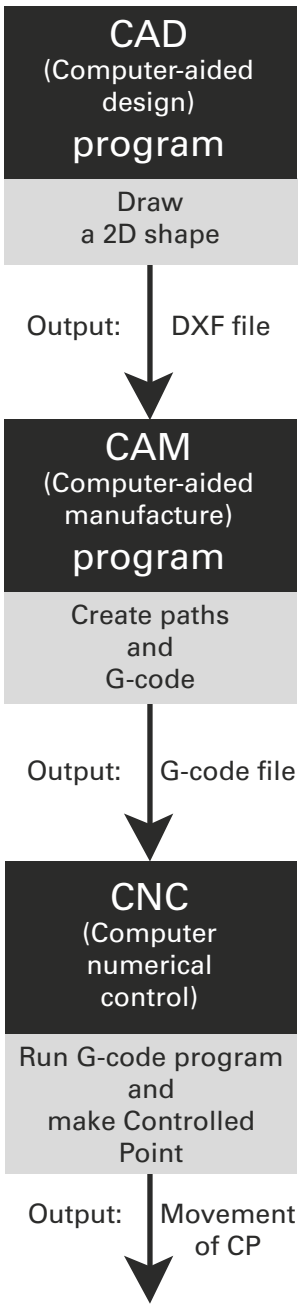
Drawing packages

The choice of CAD packages is wide, and for the most part it comes down to a personal preference, except for one important factor: the output file format. AutoCAD has set the standard here, and it is important that any CAD package allows files to be saved in DXF format. This is the universally recognised Drawing eXchange Format. Originally devised by AutoCAD's creators, this kind of file contains a description of the elements of a drawing, in an agreed format. DXF files are package-independent, so that if I prepare a drawing in, say, AutoCAD, save it as a DXF file, then give it to you, your own choice of drawing package should be able to open the file and use the drawing – provided your package recognises the DXF format. All of the fully fledged CAD packages can save and open DXF files; many of the mid-range CAD and drawing packages can too; but most of the very cheap CAD or drawing packages cannot.

101

The pair of heelguards.

Fig. 87



Note that I draw a distinction between CAD packages and 'drawing' packages here. It's useful to highlight some important differences:

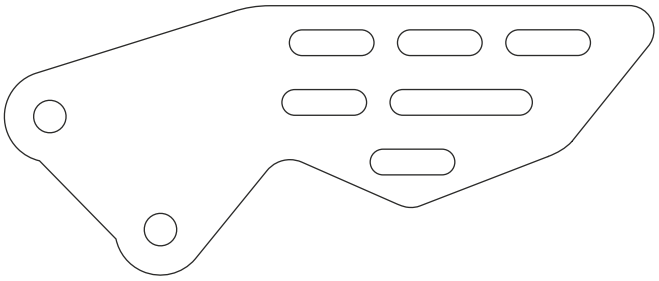
First, the CAD packages contain many features designed specifically to ease the task of creating a technical drawing, such as creating lines, circles and other features using precise co-ordinates and dimensions, quickly adding dimension lines, text, Title Blocks, and production of standard technical drawing layouts of views (such as the classic first or third angle combination of plan, side and front elevation layouts). AutoCAD has most installed users, with AutoCAD LT (i.e. 'Lite') being the most popular version. Programs like TurboCAD have their fan base; and DraftSight (by the company which sells SolidWorks) is free, although it does require registration.

Second, the drawing packages are often easier to use when creating flowing curves. By 'drawing' I mean vector-based drawing and not the pixel-based or raster-based illustrations produced by 'painting' programs such as Paint or PhotoShop, which are of no use for this kind of task. Compared to the methods used by drawing packages for creating and amending curves or fitting curves to shapes, the tools provided in most CAD programs are quite stilted and awkward to use.

As with CAD programs, any useful drawing package must be able to save files in DXF format. You do tend to get what you pay for, to some extent, and the very basic 'sketching' programs are neither easy to use nor can they create or use DXF files. My personal favourite is Adobe Illustrator, with CorelDRAW a popular alternative, but you may find Inkscape both powerful and easy to use. As it is free Open Source software it may be more to your financial taste, although it may require considerable computer system knowledge to set it up initially.

Third, there is a very important distinction between drawing packages which can accept precise input of co-ordinates, and those designed for an artist to use by the computer equivalent of free-hand drawing. Adobe Illustrator allows precise co-ordinate input, while programs like MAYA are designed for use by artists and illustrators working freehand. MAYA is a wonderful tool for artists, and is widely used for graphic effects in films, but is not much use for CAD work. AutoCAD and MAYA belong to the same company, but the packages serve different kinds of users. Horses for courses.

Fig. 88

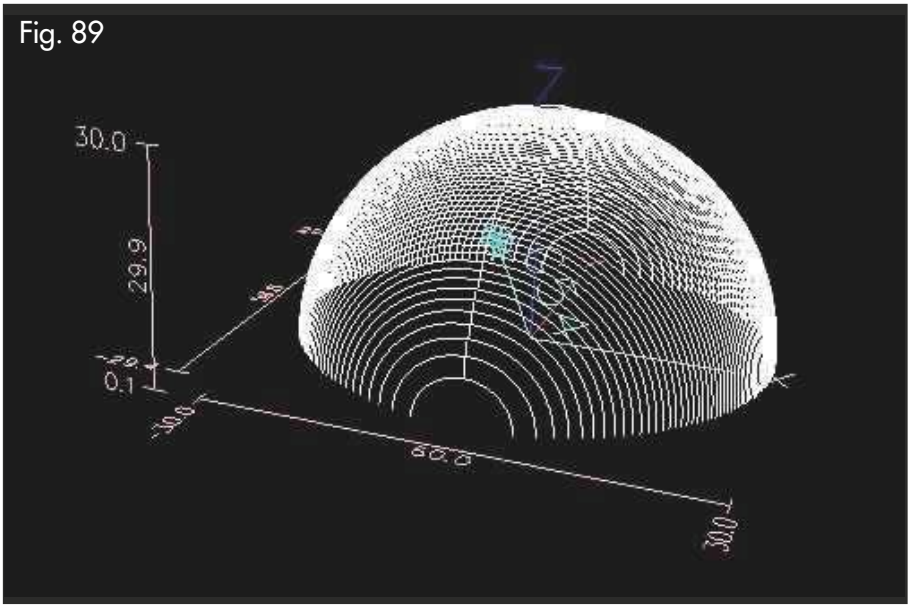


Many of the more capable CAD/CAM programs combine fairly decent drawing tools with the ability to output a completed program for a CNC package like Mach3. That means you may be able to do your drawing directly within the CAD/CAM package. The popular Vectric software allows this, to varying degrees, with Cut2D incorporating some basic drawing tools (but omitting some I would consider essential), its more expensive brother VCarve Pro having a good set, and the top-of-the-range Aspire having most (as well as being most expensive). There are alternatives, of course, and lots of them; some cheap, some more expensive, and some entirely free, and *MEW* has already carried articles by other authors listing available packages. I am most interested in what works best for me, for what I consider good technical or personal reasons. You should make your own choice. All capable packages can do pretty much the same things, but may differ in the commands and menus they use or the fine detail of how things are done. The end result should be the same, though; and for vector drawing packages that includes the ability to open and to save DXF files. There should be little in this series you can't do with alternative software packages.

For the heel guards, I chose to scan the original flat (or nearly flat) part in a conventional scanner, then I used the scanned image as a template in Adobe Illustrator and recreated the outline of the features, with some modifications to suit my own taste. I drew one of the rounded-end cutouts, making it just large enough to be cut by a 6mm diameter end mill, then copied and pasted it multiple times to make the pattern (**fig 88**). I omitted the chamfer at this stage. I exported the resulting vector drawing as a DXF file, then imported it into CUT2D. I could have drawn the whole object using a 3D CAD program (e.g. Inventor or Solidworks or similar) but that would not have been useful, because it is not easy to output 2D DXF files which can be used in my CAM program, so, in this case, a less ambitious 2D drawing program works best.

There's a bit of an overlap in the popular everyday meanings of the terms 2D, 2½D and 3D that's worth clarifying. 2D shapes are flat and have only length and breadth, so they really don't exist except as drawings on paper. Everything in the real world has length, breadth and thickness (or height), so it's all 3D, including the flat sheet of metal lying on your mill. But a true 3D object may have overhanging parts, and our 3-axis mills can't reach underneath an overhang, and can't machine the underside of an object unless it is turned over. Other parts of 3D objects can be machined on a 3-axis mill, and **photo 102** shows a 3D object with a simple curved shape which can be machined using co-ordinated movements in X and Y, while Z remains constant. **Figure 89** shows the backplot of a hemisphere. For any point on the surface,

Fig. 89



102

A simple 3D shape.

moving to an adjacent point involves simultaneous co-ordinated movements in X, Y and Z, but there are no overhangs, and we don't need to machine the underside, so the object can be machined on a mill which can make co-ordinated X, Y and Z movements. In recognition of the fact that a 3 axis mill is capable of producing a range of 3D objects, but is subject to some restrictions, this type of not-quite-true-3D operation is termed 2½D machining, and the term indicates the level of complexity of the features of an object. Although most current CNC software can easily control co-ordinated movement of 3 or more axes, there is a very significant difference in complexity and cost between CAM packages capable of coping with 2½D and 3D objects. While CUT2D (which deals with 2½D objects) costs around £114, CUT3D costs £235 and involves machining the top and bottom faces of the object by turning it over. CUT3D cannot machine underneath overhangs. Some care is required in interpreting what is claimed for each software package, though, and a top of the range package like Aspire costs £1554 but it is best at creating 'low-contour' 3D relief surfaces. That means it can create the kind of surface you might see on a coin, with a basically flat background and a design sitting proud (like Her Majesty's profile, for example). That is easily achievable using 2½D machining techniques.

There is a kind of half-way house which is a pseudo-3D object where the projecting features have sides which are not vertical but are all at the same angle, a typical example being text on a sign, where the text stands proud of the surrounding surface and has angled sides to the letters, giving it a three-dimensional look (**fig 90**). A cutter with angled or shaped sides (**photo 103**) can give more shapely external or internal faces to features, but it would then be difficult to produce vertical sides on a feature. Some software vendors use the term 'v-carving' to refer to machining using a vee cutter with straight angled cutting edges, and it is a useful variation on 2½D machining which can produce pseudo-3D features. Using a chamfering cutter is a simple example of this.

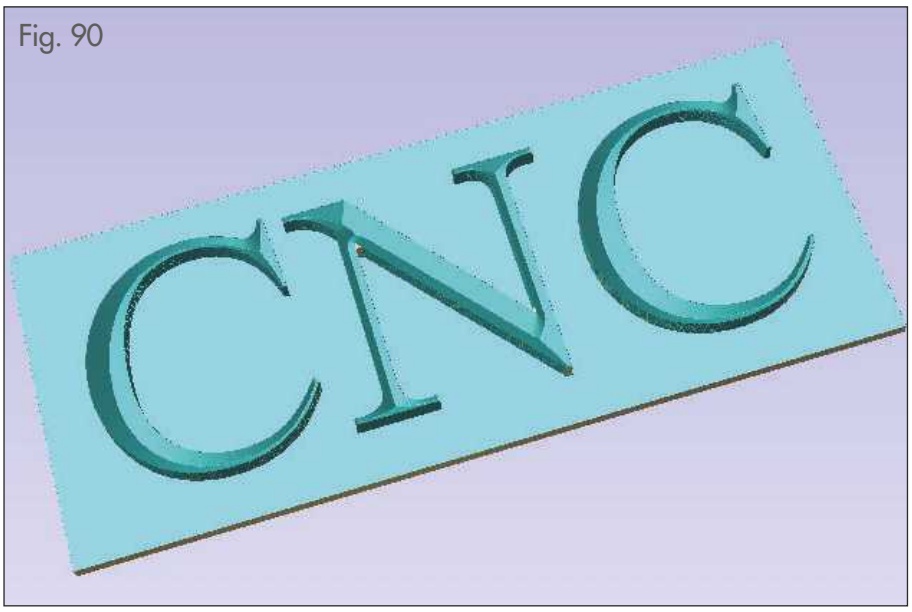
As a rule of thumb, 2D drawing programs work best for 2D or 2½D objects. 2D drawing programs cannot be used to create true 3D models, while most 3D drawing programs don't do a particularly good job on 2D objects, and their output is generally not well suited to 2½D CAM programs either.

For the moment, we will stick to 2½D objects, 2D drawing programs, and 2½D CAM programs. CNC software packages like Mach3, Mach4 and LinuxCNC are quite capable of both 2½D and 3D machine control and simply execute the code produced by a CAM program.

CAD to CAM workflow

What's required at this stage is not necessarily a fully developed technical drawing. That is useful at the initial design stage, but is not ideal when moving from design to CNC. What the CAM packages require is a set of two dimensional lines in a vector drawing which can be used as the basis of a set of paths for the Controlled Point (CP) i.e. a plan view of the shape. The periphery of the object should be one continuous line, forming a closed shape. The boundaries of internal features should also be closed shapes described by a single continuous line.

Fig. 90



For the heel guards, we have one continuous line describing the periphery of the overall shape, and sets of lozenge-shaped lines each describing a full-depth cut-out. The two attachment holes are drawn as two separate but identical circles. Some software packages such as Cut2D have facilities for examining a shape and checking if its outline is closed. If not, the package can close the outline for you.

The whole vector drawing is saved as a DXF file, then imported into the CAM program; or the object is created directly within a CAD/CAM program by using the built-in tools to draw the periphery and the cut-outs.

103

A selection of cutters for making profiles.

CAM to CNC workflow

Once in a CAM program, each of the lines represents a potential path for the Controlled Point (CP), so the process of creating G code for the CNC program is to take a path, then make the CAM program calculate and save the corresponding G code which describes the path the CP and the cutter must follow. The CAM program uses a post-processor (a specific bit of built-in software) to create the G code required for a specific CNC program. The post-processor section of the CAM program will require you to choose the appropriate post-processor for the CNC program you will use to control our mill. In theory, a G code program should contain statements conforming to a G code 'standard', but each software company tends to add particular features to their CNC software, so a post-processor will fine-tune the G code it outputs for each CNC program.

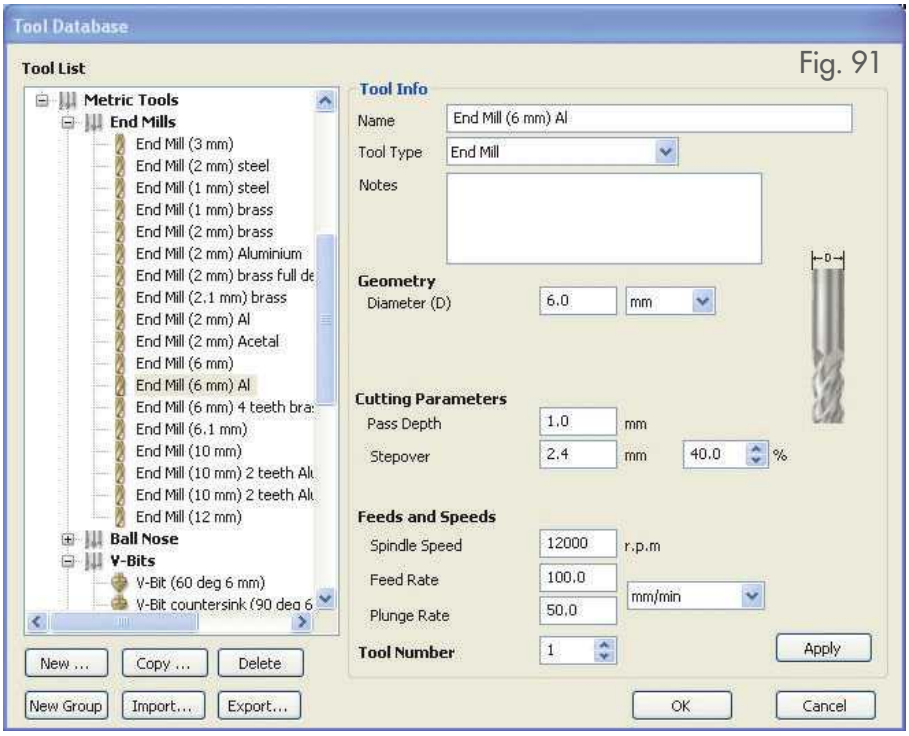
Once the CAM program post-processor has done its job, each of the G code files can be imported into the CNC program.

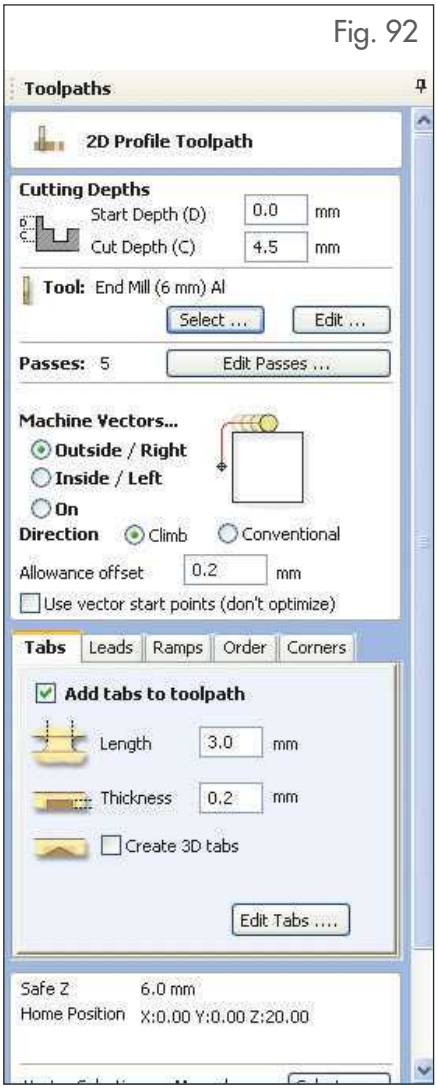
Each path can be converted separately, but if there are paths which can be machined using the same tool, it often makes more sense to group those in one file. Running the file in the CNC programs should result in all of those paths being machined in one session, lifting the cutter clear of the work between each path (by an amount specified as the safe Z height in the CAM program).

Principles of CAM programs

CAM programs may differ in detail, but the underlying principles of all CAM programs are the same. The CAM program can do the calculations to create the G code for a path, but requires some human input. There is a series of choices to be made in just the same way as you would when creating G code manually. The program needs to know which tool you will use, and the parameters associated with that tool (spindle speed, feed rate, depth of cut at each pass); the thickness of the material and the total depth of cut for each path; the order in which to machine the paths; whether to use climb milling or "normal" milling; and other similar aspects of the machining process. The tools are normally dealt with by having a Tool Table or Tool Library within the CAM program. Each tool will have associated speeds and feeds, recommended depth of cut per pass, and a step-over percentage (which specifies the amount of overlap between parallel passes of the tool). Tools

›



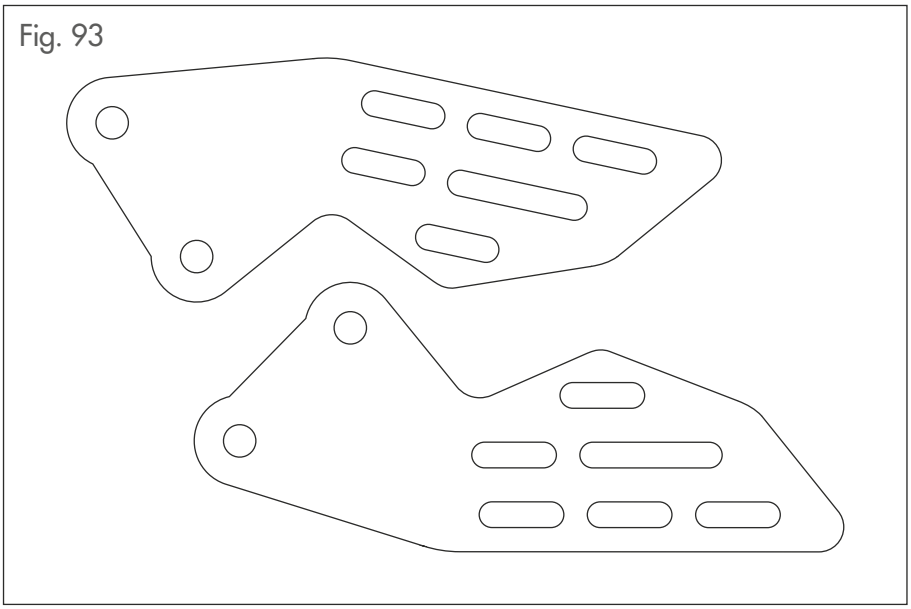


can easily be selected from the Table, added to the Table, or deleted, so that the Table can reflect the tools available in your workshop. The CAM program also needs to know whether the cutter and CP should follow the path or be offset to one side or the other (usually by half the diameter of the tool). Options are normally 'On', 'Inside' or 'Outside' the vector path. The result is a toolpath for tool and CP.

This is not the place to provide detailed step-by-step instructions on the use of particular CAM packages, but **figs 91** and **92** show an example of some of the choices to be made for a tool and other parameters required to create the path for a heel guard within a CAM program. Other makes and models of software are available, and will differ only in the way choices are made or menu items selected.

Another useful feature of a CAM program is that multiple objects may be machined at one setting by 'nesting' objects. In this case, there was one basic shape consisting of outline, bolt holes and cut-outs for one guard, which was flipped horizontally ('mirrored') to create two drawings; one for each of the handed guards. The overall shapes are identical, but the guards will be chamfered on opposite edges, effectively making one the mirror image of the other. That can be done in your CAD program, or one shape can be drawn in CAD and imported into the CAM program, and it can then be copied, pasted and flipped horizontally to create the handed pair. The method you use will depend on the shape and the facilities within your chosen CAM program.

Nesting two shapes is simple: move and rotate the objects until they sit snugly with just enough space between them to accommodate the cutter travelling around the outside of the periphery, and the layout suits the travel available on your mill (**fig 93**). Where there are many objects, some CAM programs can automate the process of nesting to optimise the use of material by fitting as many of the shapes as possible into a given area. I chose to control the placing of the second object manually. I also made sure the origin of the whole drawing was set to the centre of the material. Note that it does not matter if the various shapes are aligned with the X and/or Y axes, as the CAM post-processor can cope with shapes lying at any angle.



Tooling

A heel guard can be machined with just two cutters. The periphery and the cut-outs can be created using a 6mm end-cutting end mill, and the chamfers around the edges of holes, cut-outs and periphery can be produced using a 45° chamfering end mill. That implies a tool change, which normally means two individual G code programs, because CAM programs at the affordable end of the market cannot cope with tool changers.

It is usually a good idea to minimise tool changes at the design stage, so that, for example, the widths of the heel guard cut-outs and diameters of the bolt holes were chosen so that they could be created using the same 6mm end mill used for machining the periphery of the guard.

Profiles and pockets

The outside or periphery of the workpiece is termed a profile, created by running a cutter around the outside of the drawn shape, offset by the cutter radius.

The holes and inner cut-outs are also *profile* paths. It is true that the cutter runs inside those paths, but they are still the profiles of individual shapes. A profile is the edge of a shape and is normally machined to full depth, separating the work from the waste. In the case of the periphery, the waste lies outside of the workpiece. In the case of the holes and cut-outs, the waste is what lies inside the shape. With small shapes produced using a large cutter there won't be much waste, but larger holes or cut-outs would leave larger pieces of waste free inside the shape.

A pocket, on the other hand, would be a shape which is normally machined to a specific depth less than the full thickness of the material, and the waste material inside the shape is removed by using overlapping cuts, creating a recessed area in the workpiece (**fig 95**). Areas within the pocket which are not to be machined (like the lettering in fig 95) are termed islands, and the CAM program will arrange the machining paths to avoid those areas. There are no pockets in the heel guards.

Fig. 94

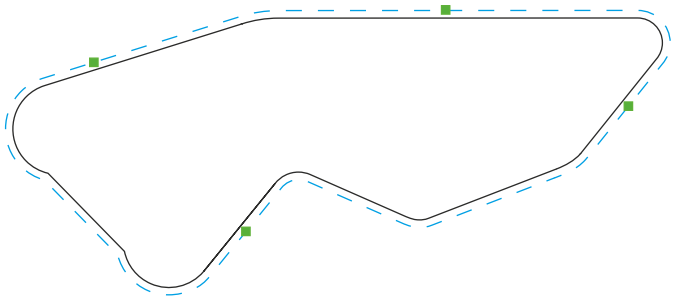


Fig. 95

Workholding

The sheet of material from which the heel guards are to be cut is secured firmly to the bed of the mill. The material in this case is a 4.8mm (3⁄16 in) thick aluminium plate which can be screwed to a suitable flat sacrificial backing plate (a piece of 18mm thick MDF, for this job) using screws through the waste areas in the corners. The backing plate is secured to the mill table using recessed bolts screwed into tee nuts. The challenge is in choosing a suitable method of securing the individual heel guards as they are cut from the sheet.

There are at least two ways to hold the guards, and they affect the number of tool changes required.

The first is to use suitable clamps, bolts or screws to prevent the guards from moving as they are cut free from the main sheet.

The cut-outs and bolt holes are machined first, then the guards are secured to the backing using screws through the cut-outs and/or bolt holes (**photo 104**), to prevent the guards from moving as the periphery is completed and the guards separated from the plate.

We need two separate machining paths within the CAM program; one path for the profiles of all the cut-outs and bolt holes, and a separate path for the profiles of the guards. The machining paths output from the CAM program should create:

- The profiles of the cut-outs and bolt holes (6mm end mill);
- The chamfers on the inside edges of the cut-outs and bolt holes (6mm chamfering cutter);
- [Clamp the guards using the bolt holes and cut-outs, at this stage]
- The profile of the guard (6mm end mill);
- The chamfer around the profile of the guard (6mm chamfering cutter).

Machining the cut-outs first allows us to hold the guards securely for machining the profile chamfers, but this approach requires 3 tool changes (end mill to chamfering tool, chamfering tool to end mill, and end mill to chamfering tool). The Z height of the tool must be re-set after each tool change.

The second approach uses a facility within the CAM program to create small tabs or bridging pieces around the profile of each guard (refer back to **fig 94**), so that when the profile has been completed, each guard remains attached to the parent sheet. Those tabs will be small and thin, and can easily be cut through with a sharp knife or a thin saw blade. The profile can then be dressed lightly with a small file, to complete.

Tabs are easy enough to create, in theory, but manually programming the resulting cutting path for the profiles would be somewhat tiresome to say the least, so this is certainly one big bonus for CAM users.

The CAM program would require one machining path for all the profiles, lifting the cutter clear of the work between each separate feature. The machining paths output from the CAM program should create:

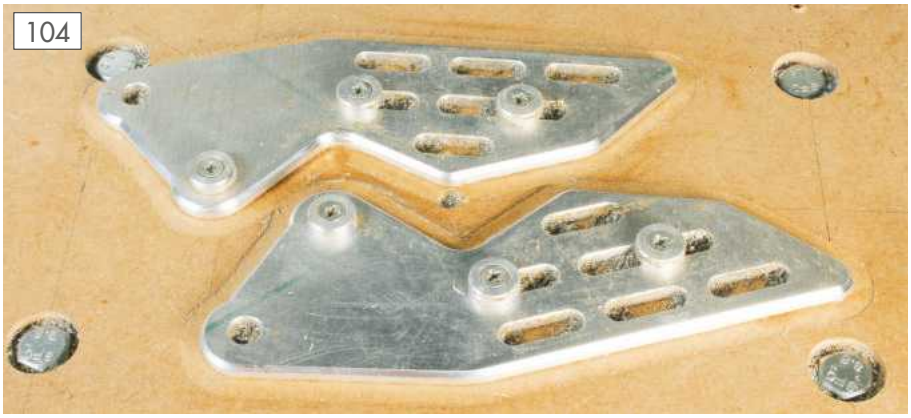
- All the profiles, but with added tabs around each guard, to hold the guards in place;
- One path for the chamfering cutter, to produce the small chamfer on the edges of the holes and cut-outs;
- One path for the chamfering cutter, to produce the larger chamfer on the edges of the holes and cut-outs.

In both cases, machining paths include features machined in a similar way, using the same cutter and with the same Z height. That means all the right-through-the-sheet profiles can be machined as one path. The chamfers differ in height and breadth, so they require two separate paths; one for the similar-height hole and cut-out chamfers, and another for the deeper chamfer around the profile of each guard. As a result, only one tool change is required (end mill to chamfering cutter).

In this case, determined to avoid hand-finishing the edges, I chose to use method 1, which involved more tool changes but avoided tabs.

To be continued...

104



The guards secured to a backing plate.

38TH ANNUAL

MIDLANDS MODEL ENGINEERING EXHIBITION 2015

Thursday 15th to Sunday 18th October 2015

10am - 5pm Daily (closes 4pm Sunday)

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11.00am	3D Modelling - Warts and all!	Derek Brown
12.00noon	Overcoming Silver Soldering Problems - Go Back to the Basics	Keith Hale
1.00pm	Building in the Smaller Gauges:- Why, What and How	Malcolm High
2.00pm	Mechanical Automata and Singing Birds	John Moorhouse
3.00pm	Setting Up and Running a Small Scale Foundry for Model Engineers	Noel Shelley

Daily Demonstration 1pm - 2pm outside near lecture theatre
Noel Shelley and a working demonstration of his brass foundry

Friday 16th October

Time	Lecture Topic	Presented By
11.00am	Hobbing Gears in the Home Workshop	Mike Haughton
12.00noon	Overcoming Silver Soldering Problems - Go Back to the Basics	Keith Hale
1.00pm	Some Thoughts on Shaping Sheet Metal	Peter Stephenson
2.00pm	Steam in Model Boats	Phil Abbott
3.00pm	Setting Up and Running a Small Scale Foundry for Model Engineers	Noel Shelley

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Saturday 17th October

Time	Lecture Topic	Presented By
11.00am	Some Thoughts on Shaping Sheet Metal	Peter Stephenson
12.00noon	Flying Engines	Chris Turner
1.00pm	Building in the Smaller Gauges:- Why, What and How	Malcolm High
2.00pm	Hobbing Gears in the Home Workshop	Mike Haughton
3.00pm	Setting Up and Running a Small Scale Foundry for Model Engineers	Noel Shelley

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Noel Shelley and a working demonstration of his brass foundry

Sunday 18th October

Time	Lecture Topic	Presented By
11.00am	3D Modelling - Warts and all!	Derek Brown
12.00noon	Steam in Model Boats	Phil Abbott
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This will be the last model engineering exhibition of 2015 with competition and display classes where you can showcase your latest build so why not enter your work and be part of the show?

Entry is free and there are 32 classes of which 16 are competition and 16 are display. These classes include: Locomotives, Rolling Stock, Stationary and Internal Combustion Engines. Models still under construction can also be entered in the display classes.

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- Hereford Society of Model Engineers
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- Knightcote Model Boat Club
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- London & North Western Railway Society
- Melton Mowbray & District Model Engineering Society
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- Model Steam Road Vehicle Society
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- Northampton Society of Model Engineers
- Northern Association of Model Engineers
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- REMAP (Coventry & Warwickshire)
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- Society of Model & Experimental Engineers
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The exhibition will be celebrating the 150th Anniversary of the first locomotive to have been constructed by the Hunslet Engine Company, one of the leading engine builders. There will be a special collection of Hunslets across the gauges.

The Len Crane Display

This celebrates the life of Len Crane, one of the Midlands Exhibition founding supporters and a judge for many years. He is best known for the restoration and rallying of Fowler B6 Super Lion Crane Engines. He also restored several other engines and was also instrumental in restoring the 1895 Vertical Triple Expansion Engine at Bratch Pumping Station, The tribute will feature his 3" scale Burrell Traction Engine "Briggitte" which was awarded the Duke of Edinburgh Trophy in 1971 and the railway locomotives he built.

John Clark Display

Polly Model Engineering will be presenting a special display to commemorate John Clark, designer of the extensive range of model steam locomotives based on his original Polly design of which many hundreds have been built.

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The Myford VMB Milling Machine Part 1

Mark Noel was delighted with his Myford mill but still found room for improvement.

Readers of this magazine will all be aware that Myford was a leading manufacturer of precision lathes, which have proved firm favourites within our modelling community. However, Myford never took advantage of their established position to produce their own milling machine, preferring instead to 'badge engineer' units imported from Taiwan. Progressing upwards in size, these were the VMB, VMC, VMC and VMF vertical mills marketed from around 1977 until the closure of the original Beeston factory in 2011. This and a subsequent article describe features of my VMB, together with a number of enhancements I have made to this machine.

My VMB as originally supplied by Quillstar was fitted with an Align table power feed and associated 115V transformer in the grey box. This heavy drive unit has since been removed.

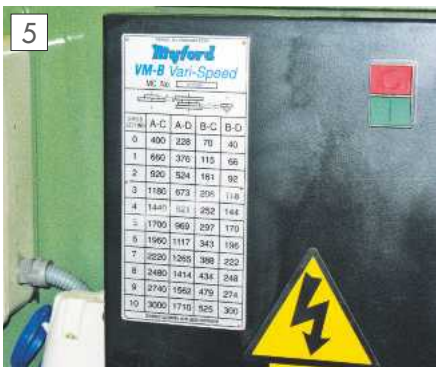
Data plates attached to the mill giving the serial number and delivery date, the inspector's signature (does anyone recognise this?) and the 3-phase motor ratings.

My VMB was supplied by Quillstar and appeared to have been very little used by the previous owner who purchased it direct from Myford in 1998 (**photos 1** & **2**).This is the MKII Varispeed model which differs from the MKI in having a 4 inch taller column providing greater clearance below the spindle nose, while the Varispeed name denotes the addition of electronic speed control via an inverter and 750W three phase motor (**photos** 2 & **3**). This facility was quite advanced for a hobby-grade machine at that time but became a popular (though expensive) option for Myford lathes such as the Connoisseur model, which marked the culmination the factory's production.

On the standard MK1 and MKII a choice of nine spindle speeds of 195 to 2340 r.p.m. could be selected by changing the position of plain V-belts between the motor, intermediate and headstock pulleys. On the MKII the drive system was improved with the use of 15mm Poly-V belts and pulleys, enabling the transmission of greater torque and, with the Varispeed inverter, continuous variation in four speed ranges spanning 40

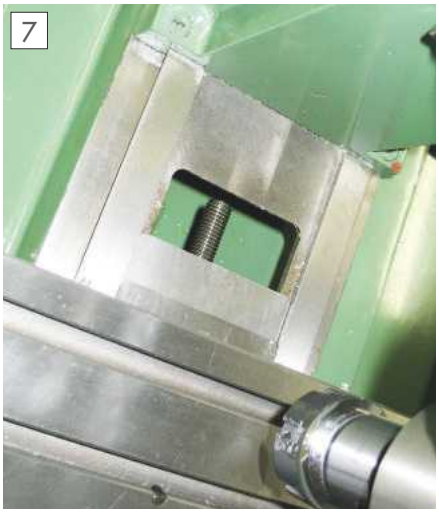
Danfoss inverter drive, zero-volt switch and associated electronics inside the black cabinet on the left side of the machine.

Motor, intermediate and spindle drive pulleys inside the head casing. The tachometer magnet and brass balance weight were inserted into diametrically opposite pulley holes.

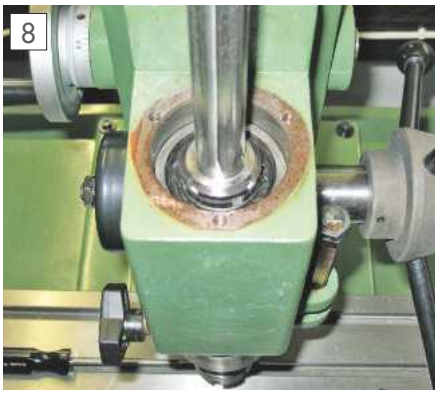


Screen-printed lettering on the original speed plate had rubbed off and so the plate has been replaced with a new part and protected with Perspex.

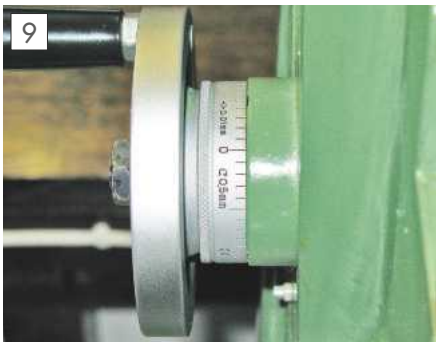
Gib adjusters on the head - initially gummed up with paint and immobile!



A pair of aluminium sash plates protect, and give access to the Y axis feedscrew.



Detaching and lifting the rubber bellows gives access to the quill, head bearings and splined shaft for lubrication.



One turn of the handwheel on the head moves it up or down only 0.5mm! However, the graduations are a superfine 0.01mm which is useful for precision boring or milling.

to 3000 r.p.m. (**photos 4** & **5**). These enhancements were engineered by Myford after the machine arrived at their factory from Taiwan, and used quality European components that include a Danfoss inverter and Brook Hansen motor (photo 2).

The MKI mill was finished throughout in Myford green, while the MKII was shipped in two-tone blue and grey. Myford are famous for the quality of their paintwork and the chap who ordered my VMB must have been aware of this and requested that his machine be re-finished in the familiar green, and the factory duly obliged. The result is a glassy lustre all over; the unfortunate consequence being the 'all over', with thick paint covering the gib adjustment screws and several other places where the spray gun should never have squirted (**photo 6**). Unbroken paint layers showed that the gibs had indeed never been adjusted, which explained why the head rattled alarmingly the first time I attempted a cut. No problem: a few minutes winkling with a scriber soon freed the immobile adjusters and the slideways were soon trimmed to perfection.

Another important improvement made by Myford was the addition of oiling points - a total of 12 throughout the machine, which is a distinct advantage over most Far East mills of similar size which generally lack this facility. A pair of sash plates protect the Y axis feedscrew, and can be opened for cleaning and lubrication of this component (**photo 7**). The spindle, quill and head bearings can also be lubricated by detaching the ring that secures the lower end of the protective rubber bellows, providing access to these parts (**photo 8**).

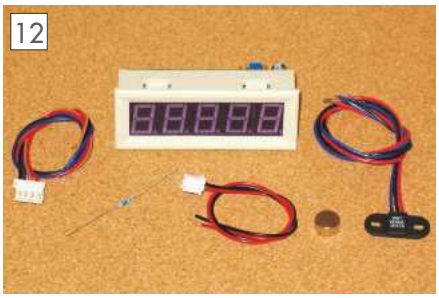
Working with the VMB

Once you have lived with the VMB for a while you begin to appreciate several aspects of good design that are a feature of this machine. Perhaps the most significant is the use of an Acme screw to raise and lower the head, acting through a point located close to its centre of gravity. Consequently, raising and lowering the head does not induce a rocking force that increases friction and wear in the vertical slideways, as is the case for example, in many small Far Eastern mills where the feed screw is located at the rear of the column. However, this design does bring with it some issues, which have lead to criticisms of the VMB. First, the handwheel on the head rotates the feedscrew via an internal wormwheel which has a very low gearing, with one rotation of the handwheel moving the head by only 0.5mm (**photo 9**). This usually means a lot of cranking to position the cutter ready for action. In fact more than 700 revolutions of the handwheel are required to move the head over its entire 390mm of travel!

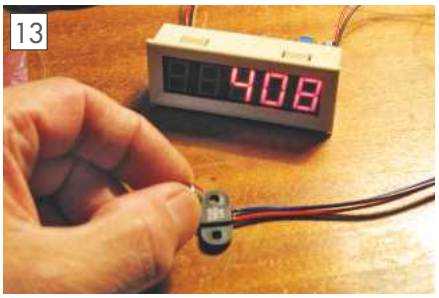
Fearing the onset of repetitive strain injury, it was important to find some solution to this cranking mania. Initially I planned to incorporate some type of motor drive coupled to the end of the handwheel spindle seen on the right hand side of the head in photo 6. There is just enough space in this area to attach a NEMA 23 stepper motor with clearance for the quill downfeed handles, but I was reluctant to dismantle the head to gain access to the worm shaft for machining,

The tedium of moving the head manually is easily rectified by using a cheap cordless drill and ¾ inch AF socket to rotate the handle.

You need a decent ceiling height to extract the drawbar from a MKII VMB!



The tachometer module and supplied connectors, with Hall sensor magnet and pull-up resistor.



Bench test of the tachometer module. Waving the magnet over the Hall sensor determines which side of the disc must face the sensor in the final installation.

and in any case my philosophy has been to minimise any damage to this monument of industrial archaeology. The answer came with the purchase of a bargain cordless drill-driver from B&Q, coupled to a spare ¾ inch AF socket found in the scrap box. Whenever I need to raise or lower the head it is now a quick and effortless task to connect the socket to the lock nut on the Z feed handwheel, press the trigger and up or down she goes, at a easily variable speed (**photo 10**).

Another problem which may arise in future will be the need to lubricate the wormwheel drive which is not readily accessible, and may require the removal of the head to reach these components. However, despite the antiquity of my machine (1998, remember) the drive is still silky smooth, so Myford must have filled the head with some secret, slippery, jungle formula that hopefully will be good for another 16 years or more.

As can be seen in photos 4 and 8, the spindle is rotated by a splined shaft that passes through the final drive pulley inside the belt casing. This shaft is bored to accept a 10mm diameter drawbar that secures taper-shank tooling. Myford's default taper was R8 but M3 was offered as a cost option as was supplied on my machine. If readers are considering the purchase of a VMB MKII mill then they will need to be aware of another potential problem, namely the 231cm ceiling height that is required to clear the drawbar when it is lifted out of the machine (**photo 11**). Imagine my panic when I discovered that my own workshop ceiling was 1cm too low to extract the drawbar, and thus having visions of making a small hatch above the mill to make this possible! Fortunately, I was able to shorten the drawbar sufficiently and yet still secure tools safely, but for many this is an issue that may make or break a purchase.

Adding a Tachometer

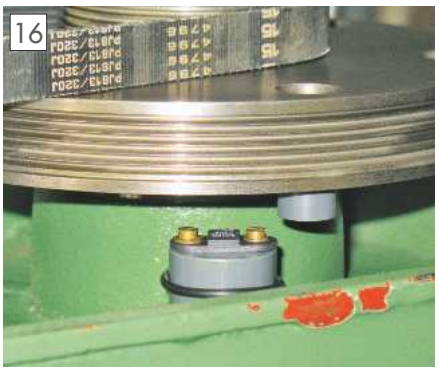
The digital speed readout on my lathe has proved so useful that I decided a tachometer on the VMB was a must-have accessory. A web search for 'counter-timer module' unearthed numerous, often expensive components, although some lower-cost units are available from suppliers such as Rapid Electronics, Farnell and RS. As usual, the bargain was to be found on eBay in the form of a compact five digit counter which can also be configured as a tachometer capable of reading to 50,000 r.p.m. (**photo 12**: See *Resources*). The module is compatible with various type of sensor, including Hall effect devices, which provide a robust solution for use inside noisy and oily machine tools. A magnet attached to the spindle revolves over the sensor, providing pulses that are counted by the tachometer circuit. For this application I chose the inexpensive Hamlin 55100 sensor and a 10mm disc magnet from Rapid Electronics, although other suppliers also offer these parts. The datasheet provided with the counter gives clear instructions on how to set jumpers to configure the module as a tachometer and to set any scaling of the input pulse rate. The only other parts required are a 5.1K pull-up resistor and a 5-15V power supply which only needs to deliver a maximum of 100mA; for this I used a 6V mobile phone charger from our local recycling centre.

It is important to recognise that the Hall sensor will only be triggered when the appropriate pole of the magnet (N or S) passes overhead. Since the polarity of these10mm disc magnets is never marked, it is necessary to experiment to find the correct orientation. The answer is simply to wire the tachometer and sensor temporarily on the bench and then wave the magnet over the sensor, oriented up then down, until the tachometer registers a number above zero (**photo 13**). The side of the magnet which triggers when facing the sensor is then marked with a sticker and it is this side which must be facing the Hall device in the final installation.

Photograph 14 shows the plastic parts made to carry the Hall sensor and the neodymium disc magnet. The sensor carrier fits in a hole conveniently drilled

The plastic parts installed inside the belt casing. On the left are holders for the magnet and brass counterweight. On the right is the carrier for the Hall sensor: this is secured using the existing hole in the base of the casing seen in photo 15.

A hole in the base of the belt casing is provided to enable locking of the spindle pulley. This hole has been used to fit the Hall sensor carrier.



Close-up view of the Hall sensor and magnet carrier which sweeps over the sensor with about 5mm clearance. Note the Poly-V belt drive fitted to MKII machines.

Tachometer attached to the Newall DRO display. This Improvement to the machine will be described in the next article.

through the base of the belt casing for use when locking the motor pulley, as demonstrated in **photo 15**. The magnet carrier is turned 15mm diameter to be a tight push fit into one of the six holes in this pulley (photo 4) such that the magnet-sensor gap is about 5mm as seen in **photo 16**. Hence, the installation does not involve drilling any new holes into the milling machine. A second dummy carrier carries a non-magnetic brass disc of similar weight to the magnet and is inserted into the diametrically opposite pulley hole so as not to disturb the rotational balance. The wire from the Hall sensor is safely secured with cable clips inside the belt casing, then routed down past the motor before entering the tachometer housing (ABS box from Rapid Electronics), fixed to the top of the DRO display with double-sided tape (**photo 17**). The result is compact and tidy, with all the machine diagnostics in one place.

Fitting a Swarf Curtain

Although the sash plates between the milling table and column protect the Y axis lead screw from cutting debris, it can still be tedious to winkle out all the swarf from this narrow area, and any major accumulation might limit the movement of the table towards the column. The simple remedy was to make a swarf curtain from a piece of 0.5mm thick, oil-resistant, Viton rubber sheet bonded with Devcon epoxy to strips of aluminium plate and angle along opposing edges. One of these plates carries three 10mm disc magnets and is drilled to clear the table oilers, while the opposite angle plate is epoxy bonded to two magnets as seen in **photo 18**. In use the swarf curtain is held securely by magnetic attraction to the column and to the fixed table guideway, from which it can be released by pulling on the old radio knob seen in photo 18. This design has again avoided any new drilling and works a treat, while still providing access to the slideway oilers (**photo 19**).

I have to say that I am delighted with my VMB and would encourage others to bear this machine in mind if looking for a small benchtop size of miller. In the next article I will describe the fitting of a Newall 3-axis digital readout system, which again was accomplished without any new drilling or damage to the machine. ■

RESOURCES

VMB history
www.lathes.co.uk
Tony Griffiths' site describes of the history and design of the MKI and MKII VMB machines

Quillstar
www.quillstar.co.uk
Suppliers of quality, used machine tools

Tachometer
www.eBay.co.uk
Search for 'Red LED panel digital frequency speed revolution meter'

Sensor & magnet
www.rapidonline.com
Sensor Part No. 50-0365. Magnet Part No. 67-1105

Viton rubber sheet www.altecweb.com
Part No. 3331-005

Simple swarf guard made of oil-resistant Viton rubber, with magnets on aluminium strips for fixing to the machine.

Swarf guard in place. Access to the Y axis oilers is retained via holes in the nearest fixing strip seen in photo 18.

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The Durston Guillotine

Jeff Gearing reviews a machine that could prove useful in many workshops.

Awaiting bolting down (guard removed).

Several months ago my daughter asked if I could produce a couple of sheet steel plates for her embossing machine. The sort of machine that 'crafters' use to make greetings cards and scrap books. Not a problem I thought. After finding a piece of sheet steel I had to decide how to cut it. At 1.5mm a bit thick for tin snips did not fancy struggling with Gilbows. Hack saw, sheet saw even jig saw could have been used. Wouldn't it be nice to have a guillotine that could cut steel. A flash of inspiration saw me on my way to a friend's home who was lucky enough to own a floor standing treadle guillotine. Twenty minutes later the job was done.

Of course now the seed was sown. To buy new, second hand or even try and make one, but whatever the method it was clear that a steel cutting guillotine was a handy bit of kit to have. I have more or less run out of floor space in my workshop so a big treadle guillotine was out of the question, which was a shame because the best deals, i.e. dealers or ebay offer best value for floor mounted machines. I figured that around 300mm throat would be about the most likely size I would need and it would have to be bench mounted, accepting of course that whatever size machine I bought it will always be too small. - Time to start looking around.

Apart from the need to cut steel sheet, brass and aluminium up to 2mm I also make a bits of silver jewellery for my long suffering wife. With the traditional tool suppliers more or less ruled out I thought about making one. My speed of making things would mean that it would not even be ready to accompany me to that big workshop in the sky. So it looked like it might be a new machine. The Jewellery world uses machine and tools similar to the normal engineering world but with a significant price lift. After scouring on line catalogues and considering machines from the USA to China I zeroed in on a British made machine produced by the Durston company. If the name does not mean a lot to you Durston are a bit of a success story in the jewellery world. They started making rolling machines in the 1960's and now have a significant range of rolls that sell worldwide. Joy upon joy they also make a small guillotine (**photo 1**). Its specification said: throat 300mm (**photo 2**) able to cut steel up to 2.5mm and non ferrous material up to 4mm. Wow, that is thick for a hand operated machine. The down side was the price – including the VAT it was a buttock clenching £900.

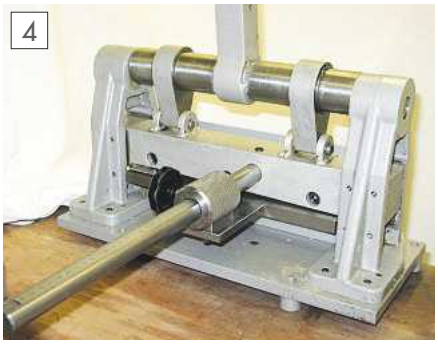
After examining all the secret stashes, bank accounts, premium bonds, daughters inheritance I reckoned I could just about raise the money. So the order was placed.

It arrived, all 65Kg of it in its 10Kg plywood crate (**photo 3**). Having made bench room for it I spent about an hour effecting an entry to the packing case, unbolted the machine from the base of the container, adjusted my truss took a deep breath and lifted it. A short stagger to the bench and it was in situ. Ensuring that I had enough room to move the almost metre long handle (**photo 4**) from the vertical to the horizontal it was then securely bolted to the bench. The only items to attach apart from the handle are the calibrated rear stop gauge constructed from 25mm steel bar. This controls the depth of material to be cut (**photo 5**).

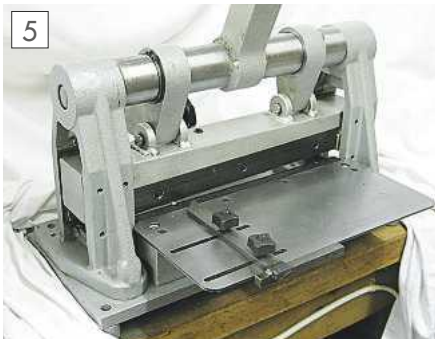
The front guide is used for setting the material to the left hand side of the feed table. This is a simple gauge taking its register from the front edge of the table. It is clamped to the table with a couple of thumb screws that screw into a plate on the underside of the table (**photo 6**). Unfortunately whoever drilled and tapped the holes in the clamp plate did not get it quite right and the thumb screws were it bit of a force fit through the holes in the feed table (**photo 7**). This rendered the guide plate pretty useless and it would take a bit of fettling to get it all to work properly, not a major catastrophe but a bit of a disappointment. I thought that as work would be required here I might as well check the gauge for square. As it turned out either the gauge was a

The large width of cut is 300mm.

How it arrived, the 75Kg crate.



The main operating lever is approximately 900mm long.

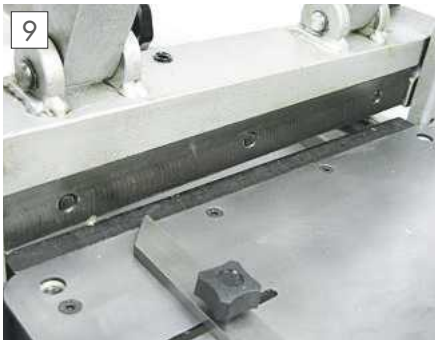


Rear view. The substantial 25mm depth gauge easily seen. You can just make out 2 of the hex headed blade securing bolts (3 in total).

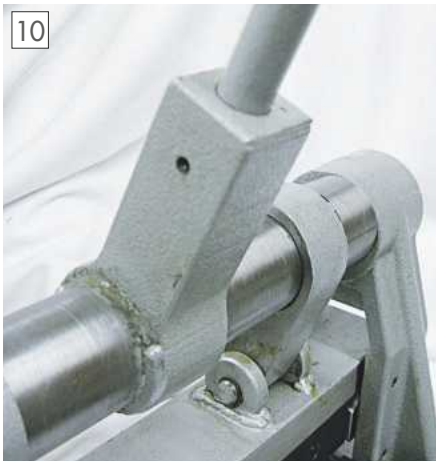
The aligning gauge and clamp fitted to the feed table.

Alignment gauge and clamp components that were not really up to the mark.

The simple guide that unfortunately does not align at 90 degrees.



The safety guard removed to see the cutting blades and you can just make out the three securing screws of the moving blade.



The 50mm main shaft and linkage to operate the moving blade.

smidgen out or my two engineer's squares were both out (**photo 8**). I decided to trust my squares. Although a fix was straightforward I decided to email Durston to make them aware of the issue. All credit to Durston as they emailed me back saying they would send a new gauge for the table.

In the meantime I decided to try the machine out. With the blade moving about 4mm and the lever moving in an arc of about 1 metre this gave a mechanical advantage of around 350 to 1. This amount of leverage allowed it to slice through 2mm aluminium effortlessly. Sheet steel of 2mm thickness succumbed easily; it was a dream to slice through. I am not at all sure about going for the 4mm test but the performance so far is pretty good.

A nice feature of this extremely robustly constructed machine is that the blade has 4 cutting edges (**photo 9**), which means that as one edge dulls it is a small matter to simply remove the blade (3 bolts) and rotate it through 90 degrees to the next sharp edge. Another feature that I found quite reassuring was the size of the main shaft that rotated to give the blade its cutting action. At around 50mm diameter it was clearly up to the job (**photo 10**). Indeed the casting of the main frame (**photo 11**), the depth stop, levers and linkages (**photos 12** and **13**) all shouted good design and manufacture.

I cut through a piece of 3mm aluminium sheet. With something this thick there was a tendency for the sheet to lift off of the table and skew as the blade sliced through. This caused the cut itself to be something other than 90 degrees and also if cutting to a marked line this could also be out.

I thought that it would have been a nice feature to be able to clamp whatever sheet I was cutting to the table to ensure some cutting accuracy. Examing the table I noticed two 10mm tapped holes exactly where I would have located a clamp if I was going to fit one (photo 13). A quick reference back to the adequate but basic instructions revealed no mention of these holes although it did say that clamping material would be a good idea. I thought I needed to be absolutely clear about this so I phoned Durston to make sure these threaded holes were intended for a clamp. 'Yes' that is what the holes are for. I also mentioned that I was still waiting for my replacement table guide. 'I will see to that' was the response.

So what do I think about the machine? It certainly will cut through 2mm steel and alloys with ease. The 4 sided cutting edge is a nice feature. It is robust and well made.

It is let down by the lack of attention to detail namely the poor guide and lack of a material clamp on the feed table despite the fact that they clearly thought it was necessary, and with a price tag of £900 I would have thought that it should have been included. I was told by some jeweller friends that Durston after sales service was excellent. My experience, however, was a disappointment as I deliberately bought 'made in England' and not resorted to either Taiwan, China or a very nice USA made product and, as it happens, at the time of writing I have still not received a replacement guide.

So to sum up, If you are in the market for a metal cutting guillotine and you have the space I think the best value is to go for second hand floor mounted type. If like me you need a bench mounted type then if you want to cut much over 1 to 1.5mm of steel then it will cost and it is probably time to 'find a friend'. ■

The end bearing of the main shaft in the cast end frame.

Linkage fixing to the blade carrier.

You can clearly see the 2 x 10mm threaded holes intended for a material clamp.

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Wanted

■ Complete novice needs help with installing and scraping new headstock spindle and PB bearings on a Myford ML7. This is the final part of my restoration project. All assistance would be most welcome. **T. 020 8890 7288. Staines.**

■ 08 or 010 Battery loco. **T. 0161 343 7791. Manchester.**

■ Warco WMT 300/02 wanted for parts, particularly the carriage and rack and pinion mechanism. Will pay good price. **T. 01462 649088. Hitchin.**

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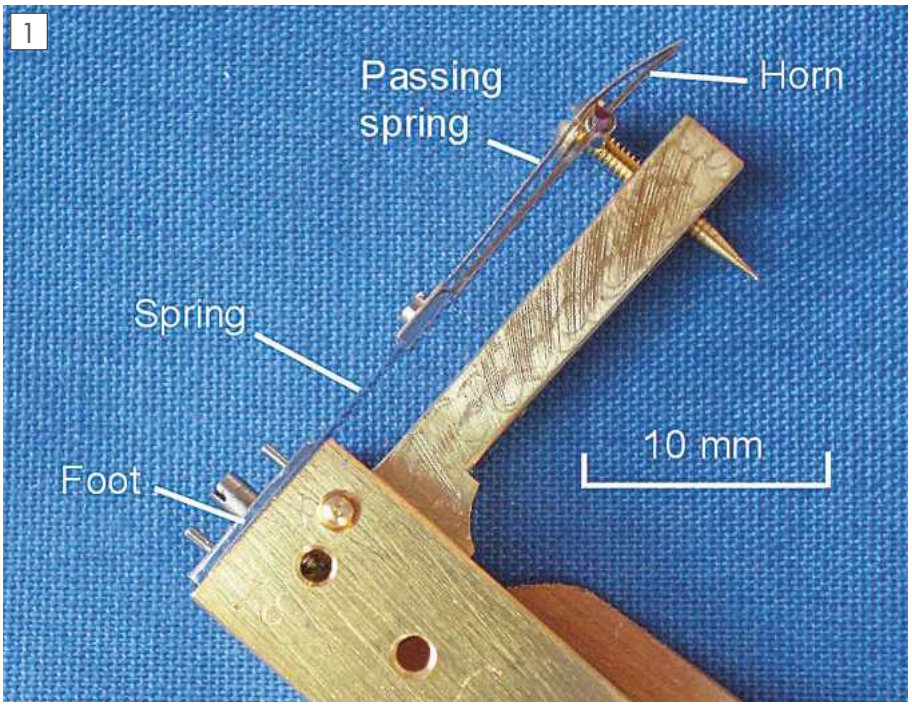
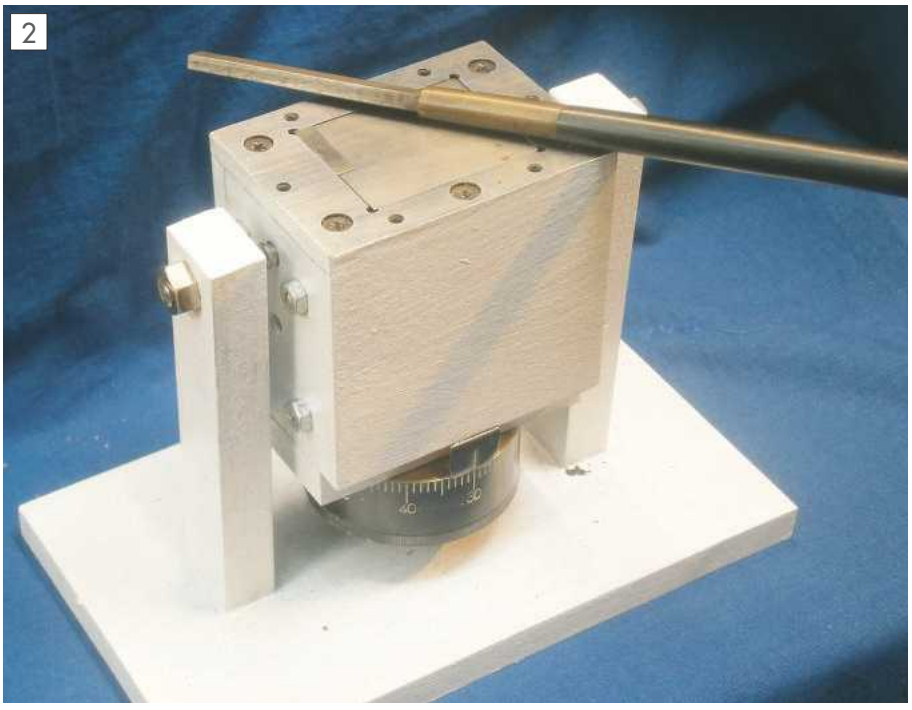
A Swing Tool Filing Guide

Bill Morris describes the making of a useful but little known tool.



Chronometer detent.

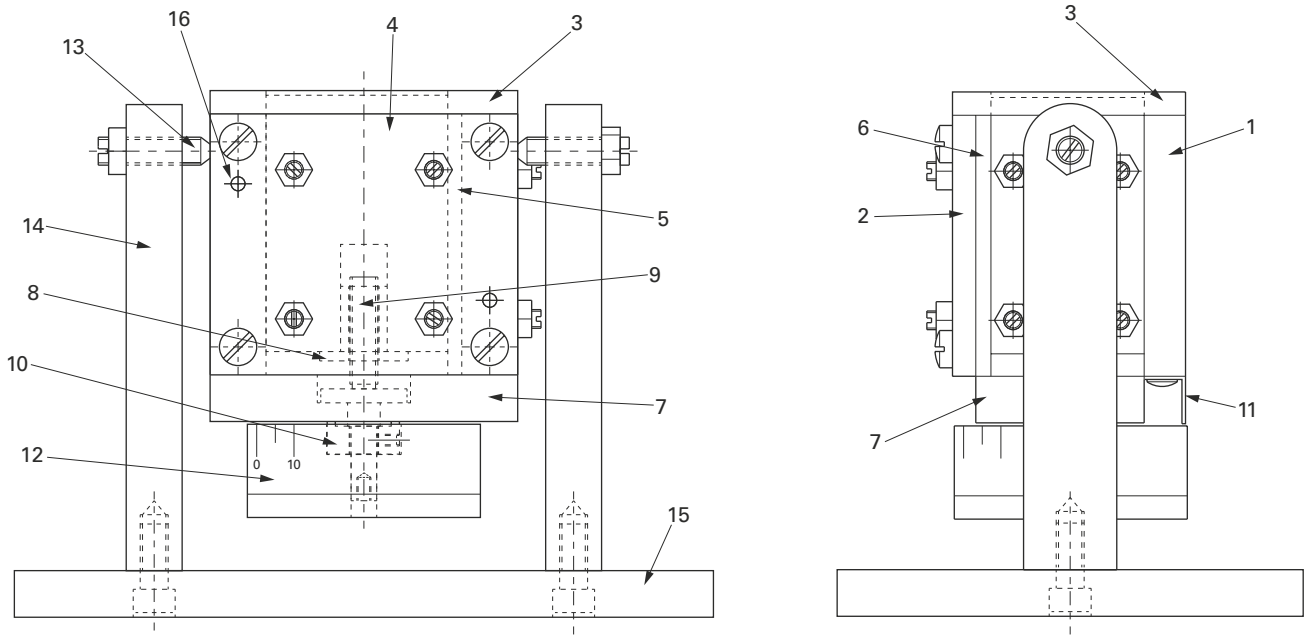


G A photo of swing tool.

A year or two after I retired, I resumed a long-standing interest in navigation and instruments of navigation, acquiring in the process many examples of nautical and aeronautical sextants that I restored to near new and working condition. One day a good friend gave me a marine chronometer and this set me off on yet another track (www.chronometerbook.com). At the heart of the marine chronometer is a delicate part called the detent, shown with a scale in **photo 1**, and if the integral detent spring breaks, one is faced with having to make a new part, as spares for these wonderful timekeepers are no longer made.

Traditionally, the detent and its spring, a mere 0.05 mm thick, would be filed up from the solid and then the whole hardened and tempered. The swing tool (**photo 2**) was devised to help in filing small, thin parts to an even thickness. The part to be filed sits on a table that lies the desired thickness below a hardened surround which guides the file. The whole is supported between centres and if the file tends to lift off the hardened surface over which it slides when the desired thickness is reached, the tool swings to correct it. The height of the table below the hardened surround can be adjusted by means of a micrometer screw and fences or rollers can be attached to the hardened top to guide the file.

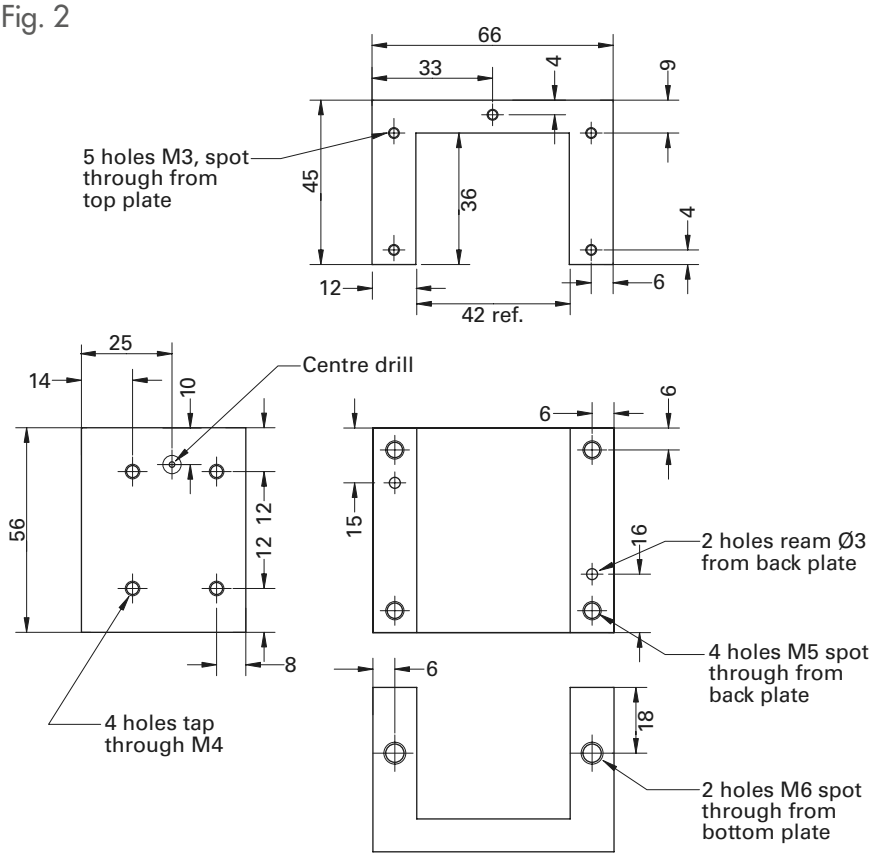
Fig. 1



All drawings are third angle projections.

While it might seem to be easiest to make the table and its surrounds cylindrical, most of the parts to be filed are rectilinear and so the swing tool table was generally made rectangular. Craftsmen of old would probably have patiently filed a rectangular hole in a chunk of steel and filed a table to fit snuggly. I am not made of such stern stuff and so I fabricated my swing tool so I could use machine tools to reach my objective. In what follows, I have shown the dimensions I used for my own tool, which I devised for a specific purpose. These dimensions are intended only as a guide and are not meant to be followed slavishly. The same applies to the screw threads, which I have shown as mostly metric, with one M.E. thread where I needed a very fine thread. You can of course buy a swing tool if you are wealthy. The only one I could find for sale costs Eu 1250 (about £880 or US$1400). While it may be that few people will wish to make a swing tool, my account contains matters that I hope will be of more general interest.

Fig. 2



Body
Mat'l: Cast iron

The body (fig. 2)

The body, 1, is a block of cast iron in which is machined a wide, deep slot. The slot is closed at the back by a back plate, 2, to convert the slot to a rectangular hole for the table, 4, which is made a snug fit in the hole by means of two gib pieces, 5, 6, at right angles to each other. On top of the block there is a plate of hardened 5 mm gauge plate, 3, which has a rectangular hole in it to accommodate the cast iron table. The bottom of the block is closed off by a bottom plate, 7, which carries the feed screw, 9, held captive in the plate by a locking nut, 10, and having a large graduated drum, 12. The screw engages with a feed nut, 8, which is recessed into the bottom of the table. The drum is read against a fiducial line on a bracket, 11. The whole is mounted by means of trunnions in the form of cone-ended screws, 13, between two tall pillars, 14, which rise from a heavy base plate, 15.

Squaring up

This begins as a rectangular block of cast iron, though other materials such as aluminium alloy could also be used. Subsequent operations are made easier if the block is first squared up accurately. I used a shaping machine, but most people would probably use a mill-drill or a vertical slide on the lathe. Begin by holding the part resting on parallels in the machine

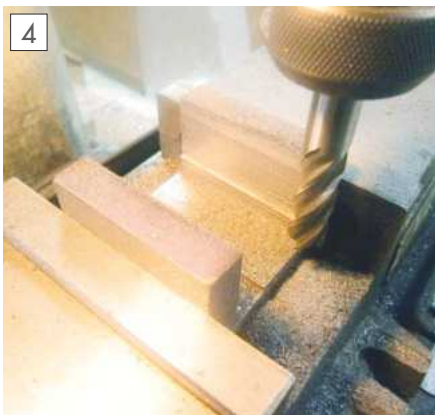
vice, with one side against the fixed jaw and with a piece of round stock between the moving jaw and the work piece, about half-way up. Tap the part down onto the parallels as you tighten the vice. You will probably find that it does not sit evenly on the parallels, but this will come later. Then machine the top flat and smooth. Next, set it up in the same way on the parallels with the machined surface against the fixed jaw, tap down as you tighten and machine the top surface, to give two flat surfaces that should now be at right angles to each other. When you then set up the part in the vice with one machined surface sitting on the parallel and the other against the fixed jaw, you should find that both parallels are trapped at both ends when you tap down, so that when you machine the top surface, you will have two surfaces parallel to each other and at right angles to the third face. The fourth face can now be machine parallel to the second. If the fixed jaw of your vice is truly square to its base, the four corners should be square. To do the two remaining faces, one machined face is set square to the base of the vice using a small square resting on one end of a parallel, as shown in **photo 3**. The slot is then marked out. It is not necessary to mark out for the various holes, as these will be spotted through from the plates. This means that the plates are used as jigs to guide a drill into the correct place and the drill is used to form dimples at the full diameter of the drill from which an accurate start can be made, if necessary with a smaller diameter drill.

Cutting the slot

There are various ways of cutting a deep, wide slot, some more laborious than others. It is possible to do it with a shaping machine, but if the slot is deep it will take a long time as many relatively shallow roughing cuts will have to be made, followed by finishing operations on the sides and base of the slot. The same applies to cutting from the solid with a vertical milling machine. Lucky owners of a horizontal milling machine and an appropriate side and face cutter will do the job with two or three passes. Most amateurs will be limited to using a vertical milling machine or mill-drill, so that deep cuts cannot be made. My compromise is to drill holes at the corners of the slot, of a diameter that will accommodate my band saw blades, after which two saw cuts are made down into the holes. They are then joined by a third cut to produce a rough slot, together with a slug of cast iron that will come in handy some day.

The slot is then finished by side and face milling with a stout long series end mill in steps or by shaping down the sides and across the bottom. An end mill in an amateur's machine tool is likely to deflect with heavy cuts so that the sides of the slot will show a series of lines and not be square to the bottom. To avoid this, use a sharp cutter with several finishing passes, blowing away the swarf at first and then the fine dust until no more is formed (**photo 4**). If a shaping machine is used, it is essential to check that the tool slide movement is set accurately square to the base of the vice, by clamping a square in the vice and running a dial indicator held in the tool post down the edge of the

Setting end of body square.



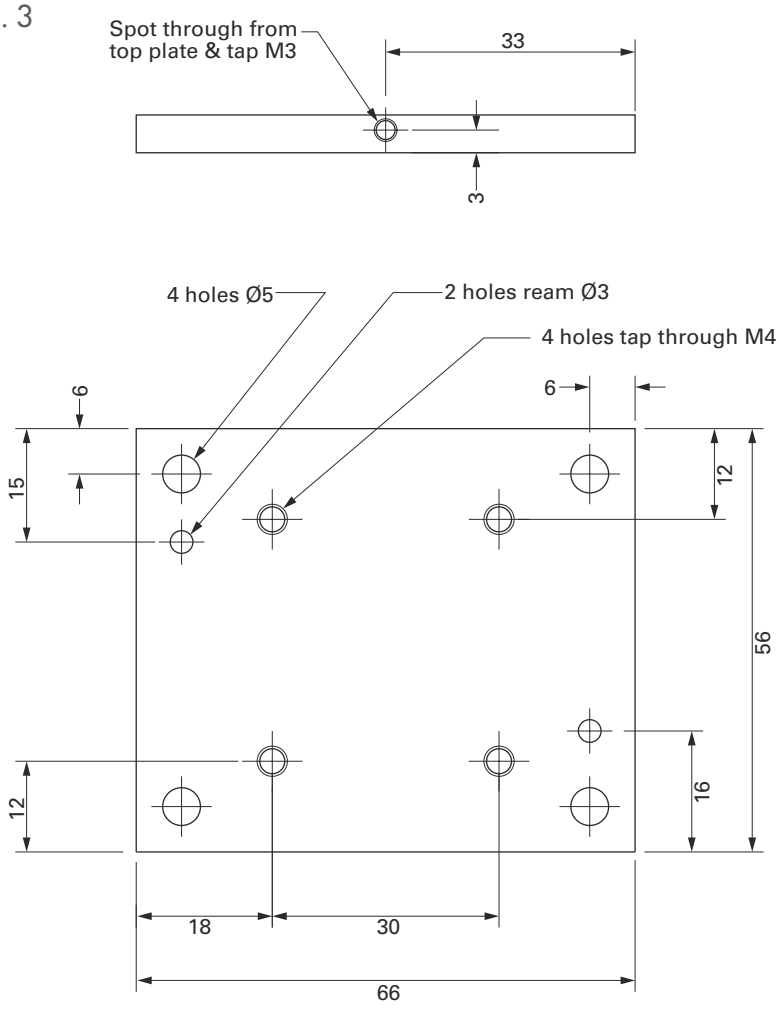
Finish milling slot of body.

square. The tool will also have to be set over so that it lifts away from the face on the back stroke if a crunchy disaster is not to follow.

The back plate (fig. 3)

I used a scrap of 5 mm steel plate. It is a simple matter to saw a little over-size and then to finish the edges to size to match the body, using a file, end mill or shaping machine. All the holes can then be marked out and drilled and tapped to size as appropriate. The two reamed holes, which are for 3 mm silver steel dowels, should not be drilled at this stage, but note that they are slightly asymmetrically spaced so the plate can be fitted only one way. The plate can then be clamped to the body and the four holes for the 5 mm screws that attach the plate to the body are spotted through. Then drill and tap the holes for these screws in the body and make a trial fitting to the body. The top edge of the plate should align with the top of the body and when you are happy that it is so, drilling the fixing holes oversize if necessary to make it so, tighten the

Fig. 3



Back Plate
Mat'l: 5mm steel plate

screws prior to drilling and reaming the dowel holes. A hand reamer will not do for this job unless the hole is made very deep, because of its long initial taper, and if you do not wish to go to the expense of buying a machine reamer, usually drilling a hole with, say, a 2.9 mm drill followed by the 3 mm drill instead of a reamer will give a sufficiently close fit for a silver steel dowel.

The top plate (fig. 4)

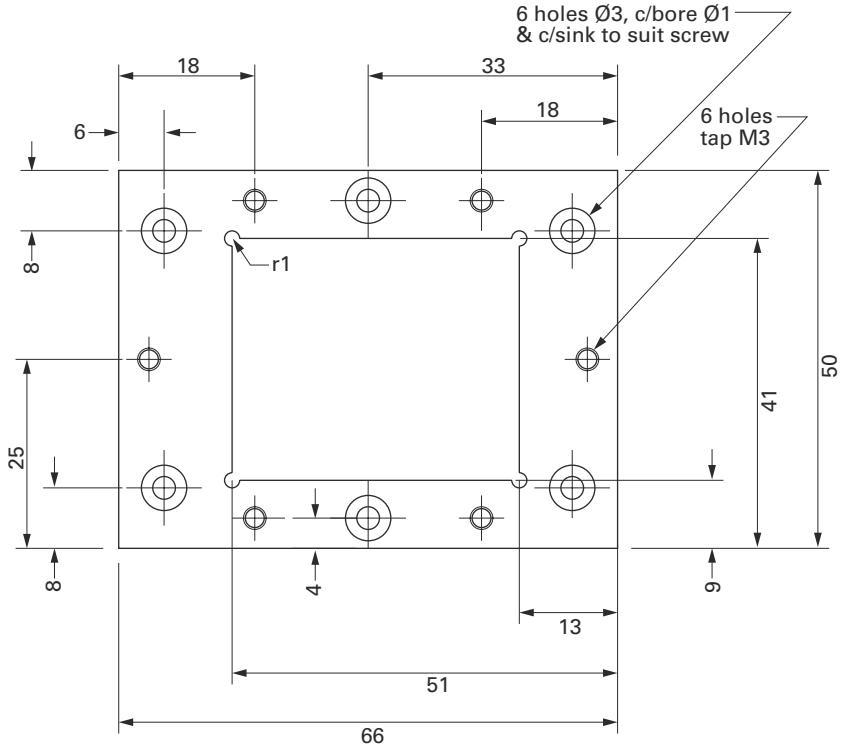
Machining

I made mine from gauge plate, sawn and milled to size, but it could be made from mild steel and case hardened on the top. However, gauge plate can be hardened all the way through, guaranteeing a long life before the top is worn completely away. I suggest that the holes are drilled first, all at tapping size, and then the central hole cut out. It could be laboriously sawn out using a piercing saw and, no doubt, several blades, but I found it easiest to cut it out using a small slot drill in my mill-drill (**photo 5**). If this is not to take for ever, the cutter should be run suitably fast and coolant used. Running it too slowly risks breaking the cutter when impatience takes over and the feed is increased beyond its endurance. Do not omit to drill the 2mm holes at the corners. They not only provide somewhere for the cut to end, but also provide a smooth radius. Omitting it and leaving a sharp corner raises the stress at that point and risks it cracking during the hardening process.

The counter-bored holes are for the attaching screws and the plain tapped holes are for attaching a fence or rollers to the plate to guide the edge of an errant file. The plate can now be clamped to the top of the body and the attaching holes drilled at tapping size, using the top plate as a simple jig. This helps to prevent errors of alignment because the drill is less liable to wander than if simply spotted through at full diameter. The holes in the plate can then be opened out to full size and counter-bored so that the screw heads are well below the surface. The front and the left hand sides of the hole in the top plate need to be aligned with the same internal surfaces of the body, if necessary by touching up the edges of the hole with a file. The other two sides cover the tops of the gib pieces and prevent them from wandering (see **fig. 1**).

Cutting hole in top plate.

Fig. 4



Top Plate
Mat'l: 5mm gauge plate

Hardening

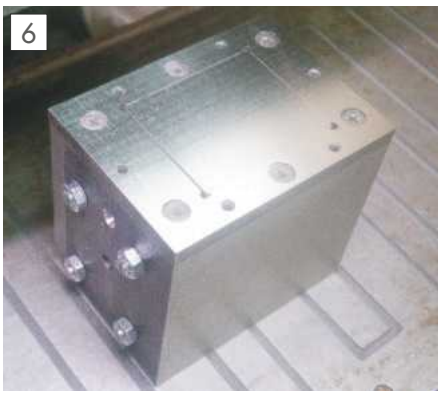
The composition of gauge plate is designed for hardening in oil with minimum distortion and expansion on hardening. The amount of the latter that occurs is not likely to bother our small work piece and, as we are aiming for maximum hardness, we could use warm water at about 30 degrees Celsius instead of the recommended 'proprietary quenching oil'. Few people will have a furnace. I made do by suspending the plate vertically by means of a stout wire hook in a simple nest of fire bricks and directing a roaring flame from a gas torch into the nest until the plate had an even bright red colour. With this plate thickness it is unnecessary to hold at that temperature, especially as doing so will encourage surface oxidation and loss of carbon. Give a bucket of warm water a swirl with the hand and immediately lower the plate on the end of its wire rapidly into the water, vertically, and jiggle it up and down until all bubbling and spitting has stopped. We want the metal to be in contact with cooling water, not hot steam. Test the surface with your second-best scriber or the corner of a triangular file and it should skid off the glass-hard surface. Actually, it will be about half as hard as glass on the Brinell scale, but such refinements need not concern us. If you are concerned about cracking because of the internal stresses locked into the material by hardening, you can reduce the hardness by cooking in your domestic oven at about 180 degrees for an hour.

The table and gib plates (figs. 5 and 6)

This is probably as good a time as any to fit the table, now that the four walls and top of the body have been completed. It is a simple piece, but good finish and squareness are required, especially of the top, while the hole for the feed nut needs to be accurately placed by using the bottom plate as a jig (see below). You will notice that its cross section fits the hole in the top plate and its length allow for the top to descend several mm below the top of the top plate. I have allowed for 6 mm in mine, though I am unlikely ever to need that much.

Start by squaring up a block of cast iron of your chosen size, aiming to get a good finish by taking fine finishing cuts with a sharp tool. If using a shaping machine, using a broad tool, something like a broad and stubby parting tool, with a relatively coarse cross feed and very light cut, gives a good finish on cast iron.

The gib plates can be of 3mm brass or mild steel plate, draw-filed flat if necessary. Mild steel and cast iron make good running mates and steel is cheaper than brass. Check the plates for fit between the table and the body, taking skimming cuts off the body if necessary and taking care to keep everything square. The dimples for the tips of the gib screws are spotted through from the back plate and from the side, at tapping size of course, and then opened out to full diameter for a depth of about 1 mm. At this point you can fit and adjust the gib



Top finish ground.

screws and their lock nuts, to check that everything moves smoothly without binding, at least over the small range of movement that will be used

Drilling the holes for the feed nut must wait for the next part to be completed, the bottom plate, but if you have access to a surface grinder you can now bring the top of the table and the top of the top plate into parallel planes by inverting the assembly onto a plane surface and pressing down on the bottom of the table until it meets the plane, locking it in this position. If you took care to get everything square and flat in the first place, it should then require very little grinding of the top surfaces to bring them into the same plane. **Photograph 6** shows the result. Alternatively, you could grind the two surfaces by inverting the assembly onto a sheet of well-oiled emery paper on a surface plate or thick sheet of glass and patiently rubbing back and forth until you reach an even finish. There is a tendency when doing this for the outer edges of the top plate to be a little below the centre, due to rocking, but this is of no importance in this application.

The bottom plate (fig. 7)

This is made from a scrap of 10 mm steel plate. It has a counter-bore for the feed screw and feed nut and as this counter-bore must have a flat bottom and be square with the hole for the shaft of the feed screw, it is best made by boring in the lathe. **Photograph 7** shows one method of centring a hole in a 4 jaw chuck using a simple spring loaded centring tool. One end has a 60 degree centre that fits in a prick centre pop hole in the work piece and the other end has a close-fitting spring-loaded plunger that has a centre hole in the end to accommodate the lathe's tail centre. A dial indicator at centre height against the tool makes centring the work take only a few seconds and the process is much more accurate than, say, trying to align the point of a centre drill with the centre pop.

Once centred, a centre drill is followed by a 7 mm drill. Purists may wish the better finish of a reamer, but it is not really necessary for this class of lightly-loaded, slow moving class of work. The drill is followed by a tiny boring tool, replacing it with a larger one as the counter bore is enlarged. The finish of the walls is unimportant, but you should aim for a fine finish at the bottom of the counter-bore, as this is a thrust face. The fixing holes can be drilled in a drilling machine and

Fig. 5

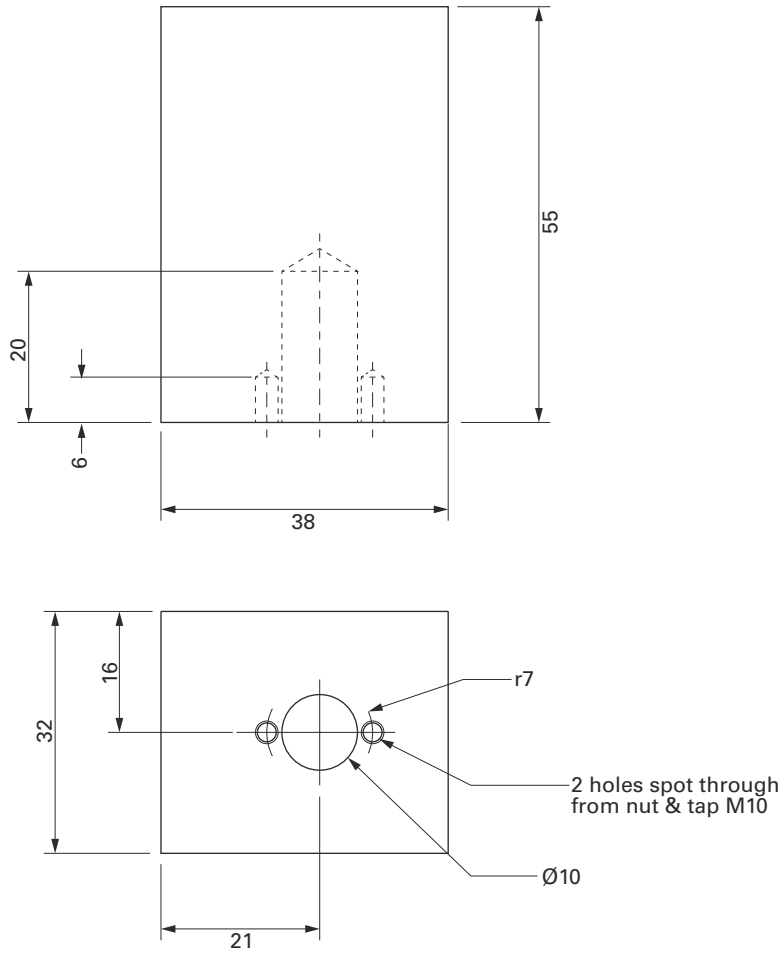
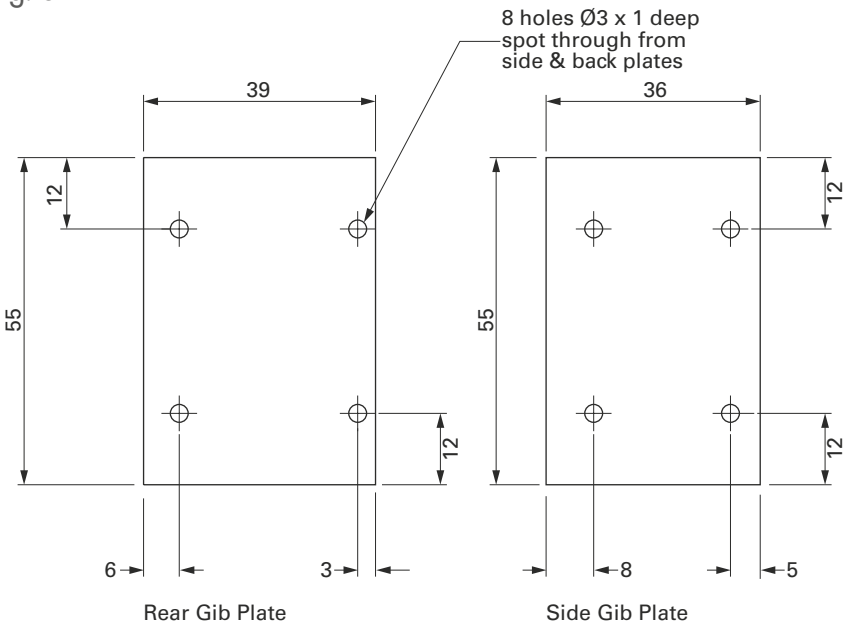
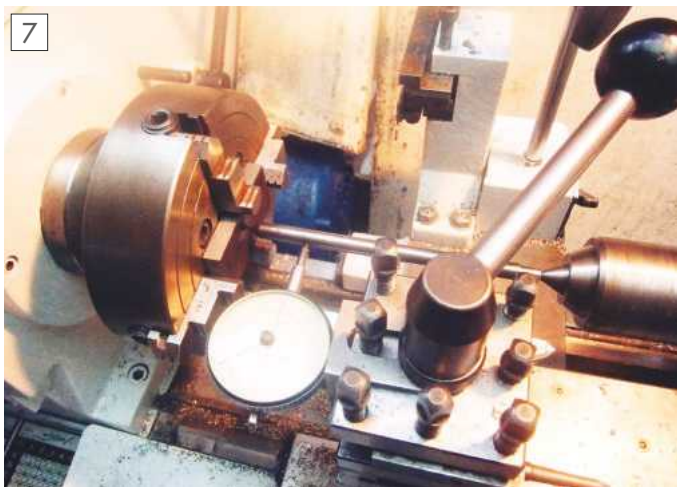


Table
Mat'l: Cast iron or mild steel

Fig. 6



Gib Plates
Mat'l: 3mm brass or mild steel



Centring bottom plate in chuck.

Starting a tap.

counter-bored for the heads of 6 mm Allen screws or countersunk, according to your taste in screws.

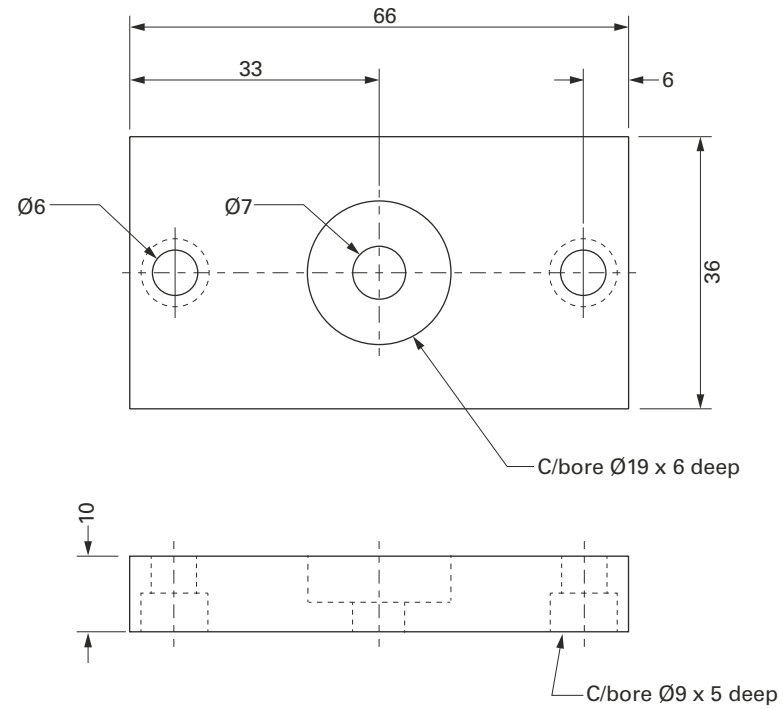
The bottom plate can now be married to the body by clamping and spot drilling for the fixing holes. Once the gib plates are fitted and the bottom plate is fixed in place, it can be used as a drilling jig for a 7 mm hole to be drilled into the lower end of the table after the latter is clamped in place by tightening a few of the gib screws. The plate then has to be removed to open out the hole in the table to 10 mm for the feed nut, which may as well be the next part to be made.

Feed nut (fig. 8)

I chose a pitch of 1 mm for this part so that a micrometer drum divided into a hundred would give adj6ustment with a precision of 0.01 mm, though its accuracy will depend on a number of factors. If you were to prefer imperial measurement, Model Engineer ¼ x 40 tpi would give a precision of 0.001 with a drum divided into twenty-five, though with a much less robust thread. **Photograph 8** shows how I guide a tap when it is crucial that it goes in the correct direction and there is no centre in the squared end of the tap. I hold the shank low down in a well-tightened and stout tap holder, and guide the shank by means of the drill chuck tightened only by hand, so the tap can slide longitudinally. The lathe chuck can be rotated by means of a spanner (U.S. wrench) applied to a chuck jaw to get the thread started truly, and as the jaws are usually hardened, there is little risk of damaging the jaw. This is also a better way of rotating the chuck when it needs to be unscrewed, rather than by using the chuck key as a lever. The exterior is then turned down to a snug fit in the table, a tiny groove turned in the face at the correct pitch circle diameter for the attaching screws, parted off and the other side of the flange faced. The two holes can then be marked out and drilled and countersunk to match the chosen screws. The nut is then used as a jig for spotting through into the table for the attaching screws. If not concentrating, it is very easy to drill the hole at full depth at full diameter, so keep your wits about you and just spot through at full diameter, following up at tapping diameter.

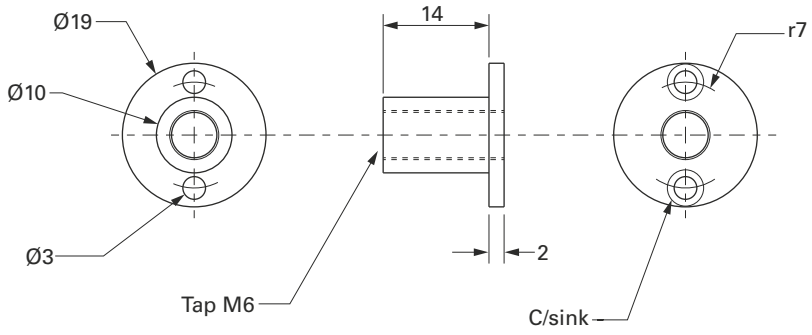
To be continued...

Fig. 7



Bottom Plate
Mat'l: 10mm steel plate

Fig. 8

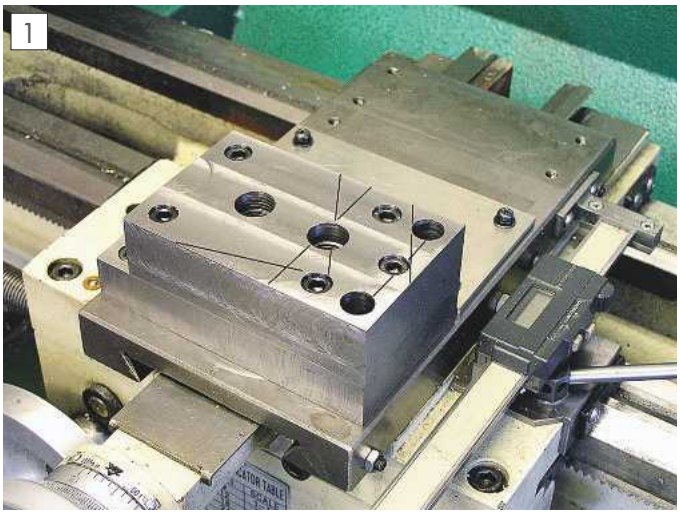


Feed Nut
Mat'l: Brass

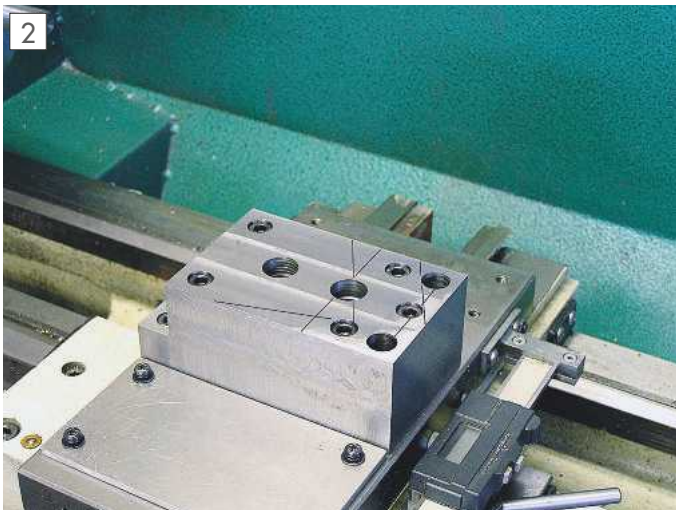
One Man and his Lathe

Richard Rex and his Grizzly G0602 Metal Lathe

Richard Rex describes his Grizzly G0602 - 10 x 22 inch Bench Top Metal Lathe.



QCTP base fitted at the front of the cross-slide.



The QCTP base fitted towards the back.

The salvaged lathe saw many hours of use before being sold on eBay for an unbelievably high price – more than enough to pay for a 10 x 22 Asian import sold by Grizzly (USA), and countless others worldwide. Many of its features turned out to be knockoffs of Emco designs, but not so nicely made. Bringing it to a functional state was a remanufacturing exercise, a process of stripping it down completely (to clean out the casting sand and other debris), then starting over. Leaving aside its agricultural fit and finish, the end result does a decent job, especially after I installed a 3-phase motor and variable frequency drive. Things that actually matter, such as the TIR of gears, spindle and chucks, are fairly respectable.

Back to the Emco; along the way I learned that its compound (a.k.a. top) slide wasn't as rigid as I like, and was too small for a QCTP (Quick Change Tool Post), a must-have item in my opinion. Anyone still shimming tool bits please note – the QCTP is a game changer.

So, what to do? My answer was to make a solid base for the QCTP that would bolt directly onto the cross slide. Now, 15 years later, I have a similar setup on the 10 x 22 lathe. The new base is 1¾ inches thick, assembled from the ex-Emco ¾ inch plate and a smaller 1 inch plate. I drilled and tapped the cross slide to allow two locations for the base (**photos 1** & **2**),

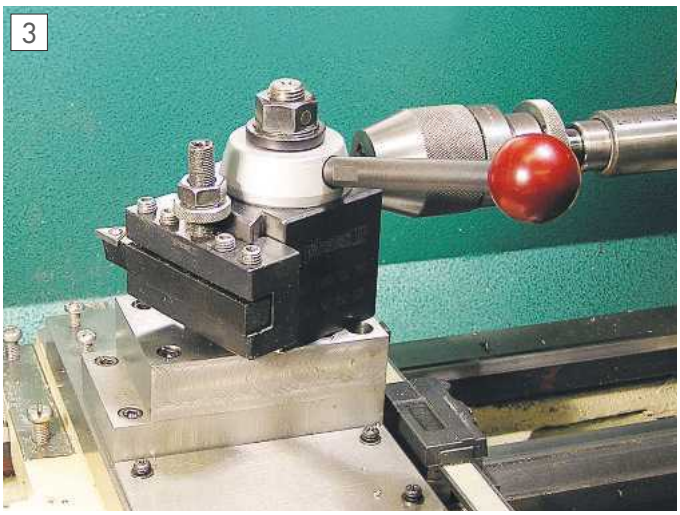
> My experience with small lathes began in England with a Super Adept. Then, a few thousand miles away and 40 years later I was given two Emco Compact 8s, so abused in a high school workshop they were practically scrap iron. After stripping them down to the last nut and bolt I built one machine from the two piles of parts, plus a few replacement items fabricated from scratch.

plus a shop-made back toolpost used for grooving, parting-off and knurling (read about it in a WWII vintage book by 'Duplex', I later saw the same thing in George Thomas's Workshop Techniques).

Scribed lines on the top plate (enhanced in the photos) allow the QCTP base to be aligned immediately, so I don't have to rely on the compound's not-very-readable graduations. The cross slide photos also show an ancient digital scale, a total pain to install, but well worth the effort (it eliminates the 1.5% error you get when dead reckoning with the dial, 0.025 mm divisions pretending to be 0.001 inches. There is also a low-budget DRO on the carriage, cut to length from a 36 inch long import costing $45. It is attached to the bed with magnets, to the carriage with a flexible shim. Pretty basic to be sure, but it does deliver a verifiable ± 0.002 inches end to end.

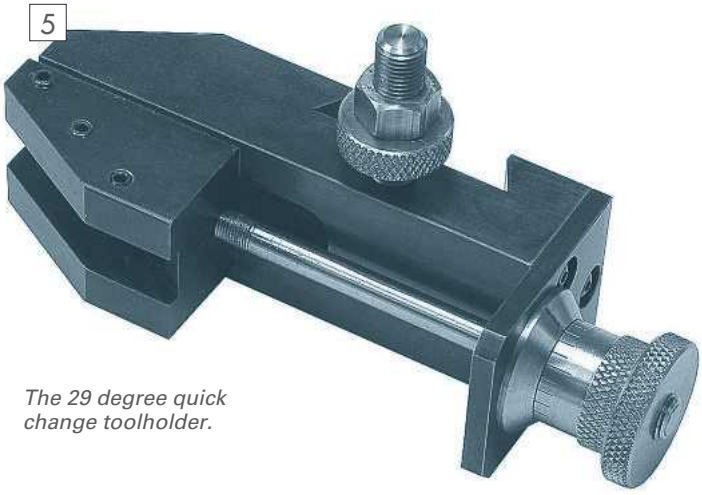
Except for screw cutting and tapers, the new 'solid base' handled everything I use in everyday work – knife tools, boring tools, and so on (**photos 3** & **4**).

I could live with re-installing the compound every now and again to cut tapers, but for routine screw cutting that became too much of a chore. The answer was a dedicated 29° toolholder (**photo 5**), another game-changer for me, almost as radical as switching to QCTPs in the first place. Basically, this is just another shop-made QCTP with a dovetail slide, leadscrew and graduated dial.

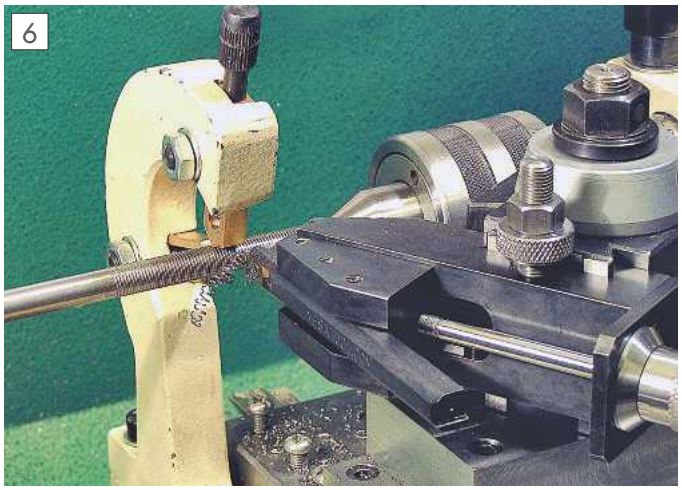


The right hand knife tool.

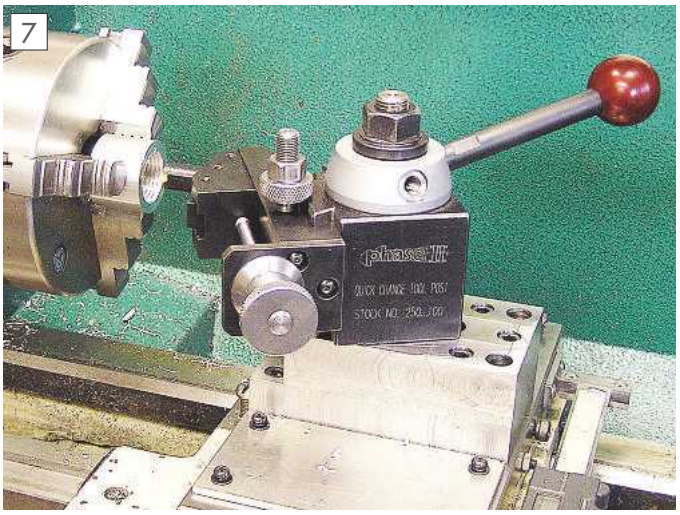
A boring bar in use.



The 29 degree quick change toolholder.



Threading using the travelling steady.



Internal, threading using the angled toolholder.

The powered leadscrew arrangement.

I can install the 29° toolholder in about 10 seconds flat, lining it up instantly on one or other of the 29° lines on the base, way more accurately than I ever did with a fishtail gauge (which might be good for ± 2° if you're lucky). Its elongated nose sets the threading tool well in front of the toolpost (**photo 6**), nicely clearing a bulky live center.

The 29° gadget turned out to be rock solid, which is good news for fracture-prone carbide inserts. A recent addition is an L-shaped holder for internal threading, typically used with an inverted threading insert, as in **photo 7**, cutting on the back surface of the bore.

There was one feature of the 10 x 22 that was just about unusable – its way-too-fast power feed. Not only was its speed over the top, it was a serious time waster to set up. My fix for this was a separate leadscrew drive that has nothing to do with spindle speed. It uses a salvaged windshield wiper motor mounted on a swing-up bracket with a toothed belt drive (**photo 8**). A bit uncouth, to be sure, but it does the job – plenty of torque and good speed control from a switching power supply. It has a shear pin to avoid a calamity the next time I try to run the leadscrew from the spindle, having forgotten to disengage the wiper motor.

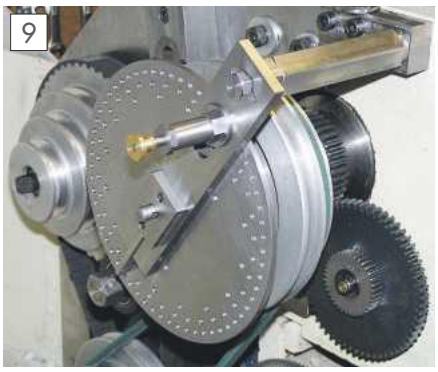
Another must-have for me is a means of indexing the spindle, something I've done in the past with a 60T change gear – but its rigidity was always a bit suspect. My current version is built like a tank – a 6 inch diameter index plate with three sets

›

of holes, 60, 36 and 16; it attaches to the spindle using a split sleeve and tapered bushing (**photo 9**). Making the ⅛ inch thick disk was simple enough, if laborious – a few minutes of sine and cosine calculations on a spreadsheet, followed by a few hours of drilling on the mill.

With an indexer you can do all sorts of shaping and drilling operations that would otherwise be difficult or impossible. Filing hexagons and other shapes on a workpiece in the chuck is one example (saves a trip to the mill and a lot of setup time). For this I use a shop-made roller assembly in a standard tool holder, setting its height in the usual way with the QCTP's adjusting screw (**photo 10**). This is about as basic a filing rest as you can imagine – took me only a couple of hours to make, and it does a nice job (**photo 11**).

The second companion piece for the indexer was a drilling spindle. Back in the Emco years I used a dedicated drilling fixture that attached directly to the cross slide. This worked fine, but took time to install and remove. Before I had figured out how to make my own QCTP tool holders (you can never have too many) I purchased a second complete set, including the toolpost itself, for all of $80. Like the original set it came with a block for ¾ inch and ⅝ inch diameter boring bars – bigger than anything in my shop. I had adapted the original 'monster block' 5 years ago to hold a flex shaft grinder, and have used it that way ever since. I was about to toss out the new monster block, then realized it could hold a drilling spindle, with the usual QCTP bonus of precise height setting (**photo 12**). Even better, the block came with a ⅝ inch ID split inner tube, just right for off-the-shelf Oilite bearings costing next to nothing.

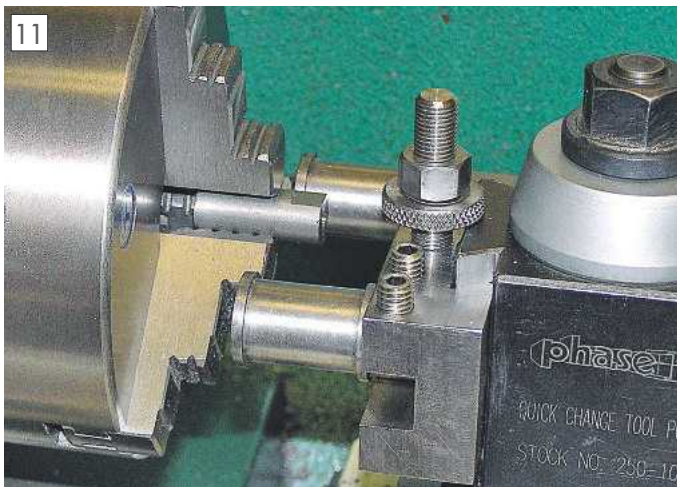


The dividing plate assembly.

The filing rest fits in a toolholder.

From there it was all downhill, a straightforward turning job – a ⅜ inch spindle with J1 taper for a 6 mm chuck. For pointing flexibility, I added a universal joint from the scrap pile, and a hardened ¼ inch hex tang to fit my tiny 12V impact driver (**photo 13**). One gotcha I didn't spot early on is that the chuck needs to be flipped from one end of the block to the other to handle axial vs. radial drilling. The fix was to make the universal removable, so the spindle could be reversed (takes all of 20 seconds). The end product can handle radial drilling on workpieces up to about 3 inch diameter, more with screw machine length drills. Axially, it's good for the full 10 inch swing of the lathe.

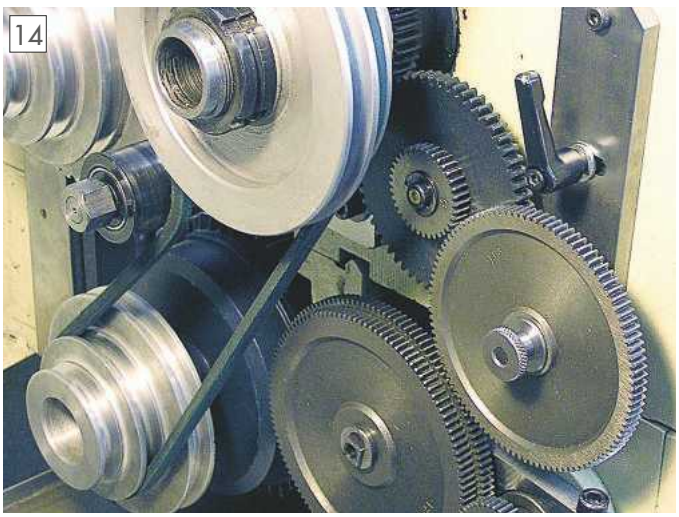
Finally, for the occasional project calling for LH threads, I needed a means of reversing the leadscrew relative to the spindle. I was about to fabricate a design with who-knows-what complexity when someone pointed out that the 104T change gear my lathe came with is intended only for power feed – which means I would never use it, see the 12V motor above. With this in hand, reversing was a breeze. All it takes is a swing arm that allows the gear to engage between the intermediate gear and the swing-up change gear assembly. End of problem. ■



The filing rest in use.

The QCTP mounted drill.

Using the drill along the lathe axis, note the universal drive joint.



The reversing idler.

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Unidentified Mill

Dear Neil, I have what I assume is a Horizontal Diesinkers Miller as indicated in the attached photo. The graduations are in imperial. I bought this machine second hand but unfortunately there was no name or reference to origin of this machine. I do know that this specific machine was in operation in 1940 on a steel plant in South Africa. A thought occurred to me that it might be a Craven, but I could not find any confirmation.

I would appreciated if someone could identify this machine and perhaps provide more information on its origin.

Also, I have a 9 inch Southbend Lathe. I want to change the flat belt system to a V-pulley system. Can anyone tell me what the bore size of the V-pulleys should be?

Congratulations on an excellent magazine.

Jurgens .J. Stoltz, Eldoraigne, South Africa

Watching the Wheels Go Round

Dear Neil, thanks for the little story (*Ed's Bench MEW* 232) - there is a sequel!

What we used to do was to test the wheel on the local golf course when walking our spaniels. The locals did question me, thinking we were surveying the land. What we wanted to discover was the amount of wear we could expect - in fact after a year of evening walking there was none discernible. Okay it was a light weight on the tyre, and a small traction engine would have made more work for it, but the test proved satisfactory to us.

The sequel; adjoining the golf course was Twinwoods airfield, where the late Glenn Miller flew from on his last journey. Part of that site is currently being developed as a Solar Farm. Quite by chance very recently I met up with one of the golfers who questioned me all those years ago. His greeting "You, you b***** I knew you were up to no good, now we have to contend with this new hazard on the back of the course".

Useless even after all this time for me to deny it - sometimes model engineering makes one feel like a felon in the Emperor's song in The Mikado, but I am not going to make elliptical billiard balls.

Ted Jolliffe

Unsprung

Dear Neil, in 'Piddantic' response (pun intended) to David Hockin's mail in regard to my vice design, may I apologise for insufficient proof reading in that I had intended to include something like *'the sliding jaw may be retracted by hand - after stopping the cutter and brushing swarf away'*. Also I find I have acquired very few coil springs over many years and even now have nothing suitable to specify or where to obtain, a dilemma that excuses Messrs Hemingway from buying in bulk another 'special' item of minimal sale potential. I had already done this with the specification of square Key Steel.

Secondly may I offer a comment to the editor in the use of 'tweak' and other out-of-date words? Many years ago in another paper I described straightening a thin GM casting with *'a couple of tweaks'*. It was published as ***'a couple of weeks'*** which is not quite the same thing.

David Piddington, Birmingham

Alcan Banbury's Die Making milling machine

This Die making milling machine has now been replace in my workshop by a CNC machine. I have offered it to Banbury Museum but they do not want it. Before I scrap it has anyone got a sensible home for? It was Made by Krupps in 1930's and was part of their installation of number 3 Press the story goes that the technicians that installed it were interred for the duration of the WWII. I bought it from Alcan in 1965 when the tool room was moved and by then the Sparkatrons and NC milling had taken over the task of die making.

Paul Boscott

If you are interested in this machine please contact me at ***neil.wyatt@mytimemedia.com*** *and I will pass your details on to Paul.*

Index Addendum

Dear Neil, in issue number 229 of *MEW* you wrote about indexes for the magazine, including my MEW_Indexes. I appreciate your words, so thank you. However, you didn't mention a feature I built in MEW_Indexes I thought will be very interesting to users. It is the possibility each user has to add his own notes or comments to each and every entry (or record) of the index. The notes added may also be used as a criteria, alone or in combination with other fields, for the searching.

Dias Costa, Portugal

You can download Dias' indexes at www.diascosta.org/ME_MEW_EiM/

Frankenmill

Dear Neil, regarding the article in *MEW* and your editorial note about adapting disparate machines, I thought you may be interested in my milling machine which comprises of a Taylor Hobson engraver base with a Deckel FB 2 head (I think its FB2, it's definitely a Deckel) mounted on the top.

The head was mounted on a flamecut plate machined to suit and bolted to the engraver. The head was originally driven internally from the Deckel mill it was mounted on, the drive gear for this was removed and a drive shaft taken out of the rear of the head, the motor is fixed via a couple of pillars to the mounting plate. The original spindle in the head which had an ISO taper (I think) was completely shattered, the lower spindle bearing was integral with the shaft and was completely destroyed. I made a new spindle, and fitted a bearing housing to the lower part of the Deckel sleeve containing an angular contact bearing, the spindle now has a number 2 Morse taper with a tool ejector mounted on the spindle. The aluminium ring shown in the photo is used for mounting dial indicators etc. onto the spindle.

I did this at least 30 years ago and it has worked okay ever since. Disadvantages are the table traverse is 10 x 10 inches which is a bit short on the long axis, the table dials are graduated in .002 inch increments which I never got around to changing as the graduations are fairly wide and it is easy to read to a thou, and the table screws are the wrong hand, which took a little getting used to. The advantages are, a very large table, a large throat depth, and lots of room under the spindle.

The head gives me a range of automatic downfeeds with a wheel for fine feeds and a handle for coarse feeds with a very good adjustable stop. Because of the change in the spindle bearings the top speed is limited to 2300 RPM, it was originally 6000, and the return spring on the spindle broke shortly after I converted the head so I fitted a counter weight, (see photo). It can also be tilted +/- 90 degrees. The bits of the machine head base etc. cost about £15 as scrap from work at the time, so I have had my moneys worth! and used it successfully as my only milling machine over the years, see my previous articles on making ball handles and making a Stent tool and cutter grinder, and clock wheel and pinion cutting machine.

Charles Woodward, by email

CAD Software

Dear Neil, I'm a new reader of *MEW*, but thoroughly enjoy the articles. I have inherited my father's Smart & Brown Model M Mk1 and a Centrec 2A milling machine, both need stripping, cleaning and some TLC to restore their glory - in particular the lathe which is painted in horrendous gold hammerite!

My interest in engineering started before I left school when I made a hot air engine from a design in a book by TE Haynes (miraculously this year I found a copy in a school library in Woolongong in Aus and they kindly sent it to me - the miracle of the internet!). I also enjoy technical drawing and have had much success for my house renovation using Sketchup, but wanted something engineering focused and have found www.onshape.com which provides fully functioning software for free the only limit is 5 Active Private models or 5GB in size, neither is an onerous limit. New updates occur every 3 weeks or so and the only requirement is to sign up for an account. I'm still learning, but it appears a highly competent package that includes assemblies and, in due time, the ability to produce 3rd/1st angle projections of parts.

I just thought other readers might be interested - additionally it might be good to have a review of available CAD packages if you have someone who knows enough to do so, or perhaps a series on building CAD models?

Great mag, many thanks.

Peter Morris, New Zealand

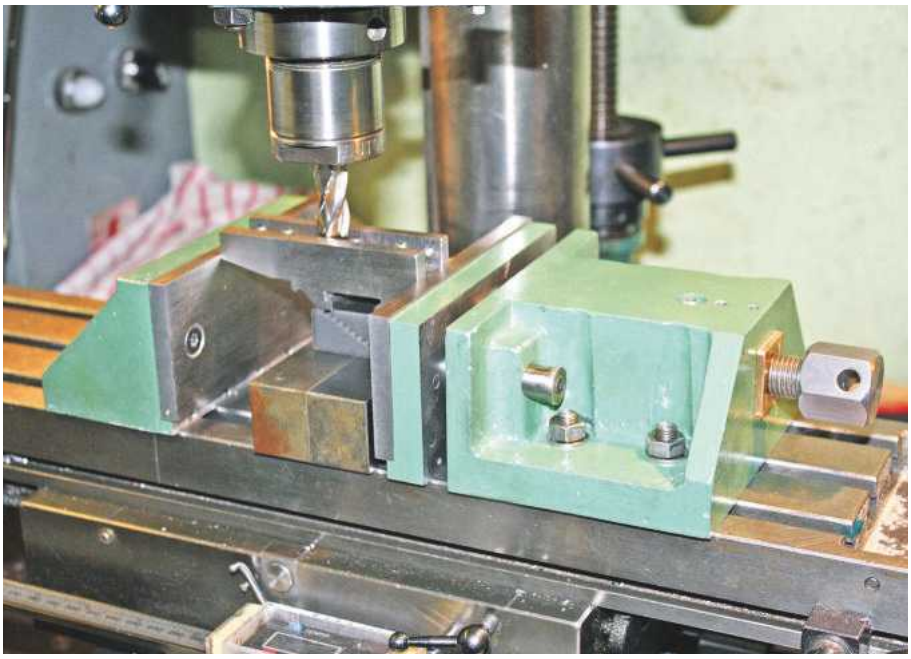
We would love to hear your comments, questions and feedback about MEW

Write to The Editor, Neil Wyatt, Model Engineers' Workshop, MyTimeMedia Ltd., Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF. Alternatively, email: neil.wyatt@mytimemedia.com

A Table Length Milling Vice Part 4

In this series, with beginners in mind, David Piddington gives a step-by-step guide to machining a milling table vice of his own design. The castings and full size drawings for the vice are available from Hemingway.

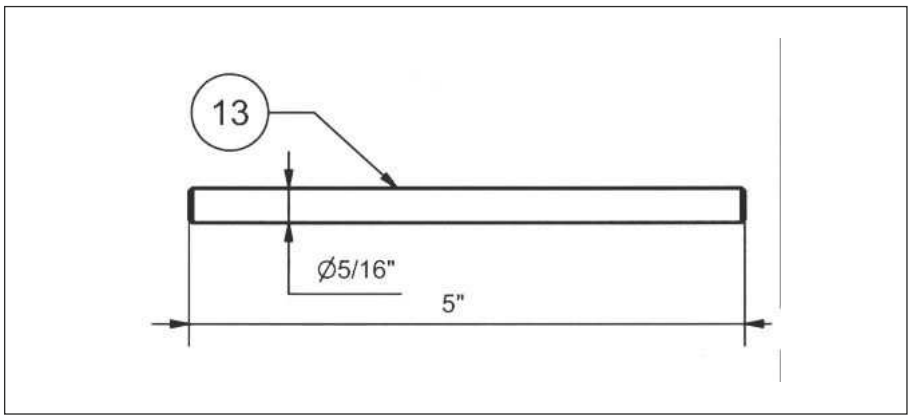
The original concept of this vice was taken directly from similar commercially available ones which are too large for model engineers like myself who only have workshop space available for lathes such as the Myford Series 7 and smaller mills such as the Senior 'E', for which the two prototype vices were made. My own workshop measures 11½ by 7½-feet so storage and workspace comes at a premium.

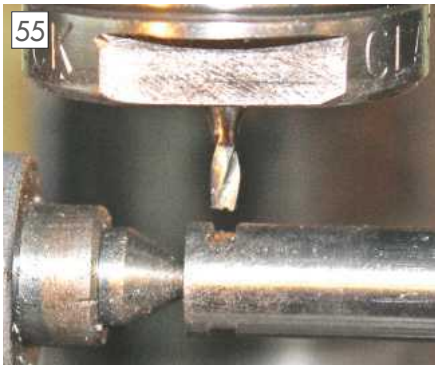


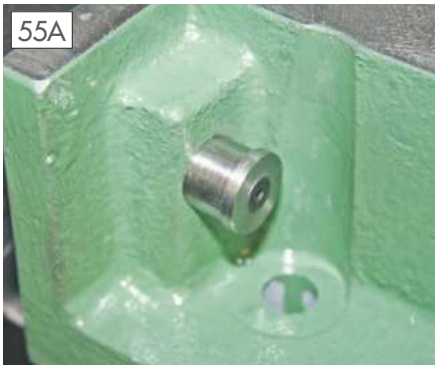
On the outer end of the boss there is room to drill and ream though 5/16 inches diameter to allow a 'tommy bar' for increased leverage to tighten the vice. Use a bar an inch or so longer than the width of your hand, and putting a hemispherical end on it. NEVER use a hammer on this bar to close the vice.

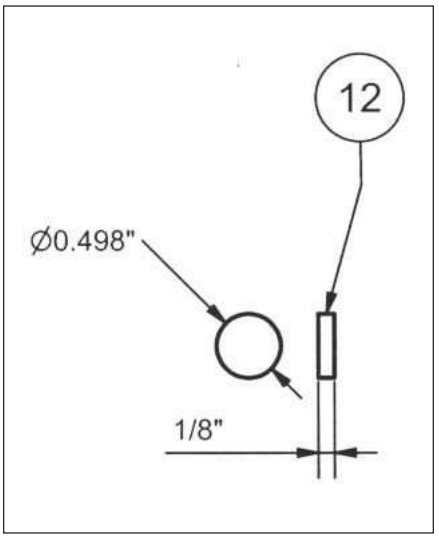
Photographs 53A to E: These photos show the sequence of fitting and finishing the taper pin should readers take this option.

A: Initial use of the taper reamer. Use a chuck-type tap wrench and take about 4-6 turns using a cutting lubricant such as RTD. Then withdraw and clean off swarf from both reamer and hole. Repeat until sufficient depth reached determined by how far the taper pin will enter. If the reamer goes 'tight' remove by tapping the small end with a light hammer to release. Do not turn the reamer backwards or the cutting edges will be blunted.





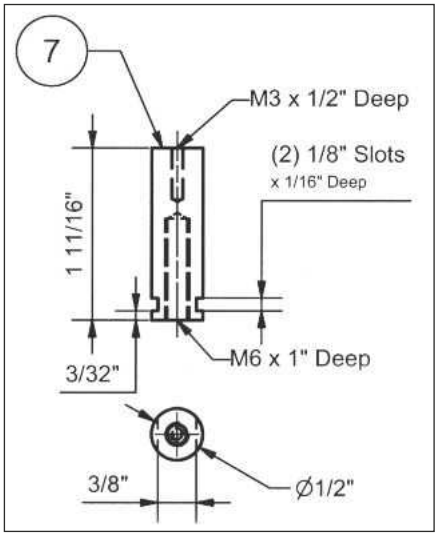




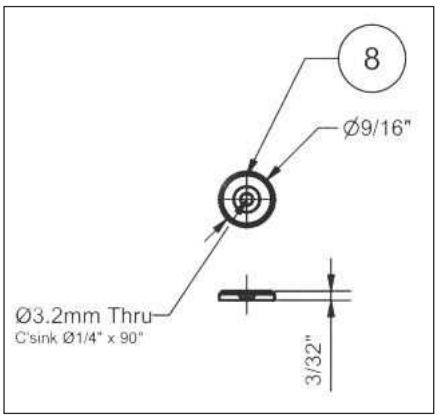
B: Hammering in now fits the pin. Just visible are the hacksaw cuts indicating the best place to reduce the pin length without damaging the boss.
C: Confirms where the pin has been cut off.
D: After trimming the pin is now invisible.

Photograph 54 shows the complete clamp screw assembly showing the bronze nut and the boss now with its 'tommy bar' hole and also the bronze pad 54.

Turn a piece of phosphor bronze bar down to 0.490 inches diameter and part off ⅛ inch long. Clean off the parting burrs both sides. This item will be inserted into the buffer hole for the clamp screw to tighten against; better than having a steel on steel contact at this point. Ultimately this can be replaced if desired.

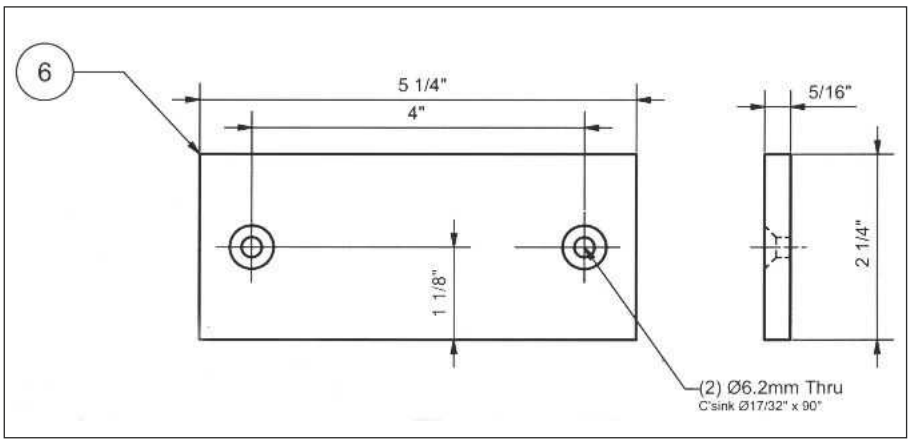


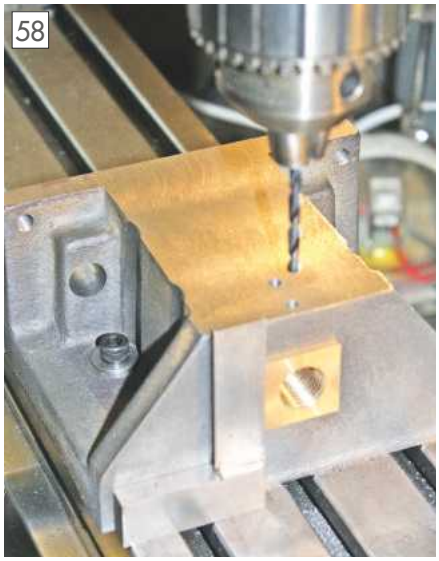
Photograph 55: The two guide pins are simple turning and tapping but there are two choices of material. Both should be precision ground, but can be either free-cutting stainless, or silver steel. If you have an indoor shop with no condensation problems then choose the latter. If you do have condensation or similar problems, then choose stainless. We have already reamed the holes in the clamp block for these and the hole for the socket cap screw in the jaw carrier. These pins should be 1 11/16 inches long and tapped one end ¼ inch BSF for the screws of which ½ inch long will be adequate. Two spanner flats at 180° should be milled on close to the jaw carrier as in photo 55 which I set at 0.180' AF that a 1-BA spanner fitted nicely. I also found on assembly, so will mention it here, that the contact face between pin and carrier needs to be a precision 90° and that by holding the pin in a collet, see later photo 56, and facing off 0.003 inches, the final assembly proved successful though it may be necessary to remove a small amount of material from the pins by use of emery cloth. Once lubricated tight spots should disappear.

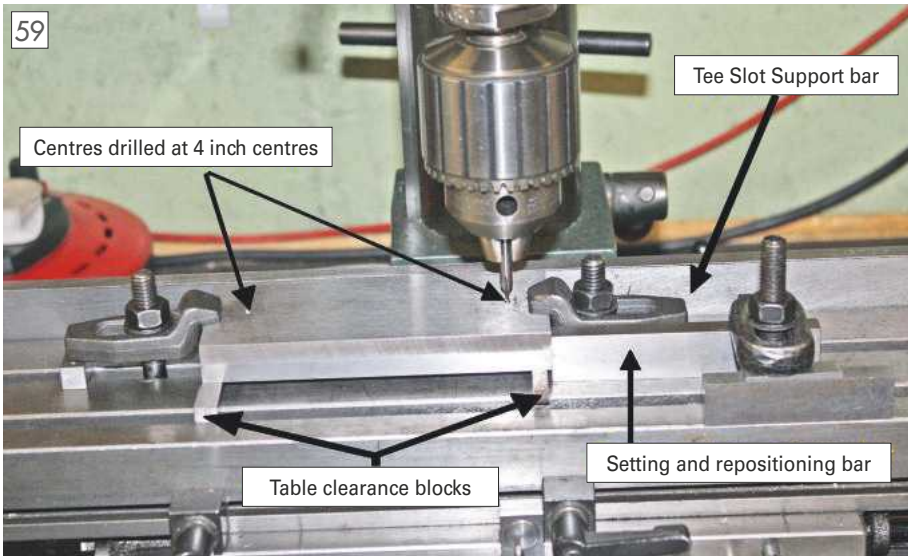


A later modification to the guide pins was made by drilling and tapping the other end 4BA and turning up an end collar 9/16 inches diameter recessed ½ inch diameter by 1/32 inch deep to fit over the end. The collar is countersunk on the outside for a suitable 4BA socket screw ⅜ inches long. **Photo 55A** shows a finished and fitted collar. A collar each side will prevent the locking jaw assembly from sliding out of engagement when the unit is out of use.

Photograph 56: I found later that the clamp screw buffer also needs this precise 90° face to its spigot that enters the jaw carrier but as it is likely that most will not have collets larger than ½ inch, then soft







jaws in the 3-jaw chuck will be the best option gripping the ¾ inch diameter

Photograph 57: Return the clamp block to the mill and set up as in this photo, in order to drill and tap two 2BA holes on the cone end top face centrally disposed lengthwise to the ¾ inch reamed hole. Use a wiggler to locate the axis of the bar, and then measure in from the end 3/16 inches for the first hole and another ½ inches for the second. Tap through and remove internal bores.

Photograph 58: Now position the clamp screw nut into the bore and with the tapping drill make a drill-point-only register into the nut in both holes. Later these may be enlarged slightly to the full 3/16' drill point only. A socket grub screw in each hole will give a positive location on final assembly, but these screws must not be screwed tightly on to the nut, or distortion of the internal thread will surely occur.

I recommend that the vice jaws are made from PGFS (Precision Ground Flat Stock) as this is a more robust material which, should makers of this unit have the facility of hardening, may be treated so. I have left my jaws plain, having always wondered why bench vice jaws are almost always made so that these put a usually unwanted knurl on any component held in one. However my factory made standard milling vice has plain-faced jaws like those specified here.

I would also suggest that a second set of extra-thick jaws is made but from standard BMS which suggestion comes from an item in *Model Engineers Workshop* issue Number 166 dated August 2010 – 'Soft Jaws for the Lathe and Mill' - which I recommend obtaining and reading as it is very informative.

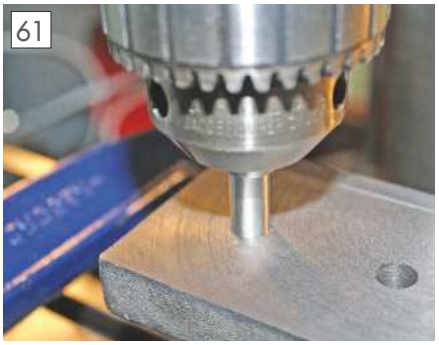
The nearest available size of PGFS is too wide at 2½ inches so ¼ inch needs to be machined accurately from one edge parallel to the other using a similar set-up to photo 35 except that the tenon bar should be in the centre table slot and the PGFS plate overhanging the table edge so that the milling is done with the side of an end mill. Adjust the offset from the tenon bar with parallel strips of metal as required. Both jaw blanks must now be squared off accurately at 90° and milled to exactly the same length.

Photograph 59: Now set the blank parallel to the mill table axis from the setting bar and locate the exact centre in both directions. Obtain an accurate measurement for both the length and width of the jaw blank. The horizontal one is most important, as the two securing screws drilled from the jaw blank will enable the jaw to be used either way up; particularly important for the thicker soft jaws should you make these, Photo 59 explains how your author drilled his jaw plates.

Working from this intersection centre and drill number 7 diameter (5.1mm) remembering to put spacer bars beneath the plates to prevent marking your mill table. If you are particularly astute the drill could be positioned to pass into a table tee slot. Alternatively arrange so you drill both plates as an identical pair at exactly 4 inches centres. This may seem wide compared with other vices, but in this unit there are additional holes in the sliding jaw carrier, which have to be avoided.

Photograph 60: Take one of the pair and centralise it on the fixed jaw and drill through the jaw but not right through the casting leaving a blind hole as in photo 60. Make sure that the plate is pressing securely against the jaw ledge. Similarly the other jaw plate may be centralised on the sliding jaw carrier but in this instance drill right through. Tap for the holding screws ¼ inch BSW, and clear out the jaw plate holes to ¼ inch diameter countersinking – ½ inch diameter - one side only to suit the socket screw heads going slightly beneath the surface.


60A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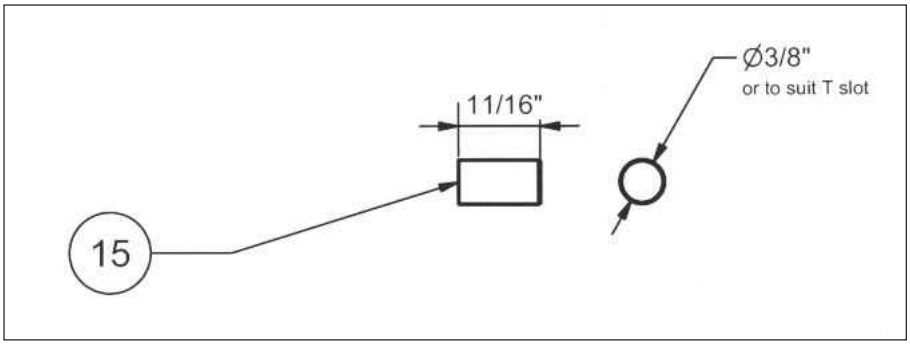


The clamp block and carrier assembly can now be tested. It is possible that some polishing with emery, mentioned earlier, will be required on the slide bars to obtain an easy sliding movement when retracting the jaw on its release from a component.

It was also found, as suggested in item 12 that positioning on the lathe was tricky though the actual alignment of the fixed block was quite easy in that a setsquare from the side of the table held against the block ledge while clamping was sufficient. The clamp block can next be set similarly to the workpiece, but both need some initial positive location such as a tenon projecting below the casting into one of the tee slots.

Photograph 61 shows how to line up on of the pre-drilled securing holes in the fixed block – another good reason for drilling these 'size' instead of 'clearance'. Now with the 'x' axis locked, the 'y' axis can be moved forward and back 13⁄16 inches (0.8125 inches) to drill two 'blind holes in which to insert plain spigots secured with 'Loctite' which will protrude below the bottom face to locate in the tee slots of the mill. I have only drilled these on one side, as the setting up alignment will still be with setsquare as noted above. The amount of projection must be minimal as there must be sufficient to allow a strong 'key' to the upper part of the tee nut, which has to clear the projection as well but there is also the tee slot chamfer to take into the calculation. For my 'Senior' mill I made this projection ⅛ inches.

An almost identical procedure must be done on the clamp block though the method of holding down is different as in **photo 62**.

Lubrication

Photograph 63: Use grease rather than oil that can seep out and make a mess. A very occasional requirement for which the simple solution is to remove the clamp screw and anoint the internal tip, inside the nut and along the screw with a small amount of lubricant. For the purist who desires a 'proper' method, then fit a 2BA straight pattern grease nipple into a 7⁄16 inch diameter flat bottom hole 0.410 inches deep, below which is tapped 2BA, which passes into the ¾ inch reamed bore (see photo 63). I found it a bit fiddly inserting the nipple but it can be done and locked in with a ¼ inch socket drive having a 7mm A/F socket on its end.

Finishing

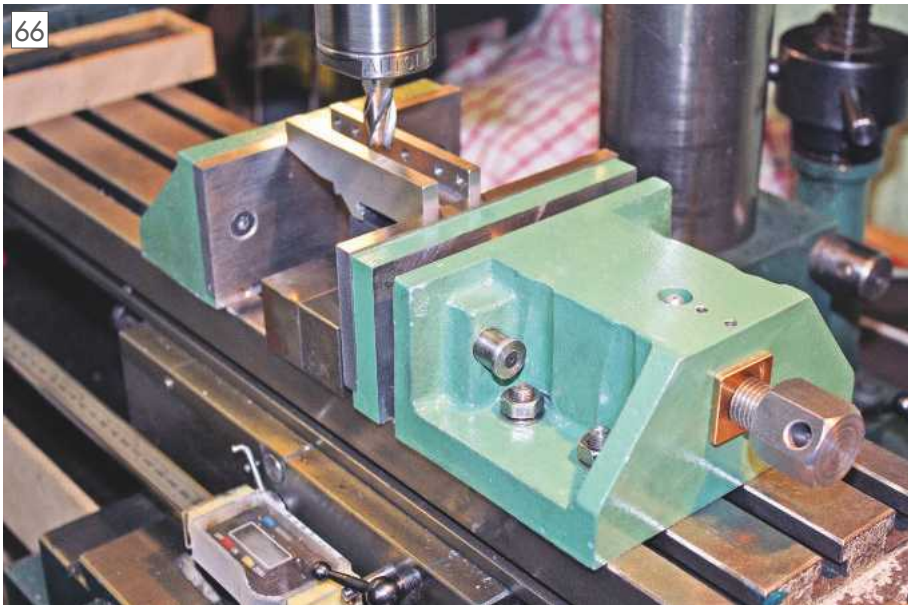
Photograph 64: (a) The four temporary holes at the corners of the locking jaw carrier should be plugged with lengths of studding (all-thread) and secured with 'Loctite', the latter allowed to cure and the excess carefully milled and filed away to leave a smooth face on both sides. The corresponding four holes on the jaw face of the clamp block should be plugged in the same way but be careful that where the two upper holes break out externally on to the cast face, that your finishing will be completely disguised once this is painted.

(b) Before painting, carefully clean all cast surfaces with a file, and put a small radius on all corners except around the bottoms of both bases, the jaw face of the fixed block and the jaw face of the clamp block which rectangular areas can have their corners simply 'broken' – a term used in my apprentice days to indicate sharp but not sharp enough to cut flesh.

(c) Machine some wood plugs to be a push fit in the screw bores and slide bar bores of the clamp block. Paint entering the bolting holes can be easily cleaned out later.

(d) I suggest that paint be applied only to cast surfaces with the exceptions of the front and back vertical faces of the clamp block. The top face (behind the jaw) of the fixed block should also be left unpainted to match that of the clamp block. All faces that contact the mill table should also be left unpainted as will the whole of the locking jaw carrier assembly. Those surfaces needing to be left unpainted should be carefully covered with masking tape.


64a-e



(e) Initial trials showed that the clamp block has to be securely bolted to the mill table with, in my instance on the Senior 'E', with all four securing bolts on the clamp block and all three on the fixed block.

See photo 64 from which the bolts on the fixed block are out of sight, but they are there. This was the initial test to see how the vice would perform. Trial cuts were taken on one of those pieces of useful metal which when one actually comes to use it is frustratingly deficient on one dimension by 1/32 inch only! The one drawback is that fully tightening all seven bolts distorted my machine's table slightly and it was difficult to move by hand. Experimenting by reducing the bolt grip may be required later; also on other machines.

Additionally I found that due to the initial pattern error mentioned and pictured in the test sections 26 and 27, I could not get either an open end or ring spanner conveniently on to the 3/8 inch BSW nuts, standard on the Senior 'E' mill. I therefore adopted 5/16' BSF and had to make some special T-nuts and studs to suit the commercial hexagon nuts I had in stock. THEN the only spanner I had that fitted these was an open-end marked 1/4W. My comprehensive 56 piece socket set didn't have one either. Search of internet suppliers and Ebay failed to locate a singleton, so I made one from a 4 inch length of 3/4 inch diameter MS bar boring one end 1/2 inch deep to 0.600 inches diameter – that's ever-so-slightly larger than the across-corners of a nut. Inserted two nuts into the hole and by brute force in my bench vice squeezed the sides in around the nut, turning the bar between each squeeze – blacksmithing without the heat! **Photograph 65** shows the result together with the vice tommy bar, which slides into a 5/16 inch, reamed cross-hole. In passing, forty-plus years ago, I made a triangular socket key by this same method, to open the access door to my home's exterior electricity meter cupboard. Too late I learned a simple key could be bought.

A further enhancement to this equipment is to make a storage box. I made a base from 12mm MDF and the sides and lid from 6mm MDF with panel pins used to hold the basic structure together as dowels and having fitted these, standard wood glue forms the 'grip'. When using these use a drill of the same diameter as, but not smaller than, the pin drilling through both components to a depth of no more than 1/8 inch less than the full pin length. This will prevent splitting of the thinner pieces of material. I made two trays to fit inside the major box, used for special tee-bolts, nuts, washers and the tube spanner.

Photograph 66: vice gripping lengthwise a 'Piddington' extended tool-holder from a new batch of standard holders as I needed a few more. ■

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Taper Turning Attachment
Adding New to Old

Alan Hearsum machines the missing parts for an old accessory that could be adapted to fit many types of lathe.

This article introduces the concept of adding new to old and in this case making a complete taper turning attachment as shown in **photo 1**. In essence the attachment is simply a dovetail slide that can be set to various angles. A sliding block on the dovetail is temporarily attached to the cross-slide and the cross-slide feedscrew is remove. As the saddle traverses the lathe bed, the cross-slide modes in and out, following the taper set by the attachment.

The author's taper turning attachment.

There are those among us who are satisfied to be in a model engineers' workshop community that enjoy finding a part of an accessory or assembly and finishing it off by finding or making the missing parts. This practice is also a useful way of developing and practising a broad range of engineering skills and at the same time introducing new methods and facilities in a model engineering workshop.

There are a number of opportunities that arise to acquire parts to complete accessories, and in this project, which builds on an old part from an original Myford Taper Turning attachment. It is amazing what can be purchased by simply visiting boot fairs, farm sales, ex-MOD sales of second hand machine tools and of course advertisements for sale or wanted items in the Model Engineers' Workshop and Model Engineer magazine. Second hand machine tool suppliers often have parts available to complete a machine tool accessory that never reach the light of day. They are tucked away behind the larger machine tools and with a bit of ferreting can end up being a useful starting point for providing a very interesting project.

If we need a taper turning attachment urgently or for that matter any other accessory for a Myford Lathe then it is prudent to contact Myford themselves (**ref. 1**). **Photograph 2** shows a new Myford taper turning attachment on a Myford Super 7 lathe. This and other photographs have been kindly provided by a member of the model engineering workshop community. You will note this is green in colour which distinguishes it from my ML7 lathe which is painted grey, any photos of the green machine are of the S7 and intended as an additional aid. It is my understanding that the Myford taper turning attachment is similar on all series 7 Myford lathes although there is a nominal 6 inch design and a 12 inch taper turning attachment.

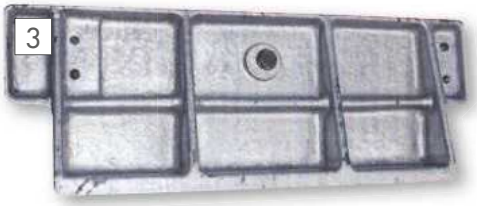
The search

If, however, you get pleasure from searching for old second-hand components to extend your range of workshop accessories, then a visit to a second hand machine tool company can be fruitful and worthwhile. There are number of these that regularly advertise in *Model Engineer* and *Model Engineers' Workshop* magazines. Today eBay provides a very useful source without leaving our workshop environment, a component delivered direct to your home by post or carrier. Of course let's not forget we may already have chosen

A new Myford taper turning attachment.

a project in adding new to old by saving a component when clearing out the workshop. We may say "I must get around to doing something with this or that before it ends up in the scrap bin".

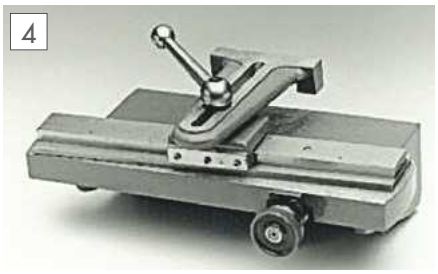
Recently I refurbished a Myford ML7 lathe, which is from where the taper



The underside of a bracket.

turning cast iron bracket emerged. The original old Myford taper turning attachment was fitted with this 12 inch long bracket attached to the lathe bed with four ¼ inch BSF socket head cap-screws. From time to time these brackets do come up for sale from **ref. 2** (**photo 3**). Equally if you have already obtained all the other components for a taper turning attachment, then the bracket can be fabricated from Bright Mild Steel flat sections (BMS) using Allen cap-head screws without the need for the welding which can easily cause distortion to a fabrication. Plans can be downloaded for the fabrication from the internet (**ref. 3**).

Hemmingway Kits (**ref. 4**) provides another alternative, whose kit uses aluminum castings and other materials for the completion of a taper turning attachment Mk2 (**photo 4**).

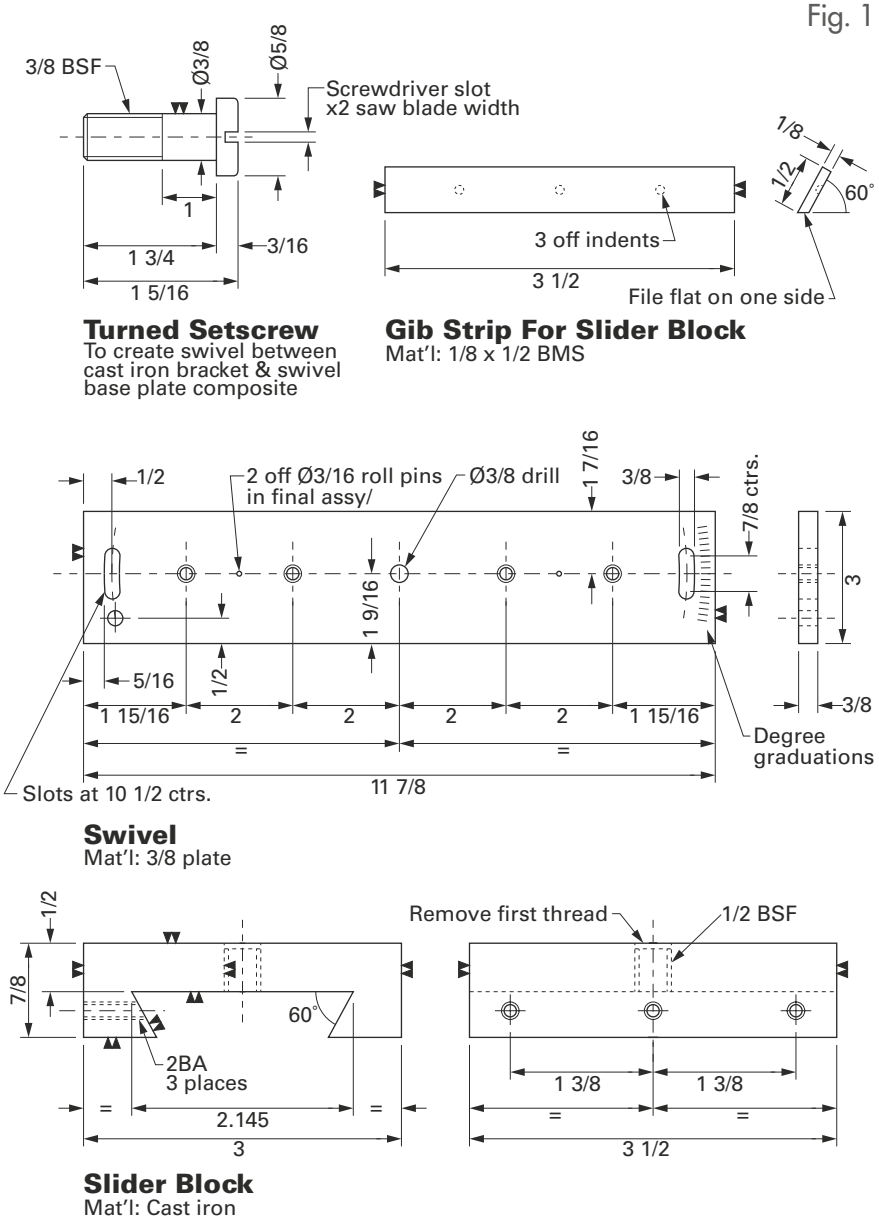


The Hemingway Mk2. Taper turning attachment.

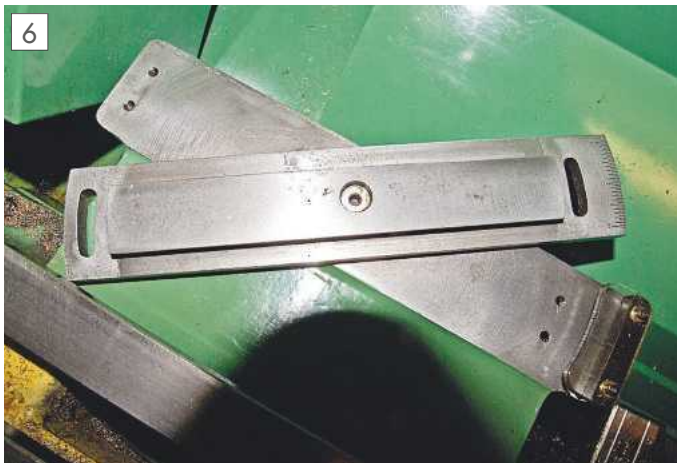
Adding new parts to the cast iron bracket

Photograph 5 is the bracket removed from my ML7 lathe held in a bench vice. The two holes on the bottom left of the photograph (one in view) are already tapped 4BA and hold a clear plastic visor positioned on top of a metal bridge. This allows the visor to reach out over the swivel plate and protects and partially magnifies the degree taper markings (**photo 6**). Two pairs of holes tapped ¼ inch BSF in photo 5 coincide with slots in the swivel plate (**photo 7**) taken off a Myford Super 7 lathe. **Figure 1** details the swivel plate I made, with the holes around the centre line slightly off centre. I am not sure what the remaining holes are for, other than the hole near the centre of the casting which can have a wood plug driven into, to use to check the arc of the slots in photo 6. You will note in photo 1 that I have used Allen screws and not hexagon head screws to provide more freedom in tightening the swivel plate to the bracket (photo 5). I

Fig. 1

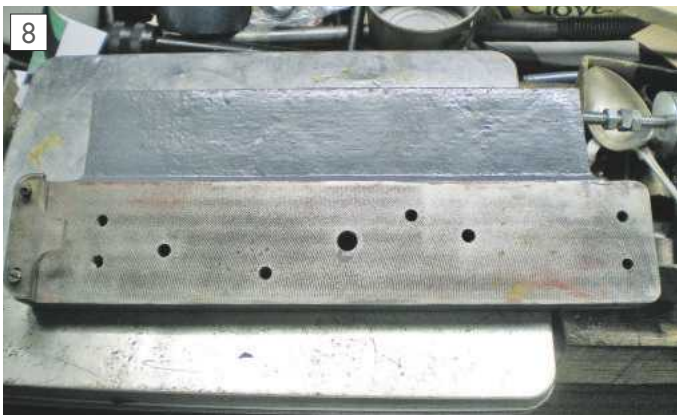


The author's recycled bracket.



The magnifying visor is at bottom right.

The swivel plate from a S7.



The cleaned up bracket.

have included a micro adjustment setting component (fig 4) which gets in the way of using a spanner to tighten the original hex headed screws. I could of course tighten hexagon heads using a socket spanner without interference, but it is not the sort of tool normally used on old machine tools. An alternative could be to use an aluminum indexable handle purchased from ref. 2. These are used now on many small machine tools and I have used one to tighten the saddle to the lathe bed, see photo 1. The cast iron bracket, scraped to remove dirt and loose rust and ready to receive the working parts of the attachment, is shown in **photo 8**.

The swivel plate

The original Myford swivel plate was a casting with an integral machined dovetail slide. I could have purchased a block of cast iron, but BMS seemed to be a more practical alternative to save on excessive machining. The fabrication comprises a long dovetail screwed to the swivel plate base (fig 1). It was made from a 12 inch long piece of ⅜ x 3 inch BMS flat and from College Engineering Supply (**ref. 5**) with other steel sections and a cast iron block needed to complete the taper turning attachment. The steel was draw filed on its surfaces to remove any ridges or burrs. The edges of the steel had their corners 'broken' with a file.

Photograph 9 shows the marking out of the arc of the slot drilled holes with a paper transfer glued in place taken from a photographic copy of the degree graduations. **Photograph 10** provides shows the position of the centre punch mark prior to drilling, on the centre line of the plate, from which the two arcs are drawn with an engineers trammel. Four pilot holes were also drilled to allow for tapping ¼ BSF later to fix the 2 x ⅜ x 9¼ inch BMS flat that would have a 60 degree dovetail machined on it in situ. The centre hole was drilled ⅜ diameter and when joined with the a dovetail piece (**fig 2**). I made a countersunk flat bottomed hole using an end mill ¾ dia x 3/16 inch deep in to provide the aperture for a turned ⅜ BSF setscrew. This has a ⅝ dia x 0.186 inch deep head, as shown in fig 1.

The two drilled holes and the centre hole initially provide a method of holding the swivel plate to a rotating table with 3 x M6 tee bolts and washers. **Photograph 11** shows the set up. The rotating table is fixed to the cross-slide on a Drummond M lathe with tee bolts. In the photograph is a Clarke vertical milling machine, permanently fixed to the rear of the bed of my lathe. This addition to the lathe featured in a Model Engineer magazine.

Marking out for the slots and graduations.

Marked out for the centre hole.

Set up for engraving graduations.

The finished graduations.

The sliding block in place on the finished swivel.

Machining the dovetails in the sliding block.

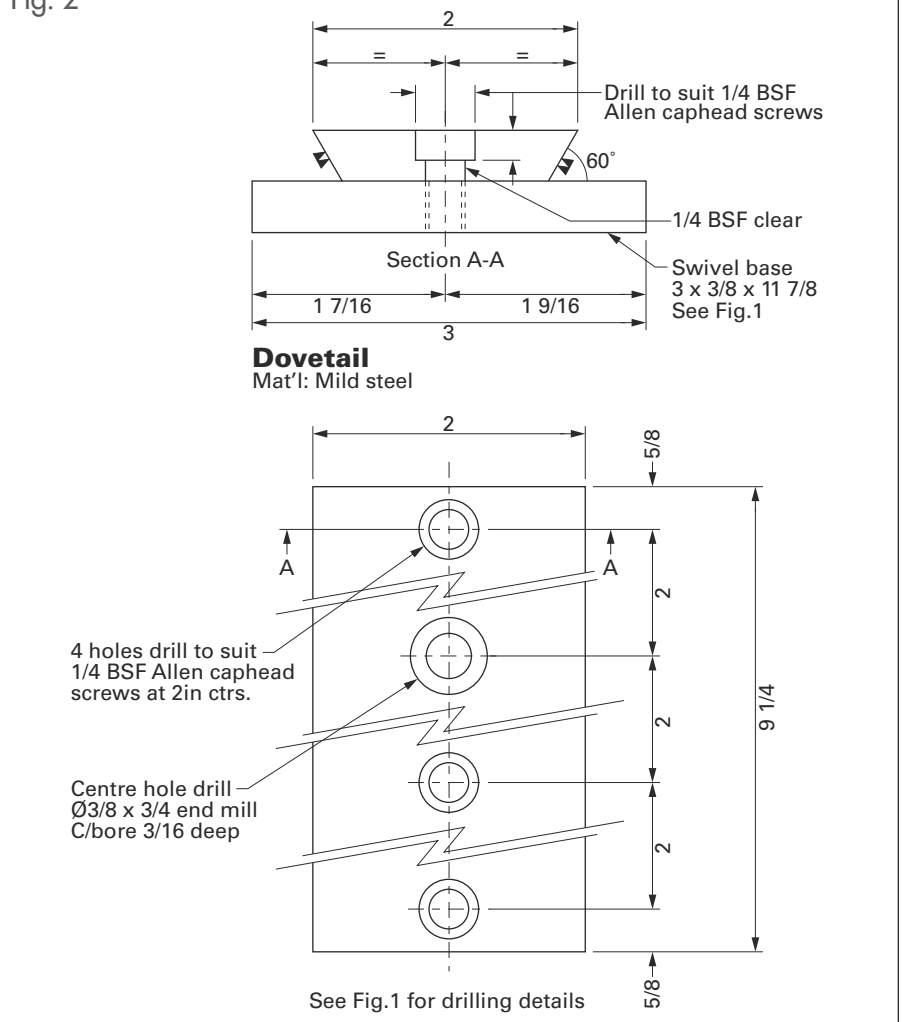
Piggy backing on the milling machine is a wood router which I use as a temporary arrangement for high speed work. The collet holds a solid carbide ⅜ inch engraving cutter purchased from Arc Euro Trade. As a test, with the cutter above the work, the rotary table is turned one degree at a time to see if it follows the paper transfer in photo 9. The actual machining commenced from the centre line of the plate, feeding the cutter towards the slot in one pass of the tool. The tool was lifted up from the work piece using the milling machine controls. One degree gradation was rotated, the tool depth reset and a similar procedure adopted until all the gradations were machined, varying the length of cut on ½, 1 and 5 degree segments as shown in **photo 12**.

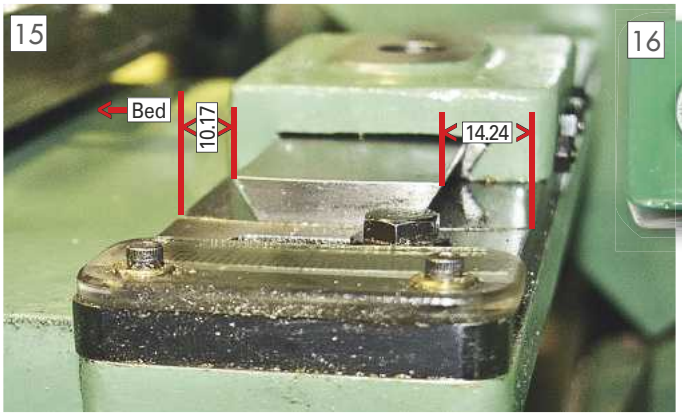
The cast iron slider block

Before machining the dovetail the slider block was made from a cast iron billet to finish 3 x ⅞ x 3½ long (fig 1). The block was machined on all sides in a milling machine. Four corners were rounded as shown in **photo 13**. A dovetail was cut in the block by first machining a square slot to remove the majority of metal to a depth of 0.378 inches then finishing with a dovetail cutter (**photo 14**). **Photograph 15** shows the slider block of an original unit in position on the dovetail attached to the swivel plate. Note the offset of the dovetail to centre the block. The gib strip (fig 1) is ⅜ x ½ x 3⅜ inches with a 60 degree bevel edge. This means the overall width of the dovetail in the slider block at its largest dimension is 2.145 inches. A ½ inch BSF hole is drilled and tapped centrally in the top of the slider block. The first thread on this hole is relieved so that the collar on the pin fits flush (**photo 16**). The pin will be dealt with later. Three holes are drilled and tapped 2BA for the gib adjusting screws and 2BA locknuts fitted. The block in photo 16 is an original cast component from a Myford super 7 lathe.

To be continued...

Fig. 2





A cast slide block fitted with a pivot pin.

A myford slide showing the offset dovetail.

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Evapo-Rust

Neil Wyatt tries out a different approach to rust removal.

I am possibly more fortunate than many, as I have a well-insulated workshop. The investment in time, polystyrene and polythene paid off and I do not have to spend my time fighting condensation and rust. That said, there are occasions when I find myself faced by something that looks more like a misshapen rotten twig than a useful item, and so I have experimented with various approaches to rust removal over the years.

A good while ago, my father passed on to me a 'basket case' Westbury Seal four-cylinder IC engine. All the castings, including the head and block, had been carefully mille out of the solid, but the project had been abandoned by the builder at the half-way point for some reason. Looking through the bits, I decided to start by trying to recover the rusty crankshaft – if that was okay then it was probably worth trying to finish the engine. I used the electrolytic method, with a battery charger and a bath of caustic soda. I've since discovered washing soda is equally suitable and less dangerous! The result was good, with only minor pitting that would not prevent me using the crankshaft – at least for a motor that would only run occasionally and do little work. I've since discovered that the process can cause hydrogen embrittlement, so, perhaps it wasn't the best choice for a crankshaft.

To round off this story, I salvaged many parts – and also discovered that the electrolytically cleaned parts could rust in minutes unless rapidly dried and oiled. On assembly, I discovered that the builder had bulked up the big ends with bronze bushes – with the result that they fouled the crankcase. The engine remains in bits until I get around to making new piston rods.

I followed on by trying chemical approaches to rust removal. The more aggressive ones use brick cleaner – strong acid, but in the end I found that cheap cola worked well, albeit very slowly, taking several days to clean up an old two-part die holder, for example.

One thing I learned was that rust has much greater volume than the unoxidised metal – it is loose, flaky and puffed up with water. This means that even unrecognisable items can be almost miraculously restored by rust removal. The big problem is that all the methods I found involved either nasty chemicals or very slow action – or had other disadvantages (like the hydrogen embrittlement of electrolysis, not to mention the issue of having a bath bubbling hydrogen and oxygen into the air…)

So, finally, to the point. After seeing Evapo-Rust recommended on the ME forum, I decided to find out more. The online claims were surprising, it was not only effective and rapid, but it was also

A rusty towball.

The towball's back plate.

Lightly rusted tinsnips.

Into the bucket with them!

High carbon steel comes out a grey colour.

Anti-shake washers on these nuts were invisible before treatment.

The snips came out as good as new.

non-toxic. Evapo-Rust is a well-known American product but isn't as familiar to folk in the UK. After a chat with the European distributor of Evapo-Rust, Aris Petitsas of Maveric International, a sample was on its way for me to try.

The sample arrived in a big plastic container, it is a pale yellowish liquid with a relatively faint smell. I decided to try it out on a tow ball that had been under a bush in the garden for several years, a rubber cover had given the ball some protection, but the backplate was thoroughly rusty (**photos 1** & **2**). One of my step-lads contributed a rusty pair of tin-snips (**photo 3**). I dropped them into a bucket and covered them with Evapo-Rust (**photo 4**). To my surprise, within a few hours most of the rust appeared to have gone, but my plan was a 24-hour soak so I didn't properly inspect then until the next day.

The results were good as can be seen from **photos 5**, **6** and **7**. It seems that the process is so gentle that the carbon from high-carbon steels that is in the rust layer accumulates on the steel, and has to be wiped off. I washed and oiled these parts afterwards, but I have learned that evaporust can be use as an anti-rust coating. This means that instead of washing the parts, you can just let them dry and don't have to worry about rapid re-rusting but do wash off the Evapo-Rust before painting bare metal..

I hadn't particularly planned to do any more trials, but I took pity on some rusty boot-sale clamps, and also a g-clamp and home-made toolmaker's clamp that had been greatly abused when brazing and welding. I didn't take a 'before' shot, but **photo 8** shows they came up a treat.

Last weekend I was doing some work on the car, and pulled out everything I could find failing to find a small 8mm socket. I even went though my old toolbox, which at one point had two inches of water in it, it. The box was full of old sockets and other bits, from the totally rusty to the simple tarnished. I sorted the actual tools from the old spark plugs, cylinder bolts and GOKW and dumped them in the bath. **Photograph 9** shows the various bits after just three hours. If my wife is reading this, they are on one of *MY* old towels!

On a roll, I found a couple of old nail pullers, completely brown with rust, and threw them in. Not only did they come up nicely (**photo 10**) but I discovered that one of them was made in Cannock, not far from here in South Staffordshire (**photo 11**). The lads are now regularly supplying me with rusty screwdrivers and the like and the original gallon or so of Evapo-Rust

I wish I had taken a before shot of these clamps...

A random selection of small rusty items after three hours in the solution.

is still going strong. When it eventually wears out (it turns black), I will certainly get some more.

So you have probably realised I am very pleased with Evapo-Rust's performance, but it's worth explaining why it is different. Instead of being acid or alkali-based, Evapo-Rust relies on a chemical process of 'selective chelation'. My school chemistry tells me that this means a large molecule that grabs hold of metals and holds them in solution. Evapo-Rust bonds to the iron in rust, but not in steel and it does not attack plastic, brass, aluminium and other metals or glass. It does dissolve light films of grease and oil (they recommend cleaning off heavy grease coatings) and I did notice that it got quite a lot of non-rust gunk as well as removing the rust.

The product is non-toxic and biodegradable (I have the material safety data sheet), and can be disposed of down the sewer without ill effects. This is a major benefit over the strong-acid based rust treatments – I'd far rather have a gallon of it slopping about in a corner of the workshop.

Compared to electrolytic removal, it is much less messing about and there are no nagging doubts about hydrogen embrittlement. Perhaps the biggest plus here is that you don't get that almost instant return of rust that happens to some electrolytic cleaned steels.

That leaves a comparison with my cheap-cola alternative, in which case the big difference is the rate at which Evapo-Rust works – it takes hours when the fizzy pop approach takes several days.

I found one unusual after-effect of Evapo-Rust, it's that treated items have a slightly sticky feel due to the film left behind. As this is an effective anti-rust treatment, I'm not complaining and it is easily washed off – but in this case I would suggest oiling or otherwise treating the item to stop the clean surface rusting again.

More details can be found at evapo-rust.co.uk, it is easily obtained in the US and Canada but it can be a little difficult to find it in the UK; google Evapo Rust UK or look at Frost Auto www.frost.co.uk ■

A couple of old style nail pullers, previously thick with rust, one of them still has a bit of paint!

It was nice to find one of them was made locally.

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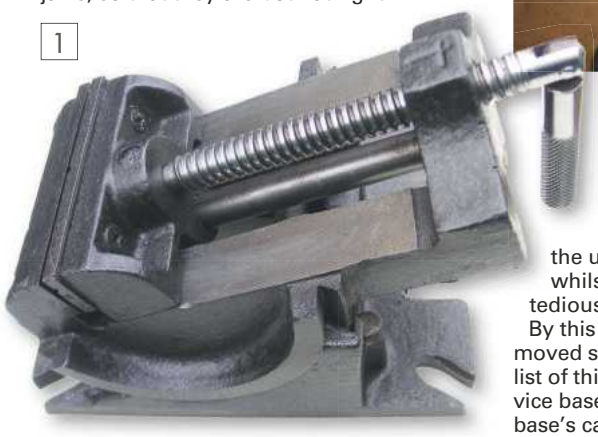
An Angle Vice Adaptor Plate

Ted Fletcher combines tilt with spin for a more useful milling vice.

When I read an article in *MEW* regarding tangential lathe tools (**ref. 1**), I thought, what a good idea, how ingenious, I'll make a couple. I then thought, how do I hold the piece of steel to accurately cut the 12-degree angled slot for the piece of tool steel to sit in? I then remembered the vices which came as part of the deal when I bought my Naerok RDM 350 Milling machine about 25 years ago, and which had been tucked away under the bench and never used. I'll say more about the milling machine later. Along with lots of slot drills and end mills came three vices, two of which were the angle type, one large and one much smaller, both new. The larger one, made in Taiwan, or so it says on the casting, had more potential but the casting was poor, flash still remaining on the base, so I thought I would clean up the casting with the angle grinder, ready for use. It is said I easily get side tracked and this might be true, as whilst removing the flash with the grinder I had yet another bright idea. Why not 'true up' the base casting to the vice jaws, so that they are both at right angles, one to another? I thought once carried out, all I would have to do in future was to line up the base with the milling machine table using a try square instead of the usual dial indicator method, which whilst accurate, is time consuming and tedious (**photo 1**).

The Rotary Vice.

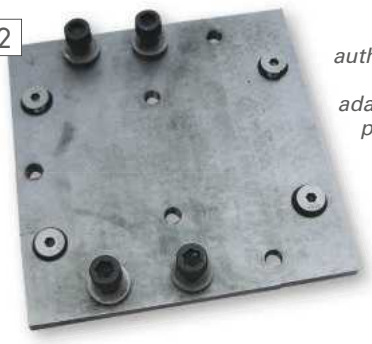
1



The original vice with the base trued up.

By this time, making the lathe tools had moved somewhere much further down the list of things to do. Having got the angle vice base sorted, I then found that the base's cast lugs didn't line up with milling machine table slots. To solve this problem I made an adapter plate (**photo 2**). Later, when I actually got round to making the lathe tools which were the original task, I thought how much easier it would be if I had a universal vice. Once before I had looked in tool/machinery dealers catalogues and did consider buying a universal vice. However, space is becoming a premium in my workshop, so I had the idea of making another adaptor plate, which would give me similar facilities to a universal vice, although less accurate. My idea was to make a rotary/disc type adaptor plate, so that I could mount my larger angle vice on to it, using the same fixing arrangement as used on the first one, and importantly it wouldn't take up much space.**Photograph 3** shows the end product. As the plate needed to be threaded and rigid to hold the vice secure, I used a piece of 6 x 300 x 300mm black steel plate. After first making sure that the plate was flat, or near enough, I used a large square to check that it had been cut square. Then, using a long straight piece of steel, I scribed marks diagonally corner to corner, to establish the centre point. Once that was

2



The author's first adaptor plate.

3

The rotary adaptor plate.

›

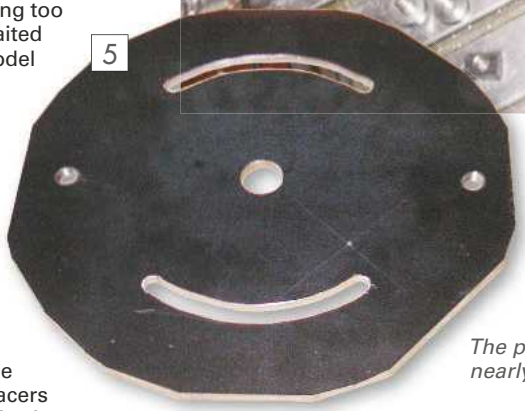
established, I used a sharp centre punch to mark the centre and with the aid of a pair of dividers scribed a circle 250mm in diameter.

Using the centre point once again, I marked out for two slots each 10mm wide, on opposite sides to one another. The dividers were set to 90, 95 and 100 mm and three lines were scribed out all to touch the diagonal lines, giving the 10 mm slot I wanted (**photo 4**). With the slots marked out, I made a chain of centre punch marks on the 95mm line, to enable me to chain drill along the curvature to form the slots. I chain drilled the holes overlapping one another in the usual manner, and then spent the next three hours with a file. I quite like filing, I feel that I am achieving some thing, it's almost like seeing plants grow before your very eyes. Having got the slot job completed, my attention turned to cutting the corners off the plate to form a rough circle (to ultimately form a disc). Initially I considered using the band saw, but dismissed this idea as being too risky, and dangerous. So, I waited for the next 'Tech College' model engineering night and, using their powered guillotine, I carefully cut the corners off the 6mm plate first 4,8,16,32 etc, until a very rough circle was formed (**photo 5**). For those without such facility as a power guillotine, they could use the slow but sure hacksaw or chain drill method, as I did when making the slots.

4

Another view highlighting the scribed marking out.

5



The plate very nearly clipped circular.

Back home once again in the workshop, and using four spacers below the plate I clamped it firmly to the milling machine table. Then using another of my home made gadgets, a centre locater, actually a hardened and ground piece of Silver steel with a fine point. I put the centre locator in a drill chuck in my milling machine and adjusted the table so as to locate the disc centre. Once the centre was located I locked up the table, exchanged the centre point for a 20mm slot drill and milled a hole in the centre of the plate. Fortunately, I had a short piece of 30mm across flats hexagon bar to hand, I put the bar in the three-jaw chuck and turned it down so that it made a very tight fit in the 20mm hole. I then Mig welded the adapter to the plate, in two places. Turning the piece at a very slow speed, a 250mm disc was quickly formed on the 6mm plate (**photo 6**). While the newly formed disc was still in the chuck, I turned away the weld, and released the stub from the disc.

For those readers with a larger lathe, it is possible to bolt the adapter disc onto their lathe faceplate, instead of using my welded hexagon bar method. To do this, spacers will be needed behind the disc, to ensure that the tool doesn't cut into the face plate. Back the home in the workshop again, the vice was carefully positioned on to the disc so that I could mark out vice fixing holes, vice to disc.

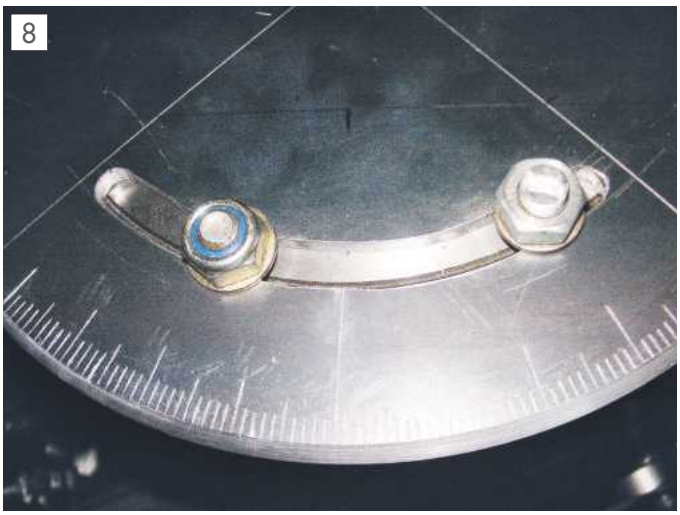
Once these positions were established I scribed around inside the lugs, centre punched the hole positions and drilled the 6 holes, tapping them with a 12mm thread, as I intended use the original 12mm cap head Allen screws from the first adapter plate. As 6mm plate is quite thin for 12mm threads, it is important that the threads are made square and true, so once the hole was drilled I put the taper tap in the mill and pulled it round by hand, until a thread was formed. I then continued using the tap wrench. It is slow work, but accurate and ensures that the threads are straight and true. To position and locate the disc on to the milling machine table I made a small two diameter-locating adapter (**photo 7**). The adapter is a tight fit in the 20mm hole, and is slightly shallower (by 0.1mm) than

6

Turning the edges of the plate.

7

The locating adaptor.



The graduations on the rotary plate.

The vice fitted to the rotary plate.

the 6mm disc. When it is positioned on the milling machine, ready for cutting, and the slot bolts are tightened up into the tee nut below, I can nip up the adapter bolt and that makes every thing even more secure when milling. The head of the adapter can be any size. Mine happened to be 30mm, as that was the length of a short piece of bar end that I had in the 'might come in handy box' at the time. Whilst the whole arrangement will never be as accurate as a proper universal vice, nevertheless it has already proved to be useful and, most important, easy to store.

Later, when having a second look at the disc, it occurred to me that by mounting the disc in my rotary table/dividing head, I could use a sharp lathe tool to scribe degree marks around the perimeter, as shown in **photo 8**. This would enable greater accuracy to be obtained when setting up milling jobs in the future. Having got that off my list of things to do (**photo 9**) I got around to making yet two more. ■

Footnote: For those readers with a Naerok RDM 350 milling machine, George Turner wrote a series of very good articles in *Model Engineer* in 1989 on modifications he made to his machine (**ref. 2**). I recommend George's ideas to any other Naerok 350 owners. Over the years I have fitted: a home made power cross feed with forward and reverse, fast traverse, and speed control; a flywheel below the quill pulley trying to get an even smoother finish on my work; a pre owned inverter; three phase motor and a digital readout. The good thing about this particular machine is you don't lose your register when the column is moved up and down, unlike many other bench top milling machines on the market. The head and column move up and down as one, the column passing through a hole in the bench.

REFERENCES

1. Michael Cox, A quick and easy tangential tool holder, Model Engineers' Workshop, Issue 179, P44
2. G.F.A.M. Turner, A Man & His Mill, *Model Engineer*, Issues 3841, 3843, 3845, 3847.

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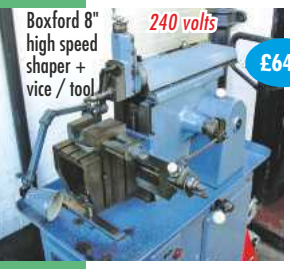

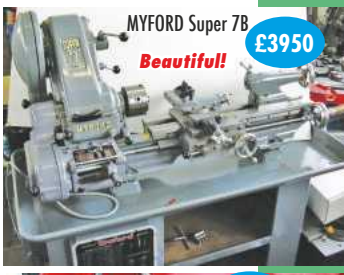

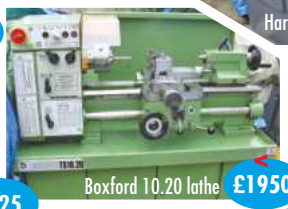

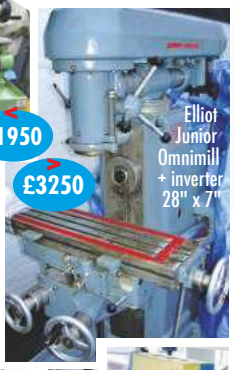

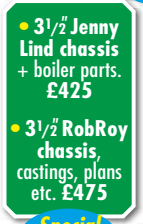

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