No.260

LATHEWORK FOR BEGINNERS – MAJOR NEW SERIES

MODEL ENGINEERS' WORKSHOP

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OCTOBER 2017

INSIDE

- Unimat Topslide
- Build a Lantern Chuck
- Myford Mod
- Cutting Splines
- Making a Dividing Headstock

COVER STORY

The Editor's New Lathe

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On the Editor's Bench

For as long as I have been Editor of MEW, I have received regular requests for more content for absolute beginners. Thanks to a sponsorship deal with Arc Euro Trade, in this issue we are able to commence a regular feature aimed at helping those with no practical experience to safely and successfully get the most out of their workshop. In this and alternate issues, I will be giving a detailed introduction to lathework. The issues in between will carry a parallel series by Jason Ballamy on using a milling machine. Jason is known for his big prize-winning models of stationary engines, which he produces at an exceptional rate!

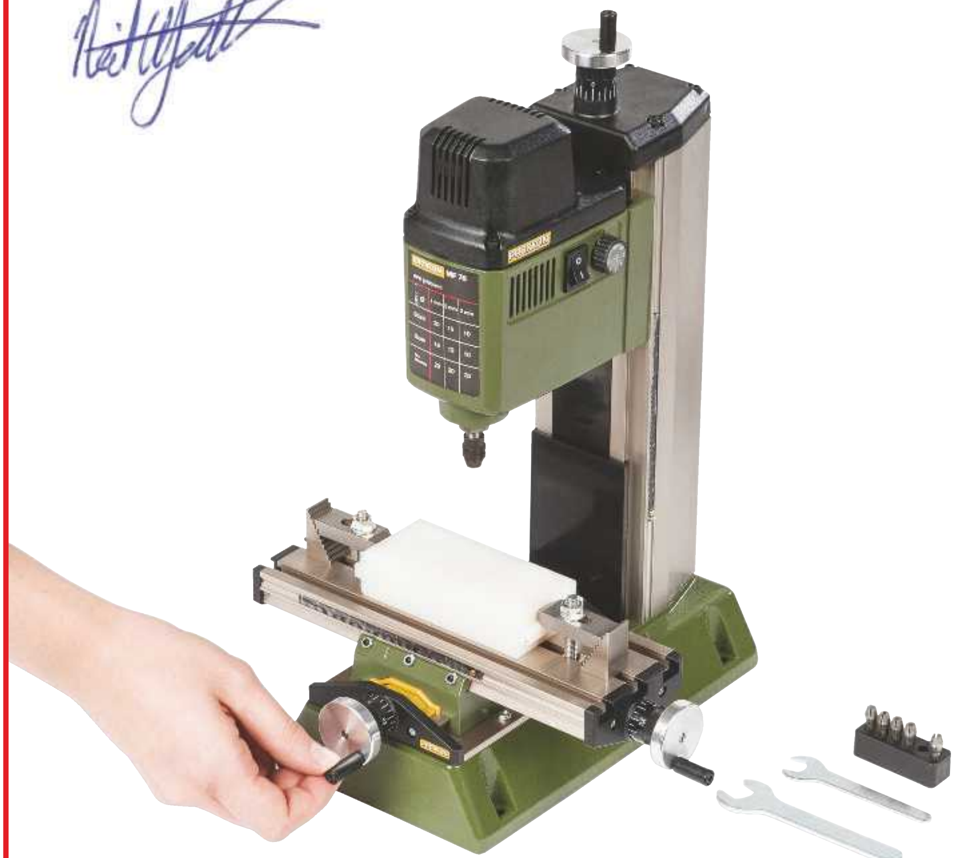
There will be dedicated threads for the two series on the forum at **www.model-engineer.co.uk** where you will be welcome to ask further questions or even suggest topics or techniques you would like us to explore as the two series develop.

Jason and I both plan to include 'tips and wrinkles' that will be of interest to more experienced hobbyists as well, so we hope that this new initiative is something that all readers will enjoy.

Competition Winner

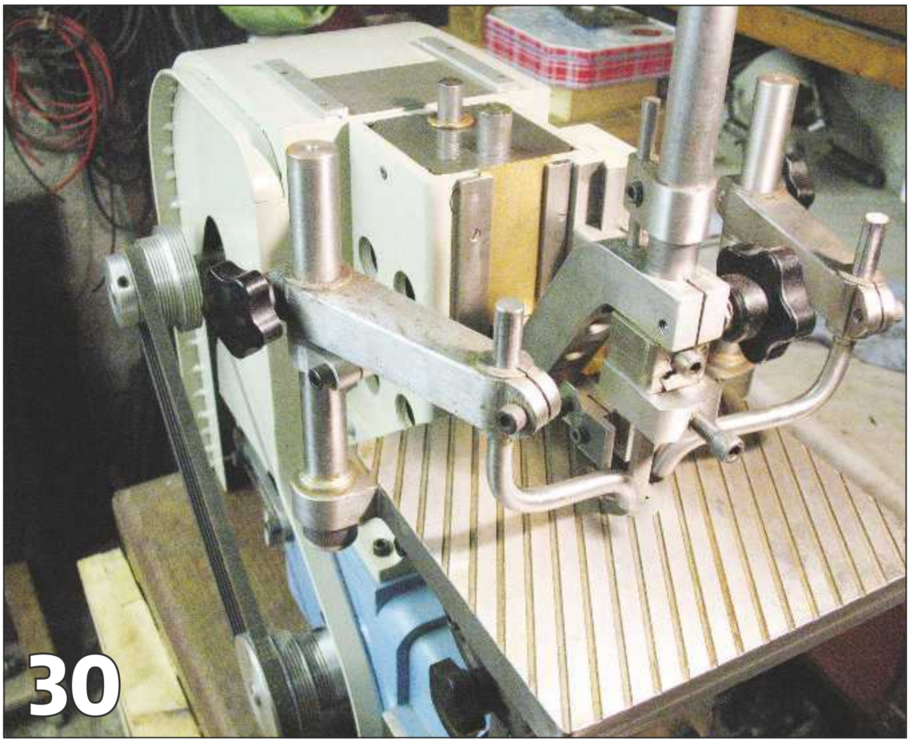
I'm please to announce the winner of our recent competition with Brimarc Tools & Machinery as David Horton of Lancashire. Congratulations to David, who wins a lovely Proxxon MF70 milling machine and a healthy set of accessories, we hope he enjoys his prize!

My commiserations if you entered the competition and were unlucky, but you can always visit www.brimarc.com to see the MF70 and other Proxxon tools and accessories.



BriMarc TOOLS & MACHINERY

Contents

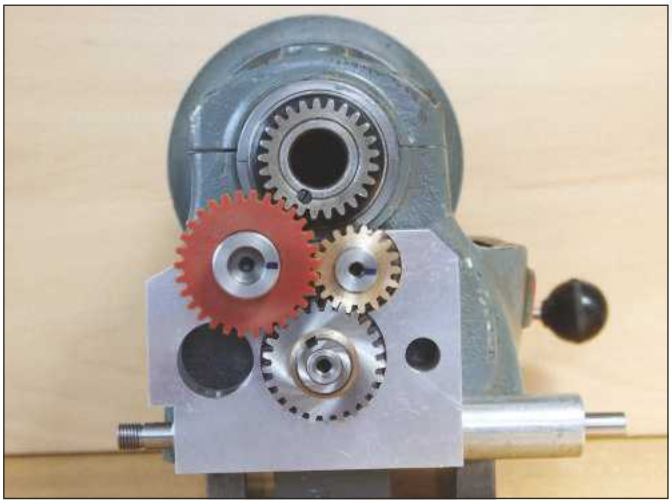


See page 32 for details.

Coming up...

in our next issue

Coming up in our next issue, MEW 261 another rewarding read.



A Screwcutting Clutch for the ML7 – **Graham Meek** refines his Myford Super 7 screwcutting clutch design to suit the ML7.

Regulars

ON THE COVER »»

This month's cover is graced by our Editor, Neil Wyatt in his workshop alongside his new Arc Euro Trade SC4-510 lathe, featured in the new Lathework for Beginners series on page 40.

HOME FEATURES WORKSHOP EVENTS FORUMS ALBUMS

Visit our Website

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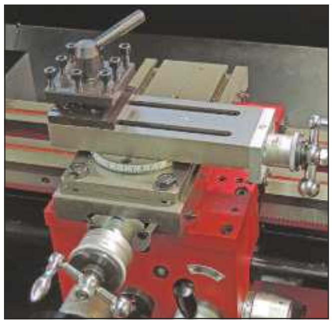
Why not follow us on Twitter: twitter.com/ModelEngineers hashtag #MEW

THIS MONTH'S BONUS CONTENT

You can also visit our website for extra content and join in our online forum

Any questions?
If you are a beginner and you have any questions about this month's Lathework for Beginners article, or you would like to suggest ideas or topics for future instalments, head over to www.model-engineer.co.uk where there will be a new Forum Topic especially to support the series.



But in any case, why not come and join one of the busiest and friendliest model engineering forums on the web at www.model-engineer.co.uk?

Drill Flute Orientation

■ Another new debate! Which is best in the lathe, horizontal, vertical or it doesn't matter one jot?

Potty Engineering Clamping Drill

■ What do you get if you cross an air-powered drill with a big toolmaker's clamp? Stew Hart's great idea is simple enough to build just from his photos of the finished article.

Bakers Fluid No.3

■ Yes, you can still, get it – but if you have it, do you still want to use it? And how best to store it?

PLUS: Model and tool builds, problem solving and engineering chat!

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

Which way is up?

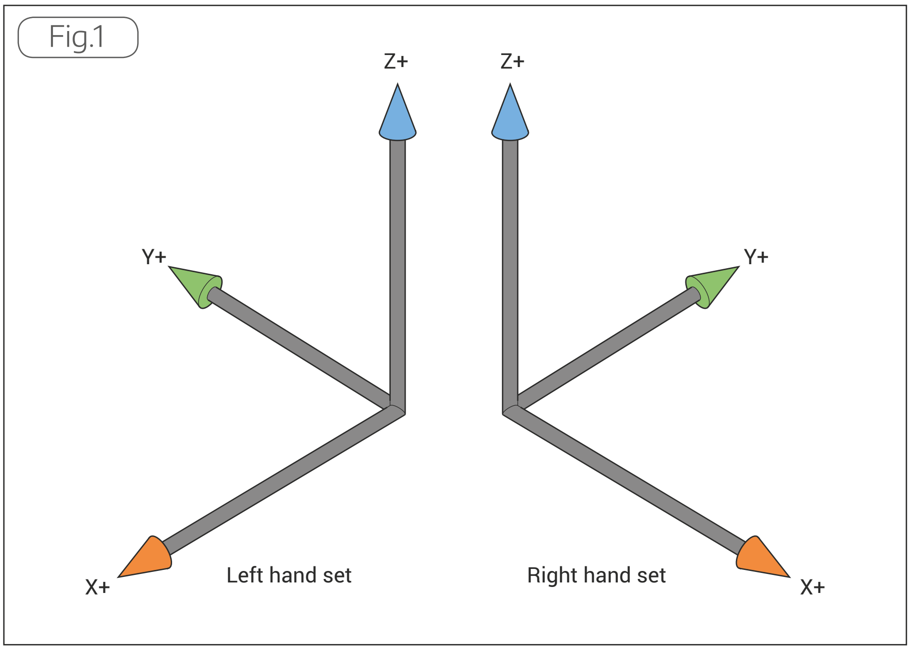
Bob Reeve looks at the CNC equivalent to shoes with ‘left’ and ‘right’ on them.

The control box on my Thiel Duplex 158 mill, **photo 2**, had been niggling me for several decades. It was grubby, not original, not in keeping with the machine and not as informative as it could have been. I could never be sure of which way it was going to go when I engaged the auto-feed.

I suspect that somewhere in it’s industrial past, the rotary switch for reversing the auto feed had broken and, in the absence of a replacement part from the makers, a substitute from RS Components had been used. This was larger than the original, so the enclosure was also replaced with a diecast box which was slightly too large. This interfered with the machine’s knee when set at its maximum height. This in turn resulted in a slight crease down the left side of the box.

All this was tolerable since it worked. There was however a slightly more serious deficiency in that the spindle ‘Start’ and ‘Stop’ buttons were original and designed well before the Safety Elf got loose. The modern equivalents have larger buttons with the ‘Stop’ button proud of the ‘On’ button. Then, in an emergency, a flailing hand stops the machine every time, as it should. With a 2.2hp main drive motor, it seemed to me that I should have improved this long ago, so a replacement was overdue.

A solution



The informative part of the control box is more difficult to explain. The modified control box faithfully reproduced the functions of a Thiel illustrated in the instruction manual from Tony Griffiths, ref. 1). I only became aware of an anomaly when I converted my X3 to CNC. There is a convention with CNC that the positive direction of the X-axis is left to right, the Y-axis is front to back and the Z-axis is down to up. For those interested, this is explained in text books on the subject such as Marcus Bowmen’s very readable book, ref. 2).

What may not be so obvious is that there are two possible sets of axis, normally referred to as right and left handed sets, **fig. 1**. One is the mirror image of the other and no amount of juggling will allow one set to be exactly superimposed on the other. For those that need to convince themselves of this, the usual recommendation is to write X, Y & Z on the ends of thumb and first two fingers respectively of both hands.

Having done this, it is instructive to see what changes need to be made to one of the sets before the two sets will superimpose. Exchanging any two axes in the set or reversing just one axis in the set will do the trick. For the adventurous, reversing one axis, preferably X, in Mach 3 should theoretically enable a component which is the mirror image of the intended component to be machined. Don’t forget to change the configuration back and wash the letters off your fingers!

So what has this got to do with the control box on the Thiel? Well, unlike Bridgeport style milling machines which can have up to three feed motors, there is only one auto feed motor. That drives all of the axes. So reversing the motor reverses all the feeds. Any or all of the axes can be set to auto-feed with a control similar to that in **photo 3** which is for the Y axis. The black knob engages and disengages the feed clutch. The adjustable stop, top right, automatically disengages the feed when it reaches the trigger plunger just left of the stop.

Suppose there was a drill in the vertical

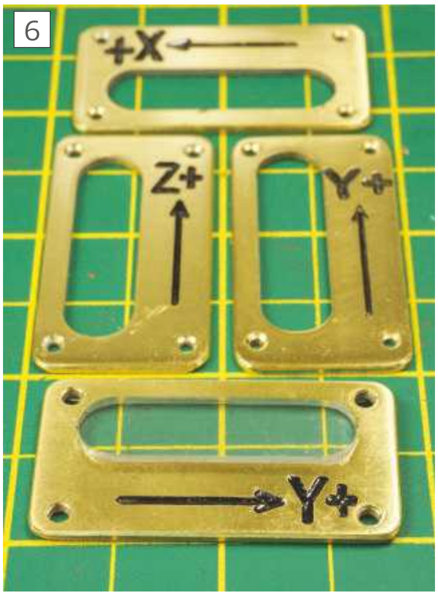
Old Box

Y-feed

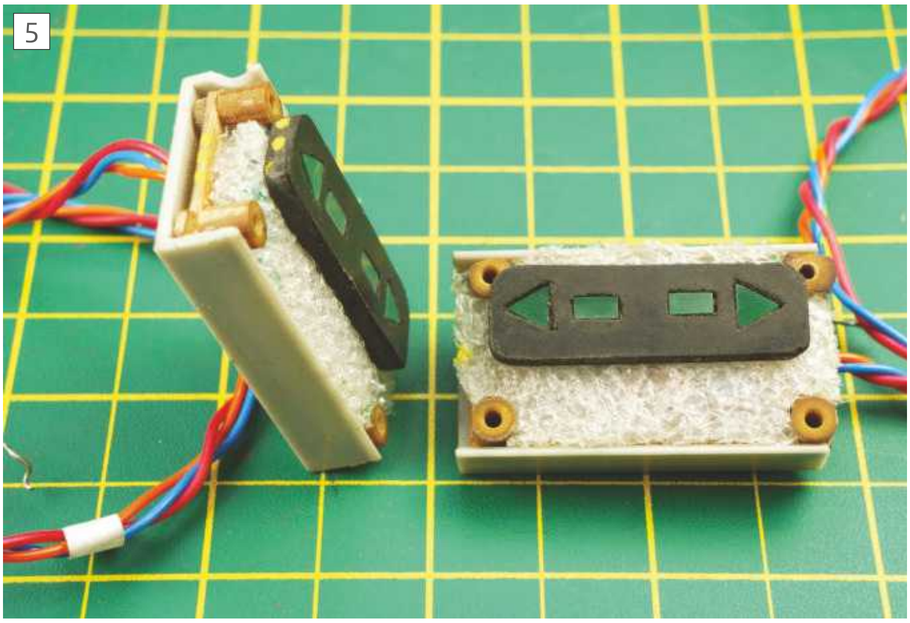
X3 Mill

spindle and a component on the table that was to be drilled using the auto feed on the Z axis. The table would need to move up, but the feed direction is labelled 1 or 2 with a centre off. Hence the question of the title –'Which way is up?'

To complicated matters further, doing the same thing on the X3, **photo 4**, would require the head to move down. The notation used for CNC, explained in detail in Marcus's book, is that of the controlled point, usually the tool tip, moving relative to the workpiece. So for drilling a hole the controlled point needs to move in the negative Z direction. That will apply equally to both the Theil and the X3. To avoid



Display Bezels



Display modules

confusion the new control box would need to indicate movements of the controlled point.

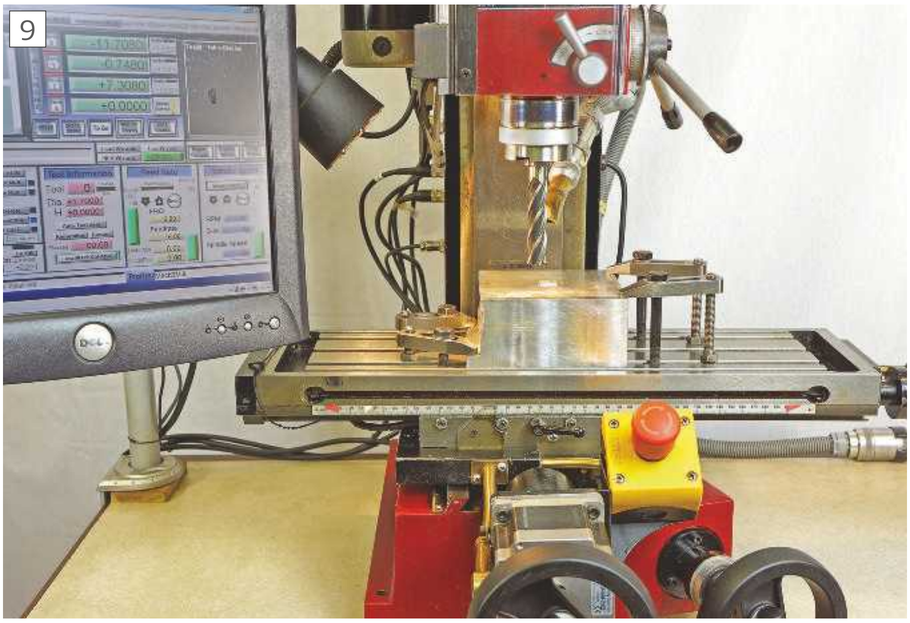
I wanted an indication on the Theil control box of what was going to happen if I engaged say the auto feed on the Y axis with the switch in the 2 position. Predicting which way any axis was going to move would have been made easier had all the axis moved in the same direction(+ve or -ve, for any given position on the switch. Alas, this was not the case, and table 1

Table 1

SWITCH POSITION	X-AXIS	Y-AXIS	Z-AXIS
1	+	-	-
2	-	+	+


Wooden Box


Wiring


Block on X3

This left only the replacement for the diecast box. The space available was really tight and after some fruitless searching I decided to machine one from the solid. I realised that this approach would create a lot of swarf. It seemed fitting that the raw material was aluminium left over after some large, 100mm diameter, Boeing fuel pipes had been machined from the billet. They also created a lot of swarf during the machining.

The first task was to design and build the display module, both to ensure they would work and to see how much of the very limited space they would take up inside the control box. I opted for three modules, one for each axis, with LED indicators showing the movement of the controlled point. The final design consisted of a PCB with the LED and current limiting resistors protected at the back by a PVC U-shaped extrusion. There was a black rubber mask surrounding the LED to provide optical isolation and a closed cell foam gasket between the PCB and the mask to push the mask onto the back of the acrylic window. The result can be seen in **photo 5**.

Each module needed to be protected from the hurly-burly of normal milling machine operations. This was achieved with a transparent acrylic cover machined to fit a polished and lacquered brass bezel which would be engraved with the axis identity and an arrow indicating the positive direction, **photo 6**. Note that only indicates what actually happened to the feed directions.

The X-axis is always the odd man out, but worse than that; the auto feed has the attributes of a left-hand set of axes. No wonder I could never work out which way it was going to go!

The required specification for the new control box was now:

1. Must indicate the direction of controlled point movements with auto feed active.
2. Must incorporate large modern pushbuttons with Stop button protruding.
3. Must be sufficiently smaller to avoid Z-axis collisions
4. Must fit in the original position
5. Should have a look and feel consistent with the rest of the machine.

The key to meeting these requirements was finding a 440V auto-feed motor reversing switch which was small enough to fit the space available and have additional contacts for direction indication. RS Components, ref. 3, provided a solution in the form of a 4-pole reversing switch with centre off which was about half the diameter of the one it replaced.

At this point I should point out that three-phase voltages are lethal. Take advice from or use the services of a professional if in doubt.

The modern 2-piece push-buttons from the same source were robust and incorporated the switch block in the mounting, so the button colours and labels could be changed if necessary.

The direction indicators supplied by Maplin Electronics, ref. 4, were shaped LED intended for just such a purpose. But these would need a separate low-voltage DC supply.


Box & lid insides

the nearest bezel is fitted with a, nearly invisible, acrylic window and at this stage there are two Y-axis bezels because I had yet to decide which orientation of the text I would use.

There was then a requirement to recess the box slightly to keep the assembly within the space envelope. This had to wait until the box profile had been machined.

The box and lid were to be in aluminium, but I first machined them in wood. Not that I would recommend this material for an electrical enclosure but it did allow the CNC programmes to be proved at low risk. I chose some well seasoned oak around 200 years old, and was rewarded with a final result that had some very nice end grain showing, **photo 7**.

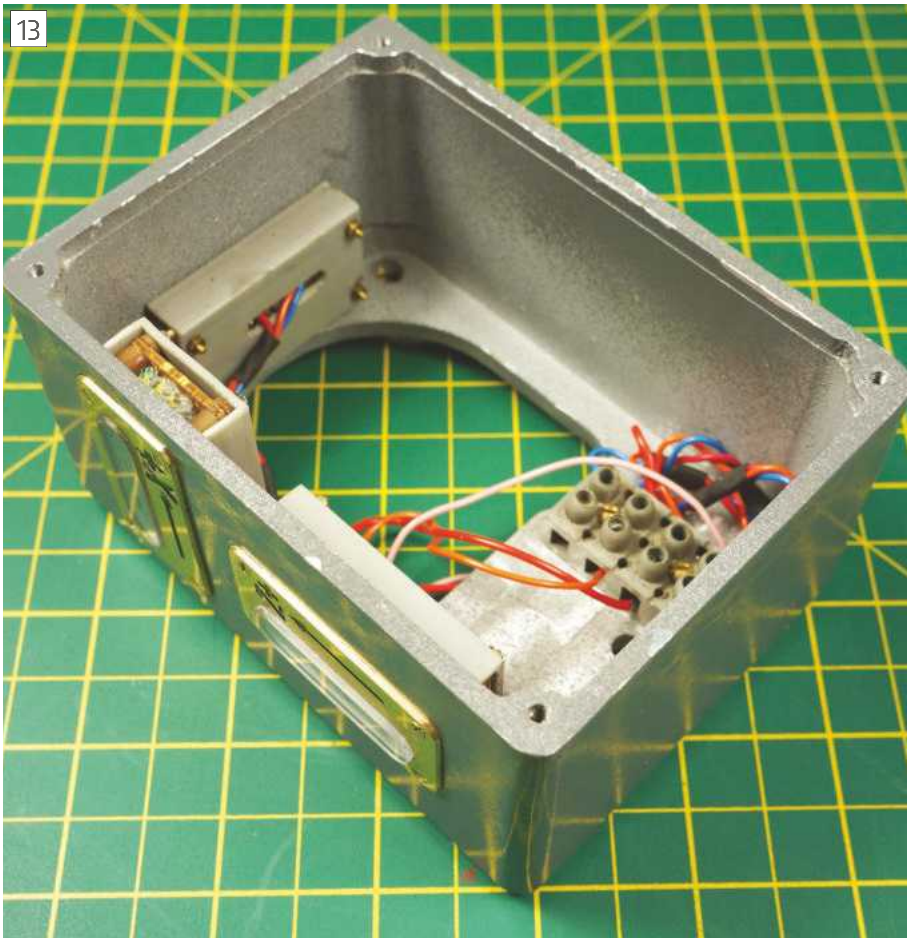
It was as well that I did, because there were three iterations before I was able to squeeze all of the components and wiring inside within the constraints of the space-envelope available. There was also the problem that the wiring was not long enough to allow the new control buttons to be installed easily. I considered crimping extensions onto the affected wires, but in the end, I replaced each wire with a longer one using the original wire to pull the new one through the machine to its point of termination.

The new rotary switch and the control buttons can be seen connected in amongst the original rats-nest wiring in **photo 8**. Although the box is not shown, it can be assembled to the wiring in this state by just un-clipping the heads of the push button switches and removing the trial lid. A large aperture in the back of the box allows the wired-up switch to pass through.

Milling a box of this size from the solid on a small mill is not for the faint-hearted. **photo 9** shows an expensive piece of metal fixed to the table which will need a pocket 62mm deep. Long series cutters are needed and vacuum extraction, shown behind and right of the cutter, helps stop the cutter machining its own chips. The

Finished box & lid

Assembled



Fitting displays

Lid fittings

initial machining was with the cutter shown but the internal profile was finished with an extra-long 10mm dia. cutter so as not to leave too large a radius in the corners.

As might have been expected, vibration was a problem, not only from the cutter but also the workpiece. The final operation is the external profile, at which point the box produced a good impersonation of a continually ringing bell.

The results can be seen in **photo 10**. Note the internal ribs in each corner for the lid fixing screws and the large cut-out in the back to allow the rotary switch to enter fully wired.

The three widows and associated fixing holes were all milled with a 3mm dia. cutter and the same programme, the box being re-positioned each time to achieve the correct location, **photo 11**. The drilled

15

DC supply

16

Electrical bay

17

DC supply fitted

18

X & Z displays

fixing holes are 10BA clearance and I was expecting a broken drill or two. However the X3 did as it was told and there were no such problems.

The engraving was completed next. I opted for relatively deep engraving which could be paint filled for legibility and durability suitable for a machine tool. As is my usual practice for engraving, I used a Hemmingway speed increaser on the X3 giving a speed of 6000-7000 rpm.

The finished box and lid are shown assembled in **photo 12**.

Assembly of the electronic components into the box was carried out before fitting the box to the machine, **photo 13**.

Similarly, the lid was fitted with the push button heads and the LED power indicator before assembly to the machine, **photo 14**.

The power supply for the LED modules is a self-contained commercial 12VDC unit, **photo 15**, which needed a home somewhere in the machine. There was no room in the control box and the main electrical bay, **photo 16**, was pretty full with contactors and fuses etc.

There was a relatively clear space above the electrical bay so a sheet metal holder was constructed for the power supply which was then fitted to the machine,

Knee clearance

Driver's View

photo 17.

All that remained was to fit the box to the machine, complete the remaining connections and screw the lid in place. Then it was time for a test. **photo 18** shows the box doing what it was intended to. Note that it shows that engaging auto feed will result in a positive X movement &/or a negative Z movement.

Part of the original specification was to ensure that the knee, in the fully raised position, did not contact the control box. As **photo 19** shows, the knee control lever to the left of the control box just misses – by about 1mm.

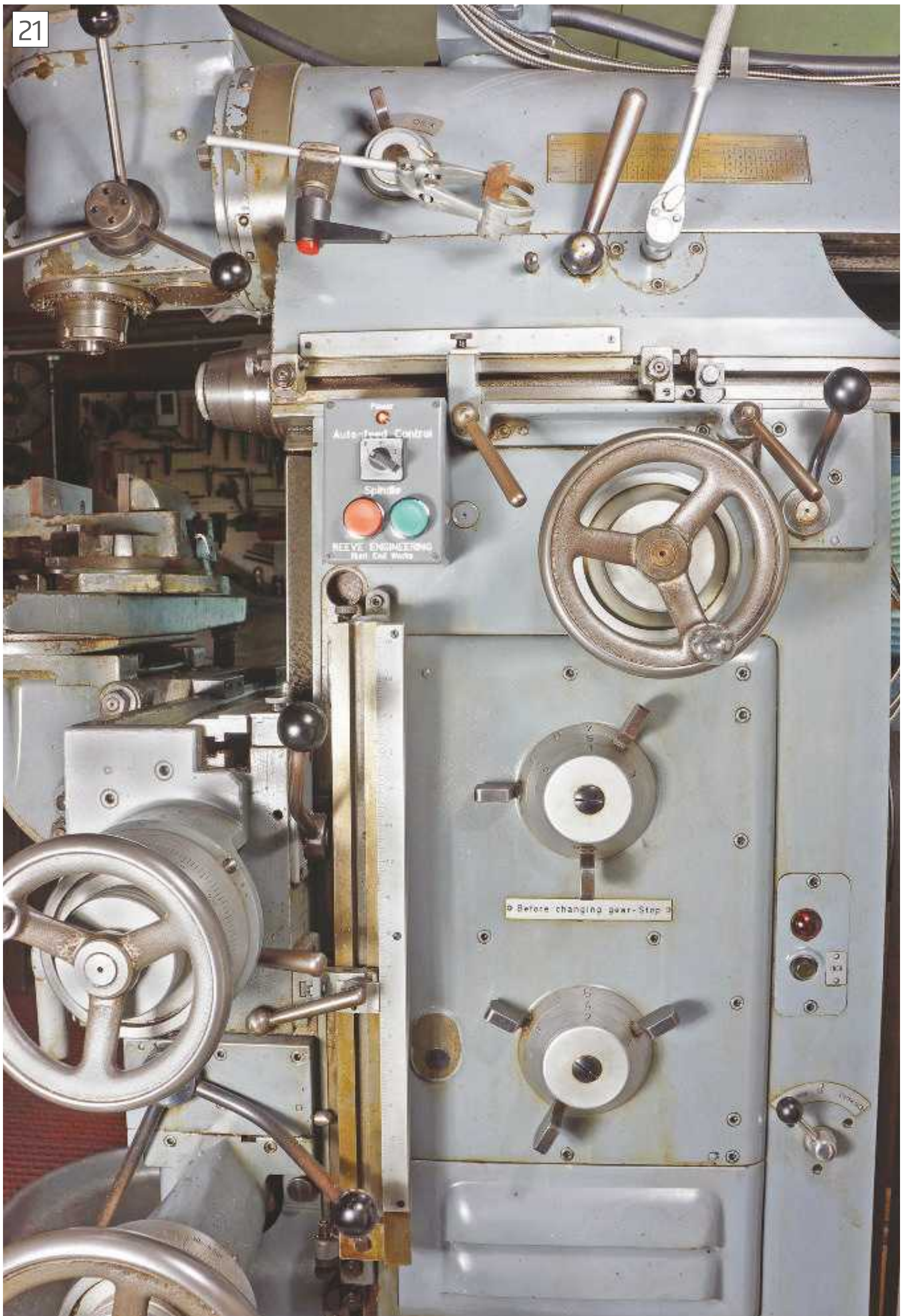
The Theil was configured for an operator standing at the right-hand side of the table. This is why the original control box was originally positioned as indicated in photo 8. Therefore the new control box should function at least as well in that position. The drivers view is shown in **photo 20**.

My specification also included a requirement that the new control box retained the look and feel of the original machine. **Photograph 21** shows the right-hand side of the machine with the new box fitted. Readers can decide for themselves the extent to which it fits the original look and feel.

Finally, in answer to the original question, with power on, feed direction set to position 1, Z auto feed clutch engaged, up goes the table with the LED indicating negative Z. ■

References

1 Tony Griffiths, www.lathes.co.uk
2 Marcus Bowman, CNC Milling in the Workshop, Crowood Press 2013, ISBN 978 1 84797 5126
3 RS Components, stock Numbers 236394, 3308975, 3310158, 3308767
4 Maplin Electronics, www.maplin.co.uk



Side view

Readers' Tips

CHESTER MACHINE TOOLS

Bottle feeding a Tiger Cub

TIP OF THE MONTH WINNER!

Chris Smith wins this month's Chester Vouchers with a tip for getting oil into small apertures or awkward places where a funnel won't fit easily, suited to various machine tools as well as motorbikes.

I regularly have to top up oil on two small British classic motorcycles and need different grades of oil for each application. The Tiger cub needs grade 20 in the Primary chain case and grade 30 in the gearbox, both of which are awkward to pour the oil into. My Velocette LE uses 20/50 grade in the engine and grade 50 in the gearbox. Both are reasonably accessible with a funnel, but often messy.

Looking through a local pound shop I spotted a simple and cheap solution, a twin pack of baby feeding bottles with silicone teats. Both bottles had graduations on the side to help with dispensing measured amounts (CC's) where needed and the tops were different colours which visually helped to identify which bottle contained which oil. Labels to identify the liquid in them can be stuck on (cover with clear sticky tape to stop the oil etc messing up the writing/ printing and change as required when damaged).

As many of you will know, the teats on baby bottles are pierced with very small holes so these need opening out a little as needed. This is easily done with small nail scissors etc, just snip the top very slightly.

The bottles have a slight "Flex" in them to allow the user to squeeze lightly to express fluid a little bit in order to speed up filling.

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 I'll chose a selection for publication and the one chosen as Tip of the Month will win £30 in gift vouchers from Chester Machine Tools. Visit **www.chesterhobbystore.com** to plan how to spend yours!

Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

Cutting Internal and External Splines

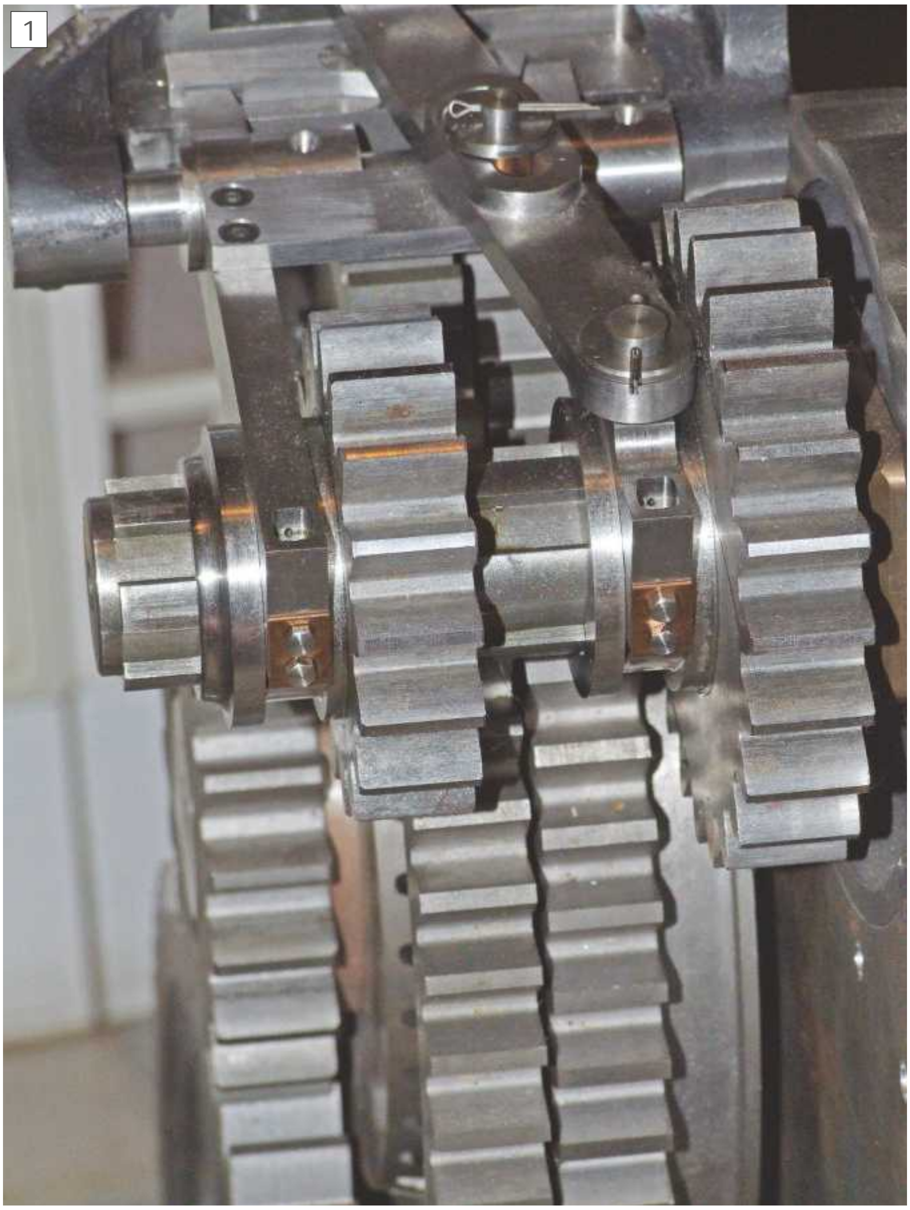
Andrew Johnston returns with another tale from the building of his large-scale traction engine.

The crankshafts on the 4" scale Burrell single crank compound traction engines I am building have a 6 tooth straight sided spline that drives two pinion gears, giving two speeds. The arrangement of the crankshaft, with splines, two pinion gears and the gear change mechanism is shown in **photo 1**. The outside diameter of the splines is 1.3125", the inner diameter is 1.125" and they are 4.5" long.

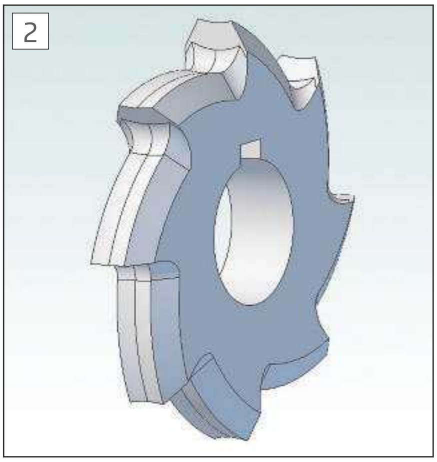
In industry splines, especially internal, are often cut by broaching. External splines can be cut with a cutter similar to those used for involute gears. The cutter removes the space between the teeth, one space at a time, and is indexed round the appropriate number of spaces, also forming the same number of splines.

Within model engineering there are two common techniques for making external splines. One is to cut blind slots and then fit keys with rounded ends to produce the splines. Alternatively, an endmill offset from centre is used to create the flat sides of the splines. The waste material between the splines is then removed with a series of small cuts.

I wasn't happy with the built-up approach as it would leave rounded ends



Gear Change Mechanism



3D CAD Model of Spline Cutter

to the splines and it would be obvious that the splines were not prototypical. Using multiple cuts would create the correct shape of spline but would require some considerable hand work with files to smooth the area between the splines.

There are a wide range of diameters and number of splines that are possible, so it is not surprising that a commercial cutter was not available for the combination of diameter and number of splines that I needed. Most of the commercial cutters were for larger diameter splines. Thoughts then turned to making my own form relieved spline cutter. If I could draw it I could make it.

Making the Spline Cutter

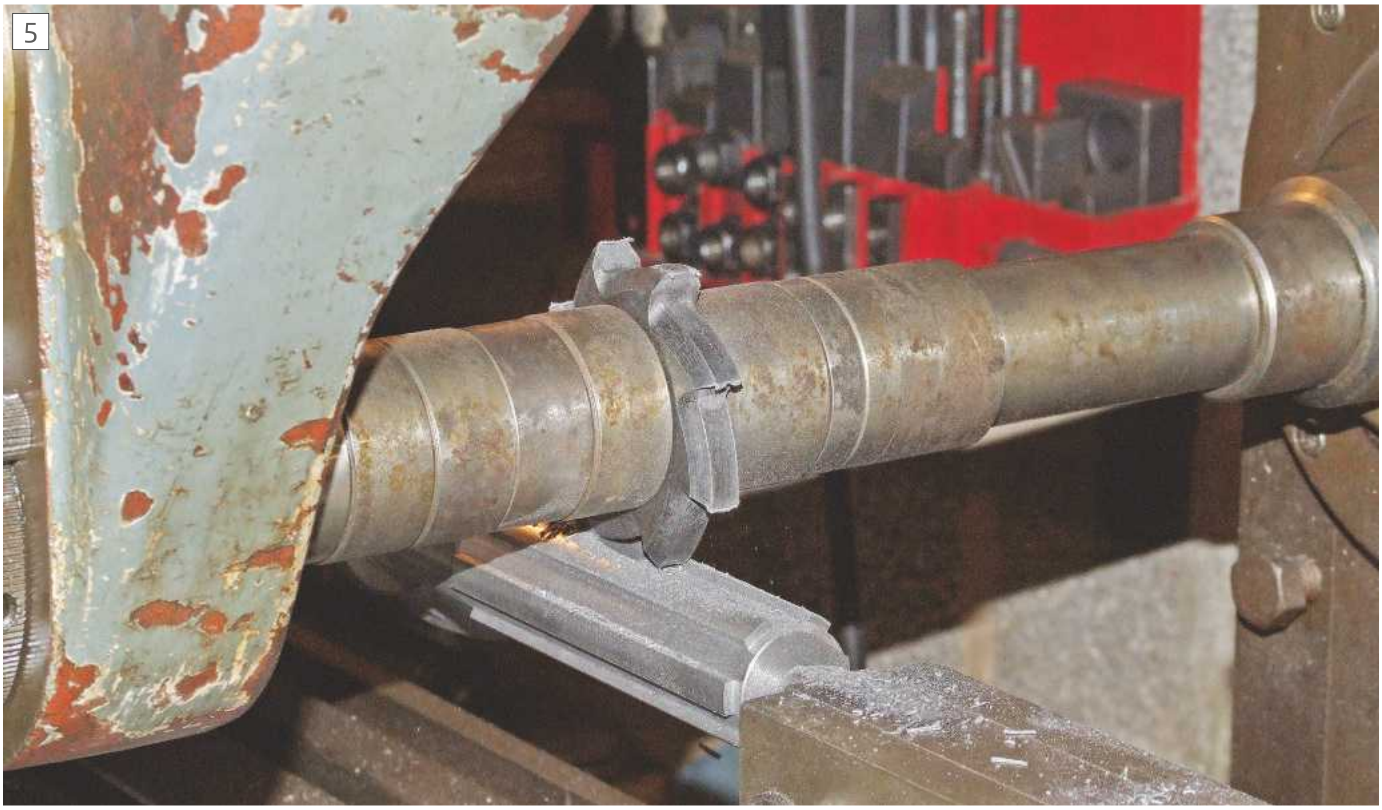
Drawing the profile of the face of the cutter was straightforward. To form a tooth and get the form relief the sketch was extruded around an axis displaced forwards from the axis of rotation of the cutter. The tooth was then patterned 8 times and fillets added at the bottom of each tooth to remove sharp corners that could not be milled, and could

3

Spline Cutter – Finishing Cut

4

Finished Spline Cutter



5

Cutting the External Splines

make the cutter prone to cracking during hardening. The 3D CAD model of the cutter is shown in **photo 2**.

The easiest way for me to machine the cutter was on the 4th axis of my CNC mill. All the milling used a 6mm 3 flute centre cutting carbide ballnose cutter and consisted of two roughing passes and a finish pass. The roughing passes were parallel to the axis of rotation. The first roughing cut went around several times stepping across 1mm each step and down 2mm for each rotation. This removed the bulk of the material. The second roughing cut did one rotation with the same 1mm stepover but covering the full profile

The finishing cut also followed the profile but going around the cutter stepping over along the axis. The step over was chosen to be 0.4mm. On a flat surface this gave a peak to peak value of 0.03mm, which was felt to be an acceptable compromise between surface finish and machining time. Total cutting time was 4 hours. The cutter was made from ½" gauge plate. A view of the finishing cut is shown in **photo 3**. The finished cutter, before the keyway was cut, is shown in photo 4. Although marks from the final profiling are visible, they are very small. A few strokes of draw filing ensured that they were not discernible to the touch.

After machining, and cutting a keyway, the cutter was hardened by soaking for an hour at 820°C and then quenching in brine. I have found that parts have to be agitated vigorously during quenching to get an Rc value of hardness in the mid 60s. After hardening the cutter was tempered at 200°C resulting in a final hardness of around 60Rc.

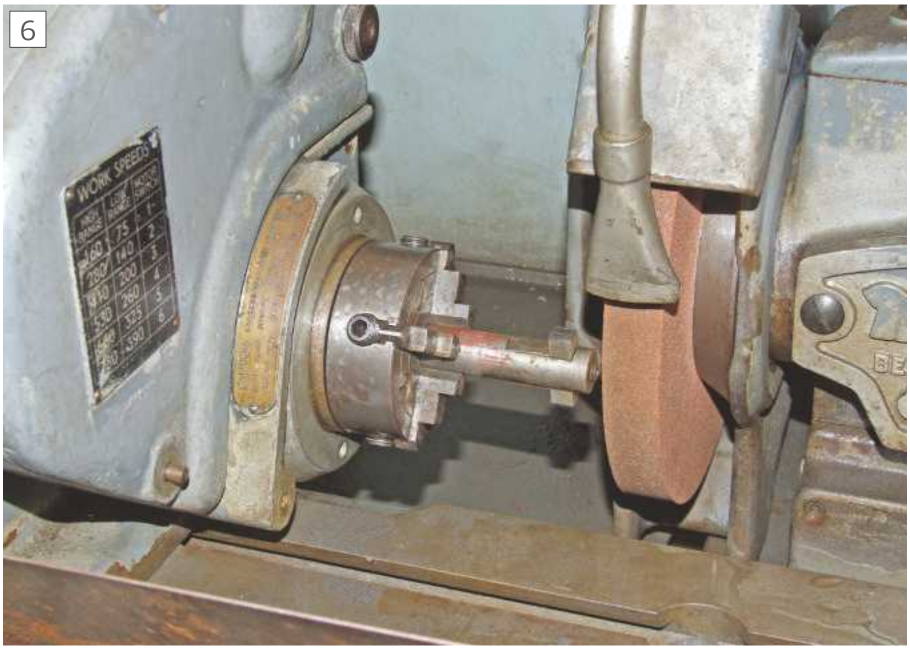
Cutting the External Splines

Before cutting the splines on the crankshafts I cut a test spline on a length of scrap steel, and an internal spline on a scrap pinion gear, where I had cut the slot for the gear change lever in the wrong place. Generally, the test spline was fine, but highlighted the importance of getting the cutter exactly centred over the shaft before cutting the external spline.

For the crankshafts, the cutter was approximately centred by touching off a piece of gauge plate against the side of the cutter and also against the crankshaft. The mill table was then moved the width of the gauge plate plus half the width of the cutter › and crankshaft combined. Final adjustment was done by lowering the cutter until it almost touched the crankshaft. Looking at the cutter with a strong light behind it there was a small crescent of light, as the radius of the cutter is slightly smaller than the outside of the crankshaft. The cutter was moved very slightly horizontally and vertically until the light just disappeared at each side of the cutter. This ensured that the cutter is symmetric, ie, centred, with the crankshaft. The depth of cut required was measured from the crankshaft model in the CAD system rather than calculated.

Once centred, and the depth set, cutting the splines was simply a case of running the cutter along the length of the shaft and indexing as required. In reality, I set the depth of cut a few thou less than measured and cut a couple of spaces after which the width of the resulting spline was checked, and the depth of cut adjusted as needed. A view of the cutting process is shown in **photo 5**. Since the crankshaft is SG iron the cutting was done dry.

After cutting the splines I found a variation along the width of each spline of about 2 thou, larger at the inner end. I put this down to not ensuring that the crankshaft was perfectly parallel to the mill table, and not supporting the crankshaft underneath the end of the cut, where it might deflect.



Grinding the Internal Spline Cutter

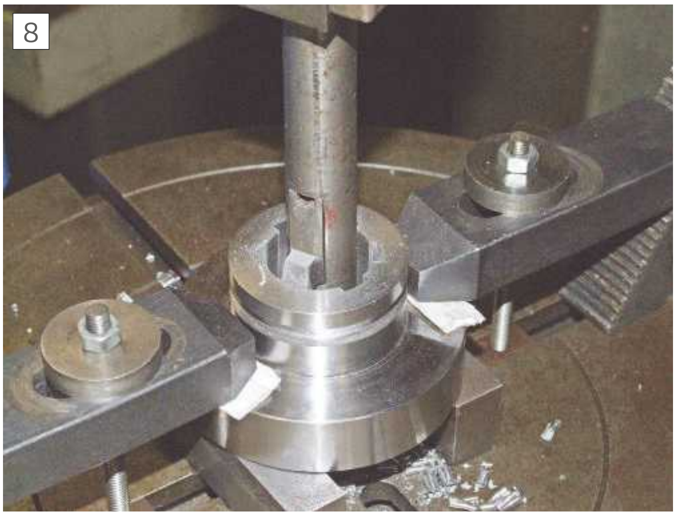
Finished Internal Spline Cutter

Cutting the Internal Splines

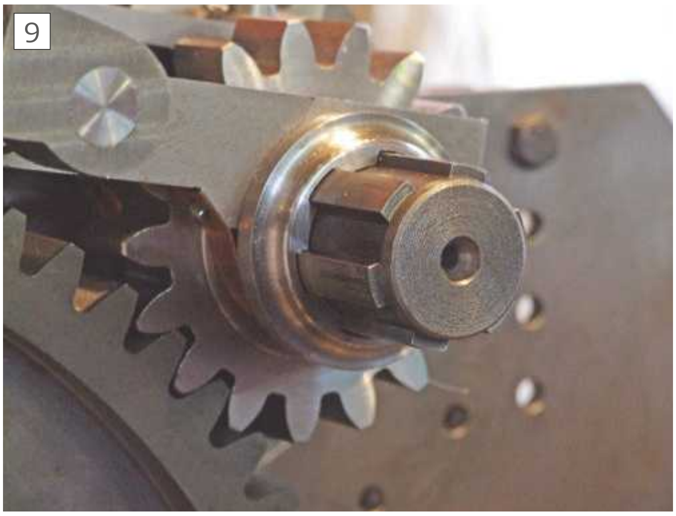
Cutting the internal splines is, in theory, simple using a slotting head and a rotary table on the vertical mill. How to get the required radius on the end of the cutter was more puzzling. The radius has no practical effect, as the splines drive on the vertical sides. However, I wanted the finished splines to look neat and therefore it was important that the radius closely matched that on the splines. It would have been possible to freehand grind the radius using a template. But since I am fortunate to have a cylindrical grinder I used that.

A length of HSS tooling was put in the holder used by the slotting head and ground until the diameter equalled that of the outside of the crankshaft, as measured with a micrometer, **photo 6**. Top rake was then ground by hand and the sides and front relieved by hand grinding until only a small witness mark was left along the front. This was finally removed with a diamond hone. The cutter was honed to be a couple of thou smaller than the nominal width of the splines. Finally, the toolbit was broken in half so that it would fit into the bore of the gears, **photo 7**. Cutting the internal splines is shown in **photo 8**. This is actually the scrap gear I used for the test splines. My rotary table has a central 1" parallel hole rather than the more common Morse taper. So centring the gear on the rotary table is simply a matter of turning a spigot with a 1" diameter length and a concentric length that suits the internal diameter of the gear.

Some work with needle files on the internal splines allowed them to move along the external splines with little or no shake. Since each gear only moves over about half the overall length of the spline each gear was tuned for the part of the crankshaft it used. This ameliorated the slight change in width along the length of the external splines. The end of the crankshaft and one of the gears, after final fitting, is shown in photo 9. I am pleased with the final appearance, and the splines look prototypical. ■



Cutting the Internal Splines



Finished Splines

On the Wire NEWS from the World of Hobby Engineering

London Model Engineering Exhibition 2018

I have had advance notice of the next **London Model Engineering Exhibition**. It returns in January from the 19th – 21st. The exhibition is regarded as one of the leading model shows in the UK and attracts over 14,000 visitors annually.

Come along and see the full spectrum of modelling from traditional model engineering, steam locomotives and traction engines through to the more modern gadget and boys' toys including trucks, boats, aeroplanes, helicopters and robots.

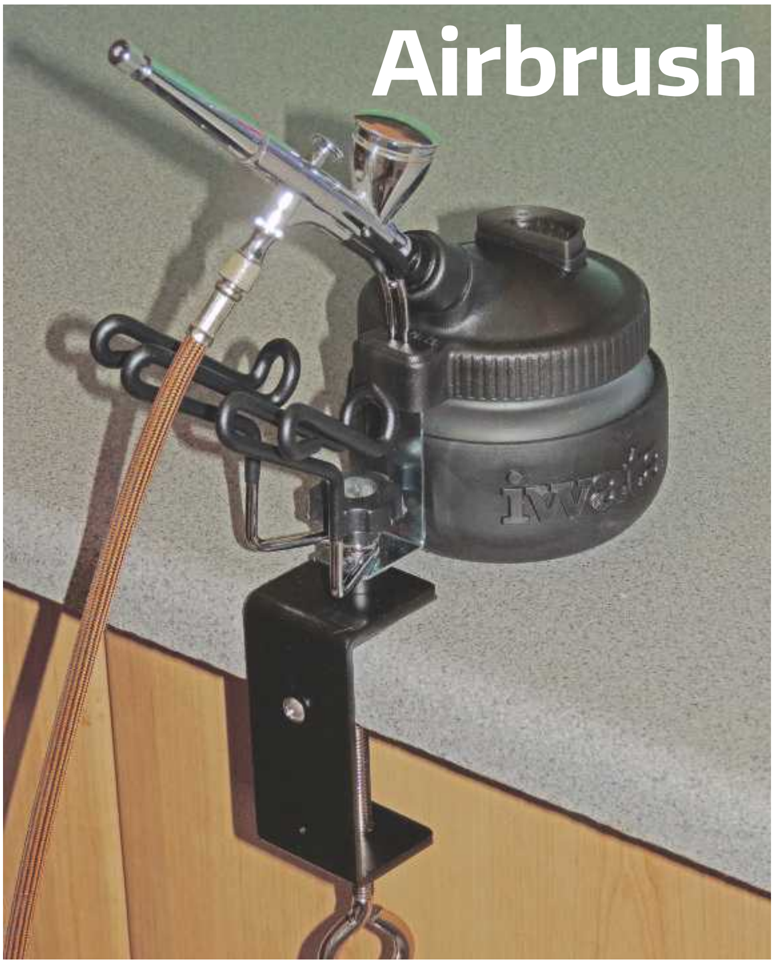
Visitors can travel between the show's different zones, trying the activities and watching fascinating and technical demonstrations. Over 50 clubs and societies will be present displaying their members work and competing to win the prestigious Society Shield. In total, nearly 2,000 models will be on display.

Many of the leading suppliers will be present showcasing new products and special promotions and giving hobbyists an excellent opportunity to see and compare products under one roof. You will be able to purchase virtually anything you need for your next model or project or to get you started in a hobby.

This is a great day out for all the family, one the children will love with all the working models. If you are interested in modelling yourself or want to rekindle your childhood memories, you will find something amongst the many diverse types of modelling on display to admire. If you are not already a modeller hopefully the exhibition will fire your imagination to build something yourself and enjoy one of these satisfying hobbies.

Advance tickets are £11 or £10 concessions and just £3 for children up to 14.To book tickets visit **www.londonmodelengineering.co.uk.**

Airbrush Accessories



It always surprises me that I don't get more contributions from people on the subject of finishing models. Of recent years I have found an airbrush increasingly useful, as I am ham-fisted with a brush. Recently the Airbrush Company has sent me a few accessories to try out. The first of these is Iwata airbrush Super Lube. It's silicone free and seems nice and clean to use. I can't really comment on its effectiveness as its more of a 'preventative maintenance' product, but it seems good and should extend the life of my airbrushes.

I also got to try an airbrush stand and Spray Out Pot. I like the Iwata spray-out pot, the base is a glass container in a rubber protective cover. It has a chunky screw-on lid with an airbrush support and a built-in filter. The idea is that you keep a little solvent (water or thinners) in the pot and use it whenever you need to clean through your airbrush. I found this vastly nicer to use than my usual cardboard box approach. It's also much less smelly when running a good shot of cleaner through the airbrush.

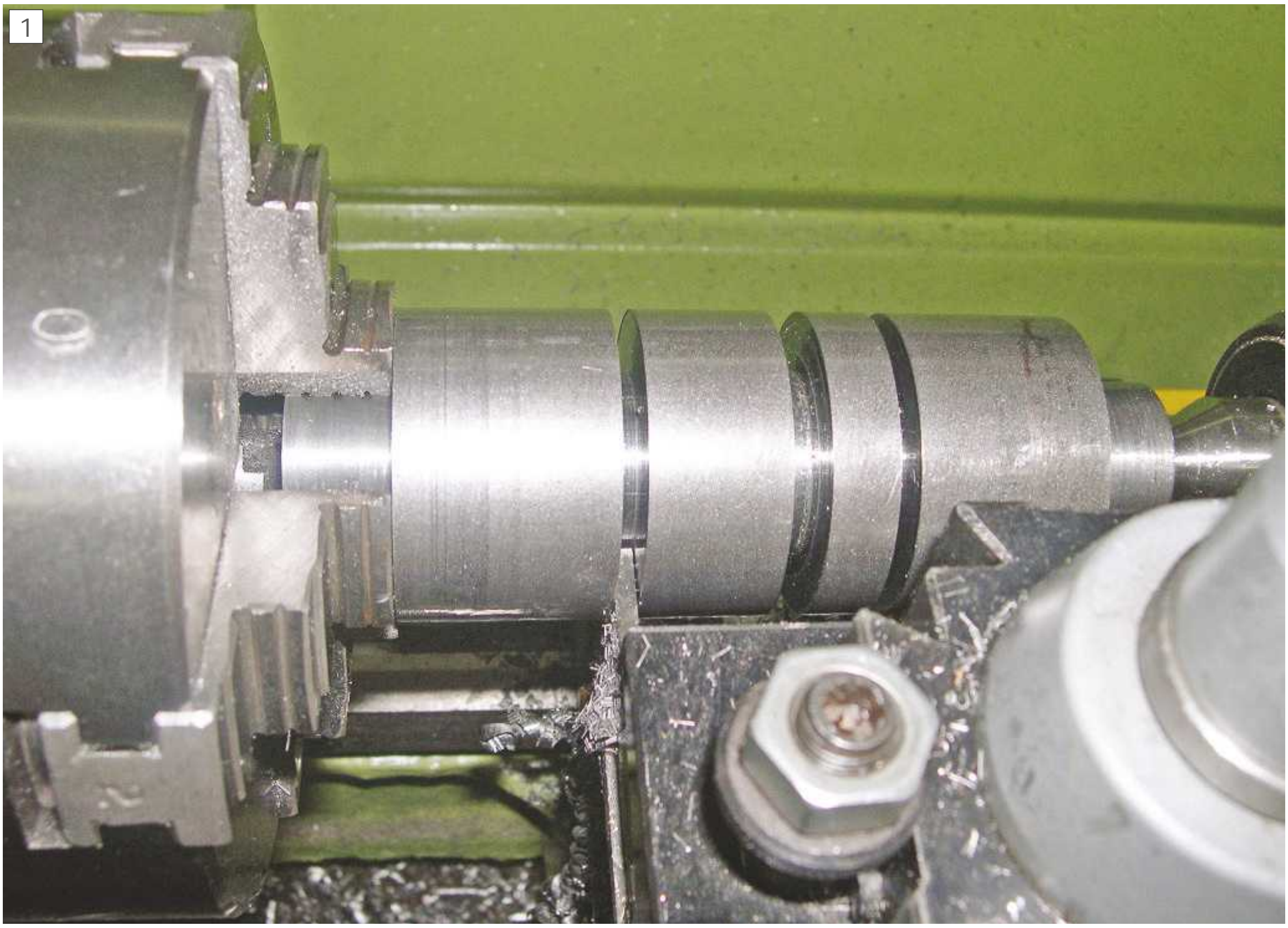
The clamp-on Iwata Universal Airbrush Holder has places for two airbrushes and works with the spray-out pot using a special bracket. Unfortunately, I found the supplied screw on knob was barely long enough to fit the two airbrush holders and I could not fit the pot on as well, I had to use an M6 knob from my bits box. This seems a shame as combined, see photo, they make a neat workstation. I did have to squeeze the holders a bit to get a good fit on my top-feed airbrushes, but as they are supposed to suit all types of airbrush I guess you are meant to do this.

The spray out pot and universal airbrush holder are £24.96 each, and the Super Lube is £7.49, all available from **airbrushes.com**.

Making a Lantern Chuck

Barry Chamberlain details the construction of a Lantern Chuck which will make a useful addition to any workshop tooling collection.

1



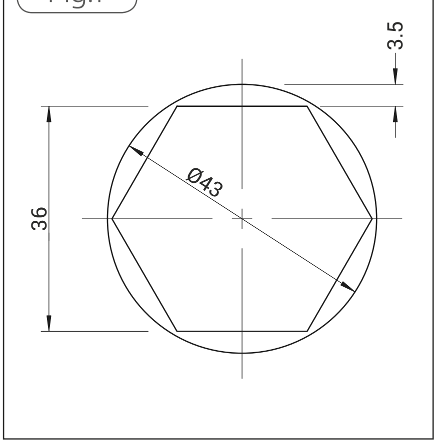
Ends turned and grooves created

Cutting bolts to size often involves screwing two nuts on the threaded portion so as to set the point at which the thread is to be shortened, holding the waste thread in the vice and sawing it off. The sawn end is then cleaned up with a file to lose the ragged edges and the nuts used to clean and prove the viability of the thread. A better solution is to hold the bolt to be shortened in a Lantern Chuck and part off at the required length in the lathe. A Lantern Chuck consists of a body and a screwed adaptor. The screwed adaptor secures the head of the bolt to be shortened within a close-fitting washer when tightened up against the body.

Finding that single ended 36mm spanners are relatively cheap to source (apparently widely used on lawn mowers), that then determined the 'across flats' dimension for the lantern chuck. Such a hexagon fits within a 41.57mm diameter circle. Having a 1¾" (44.45mm), diameter EN1a bar to hand that was selected to manufacture the chuck. The bar was chucked up and the ends centre drilled. With a fixed steady in place the ends were turned down to 24mm and 25mm diameter respectively over 15mm, to suit my two larger 5C collets.

The fixed steady was removed and the bar prepared by making two 3mm wide and one 5mm wide grooves to a depth of 9mm as detailed in **fig. 2**, using a

Fig.1



wide parting off tool, **photo 1**, The outer sections were reduced to 43mm diameter (in order for the bar to clear the mill table), and the inner section to 30mm diameter, **photo 2**,

The bar was removed from the chuck and supported between two hexagonal Stevenson 5C Collet holders. The holders were clamped against the mill table to ensure the faces of both were true before the collets were fully tightened. A small clearance gap was left between the shoulder of the bar and the collet sufficient to clear the milling cutter.

Milling 3.5mm off the top surface of the outer bar produced the required profile, **fig. 1**.

Having limited Y axis travel on the mill, once the first end was completed, **photo 3**, the bar was turned through 180º, re-clamped, and the second profile milled. Prior to milling each flat the bar was set at 90º to the table using a square set across, and in contact with the lower edge of both hexagonal holders, **photo 4**,

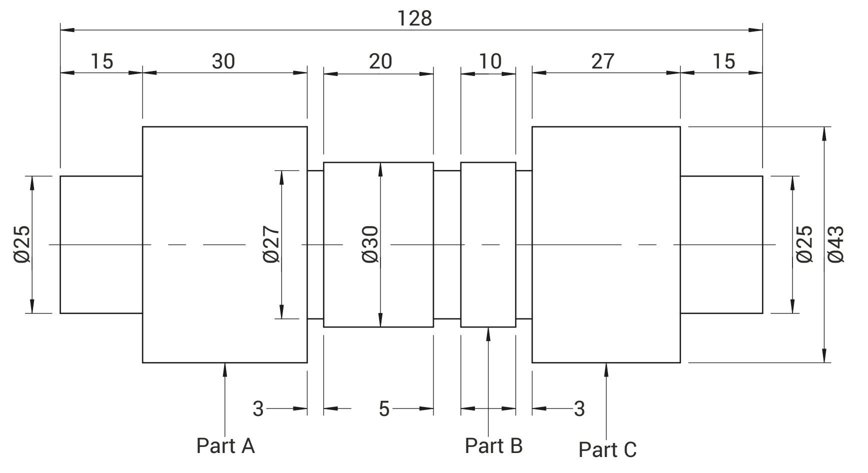
With both profiles completed, **photo 5**, the bar was released from the 5C collets. The ends used in the collets were then machined off.

It was re-chucked in the 3-jaw chuck and the right hand end, part C, parted off. The chucked end was centre drilled and the live centre moved back into contact.

The change gears were set for 1.5mm pitch, and the 60° metric thread cutting tool aligned with a setting gauge against the work to ensure that the cutter was set square. The lathe was set to run very slowly and thread cutting commenced. Progress was slow, incrementing the cutter slightly for each pass until a nicely formed thread appeared. Cutting fluid was generously applied throughout the thread cutting operation and the threads brushed clean, **photo 6**,

Next, a tailstock mounted 13mm drill was advanced to a depth of 10mm into the bar,

Fig.2

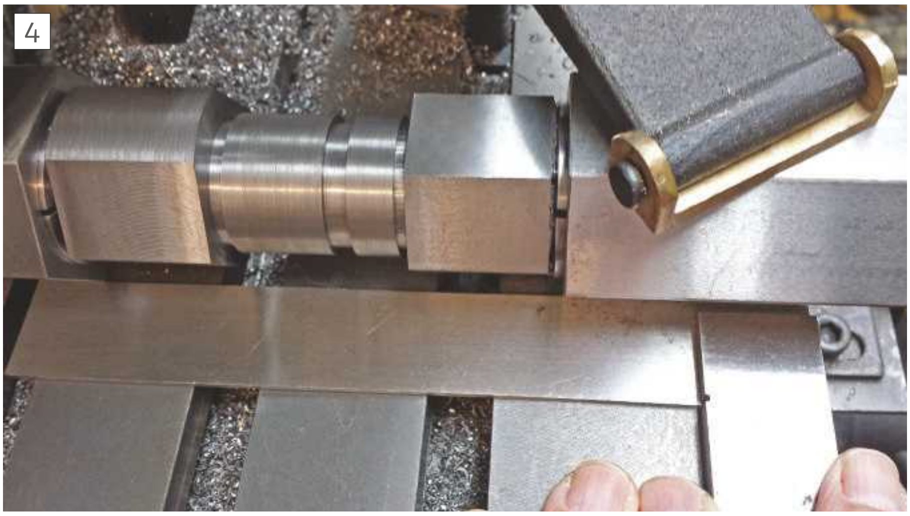


2

Outer diameter reduced to 43mm, inner to 30mm

3

First profile completed



Setting work square to the table

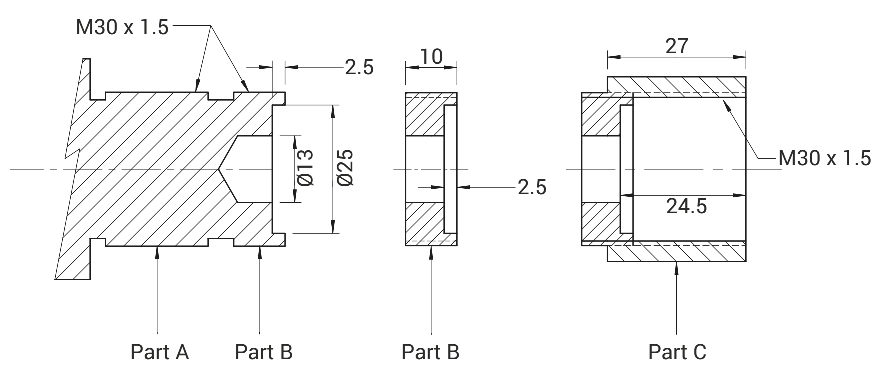
Milling operation completed

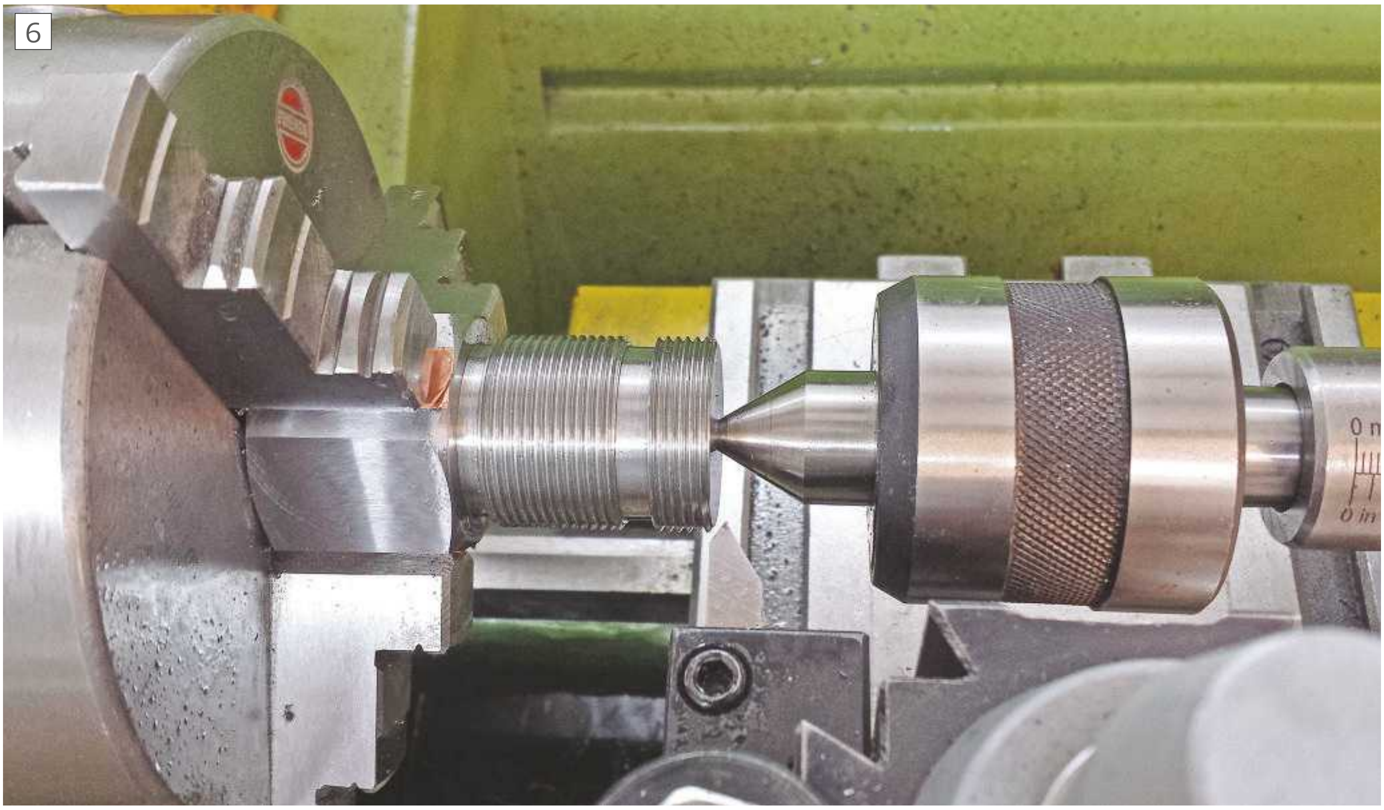
fig. 3. This end, part B, will become the inner locating receptacle for the bolt securing washers and before removal from the chuck the end was bored to a depth of 2.5mm with a diameter of 25mm.

Part C was chucked and bored out to 28.5mm diameter in preparation for forming the internal 30mm thread. With change gears set for a 1.5mm pitch thread the internal thread was produced, **photo 7**, As the thread form neared full development Parts A & B were regularly introduced to check that the thread was a good fit. When a good running fit was achieved, **photo 8**, part C was released from the chuck and the threads cleaned. Part B was then parted off and put to one side, **photo 9**,

Prior to brazing parts B and C were thoroughly degreased.

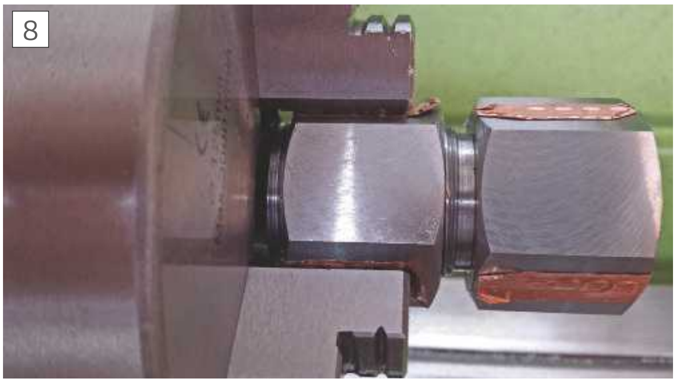
Figs.3, 4 & 5





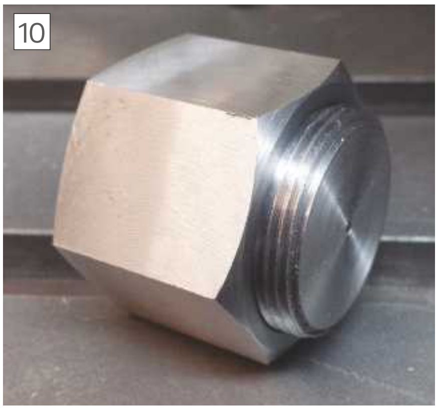
Part C turned off and external thread completed

Part C threaded internally



Mating check to prove internal thread

Parting off Part B

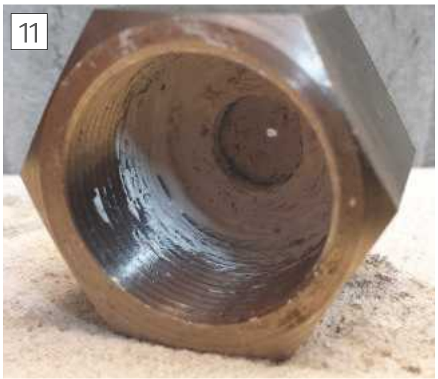


Part B set to depth within Part C

The threads on part B were coated with brazing flux and screwed into part C until the inner face was set back 24.5mm from the outer edge of part B – refer to **Fig. 5**. To complete the preparation for brazing the inner threads and lower area of part C were coated with correcting fluid (Tippex in this case), to prevent silver solder wicking past the joint and along the exposed inner threads, **photo 11**,

The assembly was placed on a fire brick and heated to cherry red prior to introducing silver solder onto the outer exposed threads. Once the solder wicked into the joint the heat was removed and the assembly left to cool, **photos 12** & **13**,

The assembly was dunked in pickling fluid to remove the surface scale and left for a couple of days or so to give the solution time to do its job, **photo 14**, This particular solution was produced by dissolving citric acid crystals in warm water, although



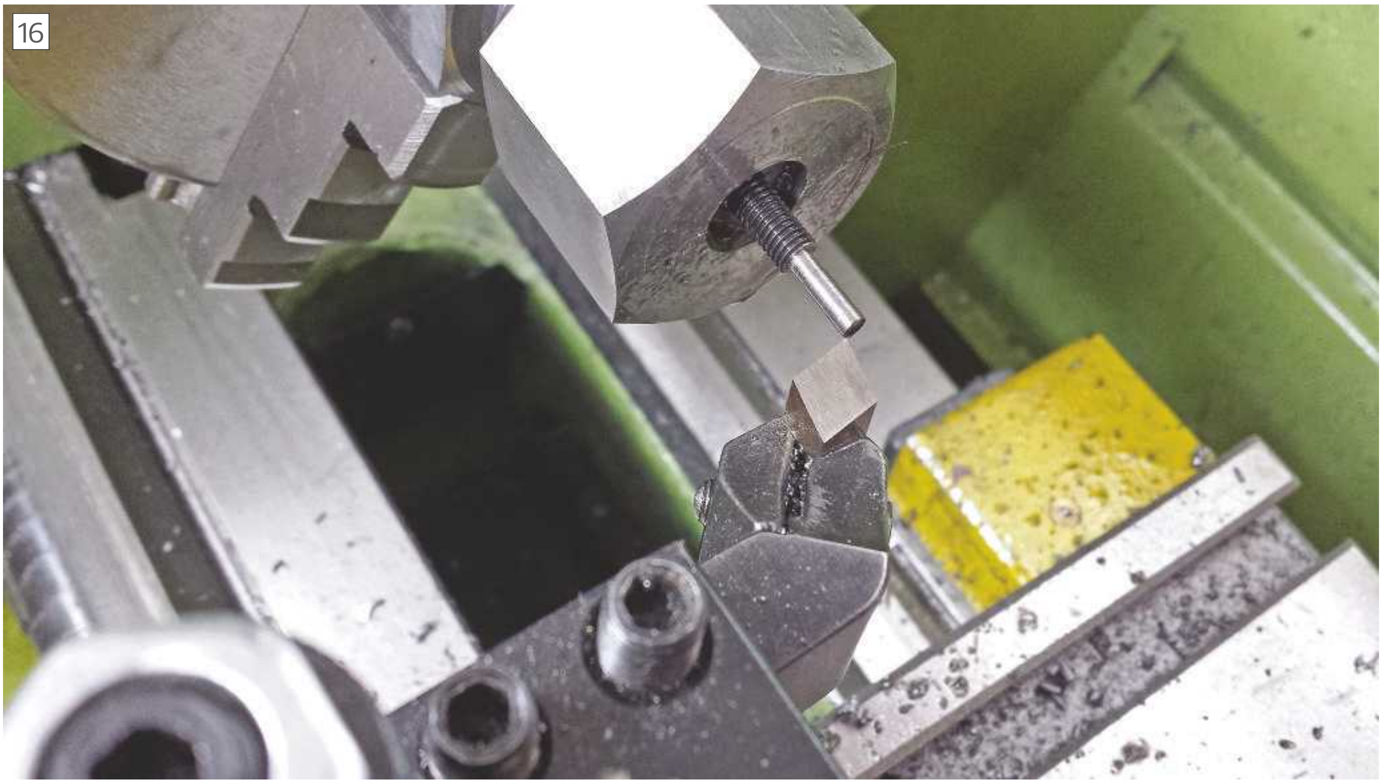
Correcting fluid applied inside Part C

Assembly being heated on fire brick

Heat source removed post silver soldering

Pickling solution at work

Shortening an M8 bolt



Shortening an M4 bolt

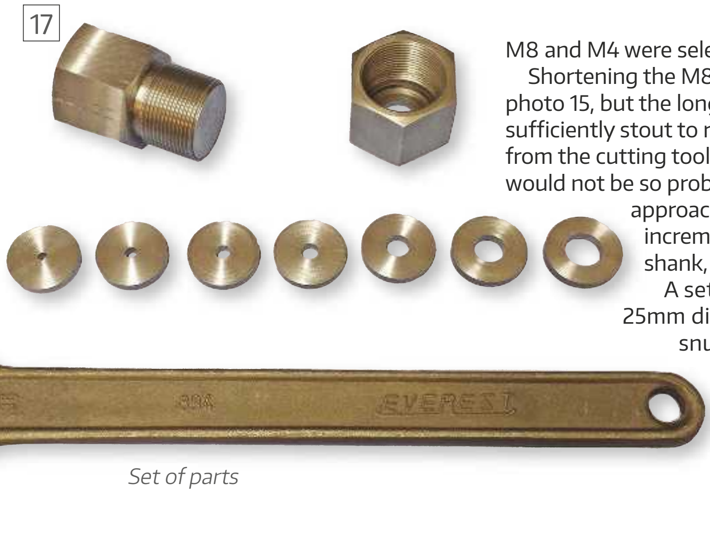
many alternative solutions will work just as effectively. Note that pickling only removes surface scale (firescale), and left over flux and oxides. It does not restore the surface to a bright shiny finish.

When the assembly was removed from the pickling solution it was washed under a running tap to remove the surface gunge. It was thoroughly cleaned with a wire brush followed by wet and dry paper then oiled, re-chucked and the surplus external threaded portion machined off flush to the body of part C.

To check the chuck out, two bolts, M8 and M4 were selected to be shortened.

Shortening the M8 bolt was a cinch, photo 15, but the long M4 shaft was not sufficiently stout to resist the side force from the cutting tool – a shorter shaft would not be so problematic. An alternative approach was adopted by incrementally reducing the shank, **photo 16**,

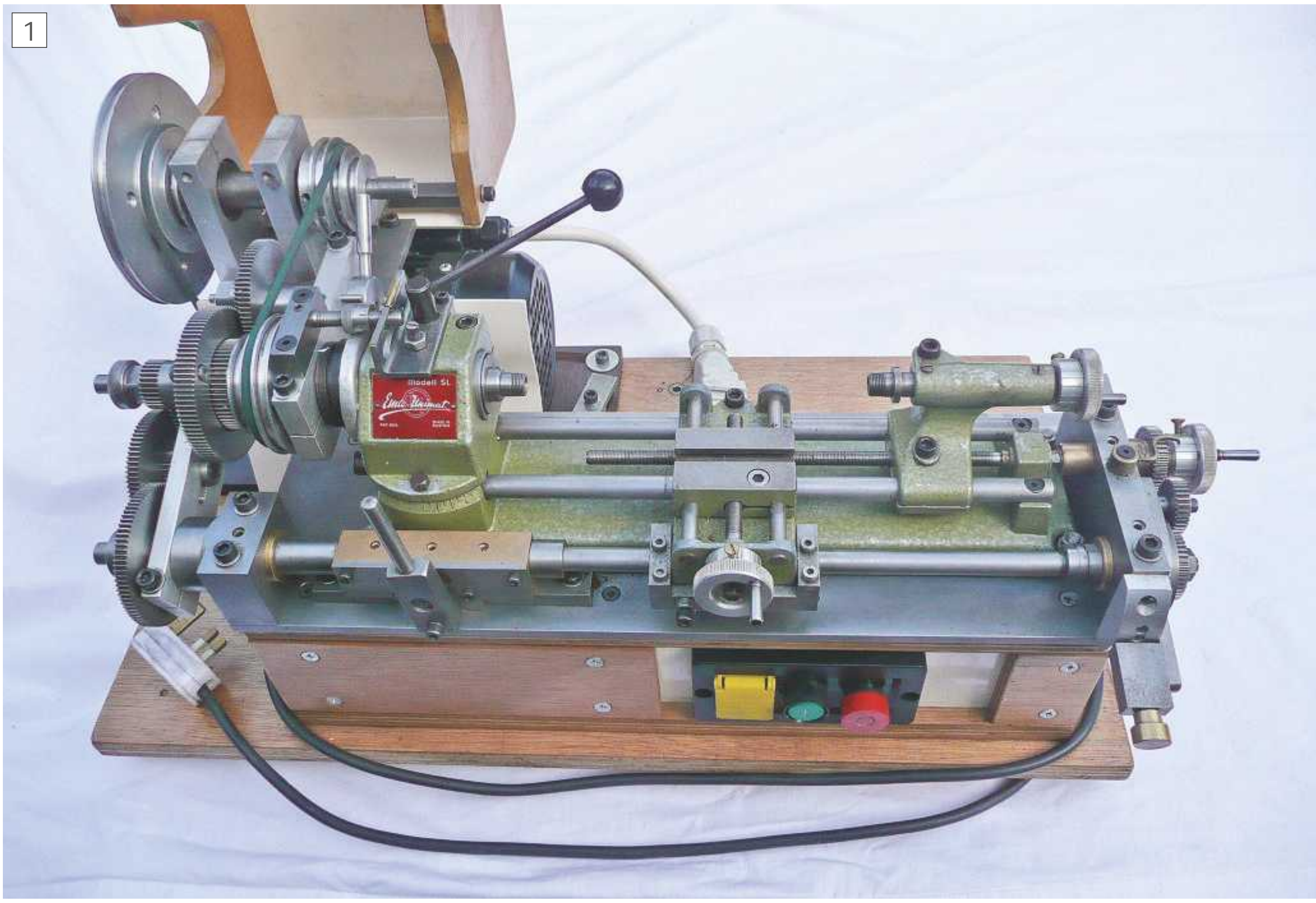
A set of close tolerance 25mm diameter by 2mm thick snug fitting M3, M4, M5, M6 M8, M10 and M12 washers were made to complete the project, **photo 17**. ■



Set of parts

Fitting a Top Slide to a Unimat SL1000

Terry Gorin has some further thoughts on screwcutting with his much-modified Unimat SL1000 starting with the addition of a top-slide



1

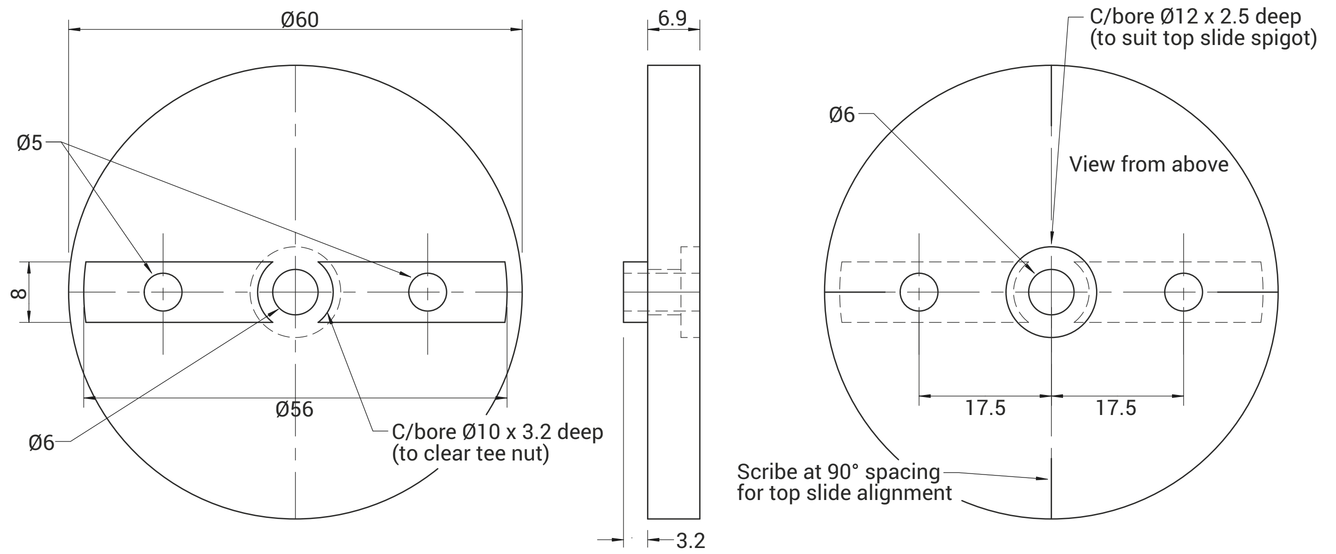
Unimat SL1000 as at the end of the 2014 series.

The modifications to my Unimat SL1000 lathe, fully covered in MEW during 2014 and shown in **photo1**, provided power feed, back and tumble gear, dog clutch and gear train to enable it to perform conventional turning and screwcutting operations but always within the capability of this very small lathe and rigidity of the bed rails. These provided the basics for screwcutting but next I needed to compare the three alternative methods (call them 1, 2 & 3) of tool advance for thread cutting, described by Martin Cleeve in 'Screwcutting in the Lathe', and decide which method best suited the SL1000.The headstock of this lathe can be mounted at low (normal) height or mounted on a block to a raised height. At low height, the spindle centre is only 12.5mm above the top of the cross-slide and insufficient to accommodate even a small top-slide. Screwcutting at this headstock level can only be attempted with the cutting tool clamped in the standard toolpost, perpendicular to the workpiece, and then advanced by the cross-slide, with the thread cutting simultaneously on both flanks as method 1. This is never ideal and definitely not for a lathe happier with light cuts.

Adaption of Commercial Top-slide

With the headstock mounted on its raising block the cross-slide to spindle height increases to 32.5mm, giving sufficient room for a top-slide designed for the Unimat 3, or similar, and one was duly purchased.

At this time I was not aware of D. Scroggins' top-slide design for the Unimat 3 (printed in MEW in 1997 and republished on the forum at www.model-engineer.co.uk



Cross Slide Adaptor Plate For Mounting Top Slide
Mat'l: BMS
All dimensions in mm unless otherwise stated

Fig.1

in December 2016) but I would not have wanted to 'steal' the time for fabrication from my main hobby of ship modelling. I have lost record of where my top-slide was purchased but it was not an authentic Unimat 3 accessory, or from eBay

The top slide when mounted on an adaptor plate, turned, drilled and milled as **fig. 1**, and shown in **photo 2**, positions the top of a standard 6mm square tool bit, clamped in the top-slide integral toolpost, just below spindle centre height. **Figure 2** shows the top-slide positioned for threading by methods 2 and 3. The latter, with the top-slide set parallel to the axis of the thread to be cut and giving complete control of leading and trailing flank cuts is, perhaps, the 'kindest' method for this lathe. However, when planning to cut relatively long threads needing tailstock support, care is needed with this small lathe to ensure the top-slide will not foul the tailstock with method 3 and method 2 may be the only alternative.

The toolpost of these small top-slides are not rotatable independently of the slideways. The toolpost central pillar of

2

Adaptor plate.

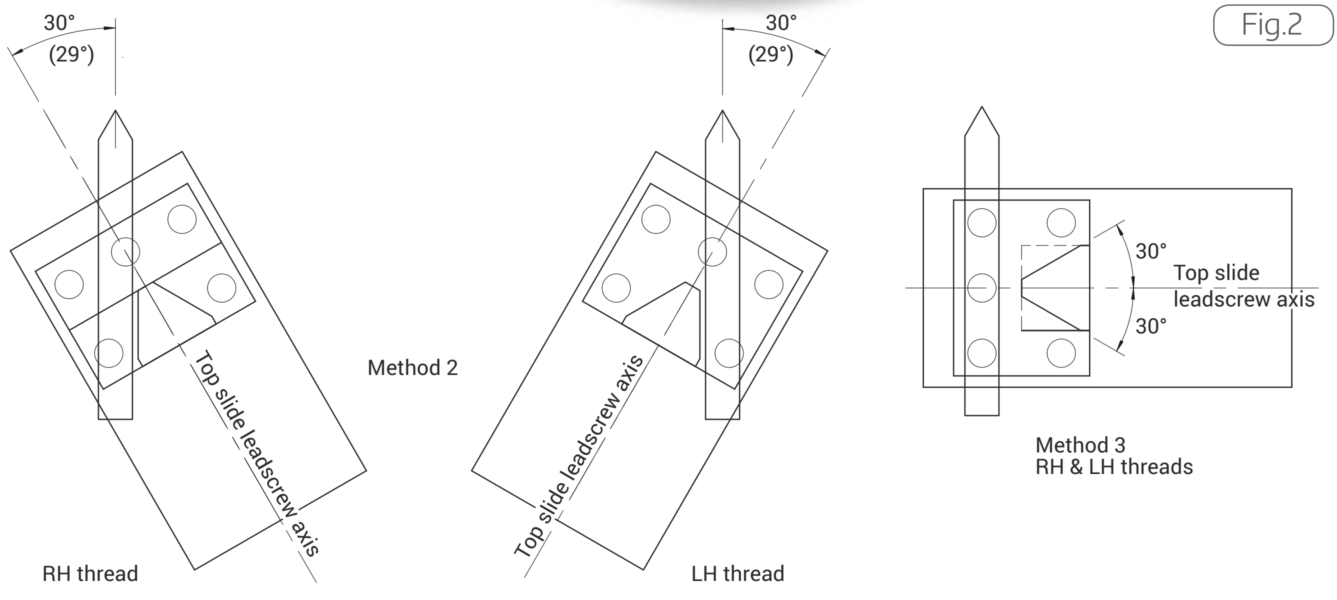
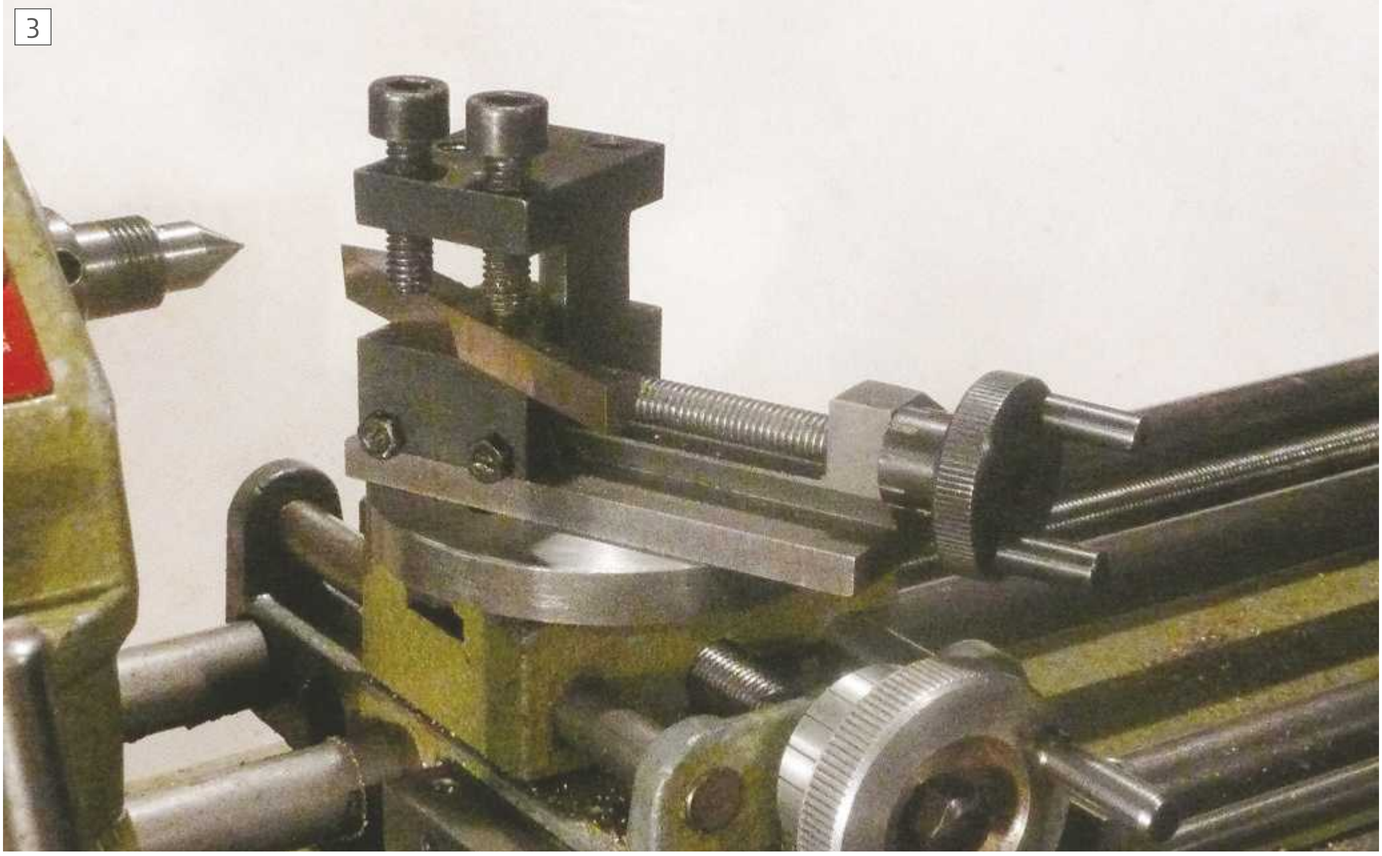


Fig.2

Alternative Top Slide Arrangements

3



my purchased top-slide is 12x15mm, the same as D Scroggins' design, and fig. 2 also shows the relieving needed to the innermost corners of the pillar to enable the threading tool bit to be set perpendicular to the thread axis, for both RH and LH threads, using method 2.

Photograph 3 shows the top-slide and adaptor plate mounted on the Unimat for method 2 screwcutting.

Need for Tailstock Raising Block

Any turning and screwcutting operation needing tailstock support at headstock raised level will also need the tailstock at the same level and a raising block to provide this will be covered in a later article. ■

REFERENCE

1. Screwcutting in the Lathe - Martin Cleeve.

A Heavy Duty Filing Machine

John Crammond describes an interesting piece of specialist machinery inspired by a commercial machine.

I read with interest a series of articles by Harold Hall in which he described the production of a filing machine to his own design. However, this was a lathe mounted accessory and would need removing before the lathe could resume its normal functions.

My memory returned to an article in MEW issue 37 where a gentleman acquired a damaged Thiel Produro 111 unit and went through the work required to make it function again.

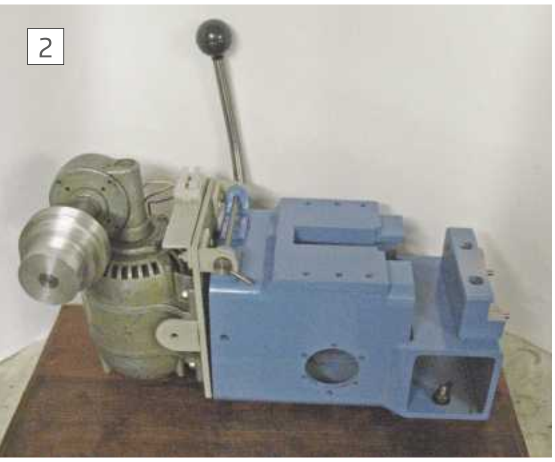
Thiel machines are made to the highest standards, so much so that their owners are invariably unwilling to part with them, and I have never seen a Produro 111 for sale. Some of the nice touches of this machine include means of positioning files accurately with tiny dovetail slides, a graduated scale for adjusting the work table from side to side, plus an ingenious system for varying speed and stroke, details of which I was never able to obtain.

Despite this my admiration for the machine remained undiminished and I decided that I could produce something similar, and started working out some basic dimensions from the photos available. Assuming a hand wheel to be around 4"dia, this gave the height of the machine to be 16" with a work table of 7 ½" square. My machine was built on the hoof as I'm no draughtsman. What looks right often is, though I confess that I'm often guilty of over engineering parts, and my finished machine is well over 60 kg.

1

Assembled machine from right hand side, large lever to rear tensions drive belt.

2



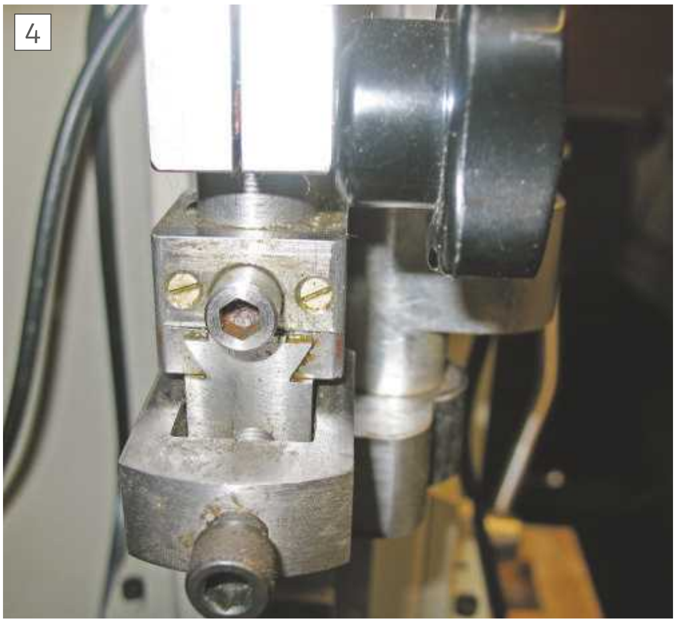
Bare crankcase and motor.

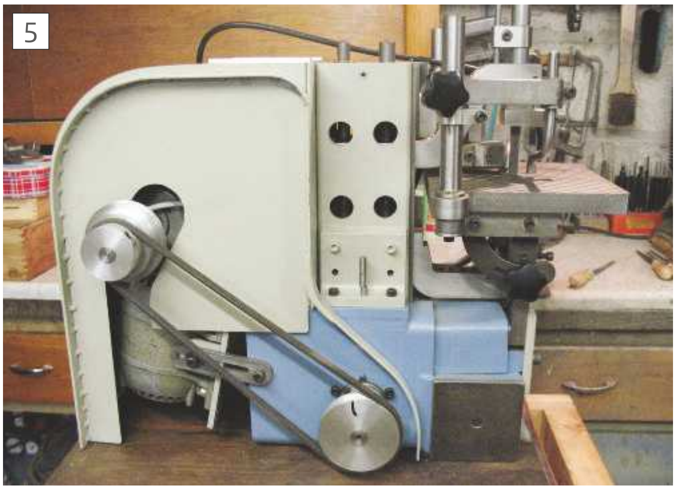
The purpose of this article is not to provide a blow by blow description with every component dimensioned, but rather to illustrate what can be achieved with a little determination; I hope **photos 1-7** will show what was involved, as they say "a picture paints a thousand words".

The machine briefly consists of a crankcase, on top of which sits a tower housing. Two steel rods slide vertically and are powered by a variable throw crank. Attached to the steel rods are two arms protruding through the front of the tower, one placed above the work table, the other below. Files are threaded through the work table and attached to the two arms. This is of course a simplified description and does not address the problems of how to keep the arms in alignment, or how to keep filings out of the works etc.

While a Thiel is built from castings, mine had to be fabricated, and I was lucky enough to find a length of 6" x 6" square tube with a wall thickness of 1/4". This would suffice for the crankcase and provide mounting points for the tower drive motor and work table. A 10" length of 90mm x 90mm square tube with a 6mm wall


Assembled machine from left side with belt cover in place.


The upper dovetail slide used to position files etc accurately.


Tower and work table fitted to crankcase.


Work table and top arm, just visible are some of the weight reducing holes.

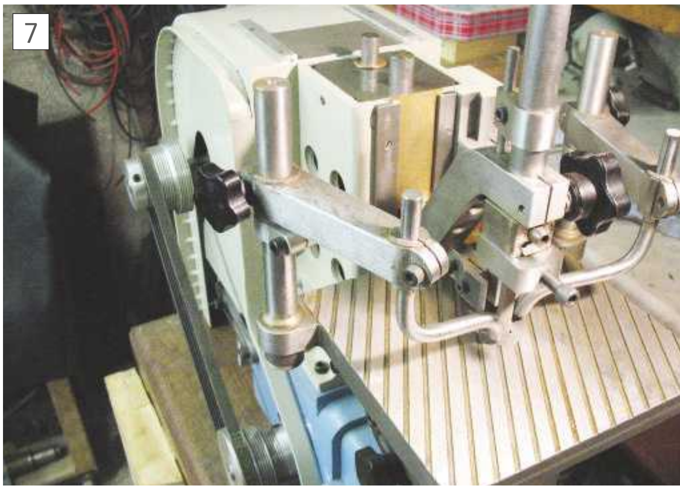
thickness provided tower material and work could commence.

Large holes in the crankcase were needed were needed to not only house the crankshaft but also to provide access to assemble other components. The tower was also provided with holes enabling arms to be attached to the sliding rods which in turn needed bearing blocks top and bottom in 20mm thick cast iron. The tower is fastened to the crankcase with both bolts and dowels.

The adjustable crank throw mechanism is similar to Harold Hall's but is a rather larger version, and is driven by a geared motor via 3 step poly-v pulleys. Stroke is variable between 1/2" and 2" while speeds available are 140, 225 and 310 rpm. Due to the considerable weight of the reciprocating parts the highest speed is only used with a stroke of no more than 3/4". While all rotating parts include ball or roller bearings, the cast iron bearings at the top and bottom of the tower need a couple of drops of oil applying to both sliding rods before each session; one day I'll get around to fitting a proper lubrication system here.

Dedicated files for these machines are now virtually impossible to come by, some people have been lucky but I use slightly modified ordinary files in a variety of shapes. Despite Mr Hall's machine working at speeds in excess of 400 strokes per minute, filing machines are renowned not for their metal removal rates but rather for the control and precision they provide, and one needs to exercise considerable care in their use, work holding down arms are essential, and do not let your concentration lapse for one second as disaster and pain lurk just around the corner. ■

Editor's footnote: Two stand-alone filing machines have appeared as free plans in MEW. A machine by Stan Bray appeared in MEW issue 4, and one for filing and fretsawing by G. Gray was in issues 9 and 10. Both plans are available here: http://www.model-engineer.co.uk/news/article/the-model-engineers-workshop-free-plan-collection/18439 these machines are both much lighter than John's machine but may be useful to those who want some more details if they wish to follow his example.


General view showing the two drive rods protruding from the top of the tower, also visible is the two piece brass swarf shield that slides up and down with the arms

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One Man and his Lathe

Bill Morris and his Lorch Watch Maker's Lathe – Part 3

Taps too can wander. I chose M 6 for the thread as it has a pitch of 1 mm, but 0 BA with the same pitch and diameter though different thread form would have done just as well. **photo 30** shows my approach to guiding a tap. I grind a small flat on the shank of the tap so it can be held low down on the shank, and use the jaws of the drill chuck to guide the shank until the thread is well and truly started. The lazy can jam the tap holder into the flutes of the tap, but this is not good for the tap holder and I try to avoid doing it, photo 30. **Photograph 31** shows the finished part assembled on the bed.

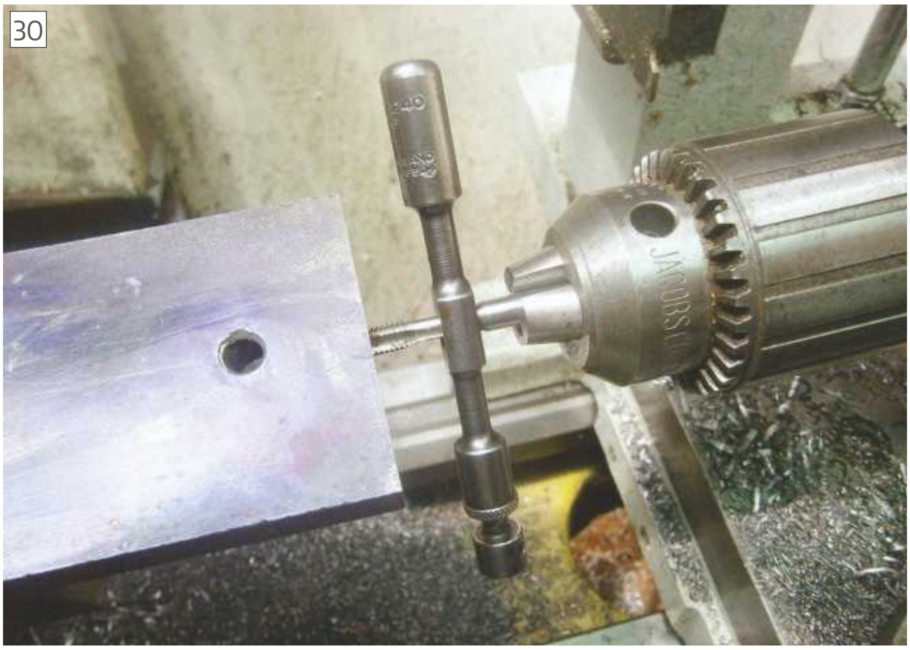
The cross slide

Machining this after roughing out another remnant of the X-ray table and carefully marking out is very similar to making the dovetails for the saddle (**fig. 8**). Drilling and tapping the two holes to hold the feed screw bearing in place was best postponed until the bearing had been made, when the holes could be spotted through. Once the slot for the dovetail had been roughed out, I thought it a good idea to drill the holes for the gib strip screws, as otherwise there was a risk of breaking the 2.5 mm tapping-size drill as it broke through the angular surface of the dovetail. Next came the boring of the table for the spigot, **photo 32** that locates the top slide.

About thirty years ago I made a 360 tooth worm wheel that screws on to a register at the outboard end of the lathe spindle, and lashed up a worm to match, so that one turn rotates the lathe spindle one degree, **photo 33**.

If your lathe will allow it, this is the idea point at which to scribe the graduations that indicate the set-over angle of the top slide, **photo 34**. Although fig. 8 does not show it, because it would make the fig. too fussy, the pitch circle diameter of the graduations is 45 mm and this gives nice open graduations.

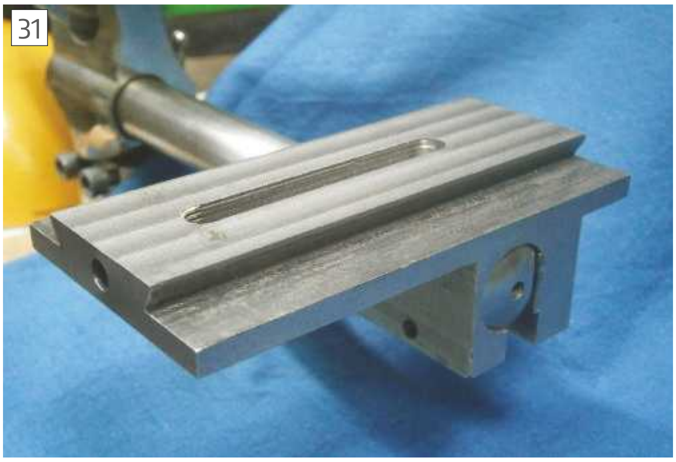
To number graduations I use a crude jig which consists of a piece of square bar held in the lathe tool post with two threaded holes at 90 degrees to each other. The ends of screws in the holes guide the number punches, **photo 35**. This crude system has served me well, though it needs a little practice to strike the punch with just the right force, since 1s require less force than, say, 8s.


30

Tapping saddle for screw

Feed screw

Making this next helped in locating its bearing. The pitch of M6 is 1 mm. The screw is a relatively slender part (**fig. 9**) and yet not quite long enough to make using a travelling steady easy, so that finishing the blank to size needs a very sharp tool and shallow cuts to ensure a uniform diameter. It must of course be turned between centres to ensure concentricity, **photo 36**. To avoid cutting a drunken thread, a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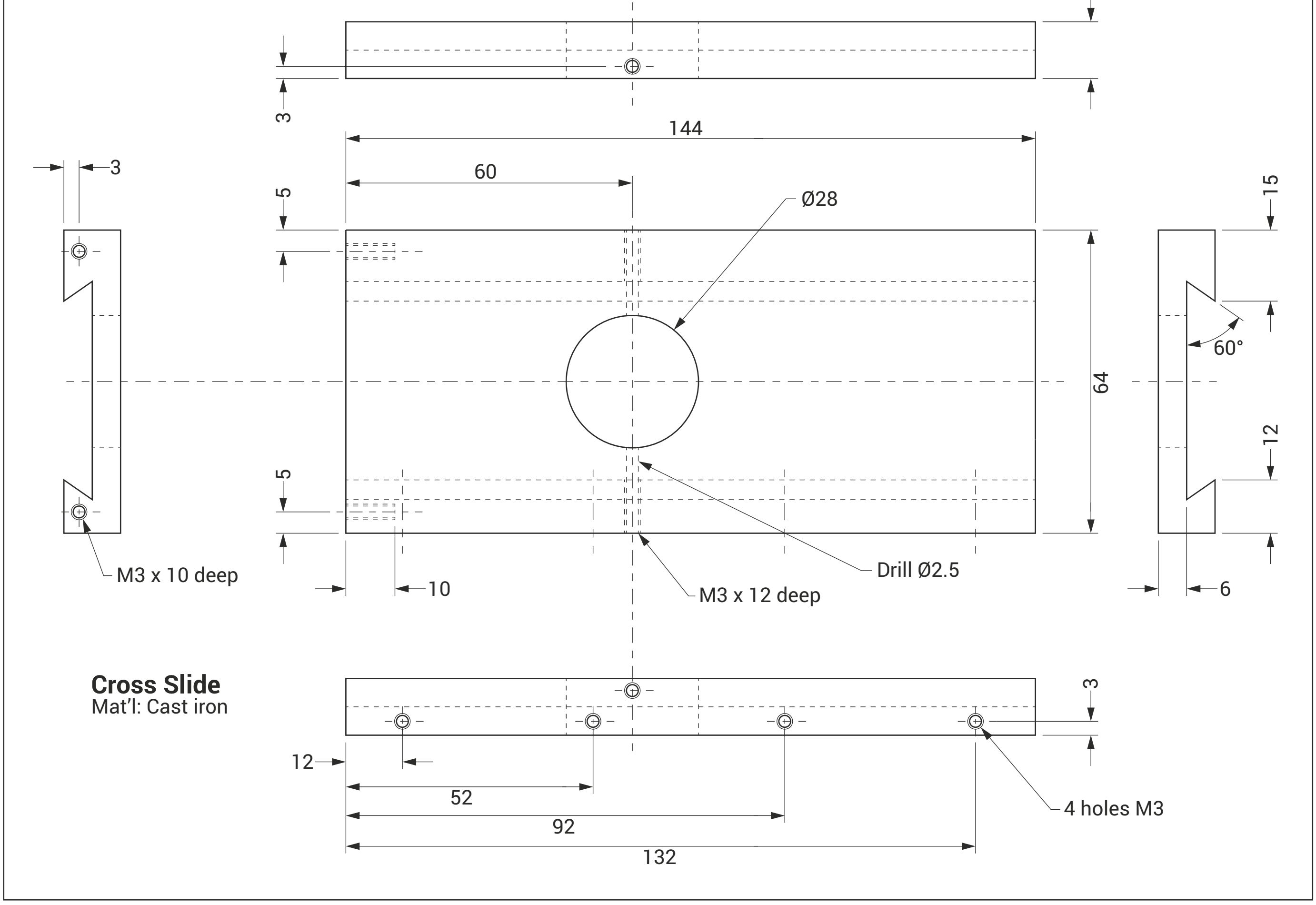
Finished saddle on bed


32

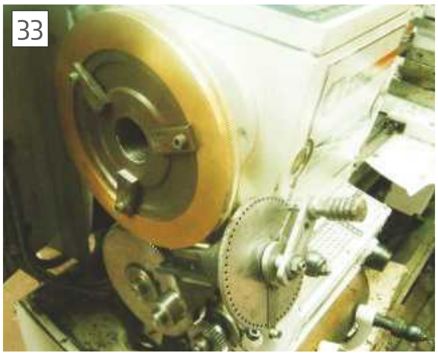
Bore cross slide for topslide

Fig.8



tailstock die holder is very useful, but even so, it is best to screw-cut the thread in the lathe to at least part of its depth and to full depth if possible. The depth of thread is likely to be less in the middle part because of flexion due to the relatively heavy cutting forces, but enough to give positive guidance to a finishing pass with a die.

Although I have long tried to use only metric standards in my workshop, I chose ¼ inch x 40 tpi for the outboard end of the screw as I have taps and a die for this size, while the smallest metric fine screw is 8 mm in diameter with a pitch of 0.75 mm, about 34 tpi. It is essential that this thread should not be drunken, so it should be cut in the lathe and a die used only for finishing. The outboard end of the collar receives thrust so it should receive a fine finish.



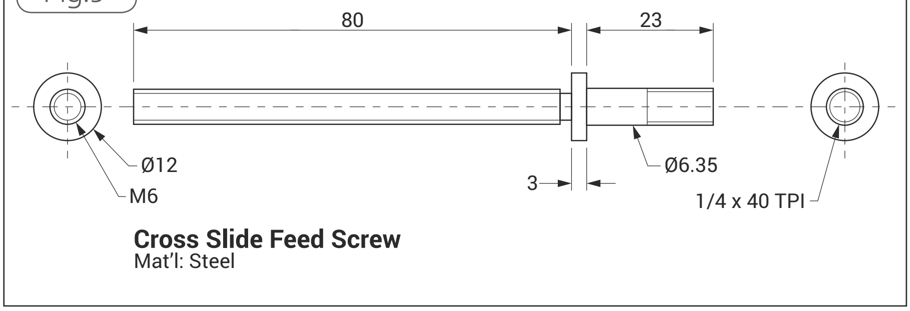
Headstock dividing device

Topslide graduations

Feed screw bearing and index disc

Most of the machining of this part, made from 10 x 25 mm stock, was straight-forward marking out and drilling, but the 14 mm diameter recess for the feed screw collar had to be bored and the bottom faced flat in the lathe. The index disc (**fig. 10**) is a 3 mm slice of round aluminium bar, from which the collar and graduated thimble will also be made. Once the fixing holes were drilled and countersunk, the central hole could be drilled and reamed to ¼ inch (6.35 mm). This could then be clamped to the bearing with a piece of ¼ inch bar locating the holes and the fixing holes spotted through, drilled and tapped M3. At this point, I assembled the cross slide with its gib strip adjusted, inserted the feed screw and used its outboard end to locate the bearing for spotting through for the M 3 fixing screws.

Fig.9



35

Number punch jig

36

Turning leadscrew blank

Thimble and nut

The thimble (**fig. 11**) is a fairly simple turning and boring exercise, except for the knurling, which takes a little practice to get the knurls to the right depth. It is a little easier with straight knurls and I always pull the chuck around by hand, increasing the depth gradually until the correct pattern appears. Knurling exerts a lot of force on the workpiece as it is a moulding rather than cutting process, so it is best to do it as the first operation. Postponing it to the last risks closing up the bore of a hollow work piece. Dividing used the same set up as for the set-over graduations, **photo 37**, using the top slide to ensure that graduations are the correct length. It is as well to avoid distraction while cutting the graduations, as it is always frustrating to end the dividing only to find that you have 99½ graduations instead of a hundred. With the feed screw pitch being 1 mm, each of 100 graduations will give a reduction in diameter of the workpiece when turning of 0.02 mm.

The nut is turned to be a nice close running fit in the thimble and precautions must be taken to ensure that the thread is square to the face. It could have been locked with a locknut, but space is limited and I opted for a brass grub screw. There are various ways to give friction to the thimble. I used a piece of clock spring and **photo 38** shows how to wangle it into place while sliding the thimble over the nut, using the two index fingers to compress the spring, while sliding the thimble with the fingers and thumbs. I cut a washer out of brass shim stock to take the thrust of the face of the nut.

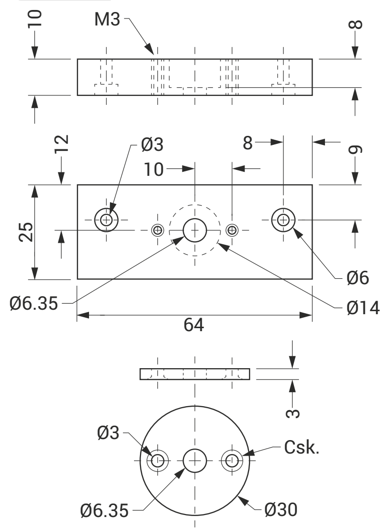
Top slide base

The X-ray table yielded another piece of cast iron for the top slide and its base (**fig. 12**). Formation of the dovetail and feed screw "nut" was a smaller version of making the dovetail on the saddle. Forming the spigot that attaches the base to the cross slide began by turning a parallel spigot, **photo 39**, followed by very careful facing of the underside of the base. I then turned the circular 60 degree dovetail, leaving about 1 mm parallel to ensure correct location in the cross slide. Note how the workpiece is supported on parallels to clear the chuck jaws and how I have secured the parallels to

37

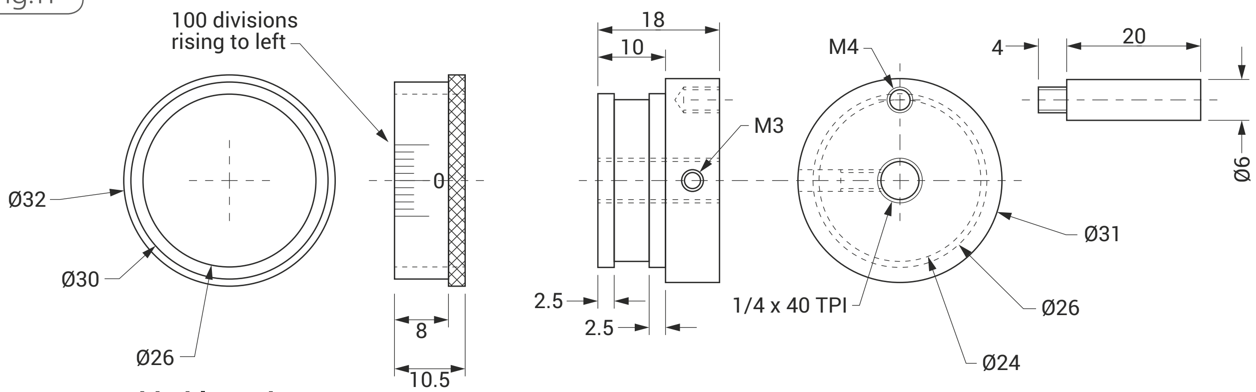
Graduating thimble

Fig.10

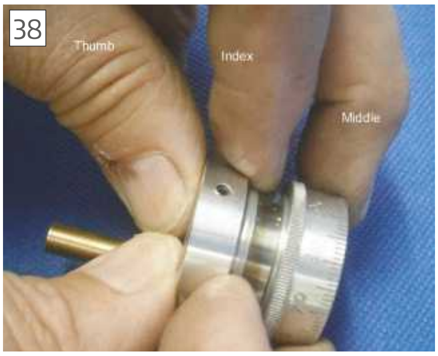


Feed Screw Bearing And Index Disc
Mat'l: Steel & aluminium

Fig.11

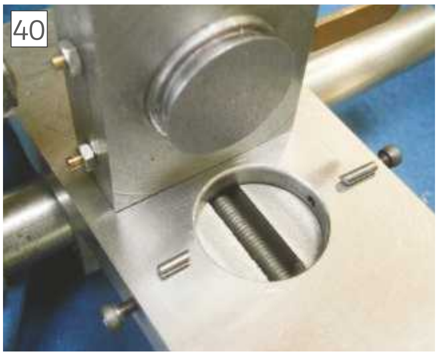


Thimble And Nut
Mat'l: Aluminium alloy or brass

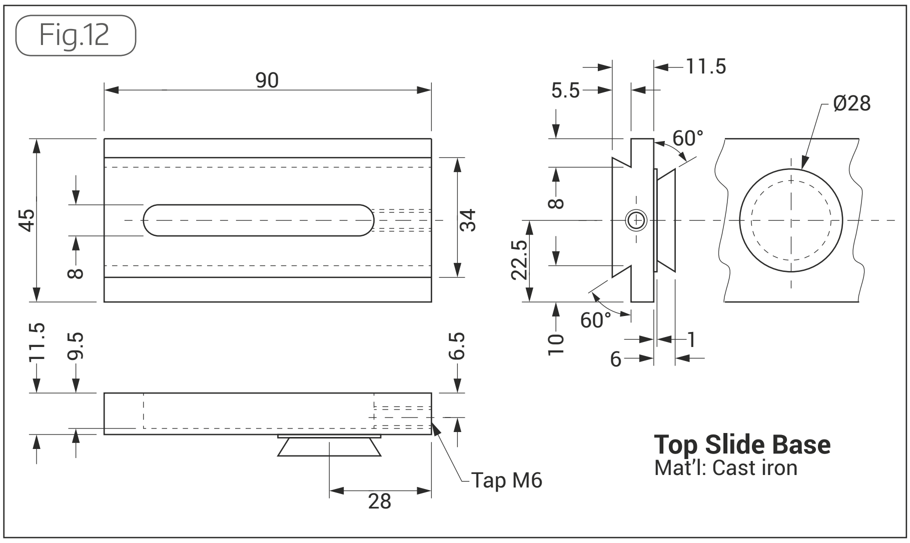


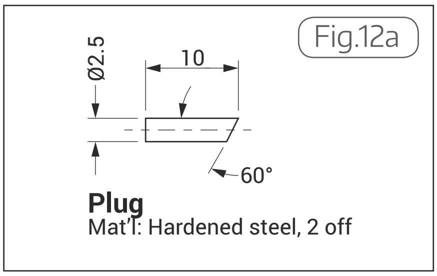
Inserting thimble frictions spring

Turn topslide spigot



Topslide spigot dovetail





posts (**fig. 16**) that would have the facility to adjust the tool height in a controlled way, rather than spending time with shim and cigarette papers, trying to home in on centre height.

Several years ago, while in the USA, I bought a job lot of blunt solid carbide engraving cutters to use as inserts for lathe cutting tools. The parallel shanks are 30

the chuck jaws to prevent them from flying off if they should work loose.

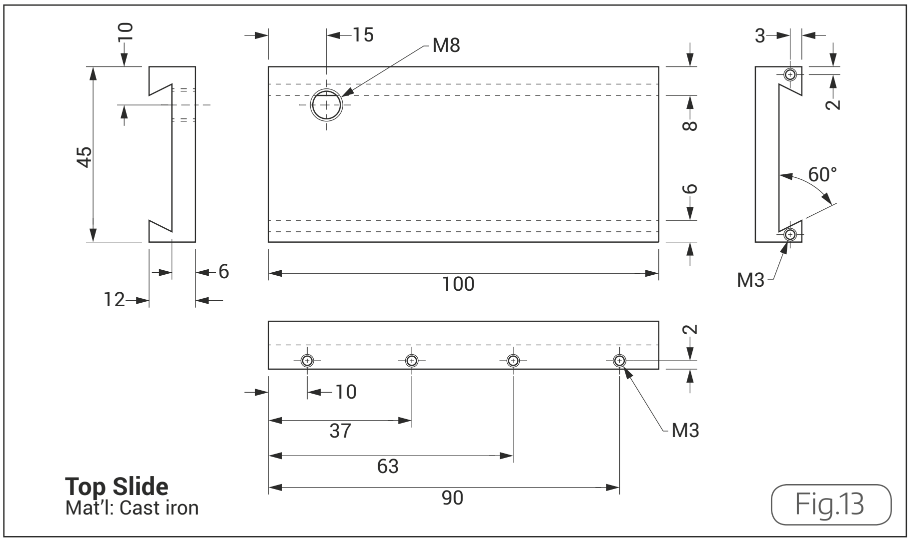
Photograph 40 shows how the top slide base is secured to the cross slide with two hardened radial plugs forced against the circular dovetail by means of M3 screws. This seems to be a very secure method that both prevents rotation and lifting of the top slide. As shown in **fig. 12a**, the ends of the plugs are cut across at 60 degrees to match the angle of the dovetail. A scrap of brass angle screwed to the front of the base carries the index for top slide set-over.

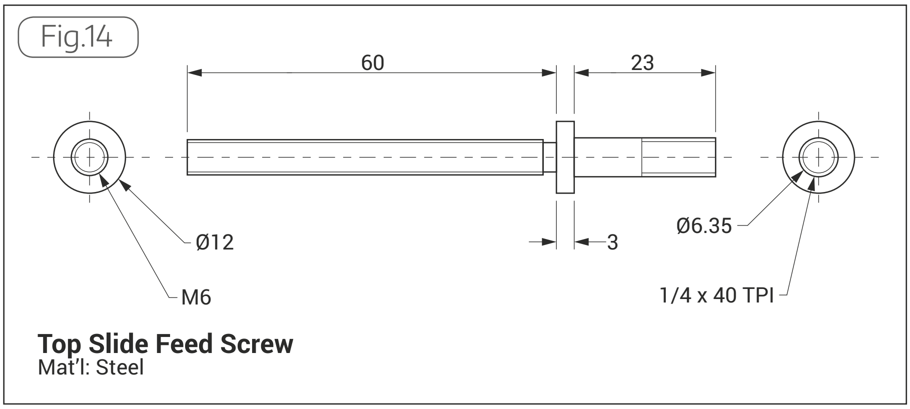
Top slide

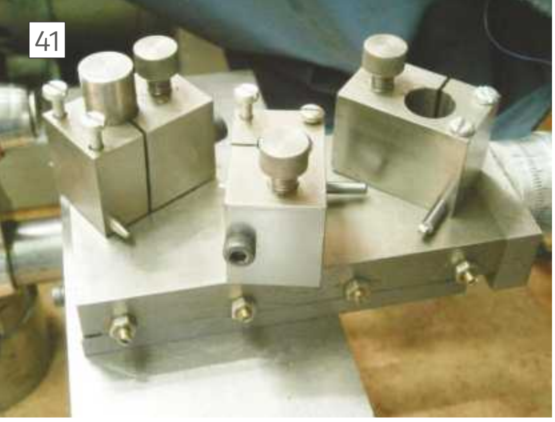
Machining the top slide is really like machining the cross slide (**fig. 13**) at a smaller scale and with slight variation in the feed screw and its bearing (**figs 14 and 15**) except that instead of the hole for the top slide base, there is an M8 tapped hole for a 12 mm diameter tool post pillar. The index disc is identical in dimensions as are the thimble and nut, but the thimble, though it has 100 divisions, is numbered 0 to 1 mm instead of 0 to 2 mm, since it spends most of its time traversing the tool parallel to the lathe's axis.

Tool posts

When turning very small diameters, as in chronometer and watch pivots, the tool needs to be dead on centre height and very sharp if it is not to break the pivot as it approaches finished size. Because of this I decided to make several quick change tool







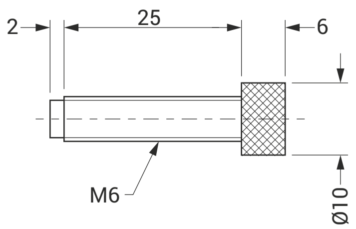
Too posts

mm long and 1/8 inch (3.17 mm) in diameter, just the right size, used whole, for the scale of the lathe, and are rapidly sharpened on a diamond grinding wheel or, less rapidly, even with a diamond file.

The tool shanks are anchored in a reamed 1/8 inch hole by two long M3 screws or M3 grub screws and the amount of tool projecting is easily adjusted. They are long enough and rigid enough, given the small cutting forces, to be used with a relatively large amount of overhang to get into confined spaces, very much more than one would ever contemplate with a full-sized lathe. A reamed 12 mm diameter hole is split to allow the post to be clamped to the pillar projecting from the top of the top slide by a single M5 screw. Parallel to this hole is one tapped M6 for a height adjusting screw (**fig. 17**). **Photograph 41** shows a selection of tool posts on top of the finished slides.

Headstock indexing

The front face of the drive pulley has 60 holes in it, presumably intended for gear cutting with a cutter mounted on the top slide and driven off a counter shaft. The tapered hole at the rear of the headstock, shown in photo 5, was presumably intended for an indexer, though I cannot think why the headstock was not designed to have



Height Adjusting Screw
Mat'l: Steel
Fig.17

Headstock indexer

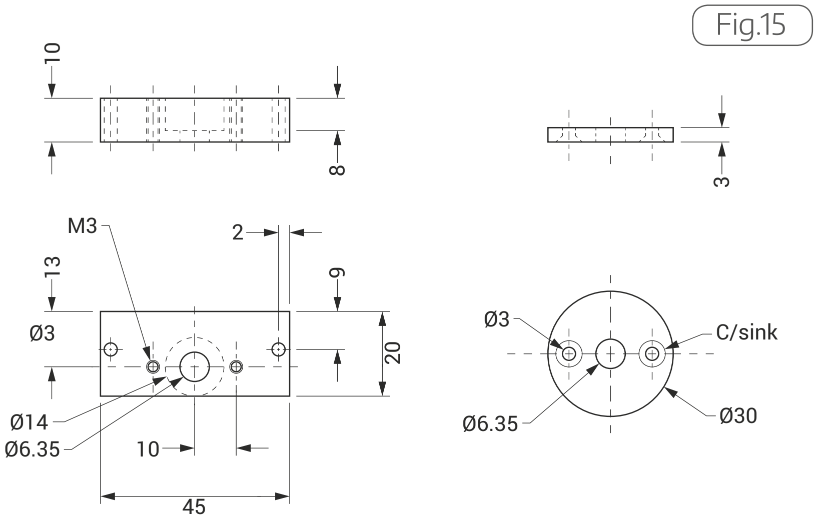
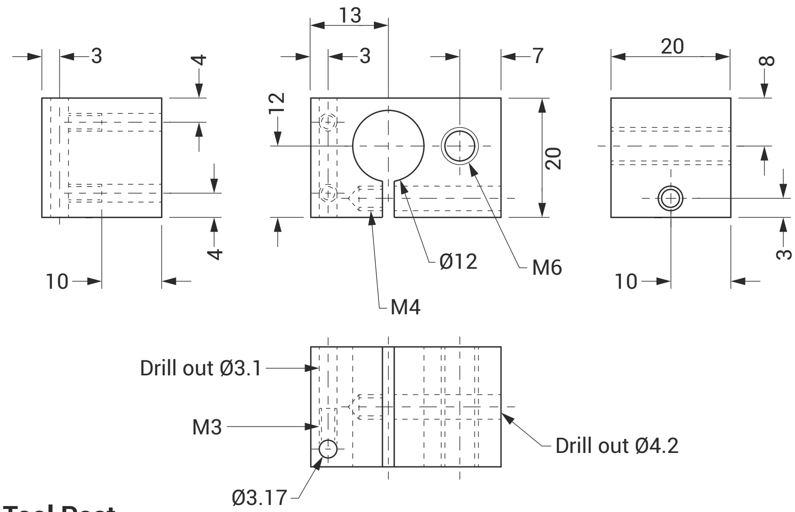


Fig.15

Top Slide Feed Screw Bearing And Index Ring
Mat'l: Aluminium & steel

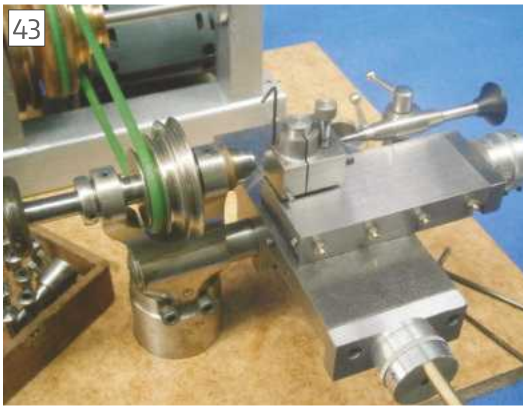


Tool Post
Mat'l: Steel
Fig.16

the large diameter of the pulley at the rear. At any event, as I have a souped- up and improved New Zealand version of the Jacobs gear hobbing machine (of which only three exist) I am unlikely to use the little lathe for gear cutting, especially given the price of horological spur gear cutters. However, for completeness, I lashed together a leaf spring and a few bits and pieces to make the index shown in **photo 42**.

Also visible in photo 42 are the countershaft pulleys, the stepped one made of brass and the motor pulley made of varnished MDF. The round plastic drive belts are made from cheap stock imported from China through the good offices of e-bay. This material is very easy to join by heating the ends in a spirit lamp (to avoid the presence of soot) and holding them together in a small vee block to align them while the joint cools down. It then has to be trimmed with a razor blade and by grinding. As sold, the material tends to slip on metal pulleys, but a rub down with some rosin soon cures this tendency. **Photo 43** shows the slides and tool post completed.

Readers who might wish to see photographs of the lathe in use will find an account of a chronometer balance staff being turned here: https://chronometerbook.com/?s=intact+staff ■



Finished slides

Lathework for Beginners

PART 1 – INTRODUCING THE LATHE

This new series will build into a complete guide to using an engineering lathe. This month Neil Wyatt starts right at the beginning by taking you on a tour of his new lathe.

If you are a beginner at model or hobby engineering, may I start by wishing you a warm welcome and saying that you can look forward to one of the most fascinating and rewarding of hobbies. Wherever your new hobby takes you, and whatever you decide to make, repair or repurpose it's almost certain that one machine tool will be there with you on every step of the journey, a lathe. The lathe has been described as the ultimate machine tool, it certainly is the most versatile as with a bit of ingenuity it can be made to serve as many other tools such as a drill, shaper, mill or dividing head!

In hobby engineering, there is rarely a right way to do anything, there are usually a good range of options and the best one to suit you will depend on the size, capacity, quality and condition of your machine and tooling, as well as your own experience and skill levels. That said there certainly are wrong ways of doing things, the consequences of which range from merely sub-standard results through damaging or spoiled work or tools, to a genuine risk of injuring yourself.

In this series, I will cover a range of ways of approaching different jobs and my aim will be to give you lots of practical explanation and advice. This doesn't mean that my solutions will be the best for every situation, but they should give you a sensible starting point.

If I can give one piece of advice at the beginning that should apply to every machinist, it is to trust your intuition and your senses. Before you start a machining operation, take a quick look around – is everything secure, are leads and tools clear of moving parts. Turn the lathe by hand to

1 It's not every day you get a delivery this size!

2 The lathe in its packing crate.

3 Assembling the stand in its original position.

make sure that nothing is going to clash, that guards are closed and switches and levers are set correctly.

If you think a workpiece doesn't look secure or balanced, it probably isn't. If you feel strange vibrations or hear unpleasant sounds, then something is probably not right. Develop a feel for how your machine behaves and feels when it is working happily, and if it starts to protest, stop and think about what might be going wrong before you damage a tool or spoil a piece of work.

Many readers will know that, for the last eighteen years my lathe has been a 7x12 Mini-Lathe. Over the last twenty years these machines have proven to be a capable and affordable introduction to hobby engineering for thousands of people. There are many, many other machines associated with model and hobby engineering, notably the Myford ML7 and Super 7 lathes; I could go on to list a dozen other popular machines and I would be accused of leaving out important examples.

For this series, I will be using my new SEIG SC4-510 lathe from Arc Euro Trade, photo, who have sponsored this series. The SC4 is a medium-sized machine, quite a bit bigger and more solid than a Mini-Lathe, and slightly larger than the Myford 7-series machines, however, all engineering lathes work on the same basic principles, from the tiniest to the very largest, and this series will be of use to anyone who is starting out in lathework.

The lathe arrived in the larger of these two wooden boxes, **photo 1**. This is box the lathe was shipped to the UK in, and although it had been opened for a basic check, I don't think the machine had been removed from the crate, **photo 2**.

It's important that any lathe is used on a good solid bench or stand, not least to make sure that it doesn't move around if you start it up with an unbalanced workpiece. Smaller machines can be attached to a board that can temporarily be clamped to a bench, but once you get to mini-lathe size or larger you probably want your machine to have a permanent home. The SC4 weighs in at around 90 kilos (200 pounds) and as my existing lathe bench was to narrow I had the choice of building a new bench or using the dedicated stand for the lathe, in the top box in the earlier photo. The stand was partially assembled, with just a few parts to screw together, **photo 3**. This was mostly easy but it was a challenge to start two of the nuts that were close to the door frames.

Thanks to the help of my step-lad, we were able to move the lathe into my workshop and lift it onto the stand, it fits over six long studs that thread through a large drip tray and into the top of the cupboard units. Fortunately, Wes is a lorry driver and used to handling heavy items.

The stand and lathe were a good fit in the space I had cleared for them, but I soon discovered a problem – no room for the gearbox cover on the left of the machine to open! I was very glad I hadn't built a custom bench at this point. The solution,

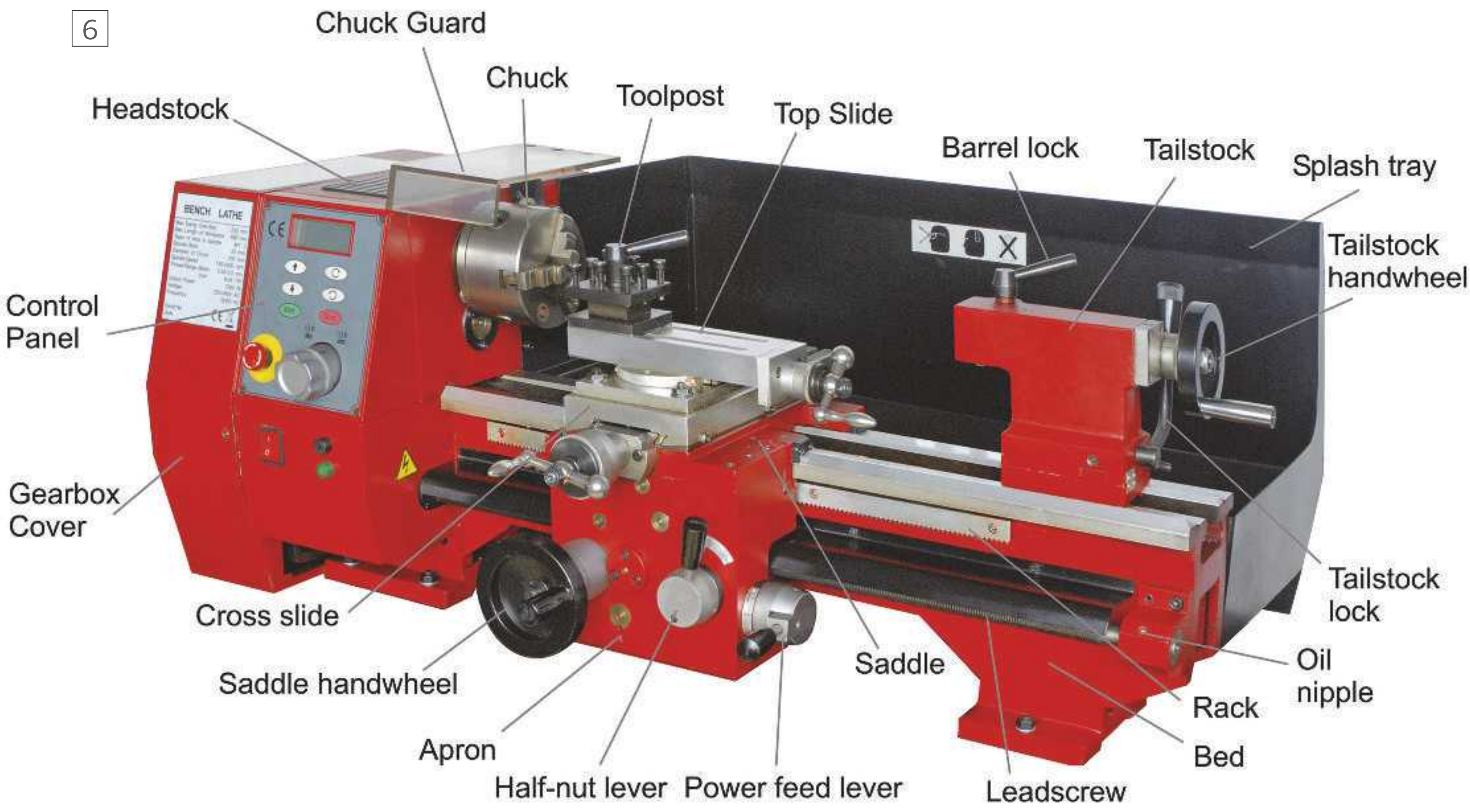
On the Origin of Lathes

In principle, a lathe is one of the simplest of machine tools, in fact it is probably the oldest of machine tools. In its earliest form, it was probably two fire-hardened wooden points (centres) between which a piece of work was fixed; the work was then rotated back and forth either by the cords of a bow or a thicker cord between a springy branch and an improvised foot pedal. A simple wooden block would suffice as a tool rest, and the tool could be a stone edge embedded in a wooden handle. If you have ever seen a demonstration of green woodworking or 'bodging', then you have seen an ancient human skill in action.

A curious property of a lathe with two non-moving (dead) centres is that, at least in theory, any work you do on it will be perfectly circular (although it may well have a taper). One development of the 'dead centre lathe' was the watchmaker's turns, a tiny metal version of the primitive bowed lathe, still used by some artisans to this day.

The final position for the lathe.

This board is enough to stop any tipping risk.



The main parts of a lathe.

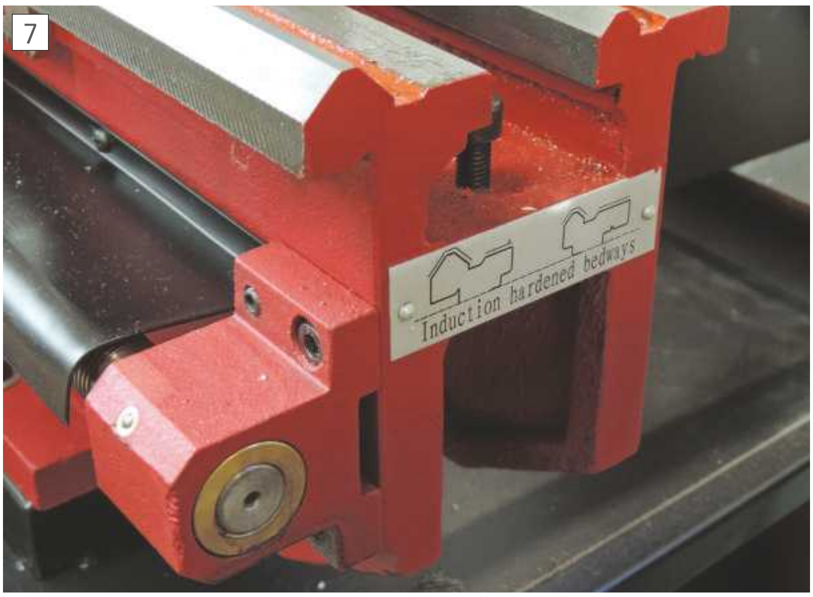
How Big is Big?

When you choose your first lathe, the most important thing to consider is the size of work you want to do with it. In the UK the capacity of a lathe is usually described by its centre height – the distance from the bed to the middle of the spindle, or its swing - the diameter of the largest object it can hold. Naturally, this means that the swing is twice the centre height. Another important number is the distance between centres, the longest object the lathe can hold.

In North America a lathe is often referred to by these numbers – but always in inches! A Myford Super 7 might be described as a '7x19' lathe in the USA, and Mini-Lathes are often known as 7x10,12,14 or even 7x16 machines, depending on the model.

This doesn't mean, of course, that you could actually turn a 16-inch length of seven-inch diameter work in a mini-lathe, a bar of steel that size would weight nearly 100 kilos! But it's not just the weight, as the height of the cross-slide limits the practical maximum diameter of work of any length, so a third useful figure is the 'centre height (or swing) over cross slide'.

To give you an idea of the size of the SC4-510 lathe featured in this article, in the USA it would be described as an 8x20 lathe. The centre height is 105mm or just over 4", giving a swing of 210mm or 8 ¼". The centre height over the cross slide is 60mm, which is a generous swing of 120mm or 4 ½". The distance between centres (as hinted at in the name) is 510mm or 20".



The prismatic bed of the Arc SC4-510

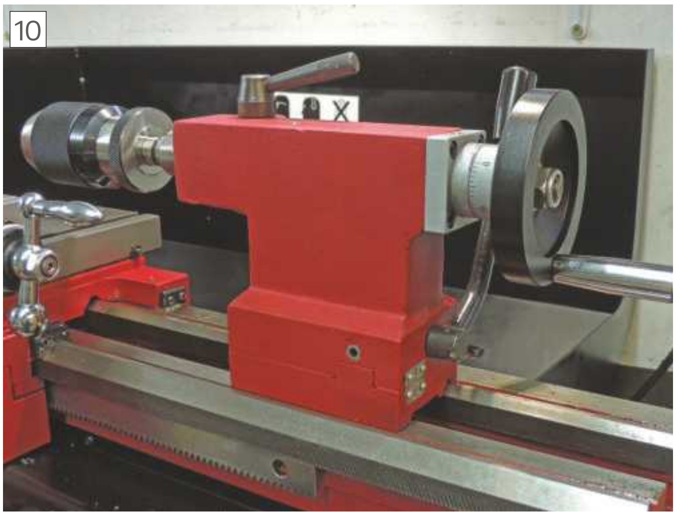
which was probably a better one for me anyway, was to move my milling bench, shortening it by about 200mm, and shuffle the lathe and stand into the gap, **photo 4**. I was able to manage this on my own. I took the opportunity to move my big record vice to a new location as well and to raise my mill by about 12mm so it could sit nearer the back of its bench. So although all this changing around took a fair bit of effort, it's actually made a big improvement to my workshop layout.

Much is made about the importance of levelling a lathe; but in practice, what matters is making sure the machine is not distorted when you bolt it down. As I have a wooden sub-floor above the concrete base of my workshop, my plan is to leave it in place for a month or two. Once it has settled in place I will make some test cuts and if any twist is evident, I will correct it – this will be for a later article. For now, I just tightened up the four studs at the headstock end of the lathe, but left the two tailstock ones finger tight.

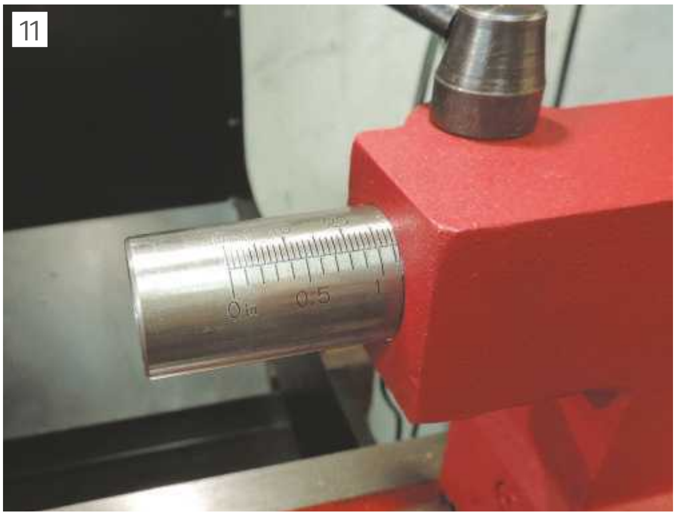
The stand has four large holes in each of the cupboard units for fixing to the floor. In industry, you would fit studs into the floor and drop the stand

A simple protector for the bed.

The three-jaw chuck, 4,200 is the maximum safe speed.



A close up of the tailstock, with a drill chuck fitted.

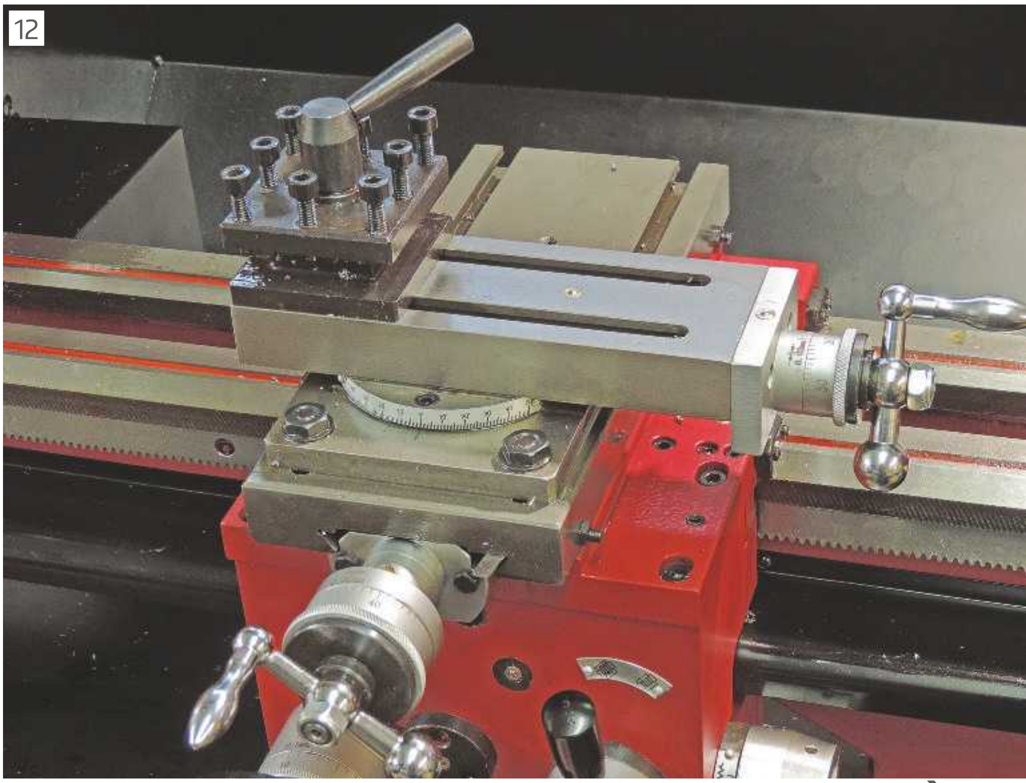


The graduated tailstock barrel.

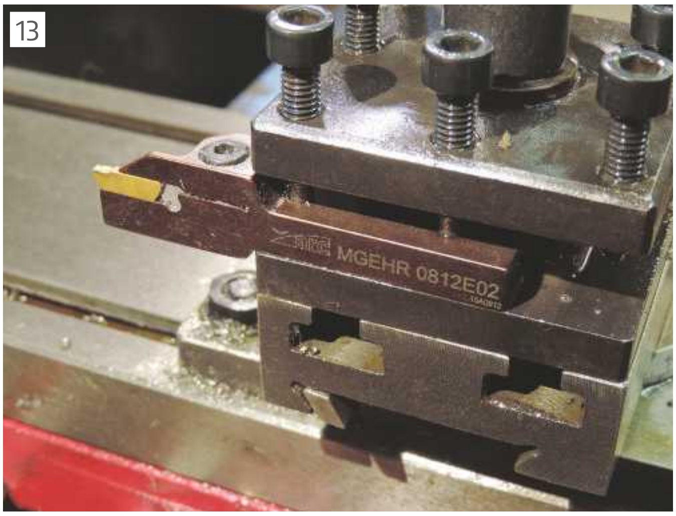
on top, but this was impractical for me. I still felt it was important not to allow the stand to rock, so I screwed a piece of 12mm plywood to the floor overlapping the fixing recesses on the inside of the stand **photo 5**. This has firmly fixed it in place, and is easy to change should it need to be moved.

Now the lathe is safely in its home, let's start the tour, as each of the parts is mentioned in bold, you can refer to **photo 6** to see what I'm referring to.

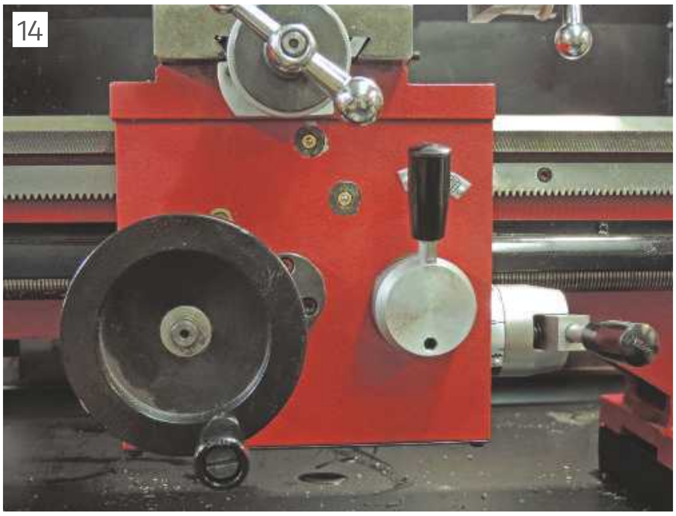
The heart of any engineering lathe is the bed, as this is fundamental to its accuracy, stability and rigidity. The bed of the SC4 is a massive cast iron affair, it has a double-inverted vee or 'prismatic' bed, **photo 7**. The bed is induction hardened, this means it has greater resistance to wear and picking up 'dings' and scratches, but be aware that there are limits to how hard it is possible to make cast iron so you should still treat the bed with respect. One of the first accessories you could make for any lathe is a board to fit across the bed, **photo 8**, with a wooden tab underneath to fit in the central slot of the bed. This acts as a protector against dropping heavy work or accessories and also prevents accidents if you ever use a hacksaw to chop short work held in the lathe!



The saddle and its various slides.



A parting tool fitted in the toolpost.



The apron has several controls.

The inverted vee bed used to be known as 'American' style in contrast to British 'flat bed' lathes, but in practice most modern lathes now have either one or two inverted vees.

The front vee runs the whole of the length of the lathe and it acts as a key for the headstock which has a matching v-groove on its underside. It carries the spindle in a combination of ball and taper roller bearings and the vee helps ensure the spindle is accurately aligned with the bed. The spindle is driven by a powerful 1kW (1.3 horsepower) brushless motor, which is operated (speed and direction) from a control panel on the front of the headstock.

The spindle can have various workholding accessories attached to it, the one supplied with the lathe is a three-jaw chuck, which is particularly suited to round material, **photo 9**. The chuck guard is fitted with an interlock switch so the motor will only run with it closed, its main purpose is to stop the lathe being started with the chuck adjusting key in position. We will go into various other alternative workholding methods in a later article.

The rear vee stops short of the headstock and guides the movable tailstock, which can be locked in place by a tailstock lever, a great time saver, **photo 10**. The tailstock contains a retractable barrel, **photo 11**, operated by the graduated tailstock handle, which can be locked in position with the barrel lever. The tailstock can be used with various accessories to provide support for long work or to hold drills and other tools.

Between the head and tailstocks, is a large and complex assembly of sliding parts, **photo 12**, one on top of the other. Sitting on top of the bed, and guided by the v-ways is the saddle, which can move left to right along the bed. Mounted on the saddle is the cross slide, this is arranged to move back and forth at ninety degrees to the bed. The cross slide has two long t-slots that can be used to mount accessories or workpieces. Normally fitted to these t-slots is the top slide, sometimes called the compound slide. Often you will leave the top slide aligned to move along the length of the bed, but unlike the other slides it can be rotated at various angles.

On top of these three moving slides, is the toolpost. It should now be obvious that in normal use a tool is fitted in the toolpost, **photo 13**, and work is shaped by moving the tool using the different slides. All three can be moved manually with graduated knobs on the top and cross slides and a large, graduated, saddle handwheel on the front of the apron, **photo 14**, which drives the saddle via gears and a rack on the front of the bed. The apron also carries two more levers. The half-nut lever engages a special half-nut with the leadscrew, by setting up various gear arrangements inside the gearbox cover. This arrangement allows you to cut accurate screw threads, or at finer feeds make roughing out cuts under automatic feed, a large selection of change gears are supplied with the lathe, **photo 15**, as well as various spanners, allen keys, a dead centre, a chuck key and outside chuck jaws.

By pushing the power feed lever down, a series of gears inside the apron provide an alternative, lower speed, drive to the saddle which is used for finer finishing cuts. When the lever is moved up this feed operates the cross slide instead, allowing a tool to be moved back and forth across the work under 'power cross feed'.

Also obvious in the labelled photo is the large splash tray at the rear of the lathe and some of a large number of oil nipples that are used to lubricate the lathe's moving parts.

If this dash through all the features of a typical engineering lathe has left you with more questions, don't panic. In the next instalment of this series we will look at basic turning and take a closer look at some of the features discussed this time. ■

The SC4-510 lathe is available from Arc Euro Trade, http://www.arceurotrade.co.uk, who also sell the SC2-300 and SC3-400 mini-lathes if you want something a bit smaller.

The accessories supplied with the lathe. Another four change gears are fitted in the gearbox, and there is the three-jaw chuck.

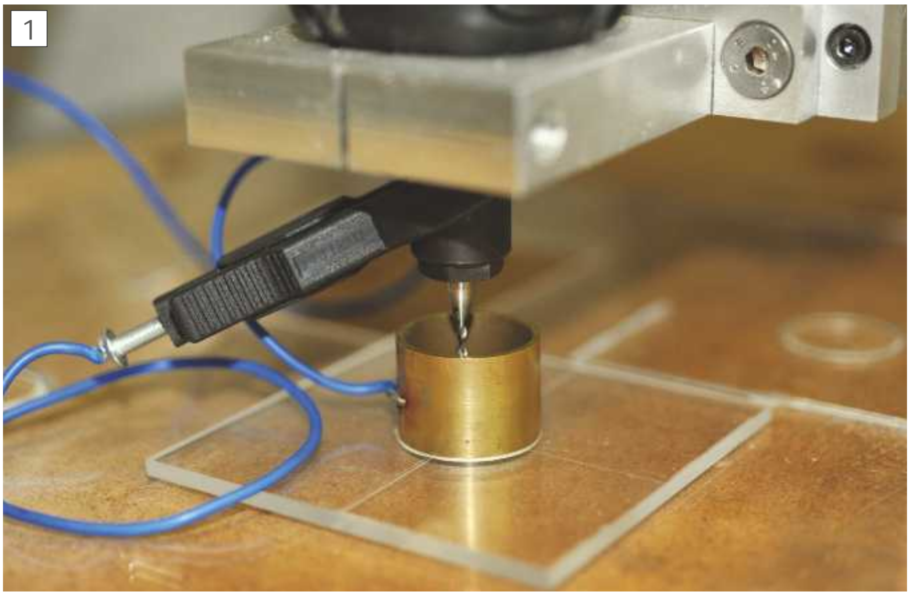
An X,Y and Z edge finder for Mach3

Glenn Bunt makes an aid to CNC accuracy

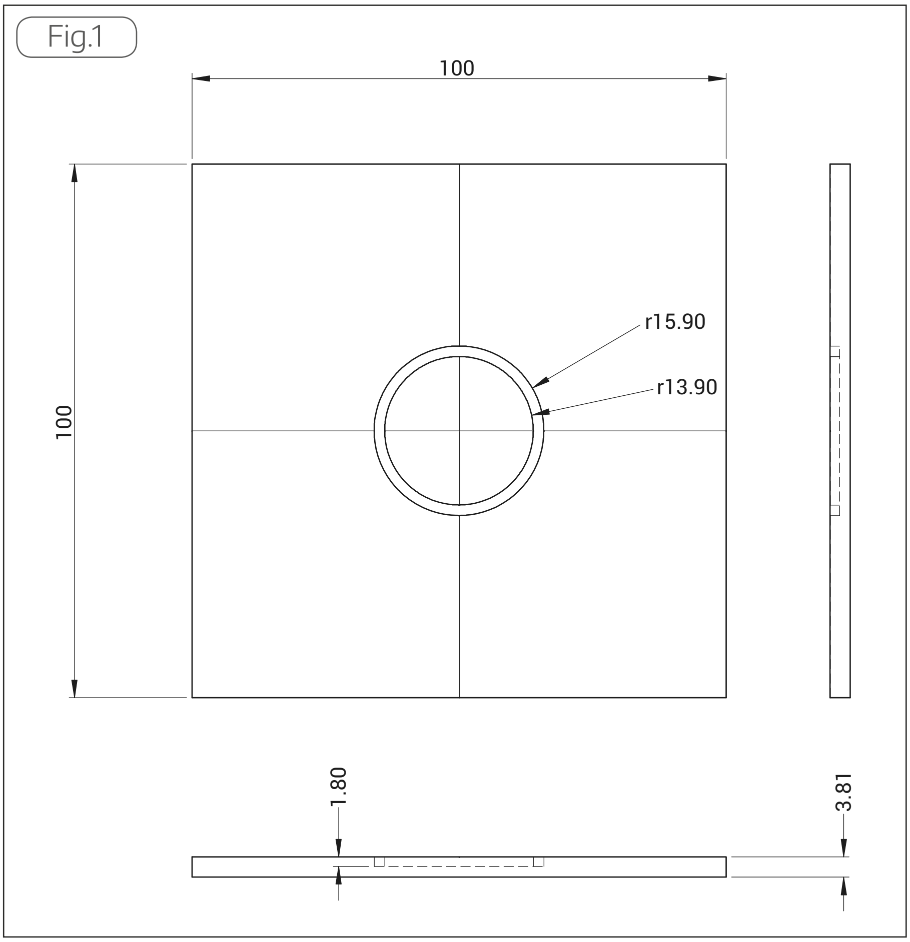
Having recently made my own cnc router engraver, I was surprised to find how difficult it was to find or set the X,Y and Z axis zero coordinates for a part.

To set the part reference on my milling machine I use an edge centre finder or wiggler. This is a tool that you put in the machine chuck and run it at a low spindle speed, gradually incrementing the axis until the bottom part is pushed off its axis when touching the edge of the part. It's then a case of subtracting half the diameter of the tool and bingo! that's the zero coordinate for the axis. When setting the Z axis, I normally increment the tool down onto the part until it starts to grab a shim that I use to set the gap.

The type of spindle used on a router tends to be high speed and therefore prohibits the use of centre finders or wigglers. The same technique can be used as above to set the Z axis but again it's not particularly easy. Therefore, I started doing some research to find out if there is an easier way to set up a router.



The XY finder in use



This article covers a system I found on the internet. There are many versions of X,Y and Z finders described on the internet, indeed if you've got deep pockets there are commercial systems available as well. Here I describe what I chose to build from the what I found.

The X Y finder I describe uses a copper tube mounted on a polycarbonate plinth and some software (button script in Mach3) to touch each quadrant with a tool and then retract back to the centre of all the points.

The Z finder gradually increments down onto a plate or plinth and then retracts back the previously set dimension plus plate thickness. Setting the DRO as it does so. It is demonstrated on YouTube (ref. 1).

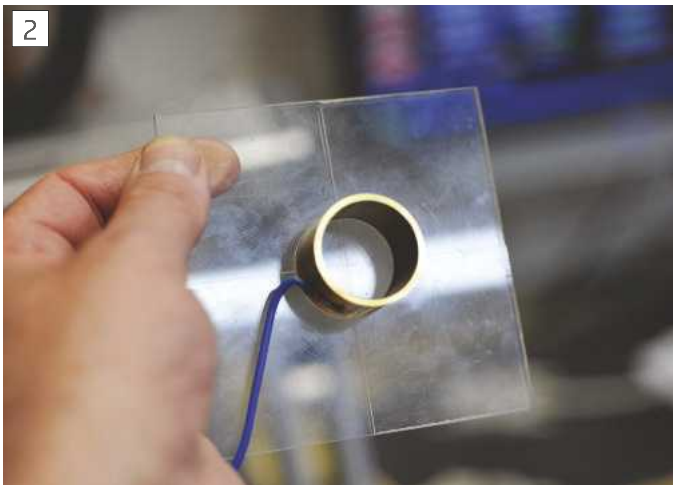
The X & Y Finder mechanical components

This system is for use with a CNC machine that is controlled by Mach3.

Photograph 1 is a clear plinth with a tube mounted on it, a cross hair is scribed into the plinth that bisects the tube diameter.

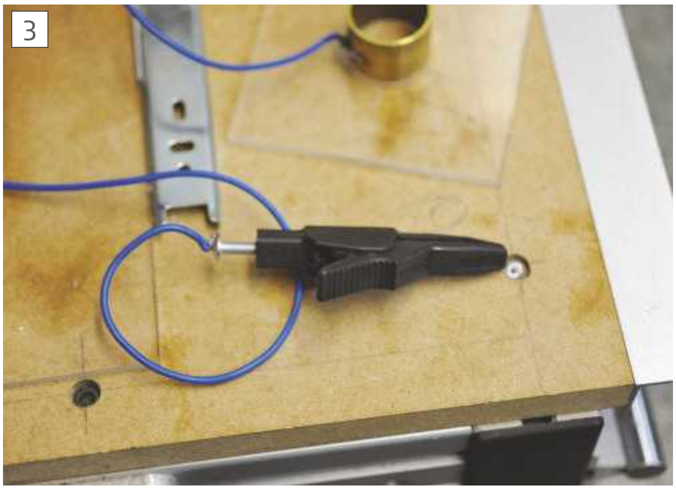
Figure 1 shows the dimensions of the plinth I made out of polycarbonate.

2



The scribed lines

3



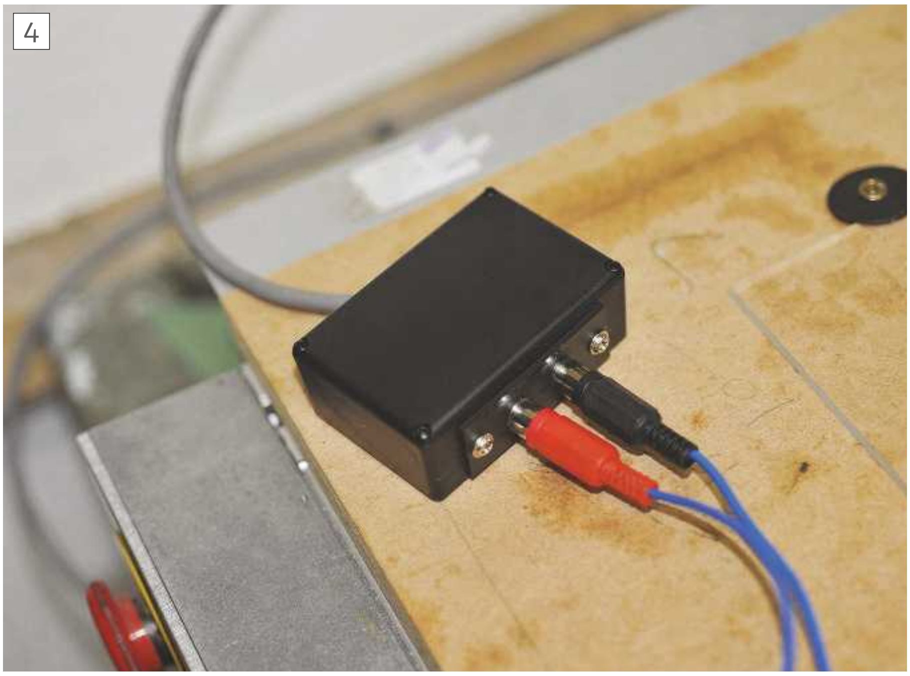
Croc clip for attaching to the probe

I used a 2mm cutter on my router to create the circular recess in the 4mm thick polycarbonate. I then cut the square shape out of the material. I had a few attempts to try and get the feeds and speeds right so that the material didn't pick up on the cutter and mark the edge of the material. In the end, I think it was more important to use WD40 as a coolant to try and keep the polycarbonate from melting!

After cleaning the edges up with some emery paper, I rechecked the dimensions side to side ready for scribing of the cross hair. On an engineering plate (you can use any suitably flat surface) I set my digital height gauge to half the measured dimensions and then proceeded to use the measuring tip to scribe one cross hair at a time. Only, if you're not playing full attention like me, you set the wrong dimension and have to scribe the line again! What do they say about measuring a part, then measure again before you before acting?

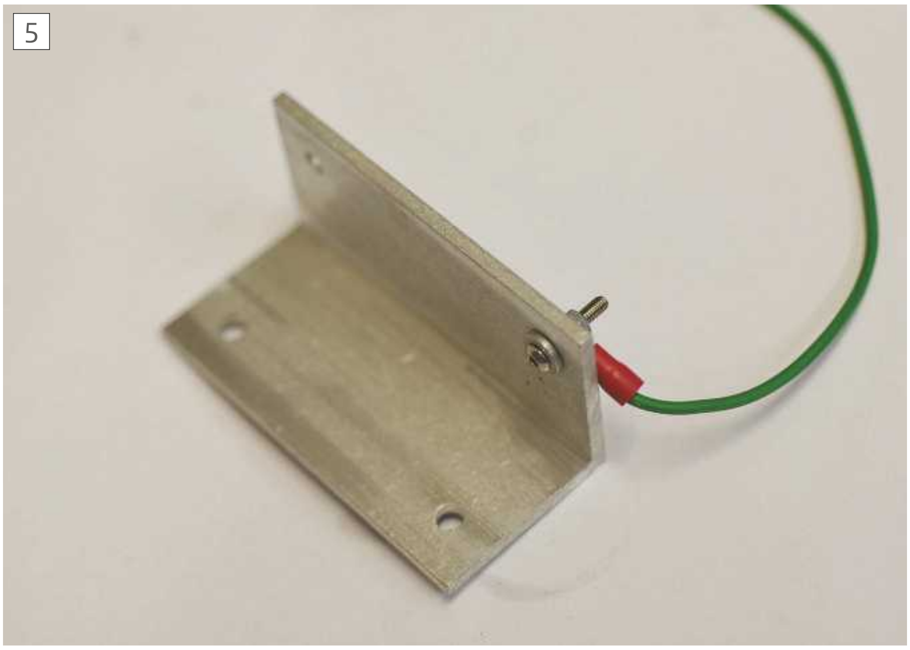
Photograph 2 shows X and Y finder plinth assembled with the soldered brass ring. Readers may just be able to see my mistake with scribing the line.

4



Junction box with phono sockets

5



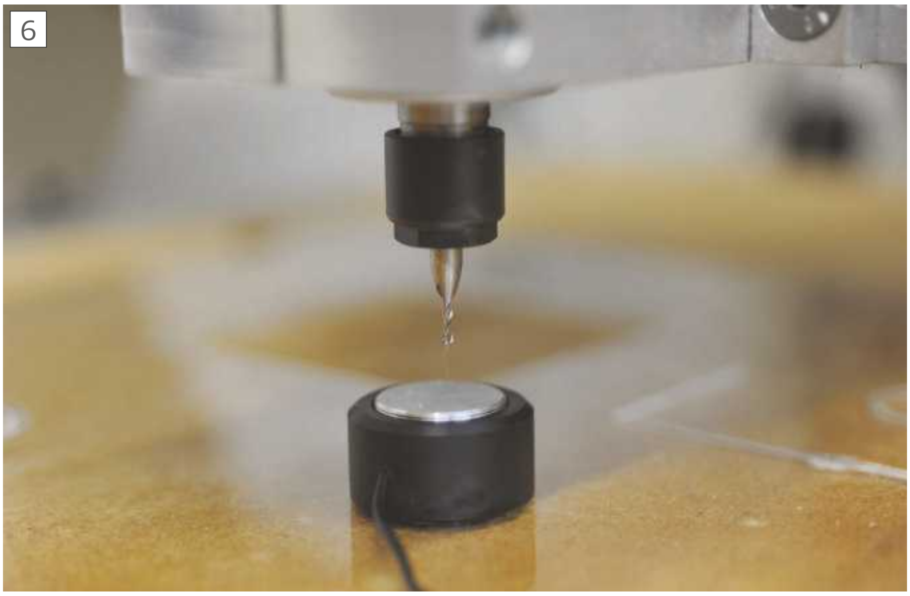
Home made z-finder plate

The circular recess was dimensioned for the brass tube I had available. In fact, it was probably better to use copper but I had none available and anyway more pleasure is derived from using something from the scrap bin.

The brass tubing was faced off and the ends tidied up in the lathe. Both outside and inside diameter were cleaned up with wire wool. The length of the tube was 25mm.

Next, I soft soldered a length of 48swg insulated wire onto the side of the brass tube. This again was cleaned up before applying superglue to one edge and inserting it into the circular recess in the plinth.

On the end of the wire I soldered a male phono socket connector. A crocodile clip was selected for the part of the X and Y finder that connects to the tool. I soldered another length of wire onto it and again



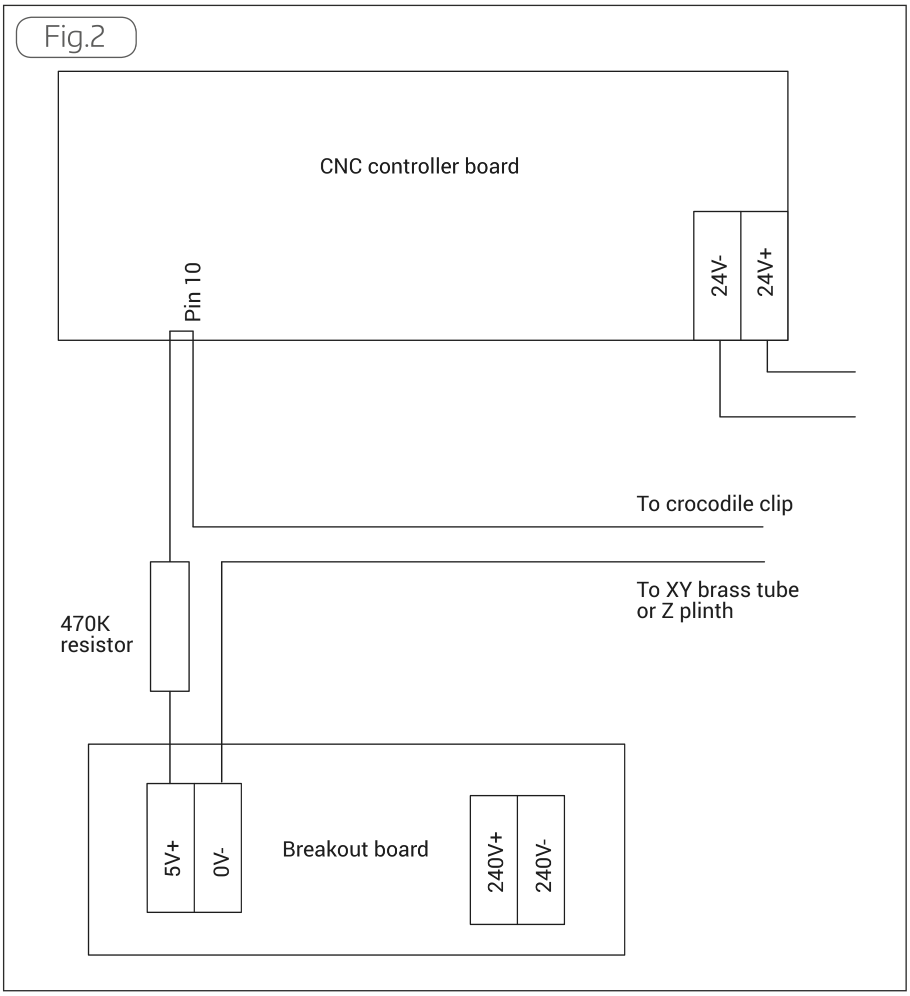
Commercial z-plate

attached a male phono socket onto the other end.

Photograph 3 shows the slightly modified crocodile clip, I chose a slightly larger version to accommodate a full range of cutter diameters (large to small). I soldered wire onto a coarse thread machine screw and then screwed this into the end of the clip. A bit of a bodge but it worked!

To tidy everything up, I purchased some female phono sockets in a panel and a little project box to mount them in (see parts list). The project box and phono sockets will allow connection of either the X & Y or the Z finder tooling to the CNC controller. Without having to unplug the connections at the back of the controller.

You could use, as I did for the trials, a chocolate block terminal block to connect the wires to the mechanical bits but it looks more professional with the phono connectors.



Two cores, of a four-core twisted cable, were soldered onto the centre terminals on each female phono socket. The cable was inserted out through the back of the box via a drilled hole and connected at the other end with a four-pin multipole socket to interface with the mach 3 control board.

In the parts list, I have specified 4 pin pole connectors and sockets (others are available ranging from two pin to eight pin). These connectors are ideal as they plug in and have a secure, threaded mating ring to lock them into position at the back of the controller. **Photograph 4** shows the project box with phono sockets

Z axis finder mechanical components.

If your attempting this project you have two choices. Make your own Z plate or buy a purpose made Z touch plate from ebay.

Photograph 5 shows the home grown version. It's a piece of aluminium angle. It must be square, flat or not distorted when placed on a surface and not vary in thickness over its length. An insulated wire is bolted to it via a soldered circular spade terminal and again its terminated by a male phono socket.

Photograph 6 is a Z touch plate that can be purchased off ebay for a couple of quid. I first made the latter to test the system out but later purchased the Z touch plate. It looks more professional and in reality, you would never be able to make this item at home for the price. The wires provided with it are terminated at the end with a male phono socket.

The wiring configuration

Figure 2 shows the wiring diagram. One wire of the shielded cable is connected to a spare input pin on the main cnc driver board. I chose pin 10. A second wire is connected to -5 volts on the breakout board. An additional connection is made from the breakout board +5v supply via a 470k resistor to the previously chosen input pin on the driver board. This is necessary to "pull up" the input to the parallel port and ensure when switching the system on an Active Hi signal is given as input into the parallel port.

Mach 3 is configured as per **fig. 3** and **fig. 4** shows setting up the charge pump. (i.e. configuration for Mach3 start up).

MachBlue screen and modifications

In order to automatically find X and Y centre point using a tool and the edge finder you will need to download a Mach 3 screen and some other files.

The screen needed for this project is called "MachBlue screen" and can be downloaded from the www.machsupport website (ref. 2) and the other files from here (ref. 3).

Important! before proceeding, make sure you have a backup of your Mach 3 software and pin settings. If something goes wrong then at least you will be able to get everything back to its original configuration!

Reference 4 is the link to the CNC Zone forum and erniebro's excellent thread, information which I have used and form the basis of this article.

In the thread, there is a link to "BlueProbeVer3.Zip" file, this contains the modifications to the standard MachBlue screen for the edge finder functionality. There are two files, the "MachBlue.set" is inserted into folder C\mach3 and the other file, "MacBlue_ProgramRun.jpg" inserted into the C:\Mach3\Bitmaps\MachTestScreens folder. The Forum thread describes the process very well.

To download the files you will need to sign up and be a member of the CNC Zone forum.

After successfully installing the files, start up Mach3 and select the "view" menu at the top of the screen. Then click on "Load screens".

Select the Machblue screen. If everything has successfully installed then you should end up with a screen like **fig. 5**.

Component List

Multipole plug, 4 pole	MULTIPOLE PANEL PLUG, 4P	8	www.cpc.co.uk	AV15051
Multipole socket, 4 pole	MULTIPOLE SOCKET, 4P, IN-LINE	8	www.cpc.co.uk	AV15048
Project box	ABS Plastic Box for Electronics Hobby Projects Enclosure Case RX2010 Dimensions 73.5 x 49.5 x 28mm	1	Ebay	
Z touch Plate	Cnc Z Axis Router Mill Touch Plate Mach3 Tool Setting Probe Milling	1	Ebay	
RCA Phono Sockets Connector	RCA female phono connectors in mounting panels 52mm x 20mm hole pitch 44mm	1	Ebay	
Cable	5472C 2 PAIR CONTROL CABLE 30.50M	1	www.cpc.co.uk	CBBR1325

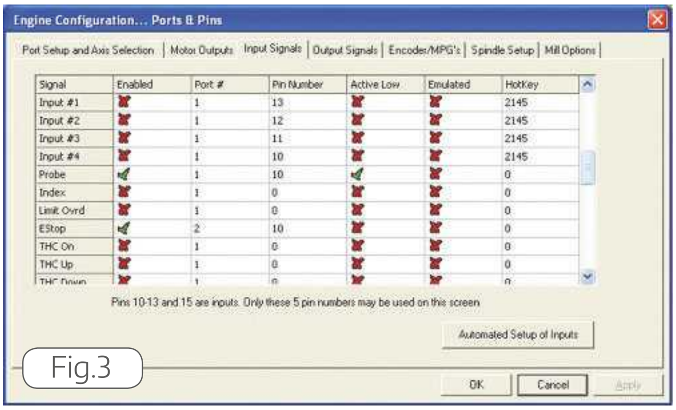


Fig.3

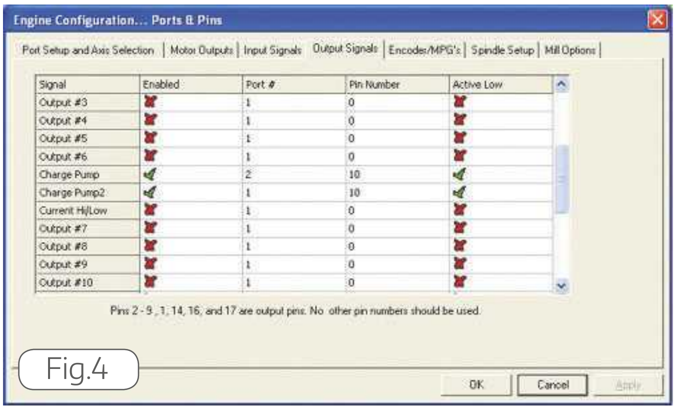


Fig.4

If there are any problems refer to the forum page as there is a lot of good advice there.

Assuming that all the mechanical bits have been made and mach3 has been configured, our next step is to test the circuit. With everything plugged in and connected, make contact between the crocodile clip and either the XY finder or Z plate (whatever you've got connected). The green led in the bottom right hand corner of the screen should illuminate, **fig 6**. If it doesn't then review your wiring configuration or Mach 3 input pin configuration.

Having successfully illuminated the green led, I was eager to test the edge finder. I placed the polycarbonate base with the cross hair on a suitable corner on my router. I moved the spindle equipped with a 3mm cutter into the centre of the brass tube and pressed the start button.

My hand was hovering over the emergency stop button but I needn't have worried. The router head moved extremely slowly and after what seemed like an age the tool eventually touched one side of the brass ring. It then retracted (slowly) and I got bored before it eventually reached the other side. I altered the feed rate override in Mach3 and tried again - with the same result. Clearly it wasn't working correctly! After scratching my head, I decided to look at the code and found out why.

Figure 7 shows the xy edge finder code. It can be accessed by selecting the "Operator" menu at the top of the Mach3 screen and clicking "Edit button script".

My system was set up for metric and the feed rates and retract dimensions were set for imperial and this was why I was growing old waiting for the edge finder to complete its cycle!

Fig.5

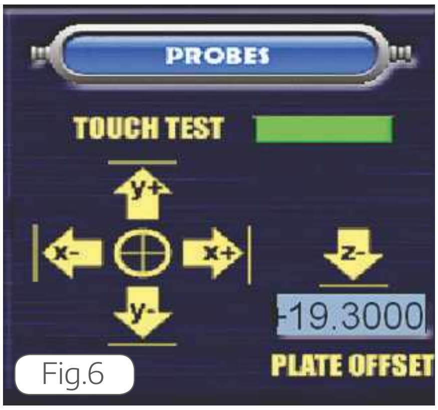


Fig.6

I made the following changes to the code to get the button script to work properly with my Mach3 configuration i.e. metric.

For the Z finder:
To modify the code select the following on the main Mach3 screen:

- On the menu option along the top of the screen select "Operator"
- Then select "Edit Button script"
- In the "probes" panel on the right hand side of the screen select the down arrow (Z-).
- In the Mach3 VB Script Editor.
- Modify the code as shown in **fig. 8**.

For the XY finder:
To modify the code select the following on the main Mach3 screen:

- On the menu option along the top of the screen select "Operator"
- Then select "Edit Button script"
- In the "probes" panel on the right hand side of the screen select the circular button in the middle of the direction arrows.
- In the Mach3 VB Script Editor.
- Modify the code as shown in **fig. 9**.

After the initial issues of configuring the button script, I tried the buttons and bingo it worked! I've used the edge finder for setting both X and Y zero co-ordinates and for setting the Z many times since.

When using the X and Y finder, the tool will touch and retract from each quadrant on the brass tube and then move to the centre of the ring. This then allows the user to set the respective axis.

The Z edge finder works in a slightly different way. As shown in illustration 6 there is a retract dimension that is input into the script. The user simply sets the thickness of the work piece and Z plate into the dialogue window provided. When running the script, the tool will touch the Z plate and then retract the amount set in the script plus user entered work piece thickness. The Z DRO readout is updated and reflects the new co-ordinate.

Interestingly, I note that the spindle start and stop buttons were sacrificed in order to add the edge finder functionality. If you do not like the MachBlue screen but want to use the edge finder functionality, you have two options.

Option 1:
Use the Machblue screen buttons to find the co-ordinate zeroes. Set your DROs and then change the screen back to the mach3 default screen "1024". The co-ordinate zeros will not change when the screen reverts back. to

The screens can be changed by selecting "View" at the top of the screen and then selecting "Load screens". You can toggle between the screens without any issues.

Option 2:
Copy the button script from the Machblue screen buttons and insert them into the buttons in the "Offsets" page on the Mach 3 default screen.

Figure 10 shows an example of this. As I don't use the gauge block height function, I copied the Z edge finder button script to the Gauge block button and re-assigned the DRO. This enables me to use the Mach3 default screen but with the Z edge finder functionality via the gauge block height tool set. Of course, this could cause problems if others are using the same software but as most of us configure their systems for personal use I don't think this would be an issue!

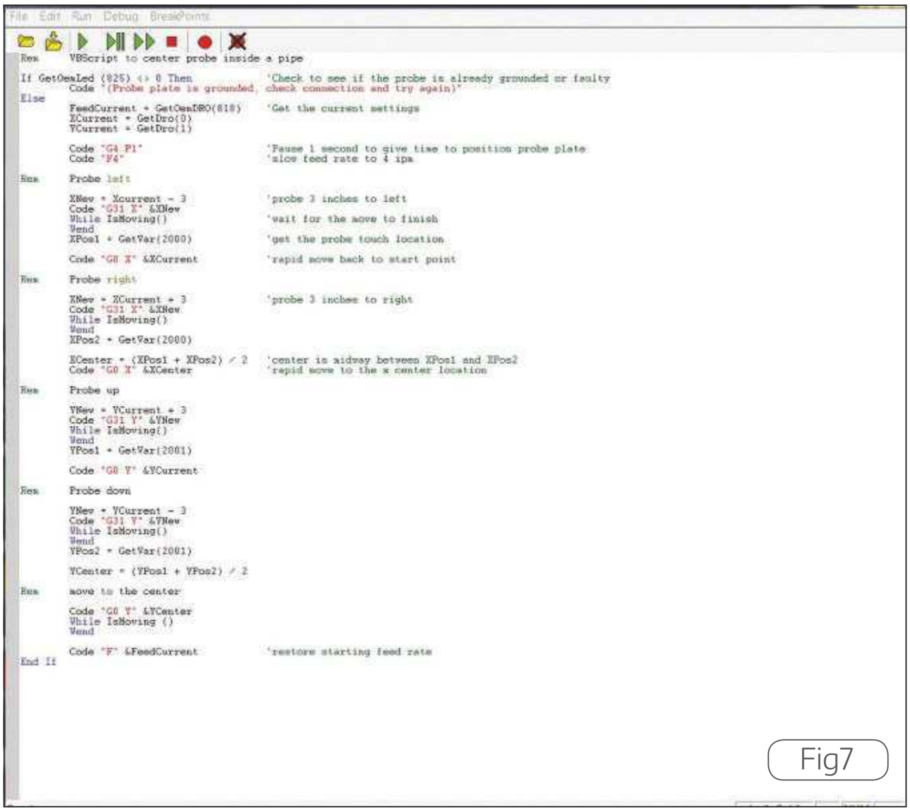


Fig7

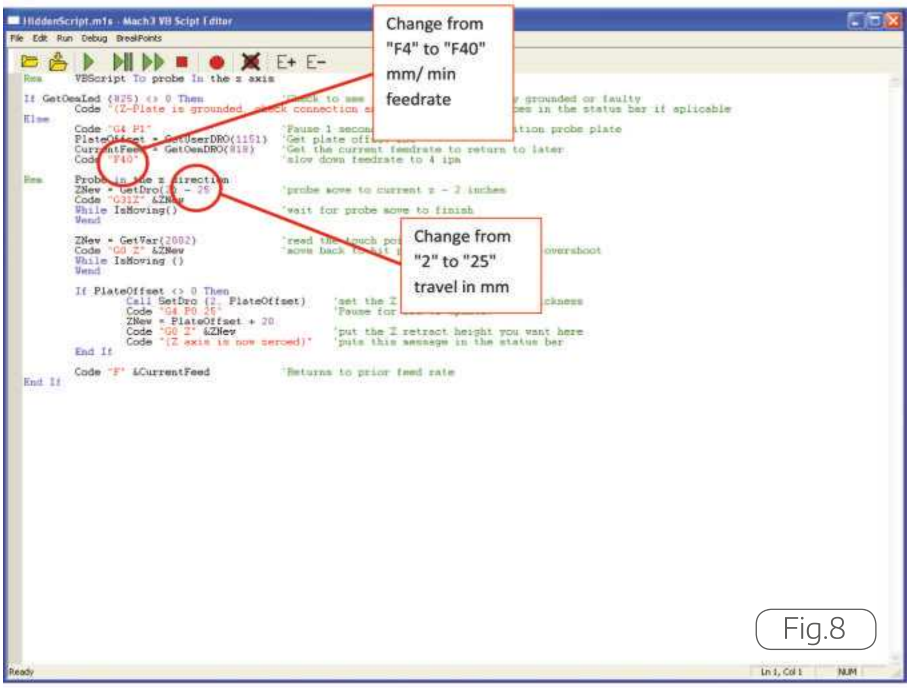


Fig.8

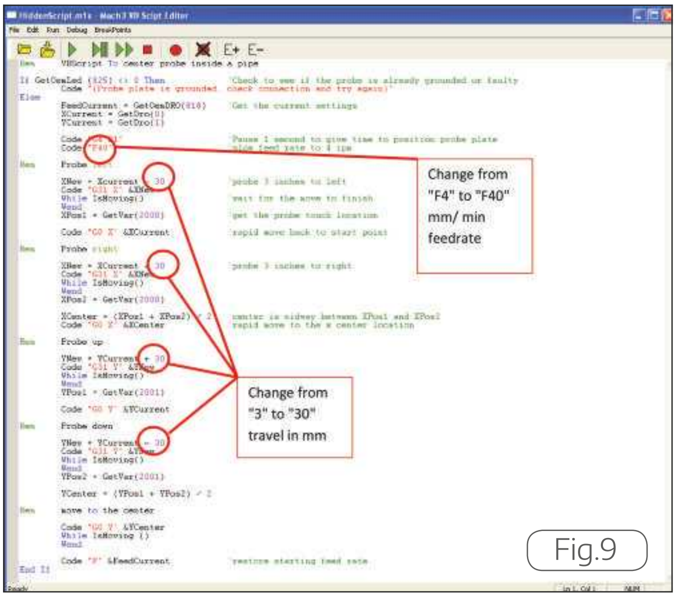


Fig.9

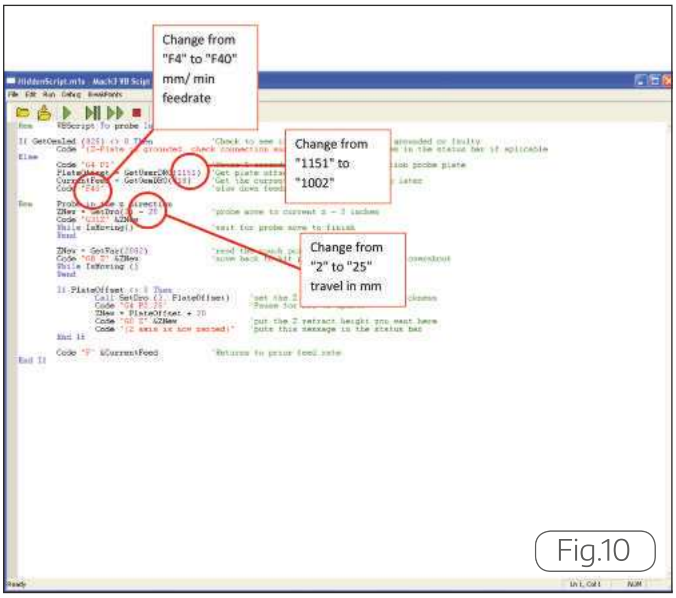


Fig.10

I hope this article will be of interest to Mach 3 users. I certainly found the edge finder function a benefit, it reduces time setting up my CNC router and it's also improved my knowledge of Mach 3.

My next challenge is to try and get the Z edge finder functionality working on my CNC mill! ■

References

(REF 1) "http://www.youtube.com/watch?v=KOXY4O0UkRM"
(REF 2) http://www.machsupport.com/software/downloads-updates/screensets/)
(REF3) http://www.cnczone.com/forums/mach-wizards-macros-amp-addons/56079-cnc-software.html#post436238)
(REF 4) http://www.cnczone.com/forums/mach-wizards-macros-amp-addons/56079-cnc-software-53.html

NEXT ISSUE

MODEL ENGINEER

- Making the Stuart Steam Hammer
- Improving 14XX Commercial Kits
- A Clock Wheel Cutting Engine
- Tips on Folding Metal
- A Dynomometer Box

Content may be subject to change.

ON SALE 13 OCTOBER 2017

A Home-Made Dividing Head

Will Doggett returns with another practical tool design for your workshop

1

The completed dividing head

After I acquired my first lathe I bought The Amateur's Lathe by Lawrence H Sparey, it was second impression 1961, it was new. I used the book for some time, then I became an apprentice in the local engineering company. The book was very useful for course work at college but after this it was put away for future reference. Then one of the projects I was making required a dividing head so I looked around for one only to find that they were out of my price range. I then remembered the book had something about dividing in it but reading through it the only problem was that the dividing head was made from castings and I could not find any at the time. The solution was to make a dividing head from stock materials that I had. The design was very roughly based on the one in The Amateurs Lathe; this book is still available but it is now in paper back form.

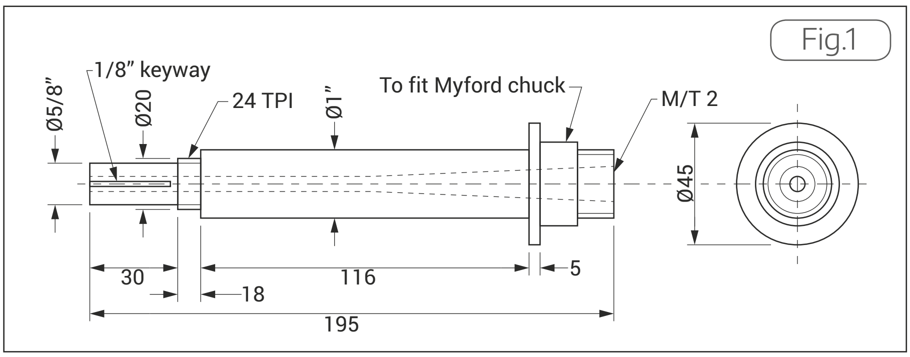


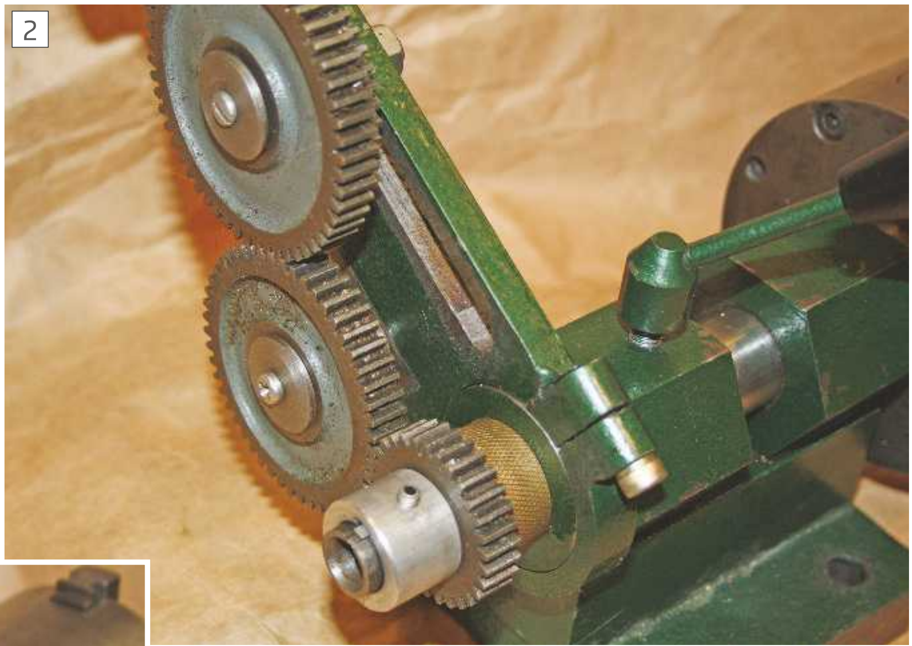
Fig.1

The dividing head in the book was designed to use a Myford chuck and gears as shown in **photo 2**. Luckily, I still had a Myford at that time so change wheels were available for this project. I later sold the Myford to make way for a new milling machine. I had a Kerry lathe as well as Myford so the Myford had to go, but I retained the 3-jaw chuck and most of the change wheels. The height dimensions shown for this dividing head are not right to fit the Myford lathe, as the design is generic and not made to fit a Myford.

I could have made a simple one with just a 60 tooth wheel with bracket for the indent as this would have served the purpose, but I thought if I am going to make the dividing head I would go the whole hog so to speak, because when you look at the finished tool there isn't a lot more work to make this one.

Main Shaft

The first part to be made was the main shaft, **photo 5**, this was a piece of 50 x 200mm mild steel machined to the dimensions on **fig. 1**. The 15mm section on the end has a 5 x 25mm keyway cut for attaching the gears this is not shown on the sketch. The 15 mm is only a guide to size as the Myford gears are 5/8" bores far



Myford gears

Compound gears marking

as I know, so the size will need to change to whatever suits your gears. The 20mm section has a thread on it, this is 24 tpi. It is this fine a thread so that there is no endfloat in the shaft. The shaft is drilled 10mm all the way through and a Morse Taper 2 is machined in the front. The thread and register are for a Myford chuck, **photo 3**, or faceplate. The Morse taper 2 can be used with the faceplate and a centre. The reason for making this first is so that it can be used to set-up the main body when it is made and put together. The fixing nut I made from some 30mm brass and made it 15mm long with a 22mm x 24 tpi thread to fit the main shaft. This was screw cut at the same time so that I could check the fit. The nut has a knurl on it to help when tightening it and it is held in place with a 2BA socket head grub screw (M5 will do just as well) after the shaft has been adjusted. The 1/8" keyway was done when it was all assembled and could be clamped to the milling table and locked with the locking screw that is on the figure. The gear that fits on the end of the shaft is retained by the keyway in the shaft and an aluminium sleeve that has a keyway cut to match the one in the shaft. This sleeve is retained by a 2BA socket head grub screw and is pushed against the gear to keep it in position.

The Dividing Head Body

The second part that was made was the base or main body **photo 4** this was made of a piece of steel finished size of 100 x 95 x 20mm machined on all faces. To get the right height a piece of 35 x 35 x 100mm was machined to 34mm high this gave the right height for the machine I was going to use it on.

The height of this part can be changed to set the right height for other machines this is were this differs from the original as it used casting so the height was fixed.

The top of the dividing head was two pieces of 48mm hexagon, the front one 40mm long the other the rear one is 50mm long. These are the finished lengths, the 50mm long one has the dividing arm attached to it so a shoulder is machined on it. The shorter hexagon was put in the chuck and trued up then faced and then bored to 1" finished size. The longer one was chucked in the same way, but the shoulder was machined first and then bored to 1". I then made a piece with a 1" hole in it 20mm long, this is a spacer to position the hexagons at the right distance when the head is assembled. The hexagon with

The base

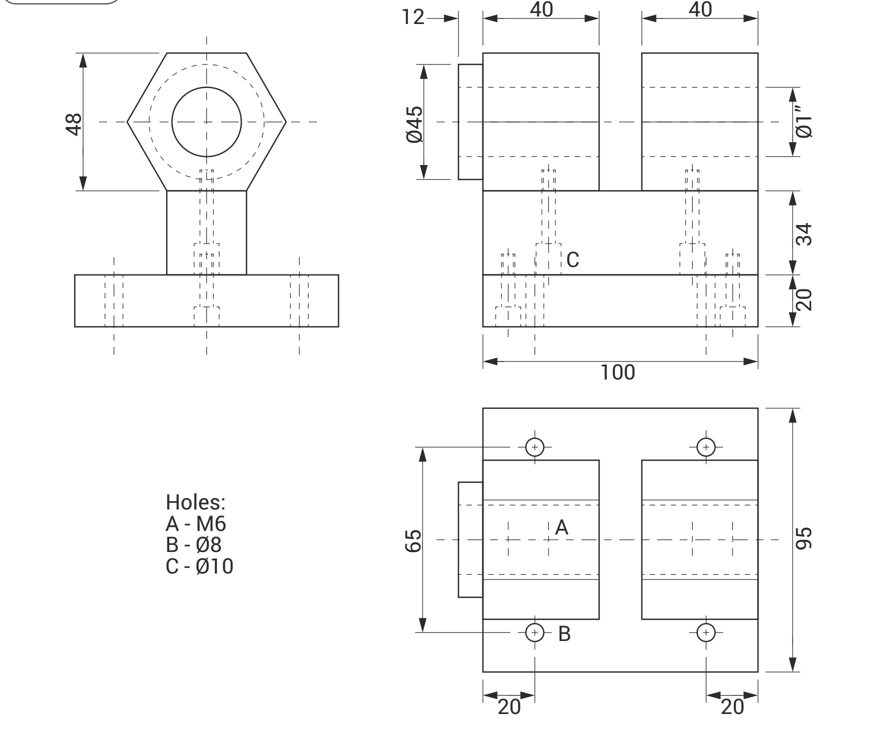
the shoulder on it has a M6 hole drilled and tapped in the top as shown at A on **fig. 2** for the clamping screw,

Figure 2 is a foreshortened sketch of the base, as after drawing the shaft and carrier I could not get it in to scale!

To finish and mark out the fixings for the top parts, put the plain hexagon on the shaft followed by the spacer then the one with the shoulder facing away from the centre then put the nut on and do the nut up on the shaft. With the hexagon on the milling table top down it is clamped with the shaft (with protection on the shaft) and a light cut is taken to level the bottom face. This is the face that is going to be sat on the packing piece. This was done to make sure the bottom of the hexagon had not gone out line in the boring process when they were held in the three-jaw chuck. It is only necessary to leave the cutter marks to confirm that they are flat (This is called leaving a witness mark).

When it is flat it is removed from the mill without moving the set-up. Put marking blue on the height piece then mark out the holes on the height adjuster piece. Also blue the top and bottom as well as the base. When the marking blue is dry the holes can be marked out on the centre line of the height piece for the holes that hold it to the hexagon. The holes on the hexagon are in the middle of the hexagon and on the centre line of both them and the packing piece drill these holes M8 taping size then transferred the hole position to the hexagon piece. The hexagons are tapped M8 and then the height piece is re-drilled M8 clearance and counter bored to fit the head of the socket head cap screws that are being used. Having marked the centre line on the base piece mark the position of the fixing holes for the height piece so that they miss the screw holes for the hexagon fixings in the height piece. Then drill the

Fig.2



base M8 tapping drill then transfer these hole to the height piece on the centre line of it the upper holes are then drilled and tapped M8 and the bottom holes are drilled out to size and counter bored as the others were.

Now strip it down and deburr and clean the parts then screw the height piece to the hexagon pieces with the shaft in the holes without the spacer and tighten the screws. Check that the shaft is not too tight in the holes if it is then clean the holes with a scraper to ease it. Then fix the bottom plate to the height piece and check that the shaft is still free to move. Now put the nut on the shaft and tighten it so there is no movement length ways but it is still free to revolve then tighten the grub screw to hold the nut in position. This part of the setting up is important as it determines how accurate the dividing head will be. The shaft should be nice and smooth when rotated with no lateral movement. The socket head grub screw can be seen in **photo 6** on the left of the brass nut.

The clamp

This is made from a piece of 15mm diameter

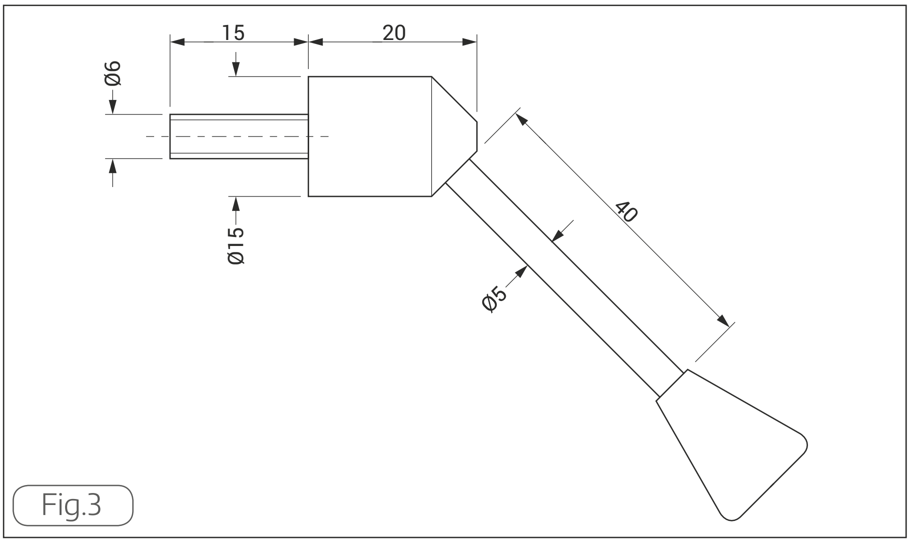
5

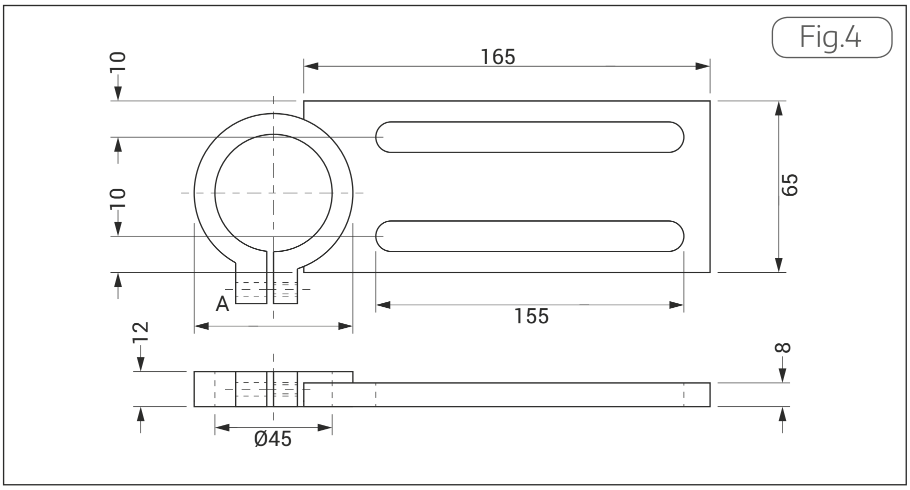
The spindle

mild steel, 35mm long with a 45 degree angle on the top, **fig. 3**. This is where the handle is fixed. The bottom is M6, 15mm long. The handle is 5mm also mild steel, 55mm overall and with an M5 thread both ends. The knob is plastic from the oddments box. After the clamp is made it is put in position and tightened this will leave a mark on the shaft. The shaft is then removed and put in the lathe and a groove is made a little wider than 6mm and 2mm deep. This is to stop the shaft from becoming damaged by the clamping action, the groove can be seen in **photos 5** and **6**. There is also a small piece of brass at the bottom of the hole to stop the shaft from scoring, this is not shown. To get the right position to fit the handle to the clamp put the clamp screw and packing piece in position and tighten it by hand then mark the top of the clamp at about 45 degrees to the centre line of the head. This will set the handle to a position that doesn't interfere with the Indexing arm when it is in position. After marking the clamp screw put it in the drill vice at an angle so the face to be drilled is flat and drill and tap M6, then assemble the parts. Photograph 8 shows the clamp finished; this shows the drilling position better than the explanation above.

The keyway and keyway slot

This is done by assembling the head with the part that are now made, tightening the clamp on the top of the body and clamping the base of the indexing head to the table of the milling machine. The base must be parallel with the machine. Use a dial clock to check it is parallel with the milling table. A 1/8" slot mill is used to make the keyway 1/16" deep in the end of the shaft as in fig. 1. Ideally the key will be a tight fit in the keyway if it is not some engineering adhesive can be used to make it tight. The alternative is to use a smaller cutter first then open the keyway up to the right size. This keyway is to fit the gears that I was going to use, if you are going to use other gears then change the size of the key to suit.





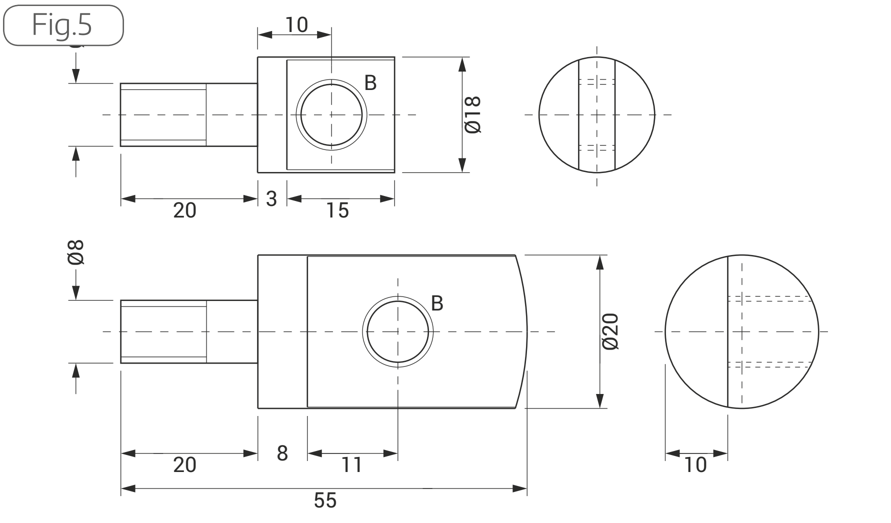
Indexing Arm

This carries the indent and the gears. The indexing arm, photo 7, was a piece of 60 x 15mm round stock that was bored to 45mm. After this I welded a piece of 10 x 10 x 25mm that had a pilot hole drilled in it length ways. This was going to be the clamp. The other part was 200 x 65 x 10mm this was shaped to fit around the 60mm part and then welded to it after clamping it to some large angle iron to stop it warping

6

The spindle with locking rings

Fig.5



too much. After it was welded the part was clamped to the milling table and machined flat, only a light skim was required as the clamping had done its job at the wielding stage.

The 10mm slots were then machined in the flat as in **fig. 4**. After this the hole in the 10 x 10mm was opened up and tapped M6, with the first half opened up to 6mm clearance, then a slot was put through the side. The square to the front was then rounded. This forms the clamp that holds it to the head when indexing.

The Indent

There are two indent supports. The first is made from 20mm diameter mild steel finished at 55mm long with an 8mm thread on a 20mm shank on one end. At the other end is a flat 30mm long and 18mm wide with a M10 tapped hole 11mm from the shoulder. The other was made from 18mm diameter steel with the same thread and shank but the other end is 19mm over all making a total length of 38mm when finished. It has a flat of 15mm x 16mm and an M10 thread 10mm from the back of the flange, **fig. 5**. The reason for two supports is that the longer one is for direct indexing and the shorter one for compound indexing, because the indexing wheel is normal closer to the arm.

The indent body is also made of 16mm mild steel with an 18mm long M10 thread on one end and the body 20mm long, which is knurled. There is an 8mm reamed hole 20mm long in from the thread end and a 4mm hole at the other end.

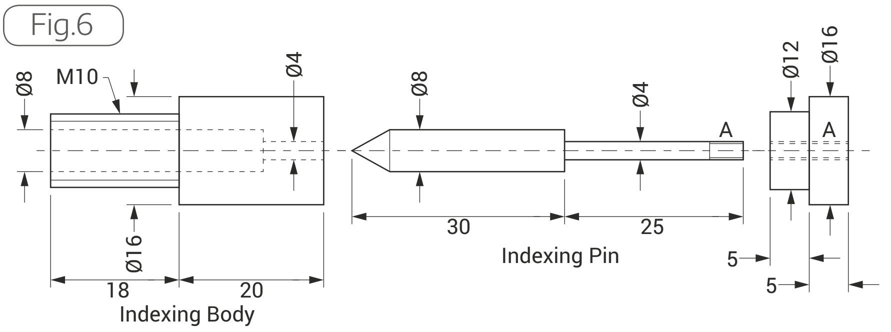
The indent pin is 8mm diameter, 30mm long with a 60-deg angle at one end and 4 x 25mm at the other with an M4 thread about 10mm long.

The retaining nut is 16mm diameter and 5mm long with knurl on it and a plain shoulder of 12mm diameter, 5mm long, this has an M4 thread right through.

When this is assembled a 4mm diameter x 20mm free length spring is put in first and then the indent pin which is retained by the nut. The indent is shown in **fig. 6**.

The longer indent is shown in photo 1 and the shorter in photo 3.

Fig.6



Gear Wheel Carriers

The plain gear carrier is of 20mm steel, total finished length 38mm as in **fig. 7**. This is designed to carry two wheels directly on the 5/8 diameter shaft but can be used with one.

The other gear carrier **figs 8** & **8A** is similar to the first one but this one has a loose sleeve with a 1/8" keyway machined in it so that the gears can rotate together.

The gears are retained with large washers these are not shown in the drawings. They have a 4mm hole and are 20mm diameter and 4mm thick. The washers are used on both carriers with a M4 screw to retain them. **Photo 8** shows the indent and gear carriers.

The Dividing Head in Use

With the right gear wheel fitted to the end of the main shaft it is possible to index directly from it, i.e. a 60-tooth wheel gives 2-3-4-6- in fact all numbers that will divide into 60. Also, if you make the indent forked this will double the divisions that can be made. So, this is one of the most useful gears to have if only a relatively small number divisions are required.

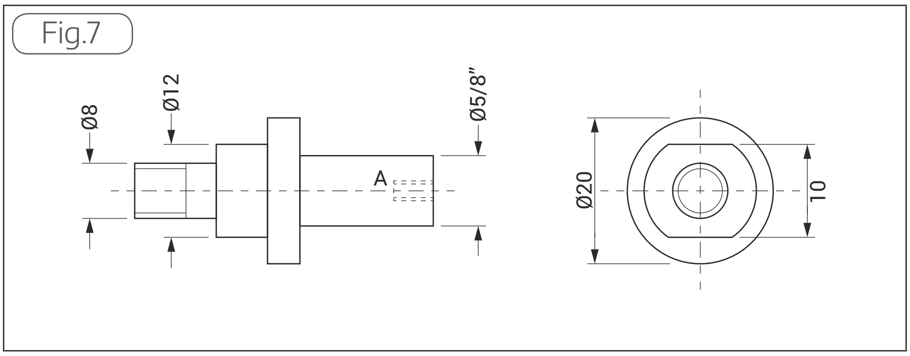
If on the other hand a large number divisions are required or an odd number of divisions then a compound set-up is required.

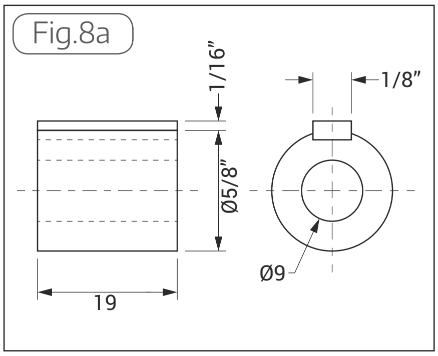
This is achieved with a pair of gears of different sizes. Two fix together on the same shaft and the one above driving the pair. The indexing is controlled by the first gear in the train on the indexing arm. You can see the tandem gears in photos 2 & 3. As an example, if you want to mark-out an imperial dial for a lead-screw with 150 divisions on the dial then the gearing would be 75-tooth gear on the main shaft a 25-tooth gear as an intermediate gear and a 50-tooth gear as the indexing gear. This set-up is shown in photo 3.

If you made the dividing head to fit onto your lathe you can set dividing head on the lathe bed and pack it to the centre line of the tool post and with a tool set at the correct height it is possible to use a vee tool on its side in the toolpost to form the lines on the dial. If this is not the case then you will need a graduating tool, there are several designs about, one in the book mentioned below.

7

Indexing arm





In Conclusion

I made this dividing head some years ago, it is not in daily use but it has been used a lot of times over the years. At the time I made it there were not a lot of affordable dividing heads about, this was the reason for making it. As the cost of a new one or even a second hand one could not be justified for just one or two times that I might use it. But when you have one, they get a lot more use than you think, so it is a project that is worth making and it doesn't take that long to make.

Most of the time I only use a 60 tooth gear wheel with the indent as this divides into most of the positions that are required for the projects that do. But with the other gear wheels most of the requirements are met.

I suppose having a rotary table does mean the dividing head is all but redundant but I do use both for dividing.

There are a lot of dividing head designs out now, some are easy to make some not. If the reader would like more information on the subject, Harold Hall's book Dividing is a very good book on the subject, it also has a design for dividing head and a graduating tool in it the book. ■

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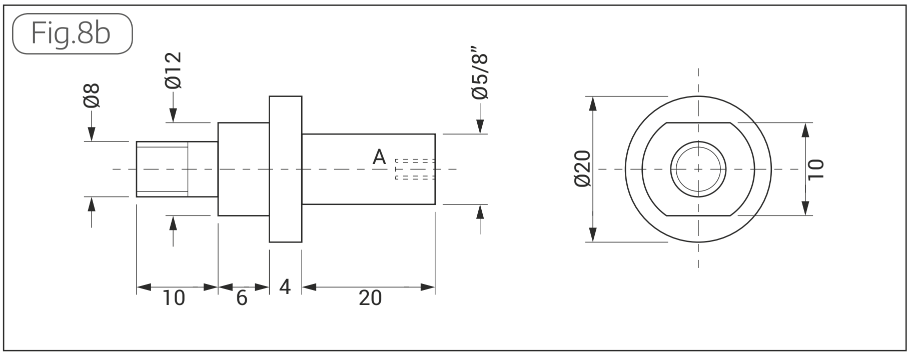
Clamp



9

Indent & carriers

A Grinding Head for the Acute System

John Ashton makes a dedicated setup for the Eccentric Engineering's Acute Tool Sharpening System

The Eccentric Engineering demonstration system consists of a double table setup with a purpose built grinding head, the left hand side utilises an Aluminium Oxide grinding wheel, for grinding HSS Lathe Tools, Fly Cutter tool bits, Trepanning tool bits, D Bits, etc., and the right hand side utilises a CBN grinding wheel, for grinding HSS tools that require a finer finish, such as End Mills and Slot Drills.

My review on machining and building the Acute Tool Sharpening System was published in issues 245, 246 and 248 of Model Engineers' Workshop. While it is possible to carry out all types of grinding of HSS with the standard kit and a single aluminium oxide wheel, I decided to copy the Eccentric Engineering demonstration model for my setup, which required an extra table kit.

This article details the machining and building of the Grinding Head, to complete my Acute Tool Sharpening System setup. My Grinding Head is a close copy of that used in Eccentric Engineerings' demonstration model. To build the Grinding Head I first emailed Gary Sneesby, at Eccentric Engineering, for details and advice on the design of his demonstration unit. Gary was very helpful in supplying me the information on his grinding head regarding the bench grinder specification, overall dimensions of the grinding head components and a UK source for purchasing the grinding wheels.

Choosing a suitable Bench Grinder

The bench grinder used by Eccentric Engineering for their demonstration setup is a Ryobi 6" (150mm) grinder/linisher with a 370W induction motor, the linisher attachment was removed for the grinder adaption. The one used at the Harrogate Show was a Draper 6" (150mm) grinder with a 370W Induction Motor, bought from Amazon. I found it difficult to source the Ryobi make in the UK.

I did find the model used by Eccentric Engineering, for their demonstration model, but it was from a company in the Philippines, I didn't bother requesting a

price. Luckily there are many clones of the Ryobi model. A brief search on the Internet revealed several makes that offered a similar or the same specification as the Ryobi model. The unit I finally decided on was a Scheppach Model bg150. There are probably plenty of others I could have chosen but once I found a suitable model I didn't bother searching any further.

Photograph 1 shows my completed Grinding Head, **photo 2** shows the Scheppach Bench Grinder fresh out of its packaging before preparing it for modification, and **photo 3** shows the grinder stripped ready for rebuilding into the grinding head. The guard on the

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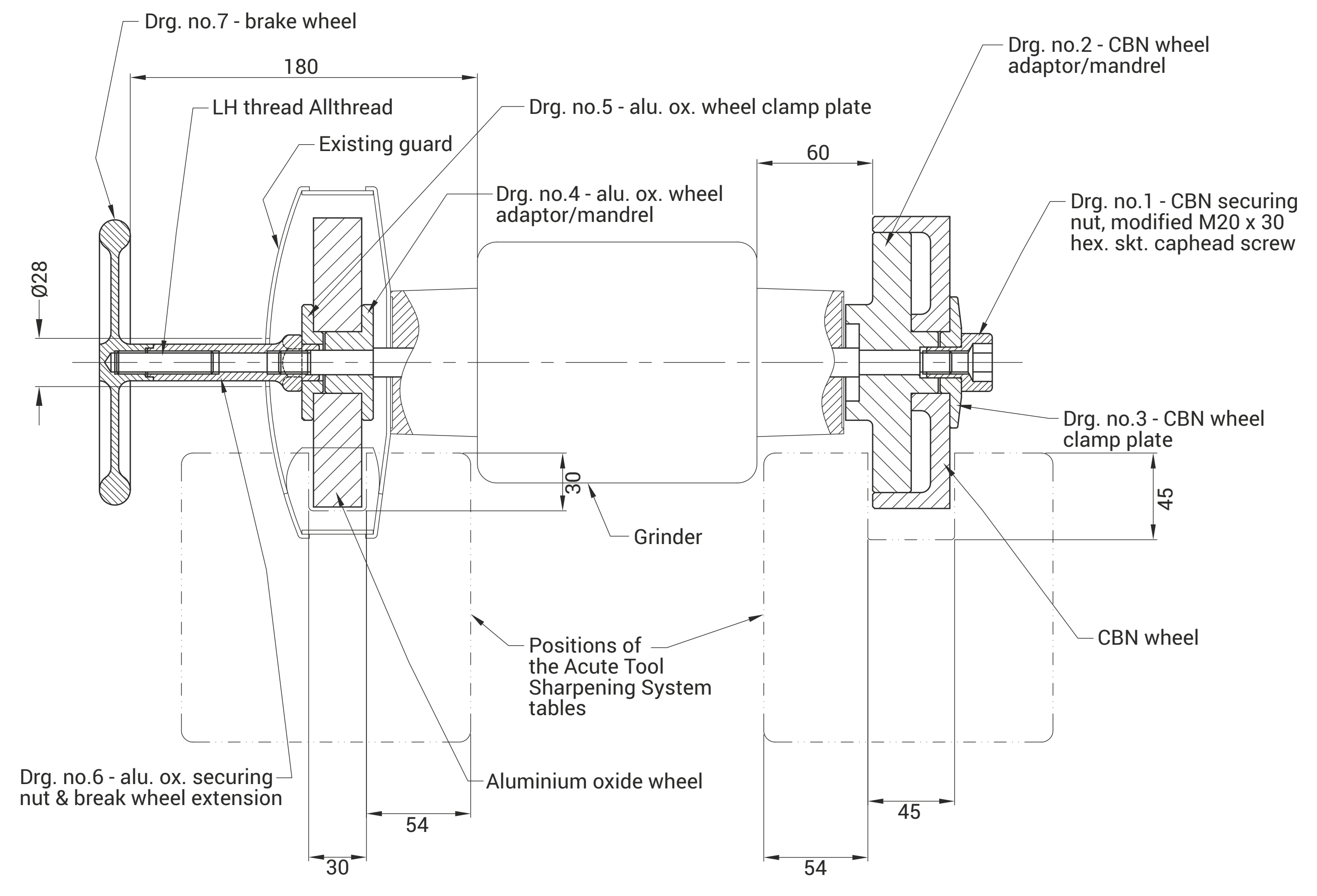
Sketch 1



G.A. Of Grinding Head Setup For Acute Tool Sharpening System

right-hand side is removed to enable the CBN Wheel to be fitted and the guard on the left hand side will have to be modified to accept the Break Wheel and Acute Tool Sharpening Table.

If you do your own search for a bench grinder beware of the motor rating, during my search many models looked the same but motor ratings varied from 150 Watts to 400 Watts it would be wise to go for 370 Watts or greater.

Choosing Grinding Wheels

I decided to go with the company suggested by Eccentric Engineering, called The ToolPost.

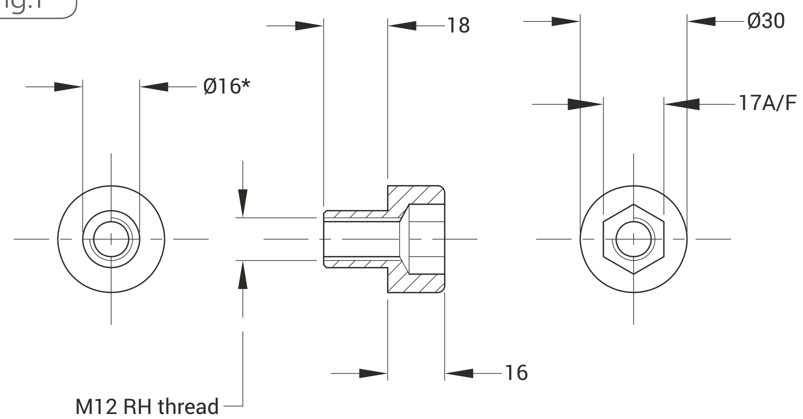
The ToolPost supply a series of Aluminium Oxide wheels, **photo 4**, called Ruby Grinding Wheels and Ceramic Grinding wheels, which are coloured blue, made by Mick O'Donnell. I chose a Ruby wheel, they give a finer finish for the grit size, an 80 grit wheel gives the equivalent to 100 grit standard white aluminium oxide wheel. The details are RUBY3-80, 150mm diameter x 25mm wide, 32mm bore.

CBN is an abbreviation for cubic boron nitride, a development of the General Electric Company, for which the name Borazon was also registered. CBN is still more costly than industrial diamonds, originally the grain was much more expensive than gold. It is nearly as hard as diamond, almost 4 times as hard as Aluminium Oxide, and has revolutionised the grinding of hardened steel, especially in the woodworking and woodturning industries. It also conducts away the heat generated much better than Aluminium Oxide. Diamond is not suitable for grinding steel because it enters into a chemical reaction with the nickel and cobalt in the steel at quite low temperatures easily generated in the grinding process. This will destroy the diamond. CBN only starts to change at much higher temperatures.

The wheels, **photo 5**, consist of a metal body, which is coated in an electro-galvanic process with a layer of CBN-grain. The particle bonding is specifically designed for grinding without coolant. The CBN-grain is of a precise size, each one just a few thousands of an inch.

CBN wheels are not suitable for grinding tungsten carbide, solid or tipped tools and cutters; these are sharpened with silicon carbide or diamond products.

Fig.1



*Close sliding fit in CBN grinding wheel adaptor/mandrel (Drg. 2)

Securing Nut
Mat'l: M20 x 30 hex. skt. caphead screw A2SS

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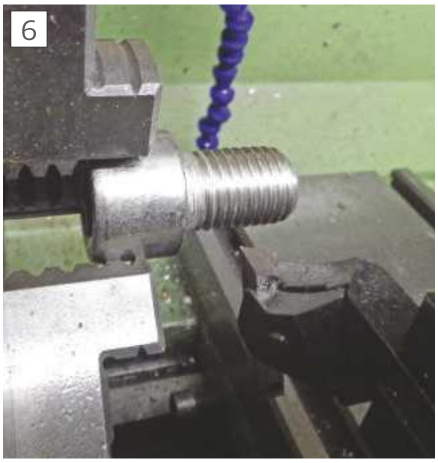

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The wheel used on the Eccentric Engineering demonstration model is a rim and face coated standard grain wheel, which gives an equivalent finish to a 180 grit aluminium oxide wheel. The equivalent wheel from The ToolPost is number CBN15040, 150mm diameter x 40mm wide, 32mm bore; be aware, they are not cheap.

Machining and Building the Grinding Head

Sketch 1 shows a section view of the assembled Grinding Head. I followed Eccentric Engineerings' setup as closely as possible, as I only had a photograph and some overall dimensions to work with, the internal dimensions and fits are my own interpretation. The left-hand side shows the aluminium oxide wheel assembly with the brake wheel arrangement. The brake wheel is an optional extra, without it the grinder takes quite a while to stop on its own between grinding operations. The right-hand side shows the CBN wheel assembly, the existing guard has to be removed to enable the CBN wheel to be fitted. The most important aspect of the design is to ensure that there are no corners, edges, recesses, undercuts, etc., on any of the externally exposed surfaces that could cause any kind of finger traps or knuckle bashing, you do not want to get a finger trapped or a knuckle bashed on a device rotating at around 2500 rpm. Another important factor is that the fits of all of the components are as close and concentric as possible to minimise vibration when the Grinding Head is in operation.

9

It should also be noted that the left-hand spindle has a left hand thread and the right hand spindle has a right-hand thread, this is to ensure that when you apply a load to either of the grinding wheels the reaction of the securing nuts is for them to tighten. Therefore, any threaded components associated with the spindle on the Aluminium Oxide side must be machined with left hand threads and on the CBN side any threaded components associated with the spindle must be machined with right hand threads.

The main material I used for the components is Aluminium Alloy 6082-T6, the old British Standard designation is H30 or HE30. T6 is the heat treatment state, solution heat-treated and then artificially aged. This is usually the best condition for machining.

CBN Wheel Securing Nut – Figure 1

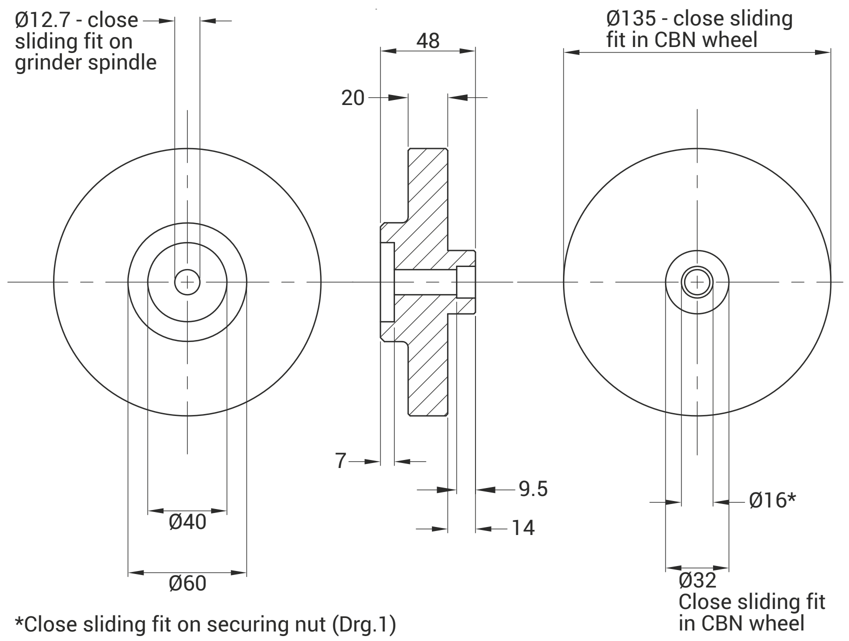
The original securing nut was discarded as the CBN wheel assembly protrudes beyond the end of the grinder spindle, see sketch 1. To make the new securing nut I used a M20 x 30mm large hegaxon socket cap head screw, made from A2 stainless steel, bought on eBay. The reason for this size is that after machining off the M20 thread there was enough material left for a location diameter and the 17mm A/F hexagon socket was retained after drilling and tapping the M12 thread (right hand).

Photograph 6 shows the screw ready for machining. The first operation was to machine the 16mm location diameter and reduce the thickness of the cap head to 16mm to minimise the amount that protrudes out from the face of the CBN wheel. I then drilled through tapping size (10.2mm) for the M12 right hand thread, **photo 7**. Next, I tapped the M12 thread, **photo 8**. **Photo 9** shows the completed CBN wheel securing nut.

CBN Wheel Adapter/Mandrel – Figure 2

Material: Aluminium Alloy 6082-T6
The first operation, I mounted the billet in the lathe 3-jaw chuck, fitted with external jaws. I faced off and machined a tooling aid spigot 110mm x 15mm deep. Next, I turned the billet around in the chuck, this would allow me to machine all of the location diameters in one machining setup ensuring good concentricity. First, I machined the 135mm diameter to a close slide fit (S/F) on the internal diameter of the CBN wheel, using the CBN wheel as a gauge to ensure a good fit. Next, I

Fig.2



*Close sliding fit on securing nut (Drg.1)

CBN Grinding Wheel Adaptor/Mandrel
Mat'l: Aluminium alloy 6082-T6

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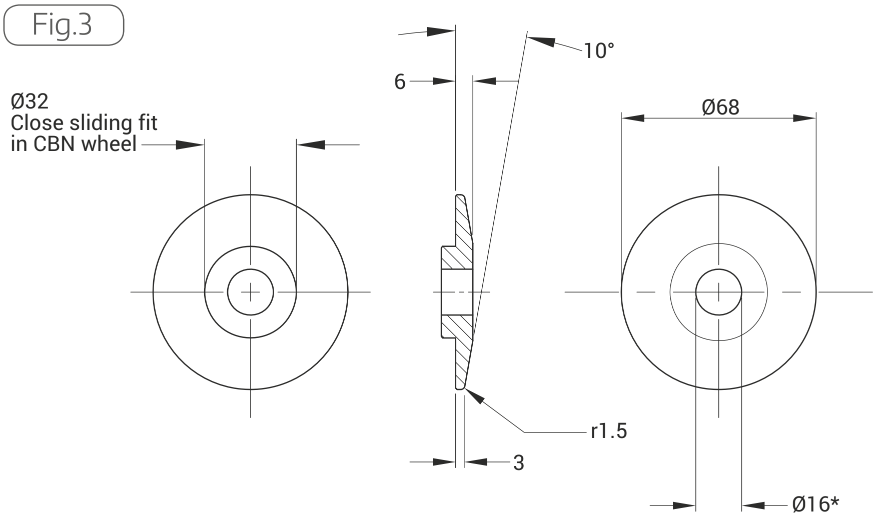
Fig.3



*Close sliding fit on securing nut (Drg.1)

CBN Grinding Wheel Clamp Plate
Mat'l: Aluminium alloy 6082-T6

13

machined the 32mm diameter deep spigot, again using the CBN wheel as a gauge, to ensure a close S/F. Next I drilled and reamed through 12.7mm (0.5") diameter S/F on grinder spindle. The last operation was to bore the 16mm location diameter x 9.5mm deep using the CBN Securing Nut as a gauge to achieve a close S/F, **photo 10**. The billet was removed, the chuck jaws changed to the standard internal jaws and the billet remounted to machine the back face. The back spigot was machined to 60mm diameter x 14mm deep, leaving the 135mm diameter flange 20mm thick. The final operation was to machine the back clearance counterbore to 40mm diameter x 7mm deep, **photo 11**. **Photograph's 12** & **13** show the finished component and **photo 14** shows the adapter/mandrel fitted to the CBN wheel.

CBN Wheel Clamp Plate – Figure 3

Material: Aluminium Alloy 6082-T6
As with the previous component I first machined a tooling aid spigot and then turned the billet around in the chuck so that all location diameters could be machined in one setup. After facing off I machined the 32mm diameter x 5mm deep location spigot, using the CBN wheel as a gauge, then machined the 68mm outside diameter.


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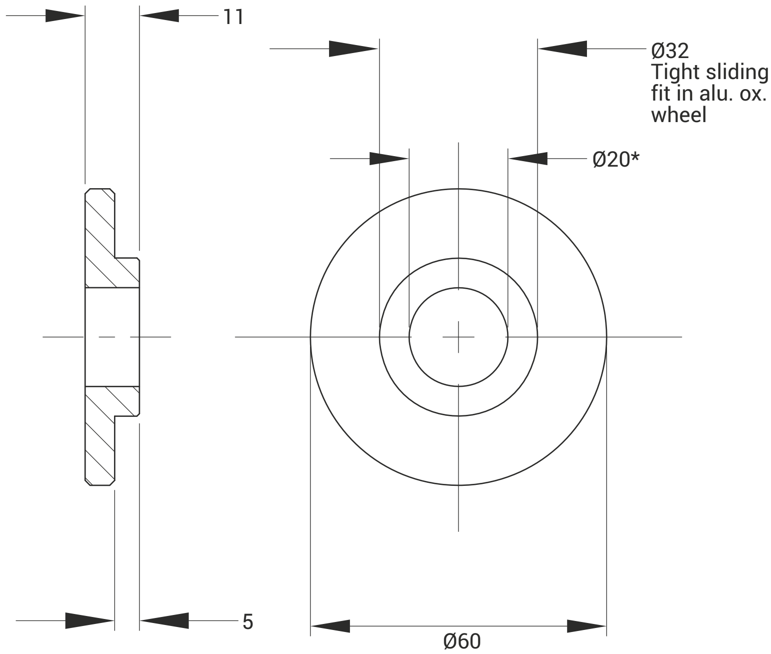
Fig.4



*Close sliding fit on alu. ox. securing nut & break wheel ext. (Drg.6)

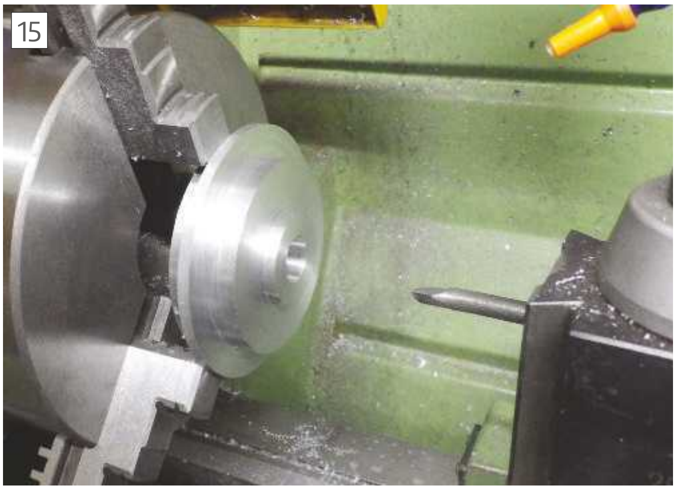
Aluminium Oxide Grinding Wheel Clamp Plate
Mat'l: Aluminium alloy 6082-T6

Next, I drilled and bored through the 16mm location diameter, using the CBN Securing Nut as a gauge to achieve a close S/F, **photo 15**. The billet was turned around in the chuck, faced off to 6mm thick, then I set the lathes compound slide to an angle of 10° to chamfer the face, **photo 16**. **Photographs 17** & **18** show the finished component.

Aluminium Oxide Wheel Adapter/Mandrel – Figure 4

Material: Aluminium Alloy 6082-T6
The billet was positioned in the lathe chuck, faced off and the 60mm outside diameter machined to size. Next, I machined the 32mm diameter x 19mm deep location spigot, using the Aluminium Oxide wheel as a gauge. I drilled and reamed through 12.7mm (0.5") diameter a S/F on grinder spindle, **photo 19**. The final operation was to turn the billet around, in the chuck, and face off to 6mm thick, **photos 20** & **21** show the finished component.

To be continued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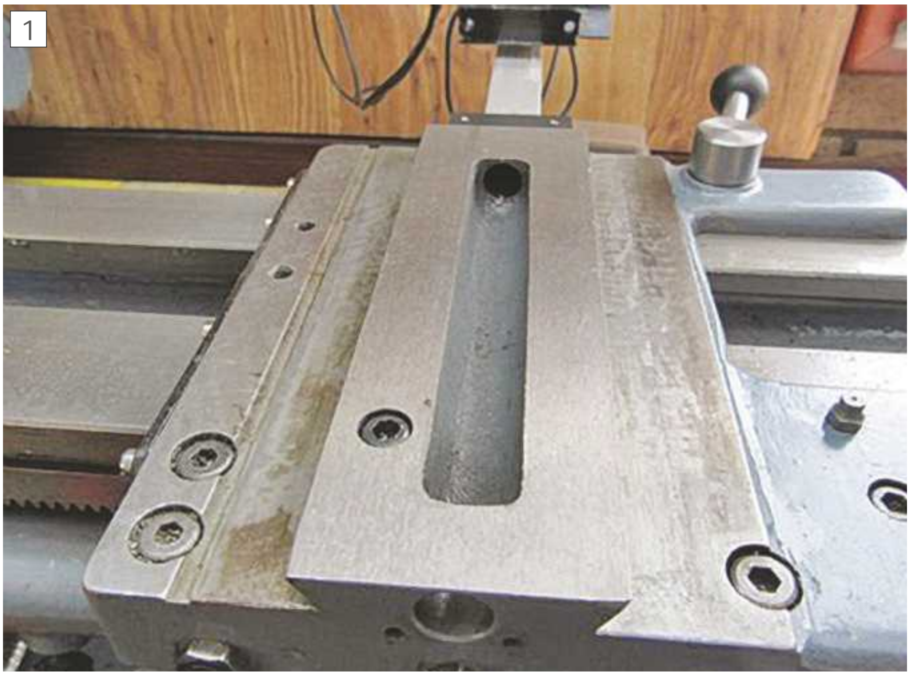
Fixing a Myford Cross Slide

Warren Jacobs cures unacceptable backlash in his venerable Super 7



Saddle with cross slide removed

My workshop lathe is a Myford super 7, which according to Myford's records, was made in 1955 and shipped to an engineering firm in South Africa, so who knows where it's been or how much use it's had until I acquired it in Perth, Western Australia in 1985?

Some parts have been renewed, reground or refurbished in my time of ownership, but one part that is still original is the cross slide screw and nut.

I have noticed over time that the backlash in the cross slide was getting bigger, even though the slide gib screws and the adjusting collar at the back of the end bracket are adjusted or checked quite often.

The acme screw is steel but the nut is some kind of alloy or aluminium, so perhaps one or both are worn excessively. The amount of backlash measured on the micrometer dial was about 6-7 divisions (thousandths) so I thought it was time to try and fix this, or at least minimize it.

After dismantling the slide and inspecting the feed screw it was obvious that the acme shape in the centre of the rod was a little more rounded than the shape at either end. The nut was not so easy to check, so I decided to purchase a new replacement .

After the new nut was installed and the slide reassembled,the backlash was now down to 4-5 divisions but I wondered if it could be reduced even further, but wanting to keep the same threaded rod .

What was needed was some kind of device to provide pressure in the opposite direction on the screw rod. The amount of space in the saddle as shown in **photo 1** is not very much , no room for adjusting bolts or large split nut, like most other lead screws have, so spring pressure maybe the answer.

I have only given a few dimensions as there are only three parts and if one is different then the other two will change, but you can see and apply the concept.

First requirement is to find a suitable size strong compression spring, **photo 2**. The one I used was 38mm long, outside diameter 15mm, 1.8mm thick and 7 turns. It was just possible to squeeze the spring, by fingers, to 28mm, but any spring greater than 15mm diameter may not fit in the saddle channel and clear the underneath of the cross slide.

Next job is to make an acme nut, 12.6mm diam and because I only had a very small piece of bronze rod, it would only allow for a short nut of about four threads long, but

The spring used, the flared tube is a spacer

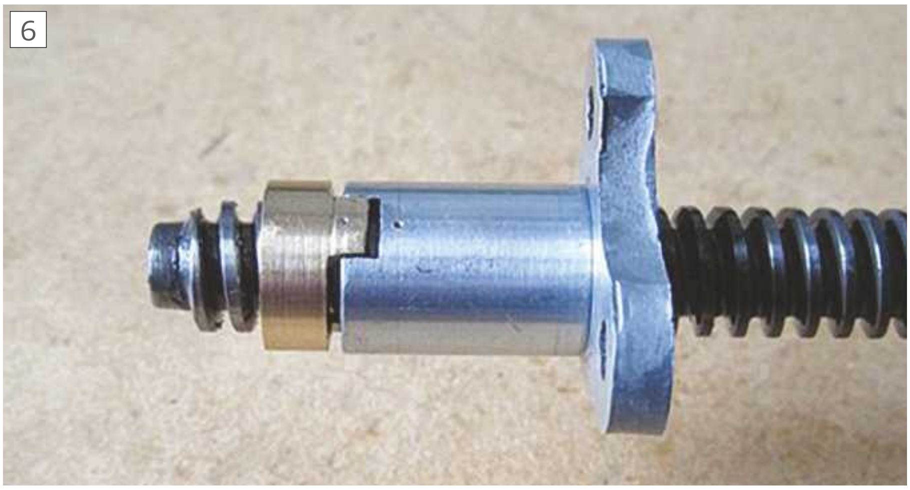
Slot in feed nut

New bronze anti-backlash nut

Nuts fitted together

possibly enough to try out the idea. Drill a 6.8mm hole right through then proceed to thread internally at 10 turns per inch (the slide feed screw on this lathe is 3/8 inch diameter by 10 TPI). A small boring bar was ground from a length of 5mm square tool steel so the end was similar to the acme shape by trying it in the end thread of the feed nut. Not very precise I admit, but so long as the rod will screw into this nut and feels smooth that is all. If you have a Myford vertical slide then use the feed screw from that for checking as it is the same size as the cross-feed screw, or remove the top slide screw and try that.

Remove the feed nut from the saddle and mill a slot, central across the end 4mm wide and 3.5mm deep, **photo 3**.Thread this nut onto the rod then thread the new short nut up to it , carefully now wind back the short nut , half a turn and scribe on it two lines level with the edges of the 4mm slot. The metal within these lines is to be kept, so mill away each side of them to a depth of 3.5mm, **photo 4**. This short nut should now sit on top of the saddle nut, **photo 5**.



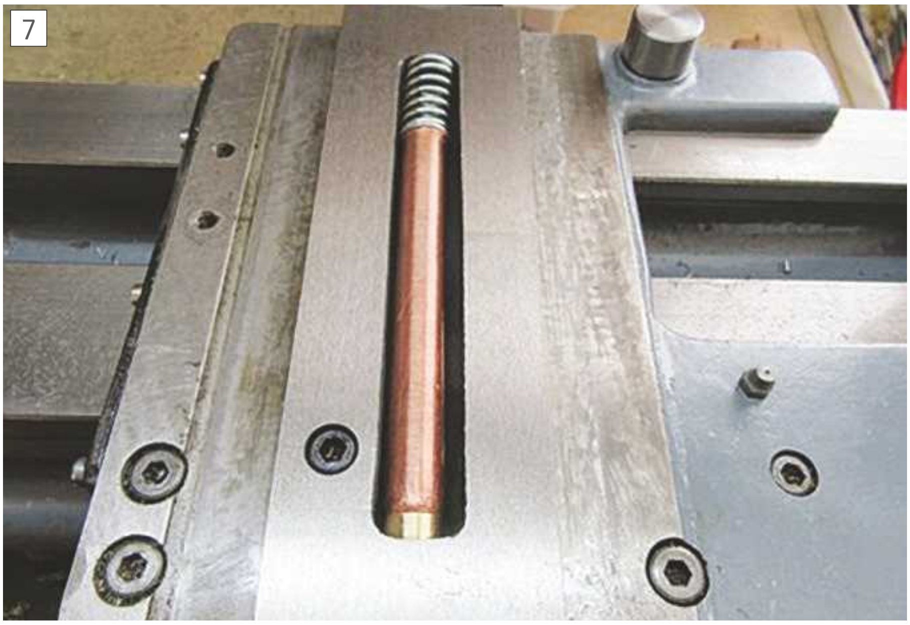
Nuts assembled on to feedscrew

The purpose of the spigots is to ensure the two nuts remain locked together, and if you now screw the two nuts together, as shown, on to the feed screw, photo 6, a small gap will be evident between them so that the new nut can provide pressure backwards on the feed screw.

Hold the two nuts together and insert back into the saddle and secure. Place the spring into the saddle channel at the opposite end and measure the distance between nut and spring. I added 10mm to this measurement, or perhaps a smaller length of say 6mm or 7mm may be sufficient to provide enough back pressure, then cut a length of suitable tube for a spacer, I used a piece of 12.6mm copper water pipe. To ensure the copper tube sits square on the end of the spring and not flip to the side under tension, flare the tube out slightly at the spring end so it is the same diameter as the spring outside, and lightly grind the ends of the spring to provide a flat face. The tube was flared by standing it vertical on the bench, placing a small ball pein hammer on the tube and tapping with another hammer until the flare was the right size.

To assemble fit the spring then the tube against the new nut, **photo 7**, fit the cross slide to the saddle wind in the feed screw, secure the end bracket and it's done.

In use, the movement of the slide back and forth now has a better feel, is smoother and consistent, with very little increase in tightness on the screw rod but best of all, the backlash is now barely detectable, it was definitely worth the effort. ■



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■ Various spanner sets, O/E, combination etc. Quality makes £20 to £200 ring for more details. Sorry no A/F sizes. Good to VGC or exchange Myford 254S accessories or spares.
T. 01773 782 151. Nottingham.

■ Clarkson MkII Tool & Cutter Grinder. Styabndard equipment includes universal head, brackets with centres, three tooth rests, straight shank holders, numerous sleeves and bushes, grinding wheels. Original 3 phase ½ hp motor but with variable speed inverter. Clarkson manuals. £500.
T. 0114 235 1472. Sheffield

Models

■ LBSC 3.5" gauge 0-6-0 Molly, close to prototype version of the LMS Jinty. Running bottom half. Copper boiler with paperwork, drawing. £875.
T. 0116 278 3549. Leicester.

■ Bentley 9-cylinder rotary engine, 1/4v scale with plans and book, 90% complete. Offers invited. Vertex rotary table, new, still in box, £70. Warco bench drill, 5 speed, 2MT quill, 5/8" chuck with vice, never used. £80.
T. 01425 616636. New Milton, Hants.

■ 7 ½" gauge electric engine, working needs work! Two 25 amp 12 volt motors plus two bogie passenger truck with electrical brake. Can be tested on site at Salcombe. £300, ONO. 7 ½" gauge Scaleaway point signal 14 inches high with 12 volt lamp bulb. Virtually unused, £170 ONO.
T. 01548 844 186. Salcombe.

■ Minnie traction engine, part finished, £50. Arc welding and brazing equipment, £40 – offers. Odd loco parts.
T. 01952 242867. Wellington.

Parts and Materials

■ Stuart Turner 'Sirius' unmachined full set of castings, £200 + P&P.
T. 0161 320 7754. Stockport.

■ Profiled steel rail, 2lbs per yard. 120 feet unused with fish plates and special bolts. Comes with steel tube for sleepers and old arc welder, £140.
T. 01548 844 186. Salcombe

Magazines, Books and Plans

■ MEW 219 (Sept 14) - 257 (Aug 17), Model Engineer 4448 (7 Feb 13) - 4505 (16 April 16). Free to collect or carriage (est. £14) each.
T. 01757 702 437. Selby, N. Yorks.

■ Model Engineer magazines from late 190s to present day, many in binders. Nine volumes Engineering in Miniature, 2002/2010. Many loose issues. World of Model Engineering by Stan Bray, 7 issues. Offers.
T. 01493 668 358. Great Yarmouth.

■ Model Engineer magazines, 35 years of probably unbroken years, plus some earlier ones. Free to collect.
T. 01548 844 186. Salcombe.

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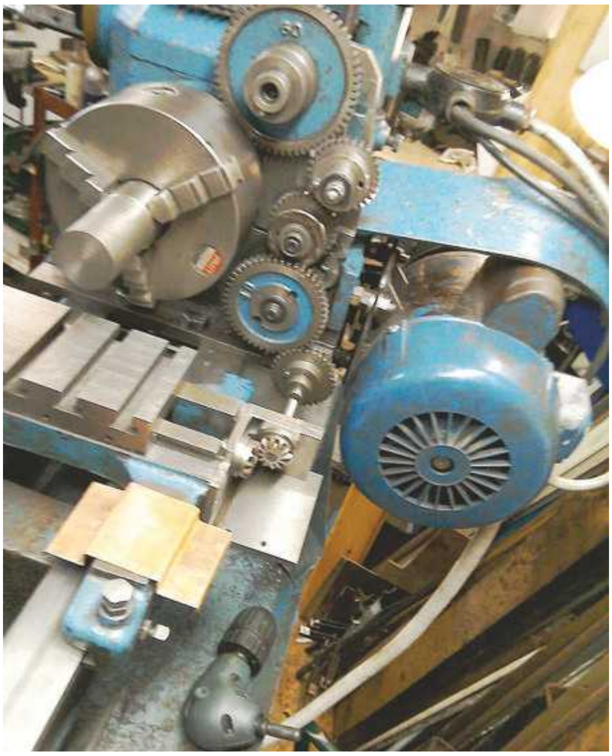

Hobbing Gears on a Lathe

Dear Neil, I was pleased to see the article on gear making in No. 258/259 MEW from t'other side of the world !

I have been making a similar attachment for my little John lathe, it is simpler and takes its drive from a 60 tooth gear fixed to the chuck back plate (this gear is used for indexing too).

I enclose a photo of this setup when I was going to make a scroll for a small chuck. The same changewheels are used to drive (in the future) a form relieving attachment and a hobbing attachment that fixes onto the cross slide. This project has not advanced since two years ago when I started.

Anyway, I thought you might like to know that a similar project is ongoing in England!

Thanks for a good mag.

Jim Simpson, Brookwood, Surrey

It's nice to see a Little John Lathe being used, I understand they were very well-made machines. Neil.

Farce Calculations

Dear Neil, Surely Van der Walls sells ice cream? My preferred unit is one Imperial gnat's, er, whisker.

Chris Smith, by smoke signal.

Perhaps we should draw a kindly veil over this matter now...? Neil.

Jock Miller's Taper Attachment

Dear Neil, I enjoy your magazine heaps thanks.

Interested in Jock Millers article in issue 258 on the Taper Turning Attachment. Can I get the detail drawings of it, or better still, can they be published in MEW?

Merv George, Manawatu, New Zealand.

Your letter is one of a small deluge that arrived in response to Jock's 'teaser'. I thought I'd print one from a fellow Kiwi, but I've had enquiries from around the world. The good news is that Jock has been locked away with plenty of paper and a box of sharp 2H pencils and won't be allowed out until he has drawn up his attachment for us. Neil.

Dear Neil, you were kind enough to run my advert for a mill in MEW No259. This has generated some interest. One caller who left a message fired off his number so fast that despite re-playing the message several times I was unable to determine what it was. So if there is space in scribe a line I would like to apologise to David for not ringing him back. To the general readership when leaving your number on an answer phone: please slow down.

Andy Steward, by email

Indexes for MEW

Dear Neil, I understand a reader was struggling to track down which issues the indexes to MEW appeared in. Here's my list!

Barry Chamberlain

MEW COMPLETE INDEX LIST

Issue Number	Issues Covered
9	1 to 8
33	9 to 20
34	21 to 32
45	33 to 44
57	45 to 56
69	57 to 68
83	69 to 80
95	81 to 92
106	93 to 104
118	105 to 116
130	117 to 128
143	129 to 140
154	141 to 152
167	153 to 164
179	165 to 176
191	177 to 188
202	189 to 200
215	201 to 212
227	213 to 224
238	225 to 236
249	237 to 248

A Sensible Response to That Letter

Dear Neil, I have a near identical Anvil to that depicted in Mark Noel's photo – mine was made in Pennsylvania circa 1845 / 50 and came to NZ in same period. It was used on a high country sheep station in the shoeing shop until the station became a national park about 20 years ago and I bought it in the equipment sale. Mine shows that it was forged under some sort of 'drop hammer' as with light in the right direction, very shallow 6" diameter impressions can just be seen.

Peter King, New Zealand

Spindle Lock

Dear Neil,

Phil Dawes idea for a spindle lock is a vast improvement on Seig's fixing pin, but I wanted to make mine as unobtrusive as possible.

I set out to copy Phil's design using the least amount of metal to connect the two M5 holes in the head to the hole in the spindle.

My "bracket" is a small triangle of 1/8" mild steel and my "guide block" is the smallest lump necessary to hold the parts together. The spring is contained in the guide block. The pin is 6mm silver steel with a brass collar soldered in the centre. The lock was blackened making it even less obtrusive. My photography is not a patch on Phil's!

Paul Etgart, by email

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£3950
Harrison 155 6" + gap lathe
£2450
£475
Rare!
Elliot Junior / '00' slotting head
Nice!
Elliot Junior / '00' vertical head
£525
Lots of aluminium - just in!
Emir 48" bench +4 vices
£345
MYFORD Super 7B
Beautiful!
£3950
Boxford MK111 CUD 5"x 28" long bed
£1725
MYFORD GENUINE PARTS
Running out fast!
Purchased from Nottingham
Check the web site for full list!
£5750
Immaculate!
Myford super 7B lathe
£2950
Colchester Triumph lathe
£5750
Burnerd 12" D16
4 jaw chuck
£425
Clarkson Model 1 grinder
£1175
just arrived!
Buffalo turret mill R8 50" x 10"
Rolsan Reelers 40" powered rolls
£2250
£625
RJH 240V linisher
Tap/Die holders
from £10
Faceplates various
from £75
as new!
£350
Bambi silent compressor (24L)
RJH vertical linisher + extractor
240 volts
£675
£2450
Harrison M250 5"x 20"
very nice
Myford Connoisseur (hard bed) equipped!
As NEW Original Myford!
£2450
Transwave 1.5HP rotary converter
as new!
£350
Myford non standard wheels
£10-£49
£525
Marlco 2 speed broaching press + rare cabinet
240 volts
Tom Senior 'V' (large table)
£725
Bridgeport Cherrying head
Machines convex & concave
as new!
£425
Sixty metal draw cabinet
very nice!
£1225
EXE bench type surface grinder
£2450
Meddings LB2 / 2MT drill
£450
Boxford 500 VSL 5" lathe
£3750
Harrison M300 lathe + gap
£525
J & S wheel balancer
12"x 12"x 24" Angle plates (pair)
£345
Well equipped!
Chester Cub 630
£1750
£145
New 18"x 6" ground compound table
Startrite 18-S-10 metal cutting
£950
WD-40
£20 each
Pacera hacksaw 240V
£140
£20 each
DP / MOD gears
Just arrived!
Micrometers
Various!
0-16"/ 300mm
Steel EN3B (mild steel)
£7 each
CRAWFORD COLLETS LTD
Myford chuck & nose collets
New
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various!
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