No.287

THE MAG FOR MAKERS, MODEL AND HOBBY ENGINEERS

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NOVEMBER 2019

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

PRODUCTION
Designer: Andrew Tompkins
Illustrator: Grahame Chambers
Retouching: Andrew Tompkins
Ad Production: Andrew Tompkins

ADVERTISING
Business Development Manager: David Holden
Email: david.holden@mytimemedia.com

MARKETING & SUBSCRIPTIONS
Subscription Manager: Kate Hall

MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

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On the Editor's Bench

List Articles

One thing you won't have seen very often in Model Engineer's Workshop are 'list articles' – you know the sort of thing: "Ten Things You Didn't Know About 5C Collets". Except it's usually something vastly less interesting than 5C collets that's being listed. A quick look on Google revealed "14 Reasons we Love List Articles" and "7 Reasons Why List Articles Are Dead". Together with many lists of ways to write your own "Listicles", which is an unfortunate portmanteau name that they often go by.

The reason this came to mind? I was musing on how to fill this month's Ed's Bench and I thought of listing ten useful gadgets. Would I resort to such cheap, throw-away journalism? Of course, I would! But to preserve my dignity, no numbers! Here are some of the things I would immediately replace if they disappeared – the real test of something being useful.

To start with, my 3D printer. I needed some plastic spacers last week, it took less than half an hour to design and print four, and most of that time I was doing something else.

My big bench mounted drill press. It was tricky to squeeze it in, being much bigger than the old one, but it gets more use than any other tool in the workshop, largely because it is solid and dependable.

A digital multimeter. I have several lovely analogue multimeters. I think I last used one fifteen years ago, my cheap as chips digital versions make them redundant.

Carbide insert parting tool. It just works; reliably, dependably, quickly.

Digital calipers. I have two in view now, and I'm not even in the workshop.

A deburring tool, with a comfy handle. Worth the small investment for the dramatic improvement to your finished work that comes from neatly deburred edges.

ER25 collets. Don't listen to the nay-sayers, I use them for all sorts of jobs, toolholding, stockholding in the lathe, jigs and grinding.

Decent files. They don't need to be the very best, but plenty of reasonable quality files, close to hand.

Finally, a belt sander. Designed for wood, it is amazing how many uses I've found for it… perhaps I could make a list!

What are the things you would never be without in your workshop?


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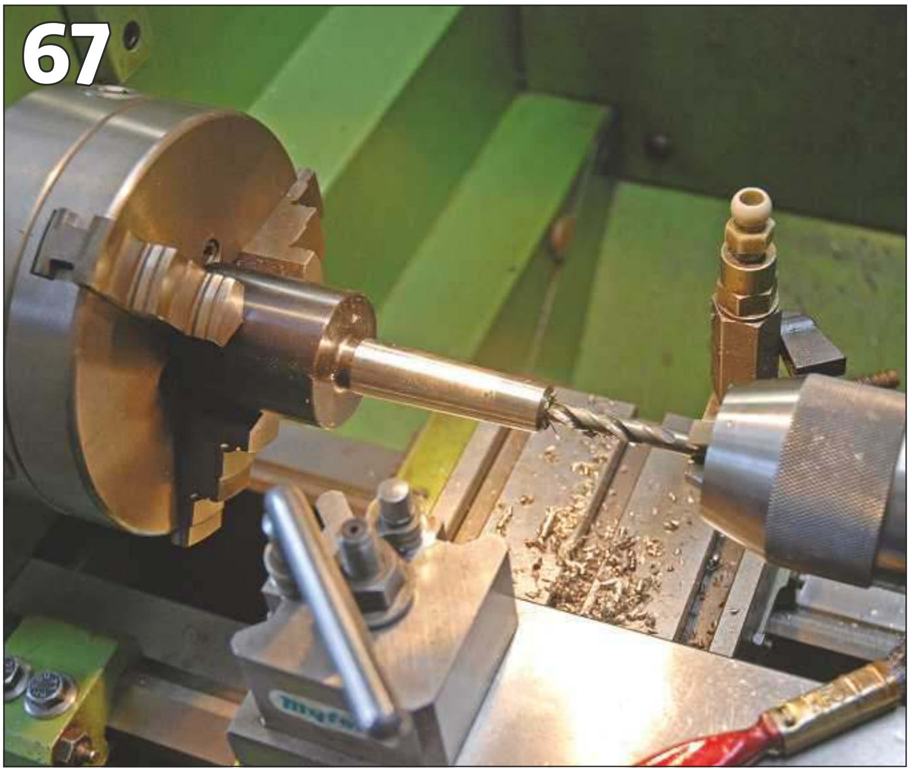
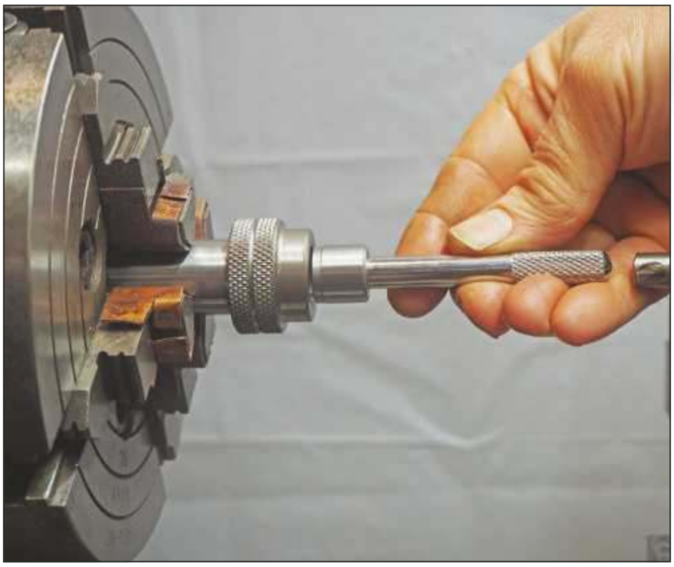


See page 50 for details.

Coming up...

in our next issue

Coming up in our December issue, number 288, another great read



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Regulars

THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

Visit our website to access extra downloads, tutorials, examples and links. Visit the link below to find a selection of workshop articles online:
www.model-engineer.co.uk/extracontent

Any questions? If you have any questions about our recent Alibre Atom3D or current Lathework for Beginners or Milling for Beginners series, or you would like to suggest ideas or topics for future instalments, head over to **www.model-engineer.co.uk** where there are Forum Topics specially to support these series.

Where are you? Come and join one of the busiest and friendliest model engineering forums on the web at **www.model-engineer.co.uk?**

What is the way to put these holes in the right place?
- A machining conundrum.

What motor pulley size for ML1 Lathe?
- Choosing drive ratios for vintage and veteran lathes.

Bright EN24T steel vs Black EN24T for cutting gears
- Explaining the difference between these two materials.

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

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ON THE COVER

This month's rather striking image come's from Mike Cox who shows you how to fit 'Angel Eyes' to your milling machine in Mike's Workshop on page 18.

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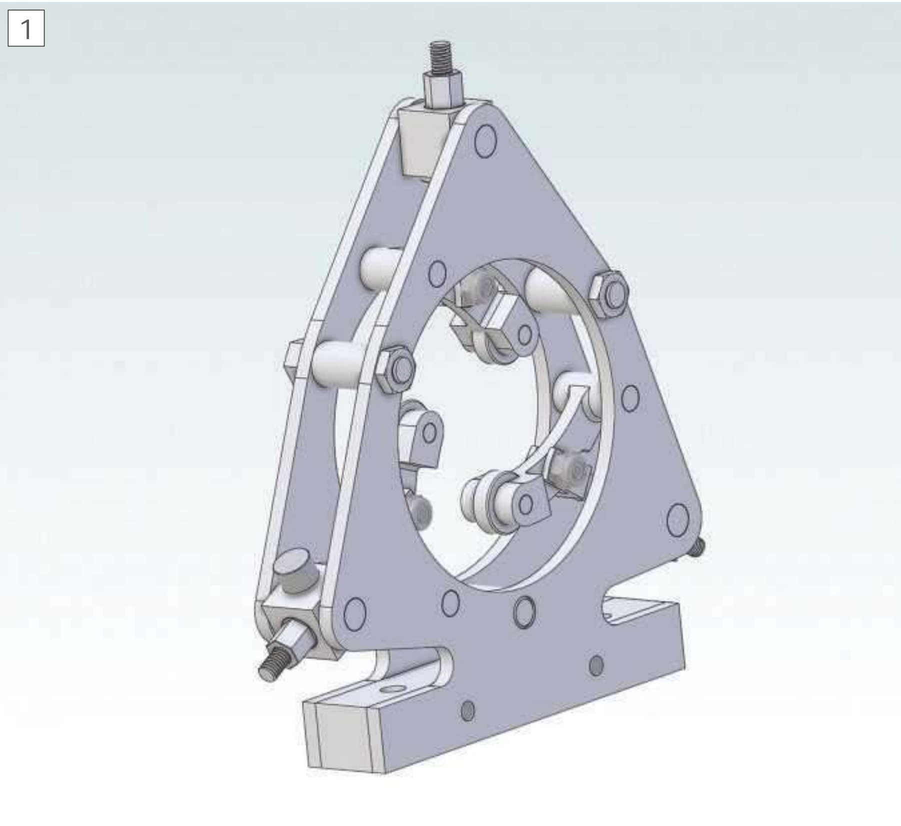
A travelling steady for a generic 9 x 20 hobby lathe



A rendered image of the steady from the CAD model.

John Hinkley details this compact design, suitable for larger lathes

Although I have no specific need for a travelling steady at the moment, I anticipate that the time will come when I will need one and need it right now! Consequently, I contemplated either purchasing a standard off-the-shelf item or making one myself. Being the owner of a rather obscure and I believe, obsolete lathe, I decided on the latter course and set about laying down some basic parameters and dimensions.

A discussion on the MEW forum, regarding the use of a roller bearings instead of bronze fingers to hold the stock being worked on prompted me to design a device using roller bearings. This allows the diameter of material being turned to be maximised while still keeping the overall size of the steady within sensible limits. The design is basically two side plates joined by three spacers and a mounting block along the bottom edge. Within these plates are three sets of fingers, hinged at one end and carrying suitably sized roller bearings on the other end. A clevis pin fork is attached approximately midway along the finger and this is connected to an articulated adjustment block. Each of these mechanisms is equally spaced around the body of the steady. Using this system, the fingers follow an arc of adjustment, allowing the maximum diameter of material to be accommodated (in my case Ø96mm) down to Ø6mm or even less. Several hours on the CAD program and many iterations later, the design evolved into what you can see in **photos 1** and **2**.

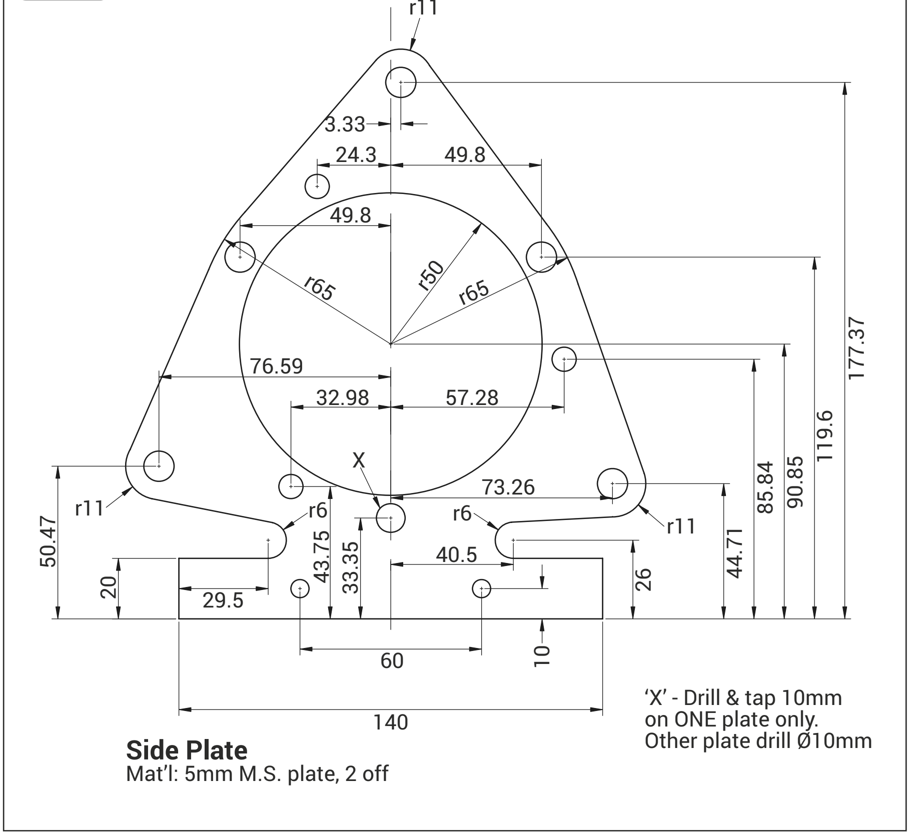
The overall dimensions of the steady could be scaled to permit its use on a smaller, or larger lathe, if required.

As I have a fixed steady which came with the lathe, I based my design on the overall dimensions of this accessory, later modified in the light of experimentation within the CAD environment with angles and finger mounting positions, etc. I measured the height of the lathe centre above the steady mounting plane on the cross slide, using a

Finished steady attached to the cross slide

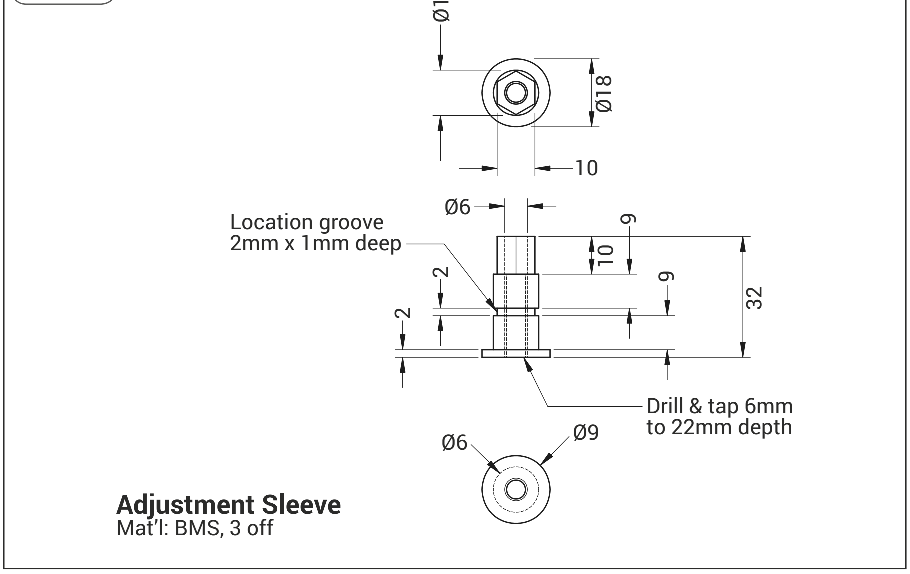
> I decided that, to save me having to spend many hours with a hacksaw and files, I would try to get the side plates laser cut.

Fig.1



Side Plate
Mat'l: 5mm M.S. plate, 2 off

Fig.2



Adjustment Sleeve
Mat'l: BMS, 3 off

digital height gauge, some silver steel held in the chuck and a calculator. In my case this came out to 90.85mm. Not exactly a convenient round figure!

I decided that, to save me having to spend many hours with a hacksaw and files, I would try to get the side plates laser cut. An appeal on the MEW forum for help in locating someone with laser cutting facilities quickly threw up a couple of possible contacts. I emailed them for quotes and received a very acceptable quote from Model Engineer's Laser (**ref.1**), with whom I placed an order for two side plates. I supplied him with dxf file which indicated where the through-holes are located with spotting positions, to be opened out to their final dimensions by me later using the DRO on the mill to ensure accuracy. The finalised design is shown in **fig. 1**. In order to ensure that the two sides were aligned with each other, prior to drilling all the holes, I lightly clamped them together and put them over the jaws of the chuck, expanding the chuck jaws until the plates were held securely in alignment. I then slid the cross slide up to them and rested the bottom flat on the cross slide where it would eventually be mounted. The clamps were then tightened sufficiently to hold the plates securely together and the plates were removed to the mill for drilling of the three 10mm clamping holes. Once drilled, I bolted the side plates together to preserve the relative position of the two plates and removed the clamps.

Figure 2 shows the adjusting sleeves which were turned from 19mm diameter precision ground mild steel (because I had some in the bin). With approximately 50mm of stock projecting from the chuck, the first operation was to face the end square, centre drill and then drill 5.2mm tapping size to a depth of 34mm. The next operation was to enlarge the hole to 6.5mm to a depth of 10mm. The diameter was reduced to 12mm for 30mm. The locating groove was made with a 2mm parting blade to the dimensions shown. All the sharp edges so far formed were then broken with a chamfer tool. Removing the stock from the lathe chuck it was placed in a "Stevenson" hexagonal ER32 block (ref. 2) and set up in the mill to form the "nut" on the end. A toolmakers clamp acted as a stop in the vice and the stock was positioned in the collet such that the 19mm diameter face was flush with the collet outer face, see **photo 3**. This allowed the milling of all the "nut" flats in one sitting without having to repeatedly align the work in the vice. The depth of cut was 1mm, derived by measuring in CAD, resulting in a "nut" 10mm across flats.

Transferring the stock back to the lathe, the piece was parted off to length plus

3

Milling the hex head on adjustment sleeve

PARTS LIST

Main side plates - laser cut 5mm mild steel - 2 off

Plate spacers - 14mm BMS - 3 off

Mounting spacer - 20mm x 20mm BMS bar - 1 off

Roller fingers - from 20mm x 20mm BMS square - 3 off

Clevis forks - zinc-plated steel - 3 off

Adjustment blocks - 20mm x 20mm BMS square - 3 off

Adjustment sleeves - 19mm BMS round - 3 off

Adjustment sleeve locking screws - 12mm brass round - 3 off

Adjustment rods - 55mm x 6mm all-thread - 3 off

Bearing pivots - 6mm silver steel rod - 3 off

Clevis pivots - 5mm dome head bolts and nuts - 3 off

Finger pivots - 8mm silver steel - 3 off

Ball bearings - 6262RS 19mm x 6mm x 6mm - 3 off

Hardware: 2 off 6mm countersunk socket screws, 2 off 6mm hex head screws, 3 off 8mm hex head screws and nuts, 1 off 10mm hex head screw, 3 off 5mm socket dome head screws and nuts

0.5mm, **photo 4**. I reversed the part in the chuck, facing off to length and the last edge thus formed was given a slight chamfer. Finally, the centre hole was tapped 6mm.

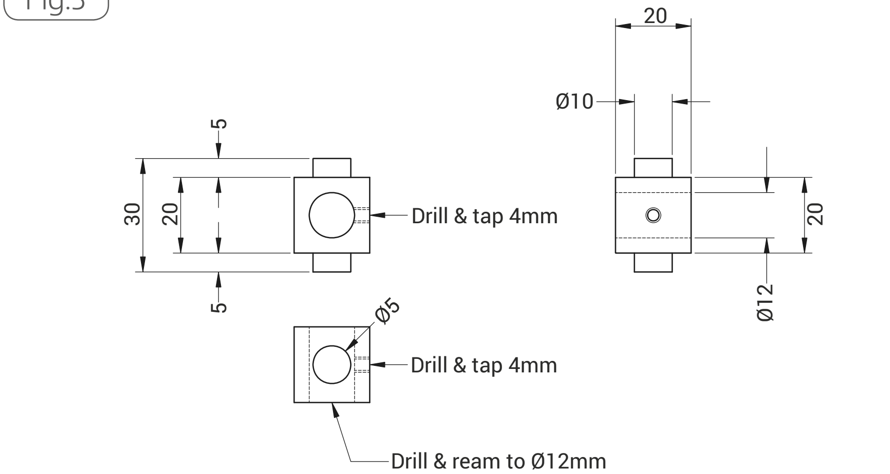
The adjustment blocks are a little more challenging and I used 20mm x 20mm square BMS stock, cut slightly overlong at 31mm in the bandsaw and then mounted in the self-centring four-jaw chuck on the lathe. Using an HSS tool because of the initial interrupted cut, the first 10mm diameter pivot was formed on one end and then the bearing area faced square. Swapping the part end-for-end, the other pivot was produced, ensuring that the main body of the part was finished to a length of 20mm, finally reducing the 10mm pivot length to give the correct overall dimension of 30mm. This exercise was repeated twice more to obtain the required three pieces.

Transferring these in turn to the mill, the 12mm through hole for the adjustment sleeve was first drilled to 11.9mm, then reamed to 12mm to give a sliding fit. The locking screw holes were then drilled and tapped 4mm, **fig. 3**.

Three knurled sleeve locking screws were made from 12mm diameter brass to the dimensions shown in **fig. 4**.

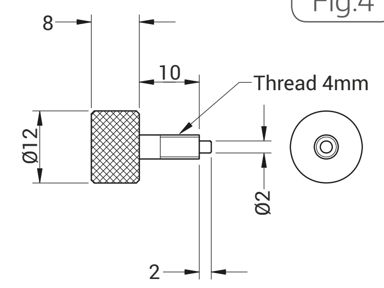
The three side plate spacers are a simple drilling and turning to length exercise which needs little further explanation, save to say

Fig.3



Adjustment Blocks
Mat'l: BMS, 3 off

Fig.4



Adjustment Sleeve Locking Screw
Mat'l: Brass, 3 off

4

Parting off the adjustment sleeve

that the length should be accurate.

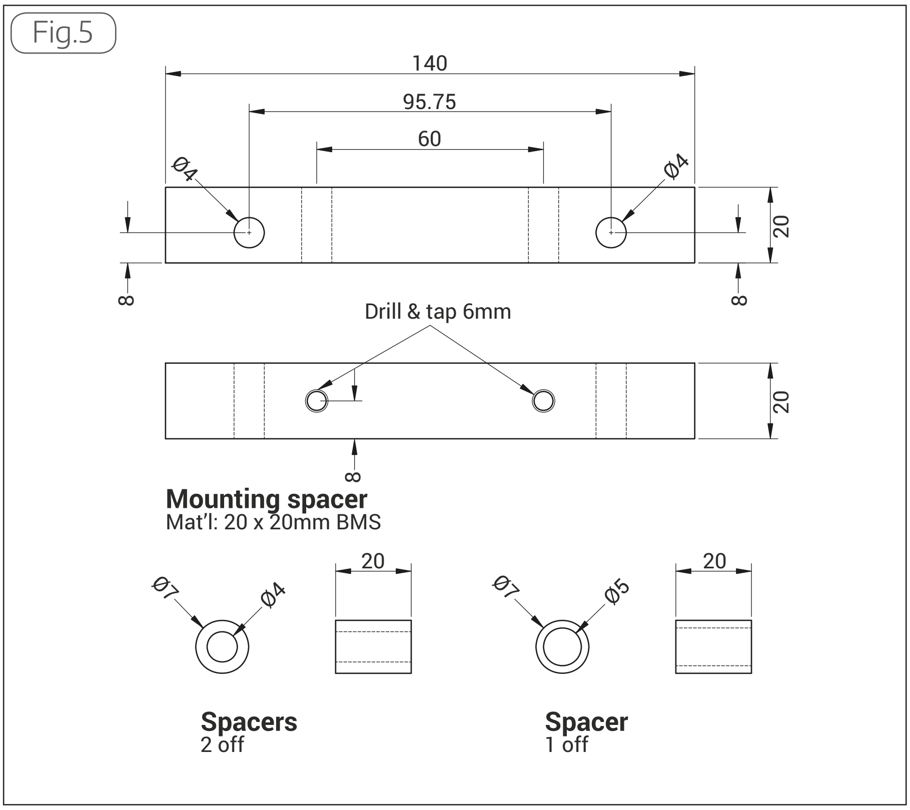
The base mounting spacer was made from 20mm x 20mm BMS, with hole spacing to suit my lathe. **Figure 5** gives the dimensions.

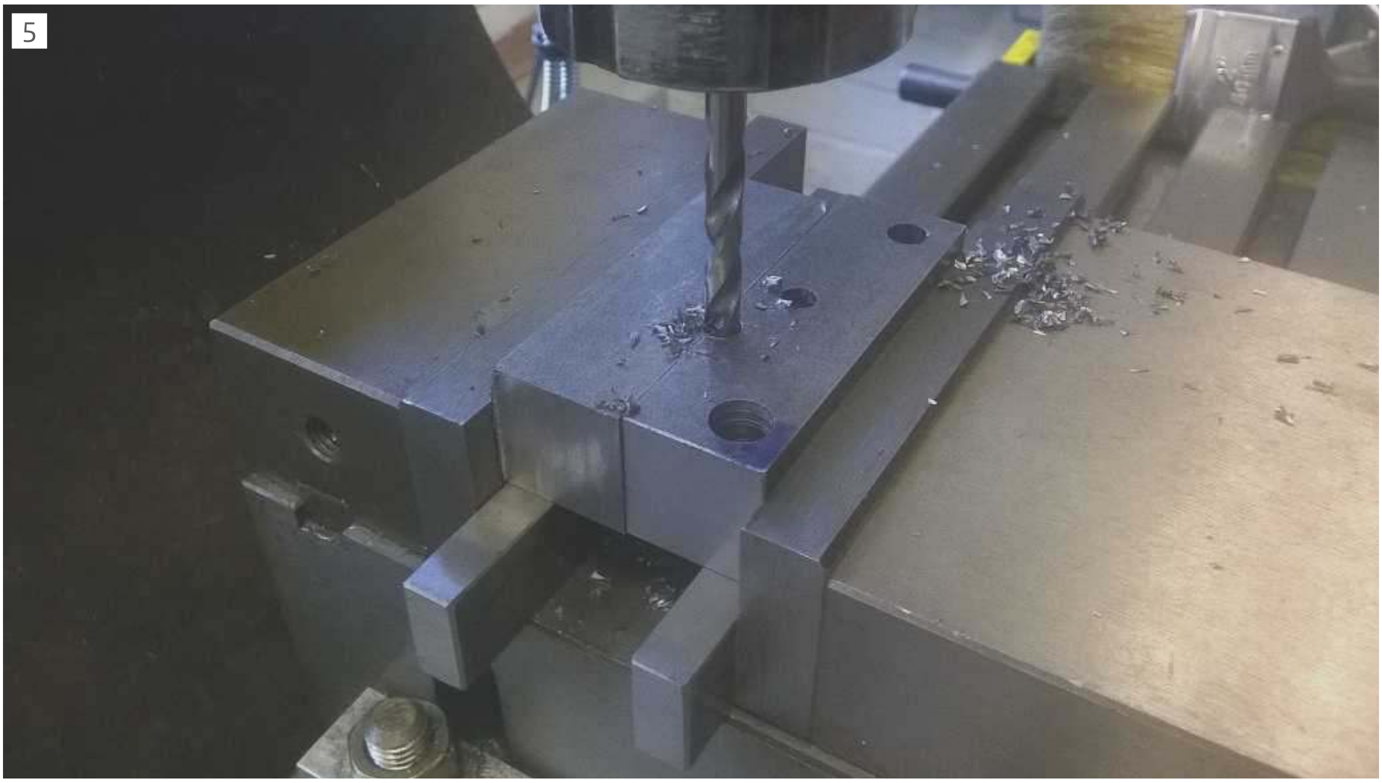
The clevis forks were commercially made items purchased on eBay simply because they were cheap and readily available. They were altered from the as-received state to suit my application, in as much as the threaded portion was reduced in length to 4.5mm to achieve the dimensions shown in **fig. 6**. The thread was enlarged from 5mm to 6mm x 1mm pitch.

The pivot pins for the fingers and bearings were initially intended to be located with circlips at both ends. Upon reflection, I considered that the likely infrequent use didn't justify this added complication and I settled for lightly knurling the ends of the silver steel pivot pins to make them very slightly oversize and pressing them into place. This also has the added benefit of maintaining the side plate alignment and adding to the general rigidity of the steady.

For the fingers, I cut three lengths of 20mm x 20mm BMS for the fingers, slightly over length on the bandsaw, before cleaning up the ends and finishing to exactly 65mm. In order to determine the relative positions of the various holes, I superimposed the finger shape onto 20mm x 65mm rectangle within the CAD program and determined the positions shown in **fig. 7**. Using a vice stop and parallels, the holes were located with the DRO and drilled in each piece with the same corner on each piece used as the datum.

I gave considerable thought to the means by which I would form the curved shape of the fingers and finally decided to make a jig on which to mount the material for the fingers. This entailed laying out the finger shape in CAD on a circle of 150mm diameter, such that the curves fitted circles centred on the plate itself. See **fig. 8**. The steel plate was intended to be sacrificial so that I could bolt the base material directly to the plate for rigidity when machining. When it came to the machining, however, I used spacers under the finger blanks to raise them slightly off the circular plate, figuring that I could make use of this plate again for later projects. The hole positions for the jig were derived from the CAD program as co-ordinates with the centre as the 0,0 position and these were as noted on the fig.. Note that both holes were drilled and tapped 6mm despite the finger having one hole with an 8mm diameter. In order

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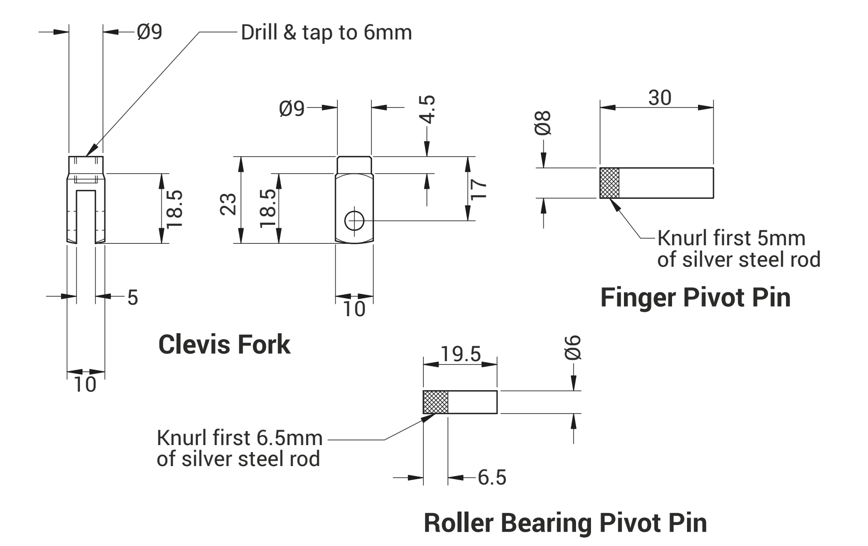
Forming the clevis fork relief

Trial assembly showed that the finger mechanism functioned as designed and the last part to be machined was the mounting spacer.

Fig.6



to be able to reverse the finger to machine both sides, a threaded sleeve was made to increase the diameter of one hold-down bolt so that it could be swapped from one hole to the other as required during the machining process. The plate itself was clamped to the mill table and centred using an edge finder in conjunction with the DRO. The other holes for mounting the finger and to hold the plate to the rotary table were drilled all in one session using the measured X and Y positions from the fig. and using the inbuilt "3 holes on a radius" facility built into the DRO.

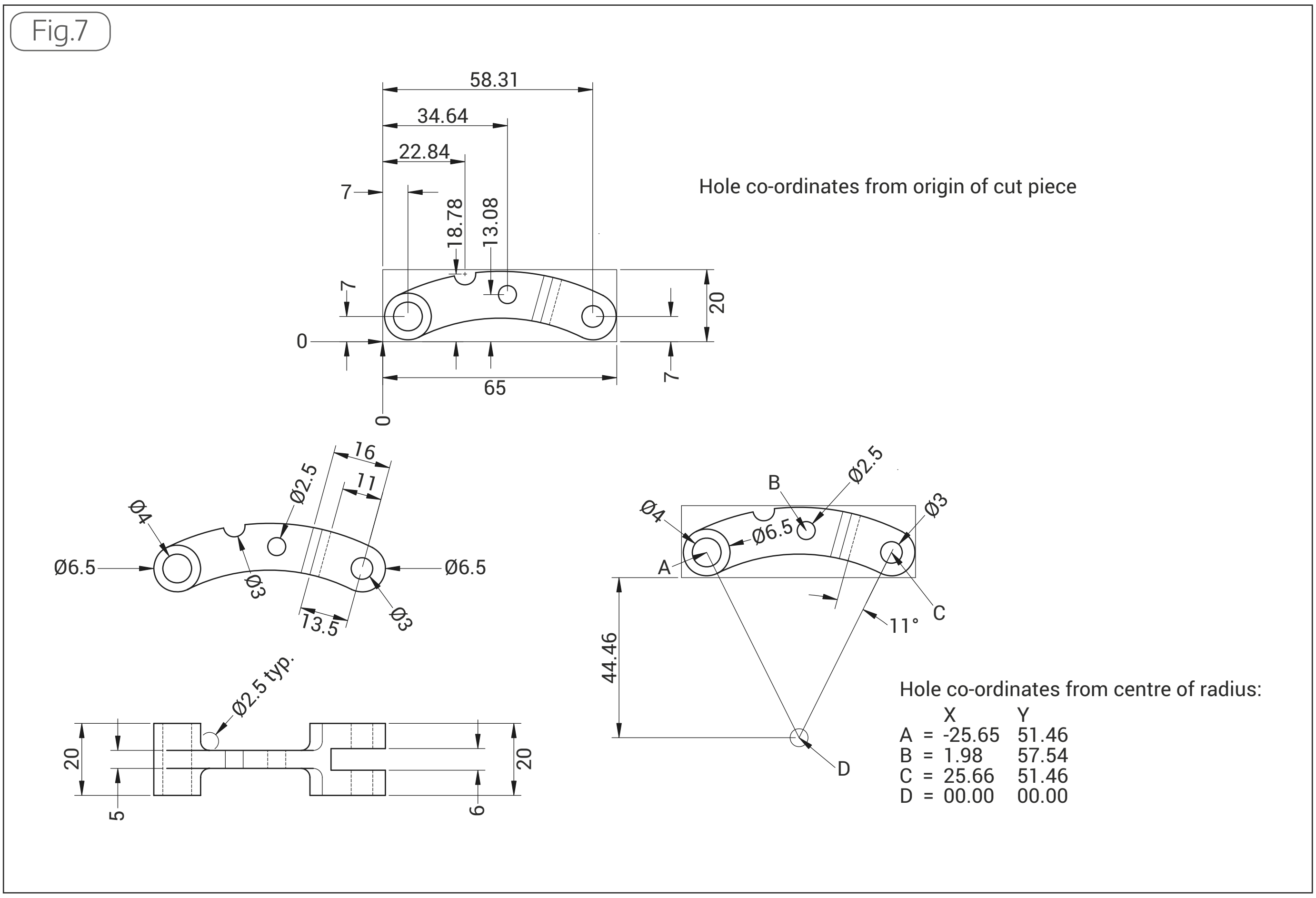
Manipulation of the various parts in CAD showed that a small relief was needed in the roller fingers in order to allow full rotation of the clevis fork under conditions of minimum diameter clamping. The position of this cut-out meant that a hole drilled at the required position would break through the edge, so I used another piece of 20mm x 20mm spare stock as a sacrificial edge, spot drilling, drilling through 4mm and finally using a carbide 3-flute 6mm milling cutter to form the cut-out. **Photograph 5** shows the last part of this process.

Also, before machining the finger curves, I decided to form the slot in the end that holds the ball bearing, so that I could more easily hold the blank at the required angle to achieve the dimensions and I used the same 6mm carbide three-flute end mill to do this, taking multiple passes to get to the full depth.

In turn, each finger blank was attached to the jig plate and the curves were cut as demonstrated in **photos 6** and **7**. Afterwards, the ends were rounded and the side waisting contours were formed. The finished article is shown in **photo 8**.

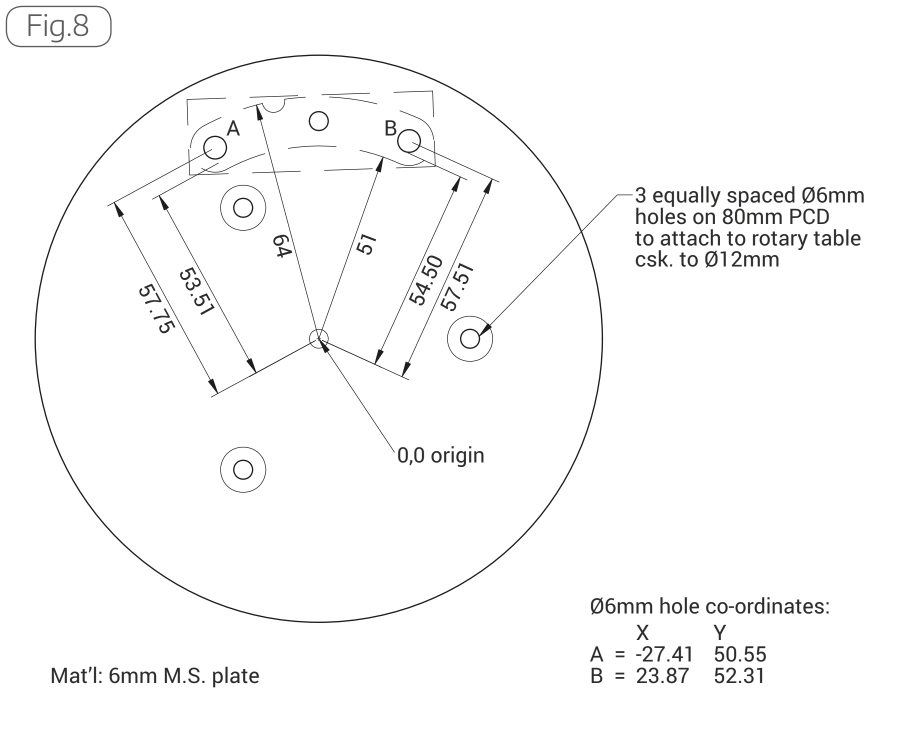
Trial assembly showed that the finger mechanism functioned as designed and the last part to be machined was the mounting spacer. After drilling the through holes for the mounting bolts, the spacer was mounted on and bolted to the cross slide, only tightened enough to prevent movement. Carefully, so as not to disturb the mounting spacer, the side plate assembly was lowered over the mounting spacer. The cross slide was then brought up to the lathe chuck and the jaws were gently expanded until they snugged up onto the inside of the steady, photo 8. In this way

Milling the finger inner curve



Finger outer curve completed

Fig.8



8

The fingers completed

I could be assured that the steady was in perfect alignment with the lathe centreline Releasing the chuck jaws, the steady was then carefully removed from the cross slide, complete with mounting spacer, ensuring that its position relative to the side plates was not disturbed. It then only remained to spot through the clamping holes and drill and tap through 6mm. Final assembly was completed by bolting the side plates to the mounting block using the countersunk socket head screws (from the tailstock side) and hex head bolts from the chuck side.

Once the steady was shown to operate as conceived, all the nuts used in the construction were thread locked to their respective screws.

In operation, the steady works as expected and can be used to hold material of quite widely varying sizes. One extra bonus which I hadn't originally anticipated is that, if your machining accuracy isn't quite up to scratch, the fact that the bearings move in an arc and not radially, a certain amount of offset from the lathe centreline is easily accommodated. Experiments using CAD show that at least 5mm of horizontal and 2mm or more of vertical misalignment can be tolerated. Even I can machine to finer tolerances than that!

All I need now is a project which requires the use of a travelling steady.

For further development, the steady could easily be adapted into the fixed type by fabricating a suitable bed mounting and bolting it to that, utilising the same fixing holes. ∎

References

Ref 1. Model Engineer's Laser - **http://www.modelengineerslaser.co.uk**

Ref 2. Available from **https://www.arceurotrade.co.uk**

9

Using 4-jaw to align steady with lathe centreline

Modifying A Toolmaker's Clamp

Lionel Pullum makes a useful improvement to a standard clamp.

Components of the clamp with extra holes.

The clamp reassembled.

I was happily making a vice for my vertical axis's milling sub-table, one based on E.G. Hatwell's "Cross vice to vertical slide" (MEW 15), when the angular adjustment on the vertical slide moved destroying my only 6mm slot drill. It was the weekend of course and my supplier (Ausee Machines and Tools) was closed until Monday. Feeling especially stupid I realised this would put off plans for another project. Then I suddenly thought of a way out of the mess. Tool makers clamps are available from Ausee and Arc Euro Trade and the like for a ridiculously cheap price, so I decided to modify one so that I could attach it to the milling sub-table.

Mine has M6 holes on a 20mm pitch and so avoiding any of the other holes in the clamp's top I drilled and counterbored three holes on a 20mm pitch for flexibility, **photo 1**.

I reassembled the clamp, then I attached it to the sub table on my Sieg SC3 as shown in **photo 2**.

All done in 30minutes or so, **photo 3**.

OK, it was not as much fun as making the vice, but to be honest this is more flexible in placement and can accommodate larger pieces, plus I still have a fully functioning toolmaker's clamp too.

I hope this might be useful to somebody. ■

Clamp in use.

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Mike's Workshop

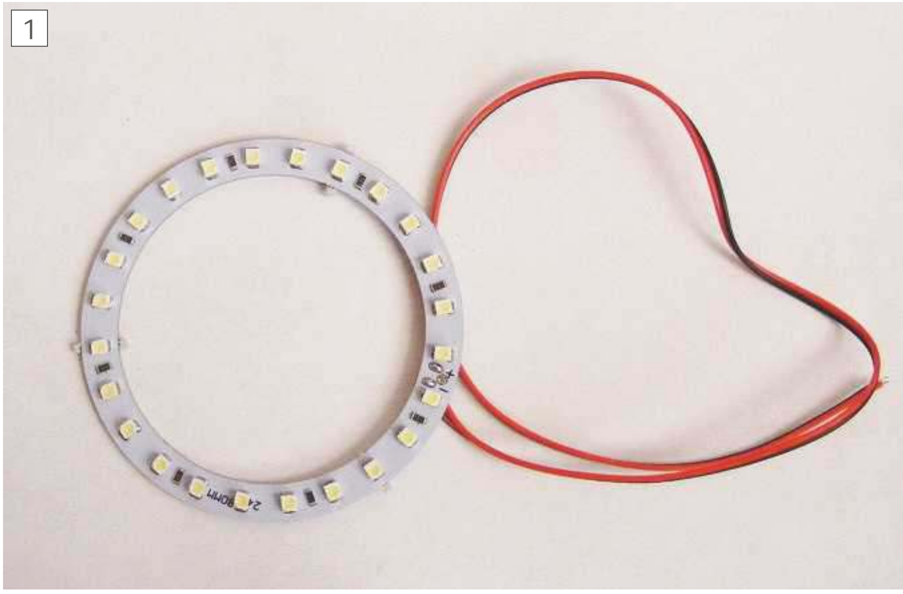
A Ring Light for The Super X1 Mill

Michael Cox creates shadow-free illumination on his mill.

Good lighting is essential when working with machine tools. The problem with most conventional machine lights is that they are very directional and whilst one side is well lit the other side is in deep shadow. This problem can be alleviated by having two lights shining from two opposing directions. The other problem with conventional machine lights is that they tend to restrict the operators view by physically being in the way.

In recent years LED ring lights, **photo 1**, also known as "Angel Eyes", have become available in a range of sizes. These are popular with car enthusiasts as enhancements to the standard vehicle lights. They are usually rated for 12 volt power supplies, come in sizes from 40mm diameter up to at least 160mm diameter, and come in every colour of the rainbow. There are many suppliers of such ring lights on eBay. Potentially these ring lights can provide all round lighting for the mill spindle.

I bought two 80mm ring lights to experiment with on the mill. These had 24 white LEDs mounted around the ring.



Ring light as received.

First version

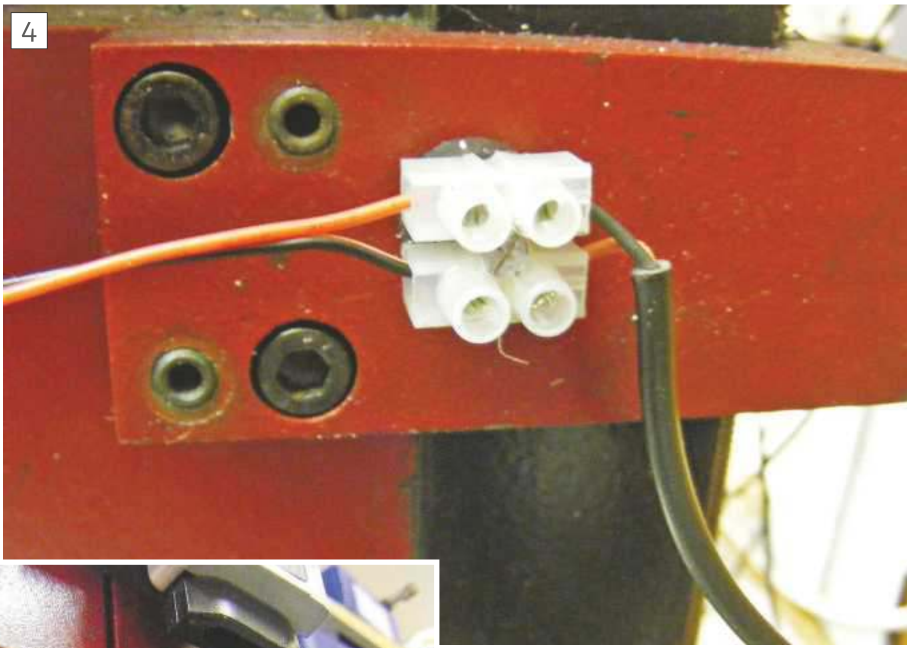
The spindle quill on the Super X1 mill is 50mm diameter. A circle of 8mm MDF was cut out using an 89mm holesaw and the centre of this then cut out using a 51mm hole saw to create a ring (note that MDF dust is bad for your lungs, so wear a mask). A hole was drilled for the ring light wires and four 6mm holes were drilled as shown to a depth of 4mm using a twist drill. Into these holes were pressed four ¼" diameter 1/8" thick neodymium magnets using the bench vice. The push fit was sufficient to ensure that the magnets were held in place and no other fixing was required. The ring was then spray painted black using an aerosol paint can. The wire was threaded through the hole and the ring light fixed to the MDF ring using cyanoacrylate adhesive

The light mounted on MDF ring.

Rear view of MDF ring showing the lead out and the magnets.

(superglue). The finished ring light is shown in **photos 2** and **3**. The wires were connected to 12 V plug in power supply via a small connector block mounted on a magnet, **photo 4**. The ring light just fits over the quill and is held to the underside of the underside of the headstock by the magnets, **photo 5**.

In use the illumination provided by the ring light was very good, **photo 6**, except when using the largest (i.e. 13mm) drill chuck which cast a circular shadow when used close to the work piece such as when using small drills. The big problem with this setup was that access to the tommy bar hole at the bottom of the spindle was restricted and unless great car was taken then the LED lights on the ring could be damaged. What was needed was a thinner ring to mount the lights on.



Connector block mounted on a small magnet.

Ring light in position on the headstock.

Version 2

The second version was made in exactly the same way but this time using 3.2mm thick hardboard, rather than the 8mm MDF to make the annular baseboard for the light.

With this new arrangement friction was not sufficient to ensure that the magnets were firmly retained in the hardboard ring and a little cyanoacrylate was used to make a secure fixing. The rest of the construction was similar to version 1.

This new version, which was only 6mm total thickness compared with 12mm for the version 1, allows much better access to the tommy bar hole in the spindle and it was in use for a number of years without any major problems. Eventually a couple of the LEDs failed (probably because of being powered by a badly regulated 12 V plug in transformer that was actually giving a much higher voltage) and I decided to make a new one.

Version 3

Since making Version 2 I had made a number of changes to the mill. One of these was to modify the top of the spindle so that the draw bar was captive. The reason for doing this was primarily to make the MT2 tooling self releasing and thus avoid having to hit the end of the draw bar and thus lessen to stress on the spindle bearings. One of the secondary benefits of this modification was it was no longer necessary to access the tommy bar hole at the bottom of the spindle in order to release the tooling because the spindle could be gripped at the top of the spindle. This meant that there was no restriction on the thickness of the ring light and no access requirement so

Lights on.

I could increase the diameter of the ring light. Another change I made to the mill was to install a digital tachometer. Both of these modifications can be seen in **photo 7**.

I purchased a 100mm 33 LED angel eye on eBay. The new ring light was made in the same way as version 1 above except I had no holes saw to cut a large circle. The ring of 8mm MDF was made by roughly cutting a disc 110mm diameter using a jig saw. The centre was drilled out 6mm and the disc mounted on an M6 screw with two penny washer either side. A nut was screwed on tightly and then the disc was mounted by gripping the nut in the three jaw chuck. The edge of the disc was turned down to give a final diameter of 105mm. The screw was removed, and the disc was then mounted in the three jaw chuck using the exterior jaws and the centre hole enlarged using a 25mm spade bit in the tailstock chuck. This hole was then enlarged to 51mm diameter using a boring bar mounted on the toolpost.

Using a CAD program two concentric circles were drawn of 51mm and 70mm diameter and the circles then divided into four. quadrants by two lines at right angle passing through the circle centre. This was printed out onto tracing paper at 1:1 scale. The tracing was laid on the MDF disc and the centre hole lined up with the inner circle and the centre for the holes for the neodymium magnets pricked through where the radial lined met the 70mm circle. At these positions 6mm diameter holes were drilled 4mm deep and four 1/4" diameter neodymium magnets were pressed using the bench vice. A 6mm hole was also drilled approximately 6mm from the edge of the disc for the ring light wires. The ring was given a quick spray with black paint.

When the paint was dry the angel eye was placed in positioned and secured using several drops of cyanoacrylate adhesive.

Since building the version 2 ring light I have installed a digital tachometer to the mill, and this is powered by a plug-in 12 V stabilised power supply. The tachometer is mounted close to the top of the headstock and it was very convenient to wire the ring light into the same power supply. In photo 7 the top plug sticking out on the left hand side of the tachometer is the wire to the tachometer sensor and the bottom plug connect the ring light to the 12 V supply feeding the tachometer.

Photograph 8 shows the completed ring light installed on the mill. With the 13mm chuck in the spindle it can be brought down to within 45mm of the table and there is no shadow, **photo 9**. If it is closer that 45mm then there is a shadow. However, if I were closer than 45mm then I would probably be using a smaller diameter chuck or tool holder, so this is not a limitation.

7

Top of headstock showing the captive draw bar and the new tachometer.

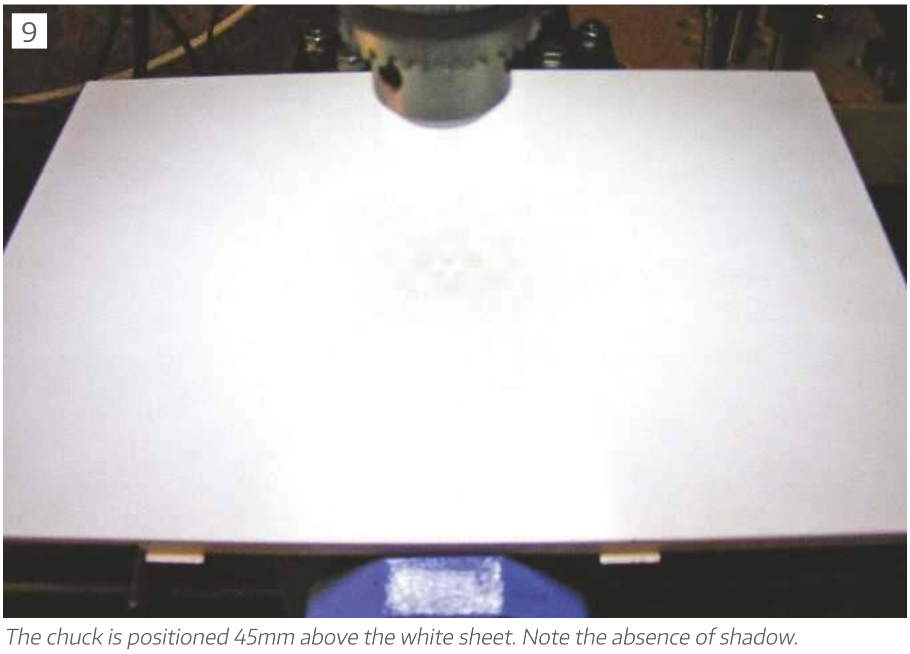
8

The 100mm ring light installed.

Conclusion

I have been very pleased with the lighting from all three versions of ring lights presented here. It is certainly much better than the lighting provided by spotlights arranged around the mill. They are relatively simple to make and cost very little (circa £2-3 for the light and magnets). ■

9



The chuck is positioned 45mm above the white sheet. Note the absence of shadow.

A Second Cross-Slide Leadscrew (Part 4).

This article by Peter Shaw is the final one of a series of articles exploring the techniques used when making a copy of an existing item such as the cross-slide leadscrew and associated components.

There is no intention to provide a full blow-by-blow account of these items, merely to use them to demonstrate the thinking and procedures involved in such a project. In this particular article, we shall look at the handwheel and handle, **photos 1** and **2**.

Handle

The handle, shown in **photo 3**, consists of a sleeve rotating around a bolt which is screwed into the handwheel. Note that there is a recess in the outer end of the sleeve to accommodate the bolt head, and that the overall length of the sleeve is slightly less than that of the bolt head plus shank, excluding the screwed portion. Thus, the sleeve is free to rotate around the bolt yet is retained by the bolt head. To make the slot in the bolt head, mount the bolt in the three-jaw self-centring chuck in the lathe, and using a sharp lathe tool scribe a line across the bolt head whilst ensuring that the chuck does not rotate. The bolt may now be removed to the vice (with protection for the turned surface) and the slot cut with a hacksaw using the scribed line as a guide.

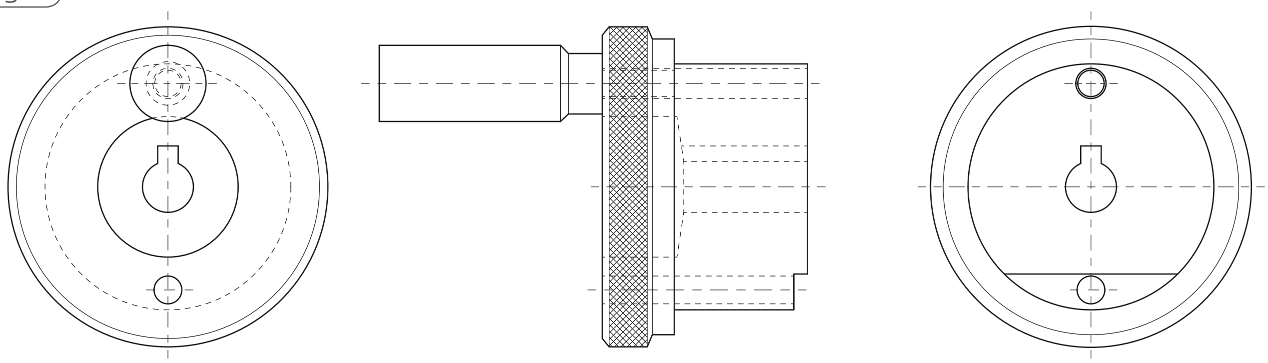
Handwheel

Most of the turning and boring is standard lathework about which nothing else need be said; however, it will have been noticed

1

Handle & Handwheel (Front)

Fig.1



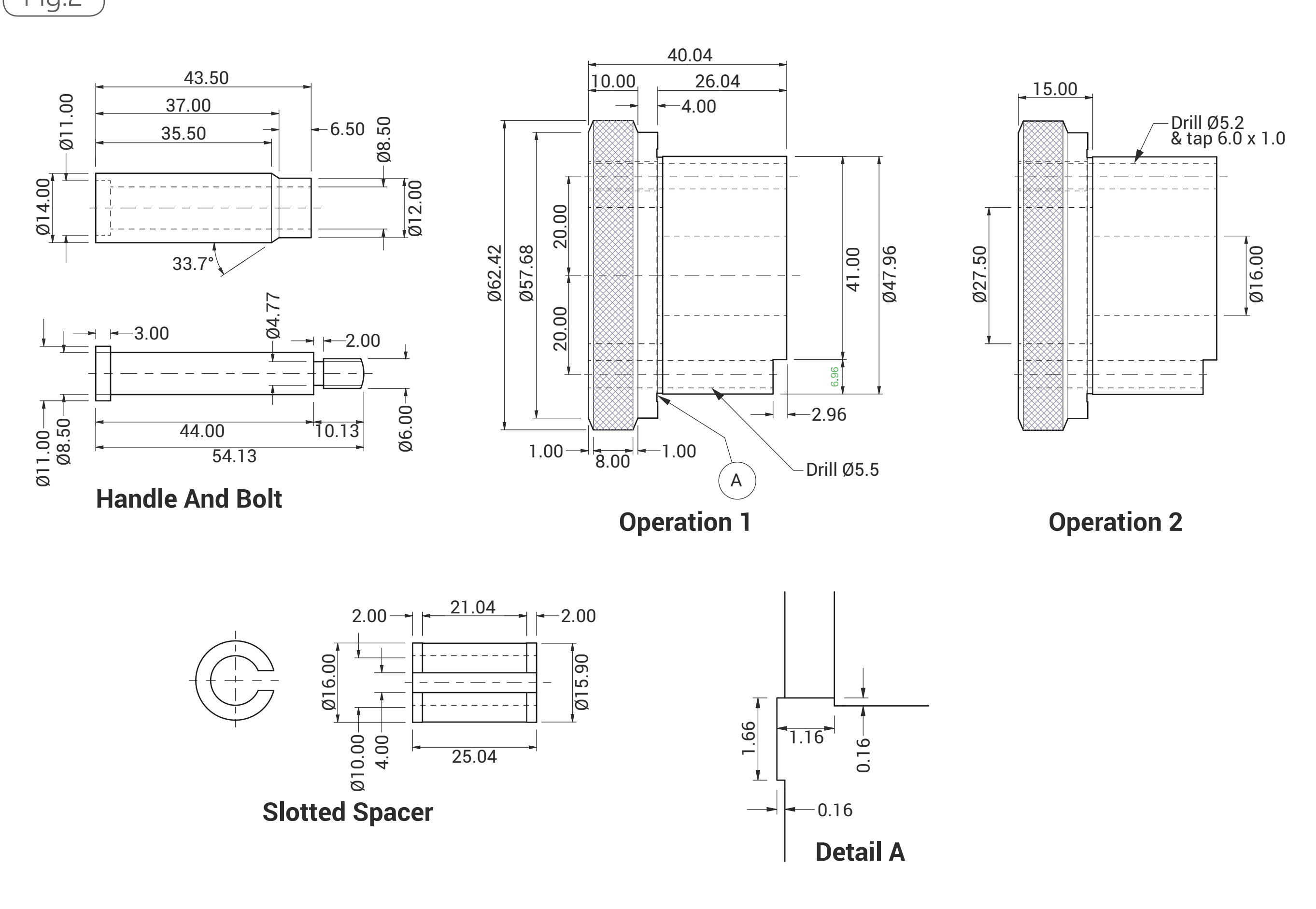
Cross Slide Handle And Handwheel

from photo 2 that there is an internal keyway cut in the body of the handwheel and which extends from the 10mm diameter axle hole. The keyway, although not visible in photo 1, extends for the full width of the body less the recess shown in the photo and is of the order of 25 x 4 x 4mm. This represents a considerable amount of work to file out using a suitably small file. I therefore considered other options and eventually came up with the idea described here. The other options considered and discarded were to drill a 4mm hole followed by filing or broaching before creating the 10mm diameter hole.

Essentially, the idea was to make an insert, something like the bobbin used for cotton threads on a sewing machine, but with a 4mm wide slot along part of the length and with a 10mm diameter hole running the full length. The insert itself would be longer than the required 25mm and would have overlong flanges which would serve to centralize the insert inside the handwheel. The completed insert would be held in place by Araldite Rapid Steel, and once set, the flange excess would be turned off leaving, in effect, a C section part tube permanently fixed to the handwheel, where the open part of the "C" would be 4mm wide and the thickness of the "C" would also be 4mm. **Figures 1** and **2** show the drawing of handwheel, handle and C section insert.

Handle & Handwheel (Rear)

Fig.2



The detail...

The diameter of the shaft on which the handwheel is located is given as 10mm. As the slot is 4mm high, then this will require an insert diameter of 10mm + 2 x 4mm = 18mm. This is also the required diameter of the hole in the handwheel, so start by boring this hole in the handwheel.

The length of the slot in the handwheel is given as 25.04mm. I therefore determined that a suitable length of flange at each end inside the handwheel would be 2mm, hence the reduced section between the flanges, and in which the Araldite would be placed would be 21.04mm long. In addition, a further 2 or 3mm would be required outside therefore the length of the insert becomes something like 29 to 30mm. (It does not have to be exact because the excess will be faced off later.)

Reading the specification sheets for Araldite showed that the recommended gap is 0.05mm to 0.1mm therefore the diameter of the reduced section becomes 16.00 – 2 x 0.05 = 15.90mm.

The insert may now be prepared. Start with a length of suitable rod sufficiently long to be able to be held in a chuck with around 35mm protruding. If using a 4-jaw independent chuck, it will be necessary to use a dial test indicator to set for minimum runout adjacent to the chuck jaws. If the rod is greater than 16 mm, turn down a length of 30mm to 16mm diameter. Now turn a length of 21.04mm down to 15.90mm diameter leaving equal amounts, e.g. about 4.5mm, for the flange at each end. Finally, drill, or if available ream, a 10mm diameter hole at least 30mm long through the centre of the insert. Remove from the chuck and cut to length with a hacksaw.


3

Handle disassembled.

The next step is to make the 25.04mm long x 4mm wide slot. If a milling machine is available, it can be milled using a 4mm slot drill. Alternatively, it can be done using a lathe vertical slide. Although I have both available, I find that using the vertical slide is actually easier for small items such as this as I find that the milling machine head will not get down far enough. The slot should be milled such that the full 4mm width extends 2mm into the flange at each end.

The insert is now complete and requires coating with the mixed adhesive, especially the central reduced section, and a smear on the inside of the 18mm hole in the handwheel. Push the insert into the hole aiming to set approximately the same amount of flange on the outside of the hole at both ends. Allow to set, preferably overnight, and remove the excess material from both ends of the insert. You should then be left with a 10mm diameter hole with a 4 x 4mm slot which may well require excess Araldite removing by means of a suitably small file. ■

In our Next Issue

Coming up in issue 288

On Sale 29th November 2019

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Our December issue, number 288, will have some great features:

Andy Prior makes a DRO Switching Box.

A Tailstock Tapping Device from **Brett Meacle**

Terry Cleife's Lathe Dividing Attachment

DON'T MISS THIS GREAT ISSUE - SEE PAGE 50 FOR OUR LATEST SUBSCRIPTION OFFER

A Combined Scroll Saw and File Attachment for Your Lathe

Mogens Kilde gives a step by step guide to aid beginners and the more experienced in making this useful attachment. – Part 2.

Next part is the end washer or end plate for the eccentric shaft, **fig 6**.

This part was made to ensure that the tool would not fall apart when standing alone.

The washer was made from 3.0mm mild steel plate, and after marking the out line, the disc was cut on my band saw, **photo 29**.

Next the 6mm centre hole was drilled in the bench drill, **photo 30**, and to end it up, the outer edge was turned to final dimensions on the lathe, **photo 31**.

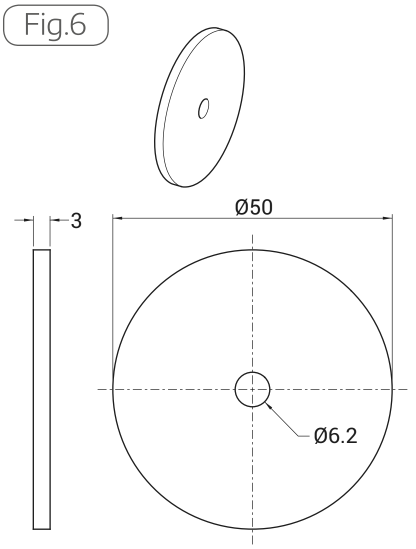
Next I made and initial setup on the lathe and all seemed to be well, **photo 32**, in the photo you can see that the length of the eccentric shaft needed to be extended to 40mm as per my final design.

Next parts are a set of tilting brackets, **fig. 7**.

These brackets were made from 6.0mm mild steel plate, and after marking out and cut on the band saw, **photo 34**.

A centre hole was drilled in the bench drill, **photo 35**.

Fig.6



Eccentric Shaft Washer

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30

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32

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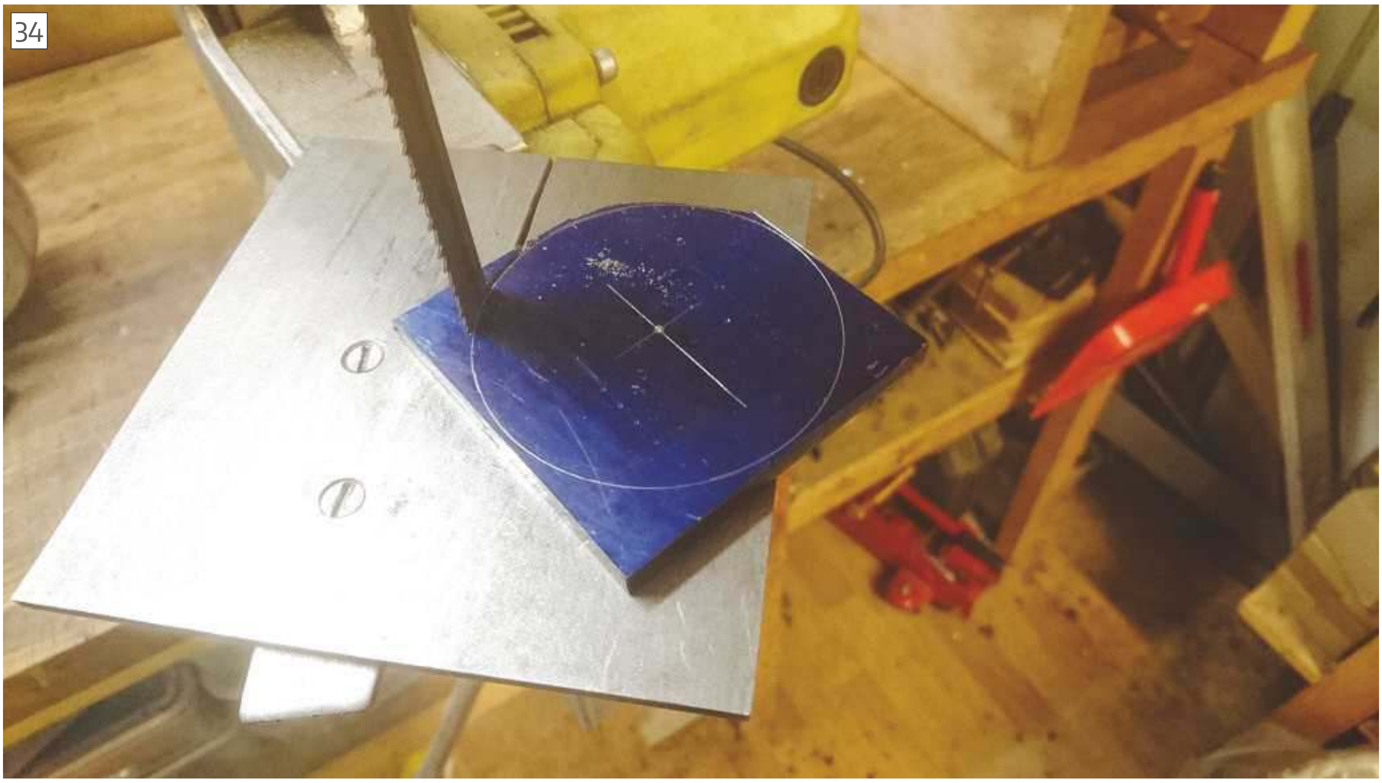

35

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Finally, via the centre hole, the work piece was turned, photo 35, to an outer diameter of 70mm.

Next the work piece was mounted on to my index table, and set up on the bench mill, **photo 37**, after locating two reference holes on the centre line, and four pilot holes for the slotted holes.

The slots were milled, using a Ø4mm end mill, **photo 38**.

Via the reference holes on the centre line, I placed the work piece in the milling vice, **photo 39**.

The brackets were cut off using a disc mill, **photo 40**.

To finish the brackets the two M4 threaded holes were drilled with tap in the bench mill, **photo 42**.

I could then check the set up on the assembled tool, **photo 43**.

Next set of parts that I made, was the locking mechanism for the worktable, these parts consists of a support bushing and a nut, **figures 8** and **9**.

First, I placed a piece of 12mm free machining steel in the lathe and for the support bushing I drilled a 4.1mm centre hole, **photo 44**.

For the Nut I drilled and tapped a M4 hole in the centre, **photo 46**.

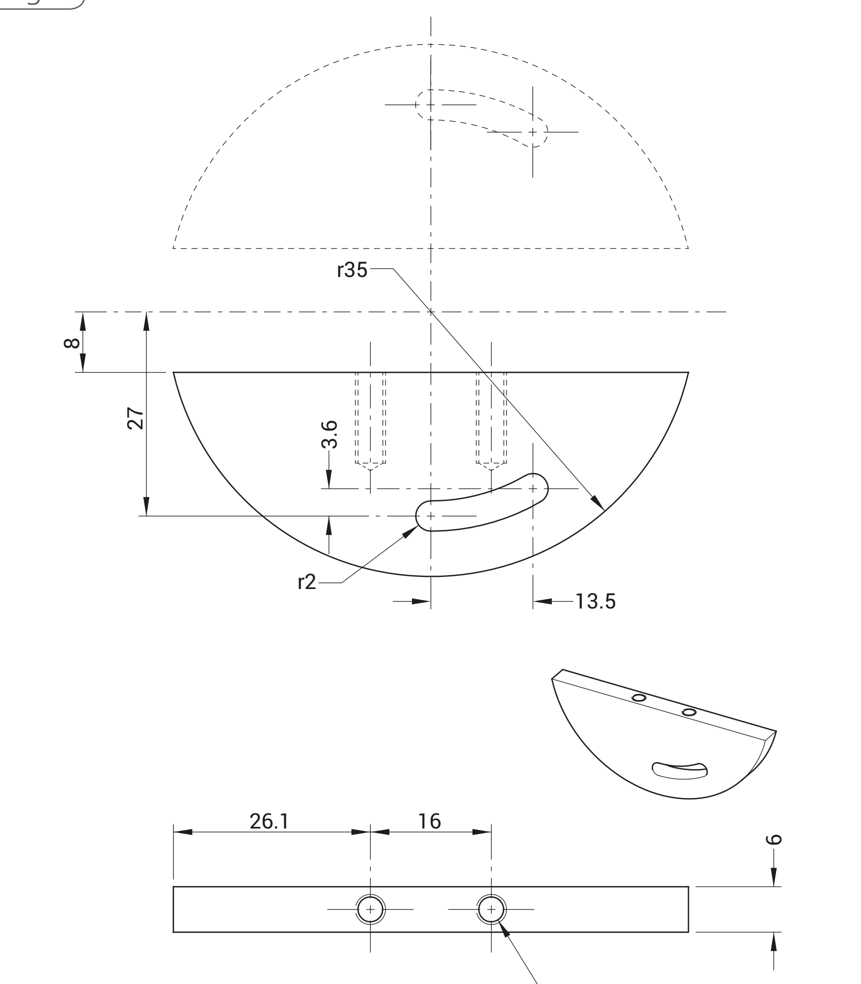
All parts were cut off in the lathe, at finished length according to the figure, **photo 47**.

Finally, the work pieces were placed in the milling vice one at a time and the R6 radius milled with an end mill, **photo 48**.

Next part was the worktable for the tool, **fig. 10**.

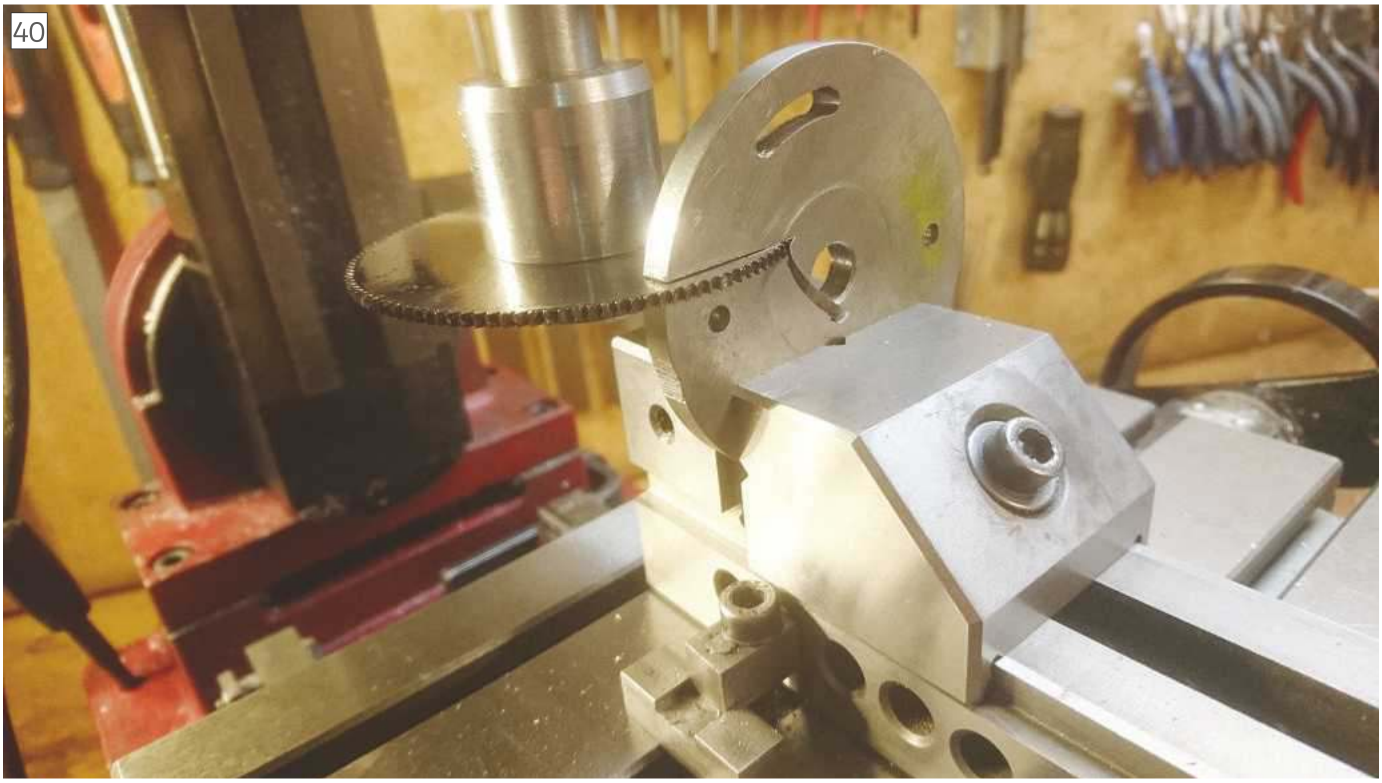
This part was made from 8.0mm mild steel plate, and I must admit that the design of 190mm in diameter is due to the fact that I had a laser cut piece of plate

Fig.7



Bracket Tilt Table

37



this size lying around.

The first process in my case was therefore to place the roundel onto the bench mill and locate the centre of the work piece and then I marked all positions of the holes according to the figure, with a centre drill, **photo 50**.

The work piece was then brought to the bench drill and all holes where drilled, **photo 52**.

For the 4mm counter bored holes I drilled some pilot holes and finally counter bored with an end mill, **photo 54**.

Please note that in the photos are shown two additional holes that initially were unnecessary and again this is due to a design flaw. These holes did however come in handy later, as you will find in the end of project.

Next the part was placed on the mill again and I milled the 40mm counter bore, **photo 55**.

To finish up the work on the working table, I tapped the M2.5mm thread using


43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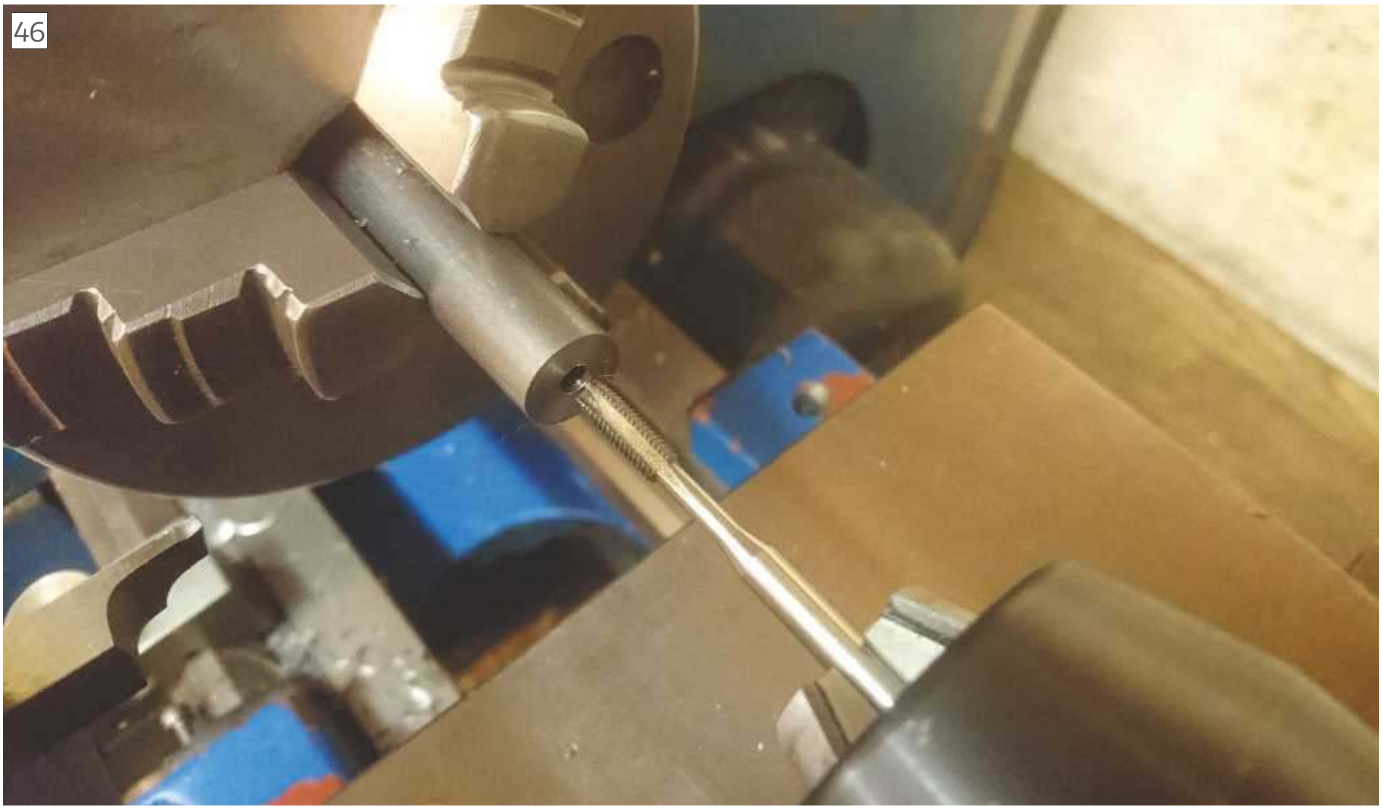
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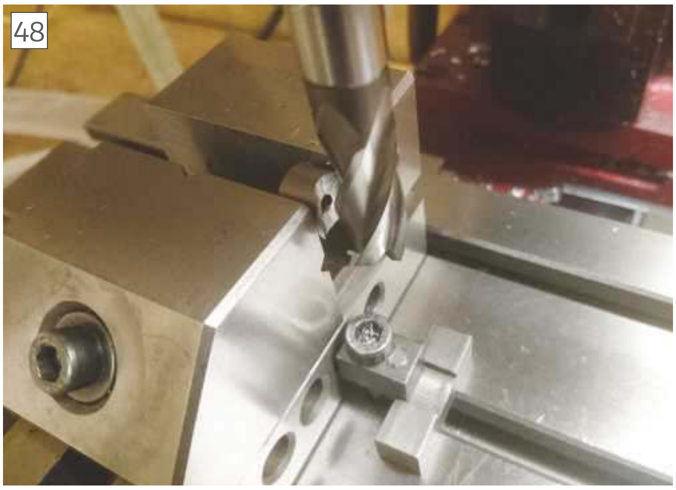
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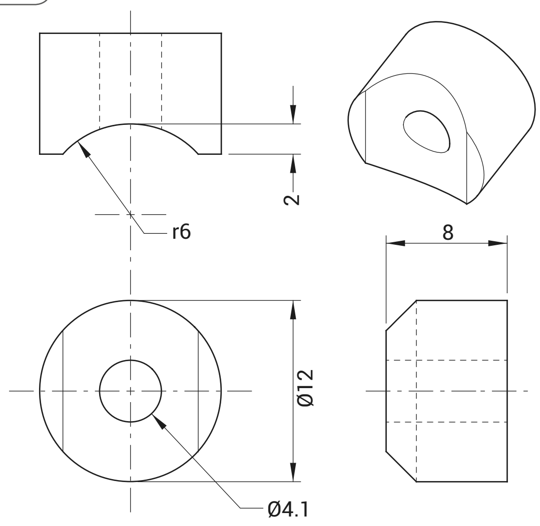
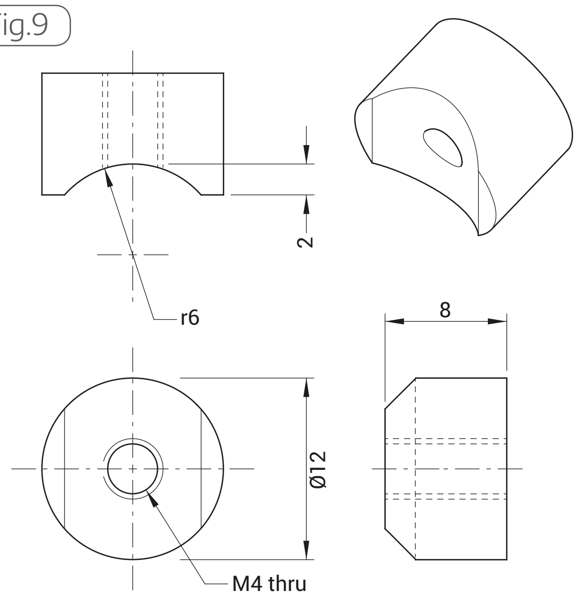
Fig.8



Lock Bushing

Fig.9



Lock Nut

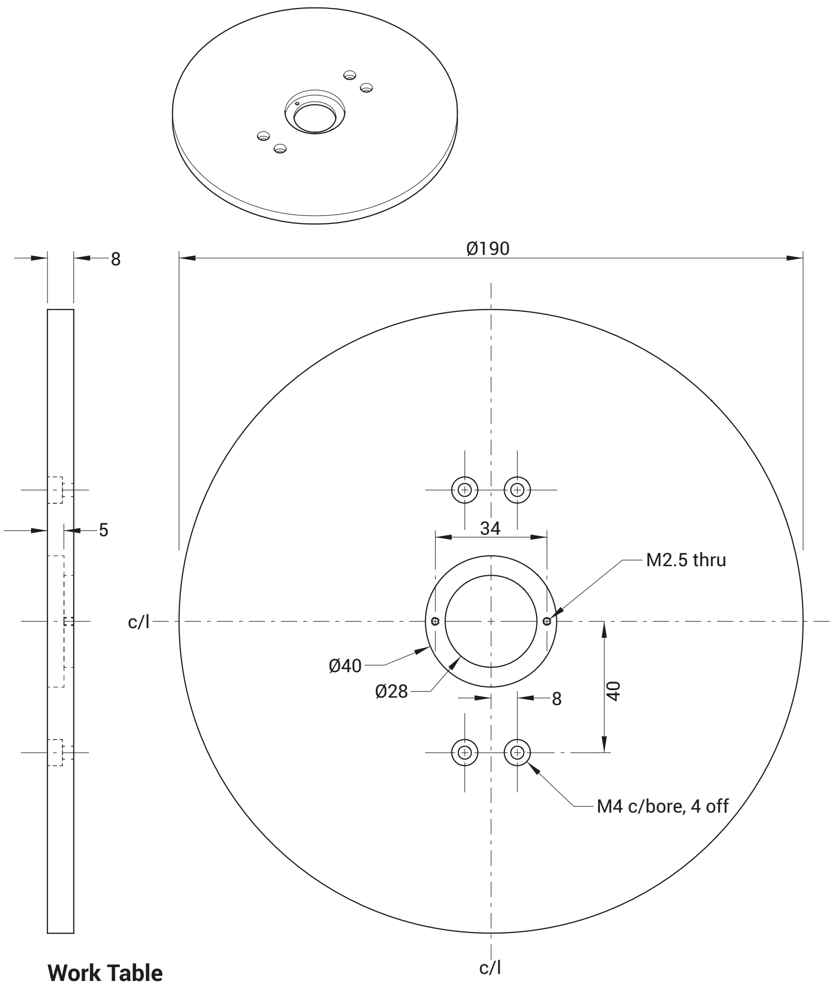
50

51

52

53

Fig.10



my parallel arm tapping tool, **photo 56**.

Now I could assemble my tool further and check if all still was well, **photo 57**.

Next part I made was the fixture for the saw cutting blade, **fig. 11**.

This part was made from 20mm free machining steel. After turning the lower section according to the figure, **photo 58**, the face on the part was milled on the bench mill using an end mill, **photo 59**.

Finally, the two M4 holes were drilled and tapped, **photo 60**.

Next part was the lock plate for the saw cutting blade, for the complete scroll saw tool you will need wo of these.

The locking plates were made from 3mm mild steel plate and after cutting blanks a little over size, the parts were milled to final dimensions, **photo 61** in the bench mill.

● To be continued

"We apologise to any readers confused by the skips in the photograph numbering; because of the large number of images in the article we have decided to keep the author's numbering rather than risk introducing errors." - Ed.

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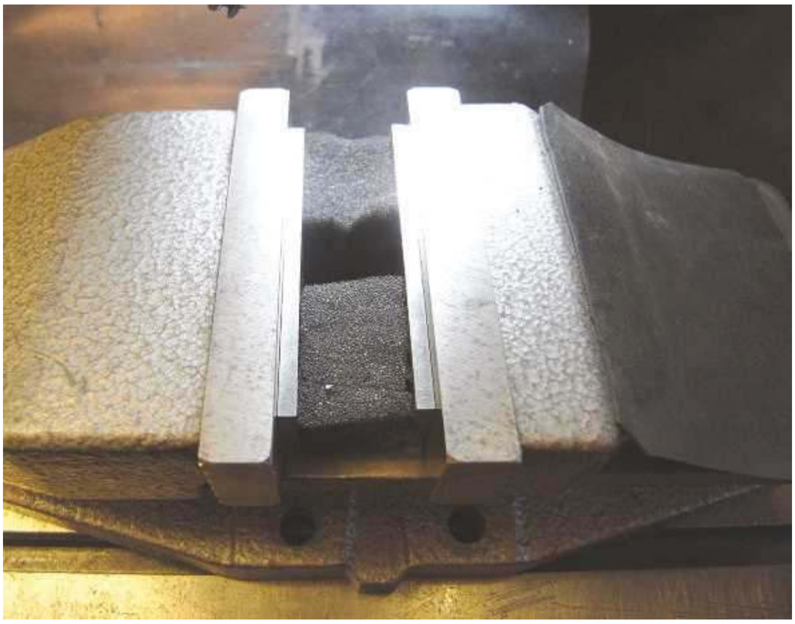
Readers' Tips

Mill Vice Advice

TIP OF THE MONTH WINNER!



This month our lucky winner of £30 in Chester gift vouchers is Brian Roberts with a neat solution if your parallels never seem to stay in the right place.

I was using my miller recently and was getting frustrated with parallels which would not stay put in the vice. Being keen to complete the job I didn't feel inclined to wait for wavy parallels to be delivered so struggled on, getting more annoyed with the set-up.

After lunch and a calming-down period I suddenly thought about using some ordinary foam sponge as a separator, it worked a treat.

It's cheap, caters for any dimension and is easily replaced - I recommend it to the house.

Brian Roberts

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.

Myford ML7 wide-guide conversion

Modifying an early Myford ML7 to the later wide-guide saddle format can be a simple, cheap yet precise way to avoid regrinding a worn bed or saddle, Pete Barker explains the process.

The Myford 7-Series lathe comes with two types of saddles, the variation being in the surface that guides the saddle along the lathe bed. Pre-1972 models used the vertical surface labelled A in **photo 1**, with the adjustable gib strip at location D used to pull it up against the vertical surface of the front lathe shear. This was called the narrow guide owing to the short distance from A to D. From August 1972, Myford used the rear surface labelled B to guide the saddle along the bed, against the rear vertical surface of the rear shear. This has been dubbed the wide guide, referring to the large width from the gib strip at D to the bearing surface at B.

Despite decades of debate over their merits, both systems worked well when new. But the shorter length of the saddle bearing surface at A on the narrow-guide models led to more severe wear, which in turn led to wear on the mating bed shear. **Photograph 2** shows the 4¾" narrow-guide surface marked with diagonal felt-pen lines. Our example had 0.025" of wear at one end of this surface and 0.010" at the other. The pencil in the same photo points to the 7½" rear wide-guide surface at B. This longer guide adds stability by matching the full length of the front gib strip at D.

However, if you have an early narrow-guide lathe that has worn the saddle and bed at point A, it is a fairly simple matter to convert it to a wide-guide by adding a strip of gauge plate at B, a mock-up of which can be seen just sticking out in photo 1. This creates a gap at A and takes the worn surfaces out of the equation. The long rear surface on the saddle, like the rear vertical surface of the rear shear, were machined at the factory on all models, but never actually used on narrow-guide machines. Both are therefore still pristine surfaces. A similar fix taking advantage of this was suggested by J.A. Radford in his book *Improvements and Accessories for your Lathe* and a 1971 ME article. But he also machined the narrow-guide surface at A and fitted second strip of gauge plate there, an unnecessary and possibly costly step, in my experience.

The quick way to confirm which guide

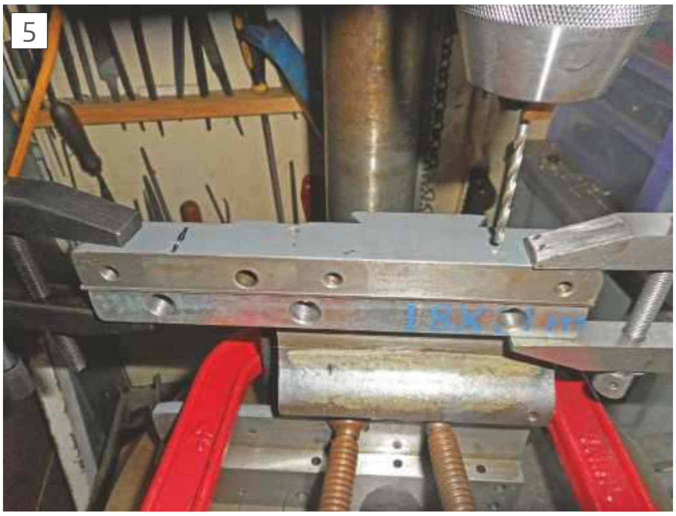
Narrow guide is at A, wide guide at B and gib strip at D.

Narrow guide surface with diagonal felt-pen lines. Pencil points to wide-guide surface.

Wide-guide felt wiper housing above, narrow-guide version below.

›

Strip of gauge plate in position with chamfer along bottom edge for scraping clearance.



Drilling the dowel holes through the saddle and gauge plate.

Dowel pins stand 0.040" to 0.050" proud of the saddle surface.

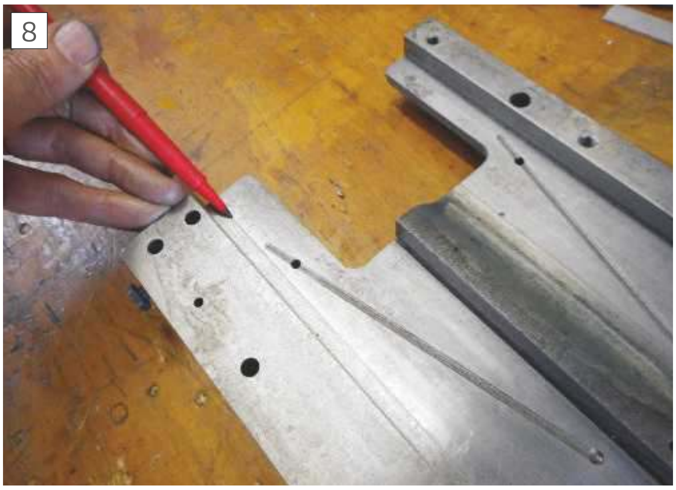
your Myford was manufactured with is shown in photo 3. At the top is the wide-guide felt wiper housing from the leading edge of the saddle. It is longer than the narrow-guide version shown below it, with the right-angle protrusion on the left-hand end. The narrow-guide wiper housing has the distinctive quarter-round protrusion amidships, as on the lower example.

Measuring wear on the narrow-guide bed and saddle was covered in a previous article. In a nutshell, a bed having more than 0.003" of wear on the vertical shear surface at A, or more than 0.005" wear on the adjoining horizontal surface atop the bed way should be reground, according to the Myford literature. Our pictured example had 0.003" and 0.004" wear respectively but was reclaimed without regrinding by performing the wide-guide conversion. The finished machine has been tested to turn zero measureable taper over a six-inch test piece and to take .100" deep cuts with no chatter. An excellent result for a well-used machine, giving it many more years of useful life for the cost of a strip of gauge plate and a few hours in the workshop.

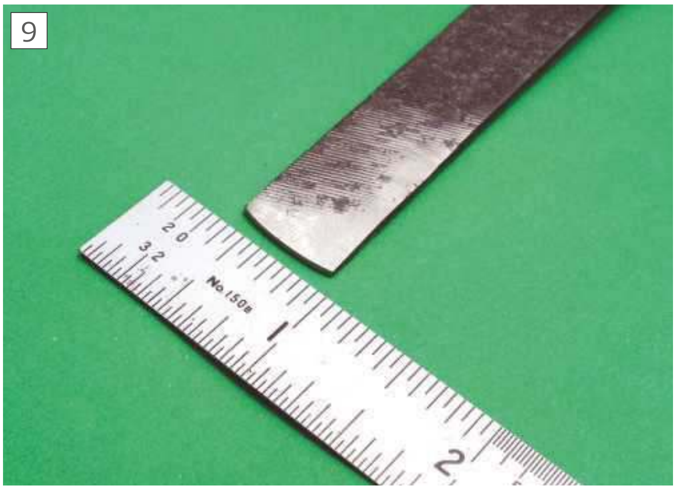
Strip show

The first step is to obtain a strip of steel gauge plate 1/2" wide by 1/16" thick. This is a durable carbon steel that comes surface ground on all sides and will wear well

Attaching gauge plate strip to saddle with Loctite. Gib screws clamp saddle and strip in place. MEW cover prevents strip sticking to bed.



Unworn section of saddle needs to be relieved to clear bed way in new position.



Small scraper made from a six-inch flat file using the bench grinder and oil stone.

against the cast-iron lathe bed. I wouldn't recommend soft mild-steel sheet metal, brass or stainless steel. The gauge plate is available at very reasonable cost from model engineering and steel suppliers.

Cut a piece of the gauge plate 7½" long to match your saddle at location B. Hold it in the vice and file a nice 45-degree chamfer along one edge. It does not have to be perfect. The chamfer is merely to provide clearance for a small flat scraper, if needed for final fitting later. **Photograph 4** shows the chamfer on assembly.

Being a belt-and-braces sort of fellow, I held the strip in place with two 3/16" silver steel dowel pins, plus Loctite retaining compound. The saddle was marked up and centre-punched for two dowel holes 1.5" in from each end. The strip, with chamfer correctly positioned, was clamped to the saddle with two toolmaker's clamps and a piece square bar so the strip would not distort during drilling. The saddle was then clamped to an angle plate on the drill press by two G-clamps, seen in red in **photo 5**. My angle plate is a piece of 6" angle iron, but care must be taken to select a piece that is truly square or use shims to make up the difference.

After an 11/64" pilot drill, the hole was drilled with a 4.7mm drill, which is 0.185" diameter but usually cuts 0.001" oversize and makes a nice press fit for 3/16" silver steel bar which measures 0.187" diameter. The strip

10

First pass of diagonal cross-hatched scraper marks to remove unworn metal.

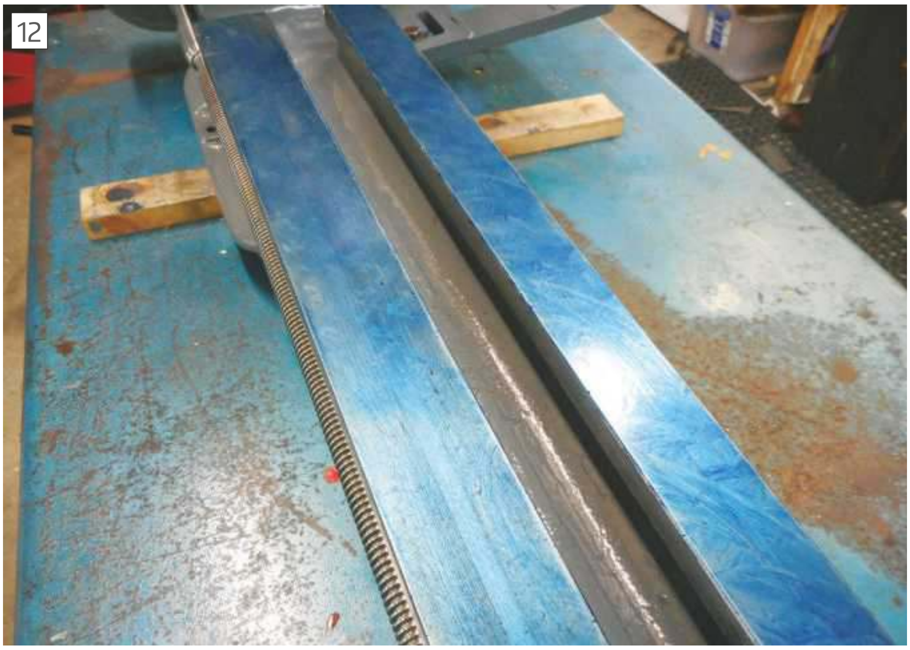
11

Small dabs of bearing blue along the bed ways.

was removed and its holes eased with a 3/16" reamer to a push fit on the silver steel bar.

Two pieces of the bar were machined to .700" long for the dowel pins. This length may vary from machine to machine. One end should be faced square in the lathe and the sharp corner just broken with a file. The other is best domed in the lathe with a fine file to give it a pleasing finished look. Always keep the file moving while doing this, taking long strokes just the same as with a stationary job in the vice. The dowels are tapped into position with a small hammer and drift so the square end protrudes past the machined surface by about 0.040" to 0.050" (Photo 6) to locate the strip but not touch the bed shear.

After a good clean up, the strip can now be glued in place with a few drops of Loctite or other adhesive. Make sure the chamfer is in the right position and then clamp the strip in position. An easy way to do this is to place the saddle on the unworn right-hand end of the lathe bed and use the gib adjusting screws and gib to apply even clamping pressure along the saddle length. A Model Engineer's Workshop back page between bed and saddle is perfect to stop excess adhesive joining them permanently, **photo 7**.



12

Smear the blue on with one clean finger; wipe it off with another to leave a thin layer.

Filing (and maybe scraping)

Now we have our 0.062" packing strip in position, we have to compensate for the resulting movement of the saddle toward the rear of the lathe. It is not the full 0.062" because there was already a gap of about 0.025" between the saddle and bed at position B in photo 1. The exact amount may vary from lathe to lathe but can be measured before beginning, or if you forget simply measure the gap now at point A in photo 1 and that is your rearward movement. On our example, rearward movement was 0.038".

This means two 0.038"-wide unworn strips on the underside of the saddle will now ride up on the top surfaces of the bed ways unless we remove them. The pen in **photo 8** points out one of these unworn areas. The other is visible in the same position near the other wear area. Fortunately, our saddle had only 0.002" wear in this area so grinding or milling was not needed. If yours needs machining here, it is best done before finally fitting the gauge plate strip.

As it was, my son and I removed the 0.002"-high sections with judicious use of a 10" square file with the saddle held lightly in the vice. It does not matter if the area is filed down a little too far. Only the first 0.038" width of it will engage the bed surface, the rest is off the edge in clear space, as it was before. You could even remove this metal with a Dremel tool if you have a steady hand. We finished the job with a small flat scraper to get final fit, although this is not strictly necessary if you are not familiar or confident with hand scraping. A suitable scraper was quickly made up from a 6" flat file **photo 9**. The teeth were ground off the first inch or so each side and the faces tapered to a thickness of a 1/16" at the end. The end was ground to a slight radius. It was then finished on the bench oil stone. Scraping is done with the file handle held in the right hand and the left hand's fingers pushing downwards on the middle of the file itself. Scraper strokes are made at regular intervals at a 45 degree angle along the section, and then you go back over with strokes at 45 degrees the other way **photo 10**. Repeat this cross-hatching process until the surface feels flat to the touch. Use the tip of the middle finger of your left hand (if you are right handed) for the best feel. It has less callusing than the index finger and the fingers of the dominant hand, so is more sensitive. Changes, steps and particles as little as one thou may well be felt this way.

Blue: spread it thin

Final check of the saddle's horizontal sliding bearing surfaces is done with bearing blue smeared thinly on the lathe bed. This blue is also known as engineer's blue, micrometer blue and marking blue, not to be confused with the quick-drying marking-out blue dye or paint. The thinner you spread the blue on the reference surface, the more accurate the reading on the work piece will be. Rolling it on like thick paint is not good practice. Place a series of small dabs from the tube along the bed **photo 11**. The "rule of thumb" I was taught as a spotty-faced apprentice is to rub it on with one clean finger and then rub it off with another clean finger. What's left on the surface is enough. It's hard to show this in a magazine that is dependent on how the printer sets the ink on his press, but **photo 12** depicts the blue ready for work, after the excess was wiped off with the second finger. The parent metal is readily visible through a thin translucent layer of blue. **Photograph 13** shows the barely visible layer of blue after a couple of rounds of testing and scraping. This is perfect for an accurate final reading, but great care must be taken to hold the saddle up to the right light to see the resultant feint markings.

The saddle was slid gently back and forth along a few inches of the least-worn right-hand end of the bed to get a reading, and then any high spots, **photo 14**, were further scraped back. This could at a pinch be done with a file as mentioned. The process was repeated until all high spots were "knocked down". No great time was wasted trying to scrape the entire surface of the worn saddle to match the worn bed perfectly as we would still be chasing our tails on that one today with one part of the bed giving different readings to another. But we found a good even reading of blue on the saddle overall, 85+ per cent, good for a worn machine. If you find evidence of a warp or marked high and low sections, either scraping or re-machining will be required.

The same bluing and scraping technique applies to our strip of gauge plate. First, a smooth flat file and oil stone were run over the rear vertical surface of the rear bed shear to knock down the tops of the virgin machining marks still evident. Very little metal was removed; just the ridges to make sure the saddle will travel smoothly. This surface was then blued up and a reading taken on the mating strip of gauge plate. **Photograph 15** shows the first run of diagonal scraper marks on the blued area, visible just at the top of the marks.

13

The even thinner layer of blue used for final, accurate spotting.

Note how the chamfer on the strip allows scraping right to the edge of the bearing surface without a burr. The saddle was held in vertically in the bench vice to make scraping comfortable. After a second run at 90 degrees to the first run of scraping, it was retried on the bed and found to have good contact for more than 85 per cent of area, **photo 16**. Final scraping may later be required on this strip to fine adjust alignment of the cross-slide at a right-angle to the bed's longitudinal axis. We will get to that shortly.

Assembling the carriage

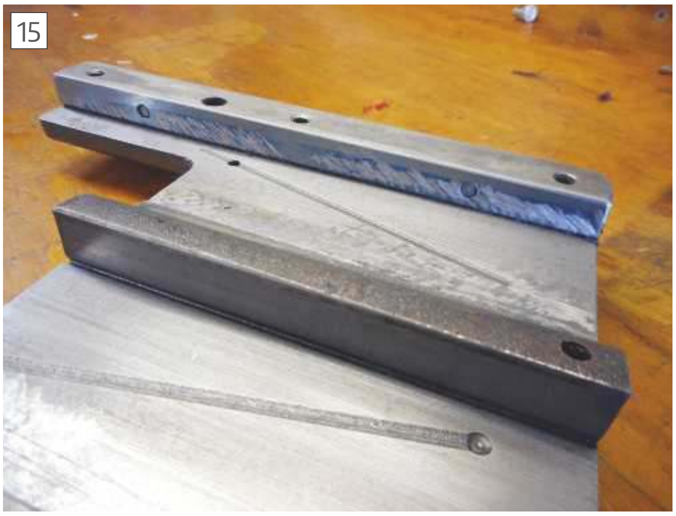
The saddle, bed and gib strip should all be immaculately cleaned and well oiled. With the saddle sat on the right hand end of the bed, install the gib strip and gently tighten the gib adjusting screws but leave them a little loose at this point. Then install the lift plates, the two long strips of steel that bolt to the bottom of the saddle and run on the lower surface of the bed shears. Some careful shimming may be required to get the saddle to move along the full length of the bed without binding but with no discernible up and down shake. I shim them until they just lightly bind with the bolts very tight, and then ease the bolts off about 1/16" of a turn to allow free sliding with no vertical shake.

Next, adjust the gib screws. Bring the two end screws in until they just touch the gib and create just discernible drag when moving the saddle. Then do likewise with the rest of the screws. Slide the saddle back and forth along the bed, checking there are no tight or loose spots. Sit the saddle at the most worn section of the bed at the left and repeat the adjustment. Now make sure it will slide all the way to the right hand end without binding. Nip up the locknuts and check again. Our saddle showed no sign of tight spots as it slid along the full bed, indicating the wide-guide conversion had been a success.

14

High spots on the saddle ways were further scraped back.

15



First run of scraper marks along the added strip of gauge plate.

16

A good reading of blue on the gauge plate strip ensures a good bearing surface. Laid on a bit thick here to show up in the photo.

17

Measuring headstock spindle to bed way alignment with a piece of scrap steel bar and dial indicator.

Quick alignment test

This success was confirmed with a quick and easy alignment check, performed with the bed loosely bolted to the bench in its "natural" position. A piece of 5/8" stainless steel bar was clamped in the four jaw chuck, sticking out about 8". Any piece of bright bar from the scrap box will do. It does not have to be straight, just the same diameter all along. A dial indicator was mounted in the horizontal plane to the saddle by magnetic base. The bar was set to have a zero indicated runout at the chuck end and the dial of the gauge set to zero.

The saddle was then slid along until the dial indicator plunger was on the far end of the bar, **photo 17**. Because any piece of random bar will have a slight curve, or worse, to it, as the chuck was rotated now it returned a reading of minus 0.002" at the low point and plus 0.003" at the high point. If we add those two readings together and divide them by two to get the mean, it tells us the amount of misalignment between the headstock spindle and the path travelled by the saddle along the bed. So - 2 plus 3 = 1, which divided by two gave us half a thousandth of misalignment. A phenomenal result and certainly confirmation the wide-guide conversion is well worth doing. A check with the dial indicator mounted vertically found a 0.001" high reading at the end of the bar, not enough to worry about on a home hobby lathe, and it will come down with headstock bearing wear anyway. Further testing was left until assembly had been completed. It is essential for all such testing that the headstock bearings be in good condition and correctly adjusted first.

Apron relocation avoided

Because the saddle has been moved rearwards by 0.038", it was found the half-nuts no longer lined up with the leadscrew. Moving the half nuts is not an option because they run directly in dovetails machined in the apron body. Radford in 1971 recommended drilling out the three counterbored screwholes in the top of the saddle to allow the apron to be moved over to align. But to get our 0.038" movement, the holes would need drilling out by almost 0.080" and the apron would stick out slightly in front of the saddle.

18

Both leadscrew brackets were milled down to align with new apron position.

Instead, the leadscrew was moved rearwards by 0.038", allowing saddle and apron to remain unmolested. This was a simple matter of milling 0.038" off the back mounting surfaces of both leadscrew brackets, **photo 18**. Remember, this figure may vary from lathe to lathe. Milling was done using a vertical slide attached to The Flagellator, my 1937 Drummond M-type lathe. The right-hand bracket was simply held in a small vice, but the awkwardly shaped left-hand bracket used the two studs clamped to a parallel and shimmed square, **photo 19**. This was sufficient because Myford's cheesy Mazak material machines like, well... cheese. Leadscrew and thinned brackets were then remounted on the bed.

If your lathe has the QC gearbox, you will need to follow Radford's lead and drill out the apron mounting screw holes so the leadscrew remains unmoved.

Final assembly

Reassembly of the apron is now straightforward, but a couple of tips if I may. Our example had three fibre washers placed between the saddle and apron, one on each mounting screw. These, or similar shims, should be retained if yours has them, so the carriage traverse pinion engages correctly with the rack on the bed. To set the final position of the apron, leave those screws finger tight, run it to the far right next to the leadscrew bracket and engage the half nuts firmly, with the adjusting screw in the bottom half-nut backed right out. Tighten up the three apron mounting screws. This sets the horizontal position of the apron. Then bring the half-nut adjusting screw in until it just contacts the upper half-nut, open the half-nuts and turn the adjusting screw in one quarter of a turn.

Final assembly involved installing the cleaned and oiled cross-slide assembly, top-slide and toolpost assemblies. Feedscrew end floats and gib strip adjustments were carefully set to be free but with no binding. We were fortunate a previous owner had the cross slide and its ways reground at some point and they were still in very good condition. A new feedscrew nut was fitted on the cross-slide for good measure.

The last task was to fit the new bed wiper felt and holder to the front of the saddle, so it covered the newly used wide-guide area. You can purchase these items from Myford. My son and I made our own, cut from a piece of 0.050" sheet steel using the original as a template. It was shown in photo 2. An extra screw hole was drilled and tapped into the saddle at the same time the gauge plate dowels were done earlier. A 5/32" BSW will do the job if, like us, you don't have BA screws and taps to match Myford's originals. Suitable felt about 3/16" thick was bought from the local hardware shop, sold to stick to the bottoms of chair legs to protect wooden floors. It was cut to shape, holes punched and fitted in place.

Turning test: job's a good un'!

The first test was to confirm our earlier initial spindle to saddle-movement alignment under working conditions. This was simply a piece of 1" diameter steel bar gripped in the chuck with about 6" sticking out. A light cut was taken along the full length with a very sharp HSS knife tool, then a finishing cut of 0.002" depth. No tailstock centre is used for this test.

The resulting cylinder was measured along its length with a good quality micrometer and found, rather stunningly, to read zero-zero from one end to the other, **photo 20**. No measurable taper at all. Result! The unused rear bed shear's vertical surface has proved to be perfectly parallel to the narrow guide original front shear surface. That was some good machining by Myford back in the day and some good luck for us today. Myford's inspection sheet specifies a 0.0008" tolerance for a six-inch turning test piece like this. I should think if you could get it to within 0.001" on a worn machine, you could squeak by with it, the 0.0002" difference amounting to a gnat's piccolo in the home workshop.

However, if the lathe is turning slightly tapered, it may usually be brought back into true by shimming or adjusting the bed-to-bench mounting bolts as per Myford's user manual. Any gross error beyond this range would require the headstock alignment to be adjusted.

In our case, being happy with our

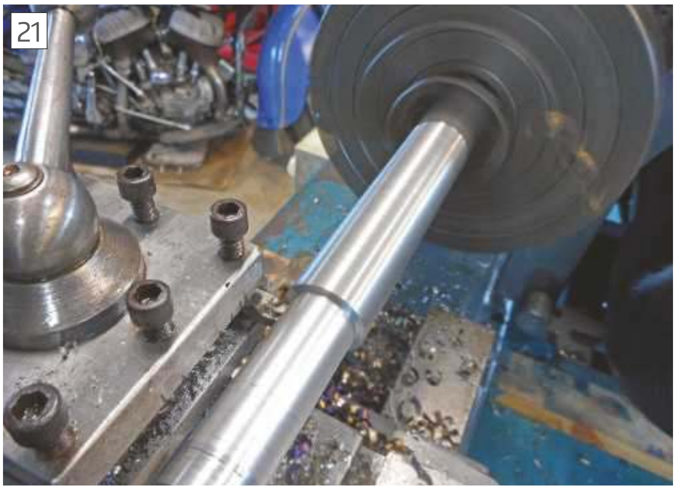
19

Right hand bracket was clamped by its two studs on a parallel bar for milling on The Flagellator's vertical slide.

20

Six-inch turning test piece with no tailstock centre showed zero taper, well within Myord's tolerance of 0.0008".

21



Taking a .100" deep cut with no chatter, tailstock centre in place this time.

Checking cross-slide travel is parallel to the faceplate and thus square to the spindle axis.

Thanks to the wide-guide conversion this once tatty old lathe now cuts as good as new - if not better.

alignment, a further "real world" test of the wide-guide conversion was to now put a tailstock centre in place in our test piece and take a .100" deep cut under power feed, **photo 21**. It cut the full length without complaint or chatter, allaying any fears about how those worn saddle's horizontal surfaces would work on the worn bed surfaces.

Facing the truth

The final test was that the saddle sat squarely or slightly toward the concave position across the bed. The quick check is to mount a dial indicator on the cross slide and take a sweep across a face plate that is known to be good and flat, **photo 22**. Many faceplates will have a little runout on the face at the outer section, so rotate the spindle by hand and find the high spot. Place this at the 12 o-clock position. Place the dial indicator then at the 9 o'clock position and set its dial to zero. Wind the cross slide inwards, gently lifting the indicator's plunger across any grooves. The reading should ideally be zero-zero. Allowable error for home hobby lathes is in the region of 0.0005" to perhaps 0.001" in the concave direction. This last is important. A slightly concave faced surface will sit firmly on a flat surface in use. A convex surface will rock.

If your faceplate is a bit chatty, like the pictured example, an alternative is to hold a parallel bar in the four-jaw chuck, or say a 6" length of 5/8" square key steel at a pinch, and set it so that, as the chuck is rotated by hand, each end shows a zero reading on a dial indicator mounted on the cross slide. It is now perfectly square to the spindle axis. You can then rotate the chuck so the bar is horizontal and sweep the dial indicator across the bar as described for the faceplate.

If the machine fails this test, adjustment is made by scraping our strip of gauge plate now guiding the saddle. In our case none was needed. But it might be that you have to scrape lightly one end of the strip a bit more than the other to swing the saddle around to obtain that zero-zero to 0.001" concave reading. The exact amount of variance is up to you, depending perhaps on how often you face large objects and how flat you want them to be. I think in most cases, one could get away with no scraping of the gauge plate strip.

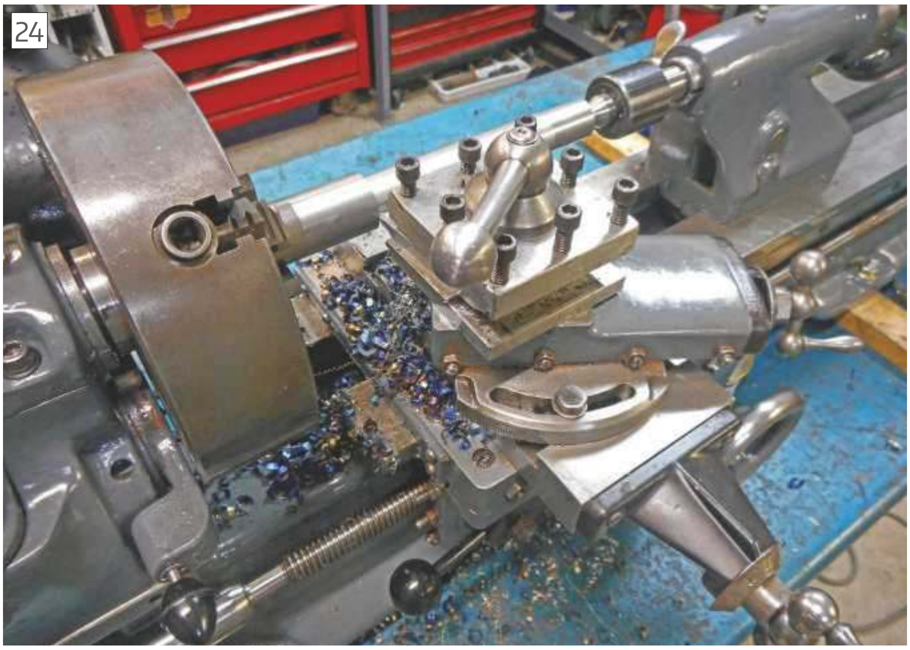
A turning test taking a facing cut across a disc of metal held in the four jaw chuck should confirm the above result. It is checked with a straight edge and feelers. Don't make the mistake of clocking the faced surface with a dial indicator mounted on the cross slide. The gauge will follow exactly the original tool path and return a perfect zero-zero reading even if the face is dished by half an inch!

Conclusion

Our tests above clearly confirm the wide-guide conversion can make an accurate and hard-working machine out of a badly worn older lathe that would otherwise have needed an expensive bed regrind, **photo 23**. It can also salvage a worn saddle. The saddle seems to wear more than the bed, so even if the saddle is reground and then converted to wide-guide, the savings on bed regrinding are still considerable.

The principle is also applicable to many other flat-bed lathes. I know of one Drummond M-type that had it done successfully. Likewise, post-1971 Myfords manufactured with the wide guide could possibly be converted to narrow guide in a similar but reverse manner as a means to extend bed life without regrinding. There may be interference problems with power cross-slide models, but others seem to be likely candidates.

Overall, I highly recommend the wide-guide conversion for earlier model Myford ML7s and other flatbeds based on the above experiences and results, **photo 24**). It is simple to do with basic workshop equipment and quite inexpensive. ■



A once discarded machine now turning out productive work, evidenced by thick blue swarf with no chatter.

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Tom Senior Mill

Dear Neil - regarding Laurie Leonard's Tom Senior M1 mill. He is obviously a man of impeccable taste, but even the best can have problems.

Unlike the other two axes, where ideally there should be no backlash, raising and lowering the knee and all that sits on it is not affected by slack in the thread. The permanently applied load ensures that the screw and nut are always on one side of any backlash and there should be instant movement, up or down.

Only if the thread is clapped for other reasons should it need replacement.

That notwithstanding, Laurie is making an excellent job of creating a new nut. Something for any new Senior owners to contemplate.

My own mill, when purchased almost 30 years ago, required two hands and a lot of grunt to raise the knee. I found that there was a bronze thrust ring sitting on top of the bevel at top of the vertical screw - a substitute for the ball bearing that should have been there.

Replacement with a suitable ball thrust bearing transformed operation. Raising the knee became an easy one (left) handed function.

Lowering (with or without a ball bearing) requires a little thought. It is easy to forget that the knee is locked up and to start winding the screw down. Nothing happens until the bevels disengage, when the penny will drop and so too will the whole knee/table/workpiece setup - with a mighty crunch, possibly hard enough to destroy the thrust bearing - if the locking lever is slackened at that stage.

If caught in that situation, always try and remember to wind the screw back up before releasing the lever.

Jerry Gower
North Wiltshire

Broken Centre Drills

Dear Neil, I am a 90 year old retired toolmaker who served his apprenticeship, from 1943 aged 14, on worn out lathes and drilling machines. In all my time toolmaking, I only ever broke two centre drills. One of those was centre drilling a boxed out die, pulling it over to split the line.

When a centre drill breaks leaving part of it in the job, leave the set up as it is.

Grind half the diameter of the broken centre drill away, replace the centre drill in the chuck and trepan the broken piece out with a bit of luck and a bit of spit!

Job done!

'Old Fred', by email

Thanks Fred, I assume you are blessed with a much more delicate touch than this ham-fisted editor! - Neil

Connector Conundrum

Dear Neil, in reply to your correspondents' letters, and your comment, yes, a simple rubber coupling clamped at each end would suffice. Where is the fun in that, though? I have used these before, to connect shafts together, from an ex-lawnmower engine driving a generator, to a ball pen reservoir tube in a clock. The great disadvantage of these is the mechanical hysteresis, which increases with increasing torque.

To Mr Lewis, yes, I could machine a spiral using a parting tool, but I have little threading experience, and did not wish to learn 'on the job'. To Mr Ponsonby, the industrial term for these couplings is 'flexible disc', and they take many forms, see https://www.renold.com/products/couplings/ajax-couplings/flexible-disc-couplings/ I used acetal and nylon because they were to hand. The frequency used was less than 30 MHz, so more sophisticated materials were not really appropriate. I attach a photo of a tuning capacitor with such a coupling attached.

Geoff Theasby, by email

Knurling Experiences

Dear Neil, I have just received MEW issue 283, it takes quite a while to reach Tasmania! The weather is just beginning to warm up so I will be back in the

workshop to try the suggestions offered by both yourself and Ian. There is

clearly a great deal more to this subject of knurling than first meets the eye. If I understand Ian correctly, the scissor knurls adjusting screw is used to feed the knurls in rather than "walking the wheels up the slope" to top dead centre with the cross slide. My set of scissor knurls have a knurled adjustment nut that could not apply sufficient pressure by hand, so I assumed that it was meant only for setting the depth before plunging in. I would have to attach some sort of leverage to the adjustment nut to apply sufficient pressure to feed the wheels in.

I thought that the apparent lead of the diamond pattern depicted on the photo might have drawn some comment as I had not expected to see this. My only other knurling experience has been with straight knurls and this present me with no problems.

Many thanks for your help.

Graham Lill, Tasmania

Spotting Drills

Dear Neil, I read with interest your piece on spotting drills, in particular the preamble brought back many happy memories. As far as I can recall I have been model making in various forms all my life. I did acquire a small EW lathe with which I mainly built 'O' gauge models, that only had a face plate, driving dog and centres. In the mid 1950s I managed to buy a Myford ML7 at Gamages. I went there with the intention of buying a Gamage Lathe, saw the Myford which was on sale having been marked down from £42 to £38. I could not really afford it but took the plunge and got it on hire purchase. It was delivered as you say with faceplate and two centres. I scrounged a used washing machine motor to drive it and set it up ready to go. I was unable to afford to buy a chuck for another four years but made many models including a Juliet. Cutting tools were made from carbon steel and hardened and tempered in the domestic coal fire.

By making various clamps the faceplate was almost as good as a four jaw and as you suggest axles, etc were machined between centres. My workshop at that stage consisted of the lathe, a Black and Decker portable drill on a stand and a large quantity of hand tools, most of which were purchased as government surplus. I did not have such luxuries as a vertical slide and any milling required was carried out using various lash ups on the cross slide. I did not get a milling machine until the late 1970s and then it was a home made set up. Even when tools started to become fairly cheap, I was unable to get out of the habit of making my own.

But I digress, I intended to write about spotting drills. Prior to going into the forces, I had served an engineering apprenticeship and we always used spotting drills to start a hole. The angle of the spotting drill matches that of the drill bit giving greater accuracy than when a centre drill is used. BUT! That accuracy is only achieved if the position of the hole in itself is marked accurately. As you suggest the initial punch mark should be made with a dot punch, which you describe as a prick punch. (A rose by any other name is still a rose). However, prior to using a centre punch the edges of the punch mark need to be smoothed, with a fine file before applying the centre punch. The effect of centre punch is to distort the metal and raise the edges around the mark. Unless the punch is held at exactly ninety degrees the raised edge will cause the centre punch to move sideways a tiny fraction. The same applies of course to the mark made by the centre punch. Unless the edges are smoothed the possibility of inaccuracy is always there. This may also be the reason for breaking small centre drills. In this case the different point angle means that there is a good chance it will move as it enters the punch mark.

The Myford, by the way, I still have but I now possess several chucks as well.

Keep up the good work,

Stan Bray, by email

It's great to hear from you Stan; some readers may be unaware that Model Engineers' Workshop was Stan's brainchild, and he was its first editor so we have him to thank for this great magazine! – Neil.

Spotting Drills 2

Dear Neil, having a poke around on the net looking for a supplier I tried Tracey Tools. Although the spotting drills aren't listed on the website, I called them and they do have them in stock, although no indication of cost. Hope this is helpful.

Pete Duckett, by email

Lathe of the Future

Dear Neil, with regard to the "Lathes of the future?" mentioned in your No 285 issue editorial. A lot would depend on which end of the model engineer spectrum, "Large or small models" the model engineer is working in. Also, whether they are looking at a manual lathe or CNC?

I consider the enjoyment of model engineering comes from actually making the parts so would veer towards a manual lathe, and for a one off part possibly quicker to make manually than write a program for CNC. But some model engineers do like the challenge of CNC, and I must admit I am quite happy to get flat plate parts laser or waterjet cut.

Who wants to cut out a pair of locomotive frame plates by hand or stationary engine base and also drill all those holes, when a simple CAD drawing sent as a DXF file will come back as a complete set of frames that only need a little draw filing on the edges to finish them off?

A model engineer requires versatility from his lathe and usually expects it to be able to do work that in industry would require a bigger machine. Also, repeatable accuracy is required, put on a couple of micron's feed and it should take off just that amount. This requires high quality, the feeds for instance being silky smooth, and this equated with expense. The ideal model engineers lathe would cost a lot.

However, keeping to a 1/12 full size scale model as an example of work to be made by the lathe my specification for the ideal model engineers lathe would be.

- Centre height 150mm
- Between centres 600mm
- Hardened and ground lathe spindle in taper roller bearings
- 50mm clear hole through spindle
- Cam lock spindle nose
- Infinitely variable speed control with inverter from motor to spindle via multi groove vee belt (Non geared head)
- A headstock spindle clutch (essential as far as I am concerned)
- Large tailstock barrel, 4MT taper, with rack type capstan feed.
- Saddle with long extensions both sides, headstock waisted in at base to allow guides to pass.
- Apron with saddle feed handwheel on right hand side of apron, stop/start control and feed direction controls on apron.
- Built into slides a DRO. Possibly of the "Newall" type
- Screw cutting gearbox with Graham Meeks screw cutting clutch. Screw cutting then becomes beautifully easy.
- Lathe bed of heavy construction in vibration absorbing cast iron, it might be worth considering a modern specification of concrete for the bed as an alternative to cast iron. Vee type bed ways. Hardened bed.
- Long travel cross slide, furnished with tee slots.
- Ball screw feeds to slides and saddle.
- Longer than normal travel to top slide, L shaped in plan to fit around tailstock.
- 3 jaw, 4 jaw self-centring chucks, 4 jaw independent chuck, travelling steady, fixed steady all supplied with lathe as standard including a stand for the lathe

What the lathe actually looked like would be up to the designer/manufacturer, smooth and rounded, or square and chunky. The above is for a traditional type lathe but there were some unique designs such as the Murad "Bormilathe", Mr W. D. Urwick's "Metal Master" and the similar "Labormil" have a look on lathes.co.uk illustrations of these. These could be very useful to the model engineer.

All three are capable of milling as well, without the need of a separate powered head. But if you have the space a separate milling machine is the ideal configuration.

Myford, Boxford, Atlas, and many of the Far Eastern model engineer size lathes can be considered in the "light lathe" category, if you want super accuracy consistently then you need rigidity and that means mass.

The pinnacle for manual lathes was probably reached in the 1950s, some of the high end lathes were magnificent machines and reconditioned ones still in demand for some jobs. You only have to look at say, Hardinge, Monarch, Smart and Brown, Dean Smith and Grace to see the levels of accuracy that could be reached.

But then it was all change to even more accurate CNC machines, and some of the things these can do is mind blowing, but would they be of any use to a model engineer? Not that they could be afforded anyway.

Anthony Mount, Devon

Milling for Beginners

PART 14 – BACKLASH COMPENSATION, BORING ANDTAPPING

This month Jason Ballamy discusses backlash and goes on to bore and tap a practice piece.

I thought it may be a good idea to run through the various stages of machining a part looking at locating various features and measuring the work. Taking the part illustrated in **fig. 1** which shows a 50 x 50 x 8mm block with a central 22.23mm (7/8 inch) hole and three equally spaced M4 tapped holes on a 30mm PCD (Pitch Circle diameter) around it.

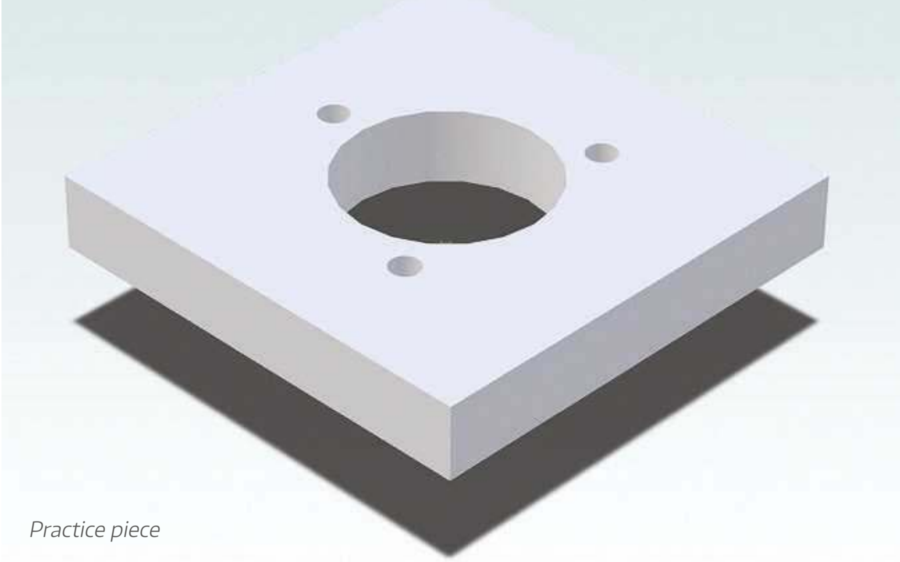
Backlash

Figure 2 shows the same part dimensioned in two different ways, on the left is all the information needed and is what will more often than not be shown on a typical model engineering drawing. If a mill was equipped with a DRO then it would be easy to use these dimensions to locate the middle of the work, bore the large hole and then use the PCD function to place the tapped holes around it.

However, most people starting out with a new mill will not have the luxury of a DRO, so will have to make do with the machines hand wheels. A DRO will display the actual table position but due to play in the lead screw and nut as well as how closely the hand wheel can run against the bearing face it runs in there will be varying amounts of play known as "backlash", so the dials may not show the exact table position. You can get an idea of how much backlash your particular machine has by gently turning the hand wheels in one direction and then the other and you will feel an arc where the hand wheel moves but the table does not. For those that are fussy, a DTI can be set up and the actual amount measured but at this stage it is not worth getting over concerned about it.

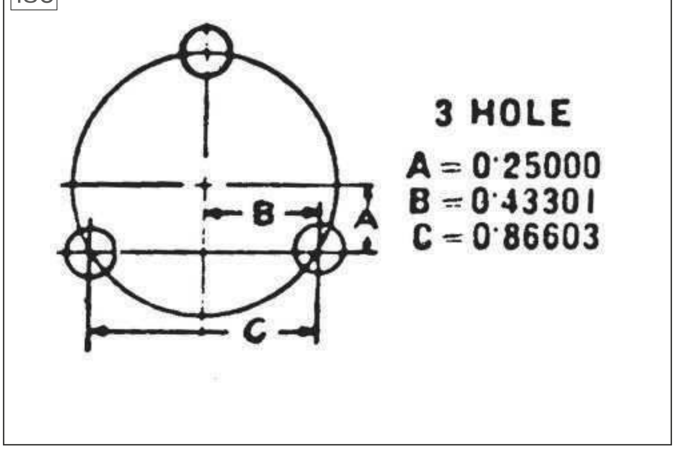
Lets say for example that you had 0.12mm backlash in the X-axis and 0.07mm in the Y-axis and then tried to set out the holes from the centre of the 50mm square, you would soon loose track of where you

Fig.1



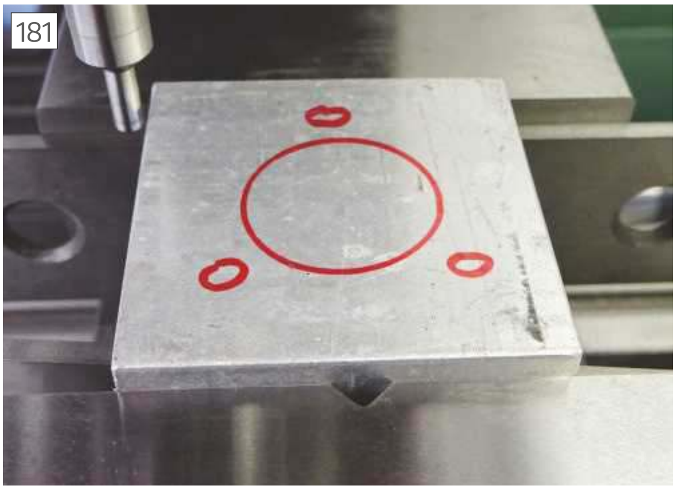
Practice piece

180



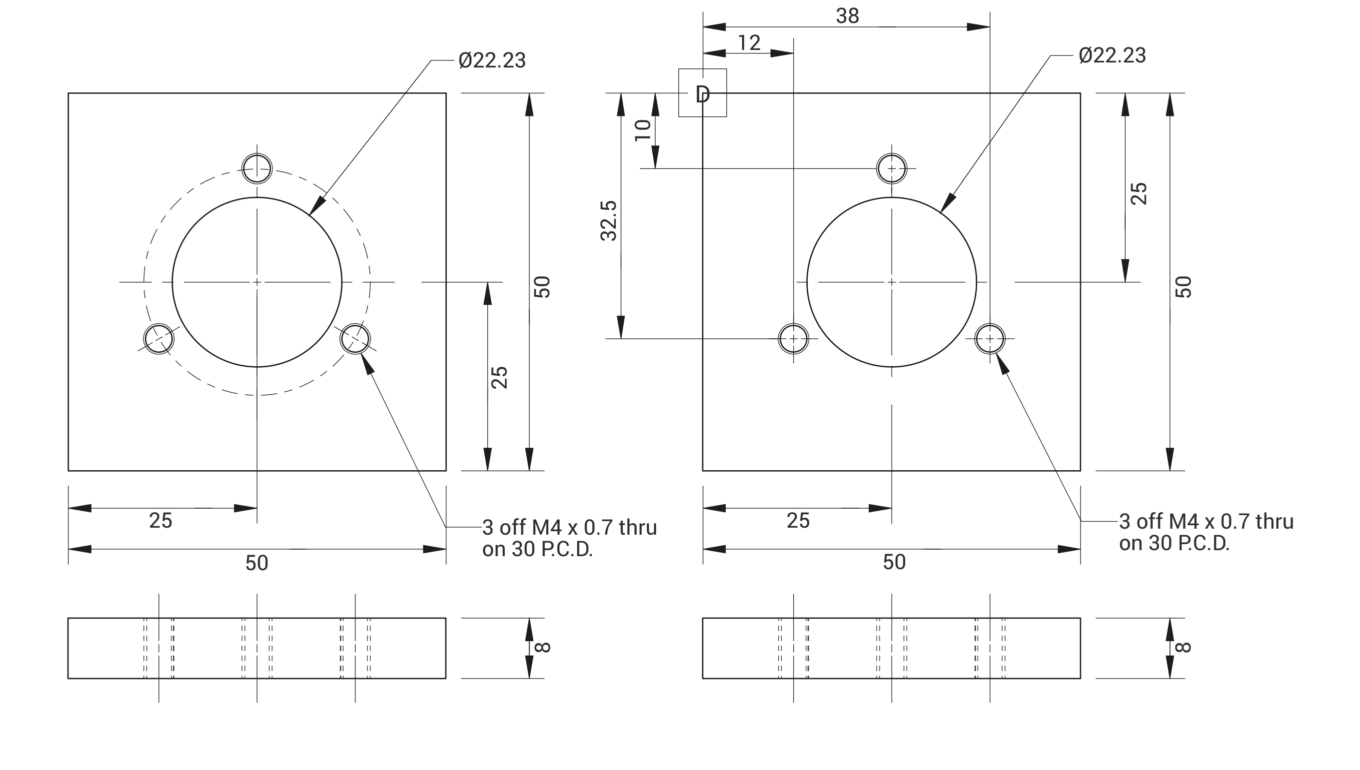
Extract from Zeus book for 3 hole co-ordinates

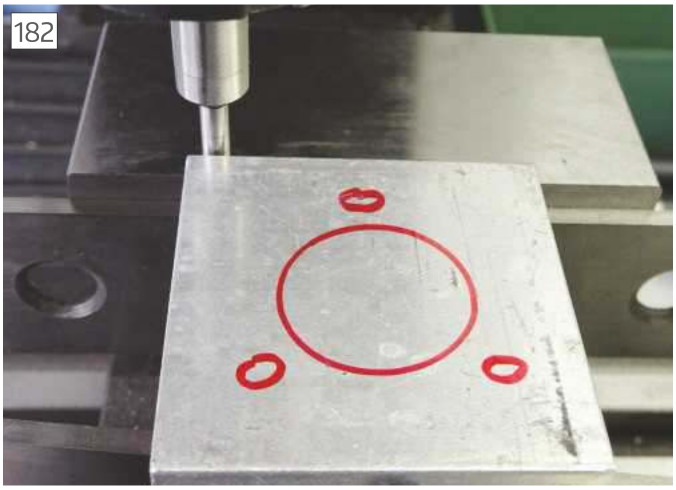
181



Locating X-axis datum edge with edge finder

Fig.2 *Typical dimensions on the left and hand wheel friendly on the right*




182 *Locating Y-axis edge with edge finder*


183 *Initial drilling of hole in stages*

actually are and whether you should add or subtract half or all the backlash from any hand wheel reading. For this reason, when working with the hand wheels it is better to work from a datum point which is usually taken as the top left corner of the work, marked as "D" on the right hand sketch. If you now work out the position of all the features from that datum you will always be moving the hand wheel in a positive direction so any backlash will always have been taken up in the same direction.

To arrive at the positions of the three holes on the 30mm PCD you could draw them out in a CAD program or do a simple calculation to get their relative position from the centre of the circle and then add or subtract that from it's position. A good investment is a "Zeus" book which is not expensive and among other things includes a page giving numbers to multiply the PCD value by to obtain the co-ordinates for various hole patterns, **photo 180**.

For our 30mm PCD the lower two holes are located 30 x 0.43301 = 12.99 say 13mm either side of the centre point therefore the distances from the datum are 12mm (25-13) and 38mm (25+13) in the X direction and 30 x 0.25 = 7.5mm from the centre point or 32.5 (25+ 7.5) from the datum in the Y direction.

There is no real need for proper marking out with the methods described below but it can sometimes be worth doing particularly on more complex work pieces just as a check that you have not lost count of the number of turns of the hand wheel. For a job like this a quick sketch on the work with a Sharpie is usually more than enough.

Locating the datum

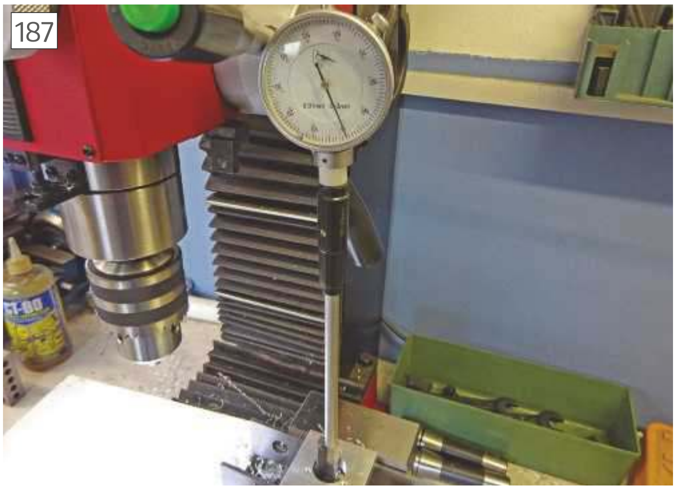
With the machine vice clocked true along the X-axis as shown in an earlier section the block of metal that has already been machined to overall size is packed up on parallels and tapped down lightly with a hide hammer as the vice jaws are tightened.

The first job is to locate the datum which means locating the left and top edges so with your chosen edge finding tool in a collet position it just to the left of the part and wind the X-axis hand wheel in a positive (clockwise) direction until the edge is touched and then zero the hand wheel dial, raise the edge finder and then wind the hand wheel to move the work by half the edge finder's diameter then zero the dial again. This will now have positioned the mill's axis directly over the left hand

16mm milling cutter used to enlarge hole

Checking progress of cuts with digital calliper

Size a measured with digital calliper



Checking size with preset dial bore gauge

edge of the work. Now repeat this starting with the edge finder just beyond the far top edge of the work piece and feed the Y-Axis hand wheel until contact is made, zero dial, raise and move by half diameter then zero again. **Photographs 181** and **182** show this being done with an edge finder that has a 4mm tip so once contact is made the hand wheel needs to be rotated to give 2mm of movement to get the edge under the spindle axis.

Boring the main hole

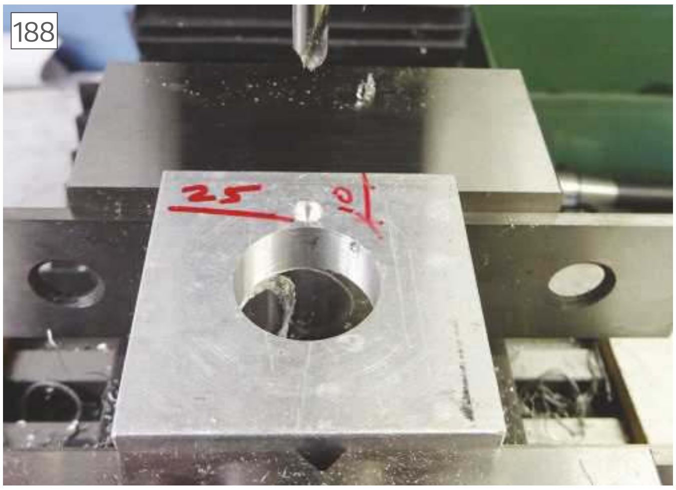
At this stage the spindle of the tool should be over the Y-axis zero so turn the hand wheel in a clockwise direction to move the work 25mm, in the case of the SX2.7 this needs twelve and a half turns as the lead screw has a 2mm pitch. The X-axis can also be turned clockwise to bring the spindle 25mm in from that datum at which point both axes should be locked.

As the hole is quite large and an accurately sized one was wanted boring to final size was the chosen method. The hole can be started by drilling and as the final boring will ensure a true hole there is no need to worry if the preceding holes are spot on so there is no need to start with a spotting drill. Start with something like a 6mm diameter split point drill and then open up to 10mm and then 12mm, **photo 183**. If you have larger drills then they can be used to work your way up to a larger hole or a milling cutter can also be put to use, **photo 184** shows a 3-flute HSS cutter being used to "drill" the hole to 16mm diameter.

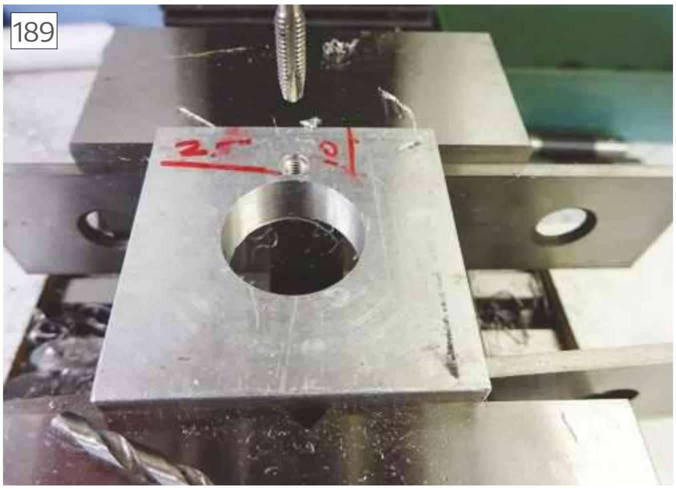
As you get towards the final size or run out of larger drill bits remove the collet holder and replace with a boring head and mount up a suitable size tool bit, aim for the shortest and thickest that will do the job to reduce any flexing that can produce a tapered hole. Start with a slow speed as the head may be out of balance and wind up the speed to the desired cutting speed for the material or just below when vibration starts - whichever comes first. For the initial cuts you can use the mill's quill feed lever to steadily lower and raise the cutter taking 0.5mm off diameter to start with then more if the machine sounds happy and is not labouring.

For many a digital calliper will be the only tool available to measure the size of the hole, I prefer to close the (clean) jaws and zero the display then open up the calliper to the desired finished size in this case 22.23mm and then press zero again. This makes it easy to see how much metal still has to be removed rather than having to risk errors with arithmetic, **Photo 185** shows that the hole is 0.47mm below desired finished size. ARC's callipers with the large digits on the orange background really help on a job like this as the usual can be harder to see when held in odd positions. The last couple of cuts are best done with a finer cut in this case I took 0.30mm off diameter, checked size again and then the final cut, both these last two passes were done with the quill fine feed knob rather than the lever feed winding both down and back up with a slow steady rate applied with both hands on the feed wheel.

It is worth bearing in mind that callipers can read a little under size when used to measure holes with the error becoming greater the smaller the size of the hole. **Photograph 186** shows the hole measured 22.20mm with the callipers but when measured with a dial bore gauge that had been set using a micrometer the size was OK, **photo 187** and also when measured with a telescopic bore gauge, **photo 188**. The only problem with these latter two methods is that you need room to get them vertically above the hole which with most bench top mills means moving the work sideways and then having to get it positioned again for the next cut, easier with a DRO but a bit more time consuming with just the hand wheels but for a lot of work the callipers will be fine and may just require the head raising a little to get them in, alternatively if the mating part or an off-



Measuring telescopic gauge set in hole



Deep spot drilling of first hole

Hole drilled and tapped under power with spiral point drill

Deburr work on completion

cut of material is available that can be used as a plug gauge to finally size the hole.

Drilling & tapping the smaller holes

As a 3.3mm tapping size jobber length drill is quite slender for it's length unless you have a stub length one it is best to start the hole with a spotting drill to ensure that these three holes are located accurately. So with a 5mm diameter spotting drill in a collet the X-axis can remain locked but the Y-axis needs to be reset to 10mm for the hole furthest from the operator so wind back just over 15mm and then you can approach the 10mm setting by winding in the same positive direction used previously and lock that axis too.

The quill lever can then be used to drill to almost the complete diameter of the 5mm bit, this has two advantages over just making a dimple, first, it will stop a raised area forming around the hole in soft materials like this 6082 aluminium. Second, it will save having to visit the hole again after tapping with a countersink or deburring tool to clean up the entry, **photo 189**. If I were using a DRO then I would more often than not go around all holes and spot, then round again to drill, etc. but when using hand wheel dials, it is less time consuming to do all the operations at each position before moving on to the next. So change the spotting drill for a 3.3mm jobber drill and drill right through easing the drill out a couple of times to break and clear the swarf and then if using a mill equipped with "tapping function" change the drill for a tap, lower the speed and tap the hole, for this job I chose a spiral point tap which pushed the swarf ahead of the tap and out the bottom of the hole. If you don't have this function then put a tapping guide into the chuck and turn the tap with a tap wrench, **photo 190**.

The two axes can now be unlocked and the spindle located over the next hole, I opted for the bottom right so the Y-axis is wound clockwise a further 22.5mm, the Y axis will need to be would anti-clockwise to just beyond the 12mm position and then turn clockwise to 12mm, lock both axis and drill & tap as before. For the final hole the Y-axis remains locked and the Z-axis is moved clockwise 26mm to give a position 38mm from the datum then locked before drilling and tapping again.

With no more work required on this piece it can be removed from the vice and the main hole deburred both sides with a hook type tool, the underside of the tapped holes are better done with a countersink style deburring tool. It is worth getting into the habit of removing burrs from work as soon a possible, not only does it reduce the risk of cutting yourself on sharp edges but if a burr is left on work that is then repositioned you may not get a good grip with the vice jaws, it may not sit down on the vice bottom or any packing and an edge finder will read against the burr not the surface of the work, **photo 191**.

In the references at the end of this article is a link to a video showing some of the operations described above. You can see how the edge finder jumps off to one side as it makes contact with the edge of the work at 12, 26 and 34 seconds in. Then a cut being take on the large hole feeding with the quill lever. Tapping one of the holes and finally a view from below showing how the spiral point tap pushes the swarf ahead and out the bottom of the hole. ∎

The items featured in this series are available from Arc Euro Trade, **http://www.arceurotrade.co.uk**, who also sell the X series of mills.
See the accompanying thread on Model Engineer Forum **https://www.model-engineer.co.uk/forums/postings.asp?th=131318&p=1** for more discussions about this series.
Video Link **https://youtu.be/PGfmdrU85I8**

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The Tale of a Turret Mill

Peter King tells the tale of a bargain; a problem; how it was cured; the other problems; what else was done.

A couple of weeks just before Easter '18, I was cleaning up a slab of 'as cast' bronze by vertical milling across the first face. It soon became obvious that something was out of line as there were a series of very slight 'ridges' across the face detectable by a fingertip and just barely by eye.

Application of my 'Tramming Head' showed that all was not as well as it ought to be across the centre of the table from front to back and along the length. Application of a single 'DTI' working from the centre of the table showed a 'hollow' that got shallower towards either end and across, concentrated around the middle. A short session of 'Engineering Esperanto' failing to correct the problem, led to the distant memory of a near new lathe that was exposed to hot sun way back in about 1982. The bed casting of that could not have been 'aged' before machining. My heart sank as I thought: "Oh no, not again"! This summer of 2017 – 2018 in New Zealand has been particularly hot and daily temperatures have been in the 22°C to 35°C+ range so the workshop has been stifling. The amount that an 'un-aged' iron casting can move when exposed to hot and cold variation and effectively 'aged' can be horrendous. The 1980 lathe had warped such as to require grinding up to 0.050+" in places along the bed shears to true it (the headstock, saddle and tailstock were removed with a large crowbar and great difficulty). There are massive stresses locked in iron castings, which 'ageing', i.e. dumped outdoors to be exposed to changing temperatures and weather, then relieves. Cast iron has a very coarse grain when new and slowly changes to a finer structure with 'aging' at ambient temperature. It does not normally change dimensions after proper aging and the stresses are worked out, but just goes on developing a finer grain at a reducing rate for a very long time – years – this actually makes it 'stronger'. Two advantages and they don't cost anything.

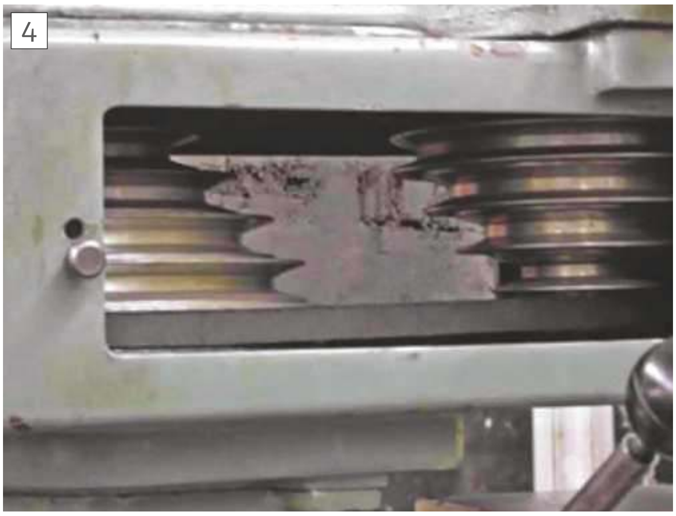

Newly arrived mill, partly cleaned.

I checked the mill again in the late evening when the heat of the day had passed; the figures had changed somewhat but still 'not good'. A straight edge was applied across and along the table and could be seen to sit nicely in some places, but had a very, very and just barely detectable slight gap in other places near the centre. A further check with my "Starrett" Tramming Unit did nothing for my peace of mind.

At the time I bought the mill (at about 25% of new price), I knew that it had possibly only been used once despite the chips on the paint – though about 10+ years old it still had 'delivery' grease on it with a heavy coat of plasma cutting arc soot. So, it was a bargain at the price. **Photograph 1** shows it partly cleaned and before modification. I have since ascertained its provenance locally; a firm known for importing very good quality machinery and inspecting it when it arrived! However, until I created some, I could not find any swarf so


Drive arrangement.

Mitutoyo DRO.

4

Original pulleys.

5

Poly-vee replacements.

it may never have been used.

The next operation was to remove the table for examination and possible correction by surface grinding. This was a long and difficult job dismantling all connections to the feed screw (powered), removing the taper gib strip and DRO scale tube. When the bare table was eventually merely sitting on the machine 'knee' I realised that it could not be rotated along its axis to stand on edge as it would not clear the dovetails. The only way it would come off was longitudinally and at 75, I was not going to be able to lift that weight safely (at a guess about 60+ kg – 120lb?) Assistance was called for - and then the table was removed to the back of my hatchback 'estate' using a sack barrow. The table's next appointment a couple of days later was with a firm of precision engineers who operated a largish surface grinder. It had taken me some time to find anyone with a large enough surface grinder. An old established firm that I had used before for the lathe, had what must have been the largest surface grinder in the southern hemisphere and I intended to use them. Alas! I discovered that they had ceased to exist several years before and the new owner of the grinder had not set it up for use.

6

Replacement motor.

I had not taken notice of anything particularly odd during this demolition operation as I was too busy concentrating on the job but should have taken more notice of the difficulty in removing some components. The hand wheels and associated dog clutches were tight on the feed screw seatings. Then when removing the end bearing housings/suds pockets, I had to use a hydraulic puller. It did not occur to me to re-check the table with a straight edge after this effort.

At the Engineer's establishment, the table was set up on a vast black granite surface plate (about 2M x 1M) on precision parallels under the flat 'ways' of the table alongside the dovetails. The surface was then 'swept' with a very expensive DTI (both DTI and plate a bit beyond the pockets of Model Engineers) and proved to be well within the expected accuracy. I was very surprised, and I wondered where the hollow I had detected had gone. Advice from the Engineer's was firstly to check all ancillaries to the table and then check the spindle alignment of the mill head to the table. Finally, to check the adjustment of the taper gib between the knee and the machine column to ensure that the knee's top was level – then anything else however bizarre that came to mind.

There followed a very long workshop session with precision levels, wedges, pinch bars and sundry shims, as I discovered firstly that the machine which is on a small plinth had settled by about 0.003"+ at the front since installation (whilst it is on a very heavy load bearing floor designed to take a large number of 450lb wool bales stacked three high per 6+ sq. ft., it is not a concrete floor).

When restoring the table to its rightful place, I discovered several factors that were not pleasing; the first was that the threaded part of the table feed screw was very slightly longer than that dimension between the 'laterally locating' pair of bearings under the end bearing housing/suds pocket of the table to the left of the 'knee' and the single support bearing ditto to the right under the table. The feed screw should be a sliding fit in the single bearing as it is in the power drive arrangement. This meant that the single bearing housing casting when emplaced sat slightly clear of the table end on re-assembly. At that point it finally dawned on my elderly brain that the feed screw had been slightly bending the whole table longitudinally with a hollow in the middle. With steel expanding slightly more than cast iron with a rise in temperature and the length involved, it was enough to do so and particularly when there was an existing pre-load. What still surprises me is that the feed screw could actually bend such a massive table, and secondly how quickly the table returned to normality when it was removed. When the feed-screw and all the ancillaries were fitted back into place it would, if not corrected apply a 'bending' moment to the table again. I machined the feed screw thread back about 0.1" at the RH 'floating' end, which eliminated that problem. I have been told that cast iron does not easily take a 'set' like steel does, hence its return when loading is removed

The next job was cleaning up some slight burrs around the cross drillings (with a fine file) for the 'spring drive pins', these secured the dog clutch collars for the hand wheels. I then had to deal with the plain shafts at each end, which were both rather more than a 'push' fit in the bearings/ hand wheel dog-clutch collars and hand wheels These were reduced by a 'tenth' of so with fine grade 'wet and dry' abrasive paper while spinning in the lathe until the sundry parts would 'just' slide into place

Head mounted inverter drive.

Knee lift power feed.

with a reasonable push. Crude but effective! Everything can now move very slightly at the 'floating end' to accommodate adjoining artefacts! At a wild guess there is now a minute radial clearance, just enough for a heavier hand push allowing movement.

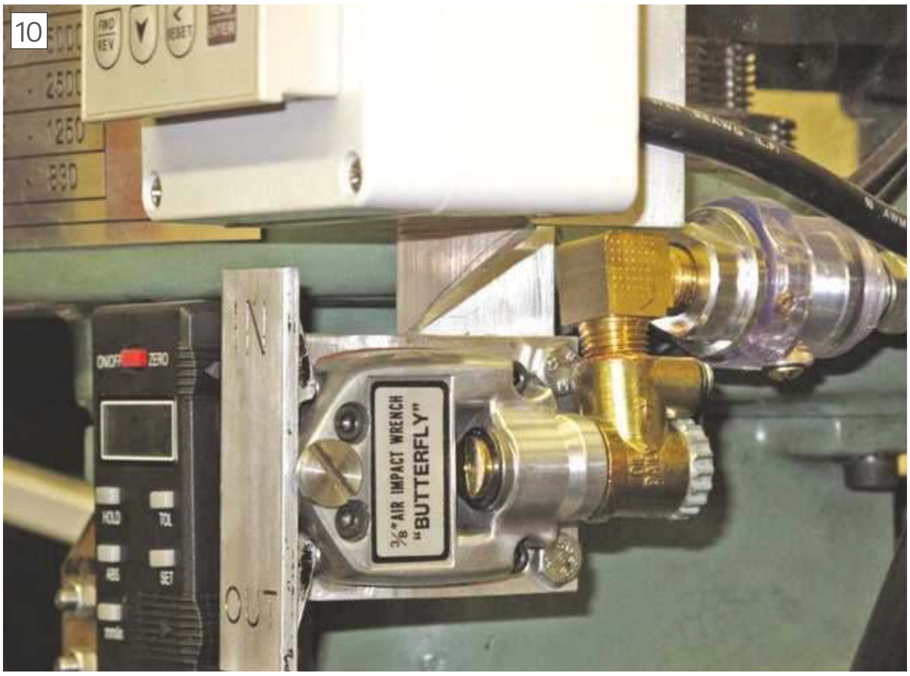
The ends of the feed screw having been tidied up by the slight reduction in diameter, I checked for other problems. Everything that needed it having been 'fettled' to an actual 'push' fit, I then re-assembled all the bits and pieces and slid the taper gib strip into place and then adjusted it. That operation is not easy on this machine as there are large headed adjusting screws that overlap the Gibs at

Air powered drawbar.

each end deep down in 'pockets'. Some of these are not particularly accessible. This feature meant that one screw has to be 'eased' before the one at the opposite end is tightened then the ease of use checked. The knee's vertical taper gib strip proved to be properly adjusted when inspected – just as well as with all the overhanging weight on it, adjustment is not easy.

Being a distrusting soul, I then placed my Tramming head ("Starrett" two DTI type) into the spindle and ran another check. This check revealed that the spindle and head were very slightly angled towards the left (X-) at the bottom (head very slightly turned clockwise as looked at). Fortunately, this model of mill has a worm and wheel arrangement to adjust the whole head in that aspect combined with a powerful screw clamp brake on a disc attached to the power head pivot. **Photograph 2** shows the two drives. A further session of 'Engineering Esperanto' followed as the blasted thing would move very slightly whenever the clamp brake was applied. Eventually I got the spindle within a guessed rather less than 0.0001" perhaps, and stretching reality a bit, maybe 0.00005" in 5" of true – this being an 'eye-ometer' gauging of the dials of the two DTIs with the tramming head set along the length of the table, which is amazing, debatable and probably unrepeatable, and has also probably already changed with use. At some stage I will wheel the shop crane in and dismantle the machine head from the pivot and investigate to fix that clamp. Alas there is no 'cross' ('Y') adjustment on the machine head, but the Engineers check had shown only a variance 0.0005" low to the front in 8" across the table in one place. My tramming head indicated 'true' to the spindle at all positions of the tramming head across the bed as one of the DTI needles was a barely visible and debateable tiny amount off an alignment to a division, too small to even guess the proverbial "gnat's appendage" in the one small area. I figured from that indication that the table is actually as near at a true 90° to the machine spindle as I was likely to get without extensive investigation. Enquiries of a couple of fitters of my acquaintance confirmed my expectation: that few mills of lower to mid-range price would be that accurate (and some much more expensive are not so 'bright' either).

The end result was that the machining has vastly improved, possibly partly because I had re-adjusted all the gib strips I could, and the power head and cleaned all the slides and re-oiled. I figure that for beneficial improvement in machining finish, we should all do this from time to time to all our machine tools – instead of 'putting it off'. I had also discovered when the table was removed that one of the 'One Shot' oiler pipe couplings was leaking in a normally completely inaccessible place out of sight. Having long previously laid in a range of spares (for upgrading another machine tool) I fixed that while I could see



Drawbar valve.

Mill as 'refreshed'.

it. I also discovered how to adjust the static nut of the table feed screw to reduce any backlash – it being normally down in the dark depths under the table and thickly covered in black grease, the means was not detectable before (the handbook neither shows it nor mentions it). I do not know if these are common, but the nut is in two parts and one – rotatable and shorter - part fits into the part that is attached to the Knee. It also has three slots in a flange of the rotatable part with cap screws through and into the fixed part. Slackening the cap screws and slightly rotating this part takes up clearance to the feed screw.

This arrangement allows of quite fine adjustment. The feed is now silky smooth and the slight backlash has not only gone but it showed that there are no tight spots along the usable length of the screw.

After this marathon session, the bronze slab was replaced on the table and, when machined, a most satisfactory finish was achieved. This meant that the next operation could be done – CNC machining multiple 'two bolt mounting steam pipe flanges' from the bronze plate for silver soldering to steam pipes.

These 'problem sorting' jobs however are slow, tedious and boring and usually result in other previously undetected problems being discovered. If planning such an enterprise, before starting the job it is worthwhile to look for all the required measuring equipment and implements of deconstruction that have wandered into odd corners of the workshop. These will have gotten into very dark corners as soon as you start the job.

This mill – which has both horizontal and vertical drives, came with a Mitutoyo DRO, **photo 3**. It has been much modified since purchase, the older Mitutoyo unit having been replaced with a newer more versatile Newall unit. The original '4 step' 'V' pulleys of the vertical drive, which gave an 'anyone's guess' at spindle speed, **photo 4**, have been replaced with 5-step, 6-groove 'Poly- Vee' ones made in the workshop giving almost exact 3:1 / 2:1 / 1:1 / 1:2 / 1:3 ratios, **photo 5**. These were cut from solid 'tooling' aluminium (for 'flywheel', anti-vibration and hard-wearing purposes) and checked for balance on my 'knife edge balancer'. The original vertical drive single phase motor has been replaced with another end-flange mounted 2-pole 415v 3ph, 3hp "Teco" motor, **photo 6**, with a Teco inverter unit for speed control, **photo 7**. Simple mental arithmetic allows of converting the motor speed to accurate spindle speed – the pulleys are very, very close to size. The five step pulleys along with the inverter give a range on the vertical drive from 115rpm to 7500 rpm (top speed for tiny carbide cutters, not often used and limited at that speed by the inverter limiting the motor to 2500 rpm). A power drive has been fitted to the 'knee lift' as the 'cranking' was a bind, **photo 8**. An air-powered draw-bar puller detailed in an American magazine was made and fitted, **photo 9**, all parts as per original proving to be available here in New Zealand. This uses an air 'hammer wrench' nut spinner – the activating valve part was separated and moved to an accessible position as shown **photo 10** and details may be found on the internet. Something in the grease or arc cutting mess had faded almost all the anodised instruction plates to near invisibility (I had thought this was impossible). Both the vertical and horizontal spindle 'speed' plates had to be replaced anyway, along with the table feed plate. So, I drew replacement designs for essentials and had these all engraved on thin stainless steel sheets. The cleaned and modified unit looks much better than as received, **photo 11**. **Photograph 12** shows it set up for horizontal milling. The original rather small motor for the horizontal drive has been replaced with a suitable 6 pole 3ph 415v motor as this more powerful but slower motor gives quite adequate speeds for my many 4", 6" & 8" milling cutters at low speed - mostly 'side & face', slitting and 'form' types. The other smaller cutters and gear cutters are also OK at the other speeds available, so I have not bothered with an inverter. If it becomes a nuisance, installing one would be an easy job. The 'decorations' on the mounting plate for the upper motor were on the 'Tooling Aluminium' blank when I bought it as scrap long ago from a firm of 'jobbing engineers' – I proclaim my innocence – it looks to me like the 'kiss' of a roughing end mill. My workshop being in an ex-wool shearing shed, there is a 415v 3ph 100a supply to my advantage, so most motors are 3ph.

In horizontal milling mode.

Having over the last 50 odd years refurbished several machine tools – three lathes, two mill-drills, a turret mill, a heavy horizontal mill, a light 'production' horizontal mill, a massive shaper, a 6 ton fly press, a cold saw, a bandsaw, and sundry pieces of farm machinery (sounds like a Model Engineer's 'twelve days of Christmas' with a workshop exchanged for a pear tree) - some near new and others second-hand (some 'very'). I now think that it is worth checking and resetting any machine acquired, even if it is 'brand new'. This thought came about because I have found 'bodges' on several machines, they were all in 'out-of-sight' places and would not be seen by an inspector. A dead giveaway on older machinery is to look to see if there is a number stamped on all the components of a machine – then to find that a couple of parts have a different number. The turret mill has a couple of these (the Taiwanese must be 'old-fashioned') and on a "Herbert" horizontal mill from about 1930 that I once had, there were a couple as well – and that from the much vaunted days of 'skilled fitting'. I have also found "Oopsies" that had been skilfully 'plugged' and camouflaged on machines. Modern machinery being mostly Machined with CNC, it is probably more accurately made than anything from the mid '60's back, and if properly set up would be more accurate. However, I do note that some modern machinery is much lighter in construction and is possibly unlikely to last as long – particularly plastic gears on lathes. ■

NEXT ISSUE MODEL ENGINEER

- **Wrexham**
  John Arrowsmith chooses a suitably sunny day to visit the Wrexham club on its attractively landscaped site.
- **Walschaerts for *Sweet Pea***
  Frank Birchall fits Walschaert's valve gear to his *Sweet Pea* locomotive.
- **Usk Show Steam Corner**
  Graham Gardner explores the 'steam corner', originally started by John Haining at the long established Usk show.
- **BR2 Aero Engine**
  Mick Knights finds the right propeller to add the finishing touch to his BR2 aero engine.

Content may be subject to change.

ON SALE 8 NOVEMBER 2019

A Workshop Press

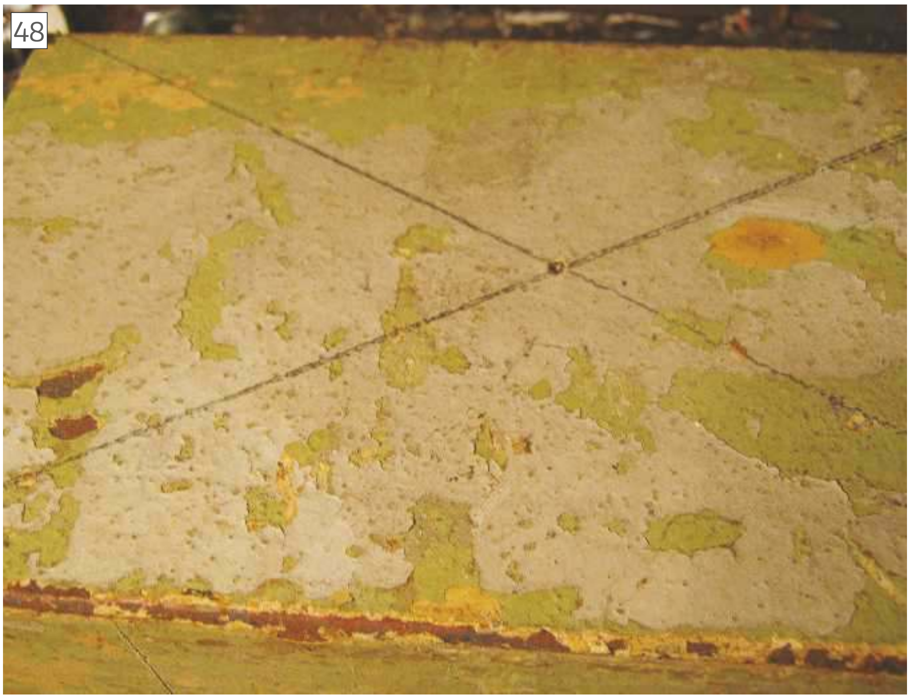
Will Doggett introduces a short series on making a workshop press tool. Part 3.

Having cut the channel to length I put two lines corner to corner to mark the centre with a punch for the hole that was going to be in the middle of the base plate, shown in **photo 48** ready for drilling.

The reason for drilling the hole before cutting the waste away is the channel is more stable with the waste left on so clamping the channel to the machine bed is a lot easier and safer.

First I positioned the centre over the centre punch mark then tightened the table clamps when they were tight I drilled the first pilot hole with the centre drill I then removed the drill chuck that had the centre drill in it I then put the 33mm drill in the sleeve of the mill/ drill, **photo 49**, this is the same drill I used for the box section.

Next, I marked out for the side parts that required removing in **photo 50** you can just see the line at each end of the channel sides. To remove the side parts I used an angle grinder with a cutting disc in it to cut out the corners on the marked lines. After cutting I cleaned the cuts with a grinding wheel then I used a file to finish the corners as the grinding wheel left a radius in the corner. The unpainted and cleaned up base bed is shown in **photo 51**.



48

Ready to start drilling

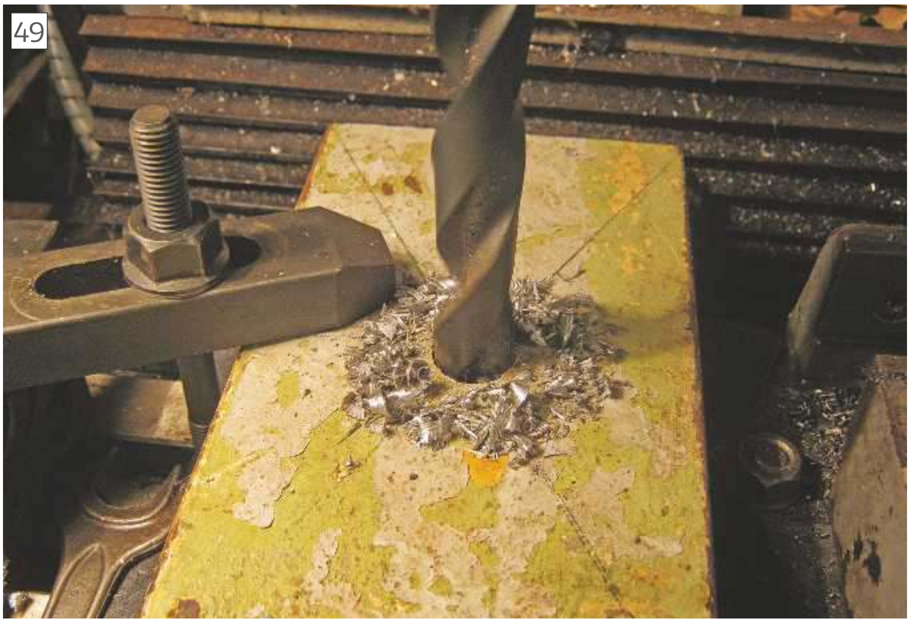
The 2 part base beds

Having made the first base bed as a one-piece part, I thought it would be a good idea if the next one is made a two pieces giving more flexibility on the press when setting up on the base frame, **fig 14**.

Having found a piece of 3½ x 2½ x ¼" angle in the garden when tiding up I thought I would use this for these second plates. (It was intended to be used to support a fence post but needs must - as you can see it was very rusted).

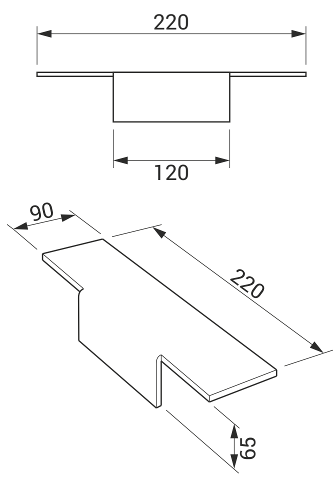
The angle iron was shorted in the bandsaw and the shorter piece was put back in the bandsaw. The part to be removed was marked, **photo 52** and the cut was made down to the web, **photo 53**, the angle was then moved in the saw vice to the next slot position and the cut was made in the same way as before.

The angle was moved again and repositioned to cut it to length, **photo 54**. **Photograph 55** shows the slots– these are



49

Drilling 33mm hole in 1part base bed



Two Part Base Bed
2 off

Marking out on large channel

1 part base bed cleaned up

Measuring for cut on two part base bed

Cutting part way through

the ends of the parts to be removed.

To finish, I again used an angle grinder with cutting disk to cut in from the ends, **photo 56** makes this clearer. As you can see the corners require cleaning out and squaring, **photo 57**, I did this with a file back in the workshop. With all the parts outside I removed the rust and paint at the same time as it was a dusty job.

Finishing

To finish the press the parts were cleaned up either by using a linisher or wire brush ready for priming and painting. The type of cleaning I did is shown in photos 51, this is the one part base bed and photo 56 shows the two part base beds ready for priming.

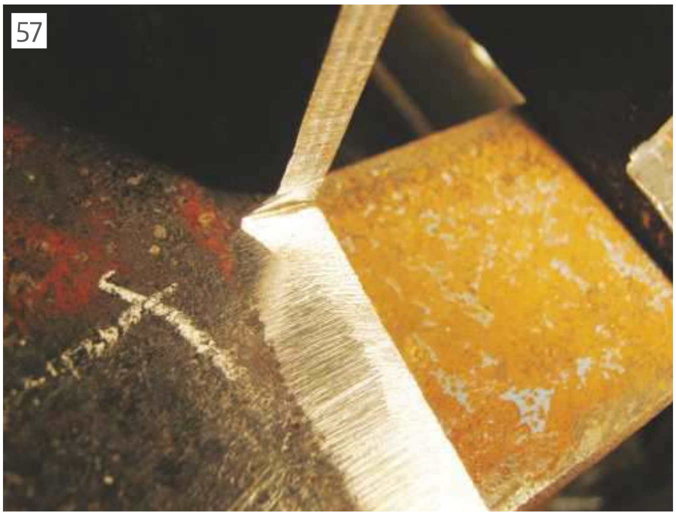
After priming the base frame, the tops looked a bit vulnerable to wear on the top faces. Moving the one part base bed and changing it for the two part base bed and back again was bound to take its toll, scraping the paint etc. I could just leave the top unpainted, but this wouldn't stop the wear.

The answer was a wear plate in the form of piece of 40mmx10mm flat fixed to the top of each channel this would be left unpainted,

Cutting off from the main angle

Showing parts to remove


Cut out removed on two part base bed


Filing required to clean up


Marking blue & one hole on wear plate


Counter bored holes on wear plate

the size of this plate is not critical.

To make the plates I cut two pieces of 40mm flat to 385mm long to fit the opening between the support rails and then cleaned it up ready to mark it out for the fixing holes.

The three holes were set on the long centre line, two 50mm in from the ends the other in the centre of the plate, **photo 58** shows the marking blue and one of the holes drilled for M5 bolts in one of the plates.

The two plates were then clamped together I used a transfer punch to mark the other plate which was then drilled and counterbored. **Photograph 59** shows the two plates with counter bored holes for the M5 bolts that will hold them in position.

The completed wear plates were clamped on the inner edge of the frame channels, **photo 60**, and using a transfer punch the corresponding holes marked on both channels. These holes are then drilled then tapped M5. **Photograph 61** shows the plate being used to guide the tap and keep it upright.

The transfer punch that I used is shown in **photo 62**, this one is from a set of transfer punches.

After the distraction of making the wear plates the rest of the priming and painting continued and finished in red gloss. The reason for the red was I bought a tin of red to paint a trolley jack that required repainting that was already red, so I used this on the press as well. The ram plate didn't require painting as looked ok so it was left as it was.

Final assembly of the press

When all the painting was finished, I had to

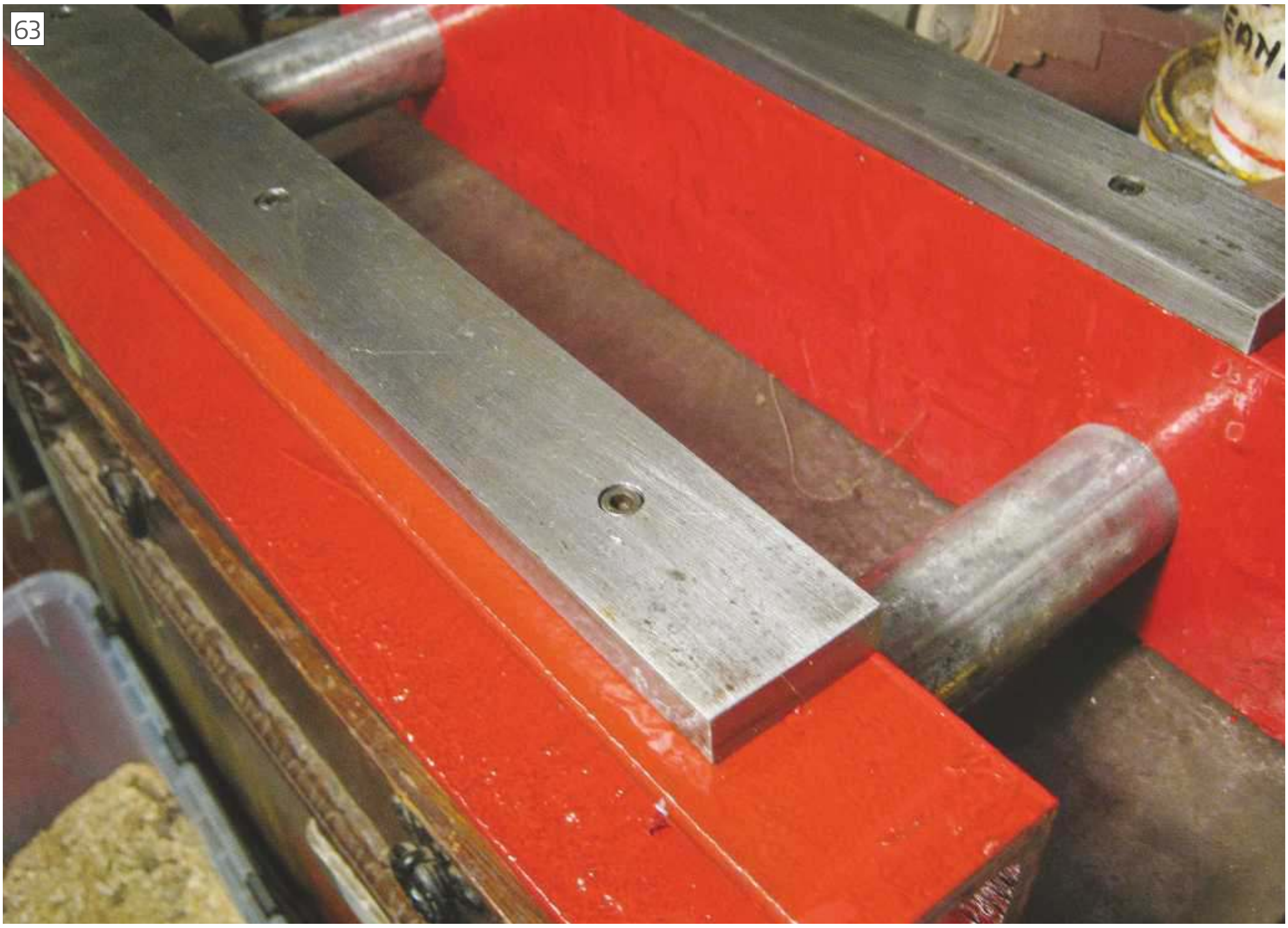

Wear plate clamped in position

61

Using wear plate as tapping guide

62

Transfer punch



63

Cap head screws holding the plates

wait two or three days for the paint to dry properly this is when I started to assemble the press.

The first part to be assembled was the base frame, I put the channels on a flat plate and using this to keep the frame flat I put the large studding through both the channels with the large tube in between them then fitted the washers and nuts the nuts were then tightened with two large spanners.

The next part of the assembly was to fit the wear plates to the base frame, the plates were put on the frame they were then lined-up with the tapped holes in the frame and the 5mm cap head screws were put in and tightened. The frame with the plates are shown in **photo 63** with the screws in place .

The assembly of the main frame was next; I fitted the ram to the ram plate with the M8 cap head screw, the jack was fitted to the ram plate with the clamps shown in **photo 64**.

I then put the trampoline springs in the top fixing brackets on the top channel, photo 65. The jack assembly was then fitted by putting the ram of the jack in the jack register ring in the top of the channel and hanging the jack assembly on the return springs; because of the tension on the springs it all stayed there **photo 66**.

The ram guide was next to be installed, to get it in the correct position the jack was pressurized to lower the ram and ram plate to its lowest position when it was there

Jack and ram plate

Trampoline springs

Jack plate and springs assembled

Ram guide in place

Support legs in place

Both sets of bend plates

the ram guide was put in position under the ram plate, and the four bolts were inserted and tightened to keep the guide in position. The jack was then allowed to return to its top position to check that it was in the guide hole at the top of its stroke. This was ok, **photo 67** shows ram guide bolted in position.

The support legs were then fitted to the main frame so that the rest of the assembly could be continued **photo 68**.

The base frame that had been assembled earlier was fitted to the main frame. Two support pins were inserted in the main frames base frame support holes and the base frame was placed on them.

The bed plates were then placed on the base frame, photo 69, to check that they all still fitted together. These were the one piece bed plate and both of the two piece bed plates, the base frame and the one part bed plate are shown in **photo 70**.

Conclusion

The question is, is it worth making the press?

As I said at the start of this article a press is not the most sought after tool in the workshop as a lathe is, and many other tooling is more important to have than a press. On the other hand if you have one, it will get used – not every day perhaps, but it is handy to have one standing in the corner of the workshop because with the support legs removed it doesn't take-up much room and is ready to use as soon as you put the legs back on.

There have been several occasions that I have had to find an alternative way off doing a job because I haven't had a press, this made the work harder to do – this is one of the reasons for making the press in the first place.

Back to the main question was making the press worth the time it took to make? I think the answer is yes, the press was made over several weeks to fit in with other jobs that required to be done and from material that I had in and around the workshop. The red paint is another matter entirely! The choice of red I thought was a good idea at the time, I suppose I will get used to the colour in time or I could just repaint the press if not. ■

The one piece bed plate

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A Clarkson Deadlock Mandrel

John Fawcett makes a custom mandrel for these cutters.

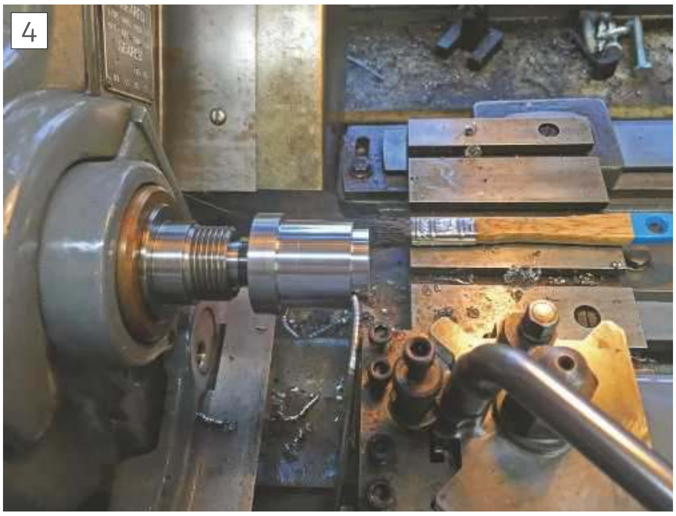
A selection of Clarkson Deadlock cutters.

This short article was prompted by a request in MEW from Geoff Garrett asking about some cutters he had and did not know what they were. They were indeed Clarkson Deadlock cutters, easy for me to identify because I had used them many times in industry and had several in my "armoury", **photo 1**.

However, I had only one size of mandrel which suited the larger cutters I had: 1½" & 2" diameter these have a spigot diameter of ¾" and a ¾" x 12 BSF thread. The other cutters I have are 1" & 1⅜" diameter these are threaded ½" Whitworth with a corresponding ½" bore for location on the mandrel. I had somewhat perilously used these with VERY light cuts mounted on a "temporary" mandrel made from a ½" Whitworth bolt, **photo 2**. Now was the time to remedy this and make a properly manufactured mount and thus reap the befit of being able to use the cutters to the best advantage.

Temporary solution – cutter mounted on a bolt.

Tapping blank for drawbar.



Roughing out spindle.

Ready for threading.

As an aside, I don't understand why most other suppliers have such a small blank end? The cost of a larger one would be minimal and increases the possible uses greatly IMO.

Not having the ability to use CAD after some careful measuring and a sketch I produced a working drawing the longhand way – tech drawing! **Figure 1**.

I had a No2 Morse taper blank in stock, purchased some years ago it was much larger on the blank end than most of the ones available, it came from Myford Nottingham, I see they still sell them today. As an aside I don't understand why most other suppliers have such a small blank end? The cost of a larger one would be minimal and increases the possible uses greatly IMO.

First job was to drill and tap the Morse taper end to accept a draw bar, this was ⅜ BSF. I chose this size to match the other original mandrel, **photo 3**.

Next the embryo mandrel was mounted direct into the Super 7 spindle and with a draw bolt fitted for added safety, aka threaded rod. Using a bed stop I then proceeded to turn the O/D to size 1.5" followed by the location spindle for the cutters I roughed this out with 0.100" deep cuts, .200" off the diameter. until close to the finished size of 0.5045" - 0.505" as per the drawing, **photos 4** and **5**.

The thread in the cutters is ½" Whitworth and to ensure concentricity this

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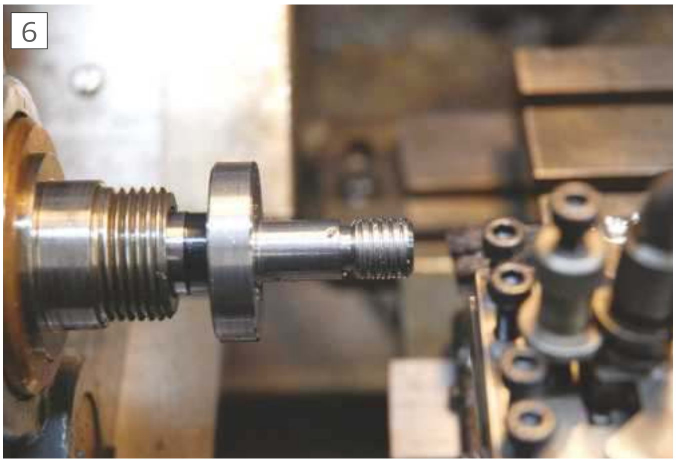


Threading spindle.

7

Test assembly.

8

Finished thread.

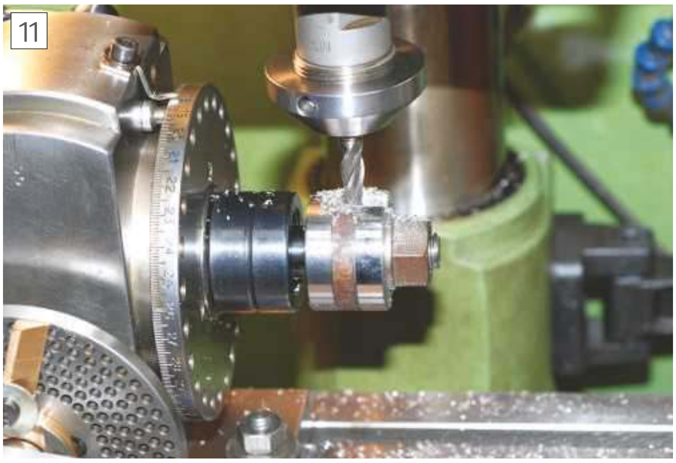
9

Drilling embryo locking plate.

10

Checking bore for size.

11



Making packing piece.

is best screw cut with a single point tool. A suitable undercut to the root diameter was made with a corner radius and a chamfer on the thread runout, the front was also chamfered 45 degrees to the thread depth, the diameter for the threaded portion was reduced to 0.494" thus truncating the crest to compensate for it not being full form. As rule of thumb you can truncate the nominal diameter by half the crest radius – this is not 100% correct to BS standards but close enough for M/Eng use, **photos 6**, **7** and **8**.

Now I needed to make the locking plate assembly, this is a simple turning, milling and drilling operation. It was made from EN9 – well I just happened to have a chunk of the right diameter of 1½". If desired I could harden this as well but decided it was not necessary for home use, time will tell and if I do see signs of wear I will heat treat it. It was chucked, a pilot hole drilled and opened to 15/32", then bored to size plus 0.002". Finally, it was parted off, reversed and faced up to size, **photos 9** and **10**. I also made a packing piece from the scrap box to facilitate the milling operation - see the rusty part in **photo 11**, this allowed me to mill through the locking plate into the sacrificial packing piece. Two flats 1/16" deep were also machined on the main

As a rule of thumb you can truncate the nominal diameter by half the crest radius - this is not 100% correct to BS standards but close enough for M/Eng use

12

Slotting the locking plate.

13

Using tenons to locate block.

mandrel body on the 1.5" diameter leaving the A/F (across faces) measurement at 1 7/16" this is to hold the mandrel in a vice or use a spanner when changing a cutter, a C spanner is used on the locking ring.

The milling was done using the dividing head and direct indexing, in this instance with the mandrel mounted in the Morse taper. Again I used a draw bolt to make sure it could not come loose during milling, **photo 12**. Note the two tenon blocks made previously from BMS 5/16" x 5/16" x 0.400" long being used to locate the plate in the milling vice in the correct orientation. The slot was milled with a ¼" cutter then opened to give a good fit for the tenons, **photo 13**. Two holes for the tenon screws were drilled in the plate to accept 4mm countersunk screws the countersinks being done on a pillar drill.

Little explanation is needed for the tenon blocks they a simple part to make from BMS and require only a tapped hole for 4mm screws.

Photograph 14 shows the 55 degree hand ground screw cutting tool I used. The final result can be seen in **photos 15** and **16** I do use disposable carbide tip tools for screw cutting but often grind my own HSS when required and did not have a Whitworth form tip for this job.

I trust this will be of interest, to anyone else who has any of these cutters. ■

14

Hand ground thread cutter.

The milling was done using the dividing head and direct indexing, in this instance with the mandrel mounted in the Morse taper. Again I used a draw bolt to to make sure it could not come loose during milling...

15

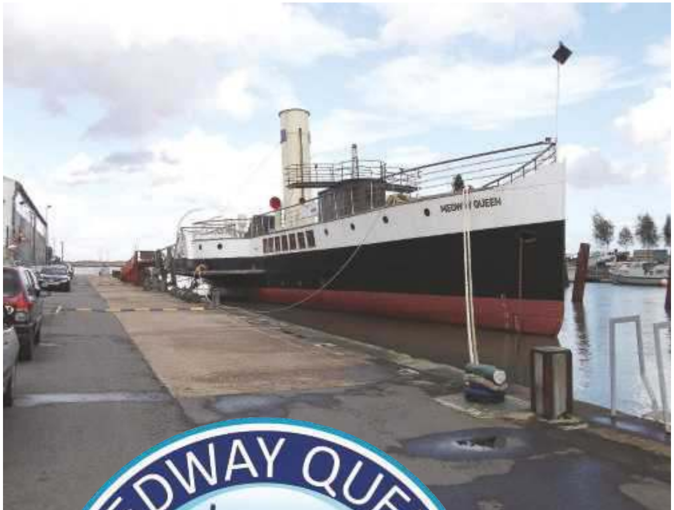
Cutter fitted to mandrel.

16

Finished mandrel.

On the Wire NEWS from the World of Hobby Engineering

The Queen and the Spam Can



The General Steam Navigation Company (GSN) was founded in 1821 to run steam ship services from London. Almost 100 years later P&O Navigation bought a controlling interest in the company, but it continued to trade under its original name. On the river Medway, GSN worked closely with the New Medway Steam Packet Company and Captain J. H. Wills of GSN and his wife were on board when PS Medway Queen made her maiden voyage across the Thames Estuary on Friday 18th July 1924. In 1936 GSN acquired the New Medway Company but, again, retained the name for trading purposes. It is quite appropriate, therefore, that the General Steam Navigation Locomotive Restoration Society who are rebuilding the Southern Railway locomotive named after the GSN and the New Medway Steam packet Co (Medway Queen Preservation Society) who have rebuilt a ship that operated under GSN management should work together and support one another's aims.

The General Steam Navigation Locomotive Restoration Society recently moved their Locomotive, Merchant Navy Class 35011, to Blunsdon on the Swindon and Cricklade Railway. There they are working to convert the locomotive back to its 1940s specification; before the class were rebuilt into the more conventional form by British Railways. This includes restoring the iconic air smoothed casing along with Bulleid's oil bath encased chain driven valve gear. Once complete, General Steam Navigation will be the first engine to be restored to as-built condition within the ranks of preserved Merchant Navy class locomotives.

The Medway Queen Preservation Society have rebuilt their vessel structurally with the aid of HLF funding and are now engaged in fitting out the ship, initially for use as a floating venue for meetings and events. The long term aim is to see the ship sail again under its own power.

Medway Queen is berthed in Gillingham, Kent, where a small team of dedicated volunteers are pushing the project forward. Like the locomotive, progress on the ship is governed by the availability of resources – both physical and financial. Although a Kent based organisation, MQPS has worldwide support and has a PR team based, conveniently, in Wiltshire and not far from Blunsdon!

The aims of the two groups' cooperation will be to support one another in publicity campaigns and appropriate merchandising and marketing initiatives. An early project will be a promotional wagon for 00 model railways. For some years now the Medway Queen has benefitted from income generated by a series of such wagons and it is hoped that a joint project will reach a wider market and generate cash for both teams. Details will be announced when the model goes on sale early in 2020.

For more information on the two societies go to **www.35011gsn.co.uk and www.medwayqueen.co.uk**.

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Coming in;
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D20

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Drilling Capacity	13mm	13mm	16mm	20mm	20mm
Chuck Size	1-13mm	1-13mm	3-16mm	3-16mm	3-16mm
Spindle Travel	50mm	60mm	80mm	80mm	80mm
Spindle to Base	350mm	535mm	620mm	600mm	1250mm
Spindle to Table	210mm	415mm	450mm	410mm	800mm
Table Size	165x160mm	190x195mm	300mm dia.	290x290mm	285x285mm
Spindle Taper	B16	MT2	MT2	MT2	MT2
Spindle Speeds	600-2500rpm	460-2890rpm	210-2580rpm	120-2580rpm	120-2580rpm
Height	585mm	800mm	990mm	1000mm	1630mm
Base Size	280x175mm	200x330mm	230x400rpm	430x270mm	460x275mm
Motor	0.25kW	0.37kW	0.55kW	0.65kW	0.65kW
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