No.306

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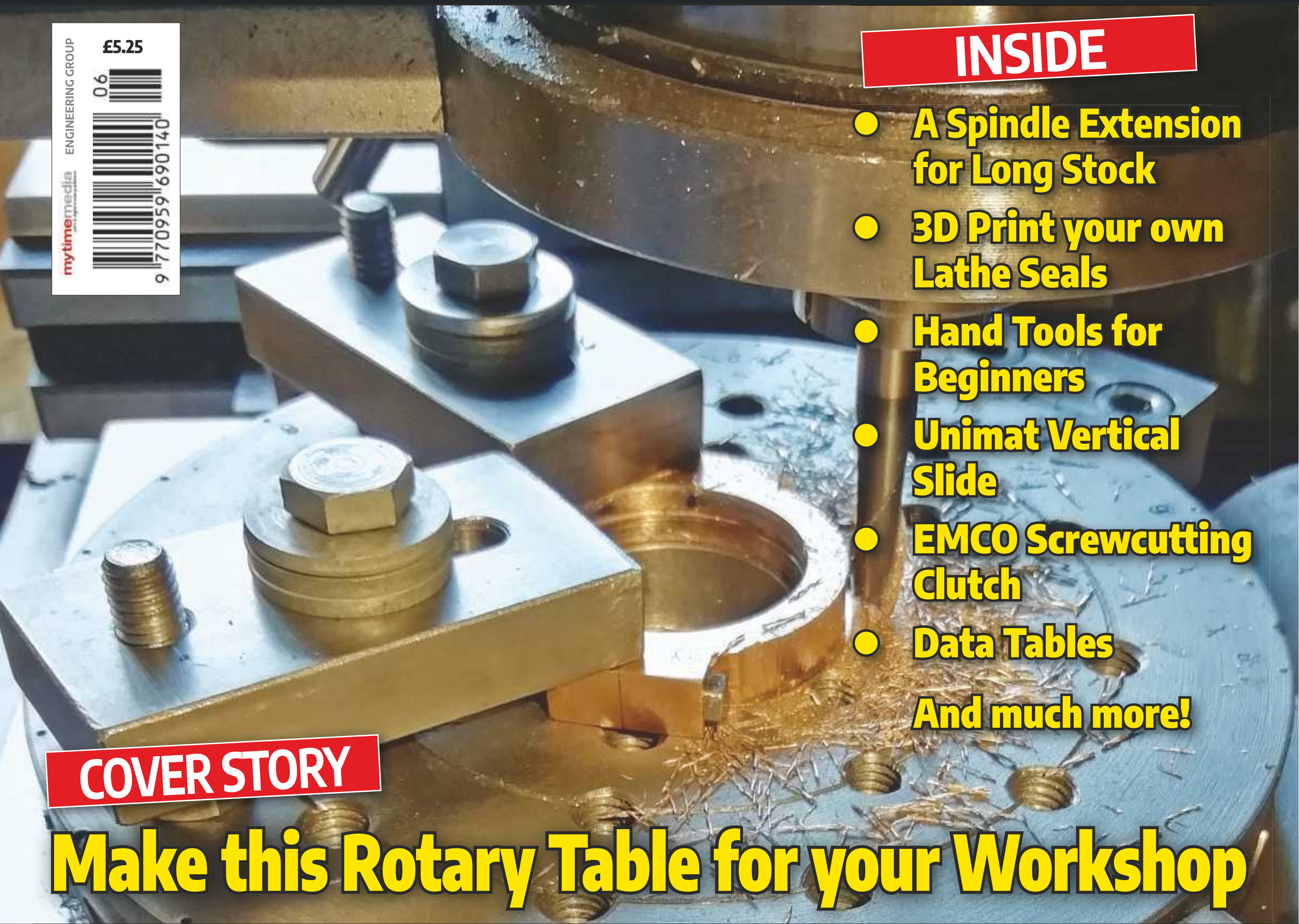

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COVER STORY

Make this Rotary Table for your Workshop

Make a Panel Punch

Make a Rear Toolpost

Make a Linishing Wheel

MODEL ENGINEERS' WORKSHOP

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On the Editor's Bench

Working Without a Workshop

I've been allaying my frustrations by bringing some of my radio-controlled boats back into service. I've also recommissioned my 3D printer, spurred on by the need to make a mounting adaptor for an astronomy camera. It's strange how PLA filament varies – I have had reels of PLA that would absorb moisture overnight and the now-brittle filament would shatter spontaneously. The PLA Plus+ filament I'm using now has been in the open air for months without drying and is printing perfectly and showing no signs of brittleness!

Mobile Numbers

I recently got drawn into a debate on the internet about telephones. Did you know that in 1920, 30 % of American households had a phone, a figure we didn't reach in the UK until 1970! Ironically, after a high point in 2020, landline phones are in a steady decline.

There is a point to this! Following a discussion sparked by a query sent to Martin Evans, over at Model Engineer, we have decided to drop the requirement of a landline telephone number for classified ads. Cost is no longer the problem it was, and a significant number of readers don't have a landline anymore. This does make it slightly easier for a scammer to disguise their location, so please be careful before sending money to people you don't know, and be sensible if meeting up with a stranger -go to their home or meet in a busy public place, not a windswept layby in the middle of nowhere!

Datasheets

Rather than print several redundant pages, the mis-set data page from issue 302 has been reprinted as page 35 in this issue. I hope the slight mis-ordering doesn't cause problems. Anyone familiar with the original series will notice we haven't been printing the sheets with tables of sines, logarithms and the like as calculators and computers make printed tables of these values of little use. We are just focusing on data that is less easy to find elsewhere, and expect readers to select those useful to them and pin them up in the workshop.


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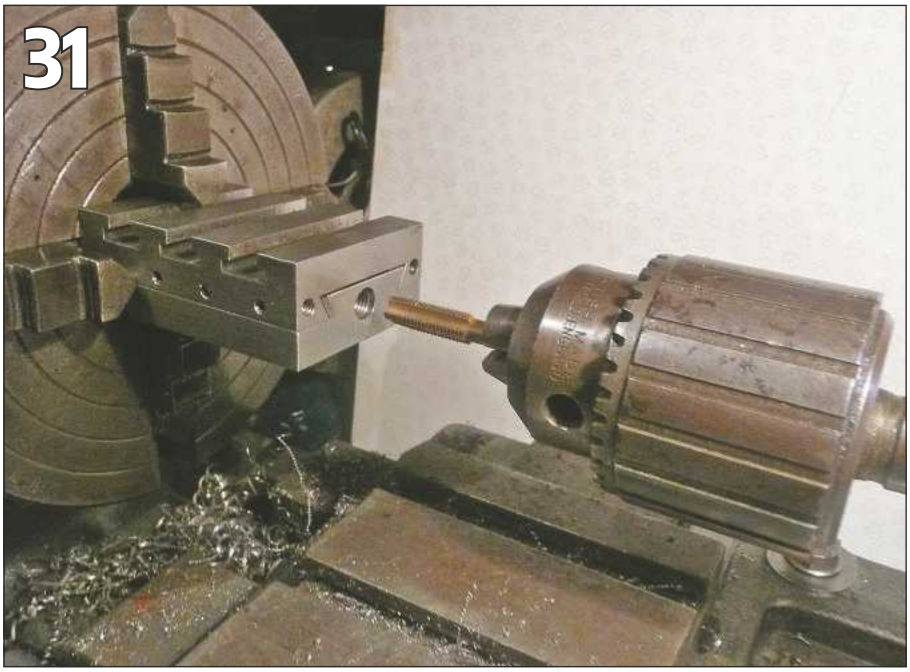

See page 48 for details.

Coming up...

in our next issue

In our next issue Ian Robinson makes a metric translation gear for a big old Holbrook lathe.

Regulars

ON THE COVER »»

John Gittin's flexible rotary table features this month, along with a host of other practical tools to make in your workshop.

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THIS MONTH'S BONUS CONTENT

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Visit our website to access extra downloads, tutorials, examples and links.
www.model-engineer.co.uk/extracontent

Lionel Pullum's Minilathe Tailstock Seals
Download an STL file to print seals on your 3D printer, or the Alibre Atom3D files to modify the design to suit another machine:

Plus:
Randa lathe missing back gear
Discover more about these vintage lathes.

Advice old British motorcycle
there are plenty of readers who restore bikes (and cars). Which model would you choose to restore, and why?

Parting off help!
It's a hoary old chestnut, but everyone struggles with parting off at some time. Do you struggle, or have you got the 'killer tip' for how to part off successfully every time?

Come and have a Chat!
As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. If you feel isolated by the lockdown do join us and be assured of a warm welcome.

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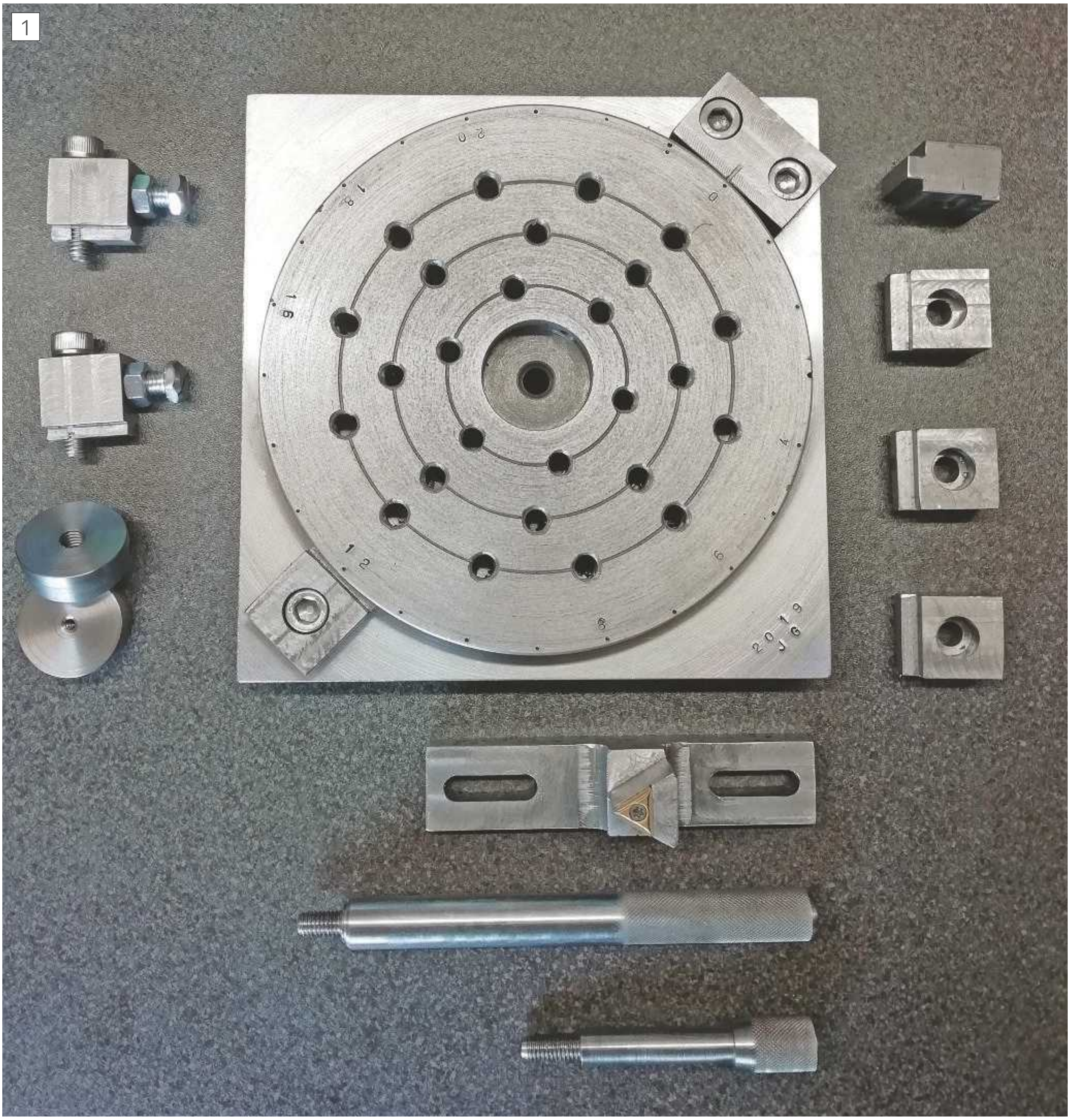
3 in 1 Rotary table

John Gittins details this flexible device inspired by earlier designs in MEW



Finished tool

I am nearing the end of a Stuart Beam engine build and wanted a device that would help machine the outside of the eccentric strap and radius the ends of ten or so rods that make up this engine's linkage. I have a Warco WM14 bench top Mill, so the cutter to table height is a limiting factor for any tooling. Firstly, I looked at commercially available worm driven rotary tables, but I felt those that offered a low profile compromised on table diameter. So, I decided to design my own tooling, **photo 1**, that could meet the following requirements:

1. Mill radial slots, **photo 2**.

Radial slot mode

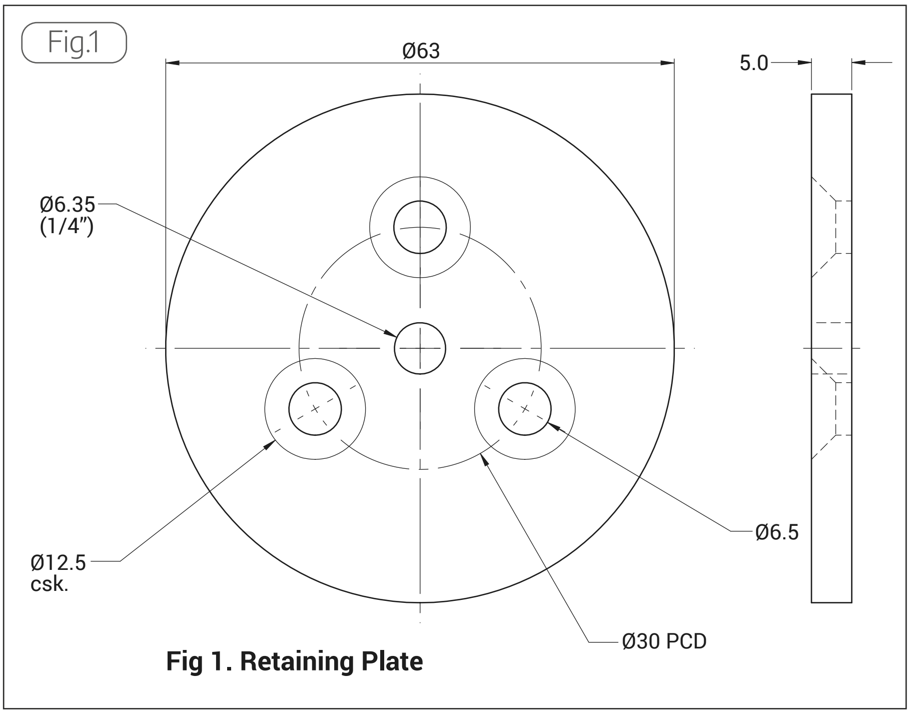
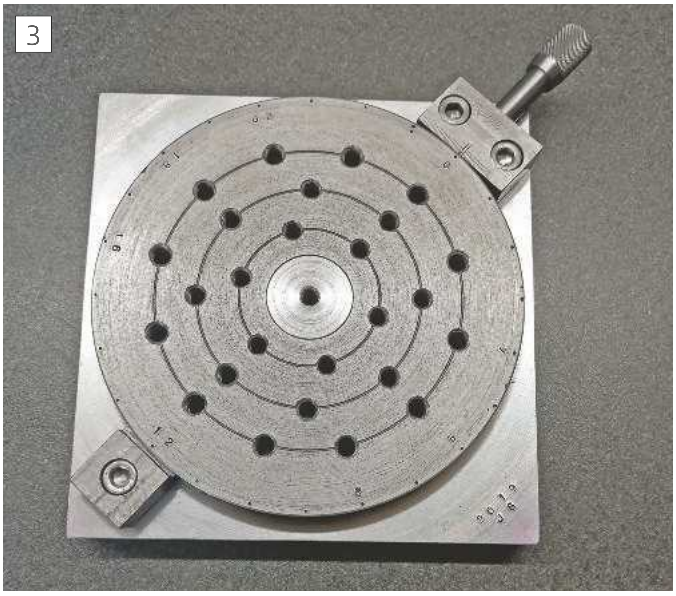
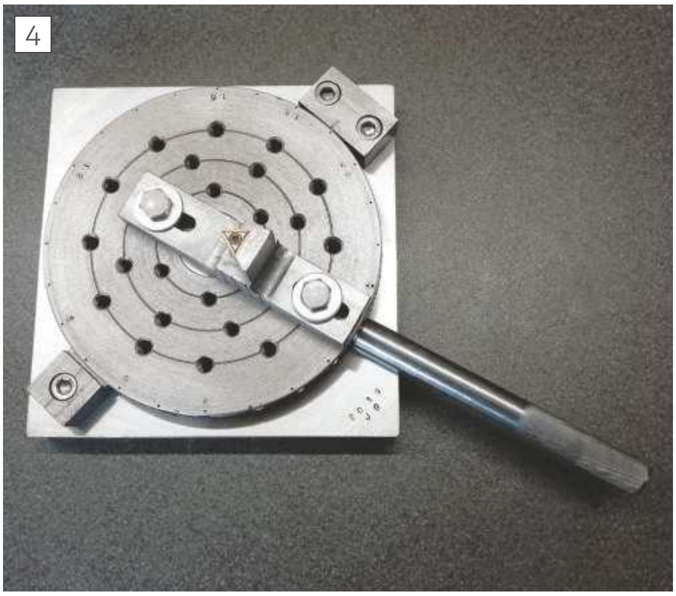


Fig 1. Retaining Plate



Indexing mode



Ball turning mode

2. Simple indexing (hole pitches of 2,3,4,6,8 etc.), **photo 3**.
3. Ball turning (so it would need to fit my Mill and Lathe), **photo 4**.
4. Low profile (<40mm in height).
5. 125mm or 5" table diameter.

The ball turning feature was somewhat of an afterthought. After searching the internet for inspiration on rotary tables I saw a lot of professionally made ball turners and thought I could simply add this feature. The 5" diameter seemed a sensible size for my equipment and the size of projects I work on, more importantly I could just about handle that dimension in my Warco 918 lathe.

At the start of the project, I thought that I may be able to make use of a chain sprocket or gear blank. The ready cut teeth would provide the indexing feature. After some more detailed research this plan was abandoned as nothing seemed quite right. I did happen across an unmachined cast 5" chuck backplate. I purchased this as it more or less looked like the table I wanted, and it would save me having to remove so much material from a larger blank.

My inspiration was mainly from Chuck Fellows and Harold Hall's own wormless rotary tables, details of both are given in the references section at the end of the article.

Retaining plate (fig. 1)

This is made from a piece of 5mm steel plate, I roughed it out from an offcut with an angle grinder first, then drilled and reamed a ¼" central hole. I used the central hole to mount it on an arbour I turned from a piece of scrap bar, **photo 5**. Holding the arbour in the 3-jaw chuck and securing the plate to the arbour with a suitable screw, I machined the outside diameter to size and skimmed the front face getting as close as I could to the fastener. Next, I indexed the three mounting holes, I used a stop under each of the chuck jaws and marked the job with the cutting tool, then I used the cutting tool to mark the pitch diameter.

I spotted the hole positions with a drill, so it was clear in **Photo 6**. Next drill through each of the three 6.5mm then set to one side.

Base plate (fig. 2)

I had this sawn from a lump of 20mm plate I had salvaged from the scrap bin a few years ago. I cleaned up the sawn edges on the mill by clamping it flat to the table with some parallel's underneath. I took a full 20mm depth of cut but kept the in-feed fine. I scribed from corner to corner with a steel rule to find the centre of the plate and put a deep centre punch mark there, this will be used for centring on the lathe later. I checked the top and bottom face with a steel rule for flatness and all was well.

Next to mill the slots for the clamps. I had chosen this method of clamping so the rotary table could fit both my mill table and lathe T slotted cross slide, each having different T slot centres. I held the 20mm plate in my milling vice. This set up was at near maximum capacity for my mill, **photo 7**. Clamping the part to an angle plate would be a much better set up, but as I don't have one, I made sure to only take very light cuts.

With all four slots milled I transferred the part to the lathe. Pressing the tailstock centre on the

Retaining plate mandrel set up

Indexing holes in retaining plate

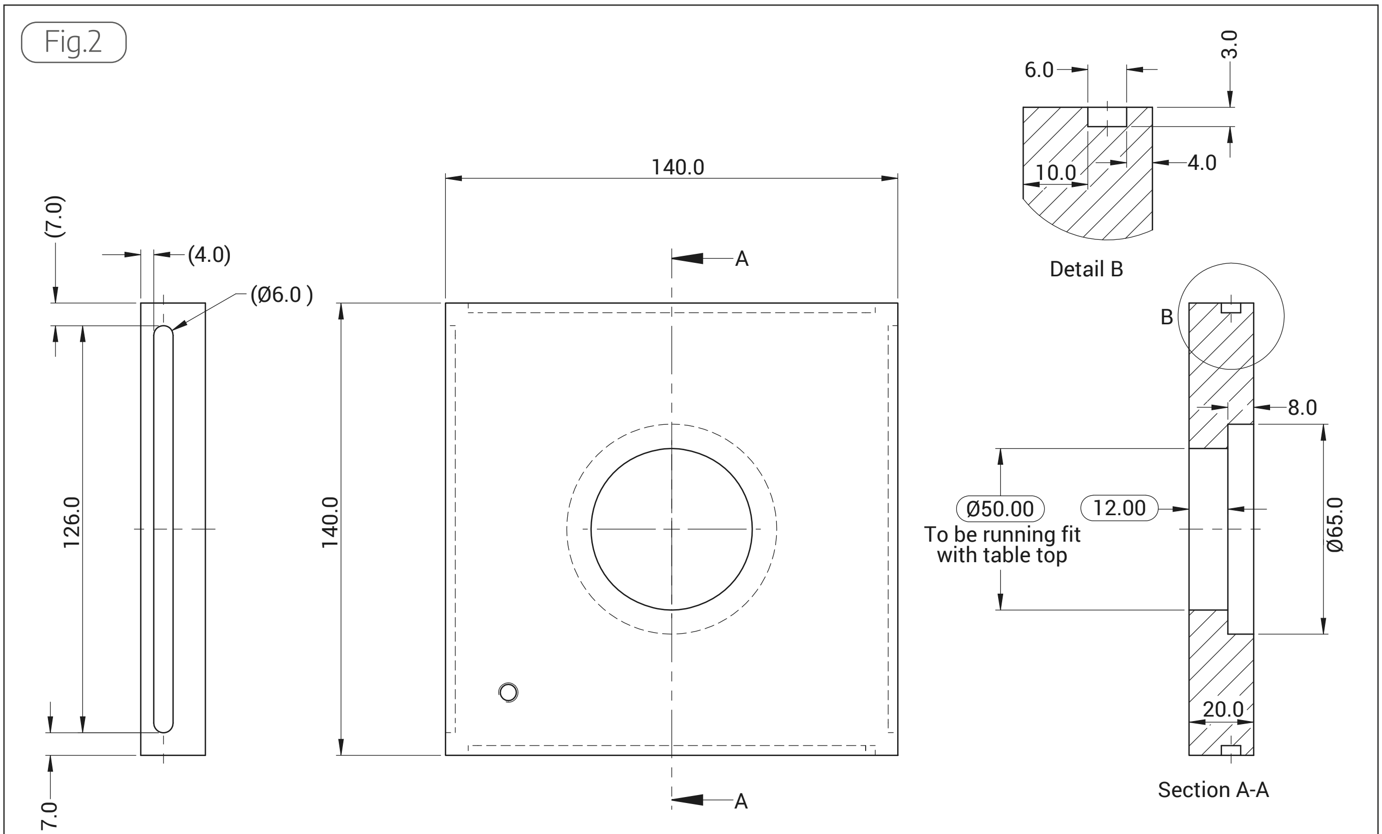


Fig 2. Base Plate

Base plate clamp slots

Base plate on face plate

Base plate 3 jaw through hole

centre mark helped locate the part on the face plate quite quickly. I centre drilled and opened up a hole with my largest drill. I fitted a boring tool and bored the 65mm diameter hole to a depth of 8mm, **photo 8**.

I fitted the 3-jaw chuck complete with outside jaws to the lathe and held the plate on the previously bored hole. I placed some packing between the jaws and the plate so the boring tool would not hit them in the subsequent operation. To be on the safe side I set a stop so that the boring tool would only just pass through the plate and touch the packing. I bored a 50mm diameter hole through, then skimmed the outer face to make sure it was square to the bore I'd just created, **photo 9**.

Table (fig. 3)

The main thing to ensure is that the centre ¼" hole and 25mm recess are concentric to the spigot on which the table rotates, and the top and bottom surface of the table are parallel.

Mounting the part on a mandrel or in a larger chuck if one was available would be better solutions, but this is how I did it. I held the casting in the 3-jaw chuck by the spigot and began to clean up the outer face which would become the table surface. I centre drilled the casting then I started to turn the diameter to size. I left the diameter around 1mm oversize at this stage. Still with the part in the 3-jaw chuck I found I just had enough room to get a left hand (LH) turning tool between the jaws and the part to machine the bottom face all on the same setting, **photo 10**. As the casting was too big for my 3-jaw

Table first skim

Table underside

Fig.3

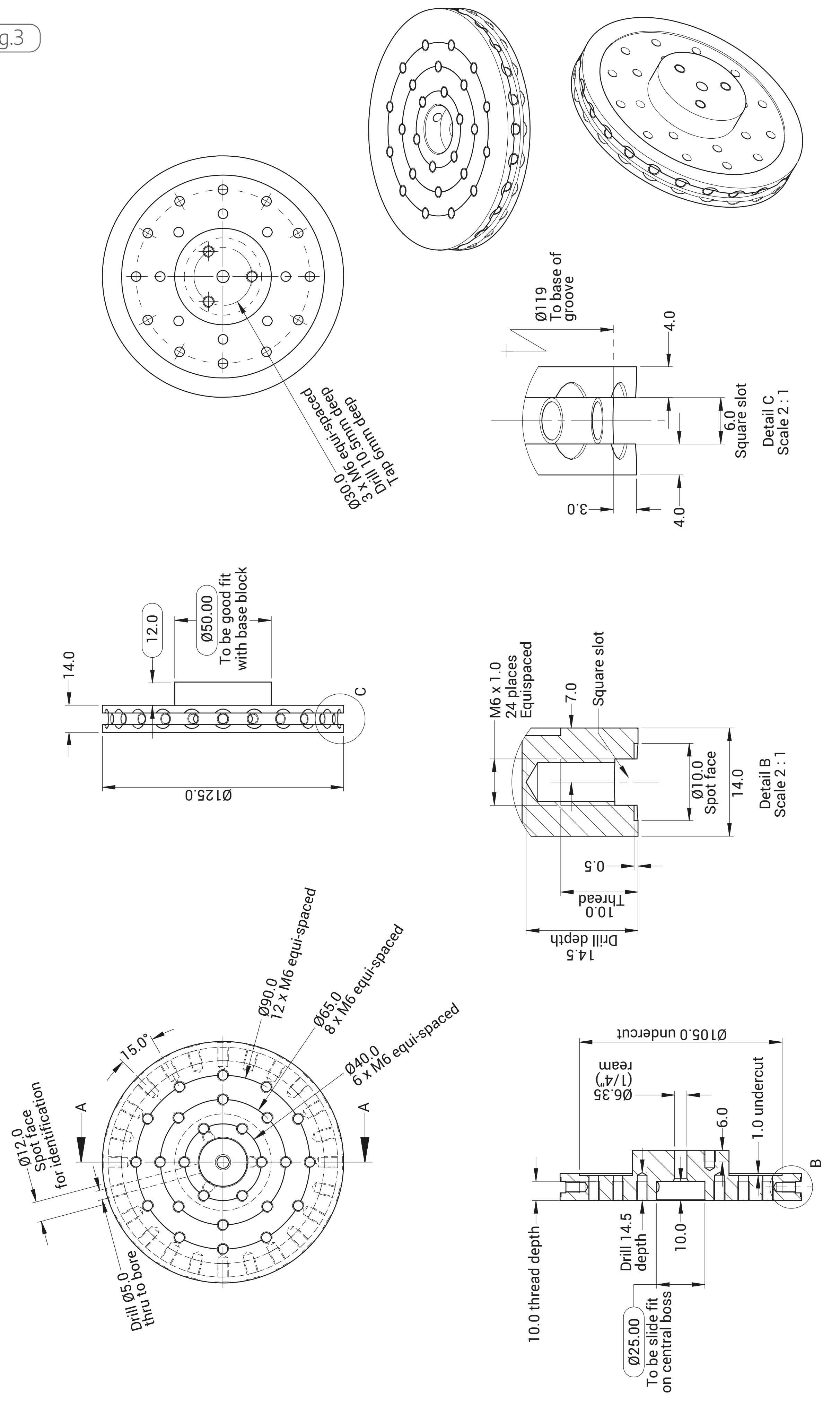


Fig 3. Table Top

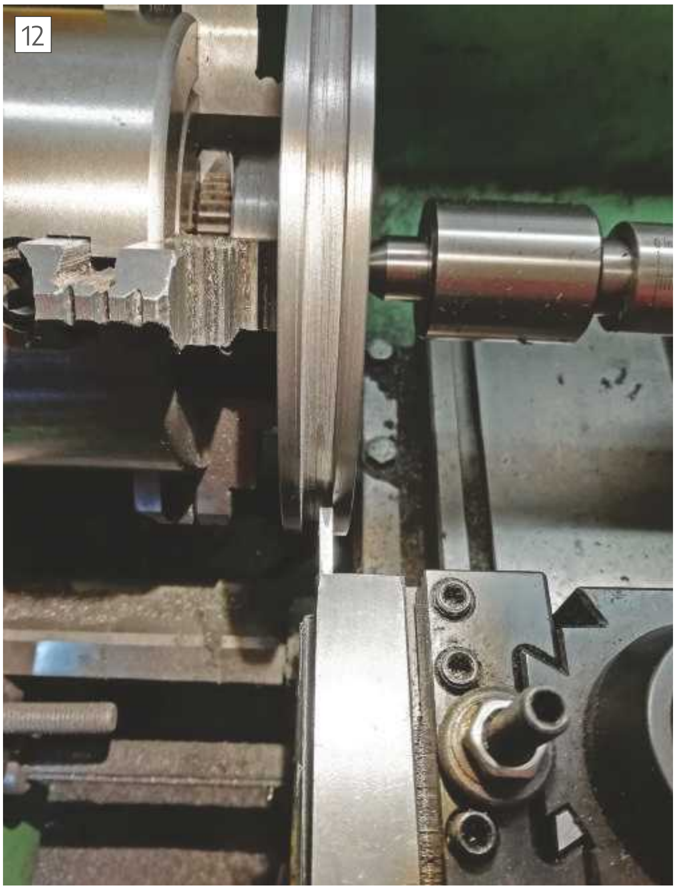


Table square groove

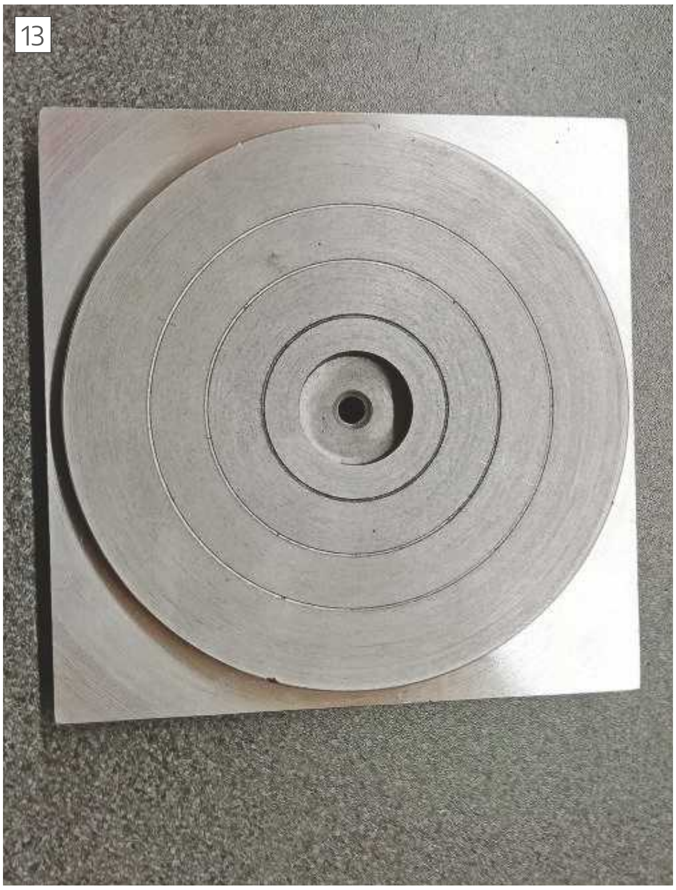


Table on base

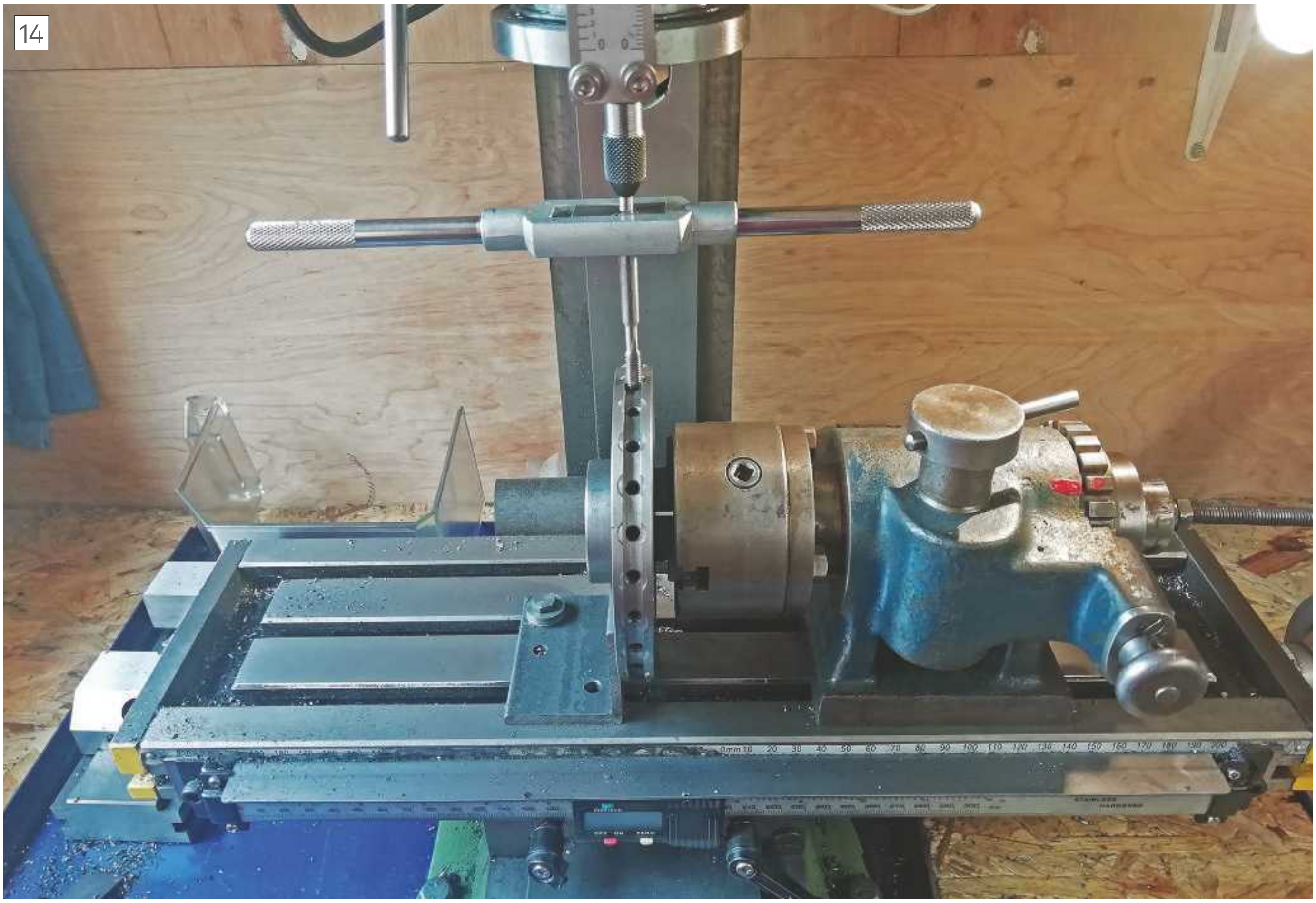


Table tapping indexing holes

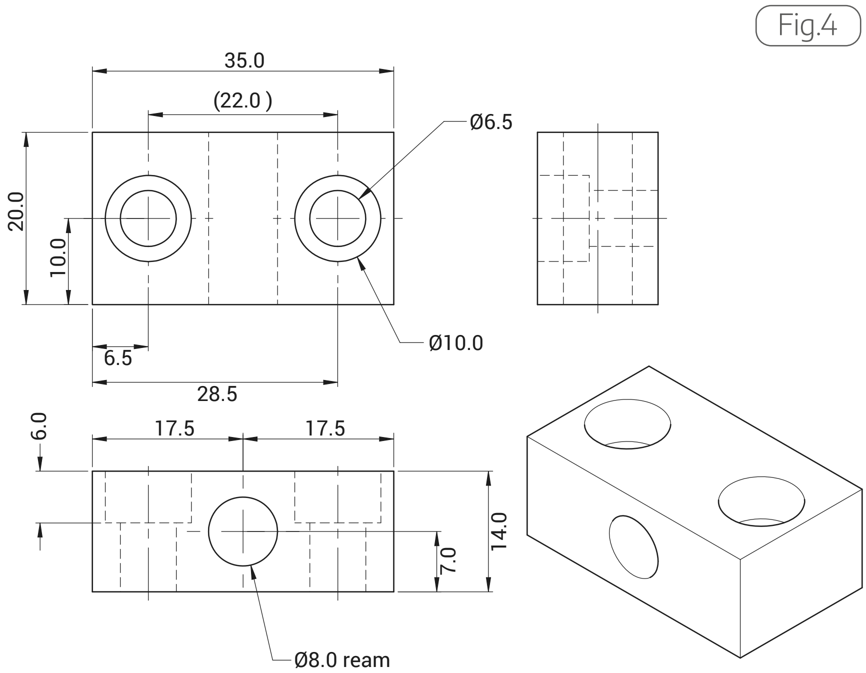


Fig 4. Block For Indexing Pin

Table deburring holes for retaining plate

Indexing pin block

chuck I mounted it on the face plate and checked run out with a dial gauge. I proceeded to machine the spigot to diameter (50mm) and height (12mm). I cut a recess on the underside face to reduce the bearing surface on which the table would rotate, **photo 11**. I had to avoid the clamps and wanted to get close to the central boss, so I used a boring bar and a LH turning tool. Finally, I drilled and reamed the central hole ¼" through. In hindsight, choosing 8mm for the central hole would have allowed a location feature to be added to the central removable boss. I would have then tapped this M6 and used it to secure the central boss from underneath.

At this stage it is useful to scribe a datum line with a lathe tool across the bottom of the table. This will help locate the threaded holes later.

I held the part by the spigot in the 3-jaw chuck and checked for run out on the diameter and front face. The diameter was good, but the front face had a significant wobble. To correct this, I pressed the casting firmly against a change wheel used as packing in the 3-jaw chuck with the tailstock. With a live centre in position, I mounted my parting off tool and proceeded to cut the 6mm wide groove around the circumference, **photo 12**. Finally, I took a skim off the outside diameter to bring it to final size.

Next with a threading tool I cut 3 grooves on the top face to help align parts when in use. It conveniently set the pitch diameter for the clamp holes too, which will be drilled and tapped later. I bored the central hole to 25mm and 10mm deep. This feature is for a removable central boss that I can thread to any size depending on the job I'm doing. On the base of the central hole, I cut a 30deg chamfer around the central ¼" hole to help locate a 60deg centre when aligning the table on the mill, **photo 13**.

To machine the indexing holes around the circumference of the table a good friend loaned me their quick indexing head. The accompanying centre was not available, so I used a piece of angle iron and clamped it to the bed to make sure nothing in the set up could move. In hindsight the centre would have been much better. I used the previous mark made with the lathe tool to find the location for the first hole, then proceeded to; centre drill, drill 5mm, counterbore diameter 10mm and tap M6 for all of the 24 holes! **Photo 14**.

One hole needs to be drilled through to the bore as it was my intension to lock the central boss in position with a grub screw and a length of bar to act as a push rod.

Finally, I used a ¼" drill to locate the retaining plate centrally to the table and spotted the three holes into the table spigot. I deburred the holes then tapped M6, **photo 15**.

Block for Indexing pin (fig. 4)

This block houses the indexing pin. It was made from an off cut from the base plate then milled to size. I drilled two holes diameter 6.5mm and counterbored for M6 cap head screws. To make sure that the hole for the indexing pin was exactly aligned with the holes in the table I turned a sharp point on a piece of M6 studding and used this to mark the position of the 8mm reamed hole, **photo 16**.

●To be continued

Readers' Tips

CHESTER MACHINE TOOLS

Controlled Oil Dispenser

TIP OF THE MONTH WINNER!

This month our lucky winner of £30 in Chester gift vouchers is David Yates of Lincoln who has a simple idea for the application of cutting oil.

I wonder if my idea for dispensing controlled amounts of cutting oil would be of interest? I think the photo is self-explanatory.

The plastic nozzle was too big to get into confined spaces such as narrow slots when parting off and the hole was too big resulting in a lot of wasted oil. I cut off the end of the nozzle and screwed in an old No. 1 DH oxy acetylene tip.

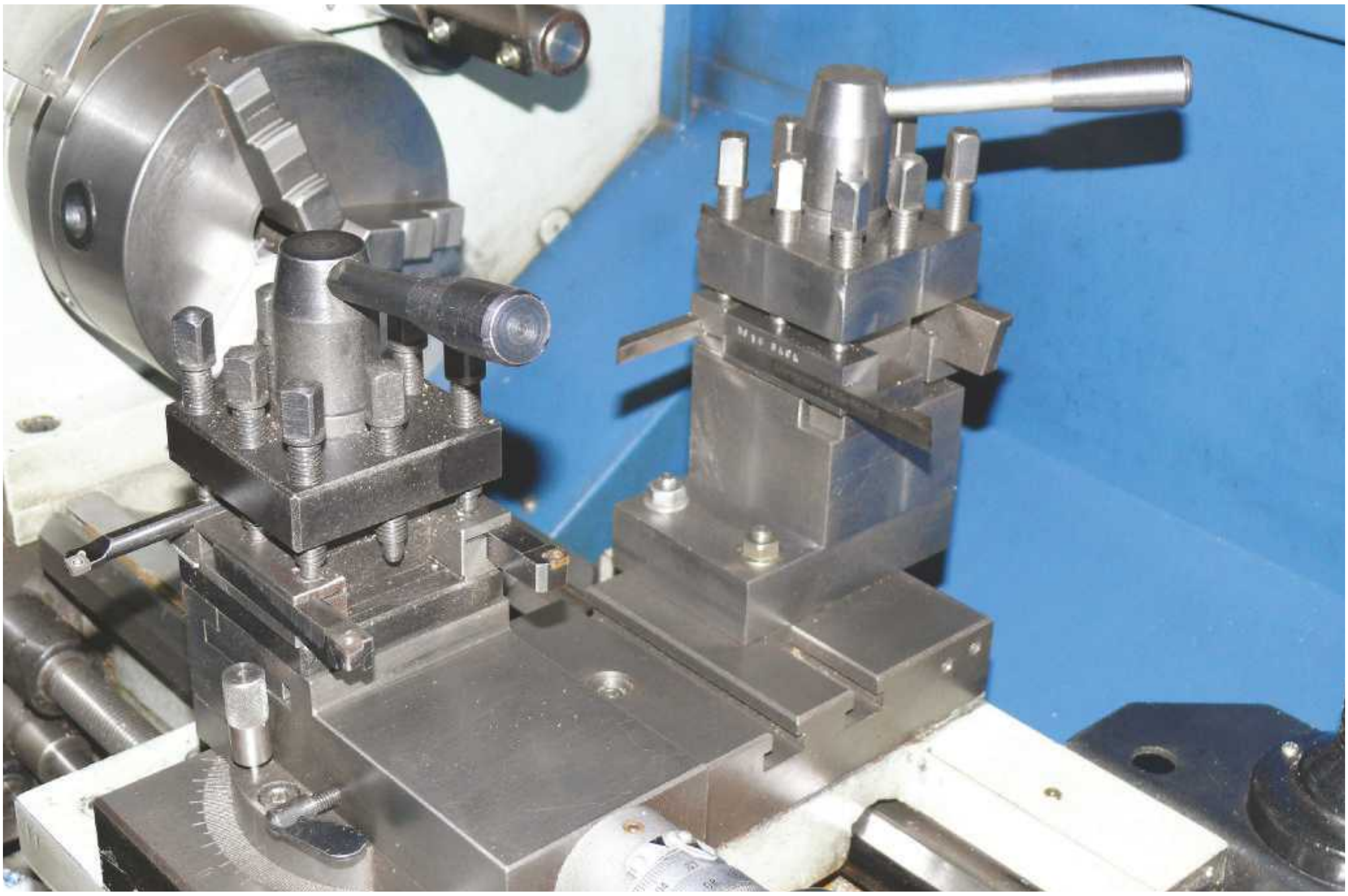
The fine hole makes dispensing the oil much more controllable.

Dave Yates

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.

A Four Way Rear Tool Post for the Engineers Tool Room BL12-24 Lathe



Howard Lewis details a multi-tool rear toolpost for larger lathes

Having made a Rear Tool Post for my Myford ML 7, and found it a boon for parting off, when I upgraded to the BL12-24, it was soon obvious that something similar was needed.

Remembering, from apprentice days, that Capstan Lathes carried form tools as well as parting tools, in the rear tool post, the seed of an idea began to germinate, hence a Four Way Rear Toolpost.

The BL 12-24 is similar to the Warco BH600, Warco BH 900, and Chester Craftsman, so the design should suit these machines. There is no reason why the fitment, with modified dimensions, cannot be applied to any lathe with a Cross Slide having a machined flat on the upper surface, and Tee Slots. Similarly, alternative threads may be used if this is more convenient.

Making the Tool Post

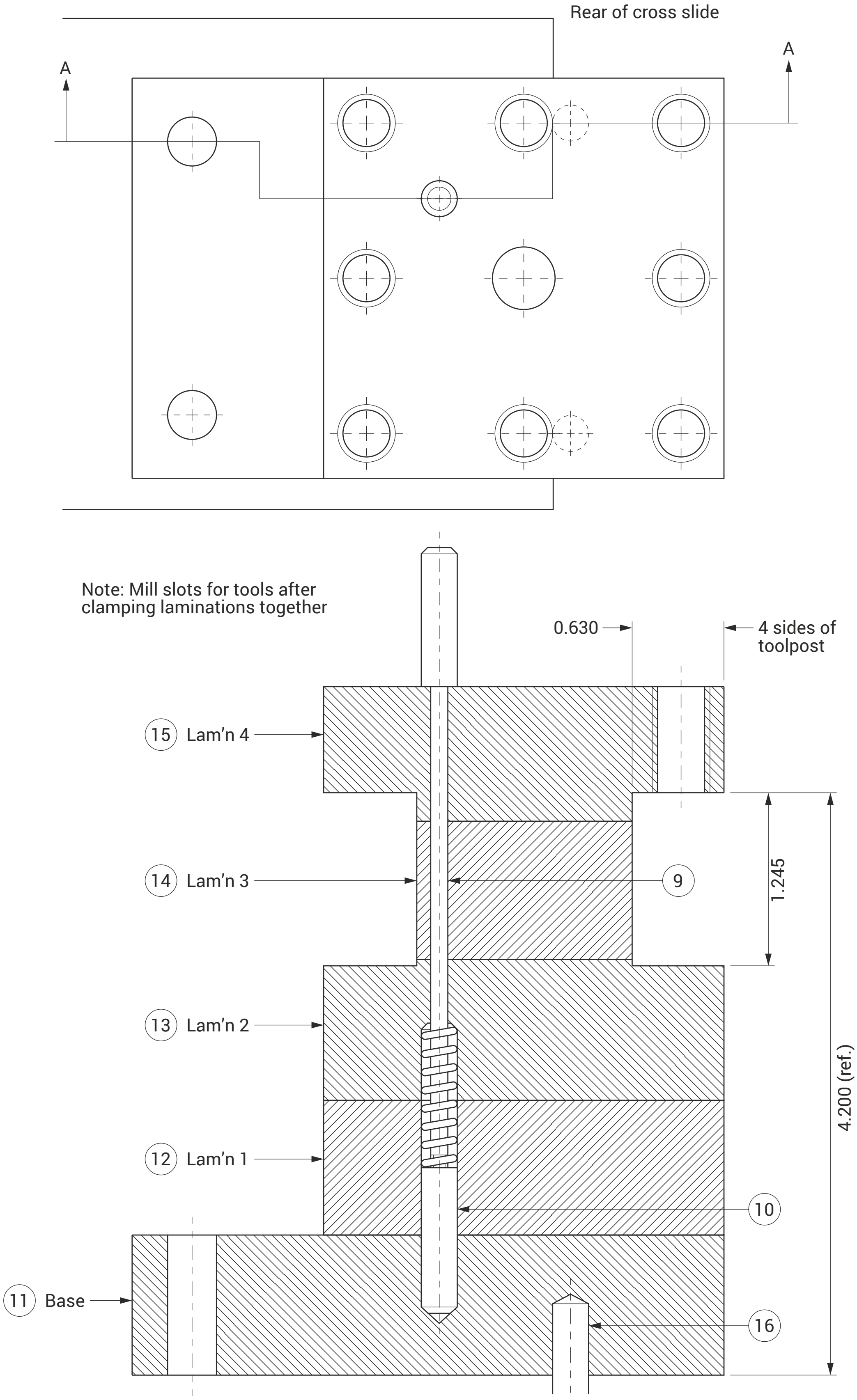
Whilst helping a friend make a four-way tool post for his new, small, lathe, the idea came of making a rear tool post similar to the front one, on my lathe; but a four way. In this way, chamfering tools, as well as a parting tool could be carried.

It would be visually more satisfactory if the rear tool post matched the existing front four way post as closely as possible. Consequently, the front tool post was measured to obtain as many dimensions as possible so as to avoid actually having to think for myself!

Having been given a one metre length of 3 x 1 inch ground steel, much of the raw material was already to hand, so thought needed to be given to the details of the design.

After taking measurements, and making a few calculations, it was clear that the length of ground steel would provide sufficient material for the base, and the tool post body.

Fig.1



Section A-A

Back Tool Post General Arrangement

There is no reason why the main toolpost cannot be made in one piece out of a piece of larger steel dispensing with the need for the internal capscrews...

The rest of the toolpost was made, using, wherever possible, material that was already to hand.

The toolpost body comprises four pieces of the 3 x 1", laminated and clamped together, internally, by three M6 Allen cap screws each 75mm long. The fourth position is used for the dowel that locates the toolpost in each of the four orientations.

There is no reason why the main toolpost cannot be made in one piece out of a piece of larger steel, dispensing with the need for the internal capscrews used to hold the laminations together.

Since this method results in a much longer drilling for the stem of the Indexing Dowel, there is the possibility of the drill wandering off course, so perhaps drilling part way for the dowel rod before the reamed hole for the indexing dowel is made on the bottom face, may lessen the risk.

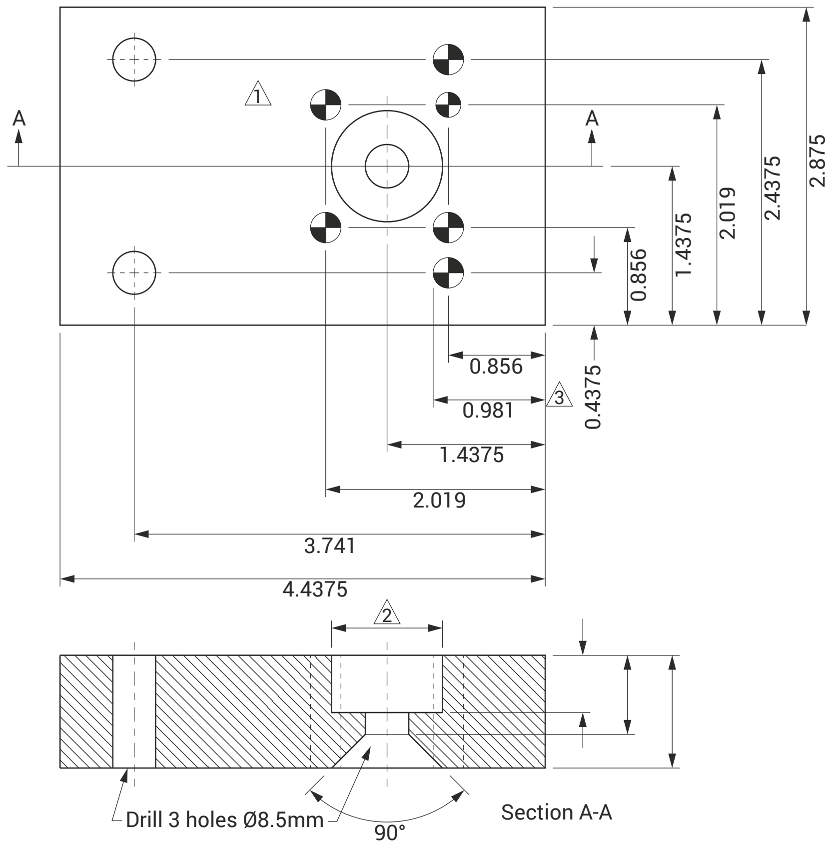
The toolpost rotates about a central dowel and is located in each of the positions by a smaller dowel which fits into one of the four holes in the base. The toolpost is clamped to the base by a clamp nut and stud, (which is tapped into the central dowel).

The thickness of the washer is initially made slightly over nominal, being finally used to adjust the position of the clamp handle assembly, so that it does not overhang the work when the toolpost is fully clamped.

An "in stock" stud, with an M12 thread on one end, provided the basis for the clamping lever, and another "in stock" stud with a M10 thread was the starting point for the central clamp. In this context "in stock" means the "it will come in handy one day" box.

The tool clamp screws were made from ½ inch round bar, using other material already to hand. Buying the three Allen cap screws for internal clamping completed the kit of parts.

Fig.2



1 Drill Ø15/64, ream Ø0.250, 6 holes

2 Drill Ø63/64, ream Ø1.000

3 Position of rear cross slide

11. Base
Mat'l: BMS/ground stock, 1 off

1

Base with central dowel and clamping stud.

The following notes are intended to recount the methods and equipment used to manufacture each part, and so should be read with reference to each detail drawing.

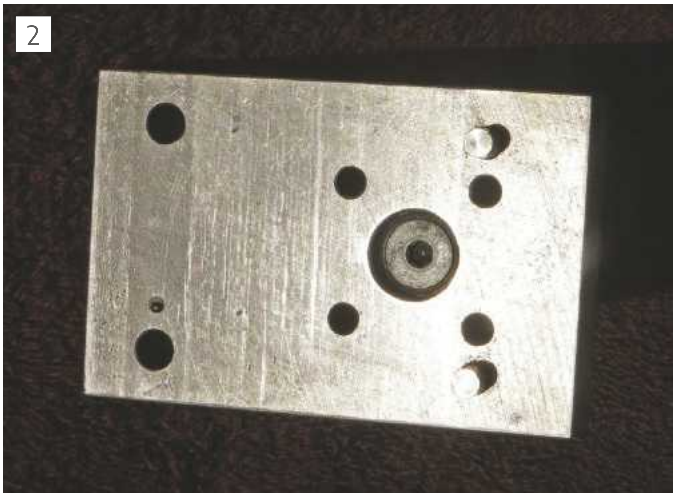
Unless otherwise stated, all dimensions are in Inches.

Figure 1 shows the general assembly drawing of the toolpost and base, with numbers of the various items. The base, (item 11) is shown in **fig.2**.

The base locates to the rear of the cross slide by a pair of dowels, (Item 16 on fig.7) made from ¼ inch silver steel, and carries a piece of 1inch diameter silver steel as the locating bung (item 6) for the main body.

The silver steel locating bung fits into a reamed hole, half the thickness of the base, and is retained by a countersunk Allen screw.

The top and underside views of the



The underside of the base.

Completed clamping handle.

completed base are shown in **photo 1** and **photo 2**. The base is clamped to the cross slide by two short studs set into a long tee nut, made specifically to suit the tee slot. The long tee nut is shown in **photo 4**.

To maximize space for any workpiece, the rear tee slot of the cross slide is used, with the small dowels locating the base against the rear of the cross slide.

Being lazy, I used commercial M8 studding as basis for the studs. The clamping nuts should have washers beneath the heads, (mine were already washer faced).

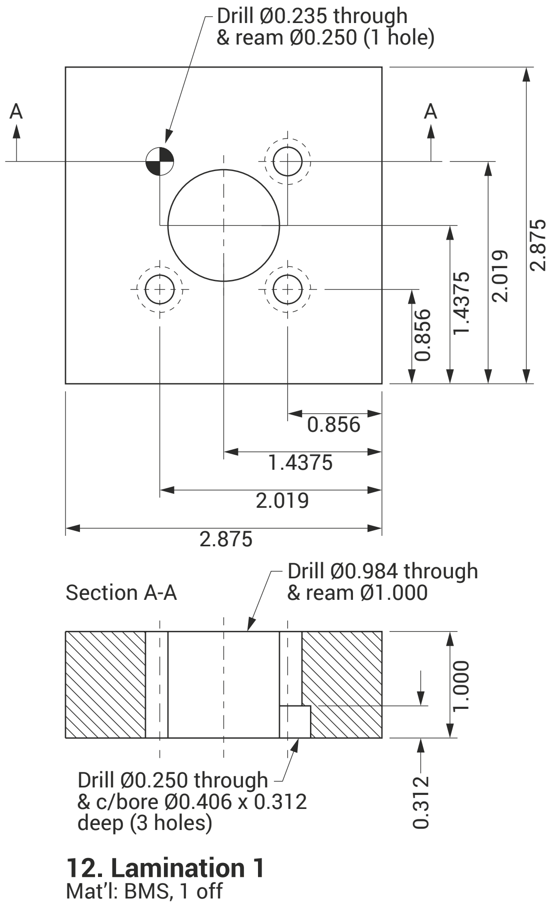
Lamination 1, the lowest of the laminations (item 12), is shown in **fig.3**.

This was placed in the milling vice, on parallels, and the reamed holes for the central pivot, and the dowel, together with the drillings and counterbores for the three capscrews, made.

Lamination 2, (Item 13) is shown in **fig.4**. This has the central hole, clearance holes for the three capscrews which clamp the complete tool post together, and the drilling for the spring intended to hold down the dowel. (the intention

Being lazy, I used commercial M8 studding as basis for the studs. The clamping nuts should have washers beneath the heads...

Fig.3



was to use the spring from a redundant retractable ball pen. It has to be admitted that this refinement has yet to be incorporated in the prototype).

Lamination 3, (item 14) is shown in **fig.5**. This has the clearance holes for the three capscrews, dowel stem, and central stud. It is this layer which will bear the brunt of the eventual milling of the slots for the tools.

Lamination 4, the top lamination, (item 15) is shown in **fig.6**. The top layer of the body was then placed in the milling vice, on parallels, and all the holes (except the three tappings for the internal clamp bolts) made.

The M10 tappings for the tool clamp screws may be put in at this stage, or can be left until later, and the threads cut using a "tapping machine", (mine is basically a converted drill stand with a T-handle and a small drill chuck on the opposite ends of a spindle). This top layer is then inverted, and the three tappings put in for the internal clamping screws (M6 x 75mm Allen capscrews). All these items were machined with the mill/drill used in jig borer mode, using one corner as a datum point.

Central Dowel (Item 6) shown on fig.7 as a locating bung. This is a straightforward turning job, made from a piece of 1 inch diameter silver steel, drilled and tapped M8 on one end to suit the countersunk Allen screw, and on the other end M10 for the clamp stud.

The M8 countersunk Allen screw, to retain this part, happened to be "in stock".

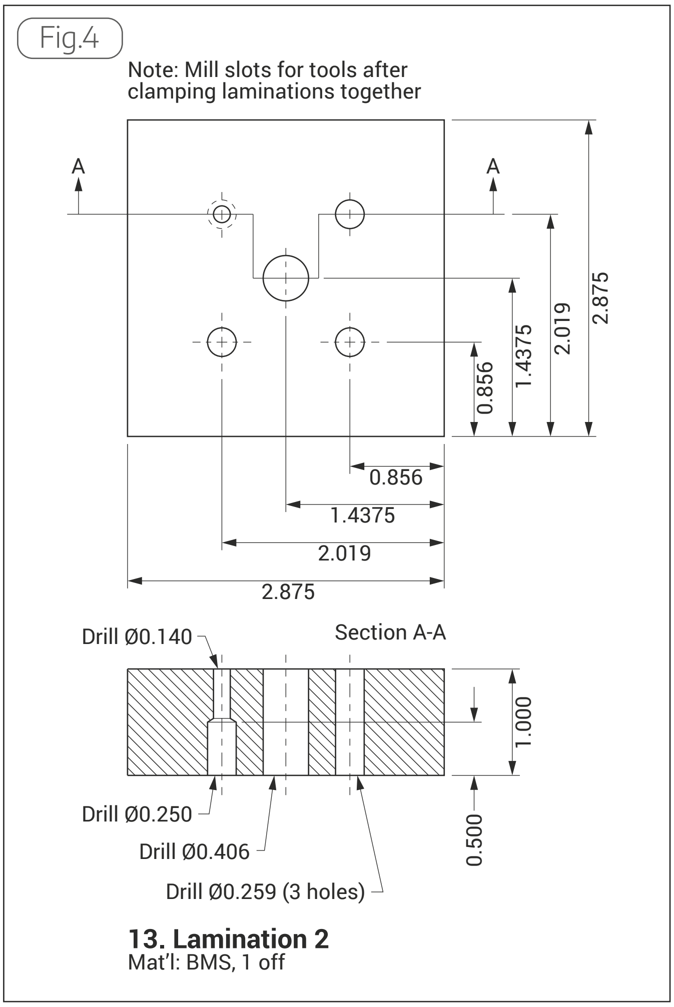
Tool Post Clamp Lever Assembly

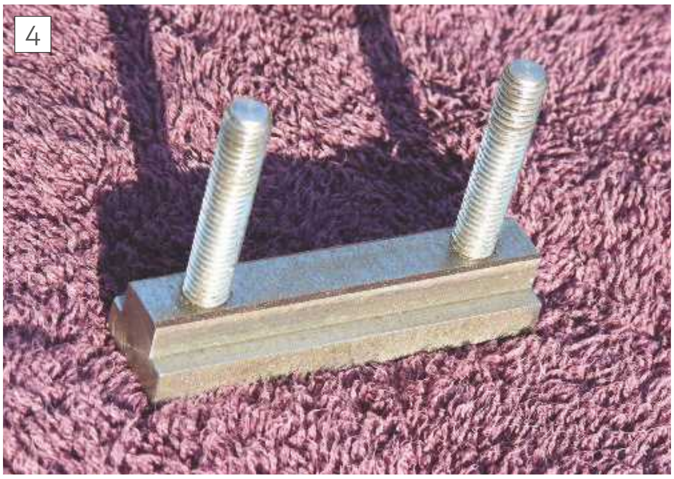
An "in stock" M12 stud, was cut to the required length, and a M12 thread cut on the "new" end, to become the handle (Item 1 of the clamping lever). (The die was adjusted using a commercial M12 High Tensile Bolt as a master).

The knob (Item 2) for the clamping lever was made from a piece of 1 inch round bar, (7/8 would have been preferred, but was Nil Stock!) turned down, and tapered (by offsetting the Topslide) to match, as closely as possible, the knob on the front four-way tool post, and tapped M12.

Tool Post Clamping Nut (Item 3)

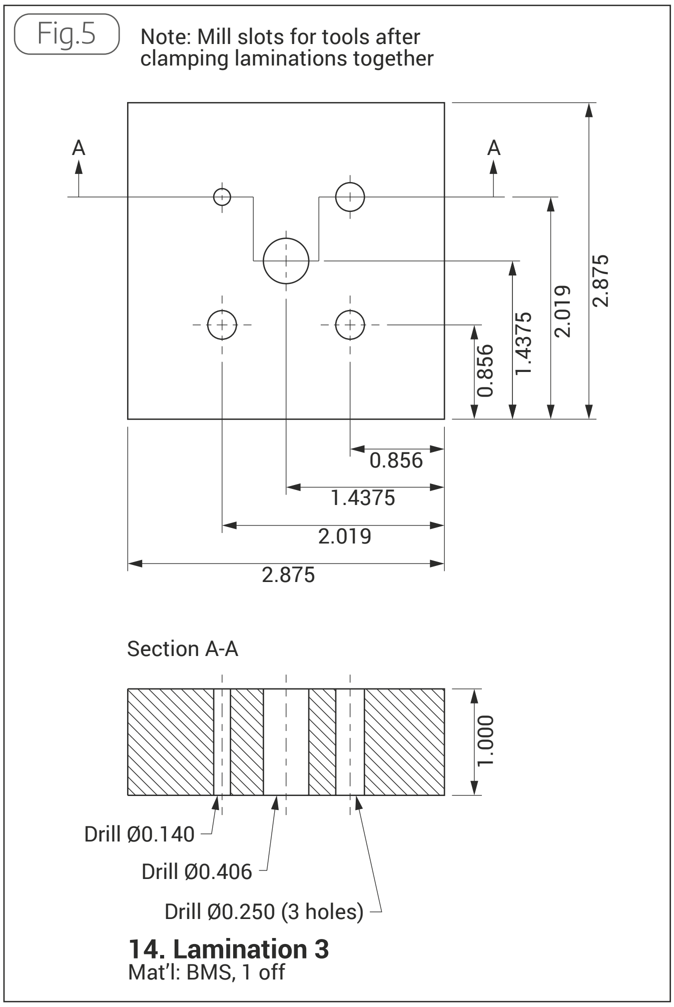
This is a straightforward facing, drilling, tapping, and turning job. The taper was turned, again, by off setting the top slide. The drilling and tapping for the clamp lever stud (5) was started by setting the tapered face horizontal with a spirit level, whilst lightly clamped in a Vee block in the milling vice. Once set, and fully clamped, a centre drill was carefully started on the centre line, before opening up to tapping size in gentle steps, followed by tapping to depth. **Photo 3** shows the completed Toolpost Clamping Lever Assembly.





4

Tee nut assembly.



●To be continued

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Tailstock DRO

Dear Neil, I would like to thank two of your contributors for enabling me to fit a tailstock DRO to my lathe. The original idea was by Duncan Webster (issue 301) using an incremental rotary encoder which was relatively easy to fit, but the Arduino and display was a stumbling block. Until J van Damme (issue 305) alerted me to the HB 961 universal digital counter. Simplicity itself, just wire the two together. The counter enables you to multiple or divide the pulses from the encoder by any number you desire which converts the tailstock thread, pulley ratio and pulses per rev into distance. I opted for distance in mm to two decimal places.

I hope this may help others not familiar with some of the more complex electronics.

F Wilson, by email

Milling Vice

Dear Neil, I read about Dave Piddington's milling vice (in MEW 305). I want one!

I thought Reeves would stock the castings, so emailed them as not on their website. Kate replied that she can find no trace. Can you name an alternative supplier, please?

John Coleman, by email.

Originally Hemingway Kits were going to supply these castings, but don't appear to have brought them to m arket. Can any readers suggest similar alternative castings? – Neil.

Testing a Three Phase Motor

Dear Neil, I write concerning the recent article in MEW No.305 on testing a three phase motor. This article has, unfortunately, some serious safety implications in it. With regard to the use of capacitors, David Dunn correctly advises that "...The capacitor must be suitable for AC mains use, not an electrolytic type...", yet a few lines further on he states "...most induction motors have a starter capacitor which would be suitable...". Almost always, starter capacitors are electrolytic types, with high loss factors and will fail if connected as a "run" capacitor, so a starter capacitor must NOT be used. The only type of capacitor that can be used in David's application is a motor run capacitor with a voltage rating, for a 400 volt motor, of at least 450 volts.

Secondly, when connecting a motor in the Steinmetz connection (one where a capacitor is used to create the third phase) the use of an inductor to improve the phase shift from 90 degrees to around 120 degrees is fraught with difficulties. This is due to the potential for series resonance to occur which can create some spectacularly high voltages and is best avoided at all costs unless you really do know what you are doing. The patent literature is full of various ways of avoiding such resonance by ensuring that the inductance itself is varied by being designed as a saturable reactor or a fixed inductor is adjusted by having tappings to avoid such resonance.

His use of "a transformer" as an inductor is perfectly feasible, but as an example, I tested a 1kVA transformer that I have and the no load current taken at 240 volts was 0.8 amps, corresponding to an impedance of 300 ohms. For series resonance to occur, the impedance of the inductance and the capacitance have to be the same and, for a capacitor to have an identical impedance of 300 ohms, the capacitance works out at 10.6 microfarads - somewhat too close for comfort to his suggested value of 8 microfarads, especially as the impedance of the circuit consisting of the transformer and one phase of the motor in parallel will modify the effective impedance of the circuit somewhat.

The analysis of the circuit of a three-phase motor in the Steinmetz connection on a single phase supply is complex, so the best advice is to leave out the inductor (the transformer) for safety and accept a lower performing system, typically around 50% of the three-phase output. He could, of course, read my book - "Three Phase Conversion", Workshop Practice Series No.47, Special Interest Model Books, ISBN 978-185486-262-4 which explains this in greater detail.

Graham Astbury, by email.

Scribe a Line is continued on page 40

Hand Tools in the Workshop

A retracting Stanley knife and a standard modelling knife

While big machines are the 'exciting' aspect of any workshop, it remains true that even in the most advanced CNC-based workshop there is the need for a comprehensive set of hand tools. At the other extreme, it's possible to achieve remarkable results with just hand tools, as was one proven by the author Tubal Cain who made a working steam engine (called 'Hand Maiden') in this way. The sheer variety of hand tools available is a trap for the unwary, it's easy to spend a fortune and fill drawers and cupboards and find out later that many of them have just gathered dust. Rather than explaining what a screwdriver or a hammer does, this section will give some advice on what is likely to be most useful and for what tasks.

Some components from a set of BA taps and dies

Hammers

For such a simple tool, it can be useful to have a small collection of hammers. Obviously lump hammers and sledgehammers have limited applications in hobby engineering, but a

> ...it's easy to spend a fortune and fill drawers and cupboards and find out later that many of them have just gathered dust.

A pair of combination pliers

range from very light to 'typical DIY' size will all prove handy.

The nail-pulling claw of a claw hammer has little value for metalworking. A small hammer with a wedge-shaped back can be more useful for tasks like tapping in wedges or working in a confined space. Ball pein hammers have a rounded back to their head, this can be useful for shaping metal and riveting over the end of pins or rivets, although you will get a neater result using a proper rivet set.

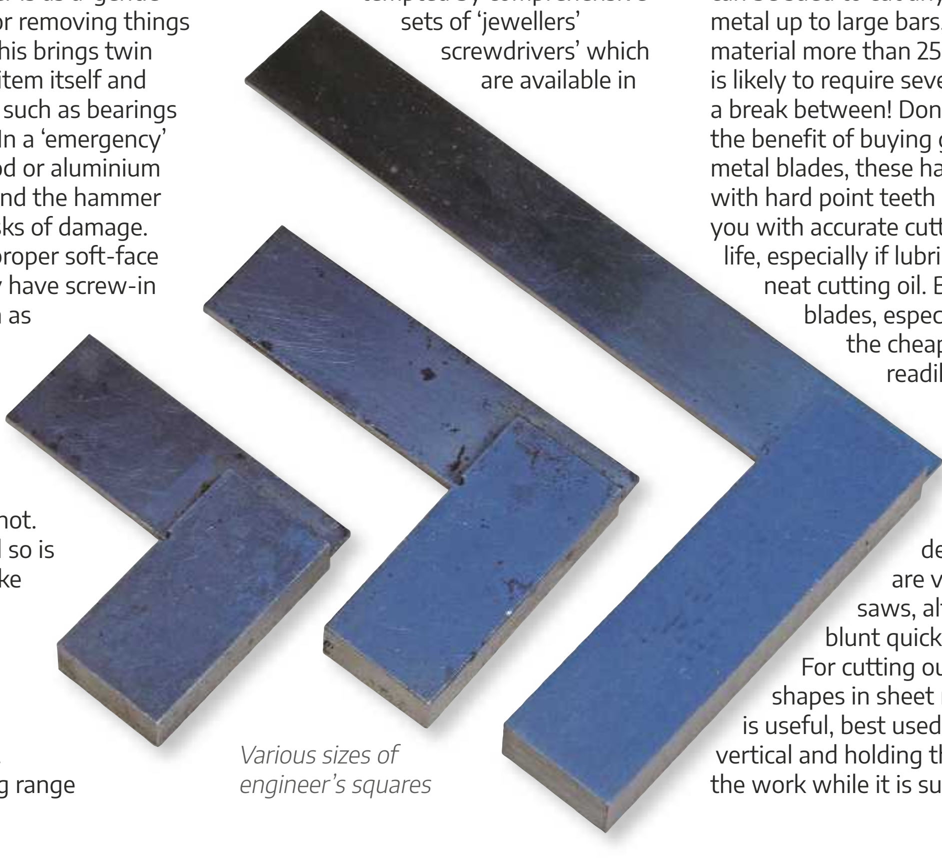
One use of a hammer is as a 'gentle persuader' for fitting or removing things that are tight fit, but this brings twin perils – damaging the item itself and damaging other items such as bearings from the shock loads. In a 'emergency' putting a block of wood or aluminium between the 'target' and the hammer can help reduce the risks of damage. A better solution is a proper soft-face hammer, these usually have screw-in faces in materials such as nylon, copper or even leather, photo 1.

Another useful hammer is the 'dead blow' type, which usually has a head filled with lead shot. It doesn't 'bounce' and so is very useful for tasks like shaping sheet metal.

Screwdrivers

Slots, Phillips, Posidrive, hex-drive, Torx, security screws... there are a bewildering range of different screwdrivers available so it is easy to blow a fortune on expensive sets that end up mostly unused. A sensible strategy is to buy cheap sets to cover the sort of fixings you expect to encounter, but invest in a few really good screwdrivers for those you use most. If you work one electrical equipment, fully insulated VDE screwdrivers are essential as even isolated equipment can still have hazardous voltages inside.

For very small screws you can be tempted by comprehensive sets of 'jewellers' screwdrivers' which are available in every quality from disposable to last a lifetime. Even a cheap set can get you out of an awkward situation, but a better solution can be a good-quality interchangeable shank screwdriver set which will still fit tiny screws but allow you a more positive grip.



Various sizes of engineer's squares

Saws

Several types of saw can be found in the typical metalworking workshop. Most useful is the hacksaw, a stiff frame typically taking 300mm (12") blades that can be sued to cut anything from sheet metal up to large bars, although cutting material more than 25mm in diameter is likely to require several sessions with a break between! Don't underestimate the benefit of buying good quality bi-metal blades, these have a flexible back with hard point teeth and will reward you with accurate cutting and a decent life, especially if lubricated with a little neat cutting oil. Beware low quality blades, especially as many of the cheapest will shatter readily.

A junior hacksaw, with a thinner 150mm (6") is particularly useful for more delicate work as are very fine razor saws, although the latter blunt quickly if used on steel.

For cutting out very intricate shapes in sheet metal a jigsaw is useful, best used with the blade vertical and holding the handle under the work while it is supported on a piece

A pair of sheet metal nibblers

of wood with two 'fingers'. A piercing saw is a delicate version of a jigsaw used by jewellers and suitable for the thinnest of materials.

For all types of saw the best results are achieved if you match the coarseness of the teeth to the work – ideally there will always be at least two teeth in contact with the work at any time. Using a saw that is too fine will tend to clog it and slow you down.

Allen Keys

Fixings with a hex socket are easy to use and ideal for most purposes and although they are rarely 'right' for scale models they are almost universal for screwed fixings on modern tooling. As they are so cheap, it's worth having both metric and imperial sets of allen keys, as using an Allen key that 'almost' fits risks spoiling either the fixing or the key. As well as a standard set, you will not regret investing in 'ball ended' versions for use in inaccessible places.

Files

You can never have too many files – that is as long as they aren't blunt! It's worth gradually accumulating different files as they are so useful. A big file will shape a block of aluminium or cast iron in a fraction of the time it would take to fit it to the milling machine. Smaller files are useful for shaping parts and enlarging holes. So-called 'swiss files' are essential for finishing small parts; it can be worthwhile buying a fairly cheap set and them complementing it by investing in a few expensive ones that you treat with special care – bear in mind that a quality file can have a life of many years.

A curious fact about files is that they need to be sharp to work well on brass and other copper alloys. Many people spare their new files for use with brass, then as they lose their edge they 'demote' them to steel and cast iron. Once a file has been used on steel it is unlikely to work well on brass.

Files should always be fitted with secure handles; the tang of a file can make an awful mess of your palm or wrist. Do not use them anywhere near rotating machinery.

Taps and Dies

Although larger sizes of screws and nuts can be made using a screwcutting

Beware of hand tools that claim to be able to do everything!

A non-marking nylon-faced hammer

lathe, to make smaller threaded items it is usual to use special cutters called taps and dies. Dies are used to put a thread on to a rod and usually need to be carefully adjusted to create an accurate thread. Taps normally come in sets of three: Taper, second and plug taps have decreasing amounts of 'lead' on the end and are used one after the other. Serial taps are used the same way, but achieve a similar result by being progressively larger. For all tapping it is normal to use a hole that is rather larger than the core diameter of the thread, this minimises tap breakage while barely affecting the strength of the resulting thread.

When creating threads use some form of lubricant such as specialist tapping compound or a neat cutting oil. This will give better results, reduce tap wear and make breakages much less likely. It can be difficult to ensure that threads made with taps and dies are truly at right angles. For tapping you can make little 'top hat' shaped guides with a central hole or start the tap in the chuck of a drilling machine – turning it by hand not under power, although it is possible to get special tapping heads that have a clutch to avoid breaking taps. Dies can sometimes be guided by using the tailstock of the lathe to support a die holder, but a better solution is to make or buy a dedicated tailstock die holder, these slide along a guide bar and ensure that you avoid 'drunken' threads.

> Files should always be fitted with secure handles; the tang of a file can make an awful mess of your palm or wrist.

Spanners and Nut Runners

When making small models, there are often a lot of very small hex-head screws and nuts to fit. Although small screws shouldn't be done up too tight (or the threads will strip) a set of matching miniature spanners is essential. Sometimes spanners are riveted together into a single folding tool, this makes it less likely you will lose a tiny spanner, but they are more awkward to use.

Make sure you get a set to match the fixings you are most likely to use, with small sets typically being available in both metric or BA sizes. Many BA fixings are supplied with 'one-size-smaller' heads and nuts, which look better on models, but this does mean you need the 'wrong' spanner such as 9BA for 8BA small-head screws, so if buying a BA set, although even-number threads are commoner, make sure it includes odd-number sizes.

If you make small scale or intricate models, you will soon find spanners won't get to many of the fixings. The solution is a set of nut-runners, at their simplest these are just rods with a suitable socket formed in the end, but small metric sizes are often supplied in the form of socket-ended 'jeweller's screwdrivers'.

Miscellaneous Tools

Here's a list of some of the most useful small hand tools suitable for any hobby workshop:

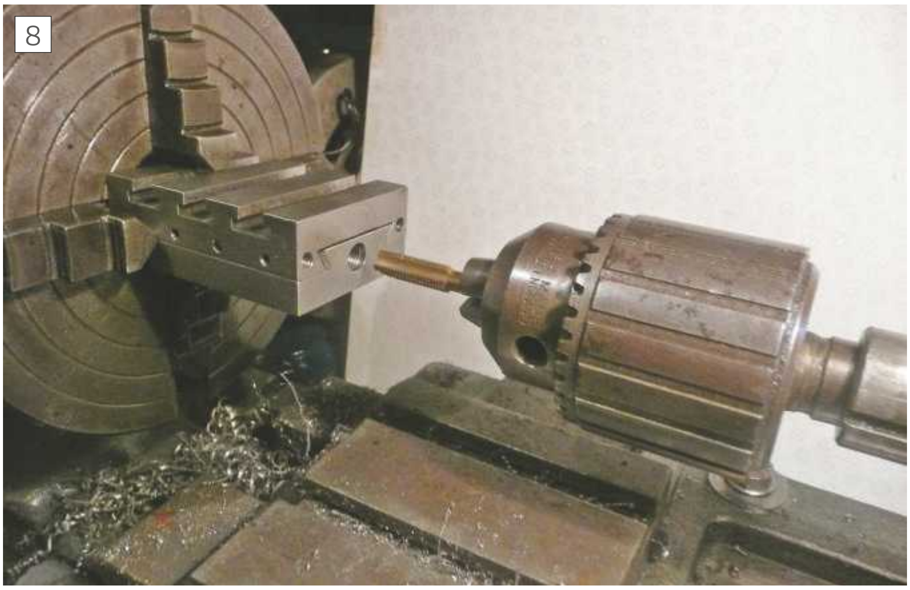
- Pliers – standard, snipe nose and heavy duty
- Side cutters
- Wire stripper
- Craft knife or scalpel handle with interchangeable blades
- Razor saw
- An assortments of scribers, centre punches
- A miniature pipe cutter
- Deburring tool
- O-ring/C-clip pliers
- Miniature and larger tweezers
- Nail or dissecting scissors
- Scissors that can cut thin sheet metal
- A magnifying glass, hand lens or jewellers loupe
- An assortment of small clamps
- 'Dental' picks and spatulas
- A selection of small paintbrushes
- A small hand-drill
- Stanley knife/box knife

A Vertical Drilling/Milling Slide for The Small Lathe

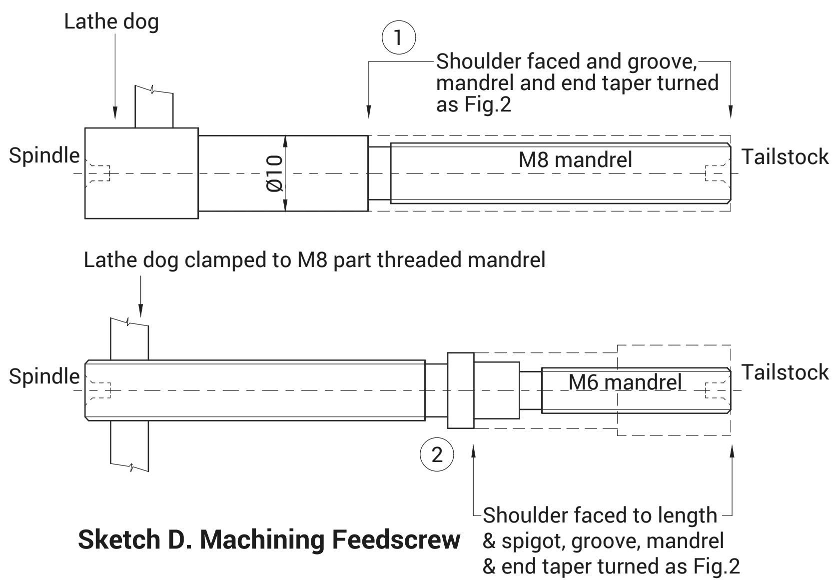
Terry Gorin describes a slide designed for his Unimat but potentially for any small lathe - Part 2

Completion of male slide Feedscrew bracket (3)

This was assembled to the female slide using Feedscrew bracket screws (4). Both then clamped to the male slide, with gib and temporary short grub screws, with the male slide tight to the feedscrew bracket. The assembly then mounted in the four- jaw chuck and centred around a short, tight fitting mandrel located in the 4mm dia. bracket spot drilling. With the mandrel removed, the bracket hole was enlarged to 7.5mm dia. With the bracket then removed, the tapping hole for the feedscrew was drilled to 7.2mm dia. for the full depth of the male slide. (This would give only about 65% thread engagement – adequate for my purpose and kinder on my taps cutting to 25mm depth in BMS). The exposed tapping diameter then counter bored 10.5mm dia. x 3.5 depth The M8 x 1mm thread was cut using a set of serial taps. The taper (1 ring) tap was held in the tailstock chuck and thread cut to near full depth by 'hand pulling', as **photo 8**. Threading was then continued by the second (2 ring) tap as deep as possible before the drill chuck lost grip. The assembly then removed to bench vice and second tapping continued, followed by plug (ringless) tap, carried to full thread depth as fig. 1. To complete, the assembly was reversed and re-centred around the tapping drill placed in the unthreaded length of the male slide and then drilled 9mm dia. to the depth indicated to ensure adequate clearance for the M8 feedscrew. When removed from the chuck the plug tap was again passed through to ensure threads fully cleared. Drilling and counterboring the 6mm dia. holes for the base plate screws completed the male slide.



Tapping for feedscrew



Sketch D. Machining Feedscrew

Feedscrew (6)

The ends of a length of 12mm dia. free- cutting BMS, cut to the finished length shown in fig. 2, were faced and centred on the Myford, for ease and convenience, and then mounted between centres on the Unimat. Length, up to the lathe dog, first reduced to 10mm dia. and then turned to form the shoulder and the M8 mandrel to size as fig. 2, and indicated at (1) in Sketch D. The M8 thread is for controlling the vertical movement of the female slide and, for smooth operation, should be as parallel as possible to the spigot axis. With the Unimat gear train set to 1mm pitch and lowest backgear speed, the tread was then cut to approximately 70% depth. The workpiece was then reversed and remounted, as indicated at (2) in **Sketch D**, with the lathe dog now bolted to the partially cut M8 mandrel. The central 10mm dia. shoulder was next faced to 3.5mm length and the adjoining spigot, M6 mandrel, together with thread clearance groove end taper all turned to finished sizes as fig. 2. The M6 thread then similarly part cut. Before removal from the lathe the 7.5mm dia. hole in the feedscrew bracket was used to test the feedscrew spigot rotating freely. The workpiece threads were then ready for hand finishing by die. When opened to oversize, and aided by the lead in taper, both dies engaged easily and accurately with the part-cut threads. Progressive die closing and cutting continued until the M8 thread engaged smoothly into the male slide.

Base Plate (7) Base Plate Screws (8)

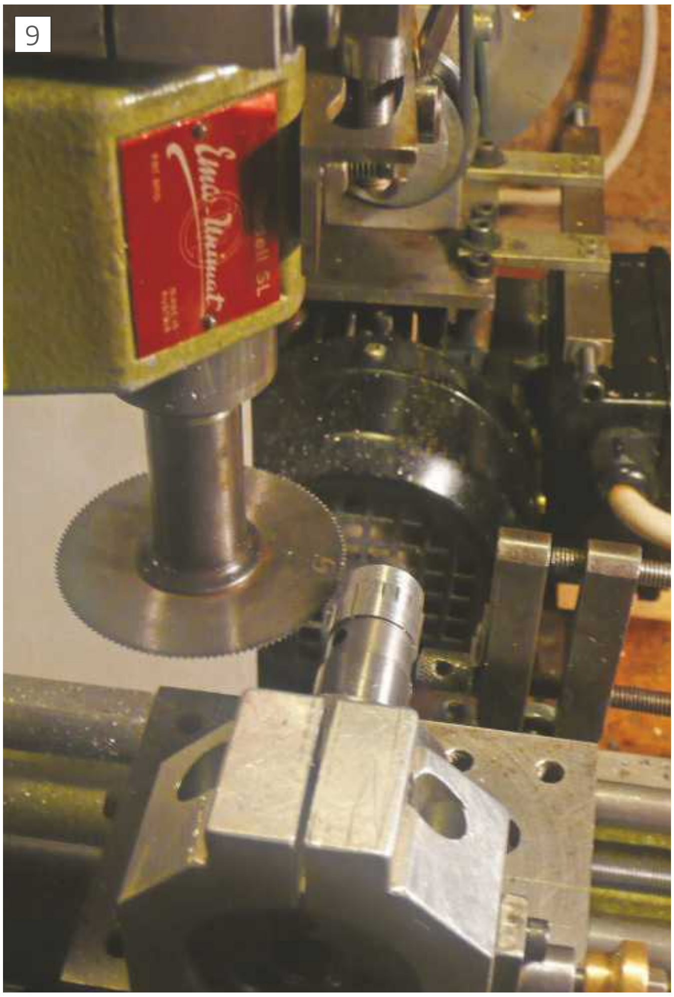
When square turned to overall size and the 6mm dia. holes, for alternative cross-slide mounting bolt positions, drilled and orientated, as fig. 1, the base plate was clamped to the bottom of the male slide, as fig. 3, and positions of the male slide M6 tapping's spot drilled. The plate then removed, the M6 tappings taken to the depths shown and base plate and vertical slide finally assembled with base plate Screws (8).

Feedscrew Handwheel (9) and Index Sleeve (10)

All turning, drilling and boring of these items was carried out on the larger lathe, to save time, but all would have been possible on the Unimat – but would not have attempted using the clamp type knurling tool on this small lathe. The sleeve was indexed using my shop-made indexing head and a 0.4mm slitting saw with the Unimat headstock set vertically as shown in **photo 9**. The milling table, also showing, was an early made copy from Bob Loader's 'Unimat 111 Lathe Accessories'.

Conclusion This first attempt at machining dovetails proved less troublesome than I had imagined, with the dovetail cutter happiest at 357 rpm and cuts not exceeding 0.015" thou. and fed (with caution!) at about 0.005" per second. ∎

9



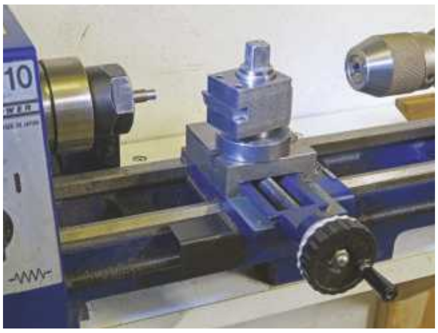
Indexing sleeve

In our Next Issue

Coming up in issue 307
On Sale 20th August 2021

Content may be subject to change

Look out for MEW 307, the September issue, helping you get even more out of your workshop:



Mike Holmes makes a quick-change toolpost.

Ian Robinson makes a quick-change toolpost.

Robert Trethewey finds a use for a damaged caliper

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Model Engineers' Workshop Data Book

MODEL ENGINEERS'WORKSHOP DATA BOOK

STANDARD DRILL SIZES

DRILL SIZES METRIC	INCH	NO./LETTER	DECIMAL SIZES METRIC	INCH
0.30			0.300	0.0118
0.32			0.320	0.0126
		80	0.343	0.0135
0.35			0.350	0.0138
		79	0.368	0.0145
0.38			0.380	0.0150
	1/64		0.397	0.0156
0.40			0.400	0.0157
		78	0.406	0.0160
0.42			0.420	0.0165
0.45			0.450	0.0177
		77	0.457	0.0180
0.48			0.480	0.0189
0.50			0.500	0.0197
		76	0.508	0.0200
0.52			0.520	0.0205
		75	0.533	0.0210
0.55			0.550	0.0217
		74	0.571	0.0225
0.58			0.580	0.0228
0.60			0.600	0.0236
		73	0.610	0.0240
0.62			0.620	0.0244
		72	0.635	0.0250
0.65			0.650	0.0256
		71	0.660	0.0260
0.68			0.680	0.0268
0.70			0.700	0.0276
		70	0.711	0.0280
0.72			0.720	0.0283
		69	0.742	0.0292
0.75			0.750	0.0295
0.78			0.780	0.0307

MODEL ENGINEERS'WORKSHOP DATA BOOK

DRILL SIZES METRIC	INCH	NO./LETTER	DECIMAL SIZES METRIC	INCH
1.45			1.450	0.0571
1.50			1.500	0.0591
		53	1.511	0.0595
1.55			1.550	0.0610
	1/16		1.587	0.0625
1.60			1.600	0.0630
		52	1.613	0.0635
1.65			1.650	0.0650
1.70			1.700	0.0669
		51	1.702	0.0670
1.75			1.750	0.0689
		50	1.778	0.0700
1.80			1.800	0.0709
1.85			1.850	0.0728
		49	1.854	0.0730
1.90			1.900	0.0748
		48	1.930	0.0760
1.95			1.950	0.0768
	5/64		1.984	0.0781
		47	1.994	0.0785
2.00			2.000	0.0787
2.05			2.050	0.0807
		46	2.057	0.0810
		45	2.083	0.0820
2.10			2.100	0.0827
2.15			2.150	0.0846
		44	2.184	0.0860
2.20			2.200	0.0866
2.25			2.250	0.0886
		43	2.261	0.0890
2.30			2.300	0.0906
2.35			2.350	0.0925
		42	2.375	0.0935
	3/32		2.381	0.0938

SCREW CUTTING CHANGEWHEEL COMBINATIONS
FOR LEADSCREW HAVING SIX THREADS PER INCH

THREADS PER INCH	MANDREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEADSCREW
2	60	idler		idler		20
3	60	idler		idler		30
4	60	idler		idler		40
5	60	idler		idler		50
6	60	30	20	idler		40
7	30	idler		idler		35
8	30	idler		idler		40
9	30	idler		idler		45
10	30	idler		idler		50
11	30	idler		idler		55
12	30	idler		idler		60
13	30	idler		idler		65
14	30	idler		idler		70
15	30	50	40	idler		60
16	30	40	35	idler		70
17	30	idler		idler		85
18	30	60	50	idler		75
19	20	38	30	idler		50
20	20	40	30	idler		50
21	40	60	30	idler		70

MODEL ENGINEERS'WORKSHOP DATA BOOK

SCREW CUTTING CHANGEWHEEL COMBINATIONS
FOR LEADSCREW HAVING FOUR THREADS PER INCH

THREADS PER INCH	MANDREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEADSCREW
2	60	idler		idler		30
3	80	idler		idler		60
4	30	45	60	idler		40
5	30	50	60	idler		45
6	40	idler		idler		60
7	30	70	60	idler		45
8	35	idler		idler		70
9	20	60	40	idler		30
10	20	idler		idler		50
11	20	idler		idler		55
12	20	idler		idler		60
13	20	idler		idler		65
14	20	idler		idler		70
15	20	idler		idler		75
16	20	idler		idler		80
	20					
17	20	idler		idler		85
18	20	idler		idler		90
19	20	idler		idler		95
20	20	idler		idler		100
21	40	60	20	idler		70

MODEL ENGINEERS'WORKSHOP DATA BOOK

FOR LEADSCREW HAVING SIX THREADS PER INCH

THREADS PER INCH	MAN-DREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEAD-SCREW
22	20	40	30	idler		55
24	20	40	30	idler		60
25	20	50	45	idler		75
26	20	40	30	idler		65
27	20	75	60	80	50	45
28	20	40	30	idler		70
30	20	50	30	idler		60
32	20	40	30	idler		80
33	20	60	30	idler		55
34	20	40	30	idler		85
35	20	50	30	idler		70
36	20	60	25	idler		50
38	20	38	40	50	30	80
39	30	60	35	70	40	65
40	20	50	45	60	35	70
42	20	60	30	idler		70
44	20	40	25	50	30	55
45	20	50	40	60	35	70
48	20	60	30	idler		80
50	20	50	40	80	45	75
56	20	70	30	idler		80
60	20	50	30	60	35	70

MODEL ENGINEERS'WORKSHOP DATA BOOK

FOR LEADSCREW HAVING EIGHT THREADS PER INCH

THREADS PER INCH	MAN-DREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEAD-SCREW
22	20	idler		idler		55
24	20	idler		idler		60
25	20	25	20	idler		50
26	20	idler		idler		65
27	20	30	20	idler		45
28	20	35	20	idler		40
30	20	50	40	idler		60
32	20	40	25	idler		50
33	20	45	30	idler		55
34	20	idler		idler		85
35	20	50	40	idler		70
36	20	40	20	idler		45
38	20	38	40	50	30	60
39	20	30	25	50	40	65
40	20	40	20	idler		50
42	20	60	40	idler		70
44	20	55	30	idler		60
45	20	45	40	50	30	60
48	20	50	25	idler		60
50	20	50	30	idler		75
56	20	50	25	idler		70
60	20	50	20	idler		60

MODEL ENGINEERS'WORKSHOP DATA BOOK

SCREW CUTTING CHANGEWHEEL COMBINATIONS
FOR LEADSCREW HAVING TEN THREADS PER INCH

THREADS PER INCH	MANDREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEADSCREW
2	50	30	60	idler		20
3	50	30	40	idler		20
4	50	idler		idler		20
5	50	idler		idler		25
6	50	idler		idler		30
7	50	idler		idler		35
8	50	idler		idler		40
9	50	idler		idler		45
10	50	20	30	idler		75
11	50	idler		idler		55
12	25	idler		idler		30
13	20	65	50	idler		20
14	25	idler		idler		35
15	20	idler		idler		30
16	25	idler		idler		40
17	50	idler		idler		85
18	25	idler		idler		45
19	20	idler		idler		38
20	20	idler		idler		40
21	20	70	50	idler		30

MODEL ENGINEERS'WORKSHOP DATA BOOK

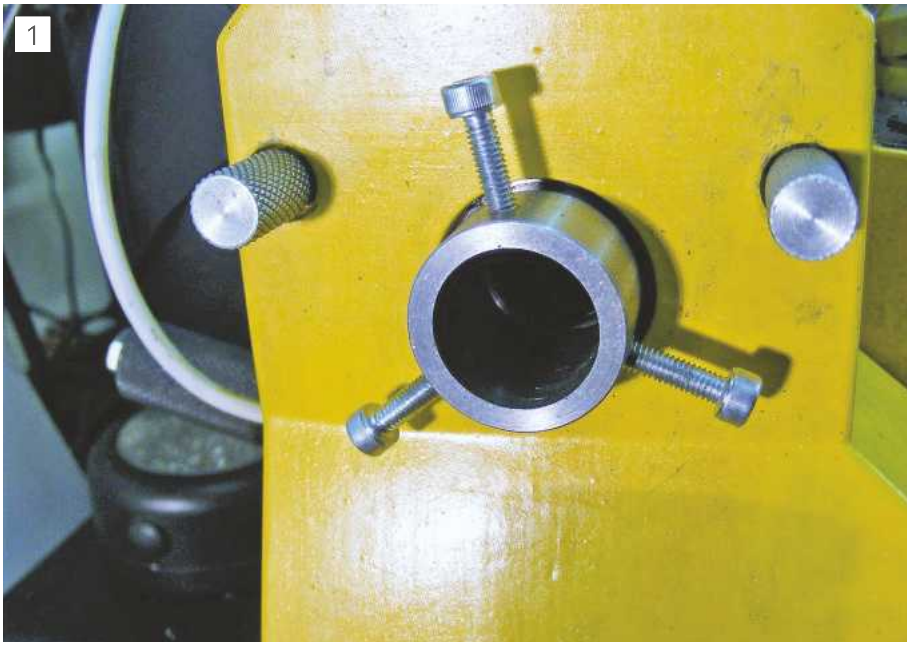
SCREW CUTTING CHANGEWHEEL COMBINATIONS
FOR LEADSCREW HAVING EIGHT THREADS PER INCH

THREADS PER INCH	MANDREL	FIRST STUD DRIVEN	FIRST STUD DRIVER	SECOND STUD DRIVEN	SECOND STUD DRIVER	LEADSCREW
2	50	25	60	idler		30
3	50	25	60	idler		45
4	60	idler		idler		30
5	60	30	40	idler		50
6	60	idler		idler		45
7	40	idler		idler		35
8	60	40	50	idler		75
9	40	idler		idler		45
10	40	idler		idler		50
11	40	idler		idler		55
12	40	idler		idler		60
13	40	idler		idler		65
14	20	idler		idler		35
15	40	45	30	idler		50
16	20	idler		idler		40
17	40	idler		idler		85
18	20	idler		idler		45
19	20	38	40	idler		50
20	20	idler		idler		50
21	20	70	40	idler		30

Minilathe Spindle Improvements and Modifications Part 2

Michael Cox returns with the second part in this occasional series, this time – turning long stock.

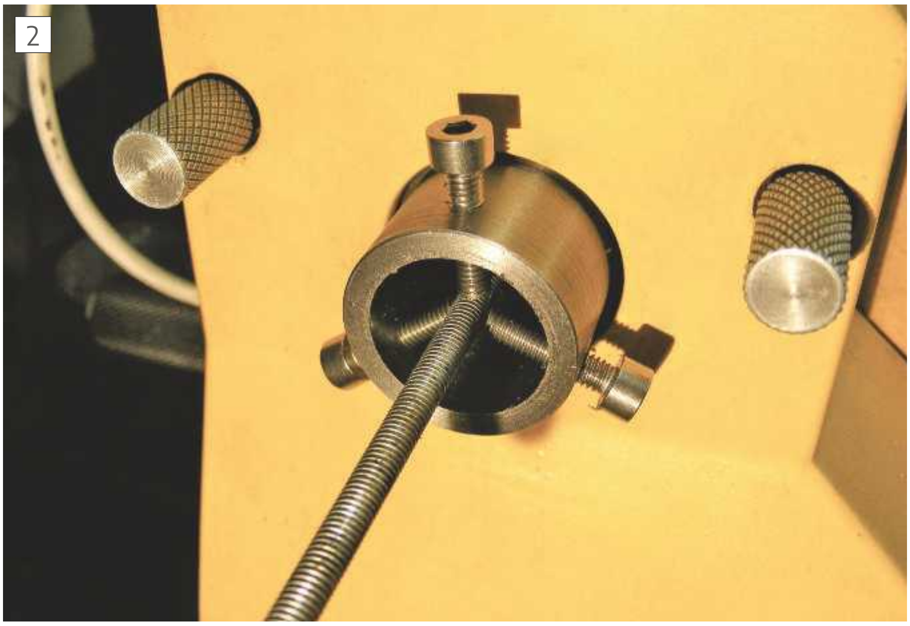
When turning short parts, it is common practice to put a much longer length of material into the chuck with just a small part protruding that is being worked on. The excess material is accommodated in the bore of the spindle. It may even stick out the back of the spindle but there are inherent dangers in doing this, especially if the stock is of small diameter. Small diameter stock is turned at high speed and there is a real danger of the protruding stock bending and whipping round potentially causing mayhem at the back of the spindle or even injuring the operator. To prevent this happening it is important to keep the stock centred in the bore of the spindle and to reduce the speed of the lathe.



1

The drilled and tapped holes in the rear extesion.

One of the first thing I did to the spindle extension described in Part 1of this series of articles was to drill and tap three equally spaced holes on the extension piece as shown in **photo 1**. Three screws can then be used to centre thin stock in the bore of the spindle, **photo 2**. This greatly reduces the possibility of the protruding stock bending and whipping around. This works well provided the protruding part is not too long.



2

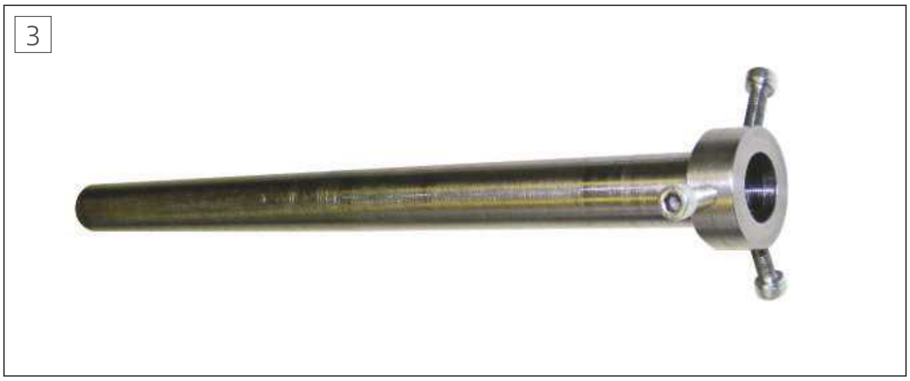
Screws used to centre M4 studding in the extension

One day I wanted to turn two shoulders on both ends of 6 mm steel bar that was 550 mm long. I did this with the long bar protruding from the back of the lathe, but I reduced the speed of the lathe drastically to around 100 rpm to avoid any possibility of the protruding bar whipping around. I also supported the far end of the bar in a simple wooden vee block. Whilst doing this I started to think that there must be a more convenient way of supporting long stock.

The sliding support tube

The solution to this problem turned out to be very simple. A support tube was designed that could slide in the bore of the spindle, **photo 3**. The end of the tube has three radial M5 screws that can be used to centre the stock in the tube. The tube slides in the spindle, **photo 4**, and can be locked in place, anywhere along its length, with the screws on the spindle extension (photo 1). The sliding tube effectively doubles the length of the spindle.

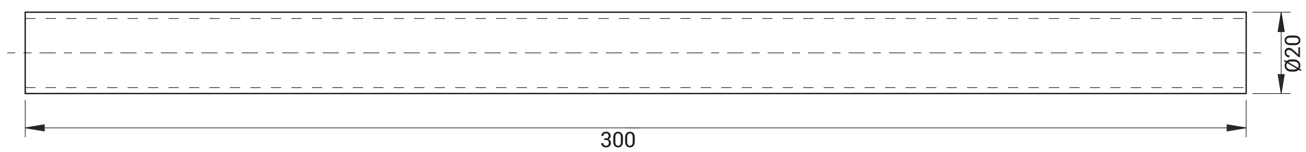
The sliding support tube was very simply constructed. The 20 mm x 1.5mm round tube is readily available and it is a very good sliding fit in the spindle. A 300 mm length of tube was cut, and the ends faced, **fig. 1**. A steel collar, **fig. 2**, was machined from 32 mm diameter steel. A 13 mm slice was cut from the bar and the end faced. The slice was then drilled out to 13 mm using successively larger drills and bored out to 19 mm internal diameter. Boring was continued in small steps and the fit on the end of the tube checked between each boring. The objective here was to achieve a good fit onto the end of the tube. The slice was then turned around in the chuck and the other side was faced. The collar and the tube were then cleaned up in solvent (lighter fluid) and dried. The inside of the collar and the outside of the end of the tube were smeared with a little epoxy resin and the collar pushed on. Excess adhesive was wiped off and the assembly set aside until the adhesive had set. Other methods, such as silver solder, soft solder or Loctite could also have been used to attach the collar to the tube but epoxy resin has proved satisfactory in use and it is clean and low cost to use.



The sliding support tube.

The tube installed in the lathe spindle.

Fig.1



The Tube
Mat'l: 20 x 1.5mm ERW steel tube

The length of the studding is circa 600 mm.

Once the adhesive had set the tube was inserted into the lathe with the collar outwards. The end was lightly faced to clean up any adhesive, the outside was lightly skimmed, and the edges of the collar chamfered. Using a sharp lathe tool, a line was scribed on the outside circumference of the collar 6 mm from the end. The same tool was also used to mark the circumference of the collar where each of the chuck jaws gripped the tube. This provided three approximately equally spaced radial marks on the collar.

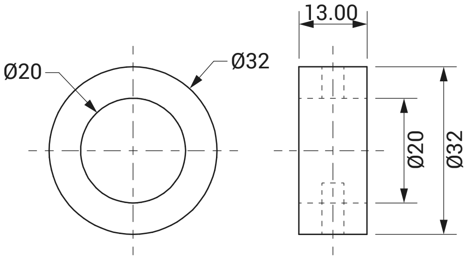
The assembly was set up on the milling machine and three radial holes were drilled, at the marked positions, through the collar and tube using a 4.2 mm drill. These holes were then tapped M5.

In Use.

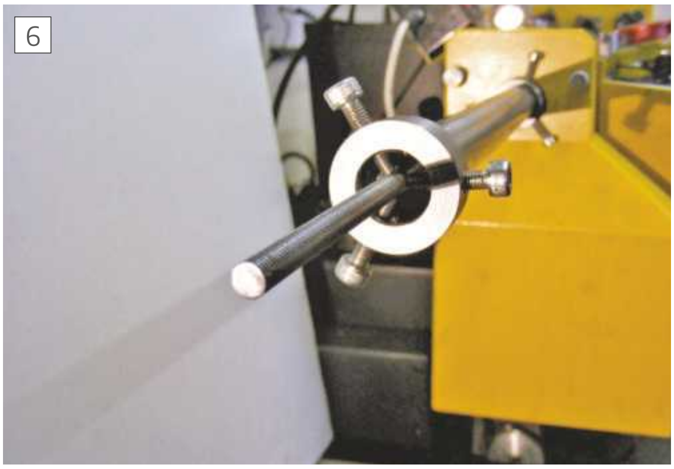
The support tube is easy to use. It can be slid into the spindle to support the end of a long piece of stock as shown in photo 4. At least 30 mm of the support tube should be inside the lathe spindle, and it should be gripped by the screws in the lathe spindle extension. The supported stock should be centred in the tube by the three screws on the end of the support tube.

Photograph 5 shows a typical set up using the tube to support a length of 6 mm studding that is 600 mm long. **Photograph 6** shows the end of the support tube and the screws being used to centre the stock. ■

Fig.2



The Collar
Mat'l: Mild steel



The studding is centred in the tube by the screws

Scribe a line *continued from page 25*

Roof Problems

Dear Neil, MEW 305 arrived this morning, and I noted your troubles with the roof for the new workshop. Some suggestions!

SAGGING BEAMS

Obtain some length of angle iron, at least 40 x 40 x 4 mm, by at least 4 M long; one per beam, possibly two?, and flitch each beam, Place under beam, and jack the beam with an Acrow or something similar, until it is no longer sags, (possibly even a little hogging? It will probably sac an inch or so when the jack is removed).

Drill through horizontally and put in bolts / studding (M8?) , and tighten the nuts, (May need penny washer on one side, as load spreader if using only one piece of angle).

ROOF LEAKS.

I cured all my leaks, permanently, I hope. Ordered rubber, etc. from Rubber for Roofs.

The site has a calculator. You quote the dimensions, and it calculates, quite generously the dimensions of the rubber sheet to be applied, the trim and nails. You select the trim, for front and sides, or for the rear to allow drainage into a gutter.

The pic shows the result shortly after recovering the roof, in September 2014 . (The shop was erected in September 2003). It will stand a lot of magnification.

If you haven't dealt with ring shank nails before, (I hadn't) don't put them in the wrong place or bend them. The do not like coming out! They go through the plastic edge trims without splitting the plastic.

Last job, is to go round with a Stanley Knife to remove the excess rubber sheeting, from below the trim.

The normal contractor's guarantee is 20 years, but some have been intact after 50! Our garage roof is still OK after about 30!

Howard Lewis, Peterborough

Thanks Howard, the basic prop and brace idea is my plan, and replacing some of the steel roof sheets. – Neil.

Milling Machines

Dear Neil, I've just received my copy of MEW No. 305 and have arrived at the article "Introducing Milling Machines. It includes a photo of a simple home-made flycutter (photo 5). As set up I don't believe it would work since the tool bit is set perpendicular to the axis of rotation (the spindle) so that the non-cutting end would foul the workpiece on each revolution. The cutter head appears to have the slot for the tool bit at a suitable angle to perpendicular to provide the necessary clearance as shown by the position of the SH cap screws. This leads me to the conclusion that the tool bit has not been correctly fitted before the photo was taken.

John Clipstone, by email

Hi John, I think that I set the tool to give a light, grazing finishing cut and didn't reset it afterwards. The photo angle makes it look like it is horizontal (it was angled enough for the tail to clear the work). So, yes, the tool should normally be snugged into the slot – Neil.

Bugatti

Thanks to Ian Blake who sent me several photos of his very nice model of a Bugatti Type 35 racing car. I know MEW is about workshops and tools, but it's nice to feature some of the products of readers' workshops from time to time.

A Chassis Punch

Chris Gabel explains how to make this simple tool for cutting precise holes in sheet material.

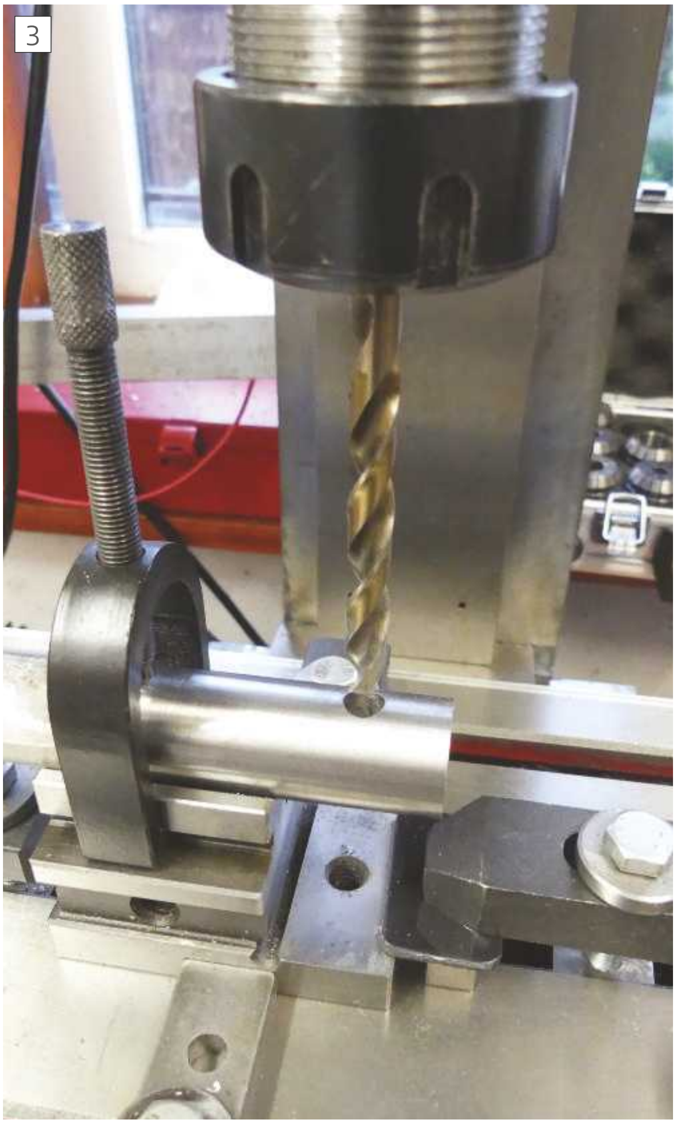
It is not uncommon to be working flat out on a project only to come to a grinding halt because you don't have the right tool or cutter. I was at the point of mounting six panel sockets on a CNC controller panel. This needed six matched holes precisely 24.5mm in diameter. I'm not very good at cutting largish hole in sheet materials and remembered seeing a chassis punch in my dad's tool drawer years ago in my childhood. He was building radios and needed 1" holes cut

1

Punch, bolt, die and washer assembled.

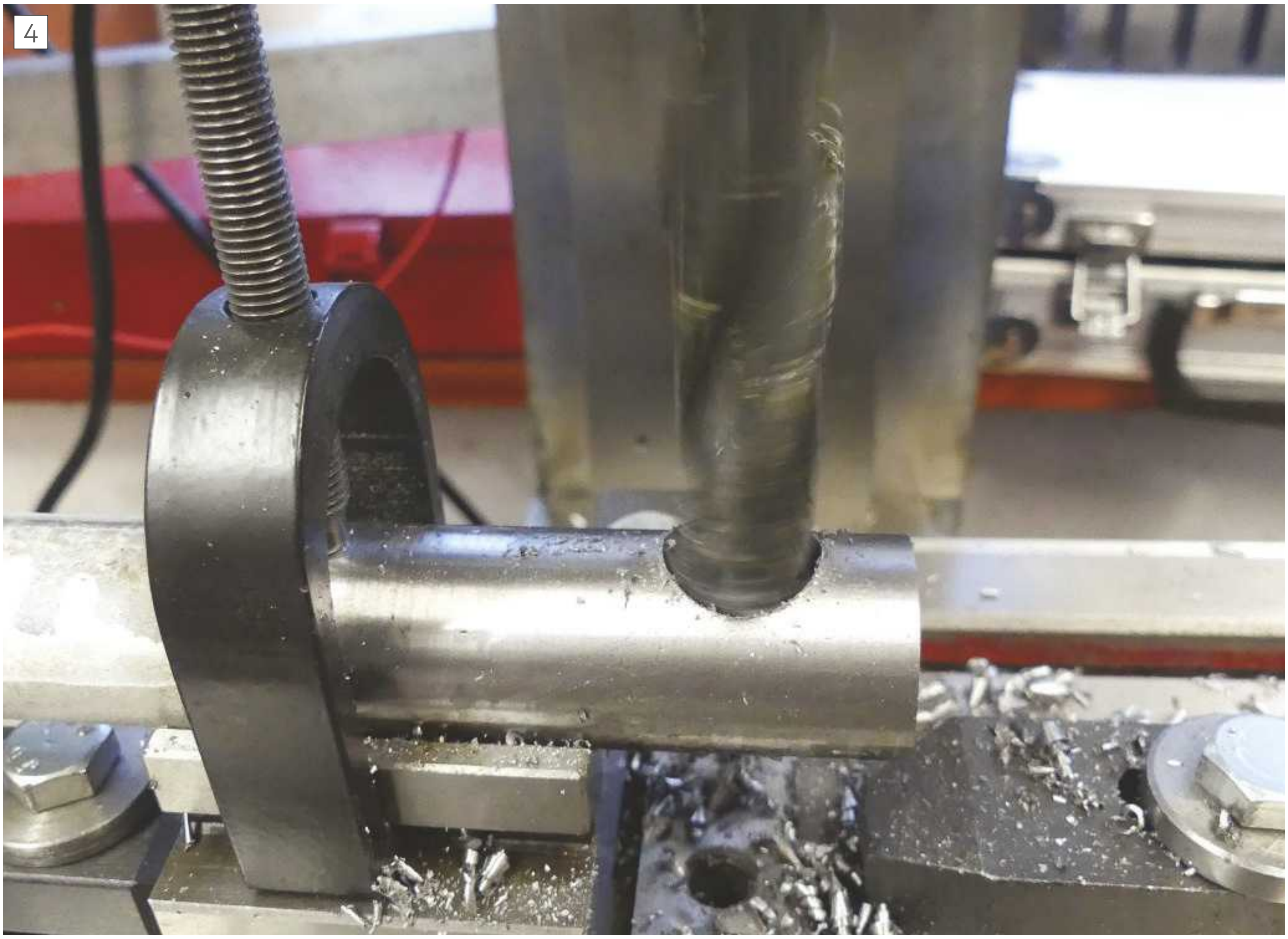
2

Tilting ruler method for centre finding.



3

Incremental drilling (1).



Incremental drilling (2).

for vacuum tubes and valve sockets.

A referral to Wikipedia brought up a variety of names for this tool including chassis punch, panel punch, Greenlee punch and Q-Max. If "chassis punch" is put into Google image search, hundreds of various punch pictures appear, and it is easy to extract the basic design principles.

My brief then was to make a simple punch that would cut a precision hole in sheet material, without distortion. The tool making time had to be short or else I would be tempted to buy it online where there were many examples for under £10.

This is my take on making a 24.5mm panel punch and describes what works well as a generic punch design. There are four parts. They are a punch with M8 tapped hole, a die for the punch to cut against, and an M8 bolt and washer to supply the cutting pressure. Die and punch are mild steel, **photo 1**.

Punch construction was straightforward. A piece of mild steel stock was turned to the 24.5mm, the diameter of the required punched hole.

The next step was to cross- drill

Boring head to enlarge the transverse hole.

My brief then was to make a simple punch that would cut a precision hole in sheet material, without distortion.

the 24.5mm stock. The centre drilling point of the stock is found by using the "tilting ruler" method, and in this instance is precise enough, **photo 2**.

The transverse hole was created using a series of drill bits, including centre drill, 5mm, 10mm and 15mm. I then used a boring head to open out the hole leaving a 4mm wall at the thinnest point. The boring head allowed exact sizing of the transverse hole, **photos 3** and **4**.

The drilled stock was moved to the

6

Drilling M8 tapping hole on the lathe.

7

Parting off with Jr. Hacksaw.

8

The end piece is not needed.

9

Boring the internal recess.

lathe and a M8 diameter 7mm tapping drill was drilled 70mm deep.

A sharp lathe tool scribed a mark halfway across the transverse hole, and this marked the parting off point for parting with a junior hacksaw. I chose this saw for its narrow kerf, **photos 7 and 8**. With the work still in the lathe chuck it is a convenient time to tap the bolt hole M8 to depth.

With the excess end material now removed the internal recess of the punch can be bored to size. This was cut with a boring tool in the lathe tool holder. The internal cavity is bored to leave 4 mm walls, and to a depth equal to 4mm below the lowest point of the transverse hole, **photos 9** and **10**.

The next step is to form the cutting edges. This is done using a 10mm burr in a flexible shaft tool , hand held at

10

Completed recess.

10mm burr at 45 degree angle.

Abrasive cartridge roll and burr.

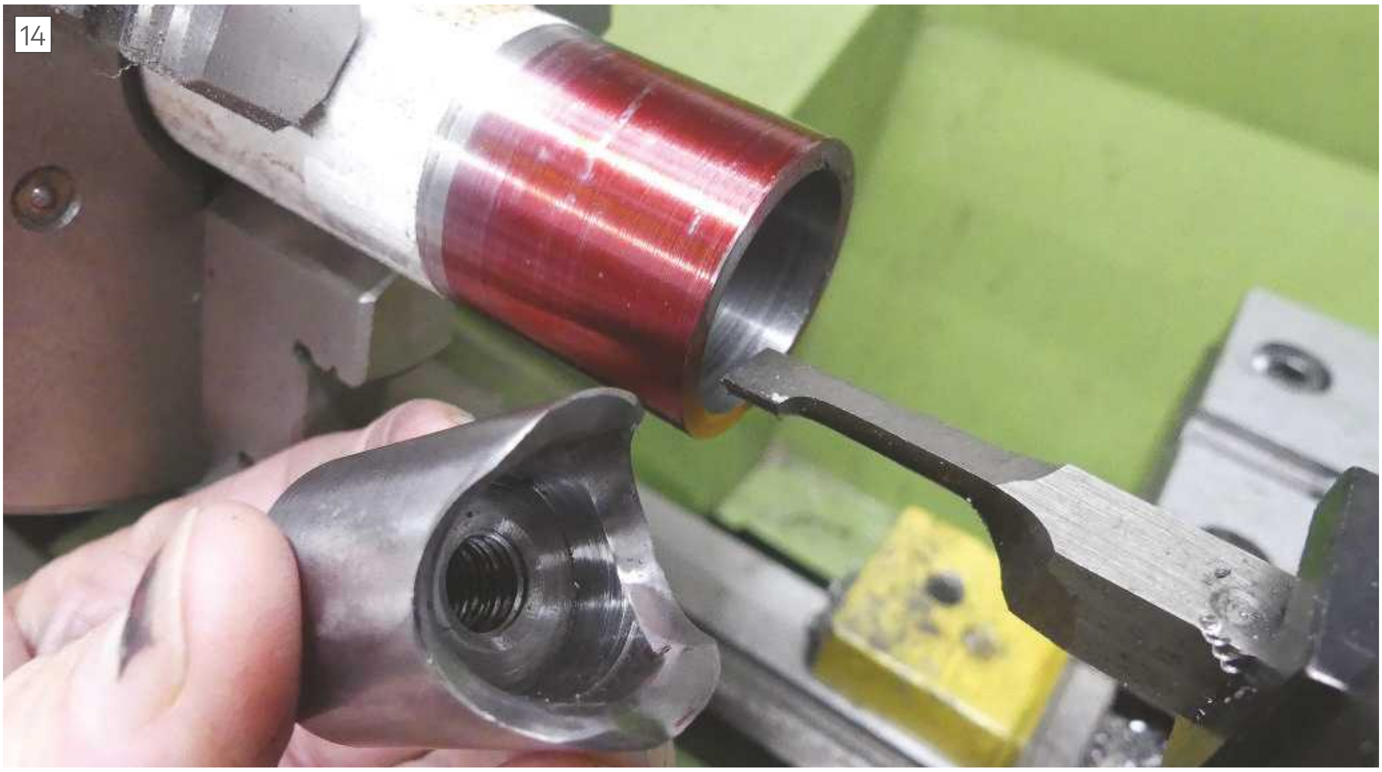
about 45 degrees, **photos 11**, **12** and **13**. The cutting die portion of the tool is a straight forward turning job. A simple cup shape is turned, with an inside diameter .4mm greater than the punch, to a depth sufficient to accept the whole cutting section. An 8 mm clearance hole was drilled for the bolt. Surfaces were neatly faced, leaving square edges at both end surfaces. A simple parting off procedure completed the die, **photo 14**.

Use was simple. A pilot hole of 8mm was drilled in the target material. The punch, die and bolt were assembled. As the bolt tightened the lobes of the punch cut quite easily. This punch easily cut .5mm sheet steel, 1.5mm aluminium, 2mm plastics of varying types, and even worked acceptably on 6mm birch ply, **photos 15**, **16** and **17**.

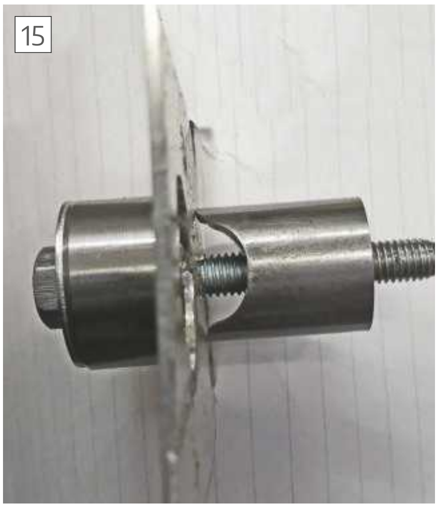
Case Hardening the punch portion of the tool is a good idea if many cuts in sheet steel are anticipated. Blackgates Engineering sells a compound in a tin which works in the same manner as “Kasenit” (no longer made) or “Cherry Red” compound. Cherry Red is available in the USA.

The method is simple. Heat the work uniformly to a bright red, dip or roll it in the powder, which will melt on and adhere to the surface, forming a shell round the same.

Finished punch.

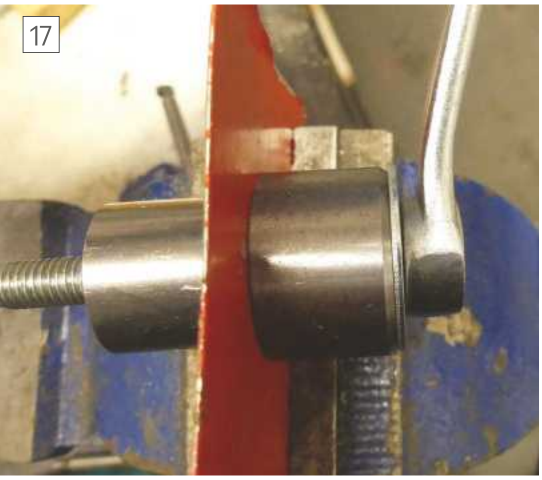


Turning the die on the lathe.



Punching 1.5mm aluminium.

Pilot holes drilled with clamping.



Punching .5mm steel.

Re-heat to a bright red, **photo 18**, and plunge in clean, cold water. This can be repeated to increase the depth of the case hardening. This is an easy process to carry out, but for low volume work it is probably unnecessary. I found the punch cut well with just a spanner on the bolt. For larger size punches a thrust washer/bearing under the bolt head and washer could make tightening easier.

I am not a believer in all jobs being quick and immediate, but this is a simple tool. It could be built from common materials in less time than if it were to be purchased online and delivered. After little more than an hour's work I was able to return to my main project with a set of precisely formed 24.5mm holes neatly made. ■

Case hardening. ▶

Tailstock Seals for a Mini-Lathe

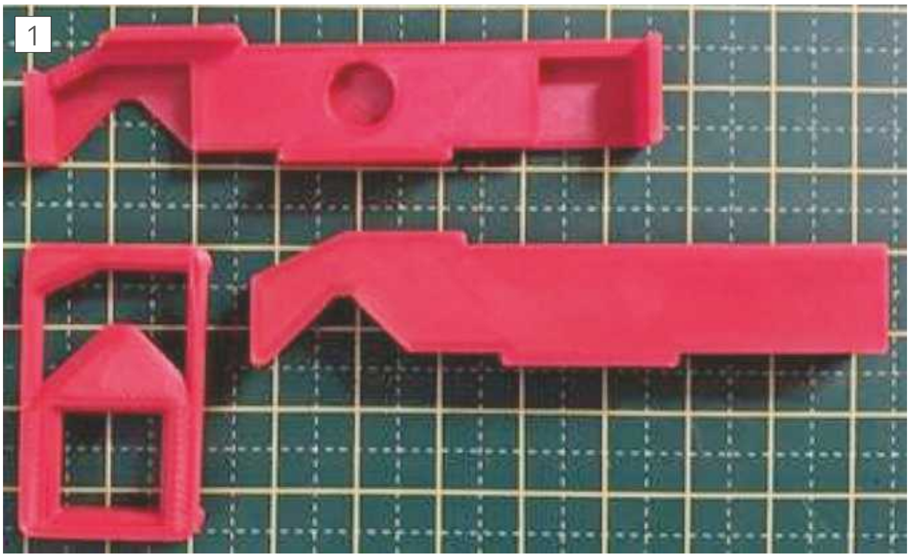
Lionel Pullum makes good use of his 3D printer

I was machining some brass with my Sieg SC3 lathe, and when I came to use the tailstock it was no longer centred. The problem of course was some brass swarf on the ways had ended up under the tailstock. I knew you could get guards for the saddle but had not seen any for the tailstock. So, a couple of hours later and the trusty Prusa Mk3S had produced the holders in **photo 1**.

I also printed a template (the smaller rectangular object) and used this to cut out the felt wipers to fit in the seal holders, **photo 2**. Which made a neat seal for the tailstock, **photo 3**. I also limited the amount the tailstock could travel vertically by limiting the cam lever lock's motion.

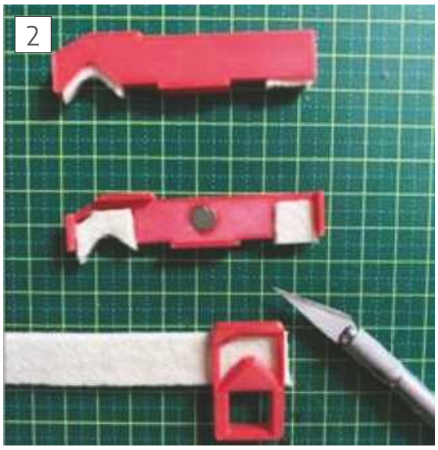
Photograph 4 is a screen capture of the design in Alibre Atom3D.

Anticipating that this may be of interest for MEW readers I have provide the STL and the Atom3D file to the readers or for the web site. In the part file if you un-surpress "Back tailstock seal version" in the design explorer, it will mirror the part to produce the back seal etc. – haven't worked out how to create different configurations with Atom3D maybe it's not implemented.



1

3D printed seals



2

Fitting felt wipers.

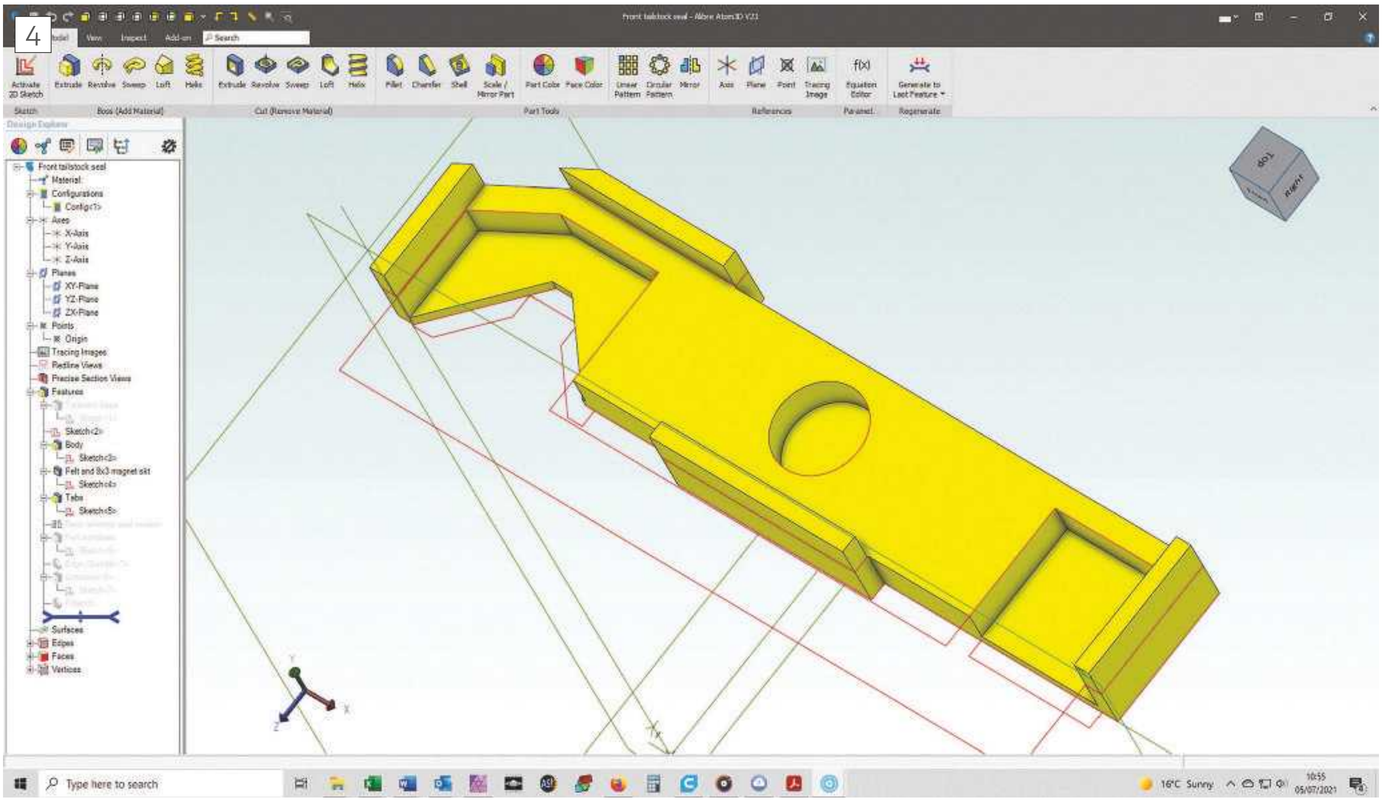
3

On the lathe.

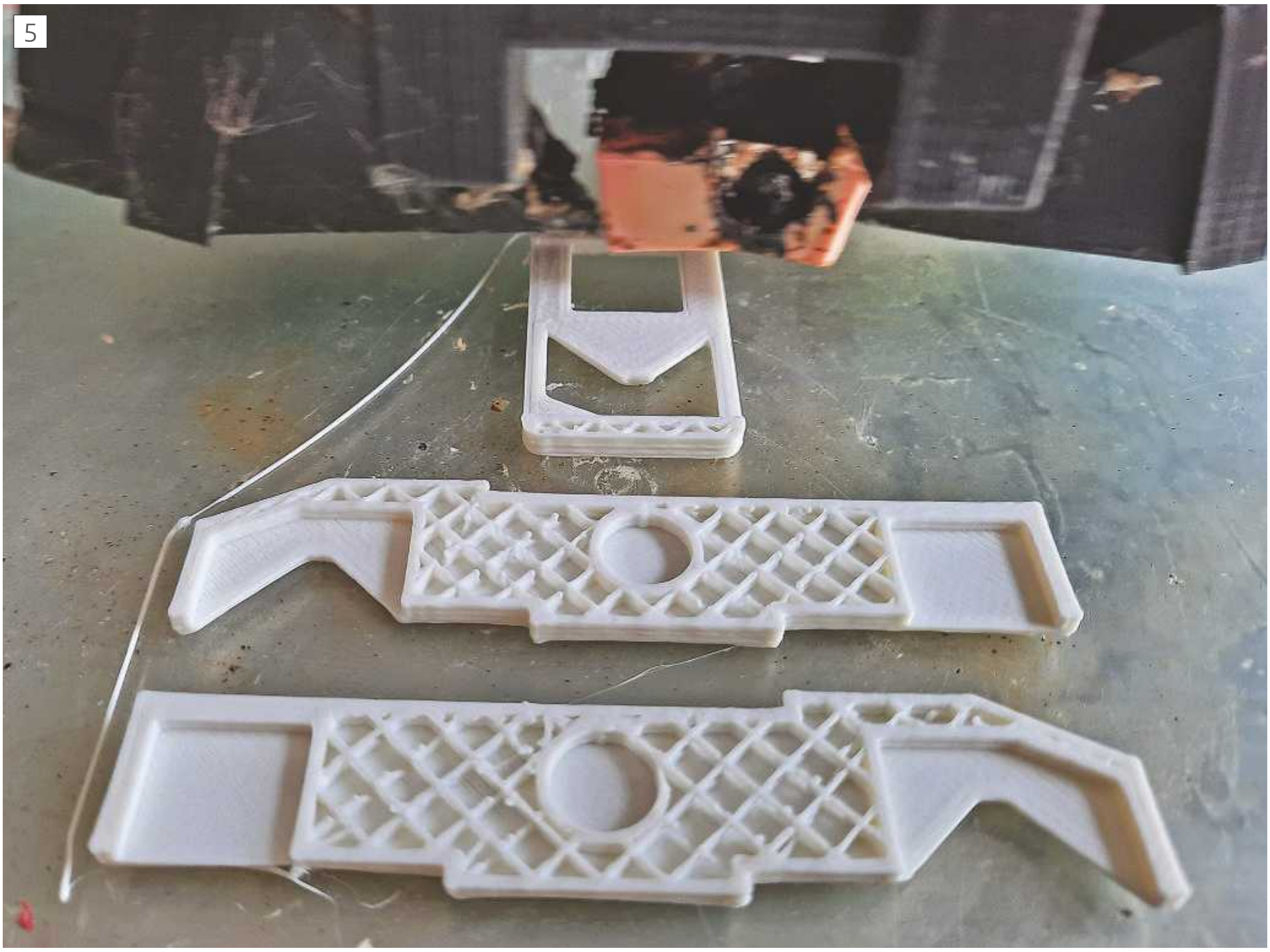
Editor's Note

As a mini-lathe owner myself, I've printed myself a set of these, **photo 5**, although my machine is in storage at the moment. You can create configurable designs in Alibre –use the 'equation editor' to enter formulas for dimensions and angles.

Lionel's files are on the forum website at **www.model-engineer.co.uk/miniseals** so readers can print their own or modify the design to suit other lathes. ■



Design in Alibre Atom3D.



A set printing on the editor's Prusa i3.

BEGINNERS WORKSHOP
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that are out of date or describe practices or materials that we would not use today either because much better ways are available or for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

BENDING AND FORMING

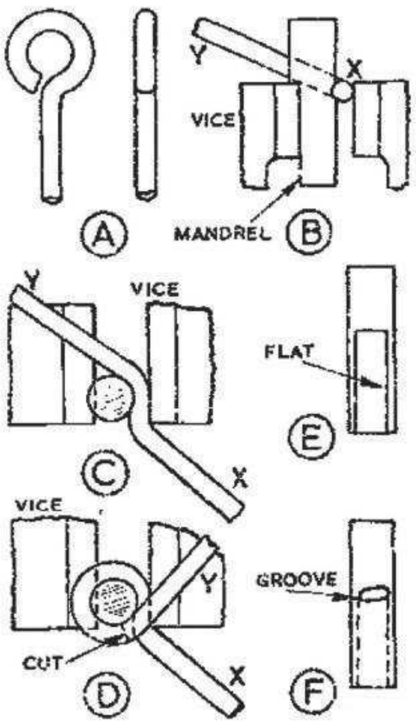
GEOMETER gives further instructions to the novice on shaping metals

NUMEROUS BENDING AND forming operations can be performed in the vice with a hammer and simple mandrels and formers. From round rod can be made hooks, eyes, special staples, chain links; flat sheet or strip serves for light-section angles, channels, boxes and endplates.

Small diameters and thin sections can be worked cold but for manipulating large sections using mild steel, a concentrated form of heating is desirable-such as a welding torch-which brings the metal to bright red heat.

Heating prevents cracking in hard steels and some types of iron are prone to cracking if bent when cold. Cracking is also prevented in copper and brass sheet by annealing; this is performed by heating the material to red and plunging it in water.

Some materials may tend to crack when bent in one plane and not when bent at right angles. Hard brass and copper, common iron and duralumin are most prone to cracking when working. The first and second should be annealed, the third worked at bright red heat and the last avoided except, for large-radii bends-or when heat treatment is possible.



Forming an eye

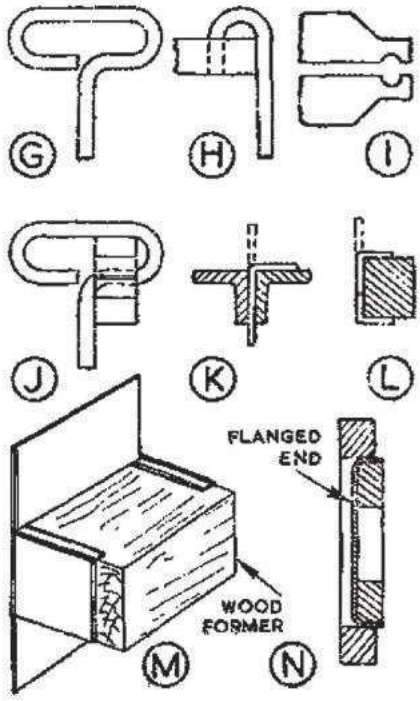
From wire, an eye can be turned on a piece of rod ***A*** using round-nosed pliers, but diameters of about ⅛ in. or over require the assistance of the vice. A mandrel from a piece of mild steel rod is then utilised; it is gripped in the vice with the rod B. It is convenient for the mandrel to be provided with a flat one side, filed for the vice jaw to grip; on the opposite side there can be a shallow groove at an angle to locate the rod to be used for the eye. This groove can be cut with a small round file.

At the second stage of the work C, the end of the rod X is pulled against the edge of the vice to form the neck; the end Y is then carried round the mandrel to form the eye, as at ***D***. Removed from the vice, the rod is tapped down the mandrel, the surplus cut off and the eye straightened by squeezing in the vice.

E and ***F*** show the flat and the groove on the mandrel, while these may not be absolutely necessary, they do prevent movement while working. If produced cold, the eye will spring open slightly when pressure is released on the end of the rod Y. Consequently, a mandrel somewhat smaller than the finished inside diameter of the eye is required. At red heat, however, close-fitting eyes can be produced from mild steel rod.

Links and tee handles

Chain links and tee handles G can be turned using simple holders. For the first stage H, a hole can be drilled through a piece of bar to take the rod, the end of the hole radiused if necessary. For the second stage, a split holder Z can be made by drilling at the joint of two pieces of bar. Cut to form jaws, they can be gripped about the rod for the second turn of a chain link and utilised as at J for the third turn forming a tee handle.



Channels and flanges

Short angle lengths in strip metal can be hammered over the vice jaws but for long lengths the strip should be held between two lengths of angle iron ***K***, gripped one end in the vice and the other fixed with a clamp. When an angle is formed, a channel L can be produced over a suitable section piece of bar.

For turning thin, ductile sheet metal and strip, hardwood formers of oak or beech should be made to the inside dimensions required, as for the metal box at M. A piece of bar should be clamped on the opposite side of the sheet metal, level with the block where the corner is to be turned-this prevents buckling as the metal is turned over.

Round flanged ends, as for small boilers, can be formed from copper discs held between two suitable large washers N and squeezed in a powerful vice. The discs should be annealed beforehand; forming can be assisted part of the way through the operation by hammering over the smaller of the washers.

Fitting a Screwcutting Clutch to the Emco Maximat Super 11

Graham Meek describes an accessory thirty-three years in the making - Part 3.

One thing that is important, and that is care should be exercised when using the tailstock to support any workpiece. As clearance is needed between the saddle casting and the tailstock base to avoid collisions, and therefore damage to the lathe.

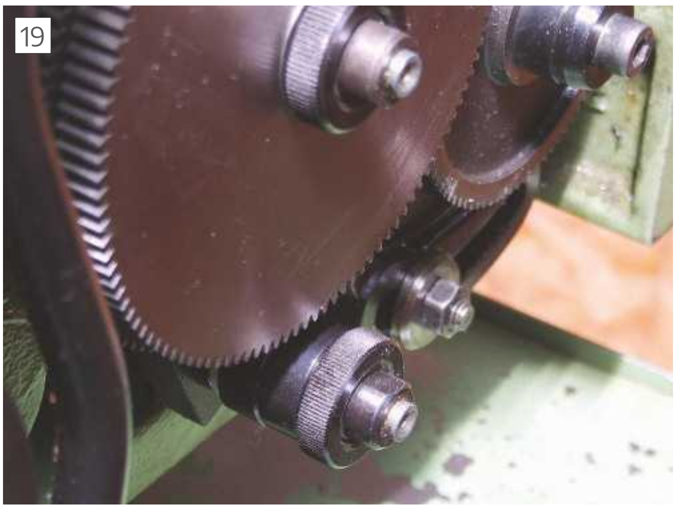
The final part to make is the extension piece, **photo 17**. This part needs a new stud and the attachment can be used for this. This will give the reader a chance to tryout his or her hard work. The installation is shown in **photo 18**, with a before and after shot shown in **photos 19** and **20**.

...clearance is needed between the saddle casting and the tailstock base to avoid collisions...

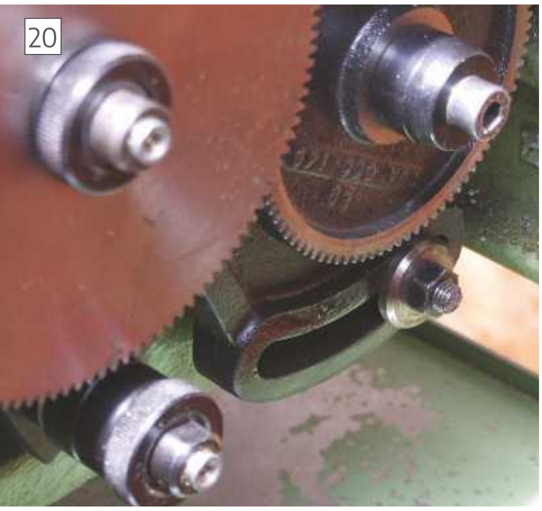
Extension piece, capscrew and stud.

Photograph 21 shows all the various components of the clutch gathered together. Lastly, I must acknowledge John Slater for his help in providing the 3D views, **photo 22**, when I was struggling to make out the shape of the main body from all the lines in 2D. Also his encouragement when he picked me up off the floor after I found a crack in the cast iron main body. ■

Extension piece and stud in position.



Original quadrant stud position.

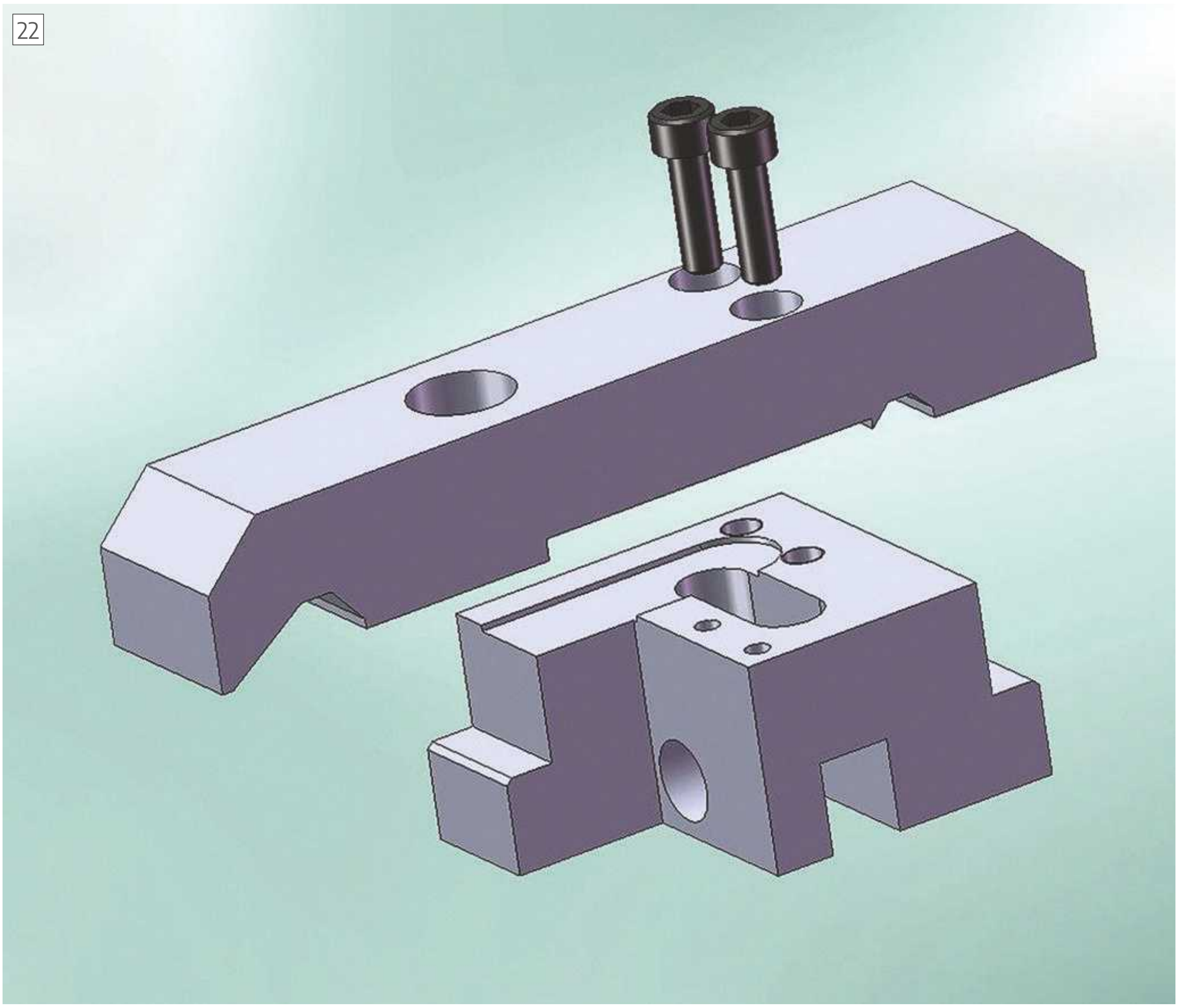


20

Stud returned to original adjustment point prior to fitting the clutch.

21

The parts that makes up the screwcutting clutch for the Maximat. ▶

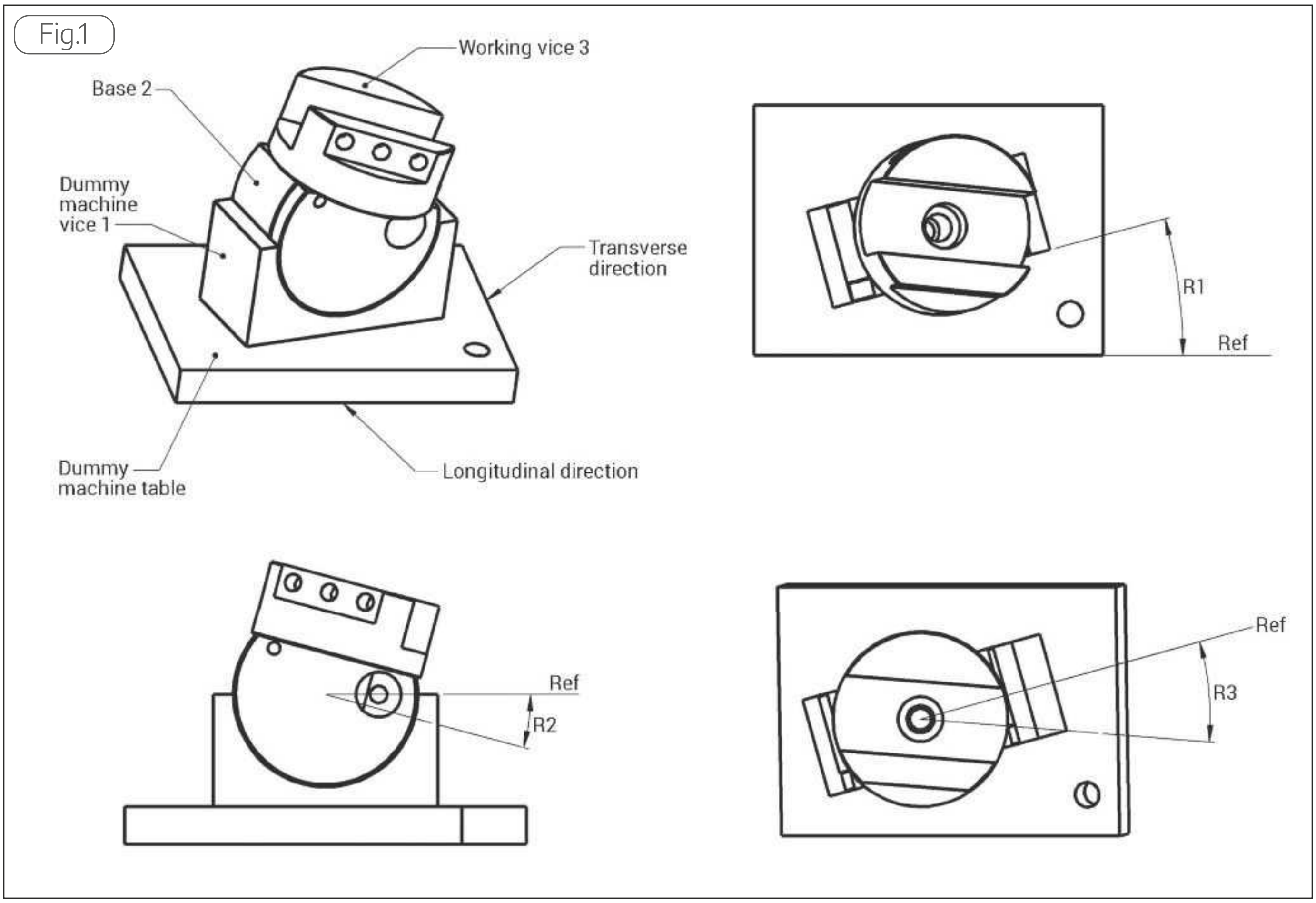


22

Rendering of the main parts of the control unit.

A Universal Vice

Jacques Maurel shares his design for a simple vice adjustable in three planes



This is a vice giving three rotations around different axes to get any plane orientation, the main purpose of which being to machine carbide tip holders and milling cutters. Such vices do exist, but are expensive (see **figs 1** and **2** and **photo 1**):

In fig. 1 a 'dummy' machine table and ' machine vice are drawn to show clearly the angles R1, R2, R3 and the machining directions. This sketch will also be used later to determine the required machining angles with the help of 3D CAD.

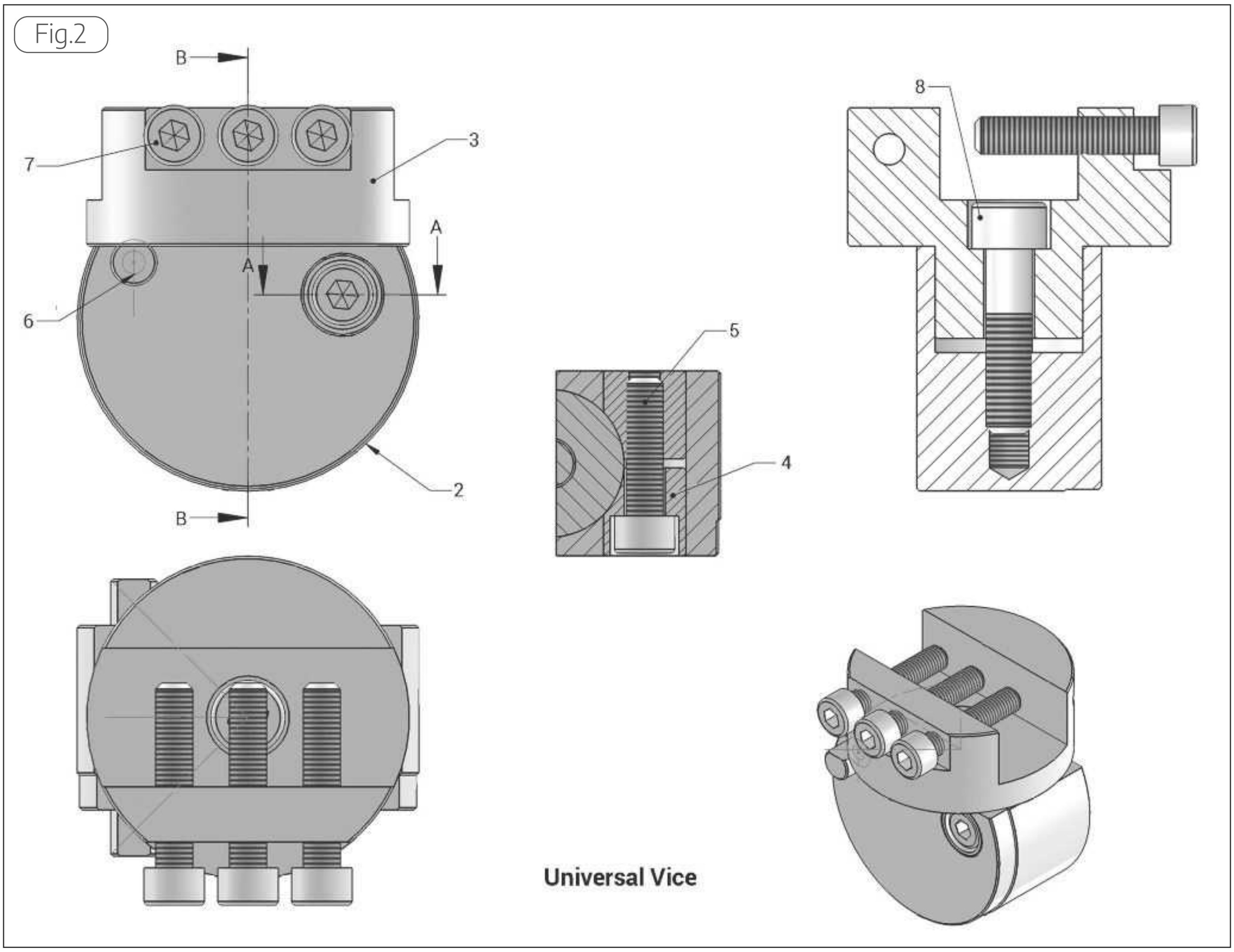
We need three rotations, but have already one R1 around the vertical axis from our standard vice 1. The two others are given in the following way: a cylinder (part 2) is tightened in the vice jaws across its plane ends, the cylinder leaning on the machine vice moving jaw shears (like on a Vee), giving the second rotation R2 around the cylinder axis. The third rotation R3 is given to part 3 around the spigot axis, this spigot being then locked in part 2 by a cotter 4 and screw 5, and also optionally by screw 8.

Setting the vice level in a machine vice.

A note about rotation direction: in fig. 1, **R1** is positive (anticlockwise) but **R2** and **R3** are negative (clockwise).

Angle setting

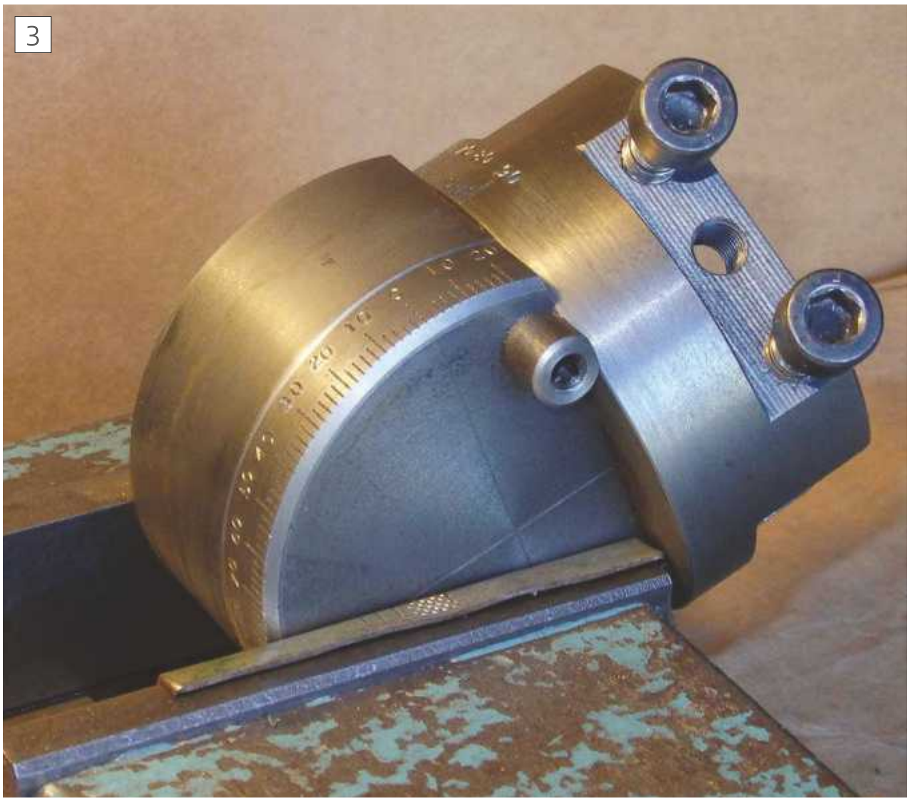
For the second rotation I used graduations (but now I use a digital angle gauge, see **photo 2)**, be careful as in this case the front part of the gauge must be perpendicular to the rotation axis for an exact value to be read. Use the following method: a vial is set on part 3 to set it in a horizontal position (see photo 1), a surface gauge is then set on the machine table, its needle pointing the "0" of the graduated part. Almost any angle should be possible with the



angle gauge and with the cylinder of part 2 resting on one of the vice shears (or a new "0" if necessary to use the surface gauge needle), **photo 3**.

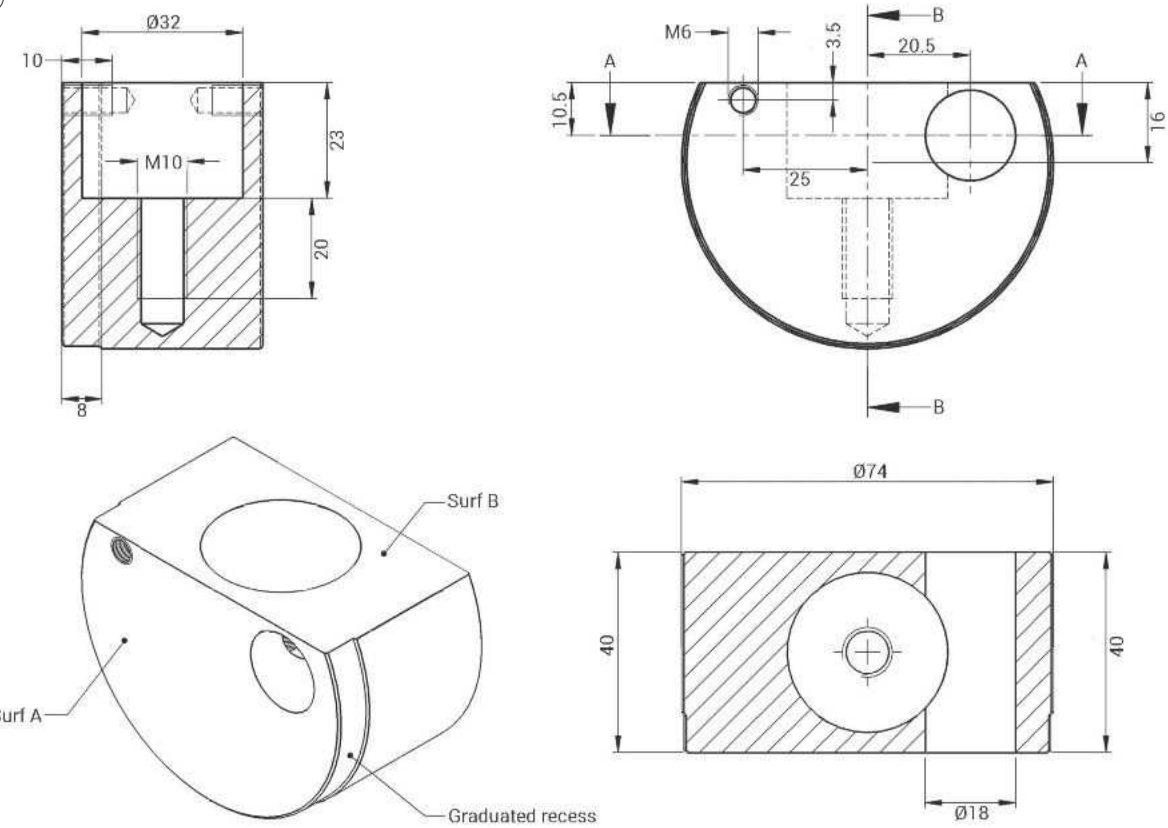
Of course, the machine must be well leveled! This is usually the case for the milling machine but not so frequent for

Angling the vice.



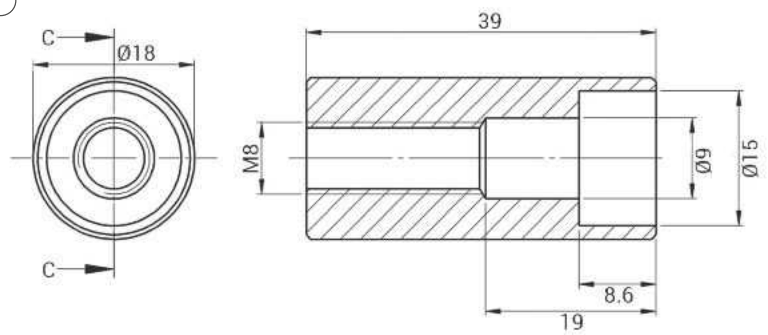
Graduations on the vice body.

Fig.3



Base 2

Fig.4



Cotter 4 Before Machining With Part 2

the drill press. In this casae take a "0" on the table in the actual position.

As can be seen in the photos, a small angle of annealed copper sheet is used on the moving jaw at the contact point of part 2 for the best locking.

For the third rotation part 3 is graduated (for 90°) and two indexes ware struck on part 2 so that any angle is possible.

Holding parts to be machined

A plain groove and three set screws are used as a crude form of vice, this is sufficient for my need, holding tool tips shanks and dividing blocks for making carbide tipped milling cutters.

Machining

Parts 2 and 3 are made of grey iron as this was available in the scrap box, but mild steel should work as well.

Base 2 (fig. 3)

First turn the cylinder and recess, rough mill the flat (leave 1mm oversize). While on the milling machine, drill a center hole for the main bore. Turn the cotter 4 (fig. 4) over length and bore the index holders 6. Set the roughed cotter in place; use an M8 threaded rod on the threaded side of the cotter, lock a washer between cotter and nut, a washer and nut are used on the other side to lock the whole on part 2. Set and tighten (use a locking compound) the index holders 6. The whole is then set in a four-jaw chuck for machining the finished bore and flat, photo 4. Push the plane "B" with the tailstock barrel to get it as perpendicular as possible to the lathe axis and align the center hole with a wiggler. After machining, the cotter is taken out, cut and trimmed before setting back in position.

Working vice 3 (fig. 5)

No problems for machining, be careful the graduations are well aligned (starting point), see later.

Boring on 4-jaw chuck.

Index holders 6

These are necessary because part 2 thickness is only 40mm, but not if you can use a 55mm length minimum for part 2.

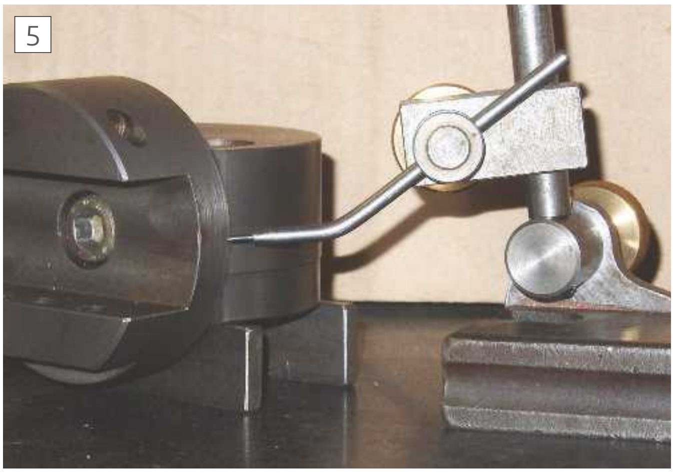
Graduations

Made every 2° as there is not enough room for 1° ones, but this is sufficient for our needs. The dividing can be made with a strip of paper, usually printed from CAD drawing, and wrapped around the chuck, a surface gauge being used as fixed index. The machining is done by hand from the carriage with a threading tool, two stops must be used for the two different graduation lengths.

Marking the graduation start for part 2. Use a scribing block, a machine level and part 2 set in the milling machine vice. Adjust the scriber to the center height of the cylinder, set the upper plane horizontal with the level, and scribe a line on the recess cylinder, this will be the "0". Mark (on the lathe) graduations 20° up and 90° down.

Graduation start for part 3: Set and lock part 3 on part 2 assuming that surface A of part 2 is well parallel with the groove in part 3 (use an angle gauge or a DTI). Set surface A on parallels. Adjust a scribing block to center height (of cylinder 3) and mark a line, **photo 5**. Set part 3 on the lathe in a 3 jaw chuck and graduate up to 0° and down to 90°. Set part 3 back on part 2, align the groove parallel with plane A (use a DTI), and mark the indexes on the index holders.

The use of the universal vice will be detailed in a future article for on turning tip holders. ■

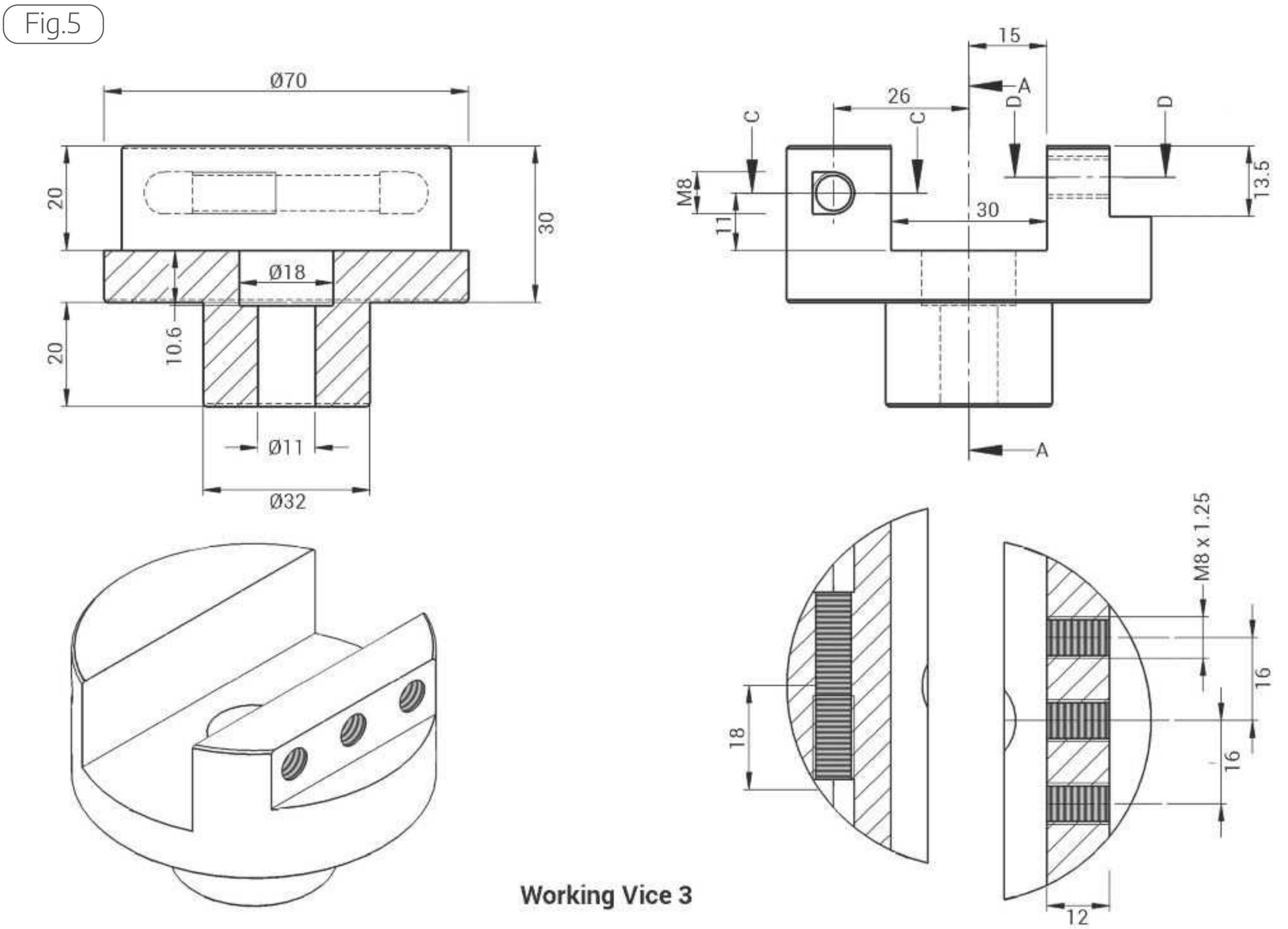


Scribing a graduation at centre height.

Parts list:

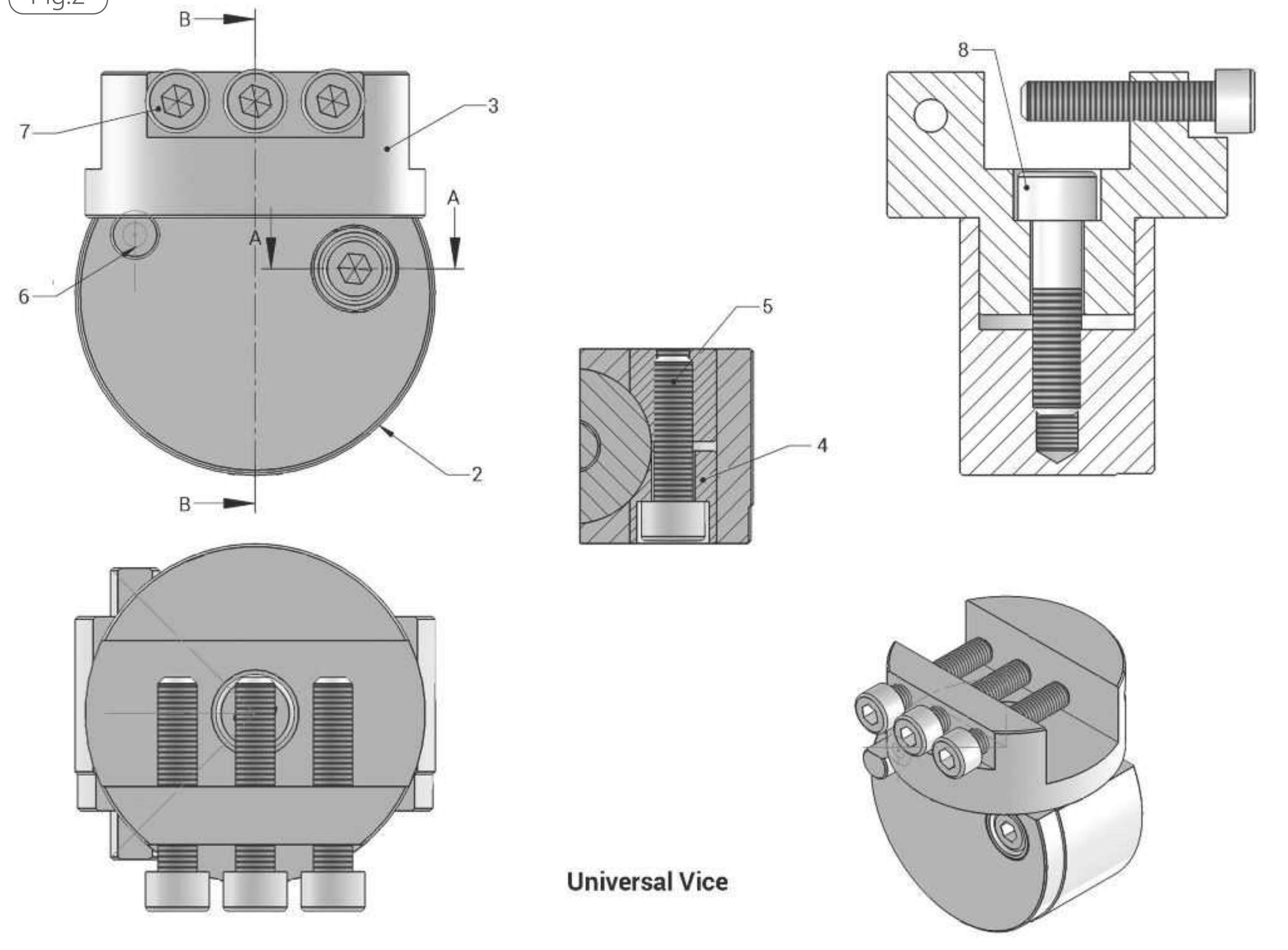
Part N°	Nbr	Name	Material
1	1	Machine vice	
2	1	Base	Grey iron
3	1	Working vice	Grey iron
4	1	Cotter	FCMS
5	1	Lock screw cap head M8-30	8-8 min.
6	2	Index holder	FCMS
7	3	Vice screw cap head M8-40	8-8 min.
8	1	Screw cap head M10-40	8-8 min.

Fig.5



Working Vice 3

Fig.2



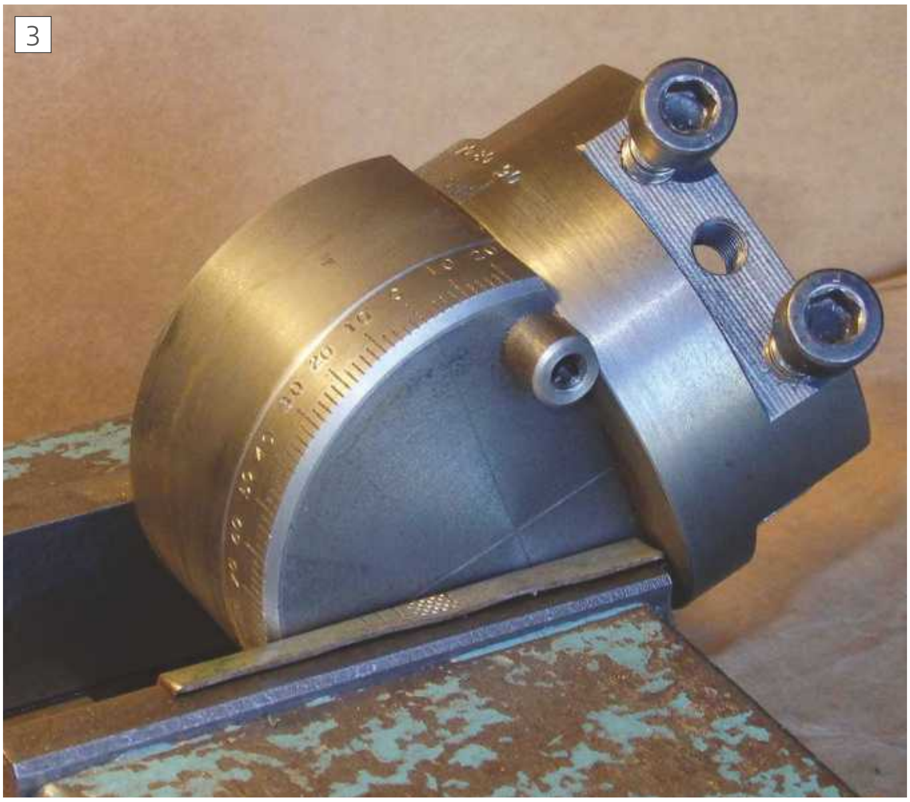
angle gauge and with the cylinder of part 2 resting on one of the vice shears (or a new "0" if necessary to use the surface gauge needle), **photo 3**.

Of course, the machine must be well leveled! This is usually the case for the milling machine but not so frequent for

2

Angling the vice.

3

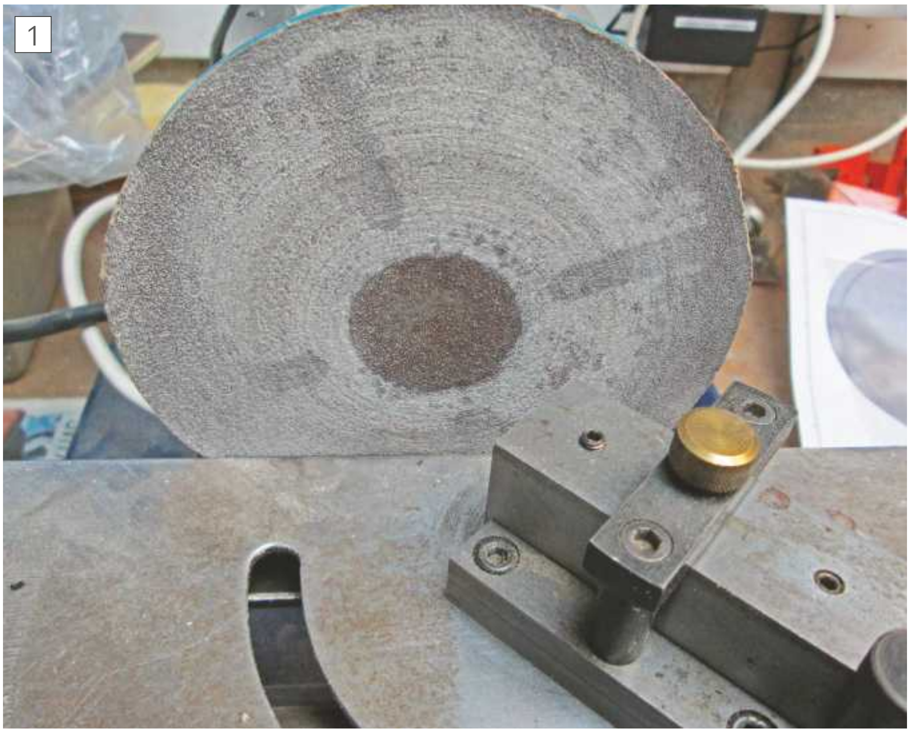


Graduations on the vice body.

Worden Linishing Disc

Laurie Leonard describes building this accessory from Hemingway Kits.

I was making a wooden picture frame for a piece of home produced artwork and found that I needed to clean up the corner mitres. A quick lick at 45 degrees was all that was needed to get the corners mating nicely ready for gluing. This could (should?) be done with a sharp plane and a 45-degree shooting board but I still have not mastered this art so an alternative was sought. A light sand by a sanding disc with the work held at an accurate 45 degrees should do the trick. What have I got that can give me an accurate 45 degrees? – My Worden tool and cutter grinder. An old Black and Decker sanding disc/faceplate was located, and an adapter made to mount it on the Worden motor shaft, **photos 1**, **2** and **3**, and we were in business but... As can be seen in photo 1 the slots in the disc meant that the work was not getting a very smooth ride and the size of the job was limited by the 4-inch diameter of the disc. A quick delve into the scrap box yielded a nice 6-inch diameter steel off cut so plans were worked out to make a larger disc until the thought of a chunk of 6 diameter steel whizzing round caused me to think again. I then recalled that there was a Linishing Disc kit marketed by Hemingway, ref. 1, and concluded that this was the way to go. This article covers my approach to building the kit.


1

Black and Decker disc trial

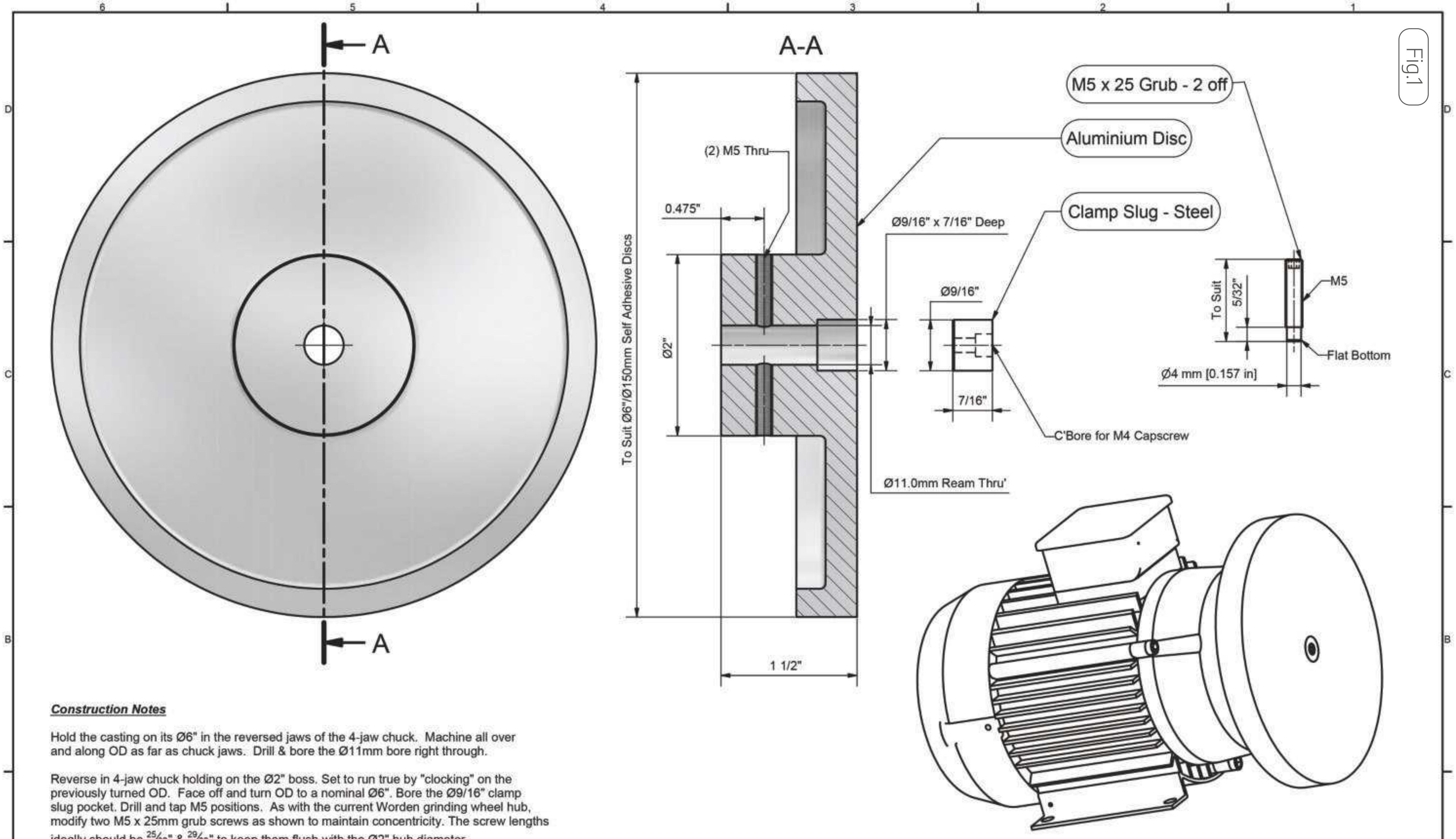
The Worden Linishing Disc Kit HK1308

A copy of the current drawing is shown in **fig. 1** (by kind permission from Kirk Burwell of Hemingway Kits).

Since I purchased my kit, **photo 4**, there has been a modification to the disc retaining arrangements in that the disc boss is retained on the motor shaft with two modified M5 grub screws


2


3



Construction Notes

Hold the casting on its Ø6" in the reversed jaws of the 4-jaw chuck. Machine all over and along OD as far as chuck jaws. Drill & bore the Ø11mm bore right through.

Reverse in 4-jaw chuck holding on the Ø2" boss. Set to run true by "clocking" on the previously turned OD. Face off and turn OD to a nominal Ø6". Bore the Ø9/16" clamp slug pocket. Drill and tap M5 positions. As with the current Worden grinding wheel hub, modify two M5 x 25mm grub screws as shown to maintain concentricity. The screw lengths ideally should be $^{25}/_{32}$" & $^{29}/_{32}$" to keep them flush with the Ø2" hub diameter.

The steel clamp slug shown, together with an M4 capscrew can be used for positive retension but you will need to cut a small central hole in your abrasive discs to allow the fixture to be removed and replaced.

Hemingway Kits

TITLE: Worden Linishing Disc			KIT CODE: HK 1308F
DESIGNER: N S Hemingway		126 DUNVAL ROAD, BRIDGNORTH, SHROPSHIRE, WV16 4LZ, UK *www.hemingwaykits.com*	
ORIGINAL DESIGN: 1992	REVISION DATE: 13/12/2019	THIRD ANGLE PROJECTION	SHEET: 1 OF 1

Linishing Disc Kit components (less the drawing)

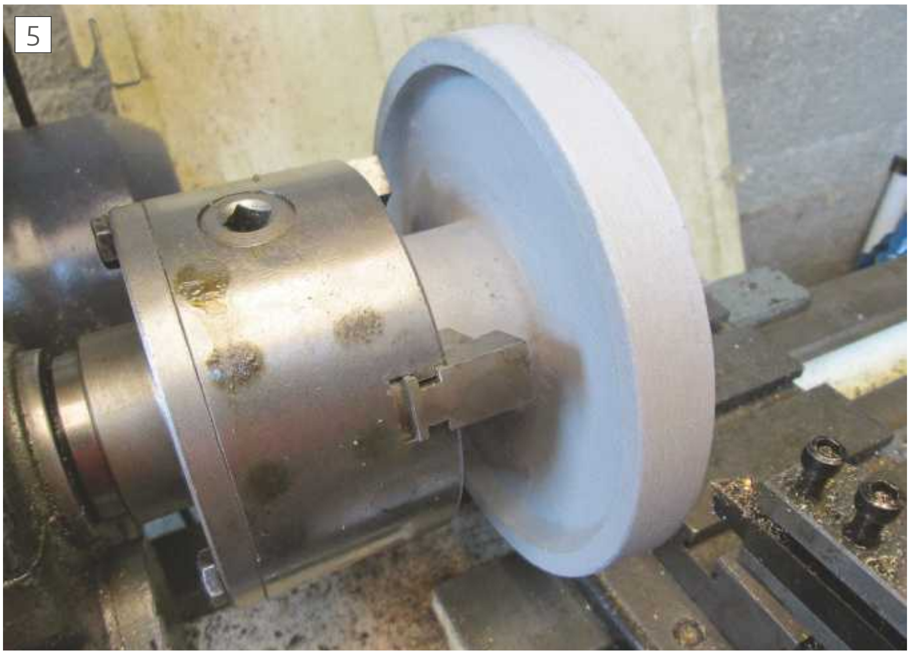
instead of the pressure piece, a piece of machined brass, so the contents of the new kit will be slightly different but the main machining will be similar. The kit comprises a nice aluminium casting, a few bits of hardware, a drawing and an initial supply of abrasive discs.

Machining

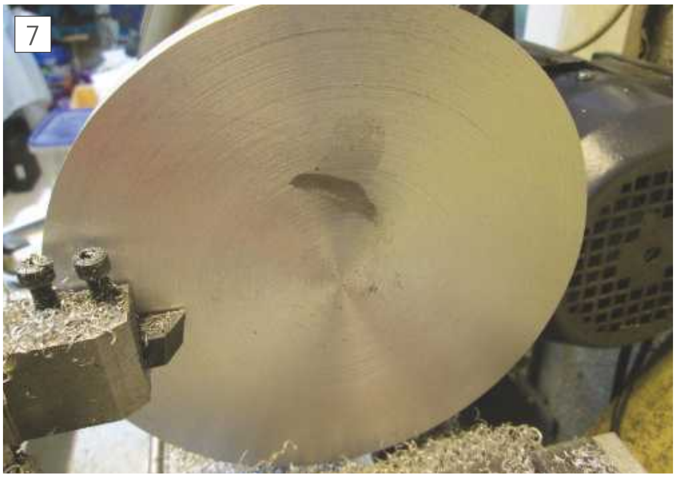
The work was carried out on a Myford ML7. Contrary to the method suggested in the constructional notes on the drawing, I mounted the casting by gripping the boss, **photo 5**. I always like to bed work against the chuck body if possible, to give added support and reduce the possibility of it moving whilst being machined. With the disc mounted in external jaws against the chuck body there will be little of the disc outer edge available to be machined and any machining of it will bring the tool close to the jaws as can be seen in the later photo 10. I used my three jaw to hold the boss despite a small known run out as I intended to machine the disc face and the mounting bore without moving the disc in the chuck. It is important to get the disc face and the bore to be true for smooth operation and accuracy. At this point it should be mentioned that the casting had been well fettled and the casting draft (taper which permits the pattern to be removed from the mould) was small, so the jaws got quite a good grip on the casting.

The disc was faced. **Photographs 6** and **7** show the work proceeding. As would be expected the centre of casting was slightly dished inwards where contraction had taken place as the casting cooled, the centre being the location of the large boss on the reverse of the disc. As the work progressed some slight blow holes and the dishing were removed. Despite my poor hearing there was a noticeable sound change as the tool reached the area of the disc where the boss was located on the reverse. This may be accounted for due to the solidity of this area, but the finish also changed. Solidity of mounting or change in crystal structure of the casting due to the increased mass and different cooling? Although my photograph is not brilliant, I think that the difference in finish at the centre to the periphery is apparent in **photo 8**.

Having faced the disc, I decided to finish the 6 inch diameter of the disc rather than drill and bore the centre hole. I argued that at the large radius it was possible for the disc to move (slip) in the chuck during this operation and if it did then all that was needed was a further skim on the face to true it up before machining the central hole. If the latter had been completed and the disc moved in the chuck, then it would be a larger problem to rectify. A centre drill was used to provide a location for



Casting mounted in 3 jaw chuck by its boss



Facing the disc


8
Faced disc (with a different finish at the centre area?)

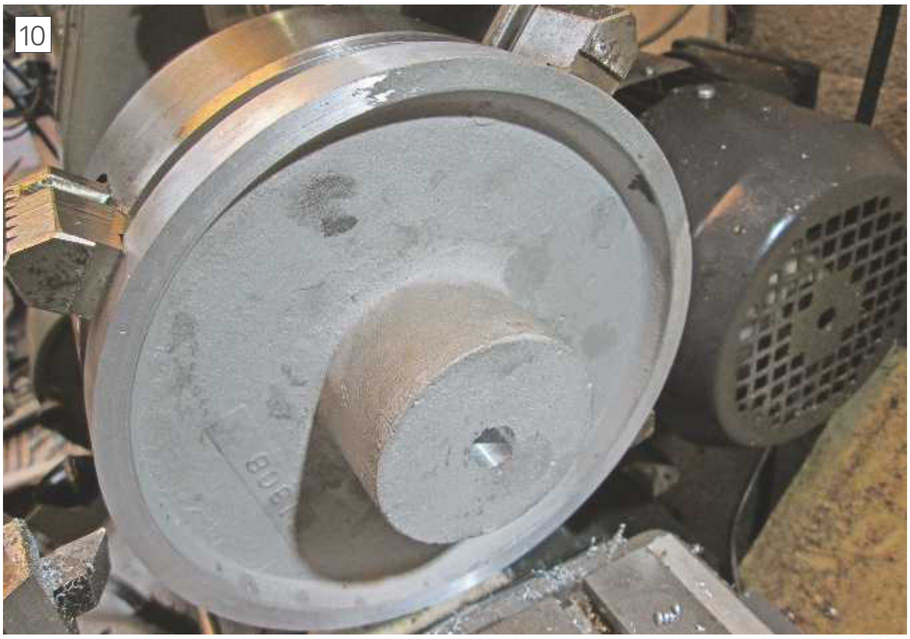

9
Machining the disc outer edge

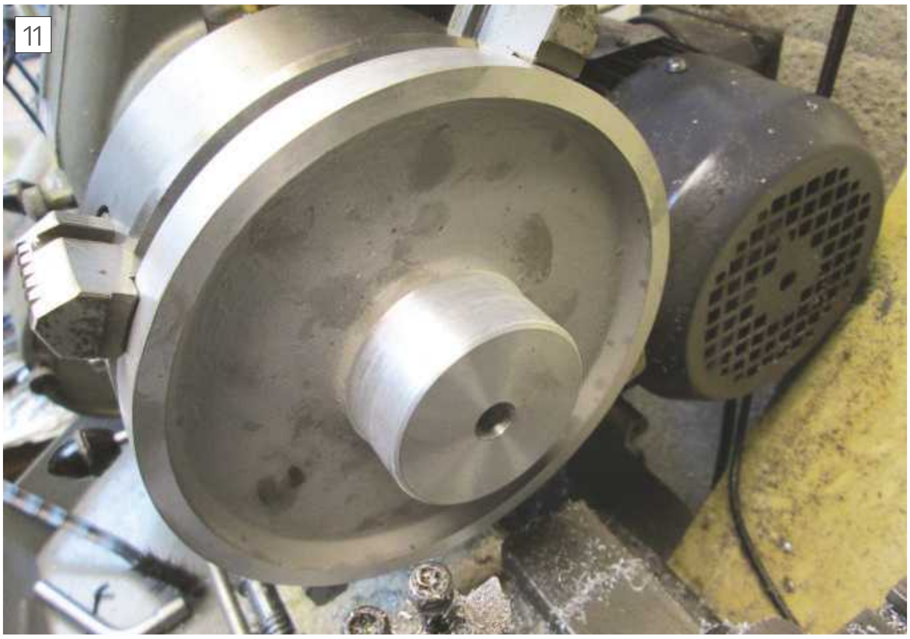
a tailstock dead centre, **photo 9**, and the 6 inch diameter was finished. The finished size of this was to suit 150mm self adhesive abrasive discs and not really very critical. The disc did not move in the chuck.

As I do not possess an 11mm reamer I used successive drills to make a hole 10.5 mm and then bored it out to 11mm. I should have made an 11mm test gauge as by measurement I ended up with an easy fit on the motor shaft. I would have preferred it to be tighter but on the other hand it is a linishing disc not a precision grinding wheel and I did not want to resort to having to make some form of extractor to remove the disc from the motor shaft.

The three jaw chuck was swapped for a four-jaw independent chuck with the jaws set to grip the disc on their inside and it was trued up using the machined 6 inch diameter . Perhaps a word of caution is in order here although it may be teaching granny to suck eggs. With such a large diameter held with outside jaws it is essential to make sure that the jaws/disc will not foul anything before applying power. **Photograph 10** shows work in progress cleaning up the back face after which the boss was finished to size. The high quality of the casting can also be seen in this photograph. **Photograph 11** shows the disc with the lathe machining work completed. Notice my oily fingerprints on the nicely machined surface!

The drawing also shows a clamp plug which can be used with a cap crew for positive disc retention but as noted on the drawing a hole would have to cut in the abrasive disc to access the screw. This would provide an opportunity for an edge in the sanding area to get caught and tear


10
Casting reversed and held in the 4 jaw chuck ready for final machining


11
Lathe work completed on the disc casting

12 Marking out in readiness for cross drilling the boss

13 The tapping drill extension

14 Cross drilling the boss utilising the extension

the disc. As anything that can go wrong usually does, I chose not to add this feature and rely on the retention grub screws. Under normal operation the forces would tend to push the disc onto the shaft and the use of the Worden table would prevent the disc being ejected.

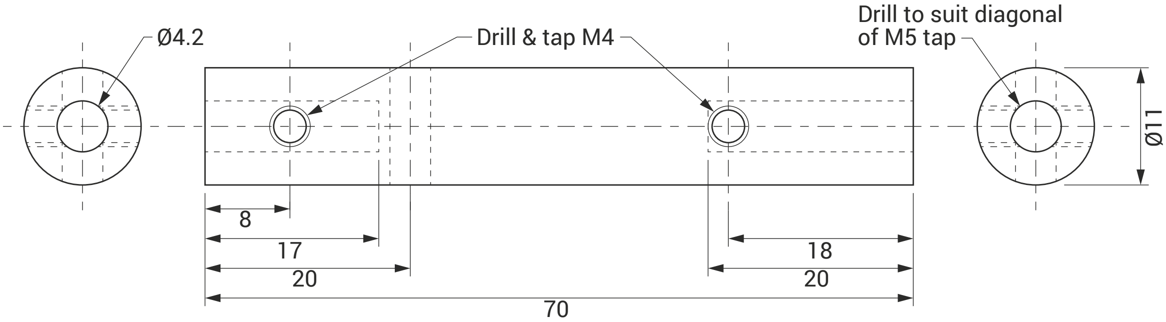
After double checking that no further work was needed whilst the work was still mounted in the lathe, it was removed ready for the positions of the M5 retaining screw holes to be located. I always seem to manage to get this sort of holes slightly "off" and the work was too big for the cross-drill jig I had made (see MEW 149). I utilised my digital height gauge to scribe a line across the diameter and a line on each side parallel to the axial centre line. **Photograph 12** shows the disc supported on a "V" block (although

As anything that can go wrong usually does, I chose not to add this feature and rely on the retention grub screws

the latter is a magnetic one the disc is not magnetic). Having measured the diameter of the boss, the gauge was rested on the top of the mounted boss and zeroed. The gauge was then and set to a value of minus half the previously measured diameter and locked. The lines were then carefully scribed so as not to disturb the disc.

Having centre potted the location of the two holes it was time to drill them, M5 tapping size but access was bad: a long reach drill was needed but I did not have one. To get around this I used a piece of steel as an extension, see **fig. 2**. This was chucked in the lathe, skimmed true and a hole was drilled using the M5 tapping drill about 20mm deep. Two cross holes were then drill and tapped for 4mm grub screws to secure the drill, **photo 13**. The disc hub was then clamped on the "V" block with a piece of scrap channel as a strong back and utilising "T" nuts in the slots in the drill press table. It appears in **photo 14** that the drill is going through the strong back. It is, but a larger clearance hole was drilled to accommodate it and so that the centre pot was visible to align the drill.

Fig.2



Drill And Tap Extension
Mat'l: Mild steel
All dimensions in mm

Holes drilled, now to tap them. The same problem of access arose so the other end of the extension above was utilised to hold the tap. A hole the diameter of the cross-corner measurement of the tap was drilled and once again two cross holes were drilled and tapped to accommodate retraining grub screws. A further cross hole was drilled for a tommy bar (actually a sawn-off nail) to drive the tap. This arrangement can be seen in **photo 15** and in use in **photo 16**. A quirk of engineering supply struck when trying to insert the bottoming tap: its shank was of a larger diameter to the taper tap and would not enter the hole in the extension. The hole was opened out to suit.

As will be noted from the photographs the grub screws to hand were too long and should ideally have been cut down therefore extra care had to be exercised to avoid the potential hazard.

Testing

Photograph 17 shows the completed linishing disc trial mounted on the Worden and under test in **photo 18**. The as supplied abrasive discs were grade P60 - rather coarse for a wood sanding job. Other grades are available and one supplier, ref. 2, advertises them with a description which says that that particular brand can be re-used simply by warming the disc with a hot air gun and then gently removing the abrasive disc and replacing it on the backing paper for future use. A disc like this would not normally be used with a guard, but do use eye protection and take care.

Conclusion

Whilst this may seem to be a rather a basic project it produced a very worthwhile accessory for the Worden which covered my requirements. It was also an unusual experience for me to be cutting something of 6 inches diameter and the aluminium casting was a pleasure to work on. ■

References

1 Hemingway Kits - **www.hemingwaykits.com**

2 Axminster Tools & Machinery - **www.axminster.co.uk**


15

The tapping drill extension modified to take the tap at its other end


16

Tapping extension in use


17

Machined disc trial mounted on the Worden


18

Abrasive paper fitted to disc and ready to go www.model-engineer.co.uk/classifieds/

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■ Lathe Mark 2 Empire. Good condition. 7 ½" Burnerd 4 jaw, soft jaw 8", lots of extras. £600. Index vertical mill dividing head. 8" rotary table. £600. **T. 01566 86683. Launceston**.

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■ Denham Junior geared head lathe,. 12" swing in gap, 3 jaw, 4 jaw, T/.stock chucks, face plate, catch plate, fixed and travelling steadies. T. D. Ind. Full set change wheels for imperial and metric. Mounted on adjustable feet. £595. **T. 0161 3305112. Manchester**.

Models

■ 5 inch gauge 0 6 0 Simplex with riding trolley, ground level and raised track. Transport box for loco included. **T. 01638 515363. Near Newmarket.**

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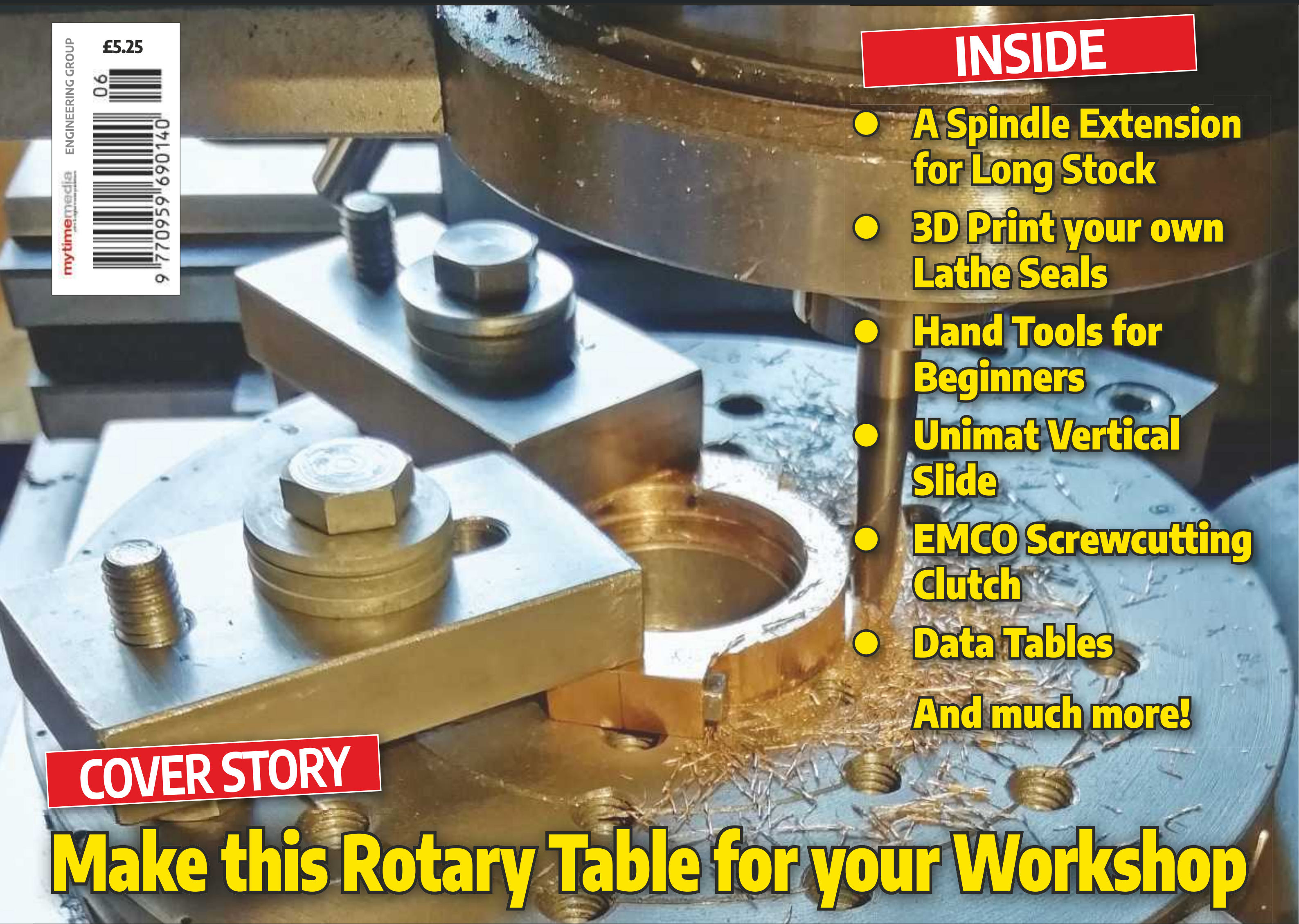

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