No.312

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS

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INSIDE

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COVER STORY

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On the Editor's Bench

It's great to have family!

In my case, my two brothers. In the week before Christmas they again helped me move machinery and tools into a Luton van and then into my new workshop. Three people is a great number to have as everything was doable as a two-person lift, leaving one to spare. Strangely a two by seven-foot benchtop disappeared during the process! Oh well, it was only a very battered piece of contiboard. Lots of smaller items have gone astray, most of these are gradually turning up along with a few things I had forgotten I ever had! A few refuse to appear, such as the screws for holding the splash back on the lathe.

As if by magic, the machines have all fitted into their allotted places, and I've been able to better position the mill and pillar drill, with the former having its handwheel projecting over the bench edge and the latter now having easier access to change speeds (aided by a step-up). The X-axis DRO on the mill had stopped working. I removed it and discovered the hot melt glue keeping the cable in place on the read head had given way so one of the wires soldered into the connector had snapped (it's one of the basic type based on capacitive scales). A not-so-quick repair appeared unsuccessful – it 'lit up' but no reading. I ordered a replacement read head from Machine-DRO, but in the end the next day it was working again, so now I have a spare.

A bigger problem is that somehow the spindle for my SC4's carriage handwheel has got bent. This will be my first proper engineering task; I will either have to bend it straight or make a replacement on my mini lathe.

It's still going to take considerable effort to get everything organised. After decades of hoarding, my philosophy is moving towards getting rid of stuff I know I will never use of that is more trouble to store 'just in case' when I know it will be easy to replace. This means multiple journeys to the recycling centre to get rid of junk that really should have disappeared long ago.

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Mike Pavie

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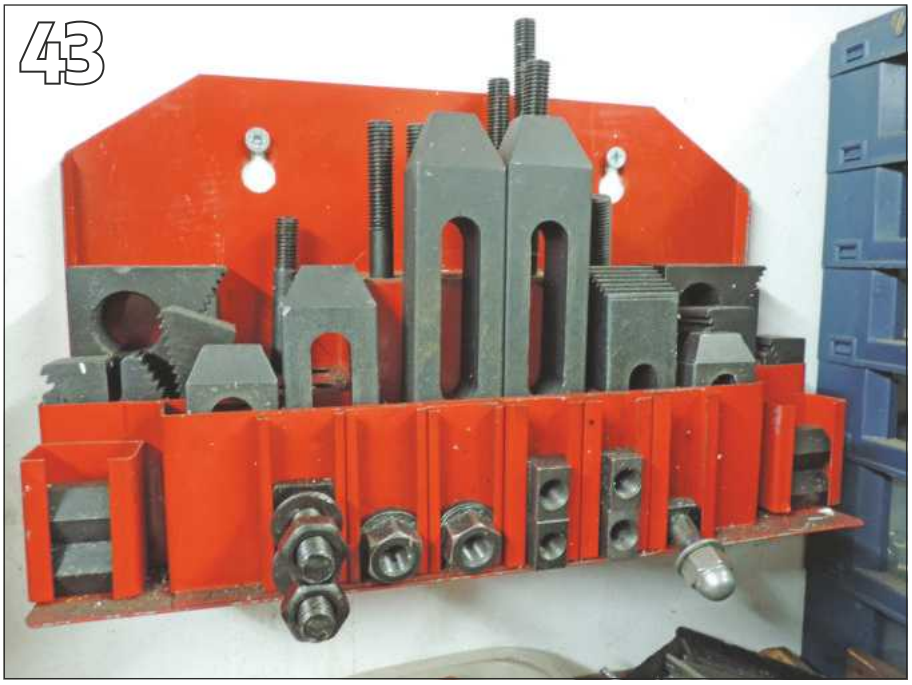
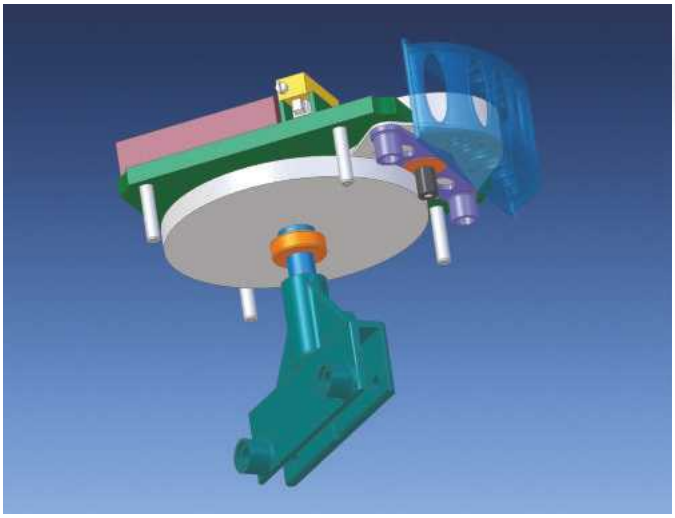


Coming up...

in our next issue

Our next issue will feature a Myford upgrade and a milling depth stop, as well as special feature on how Mark Noel approached an unusual engineering challenge.



Regulars

ON THE COVER >>>

The cover of this issue shows Ted Hansen's Quick Change Tool Post design. Details and plans for this useful accessory start on page 17

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THIS MONTH'S BONUS CONTENT

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A Searchable Index?
Check out the website for latest news of progress with a searchable index for MEW.

Other hot topics on the forum include:
Controlled release of a Clarke Bottle Jack fitted to an engine building stand
This is an interesting discussion leading to some useful suggestions.

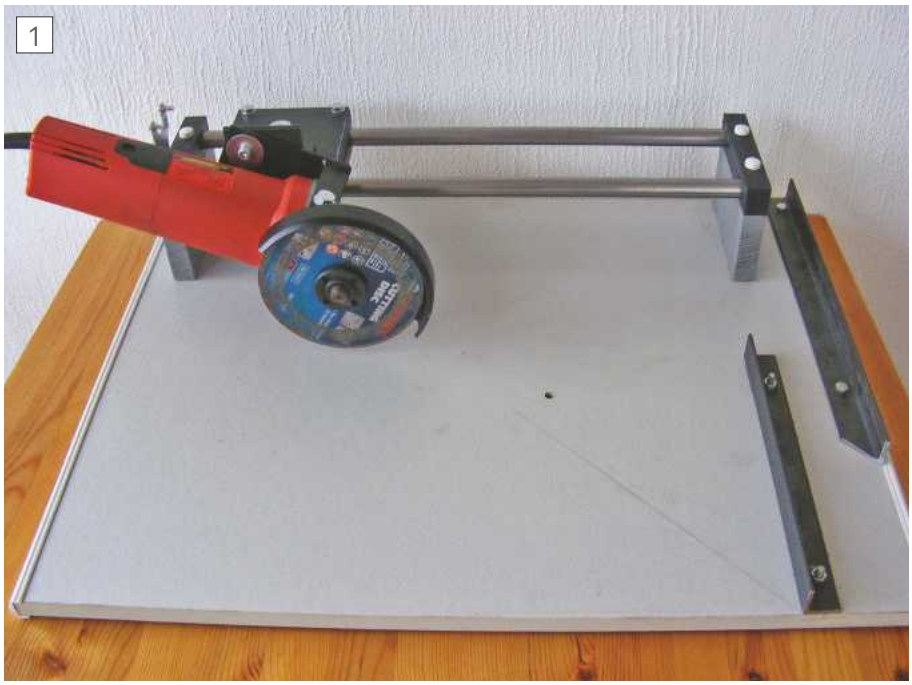
Myford ML7 1956 back gear removal
Broken back gear teeth is not unusual in older Myfords, so how do you replace a broken back gear?

Crispy fluffy roast potatoes
Yes, the forum discusses the most important hot topics in engineering...

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.

A Sliding Angle Grinder Stand

Mike Cox takes the guesswork and fiddle out of using an angle grinder as a workshop saw.



The completed angle grinder stand.

I find cutting steel using an angle grinder a bit hit and miss. Cutting straight lines in sheet steel and cutting angles in rectangular tube to make mitres are particularly difficult to do well. I have watched many you-tube videos and see many people cutting these really well and with apparent ease using a hand-held grinder but I find it very hard to achieve similar results. The idea of making a sliding angle grinder stand to overcome these problems is not new and there are many designs on the internet. I started to think about how to make one. I wanted to incorporate several features including:

1. The sliding action should enable straight cut of up to around 300 mm in length
2. The sliding action should be smooth and effortless.
3. Sparks from the angle grinder must be directed away from the user.
4. There should be a facility to lock the sliding action. This is so that in the future the set up could be used for other purposes. For instance, with the addition of a rest the angle grinder could be used for sharpening small tools.

The finished stand is shown in **photo 1**.

The stand uses two 16 mm parallel steel tubes to guide the angle grinder. The slider consists of carriage which is two 3D printed components sandwiched between two steel plate. On the carriage is a bracket to which the angle grinder is mounted. The four bolts at the corners of the carriage can be used to adjust the ease of sliding of the carriage. There is a knurled knob in the centre of the carriage can be used to lock the carriage at any position along the guide rails.

This project went through a number of changes as it progressed mainly in respect to the size of the baseboard and the position of stop.

The guide rails

The guide rails were made from two lengths of 16 mm x 1.5 mm ERW (electric resistance welded) steel tube 500 mm long. These were cut and the ends de-burred and given a good chamfer at both ends. The two rails are supported in blocks, **photo 2** and **fig. 1**, that were 3D printed in PLA plastic. In order to keep print times down these were printed with a layer thickness of 0.4 mm. Vertical and horizontal holes were provided for fixing the blocks because

The two 3D printed rail supports.

at the beginning of the project I was not quite sure what the best way of mounting the blocks would be.

The carriage

The carriage consists of two identical 3D printed slider components, **photo 3** and **fig. 2**, that are mounted around the two rails. These were printed with a 0.4 mm layer height. These slider components were bolted between two 3 mm steel plates, **fig. 3** and **4**, using 6 x 50 mm hex head bolts. The plates ensure that pressure is applied uniformly across the assembly. The plates were easy to make using the 3D printed components as a guide to transfer hole positions to the metal plates with a transfer punch.

The top plate carries an angle bracket, **fig. 5**, that is secured to it with M4 button head screws. This was a 60 mm length of 50 x 50 x 6 mm steel angle. This was clamped in position to the top steel plate and the hole positions transferred through to the bracket.

Fig.1

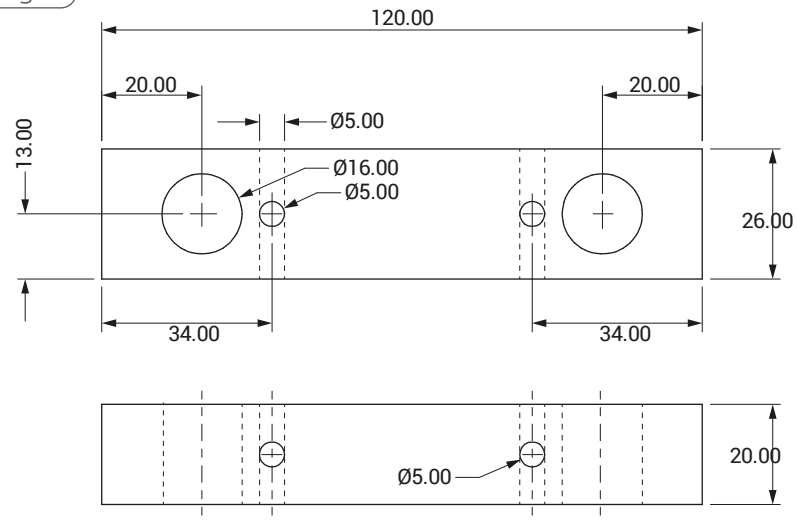
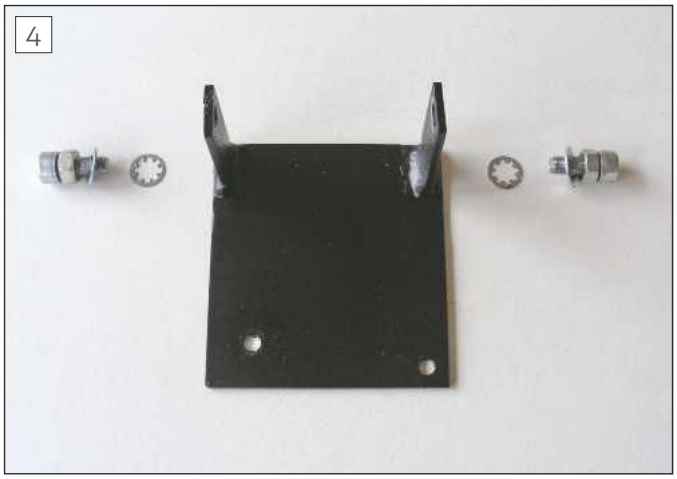


Fig 1. The Rail Supports
Mat'l: PLA 3D print
2 off

3

One of the 3D printed sliders.

4



The angle grinder bracket.

The angle grinder bracket

This was made from a piece of 3 mm steel plate 90 x 100 mm and two strips 20 x 60 mm cut from the same material, **fig. 6**. The two strips were marked out for drilling 8 mm from the end and on the centre line. The marks were centre punched and then drilled out to 8.5 mm. These strips were then attached to the handle holes of the angle grinder using M8 screws. This assembly was then placed on the steel plate on a flat surface and adjusted so that the two strips were positioned as shown in fig. 5, in contact with the steel plate. The two strips were then tack welded to the plate. The angle grinder was removed from bracket and more substantial welds built up around the strips. The finished bracket is shown in **photo 4**.

5

The rails mounted on wooden riser blocks.

Note that the dimensions given are to suit my angle grinder, but they are unlikely to be the same for all angle grinders. However, it should be straightforward to adapt the dimensions to suit any other angle grinder.

The knurled knob

This was a straightforward turning and knurling component made from some 19 mm aluminium bar, see **fig. 7**.

Assembly

The stand was built on a baseboard of 15 mm melamine faced chipboard that was available. This was cut to a size of 460 x 600 mm.

The two rails were inserted in the support blocks. They were a tight fit and they were tapped into place. No further fixing was required.

The two-rail support block were then fixed to two 20 mm thick wooden riser blocks measuring 70 mm x 120 mm using screws through the holes in the top of the blocks. These wooden blocks are to raise the rails to a working height above the baseboard. The blocks were fastened to the baseboard, as shown in **photo 5**, using screws through the bottom of the baseboard. This photo was taken during development and the baseboard is now different.

Fig.2

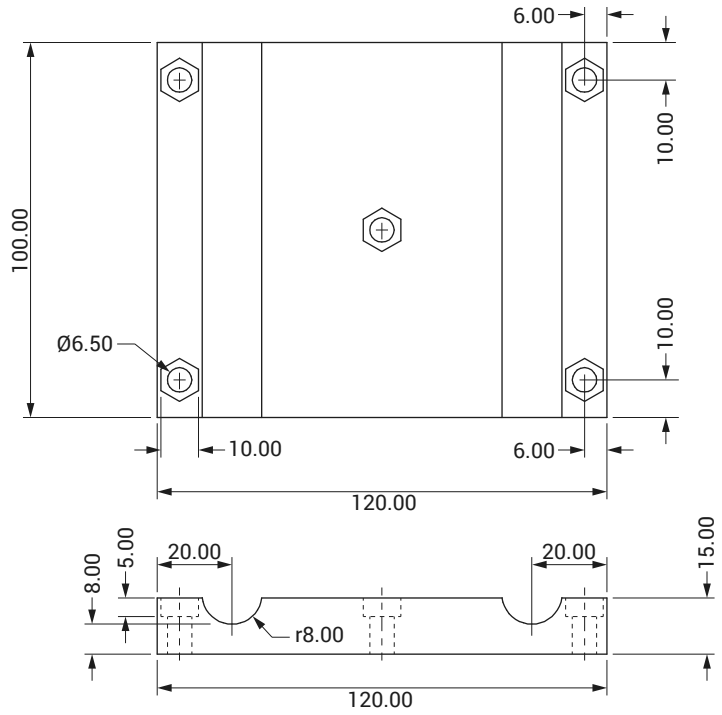


Fig 2. The Slider
Mat'l: PLA 3D print
2 off

Fig.3

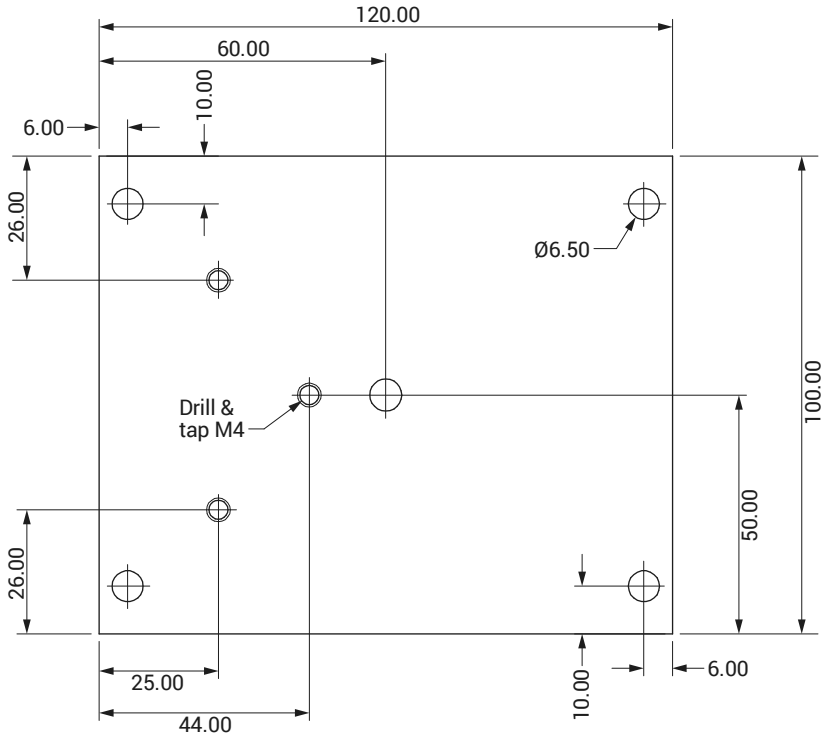


Fig 3. The Top Plate
Mat'l: 3mm steel plate

The bracket was assembled to the top steel plate of the carriage using M4 button head screws. Excess screw protruding out of the back of the plate was cut off and then filed flat with the plate. The top plate was secured to one of the 3D printed slider components using four M6 x 50 hex head screws and four nuts seated in the hexagonal depressions in the corners of the slider, see **photo 6**. This was placed on top of

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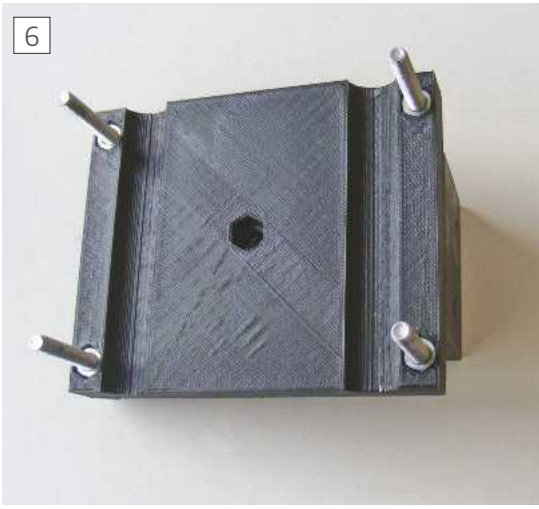
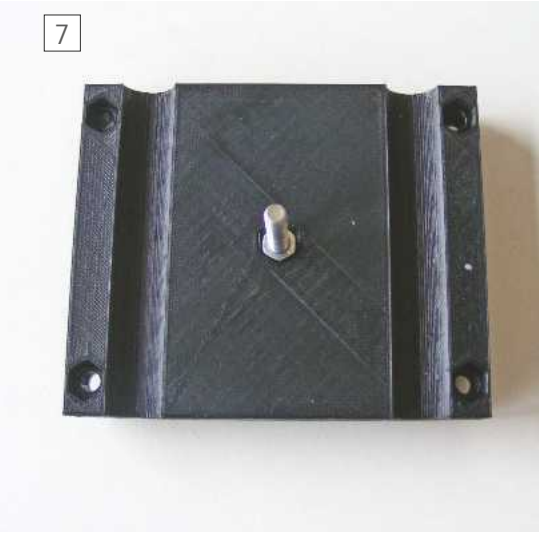


The top slider fixed to the top plate.

7



The bottom slider fixed to the bottom plate

the guide rails.

The bottom plate was secured to the other slider using one screw through the centre of the plate and a nut in the central hexagonal depression, **photo 7**. This assembly was then slid under the rails and the bottom slider pushed up into the top assembly trapping the rails between them. The two halves were held together using the knurled knob on the central screw on the top surface.

Four M6 nyloc nuts were then screwed onto the four screws protruding from the lower surface. These were tightened until a slight increase in resistance is felt as they bottom on the plate. The top knurled knob was unscrewed, and an attempt is made to move the slider. It will probably be too stiff to move easily. The bottom nyloc nuts were then slackened a little at a time until the carriage would slide fairly easily. At this stage the rails and carriage were lubricated using an aerosol spray of PTFE dry lubricant after sliding the unit back and forth a few times then the movement becomes much freer. If necessary, the four nyloc nuts can be adjusted to optimise the ease of sliding without having any rocking of the carriage on the runners. The finished carriage on the rails is shown in **photo 8**.

The angle grinder bracket was attached to the angle grinder using M8 hex head screws, **photo 9**. Shake proof washers were placed between the arms of the bracket and the angle grinder. These prevent the angle grinder rotating between the arms once the M8 screws are tightened. Do not tighten the M8 screws down hard at this stage.

The bracket was then fixed to the angle bracket on the carriage using

Fig.4

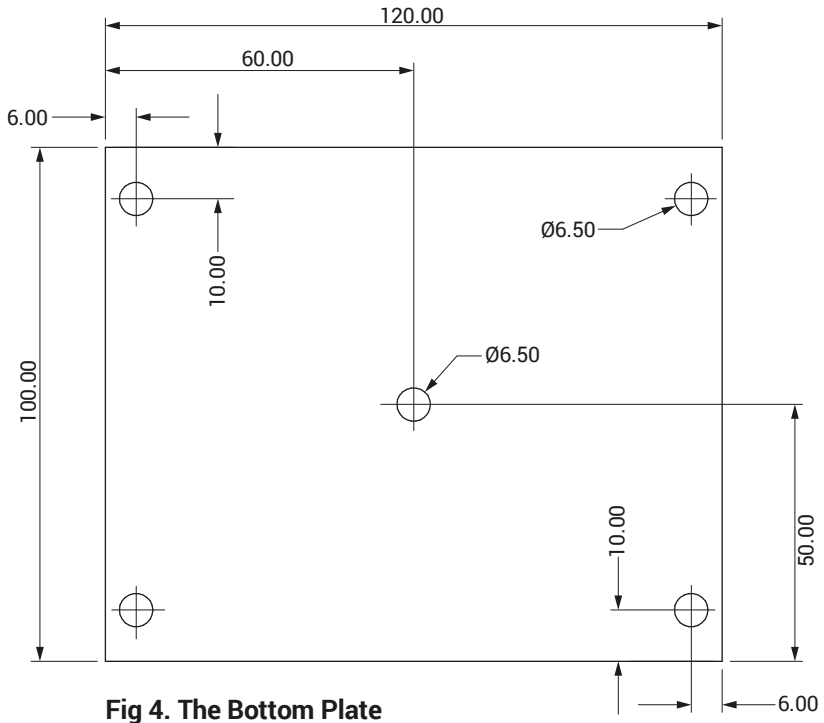


Fig 4. The Bottom Plate
Mat'l: 3mm steel plate

Fig.5

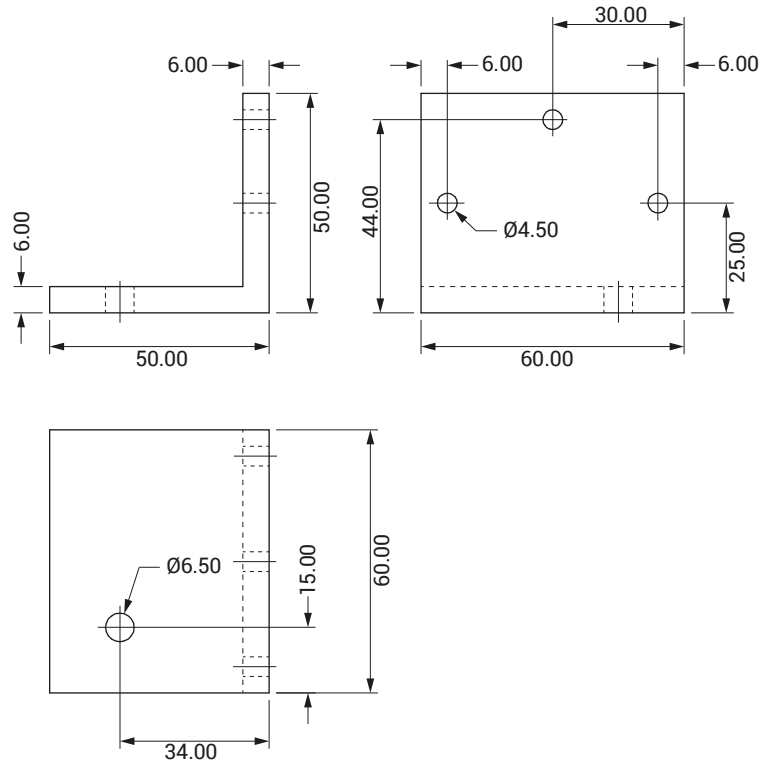


Fig 5. The Top Plate Angle Bracket
Mat'l: 50 x 50 x 6mm steel angle

Fig.6

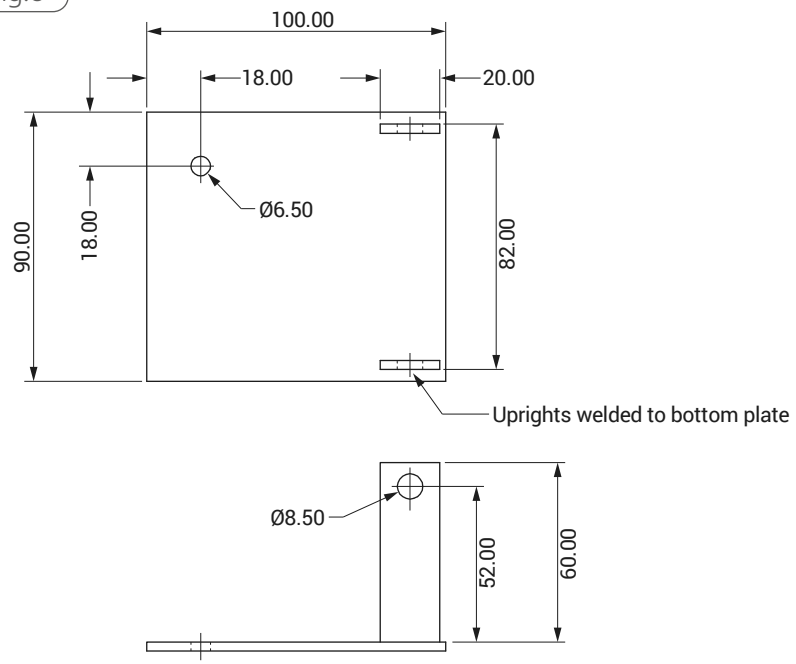


Fig 6. The Angle Grinder Support Bracket
Mat'l: 3mm steel plate

Fig.7

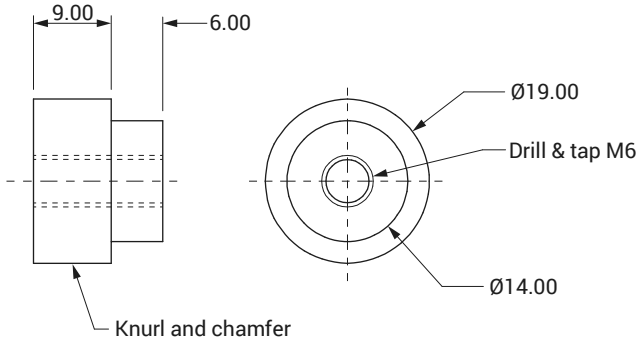


Fig 7. Knurled Clamping Nut
Mat'l: Aluminium

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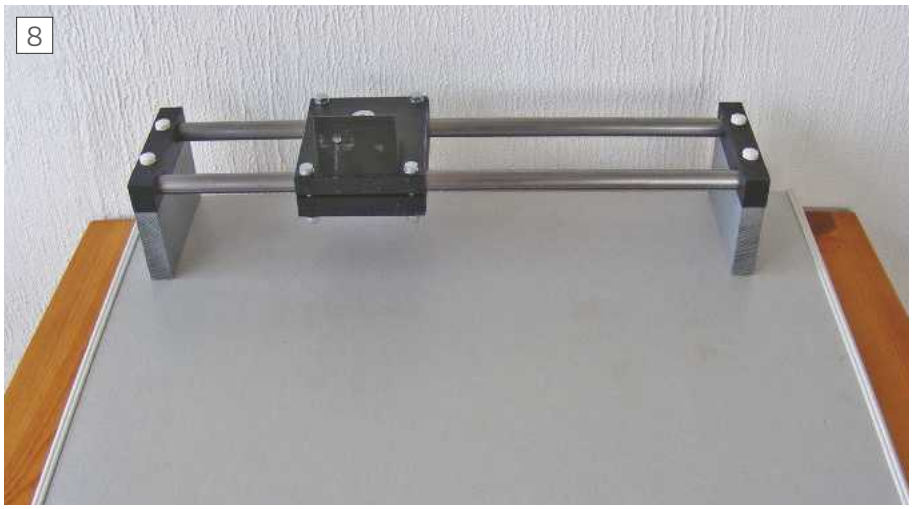

The carriage mounted on the guide rails

The angle grinder was then rotated in the angle grinder support bracket until measurements at both ends of the rail were the same.

an M6 screw. The sequence of parts for this assembly was: M6 screw, 6 mm penny washer, angle grinder bracket, 6 mm penny washer, carriage angle bracket, 6 mm washer, 6 mm spring washer, M6 nut. This sequence ensures a secure mounting with the possibility of easily adjusting the height of the cutting disc.

The cutting disc must now be set parallel to the guide rails. To do this a long rule was held gently against the cutting disc and the distance from the rule to the nearest rail was measured. This was repeated at both ends of the rail. The angle grinder was then rotated in the angle grinder support bracket until measurements at both ends of the rail were the same. Once these were correct the M8 screws clamping the angle grinder in the bracket were tightened down hard.

The final part of the assembly was to fix a 238 mm length of 25 x 25 x 3 mm steel angle to act as a stop against which the object being cut can be clamped, **photo 10**. This should be fixed about 2 mm away from the cutting disc and at right angles to the guide rails. The stop bar is fixed to the base board using M6 x 30 mm screws. Also shown in photo 10, along the edge of the baseboard, is another guide that is used for making 45-degree cuts. To use this one the 90-degree guide is removed and the longer 45-degree guide uses one of the holes near the edge of the baseboard and the other hole positioned in the centre of the baseboard which is visible in the photograph. Drawings of the two stop bars are shown in **fig. 8**.

My workshop area is too small to have the unit permanently set up on a workbench so I added a wooden batten under the baseboard which can be gripped in the vice of a portable workbench. The unit mounted on the portable workbench is shown in **photo 11**. The other advantage of

Fig.8

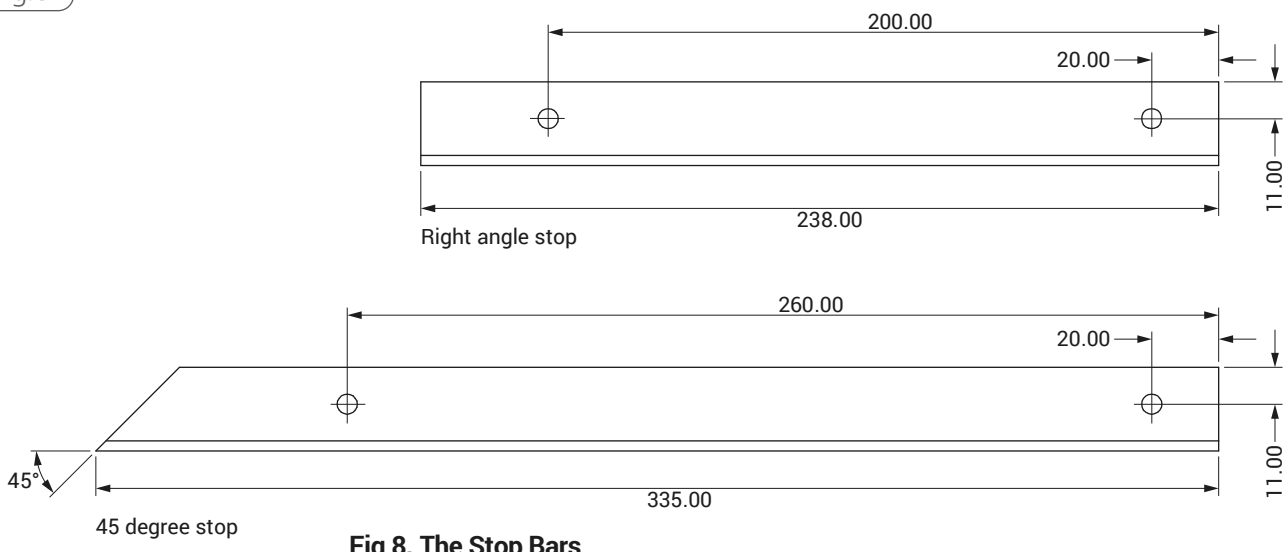

Fig 8. The Stop Bars
Mat'l: 25 x 25 x 3mm steel angle

having it mounted on a portable workbench is that it can be used outside which avoids grinding dust everywhere and also reduces the fire risk due to flying sparks.

Conclusion

This sliding angle grinder stand project was a straightforward build that was greatly facilitated by using some 3D printed components. The end result has been very satisfying in that the sliding action is easy and precise. The maximum length of cut is 320 mm. In principle the design could be readily adaptable to make a longer version but it would probably be necessary to increase the diameter of the rails to add more stiffness. The design should also be readily adaptable for different angle grinders.

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The angle grinder mounted in the bracket.

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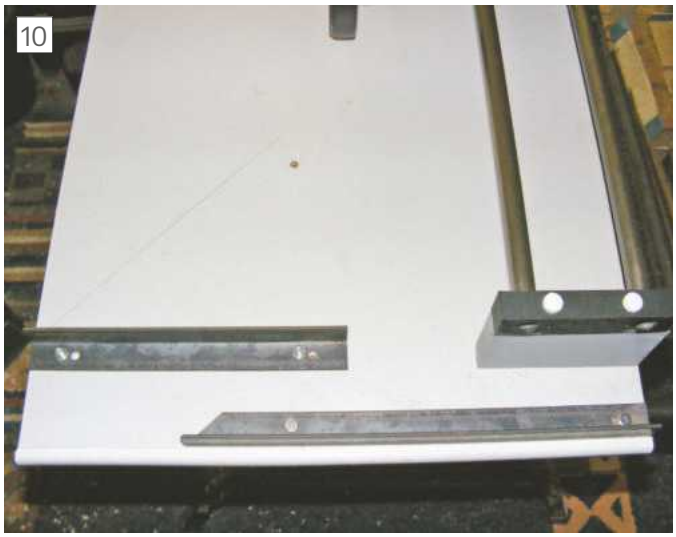

The 90-degree stop fixed to the baseboard.

If anyone would like a copy of the .STL files for the 3D printed components, then just request them through the contact form on the 'Introduction' page on my website at: **http://mikesworkshop.weebly.com** ■

11

The completed project mounted on a portable workbench.

Theasby's Wrinkles

A Scratchy Screwdriver

Another tip that will appeal to the impecunious hobby engineer, from Geoff Theasby.

I think it was Ashley Best who wrote of converting miniature wooden square stock to half round by making a semicircular profile of steel and scraping the corners off it.

Now, many years ago, I was given a host of electronic components by a company for which I was a subcontractor. Some of them have since become corroded on the wire leads, which makes them unsolderable. So, with the above in mind, I filed a notch in the end of a 1/8th inch flat bladed screwdriver, and used it to scrape off the debris so I could use the component. It works very well.

The attached photo is not with my usual camera, but a USB microscope, running Cheese on my PC. I'm not sure if the image can be any sharper, but the camera cost 20 times as much as the microscope... ∎

The Scratchy Screwdriver

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HK25L VARIO Milling Machine with Power Feed

Machine Features

- Digital speed display
- Drilling depth digital display
- Smooth speed control
- Good quality precision spindle bearings

PRICE: £1,995.00 INC

Manufacturer	Cormak
Model	HK25L VARIO
Condition	New
Max Drilling Capacity	25mm
Max Slot/End Milling Capacity	16mm
Max Face Milling	63mm
Spindle Taper	MT3
Draw Bar Thread	12mm
Spindle Feed	50mm
Head Tilt	+/-90°
Number of Spindle Speeds	Variable Speed Control
Spindle Speed Range	50–2250 rpm
Table Surface	500×180 mm
Maximum Longitudinal Table Travel	480mm
Maximum Transverse Table Travel	175mm
Maximum Vertical Travel	380mm
T-Slots	3
T-slots Dimensions	10mm
Motor Power	750 W, 230V
Weight	110kg

Cormak HK25L Vario Milling and Drilling Machine 230V, Single Phase
Compact milling and drilling machine for universal applications. Swivel head, MK3 spindle taper. Digital display shows spindle speed.




TYTAN 500 Universal Lathe with Stand

CORMAK

Machine Description

The Cormak Tytan 500 Vario lathe is a rigid, durable, and accurate lathe for metalworking equipped with multiple features such as, 200/500mm turning, smooth spindle speed adjustment adjustable with a potentiometer, LCD displayed spindle speed, threading capability, bed and guides inductively hardened and ground, change gears, lead screw in a cover with a lead screw and a base as standard. - in accordance with the newest safety and EC regulations. Also includes a 3-jaw 100 mm self-centring chuck and a base with drawers for storage of tools.

PRICE: £1,495.00 INC VAT

Manufacturer	Cormak
Model	TYTAN 500
Condition	New
Swing over bed	200mm
Swing over cross slide	140mm
Centre width	500mm
Bed width	100mm
Spindle bore	21mm
Spindle tip	MT3
Spindle speed	100-2500 rpm
Metric thread	(14) 0.3–3 mm/turn
Inch thread	(10) 10–44 Gg/1"
Tool holder	4- slots
Maximum cross support travel	55mm
Maximum transverse support travel	100mm
Maximum longitudinal support travel	376mm
Tailstock spindle travel	60mm
Tailstock quill taper	MT2
Motor power	500 W / 230V
Dimensions (without base)	900×390×340 mm
Dimensions (with base)	900×390×1160 mm
Weight	95kg



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Universal Tool Post Fixture

Spindle Kit as Supplied

Stewart Hart makes a lathe tool post grinder with a number of other applications

One piece of Kit that I've always wanted is a Boxford "Little Giant" tool post grinder, but I always seem to get outbid, as they to go for silly money. I had a disastrous attempt at making one; I struggled getting a suitable motor and my attempt resulted, in something far too big and clumsy for regular use. But things move on, and I discovered small high torque 775 24V motors and I came across videos on the internet of people using these motors to power "tool post grinders" among other things, at the same time I found a spindle that comes complete with a chuck, spindle, bearings and housing, pulleys, belt and an arbour for a slitting saw: the kit is readily available on the internet as is the motor along with a suitable power pack, **photos 1** and **2**.

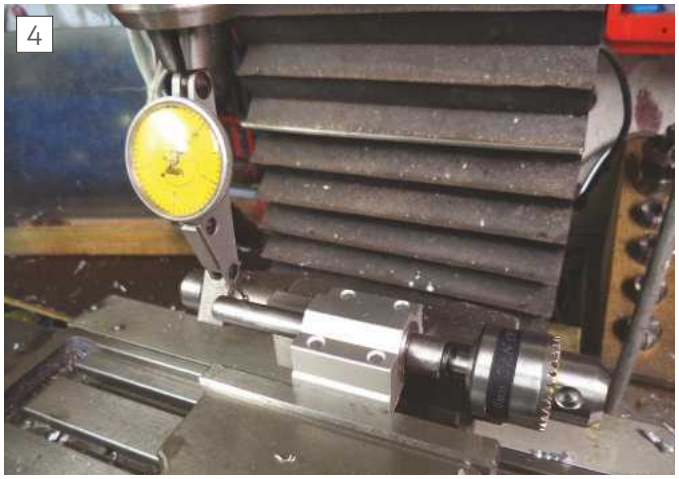
I realised that together these items would create a tool post grinder that would be about the size of a "Little Giant". I also came to realise that with a bit of ingenuity it could be capable of more functions, hence the name "Universal Tool Post Fixture", but more about its capability later, first we have to make it.

There are no assembly instructions with the spindle kit, but it is quite

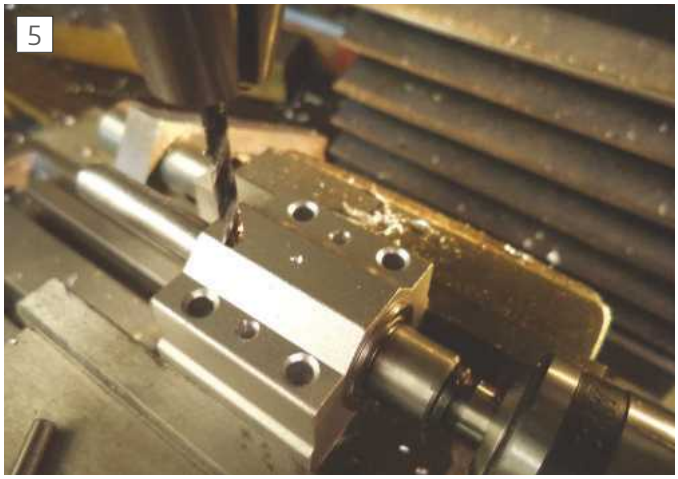
I had a disastrous attempt at making one; I struggled getting a suitable motor and my attempt resulted in something far too big and clumsy for regular use.

775 Motor and Assembled Spindle

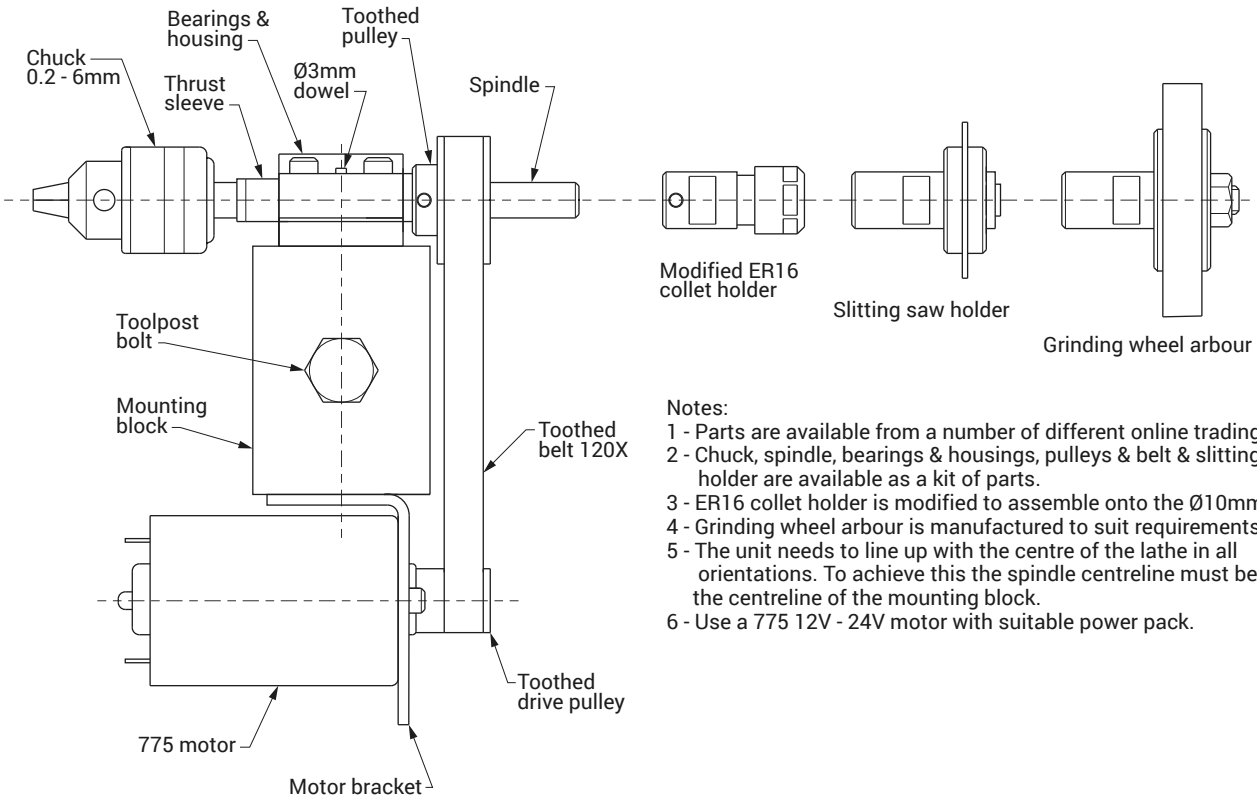
Turning Thrust Sleeve



Clocking Spindle Square



Drilling Dowel Holes



Notes:
1 - Parts are available from a number of different online trading sites.
2 - Chuck, spindle, bearings & housings, pulleys & belt & slitting saw holder are available as a kit of parts.
3 - ER16 collet holder is modified to assemble onto the Ø10mm spindle.
4 - Grinding wheel arbour is manufactured to suit requirements.
5 - The unit needs to line up with the centre of the lathe in all orientations. To achieve this the spindle centreline must be on the centreline of the mounting block.
6 - Use a 775 12V - 24V motor with suitable power pack.

Cutting Block to length with Warco Band Saw

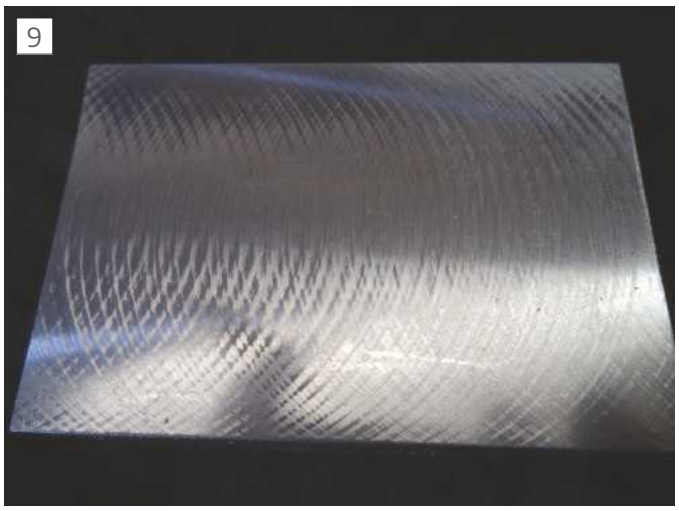
obvious how it goes together. There is a thrust split ring that goes between the bearing and the drive pulley but there is nothing to take the thrust from the chuck, so the first item I made was a thrust sleeve this goes between the bearing and the chuck spindle collar, this is a simple turning job, **photo 3**.

From the general assembly drawing you can see that not many parts are required. The key part is the mounting block and its critical feature that makes the fixture truly universal is for the spindle to be fixed on the centre line of this block, this enables the fixture to be orientated so that each tool type will be on the centre of the lathe.

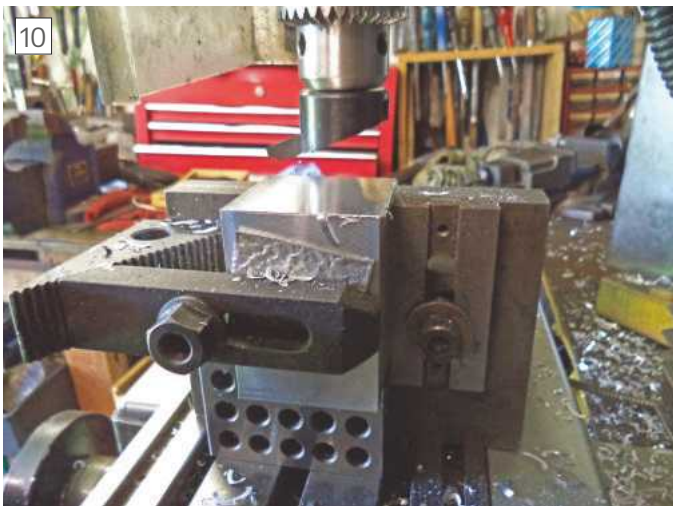
My first attempt at getting the spindle on the centre of the block failed I made the error of assuming that the centre of the shaft would be on the centre line of the bearing housing after a lot of head scratching, I found that it was 1.5 mm off centre.

Fly cutting block square in Vice; Note use of bar

Homemade trammel used to set milling head square to table



Criss-Cross Witness lines indicating that head is square



Angle Plate with Parallel used to square block to length

Drilling 10.5mm

Drilling block for bearing housing; dowel holes ensure spindle is central

Time for Plan B; The spindle was assembled into the housing and clocked square in the swivel vice then using an edge finder the mill was centred on the spindle and the direct read out zeroed, it was then an easy job to drill two 3 mm dowel holes symmetrical about the spindle centre, **photos 4** and **5**.

The motor bracket was made from a piece of box section I had available, but it could just as easily be made from mild steel angle or even bent up from 3mm thick material.

The mounting block is made from a 2" Square block of aluminium, first the block was cut off with a finishing allowance using my Warco band saw, as supplied the bar isn't perfectly flat and square. Using a fly cutter in the mill it was squared up and brought to final size. To ensure that the job came out square I first checked the head of the mill was square to the table using my home made trammel and to avoid the tilt of the vices moving jaw throwing the job out of square I positioned a round bar just above centre between the job and the moving jaw this ensured that the bar clamps up square against the fixed jaw, **photos 6**, **7** and **8**. A good indication that you've got the mill head square to the table is that you get a criss-cross witness mark from the cutter, **photo 9**.

A parallel was then clocked square on an angle plate and with the block tight up against this parallel the ends were fly cut square and to length, **photo 10**. The 10.5 diameter hole for the tool post clamp was drilled in the block. It was set on end and using an edge finder the mill was carefully set on its centre line for the two 3 mm dowel holes to be drilled the housing was located on these dowels and the position of the M5 holes spotted through and the holes drilled and tapped M5. A digital height gauge was used to check that the centre of the spindle was on the centre of the block, **photos 11**, **12** and **13**. The block was then flipped over and the four M3 mounting holes for the motor bracket drilled.

Checking Spindle is central using height gauge

Bracket made from box section

The motor bracket was made from a piece of box section I had available, but it could just as easily be made from mild steel angle or even bent up from 3 mm thick material. The slotted holes for adjustment of the motor to tension the belt were milled, and the bracket flipped round, and the four 3 mm fixing holes were drilled and countersunk.

Clamping the fixture to the tool post will depend on the make of your lathe, mine is a Chester's Model B and it's my system that I've drawn up, but apart from the details it will all be more or less the same for other makes of lathes. The first job is to carefully measure the centre height of the lathe and work out the thickness of the riser block. The block itself was made from a piece of 2" diameter mild steel drilled and carefully faced off to length, **photos 16** and **17**.

Milling Slots for adjustment

●To be continued

Measuring Centre height of lathe

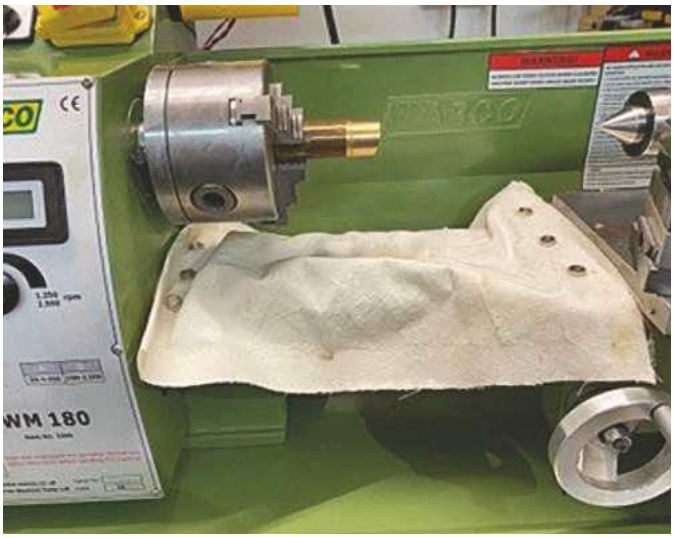
Drilling and facing riser block to length

Readers' Tips

CHESTER MACHINE TOOLS

Protecting Lathe Ways

TIP OF THE MONTH WINNER!



This month's winner is Ian Hale, with a a neat way to keep swarf from going where it's not wanted.

As a Newby to the world of model engineering and just purchased a new lathe I came up with the idea of a protective cover attached by magnets to protect the lathe ways from accumulations of removed material. Particularly useful for non ferrous metals.

Having purchased a new lathe, I was advised to keep the area between the Chuck and the saddle clear of chips and swarf. Keeping a flexible cover in place to allow free movement of the saddle etc. was the issue to be resolved.

In the pictures a piece of calico has three neodymium magnets fixed to each end using a glue gun. The magnets are then hemmed into each end to fix their positions. The cloth can then easily be removed and replaced with ease making this a cheap and practical way of keeping the lathe way free of unwanted waste material.

Two pictures show the prototype, I realised it would be better if the magnets were fixed within the material seams, so no risk of them finding their way to some where they shouldn't.

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!

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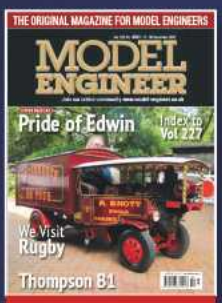

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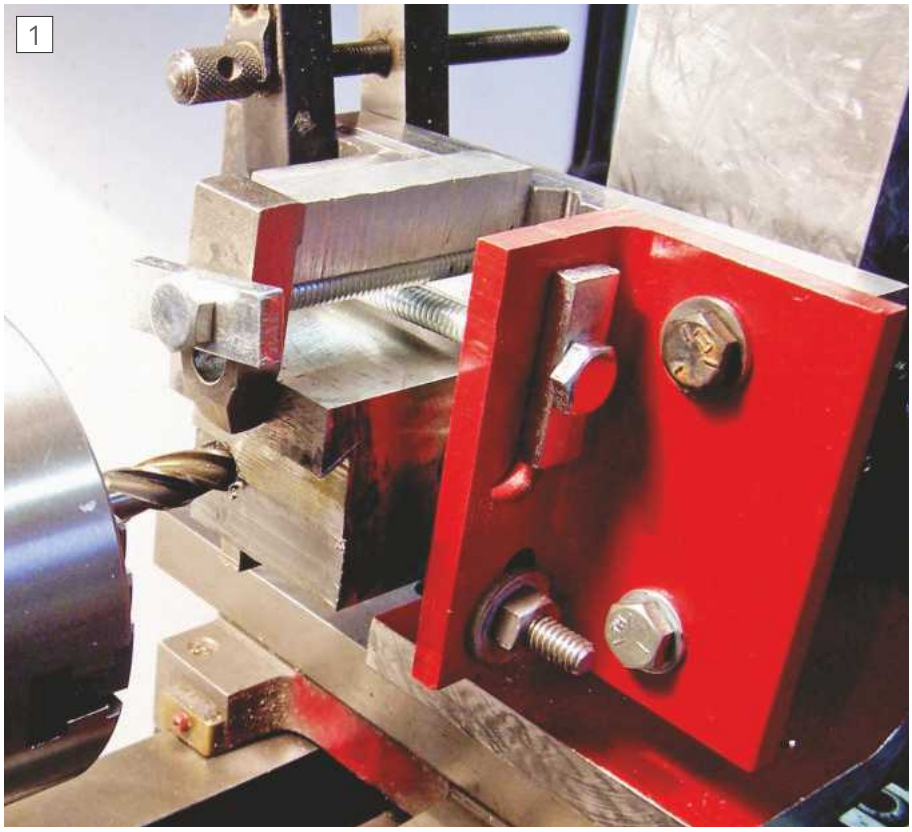
A Shop-Made Quick Change Toolpost

Ted Hansen describes his approach to making one of the most useful of lathe accessories. The drawings are not sequenced and will appear in full over this and the final instalment.

These days, most lathes are delivered with a square turret toolpost, which is a vast improvement over some earlier designs. The turret toolpost does have its limitations, however, and one of the most popular "must have" lathe accessories is a quick change toolpost and a set of interchangeable tool holders.

As the name implies, a quick change toolpost gives instant access to multiple tool bits already set up and ready to go. In addition, it allows infinite screw adjustment of tool height instead of fiddling with shims. Shims are limited to an accuracy of a couple of thousandths at best. On small diameter work where really accurate adjustment of tool height is critical, for example, two thousandths error is enough to prevent the tool from cutting on a 0.5 mm (approximately .020") workpiece.



1

Milling the face of the block with the work clamped to a vertical slide in the lathe.

As the name implies, a quick change toolpost give instant access to multiple tool bits already set up and ready to go.

A QC toolpost can be an expensive purchase. The basic set for a typical small home shop lathe will add at least 10% to the cost of the lathe. The set usually includes only three tool holders, which is not nearly enough for

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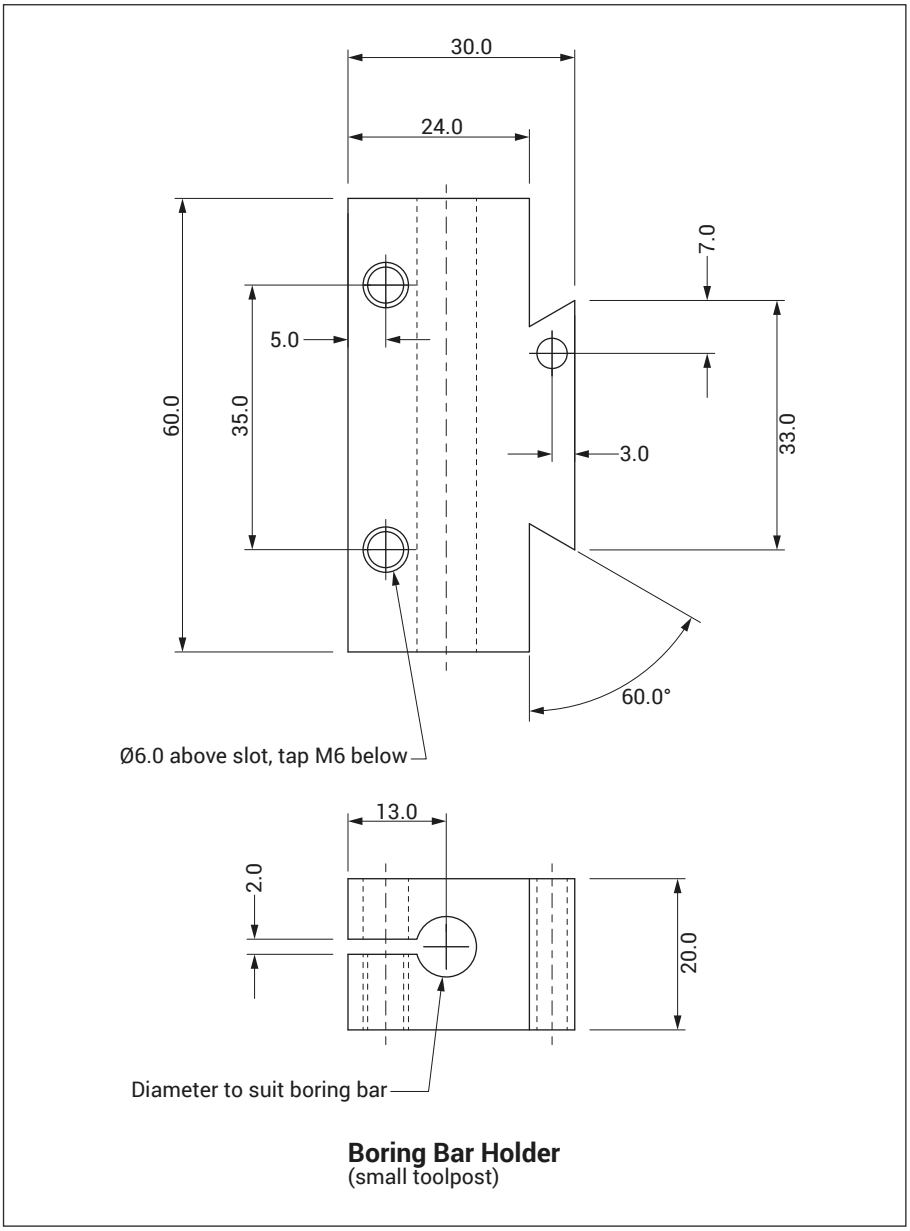


Boring Bar Holder
(small toolpost)

convenient working. Filling out the set to include more tool holders including some specialty holders for boring bars, cutoff blades, or knurling tools can more than double the cost.

However, a toolpost is not a complicated device. A shop-made quick-change set containing a variety of tool holders is a practical project for even a beginner.

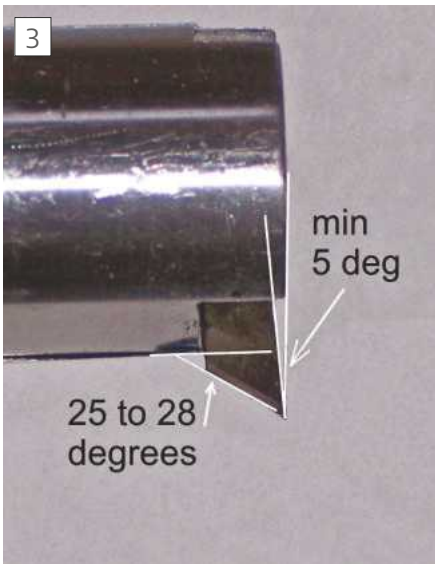
The design presented here has been simplified as much as possible for ease of construction without sacrificing the fundamental function. For instance, most commercial QC tool posts use a built-in cam to lock the interchangeable tool holders in place. This feature has been replaced by a simple clamp using an external wrench.

Another feature not included is a ratchet stop built into the base to provide accurate rotational positioning of the tool. This is mainly useful on a square turret toolpost where the toolpost is rotated to select the tool to be used. It is less useful on a quick change toolpost where tools can be exchanged without rotating anything.

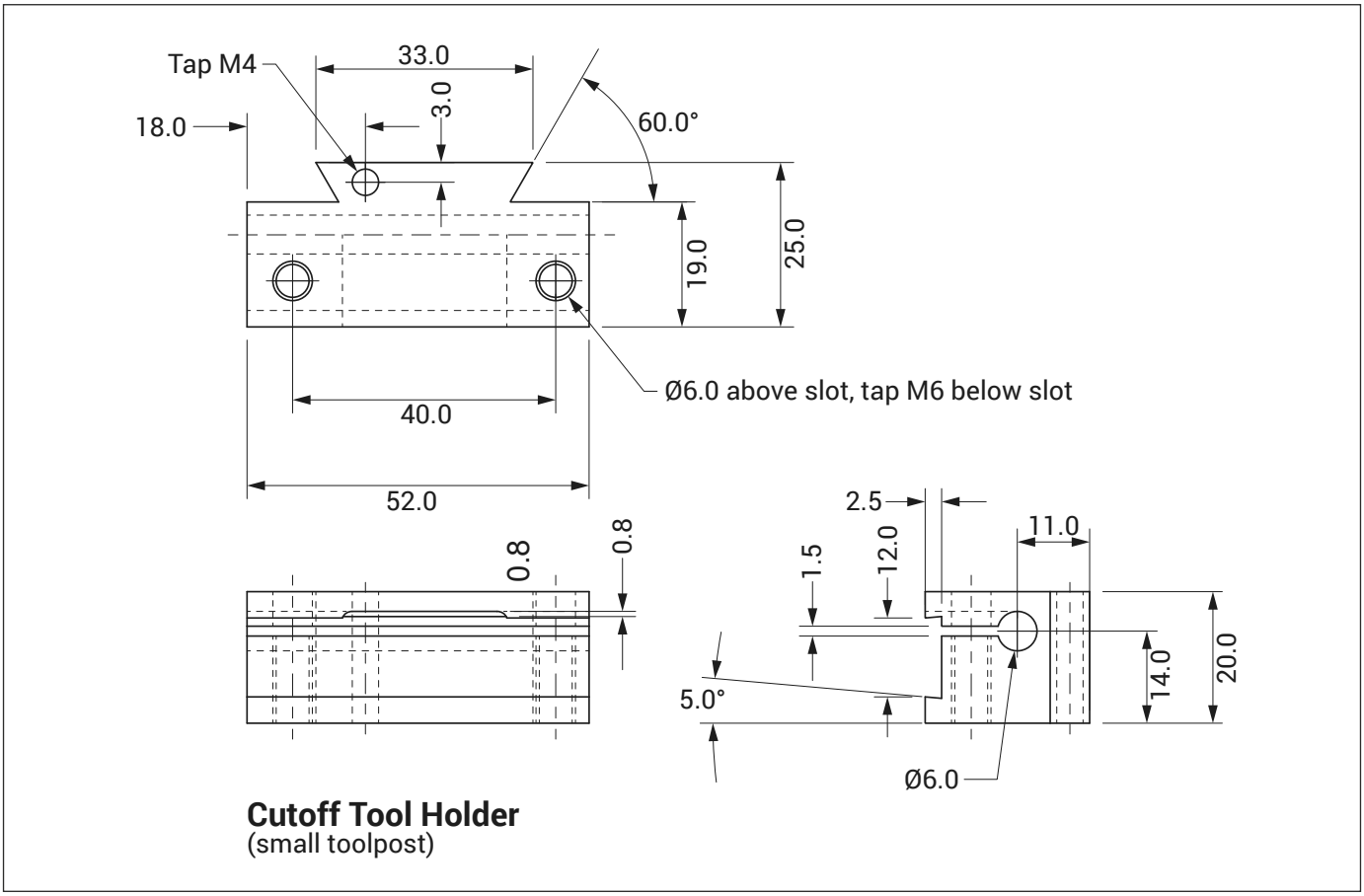
This tool post consists of only two parts, plus, of course, as many tool holders as desired. Although it does require some milling work, the entire unit can be made on a lathe using a vertical slide attachment. In fact, the prototype was made using only a 7" mini-lathe by adapting the top slide for use as a vertical slide.

The detail drawings show two versions. The smaller one is sized to be appropriate for equipment such as the mini-lathe, while the larger is more suited to a Myford, Boxford or similar lathe.

Regardless of which version you are building, begin construction by

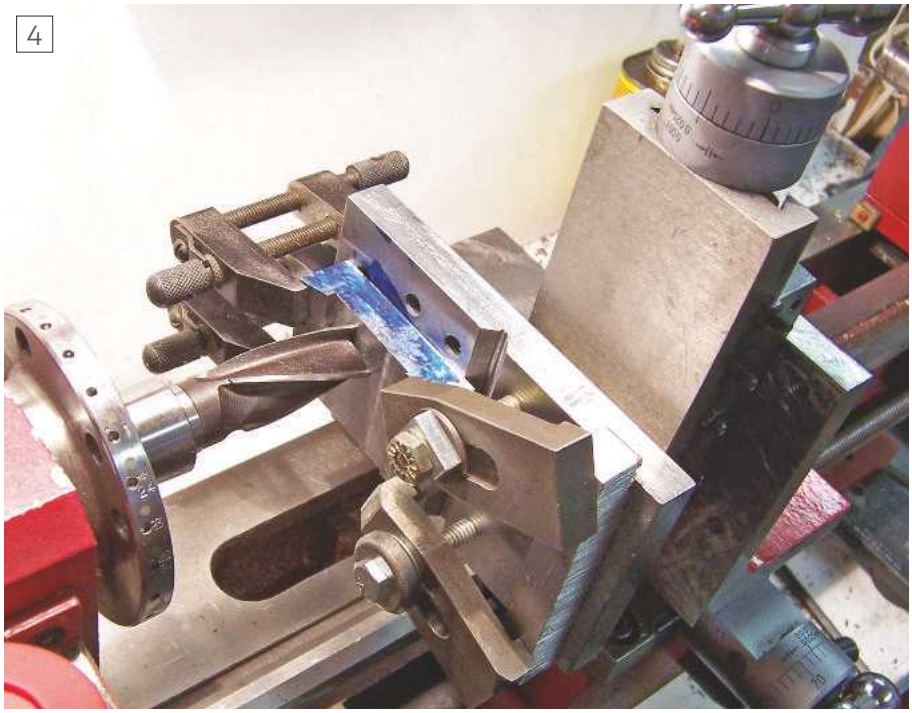


The flycutter bit.



Cutoff Tool Holder
(small toolpost)

4



Milling the centre of the clamp.

squaring up the two pieces of steel for the main block and the clamp jaw.

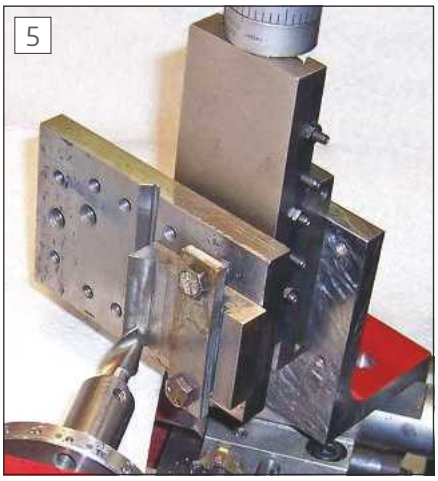
The Main Block:

Milling the block is easiest using a milling machine but it can be done on a lathe with a vertical slide. To save wear and tear on the milling cutters, mark out the dovetail and remove most of the metal with a saw before setting up to do the milling.

If you are using a vertical slide, clamp the main block to the slide making sure that the sides of the block are vertical, and ensure that the face of the block is square to the lathe axis by bumping it up against the face of the chuck, **photo 1**.

Mill the bottom of the vee first using a regular end mill, then cut the vee. It can be cut with a shop-made flycutter instead of buying an expensive dovetail cutter, **photo 2**. If your tool set does not yet include one, the accompanying drawings give some suitable dimensions for the flycutter. Most of the sizes do not actually matter much but do note that the top face of the tool bit is set 1.5 mm below the center of the cutter head to

5



Milling the dovetail vee on the tool holder clamp.

Drill the mounting hole to clear the stud on the top slide but do not drill the hole for the clamp screw at this time.

create some top rake on the cutter.

The flycutter bit should be sharpened to an angle of about 28°. The exact angle is not critical because all the cutting is done right at the tip, the angled side is just to provide clearance. The bit must be set in the flycutter so that the tip projects forward at an angle of at least 5 degrees and the side is at an angle less than 30 degrees to the axis of the cutter, **photo 3**. Make sure you grind enough end clearance on the bit to allow for the radius of the cutter.

Coat the back side of the cutter using magic marker or layout ink and then make a trial cut on some scrap material. Check the cutter after the trial cut to determine if any of the marker has rubbed off. If it has, the back of the tool must be reground to provide additional clearance.

Fly cut the vee in small steps, advancing the cutter and moving it over with each pass to create the 30-degree angle. The side movement must equal the tangent of 30 degrees (0.577. times the infeed).

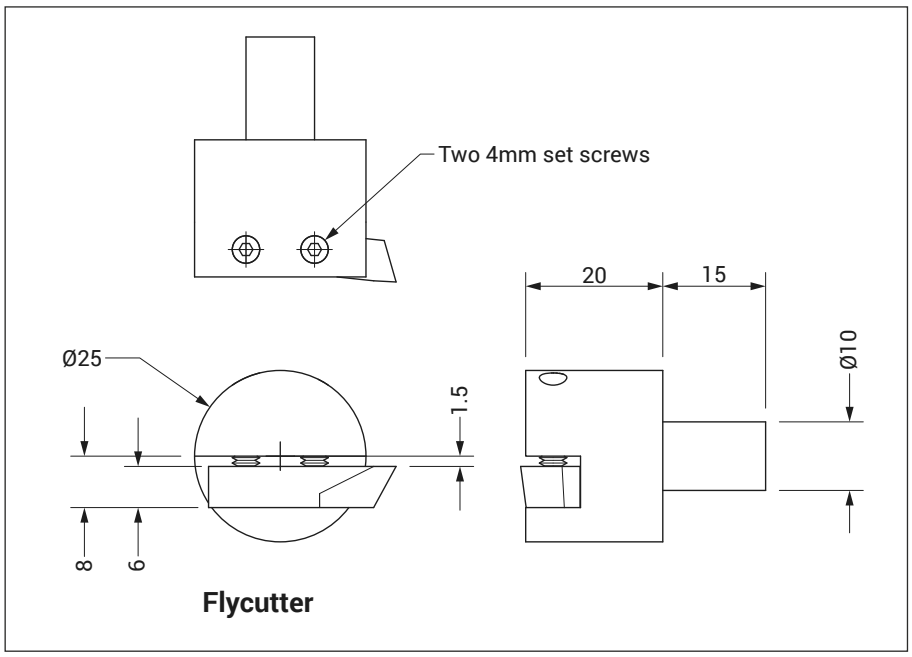
Never mind the math, with each pass, advance the cutter 0.5 mm into the work and move it sideways 0.29 mm. If you are working in imperial units, the corresponding figures are .026" down feed and .015" side feed for each pass.

Mill the vee until the tool almost reaches the previously milled bottom. The centre part of the dovetail is 7 mm deep, however it does not have to be full depth right to the corner of the vee as long as it is deeper than the 6 mm depth of the tool holder dovetails.

A few quick strokes with a file are all that should be needed to smooth the finish.

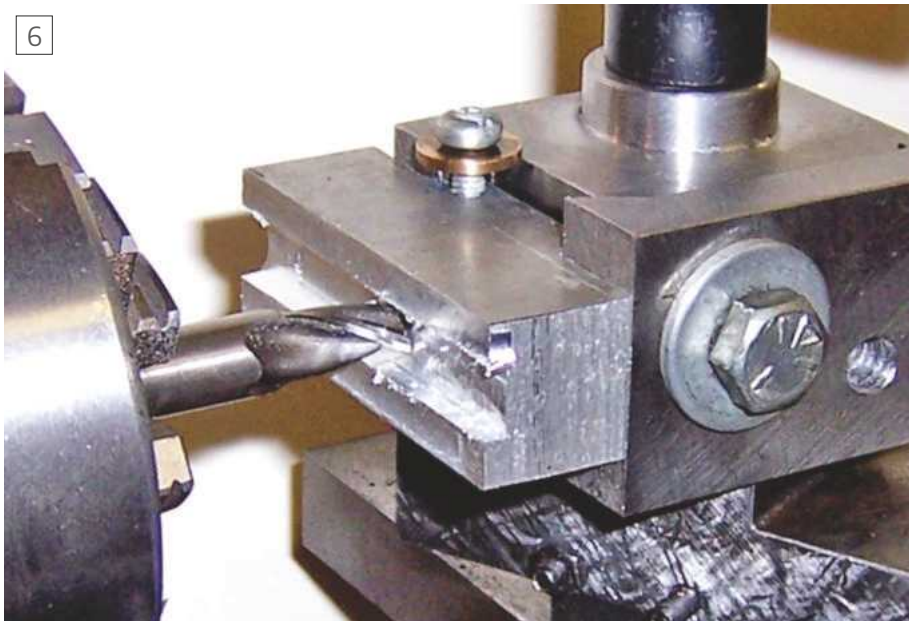
After completion of the vee, relocate the block and mill the clamping face. Don't forget to leave the raised ridge for the clamp to seat against.

Drill the mounting hole to clear the stud on the top slide but do not drill the hole for the clamp screw at this time. It will be located from the clamp jaw once that part is completed. Note that the mounting hole in the mini lathe version is offset from the centre of the block to better position the tool holder on this small lathe.



Flycutter

6



Cutting the slot for the tool bit. Note the temporary height adjusting screw.

The Clamp Jaw:

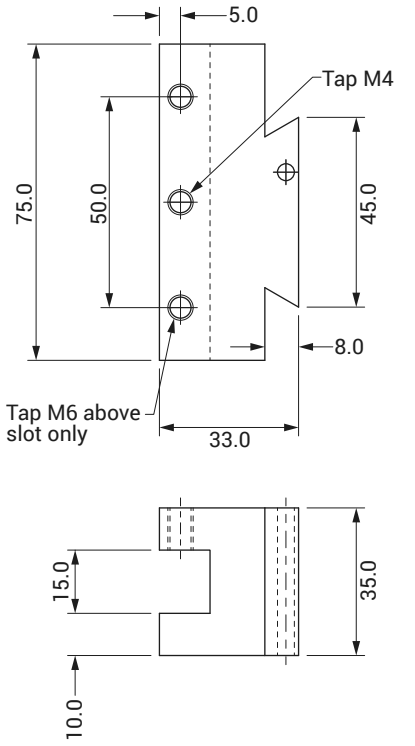
If you are doing the milling in a lathe, clamp the squared off blank to the worktable holding it only by the ends so that the center part can be milled away, **photo 4**.

Reduce the thickness of the center area to 8 mm.

Cutting the angled edge of the vee is easier on a vertical slide in the lathe than on a mill because the vertical slide can simply be swivelled to obtain the required angle, **photo 5**.

Next, drill the bolt hole 6.9 mm diameter (tap size for 8 mm thread). Note that the hole is only 13 mm from the bottom edge instead of being centred in the piece in order to create a clearance of 2 mm under the clamp. Finish off the clamp by filing a slight radius on the fulcrum end.

Use the tool holder clamp part to locate the hole for the clamping bolt (this is the reason the bolt hole was only drilled to tap size.) Set the top edges of the two pieces flush and place a spacer between them so that the clamp is parallel to the block. Clamp them together and use the hole in the clamp to guide the drilling of the hole in the tool post. When done, open out the hole in the clamp to 8 mm and tap the hole in



Toolholder For Large Toolpost

> In my experience it is almost impossible to have too many tool holders - half a dozen is an absolute minimum.

the tool post M8 x 15 mm deep.

The Top Washer:

There should always be a washer under a nut, so this simple part is next. On a mini lathe, the washer must be approximately 6 mm thick to add height so that the original toolpost stud and clamp lever can be used. Adjust the thickness of the washer so that the clamp lever projects back out of the way when tightened. Removing 0.38 mm (.015") from the thickness of the washer will reposition the handle by approximately ¼ turn.

Tool Holders:

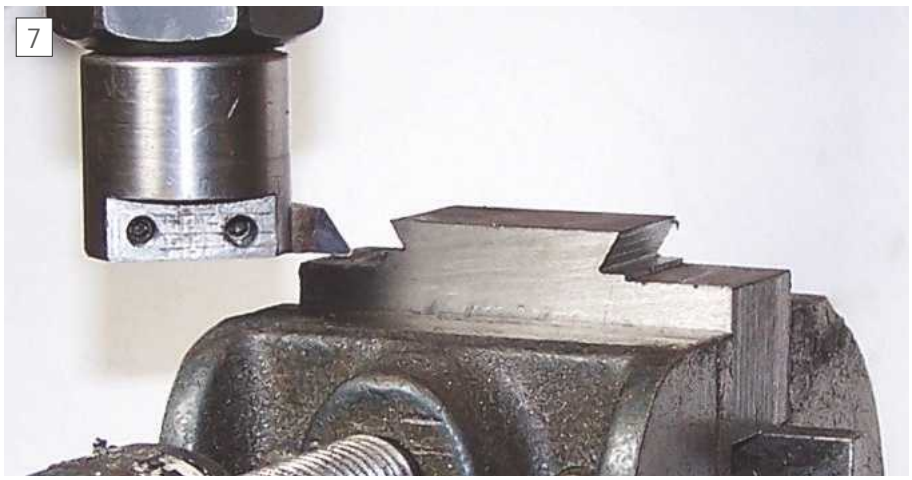
In my experience it is almost impossible to have too many tool holders - half a dozen is an absolute minimum. Material is optional, steel of course is strongest but I have also found cast iron or aluminum to be satisfactory.

The slot for the toolbit is best cut with the tool holder mounted in the actual toolpost, **photo 6**.

The boring tool holder shown in the drawings is proportioned so that the center of the bar will be located approximately at lathe center leaving some room for height adjustment both up and down.

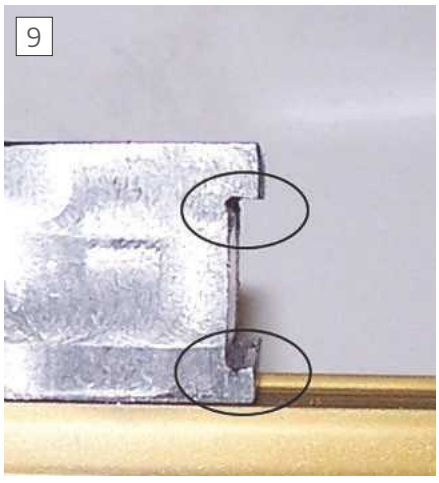
The accompanying photos show a cutoff tool holder being made from cast iron.

First, square up the block, which can be done either in the milling machine or the lathe using the four-jaw chuck. Next, cut the dovetail vees, **photo 7**, then cut the slot to fit the cutoff tool blade, which should be a close fit, **photo 8**. Notice that the centre part of the top of the slot is relieved to create a contact point at each end rather than all the way across. The edges of this slot should be angled slightly so that the blade is held securely. It is easier to file these small angles rather than grinding a special milling tool to shape, **photo 9**.



Cutting the dovetail vees on a tool holder.

Checking the width of the clamping slot using the actual cutoff tool blade.



The small angles on the slot hold the tool blade in place were created with a file.

●To be continued

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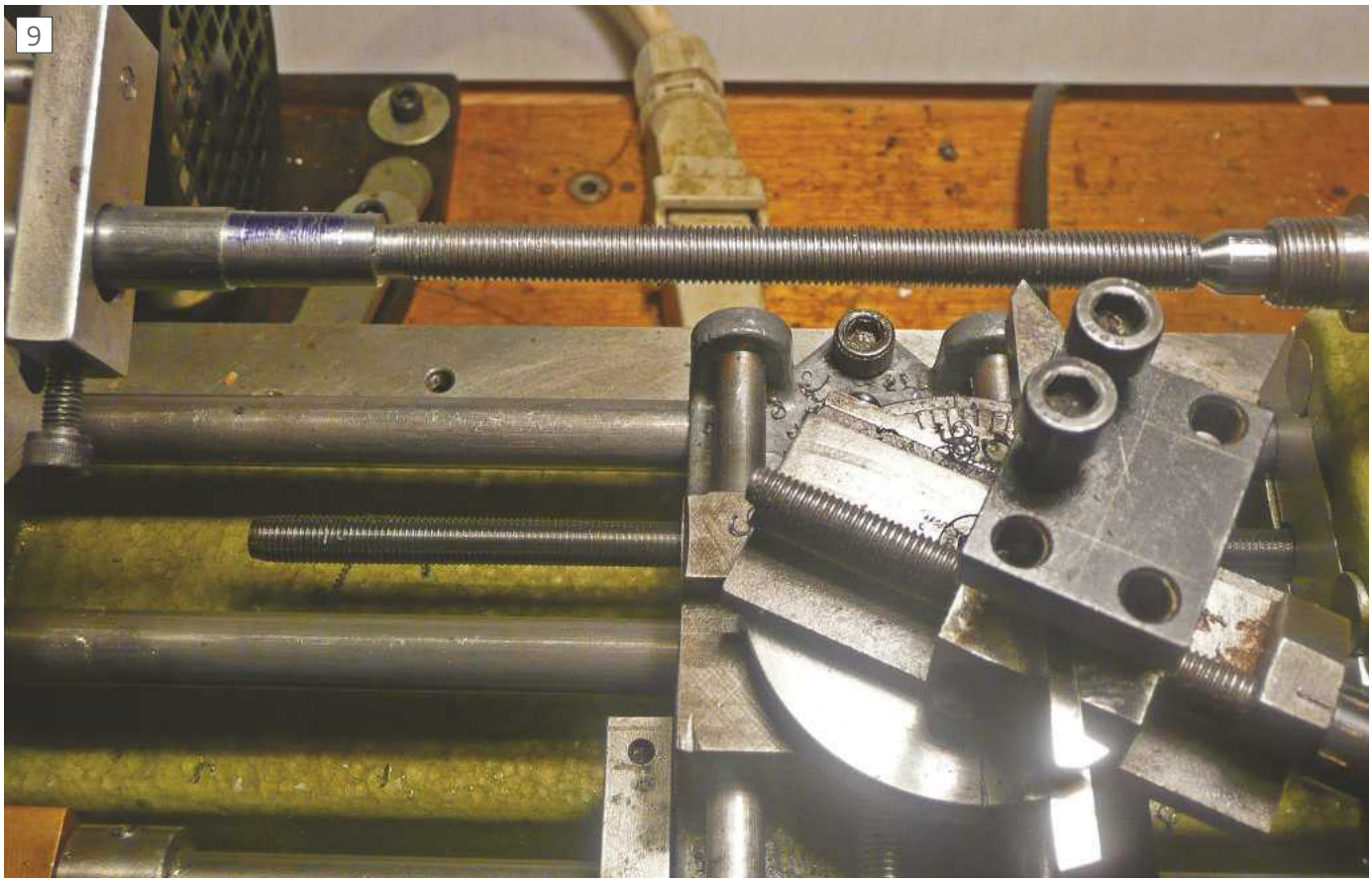
An X-Y Dual Axis Worktable for the Small Workshop

Terry Gorin makes an accessory for the Unimat in milling mode with many other potential uses - Part 3



Screwcutting feedscrews

Feedscrew Brackets (4) and (5)

These were cut from stock BMS, and square turned to lengths as **fig. 9**. The 4 mm dia. holes were drilled and counterbored but the central holes drilled 4 mm dia. only at this point. The brackets in turn were then aligned and clamped to the top of their relevant female slides, as fig. 3. The positions of the M4 tapping's, at the top of the female slides, were spot drilled through the 4 mm dia. bracket holes and then drilled and tapped as fig. 1. (The 6 and 11 dimensions for these holes in fig. 1 were indicative only). The brackets then marked as X and Y axis components.

Locating and cutting feedscrew threads

With X axis bracket and female slide (1) bolted together and, with gib and grub screws clamping both to X axis male dovetail, with bracket tight to male dovetail, the location for feedscrew (6) was drilled through the 4 mm dia. previously drilled central hole of the bracket, to a depth of about 5 mm in the male slide. The male slide was then separated, mounted in the four-jaw chuck and centred around a short, tight-fitting mandrel located in the 4 mm dia. spot drilling. With the mandrel removed, the male slide was then through drilled with a 7.2 mm dia. tapping drill and counterbored 10.5 mm dia. x 3.5 mm deep as fig. 2. While still mounted in the chuck the M8 x 1 thread for feedscrew (6) was started with the taper tap held in the tailstock chuck and 'hand pulling' until the taper tap threads level with the bored sinking. Threading was then continued by the second tap as deep as possible before the drill chuck lost grip. The male slide then removed to bench vice and second tapping continued, followed by plug tap, carried to full thread depth as fig. 2. To complete, the male slide was reversed and re-centred around the tapping drill inserted into the unthreaded length, then drilled 9 mm dia. to the depth indicated to ensure adequate clearance for the feedscrew. When removed from the chuck, the plug tap was again passed through to ensure threads fully cleared.

With Y axis bracket and female slide (2) bolted together and, with gib and grub screws now clamping both to Y axis male dovetail with bracket tight to male dovetail, location, drilling, counterboring, tapping and clearance drilling for feedscrew (7) was similarly carried out but this time for M8 x 1 LEFT ›

Worktable on lathe & pedestals.

HAND thread. The X and Y axis female and male slides now completed and the temporary, central 4 mm dia. holes in both feedscrew brackets enlarged to7.5 mm dia.

Feedscrew (6)

The ends of a length of 12 mm dia. free-cutting BMS, cut to finished length, were faced and centred on the Myford and then mounted between centres on the Unimat. Length up to the lathe dog first reduced to 10 mm dia. and then turned to form the M8 mandrel and shoulder to the finished size as shown in fig. 9 and indicated at (1) in Sketch E. With the Unimat gear train set to 1 mm pitch and lowest backgear speed, the tread was then screwcut to approx. 70% depth, as **photo 9**. 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 10 mm dia. shoulder was next faced to 3.5 mm length and the adjoining spigot, M6 mandrel, together with thread clearance groove and end taper all turned to finished sizes as fig. 9. The M6 thread then similarly part screwcut. Before removal from the lathe the 7.5 mm dia. hole in the feedscrew bracket was used to ensure the feedscrew spigot able to rotate freely. The workpiece threads were then ready for hand finishing by die. When opened to oversize, and

Fig.9

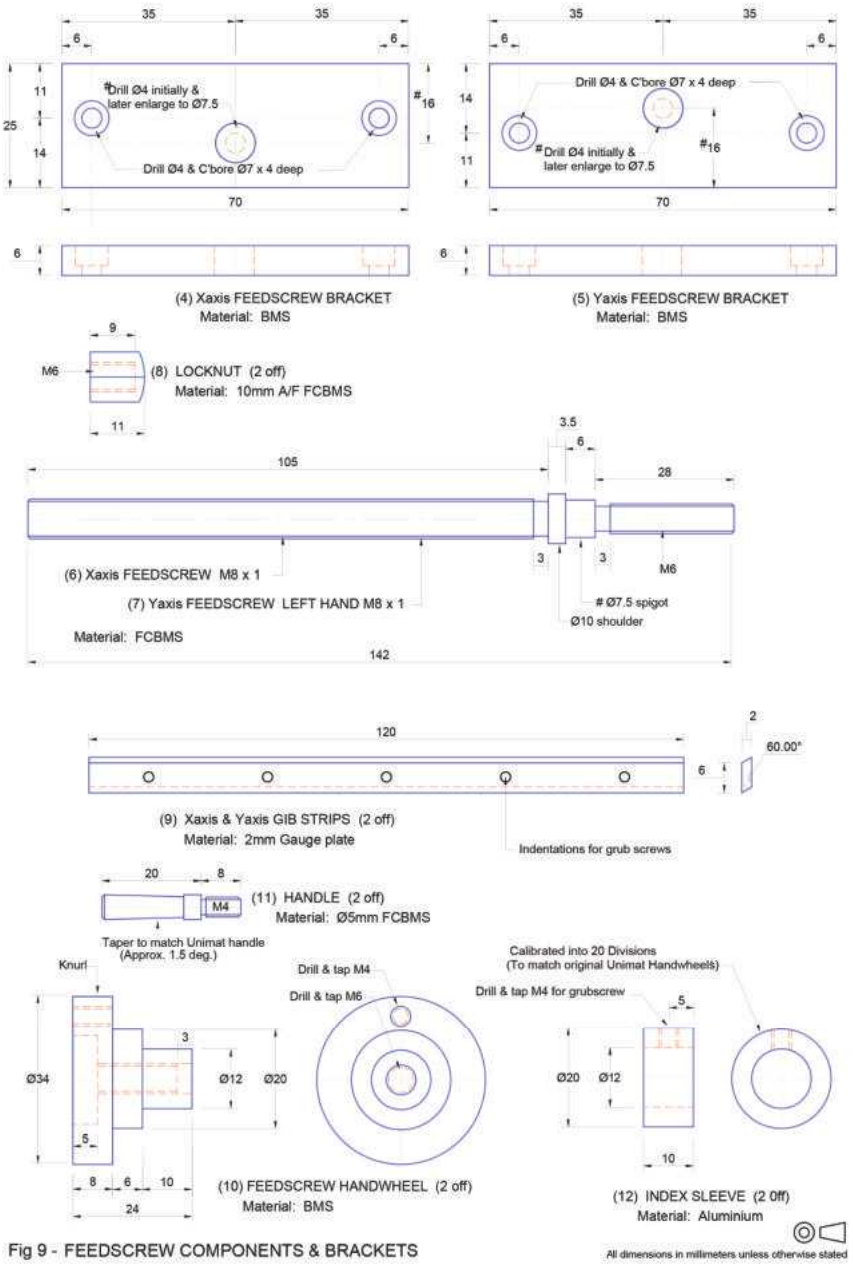


Fig 9 - FEEDSCREW COMPONENTS & BRACKETS

aided by the lead in taper, both dies engaged easily and accurately with the pre-cut threads. Progressive die closing and cutting continued until the M6 engaged with any of the milling fixture tappings and the M8 thread engaged smoothly into the top male slide (X axis) tapping.

Feedscrew (7)

An exact repeat of the above but the M8 x 1 thread to be LEFT-HANDED and finished to engage smoothly with the bottom ('Y' axis) tapping.

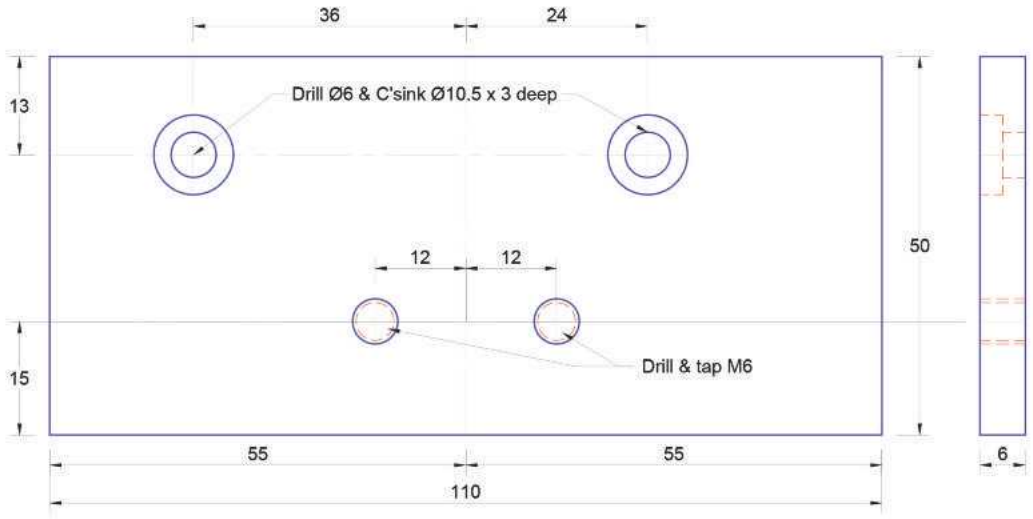
Locknut (8) Feedscrew Handwheel (10) Handle (11) Index Sleeve (12)

All turning, drilling and boring of these items was carried out on the larger lathe, to save time. The sleeve was calibrated on the Unimat using indexing head and a 0.4 mm slitting saw with the headstock mounted vertically.

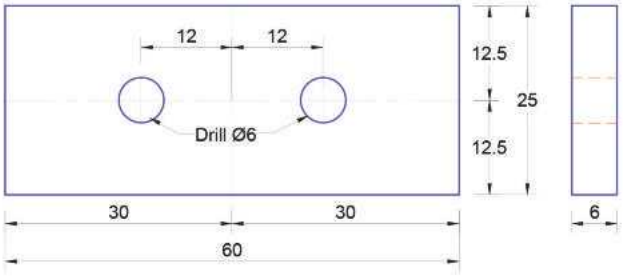
Rear Mounting Foot (13) Front mounting Foot (14) Spacer (15) Pedestal (16)

These components, detailed in **fig. 10** and showing in photo 2, are to enable the assembled worktable to be screwed or bolted to any work surface or bench drill table and provide clearance for the handwheels. The pedestals are for bolting the worktable direct to the Unimat's baseplate as shown in **photo 10**. The earlier made vertical slide added for illustration, but not bolted! ∎

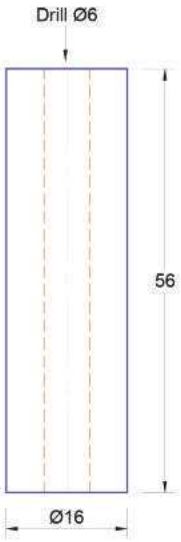
Fig.10



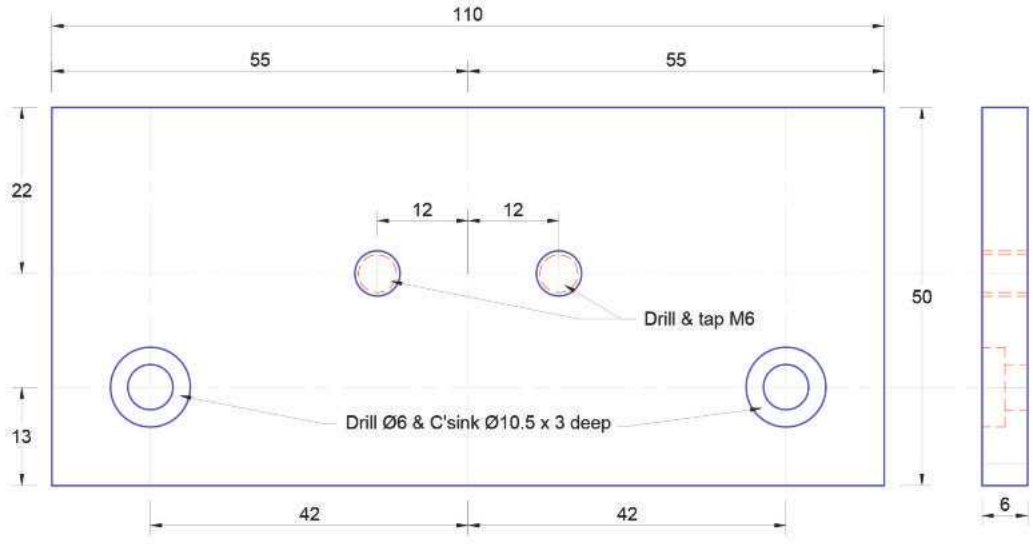
(13) REAR MOUNTING FOOT
Material: BMS



(15) SPACER (2 off)
Material: BMS



(16) PEDESTAL (4 off)
Material: BMS



(14) FRONT MOUNTING FOOT
Material: BMS

Fig 10 - WORKTABLE MOUNTINGS

All dimensions in millimeters unless otherwise stated

Scribe a line

YOUR CHANCE TO TALK TO US!

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

T&C Grinder Identification

Dear Neil, could you please ask your readers? I have recently purchased a "Kirba tool and cutter grinder made in 1977" the collet shank measures 23 mm and is 98 mm long. I assumed these were 5c collets, but when I ordered 5c collets from a reputable U.K. Supplier the ones they sent measure have a 32 mm shank and are 85 mm long. Can anyone identify these and let me know where I can get them. I would also like to get a manual for the Kirba. I would be great full for any assistance.

Mick Gallagher, by email

Source of Angle Iron

Dear Neil, this year, I have decided to really get stuck into the 'build' of my 1" Minnie Traction Engine, and as L C Mason's book suggests, I am starting with the boiler. I use the term 'start' loosely, as I have already had a go with the wheel rim castings, just to see if my Chester Conquest Super lathe needed anything?

It did - to accommodate the rear wheels, I have added a 100 mm 4 jaw chuck.

Apart from bending and forming, the main process for the boiler is silver soldering, for which I need a hearth of some description.

I had already made a preliminary design utilising 3 off 440x215x75 Celcon blocks, but was unsure if they would be suitable. I was therefore pleasantly surprised to see a recent article in MEW by someone who had done just that. Unfortunately, redundant angle iron bed frames seem to be in short supply at the moment, so I will have to bite the bullet and fork out for some 20x20x3 angle.

So, do readers know of any stockists who would supply small orders of 20x20x3 angle at a reasonable price?

Doug Farrant, Great Dunmow

Manual for Pinnacle Drill

Dear Neil, I noted the query in my recently-arrived copy of Model Engineer's Workshop No. 309 from reader Ted Fletcher seeking an instruction manual/parts list for a Pinnacle PCD 30 mill/drill. I believe that a good starting point for Mr. Fletcher would be Tony Griffiths' site, Lathes.co.uk, and in particular this page: http://www.lathes.co.uk/pinnacle/ The information contained therein appears to confirm Mr. Fletcher's belief that Pinnacle machines were marketed under a variety of names.

As you can see, Mr. Griffiths offers what he describes as a generic manual and parts list for machines of this type. I have not seen this manual or Mr. Fletcher's machine, so I am, unfortunately, unable to recommend it without reservations. The machine illustrated is a PDM-20, and not a PCD 30, so Mr. Fletcher should check the specifications for his machine very carefully against the specifications given in the web page before proceeding.

I hope that this information is useful (and I will be surprised if other readers have not already offered it).

Luther Dietrich, Earlysville, Virginia, USA

Happy New Year

Dear Neil, Happy New Year and best "workshop" wishes for 2022, with bearing balls for quick moving!

J Maurel, France.

William Cody's Tree

Dear Neil, At the end of my last submitted piece, I mentioned that I am acquainted with the great grandson of William Cody. William Cody had a go at a lot of things. His house at Ash Vale, Farnborough, was filled with his various artefacts until about twenty years ago. Cody's tree, the one he tied his aeroplane to, is hallowed ground at Farnborough airport and is always mentioned at the bi-annual air show. In the mid to late fifties, I was a Pattern maker working at the Royal Aircraft Establishment (R A E) The tree was obviously rotten. They tried coating it in an early Polyester resin, but it was unsuccessful, so three of us were detailed to cut it up and turn the various pieces into patterns so that aluminium castings could be made from them at the on-site foundry. Dozens of photos from all angles were taken before we cut it up, to assist the people who welded the castings together. The finished "tree" was then coated in black epoxy. to resemble the ancient original and replaced behind the iron railings surrounding it. All concerned were clearly informed that all such work came under the Official Secrets Act and no word of the transformation was to be published. The Secret was kept until the late 80s when the R A E was privatised.

Not a lot of people know that!

Keith Beaumont, Bracknell.

Born Samuel Cowdery, William Cody changed his name to that of his hero, 'Buffalo' BillI Cody and was an early test-pilot at Farnborough – Neil.

Bench Thoughts

Neil, Having just started looking at the Jan 2022 issue of MEW I saw your new bench. I'm into classic cars as a main hobby and have found over the years that leaving a bench top as bare wood leads to problems with stains and (not) finding things one has just put down easily. Two suggestions:

1. Cover the top with hardboard and paint it white using ordinary gloss paint (with undercoats). This will wipe down easily and can always be repainted.
2. Cover the top with some floor vinyl which, again, will wipe down easily. One can also easily bend the rear up against te wall as an upstand helping one not to loose things (or dirt) down the back of the bench!

Both allow one to have a clean bench without too much effort. I've also found that (old) Kitchen worktops also make good, sturdy, benchtops.

My workshop equipment is really quite basic apart from the specialist car tools. I have a ML7 lathe, bought new by my father. It has a serial number in the 1200's so dates from the late 1940s plus numerous accessories bought in the late 70's, a wartime Wolf 3 phase bench grinder and a small bench drill. However, I manage to do what I need to do. I have a 7 year old grandson who is becoming a dab hand at using them as well (under supervision of course)!

David Bond, by email

More Bench Thoughts

Dear Neil, your photo of the "Editor's Bench" in the editorial for the January issue has inspired me to send in this photo of my beloved bench. Constructed over fifty years ago for an electronics hobby it has done me proud ever since and it is now used for model engineering.

When I bought my first house, I wanted a bench in the attic but it had to be of low cost. A friendly joiner provided me with four legs morticed at the top to take the four rails (2 side, front and back), and a piece of blockboard for the worktop. A flooring contractor gave me a linoleum offcut and some adhesive. I bought the aluminium angle to finish it off. The back rail was screwed to the wall to give it stability.

A few years I moved house. Luckily, I had not screwed down the top but I had glued the rails to the legs. To get the frame down from the attic I had to cut off the back and front rails. When I got to the new house, I decided to re-fix the front and back rails with hinges so the frame can be folded flat, to avoid future problems. I added the vertical panel made from ¾" ply and it is just notched over the side rails. This has a rail at the bottom to support the back edge of the worktop. The top shelf is cut from an old bar counter that was being thrown out and sits in place. The power points are wired through the "big switch" at the right-hand end and then via a lead to a wall socket. The bench supply is limited to 13 amps but does not require any additions to the house wiring.

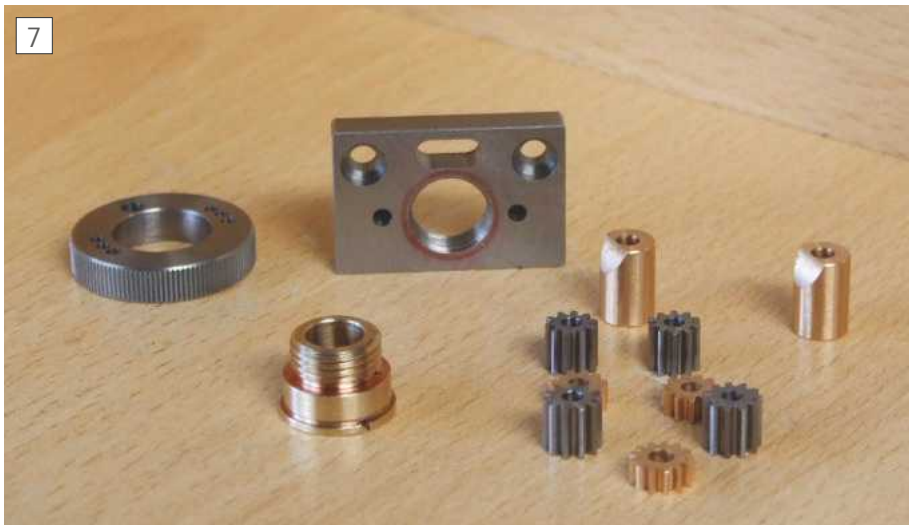
My bench is now in its eighth house! Taking it down and re-fixing each time has only required two bolts fixing the back rail to the wall. I have been lucky that this always been a brick or concrete block wall. Fixing to a stud and plaster board would mean finding the studs to fix to. To take the bench down takes less time than to type this description, yet it is surprisingly stable. I hope that I will need to move it again, but who knows.

Tony Leeming, Pickering, North Yorkshire.

New and Mk V Boring and Facing Heads

Graham Meek introduces new versions of his boring and facing head design

Originally this selector was to have two sprung ball detents to retain the chosen selection, but during use on the 50mm B&F Head it was found the selection would on odd occasions "drop out" whenever the rotation of the dial was reversed. **Photograph 7** shows the original selector with the two sets of detent holes. This state of affairs was not one which I was prepared to live with. Nor would I allow a fault like this to go into the public arena. Therefore, to overcome this annoyance the selector ring now has a slot on the one side and an M2.5 capscrew on the MKV to lock the chosen selection, **photo 8**. A special washer to go under the head of the capscrew was turned up. A commercial washer is usually larger than the available space allows, and it would look rather unsightly. The head of the central bearing bush for the selector and feedscrew does not want to protrude above the selector ring. Otherwise, the washer under the capscrew will trap this bush, which in turn will tilt the bush jamming the feedscrew. The tumbler gear also has a neutral position which allows the feedscrew to be turned manually via the Allen key socket in the M3 countersunk screw, for initial setting up purposes. The primary use of this countersunk screw is to lock the feedscrew for backlash adjustment. A micrometer "C" spanner will be found useful here. The M3 size was chosen such that only one Allen key is needed for all the major adjustments on this particular boring head. Generally, I am not a keen user of countersunk screws. My dislike with the Allen countersunk is the shortness of the Allen key socket. To rectify this the existing Allen key hole is drilled a little deeper to 2.3mm and the socket elongated using a specially ground HSS hexagonal broach, but this could easily be milled from Silver steel. This gives a much more positive location and more importantly one that will stand up to years of use, without weakening the screw.

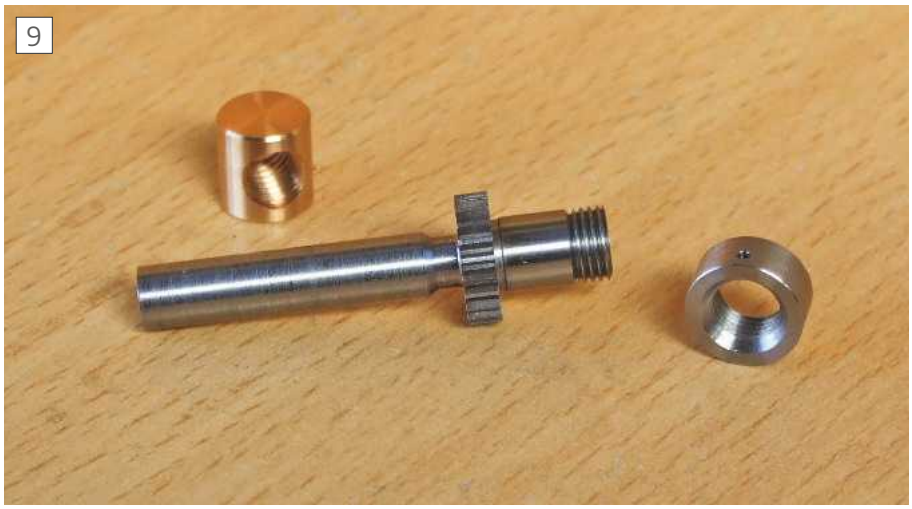


Gears, endplate and selector.

To retain machine tool convention the feedscrew **photo 9**, really needs to have a left-hand thread, (the tool slide usually moves away from the operator with a clockwise rotation of the feedscrew). Therefore, the feedscrew was screwcut with an M6X1 P LH thread.

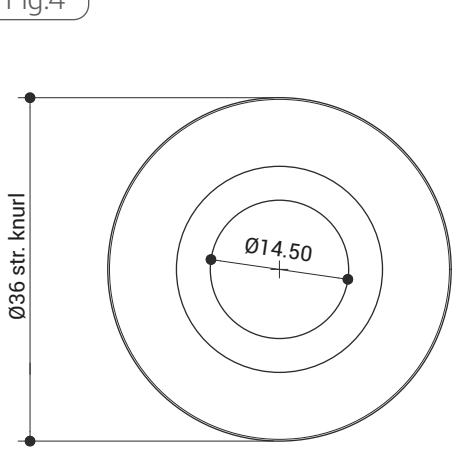
The feed ring **photo 10**, has three spring loaded 3/32" ball bearings pressing on the upper portion of the worm gear

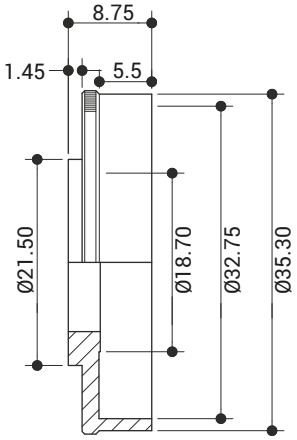
Assembled boring head.

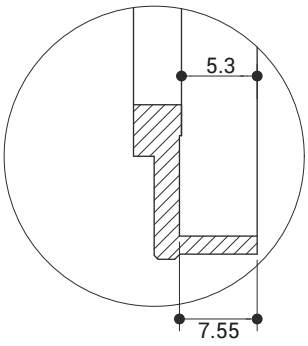


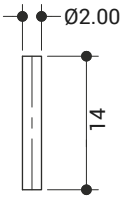
Feedscrew as yet not screwcut, feedscrew nut and locknut.

Fig.4



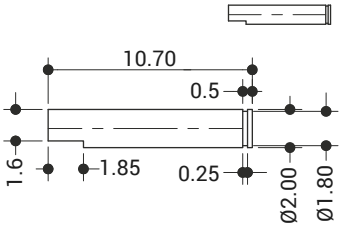




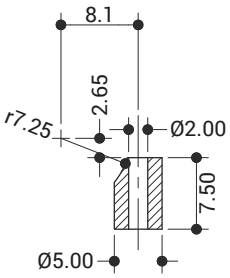


Dial
Mat'l: Mild steel

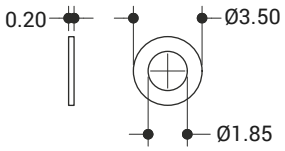
Axle
Mat'l: Silver steel
2 off



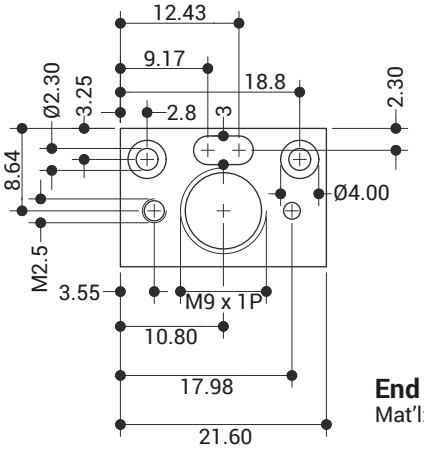
Selector Gear Shaft
Mat'l: Silver steel

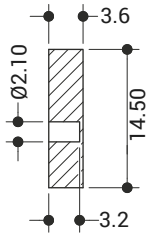


Bearing
Mat'l: Phosphor bronze
2 off

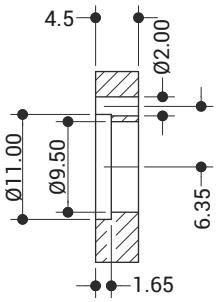


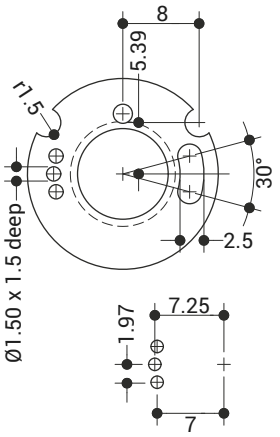
Selector Gear Retaining Ring
Mat'l: Delrin



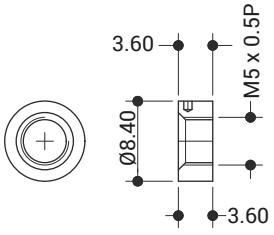


End Plate
Mat'l: Mild steel

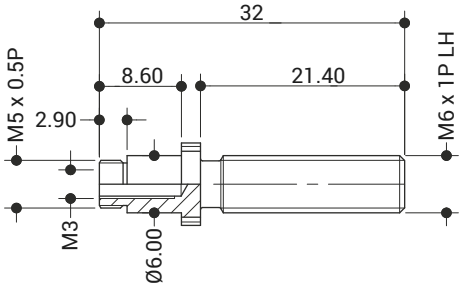




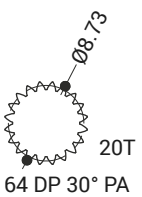
Selector Ring
Mat'l: Mild steel



Backlash Eliminator
Mat'l: Mild steel



Feedscrew
Mat'l: Mild steel



64 DP 30° PA

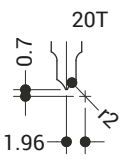
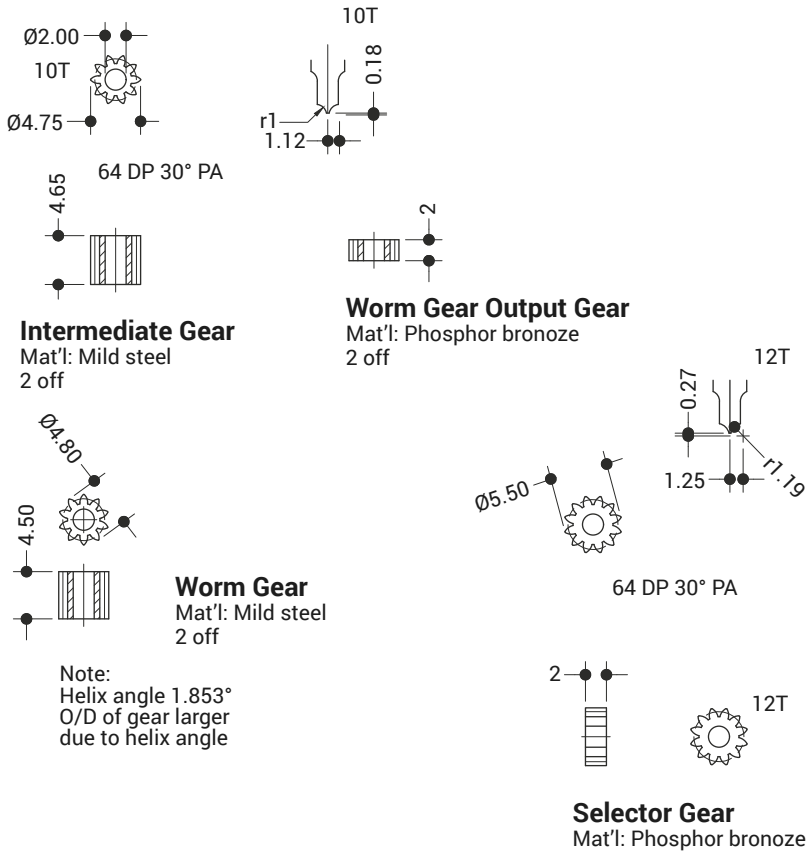


Fig.5



Feedscrew Bearing Locking Tool

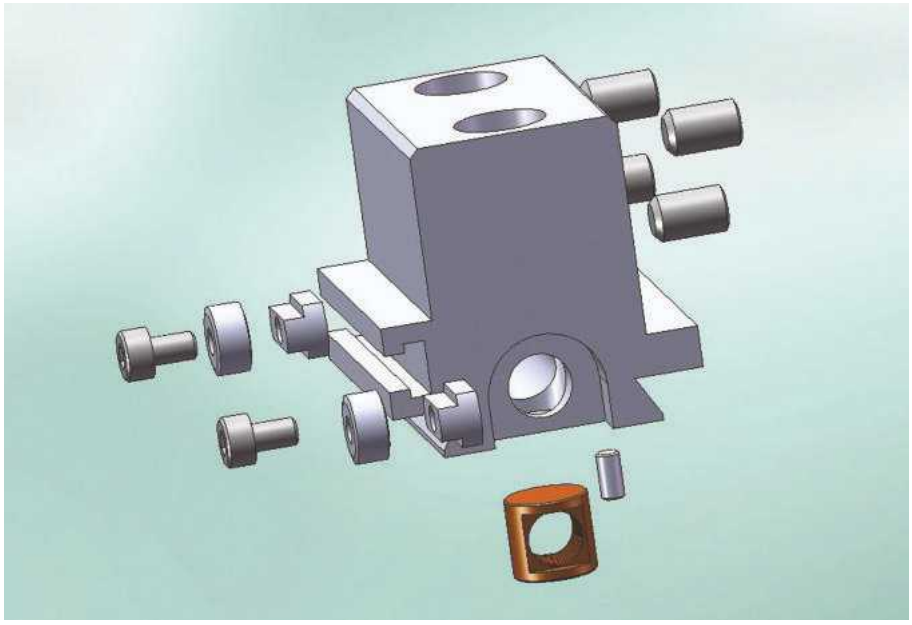
Feed Ring and ball bearing clutches.

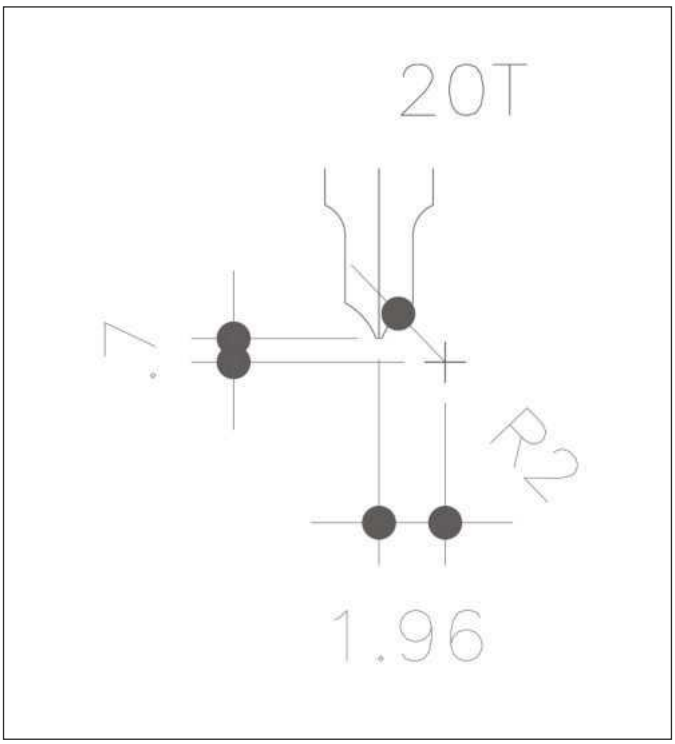
which has six holes drilled to act as the clutch mechanism. This clutch only comes into its own when the stop is set on the tool slide to limit the radial movement, or when the head is being adjusted without first releasing the tool slide lock. The upper face of this feed ring has a shallow pocket to accept the torque arm block. This pocket is a safety feature as it does not allow the torque arm block to pivot or work loose.

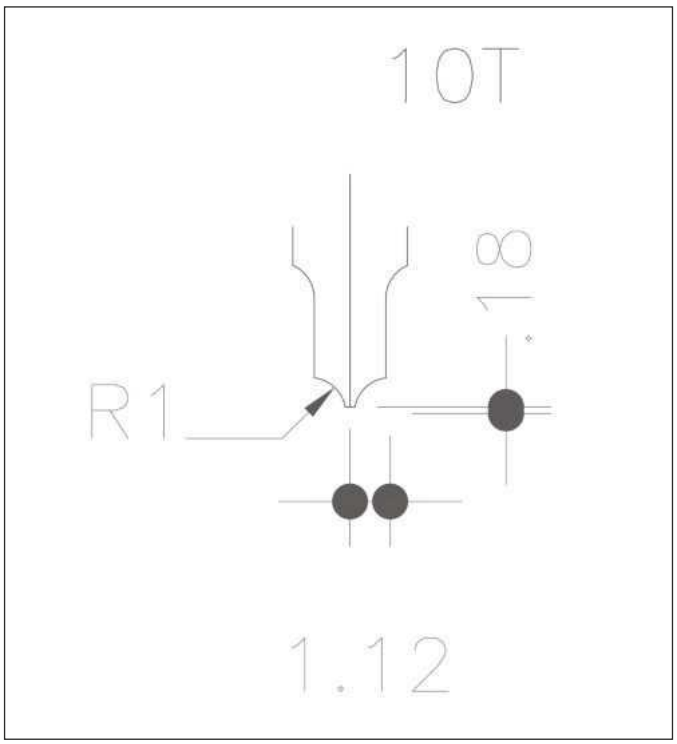
There is very little in this design that is complicated and all that is required is careful milling. I started this project with the sliding member that carries the boring tools, or tool slide. This was machined from an off-cut of EN1A Pb round stock that was to hand. By starting the tool slide first this can later be used to check the fit of the dovetail in the main body. Much of the milling is pretty straightforward and the only thing that usually causes the average Home Machinist grief is the dovetail slideway itself. This is usually because most Home Machinists try to cut the dovetail with both faces of the 60-degree dovetail in one go, this is a mistake. I have included an enlarged view drawing of the dovetail corner; it will be seen that there is a 45-degree undercut. This 45-degree dovetail cutter is used to form the undercut as well as one of the working faces of the dovetail, in the case of the tool slide. This also gives a working surface on which the roller can rest to check the progress whilst machining the 60-degree face. The underside of this cutter never ever coming into contact with the working face. Because both operations are carried out at the same setting everything is in perfect alignment. I prefer to use this technique as this relies purely on one linear machine displacement to achieve, and what's more it is easily repeatable. One thing that is important is that the dovetail is equally displaced about the centreline. Note also that there is a flat left at the top of the dovetail. It does not go to a sharp point there is no need, as the 45-degree undercut in the main body should come up this far.

A tee slot cutter was made from a standard 4.5mm Slot drill using a Toolpost Grinder to form the relief and to obtain the width of the cutter head. I have in the past used a cutter made from silver steel with good results. There is a need to keep the chips moving during the cutting of these small Tee slots, either by flooding with coolant, or an airline if you have one.

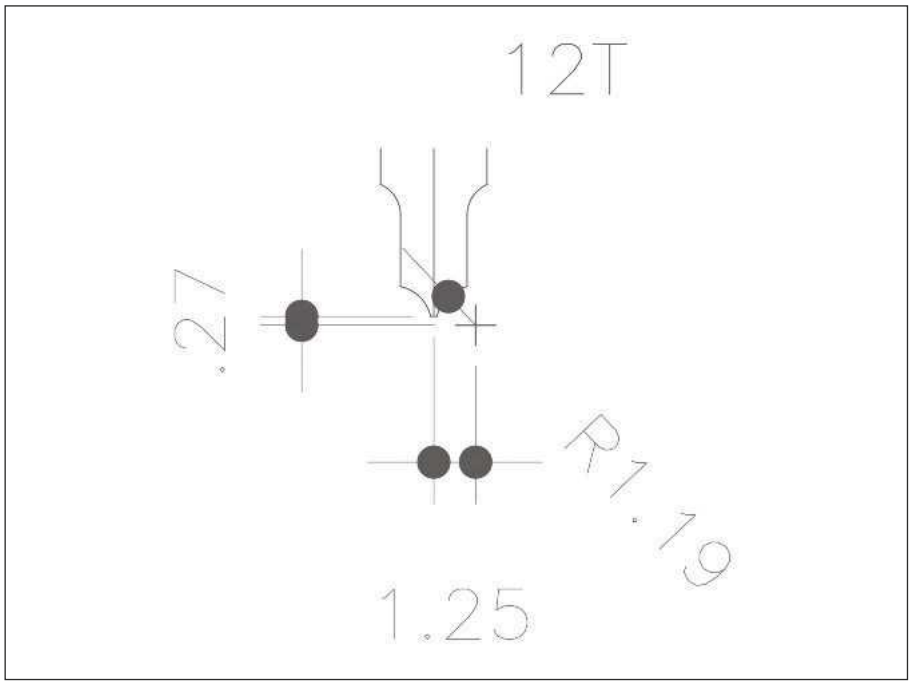
The main body of the boring head is the next part to tackle and again this was made from Leaded EN1A Pb. My original B&F head has been in use for nearly 30 years and the above combination shows no signs of distress despite a lot of use. The piece of material will shed a lot of mass in the machining process, but there is one thing that is important, and that is to stay as close as possible to the outside diameter dimension. It is necessary to measure from this face to locate the first dovetail. Straying from the dimension will need to be taken into account later on when cutting the dovetail, remember symmetry is important. The pocket for the worm is left until after all other machining is finished. Work starts with the large flat and the step for the output gears from the worm. When machining the large flat on the body, it will be found worth while doing all the other machining required at this setting, working purely to coordinates. It is advisable to leave about 0.1mm on the top face of the body in order to take a clean up cut with the 45-degree dovetail milling cutter where the tool slide will be bearing against, prior to starting the dovetail proper. The tool slide will want to move freely from one end to the other of the dovetail, a very slight shake can be taken out by the adjusting screws. A great deal of slop cannot be taken out. It is a good idea to put the locking and adjusting screw holes in at the same setting as the slitting saw operation. The screw holes actually going in after slitting as there is a space to break into with the drills and taps, but don't over do it and ruin the work. I start the M3







adjusting screws with a BS2 centre drill using just the pilot to provide a small hole to help the slot drill. This is followed with a 3.5mm diameter slot drill which is fed in from the side until there is a full diameter "U" shaped pocket in the workpiece. A BS1 centre drill is then used followed by the tapping size drill and finally the tap. This gives a much neater finish to the tapped hole than. Rather than the exposed partial threads that would be there if this was not done. The central M4 locking screw has a 3/32" ball bearing beneath it. This makes it extremely easy to use and requires very little force to lock or unlock the slide. Above all it ensures the locking force is concentrated in the middle of the dovetail and not the bottom, which could lead to permanent distortion of the Gib and tightness. Should the slide be difficult to move from one end to the other after slitting then this is because stress in the bar has been released, there is no need to panic. Insert the slide and using a nylon or soft faced mallet with the slide central, give the tool slide a tap on the face opposite to the Gib, in the direction of the Gib. Gently keep tapping until it loosens, again don't be alarmed if you over do it. With your slide central clamp the slide with the M4 locking screw plus ball. Put in the M3 adjusting screws and tighten them lightly, release the M4 locking screw and you should have a sliding mechanism, apply a drop of light oil to the sliding surfaces and continue to adjust the M3's until you are satisfied with the feel.



Some attention might now be drawn to the gears, which on this size head are 64 DP 30 degree pressure angle, (PA). Why 30-degree PA I suspect some readers are asking themselves, why not 20 degrees? One problem with making worms is making an accurate screwcutting tool for the want of a better name. Using 30 degrees as the PA means a standard 60-degree screwcutting tool can be used with a small flat on the end. To use 20 degree PA requires a 40 degree screwcutting tool and there are no screwcutting gauges to work to, thus this angle really requires a cutter grinder to do the job right. There is a second reason to use 30-degree PA gears, and that is in small numbers of teeth like we have here. There tends to be some undercutting of the teeth with the smaller pressure angles which leads to weakness in the gear tooth. This is why gear manufacturers tend to make smaller standard PA gears with a larger PCD than would normally be used. This was the route taken with the 50mm B&F head.

●To be continued

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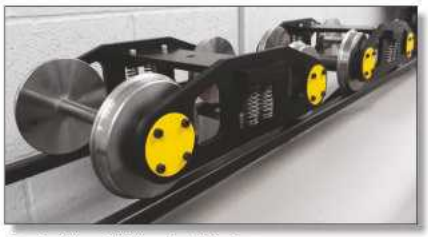

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BEGINNERS WORKSHOP
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that are out of date or describe practices or materials that we would not use today either because much better ways are available of 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.

BUSHES AND BEARINGS

GEOMETER describes the main uses of these necessary components and explains how they are fitted and removed

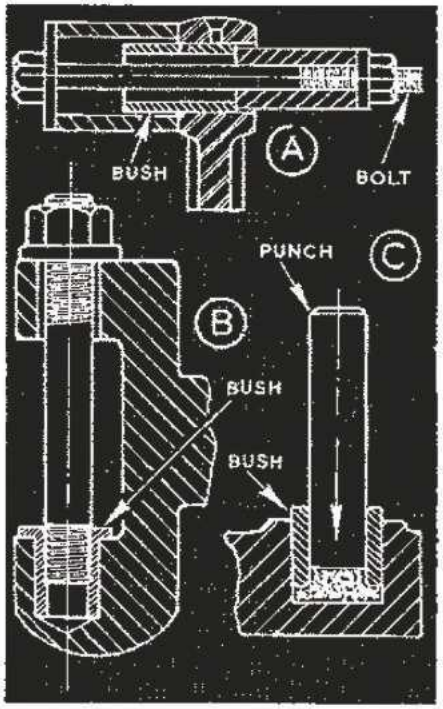
BUSHES SERVE TWO main purposes. They enable more suitable metal than their housings to be used with shafts and pins and, when wear occurs, permit inexpensive renewal. Ball races and roller types carry the principle a stage further. Light force fits in regard to shafts and housings, they carry the running loads, and being all-hard, turn very freely and resist wear.

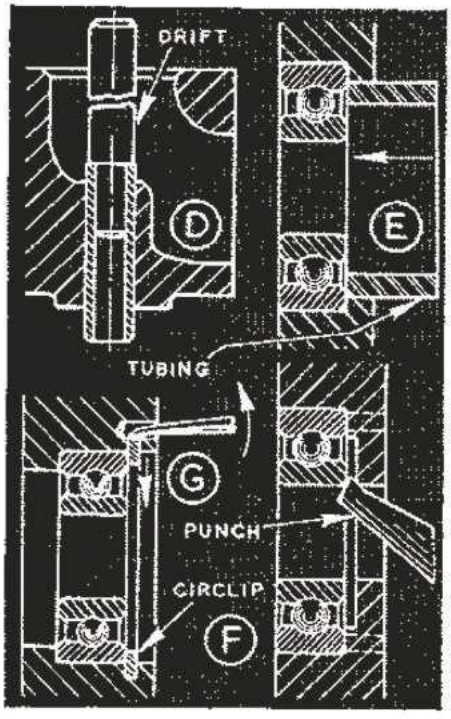
Common materials for bushes are phosphor bronze and gun metal, with which steel shafts and pins should preferably be hard. White metal is also used to some extent, as is cast-iron. When steel bushes are used, they are almost invariably hardened. All except hardened bushes generally require to be reamed after fitting.

At some time, every engineer must renew bushes, commencing with the extraction of the old. If the fitting is open, for the bush to be forced straight out, such as the small end of a connecting rod, the method at *A* is employed. A distance piece, or length of tube, to fit over the outside of the bush, another to bear on the end and pass through the housing, suitable washers and a long bolt are all that are necessary. The new bush is fitted similarly, the oil hole carefully aligned, or drilled afterwards and the bore finally reamed.

When an assembly can be brought to the vice and held without strain (engineers' vice, steel, with parallel jaws), a bush can be forced out and another pressed in, using merely the tubes or distance pieces, and checking the new bush starts squarely.

With bushes in blind holes, a problem occurs in the absence of access to the further side. Often, as at *B,* a bush which is soft can be tapped to take a stud or bolt, then can be drawn out easily. A free bush being present,. it should be removed first, to provide way for tap and stud.





Hydraulic method

The method at C is applicable to a blind-hole bush which is hard and cannot be tapped for extraction. A close-fitting rod or punch is obtained, and the bush about half filled with thick oil or grease. The housing is supported opposite the bush on a flat metal surface, the punch entered and struck with a hammer. The oil or grease is thus forced into the gap between the bottom of the bush and the housing, and drives the bush out hydraulically.

When' housings or main components can be properly supported, bushes can, of course, be driven out using a stepped punch or drift as it is generally called. This is the case with valve guides, as at *D,* where the length is such that using a bolt would be slow and laborious.

Problems similar to those in removing bushes occur with ball races. With these, however, it is inadvisable to hammer or force on the centre member if the races are to be used again, since blows or thrust must be transmitted through the balls to the outer member-with the danger of damage or failure later..

Whenever possible, a piece of tubing or distance piece should be used direct on the outer member as at *E.* The tubing can be tapped all round to keep the bearing square, or a bridge piece laid across for central blows, or the bolt method adopted.

When races are to be renewed and access to the outer member is obstructed, blows or force can be applied to the inner member through a drift, or if this is impossible, using a cranked or lipped punch, as at *F.*

Alternative method

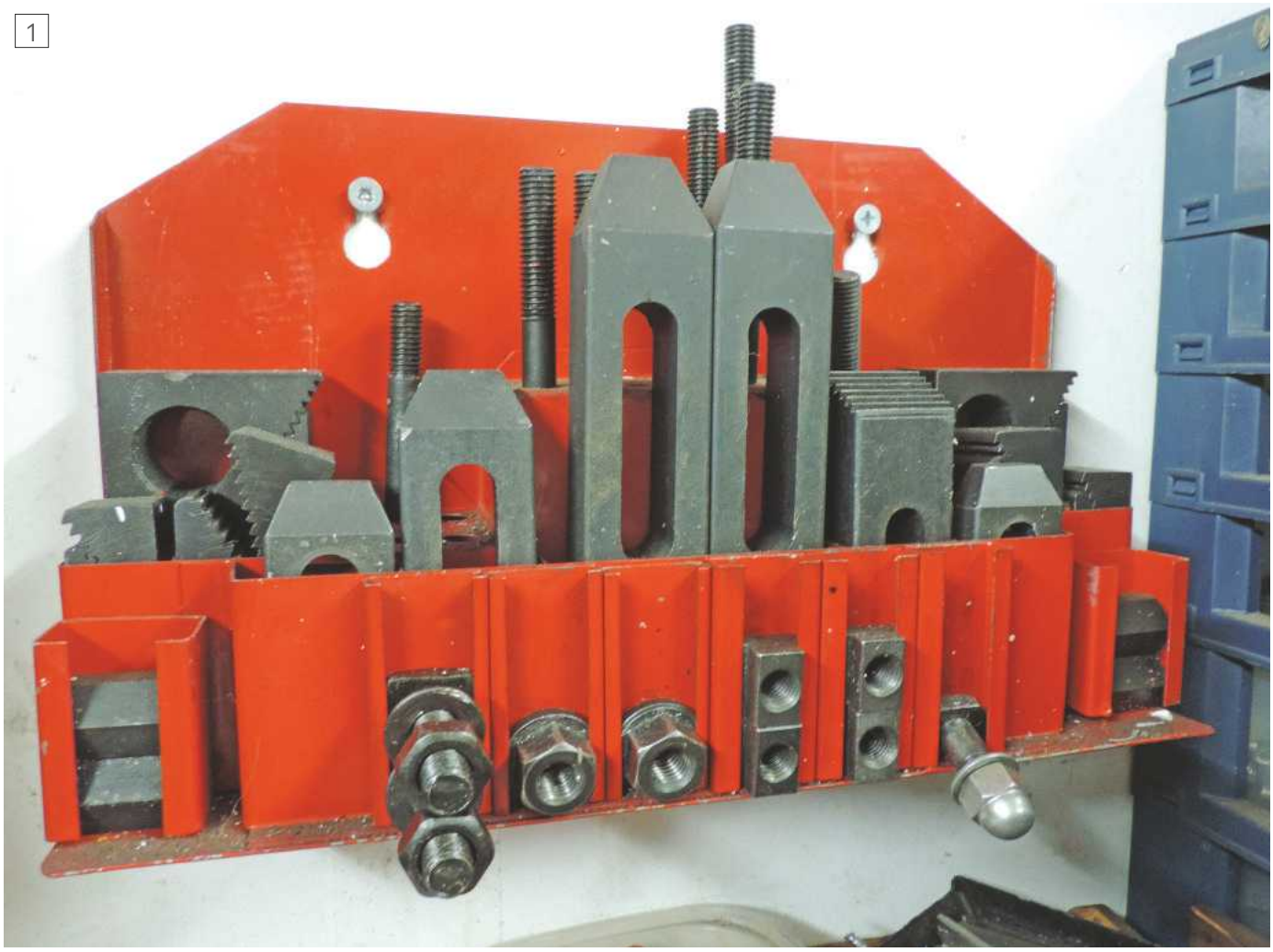
Another method is to drill two holes, using normal and flat-ended twist drills, to come on opposite sides against the outer member. A parallel punch can then be used, and the holes finally filled by tapping and fitting screws.

A spring ring or circlip locating a race in a housing can present a removal problem, owing to the stiffness of the ring and absence of access behind it. A hole, however, drilled to come approximately to the bottom of the circlip, as at G, permits an instrument like a stiff blunt scriber to be inserted and one end of the raised-nor need the hole be filled afterwards. ❑

Workholding for Mills and Drilling Machines

A guide for beginners from Stub Mandrel

1



A comprehensive clamping set – with a few additional items.

As a general principle, whenever you carry out drilling, milling or any other machining operations the work needs to be held securely for safety and to help ensure precision. There are two main ways of securing work – clamping the work directly to the table and using a machine vice.

Clamping

Many beginners are deterred from the use of clamps to hold work to a milling machine's table or a lathe faceplate. The simplicity of a vice or chuck appeals and because it is easier there is a tendency to think it is better. In truth, clamping is usually at least as secure as a vice or chuck, and when the work is an awkward or irregular shape, clamping is the only approach to take.

When buying a milling machine, it is a good idea to buy a matching clamping set at the same time to ensure you get one that is matched to the slot size and capacity of your machine, **photo 1**. If you are lucky the seller may 'bundle' one with the machine or offer you a discount.

A typical clamping set comprises several different components, usually in tough or case-hardened steel. These include:

T-nuts

These are special nuts that should be an easy, sliding, fit in the slots of the mill table or faceplate. Usually, the bottom

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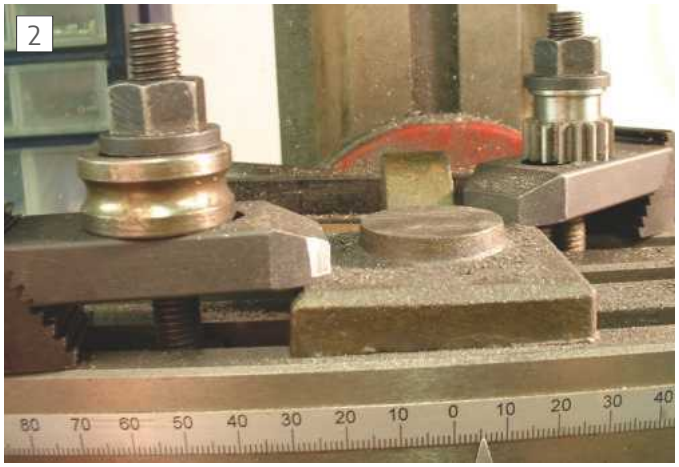
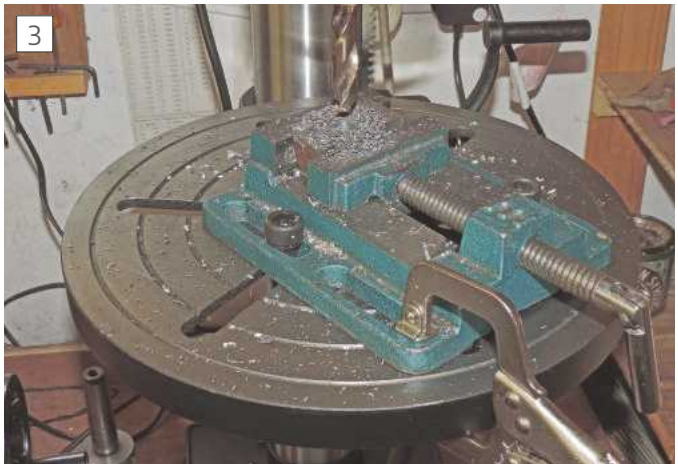


A clamp set up with packing blocks.



A basic drill vice bolted down to the table of a pillar drill.

thread is distorted to stop a stud or bolt being wound right through and 'jacking' up the t-nut which can damage the t-slots. If your t-nuts let a thread pass right through, just distort the bottom thread slightly with a centre punch, it makes setting up easier as you just spin in a stud until it stops. While you can get t-screws that fit directly in the t-slots as well, don't ever use a normal hex-head screw in the slots -they concentrate the pressure over too small a section of t-slot and can cause them to fracture.

Studs and Nuts

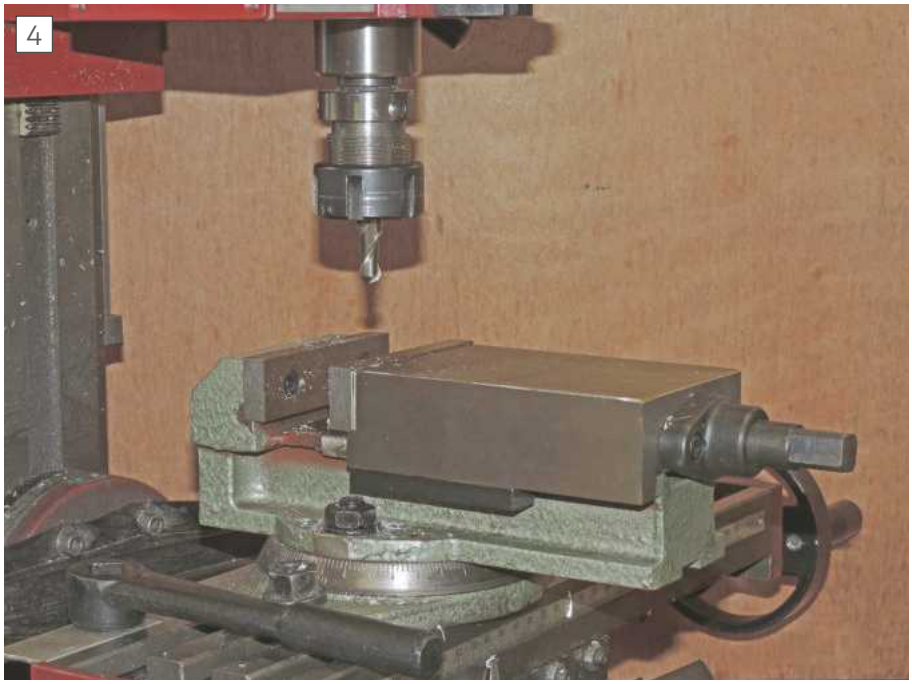
Clamping sets always have a collection of pairs of different length studs together with matching disc nuts which fit into the t-nuts to hold everything together. The disc nuts spread the load far better than ordinary hex nuts and take away the need to use washers. You may find that your set does not include very short studs which are useful for holding down vices, if so, just make up a couple of your own by cutting the ends of a pair of high-tensile screws and finishing the ends neatly.

Clamps and packing blocks

Usually, three pairs of slotted clamps are supplied. The largest are often rather oversize for benchtop machines, but they can also serve as spacers and supports for work you want to lift off the table. They usually are stepped at one end so they can be supported on the triangular 'packing blocks'. The correct way to assemble a clamp is with the packing block end slightly higher than the end which is clamping the work, and the stud as near to the work end of the slot in the clamp as possible, **photo 2**. This maximises the force applied to the work and minimises the chance of slipping.

A good rule to follow is that any workpiece should be held by at least two clamps, fitted as far away from each other as possible. If only one clamp can be used, attach unused clamps or packing blocks to the bed of the mill as 'stops' to prevent the work from twisting or sliding under the clamp.

Always check the security of clamps before you start machining, and if using them on a faceplate make sure the work is balanced (unused clamps make handy counterweights), as unbalanced work can shake itself loose. Finally, always make sure that there are no clashes between the clamps and parts of the machine before switching on.



This milling vice has a long and heavily built moving jaw.

Shop Made Clamps

If you regularly make small work, you will probably decide that the supplied clamps are too big for some jobs. There are many simple designs for making your own clamps, including types that pull work down onto the table, handle very thin work or for other special purposes. Making up a few is a good way to get used to the capabilities of your mill. One simple approach to get started is to make some t-nuts, but drill and tap them for a smaller size stud, such as M6 or M8, then make some 'miniature' clamps and studs to match – just copy the larger items in the standard set, and they will work well with the smallest packing blocks.

Machine Vices

A machine vice alone is on sufficient to secure work safely and effectively, for drilling the vice needs to be prevented from rotating or lifting up with bolts or clamps. For milling a vice should be aligned carefully with the mill table and held securely by at least two securing

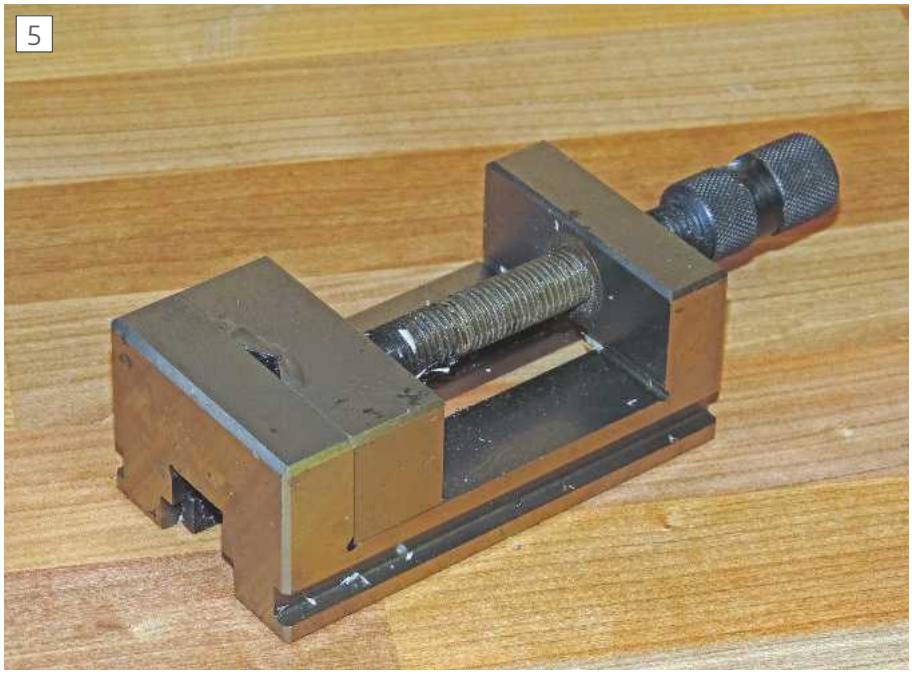
bolts. There are several styles of machine vice, you will probably want at least a drill vice and a basic milling vice.

Drill Vices

Drill vices are generally inexpensive and relatively light built. Their purpose is to hold work steady under a drill press and therefore their function is to stop the work spinning as much as locating it. They should be bolted down, **photo 3**, when drilling larger holes to stop the vice spinning. Because the drill pushes the work down into the vice, they don't need elaborate or heavy construction and this means they are rarely if ever suitable for milling work.

Milling Vices

Milling vices are much more heavily built, the moving jaw of a milling vice is very long in order to minimise the chances of 'jaw lift' and the screw thread is much finer so the jaw moves more slowly but has greater gripping power. This makes them much safer to use with a milling machine as the work is held both more accurately and more securely – milling vices must always be bolted securely to the bed of the mill. Many milling vices come with a removable rotary base, **photo 4**, that makes it easier to take angled cuts, but some users rarely use this, as they get greater 'headroom' with the vice bolted directly to the mill table.



Toolroom vices are typically ground on all sides.

Don't Forget Clamps

It's easy to always turn to the vice for workholding, but it's worth remembering that well-placed clamps are often more secure than a vice and because the work is held directly on the mill table, they can be more accurate as well.

Wherever you can, match your workholding to the needs of the job, not the other way round.

Toolroom Vices

Toolroom vices come in several styles, they are more lightly built than standard milling vices but are still robust and grip well. Typically, they are precision ground all over, **photo 5**, which means they can be held in another vice or clamped to the machine table - even on their sides or at an angle. They can be very useful when milling small parts to a high standard of accuracy. They are usually held in place with clamps, rather than bolted down.

This is the more flexible of the two styles of simple tilting vice.

Tilting Vices

Some milling vices come with a base that can be angled from the horizontal as well as rotated, some of these can actually turn in three different axes! Their complexity means they have little headroom, however, if you have a very large mill and need to machine complex angles, they may be the solution.

A simpler solution if you just need to drill or mill simple angles is a basic tilting vice, **photo 6**. There are two designs widely available, a basic type where the upper part of the vice is fixed onto a cross-shaft and a more robust style with a curved 'cradle'. The latter type has more headroom, a degree scale and 'stops' for a pin to fix it at useful angles. Both are more robust than drill vices, but they should not be used for very heavy cuts. ■

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SIEG SX3 DRO Install

Adrian Revill fits linear encoders to his milling machine.

Z-axis, bracket mounting

I recently decided to splash out and buy a new mill and DRO, after much research and thought, I bought a SIEG SX3 from Arc Euro Trade, and a DRO from Machine DRO. At the time I was buying, there were several threads on the MEW forum about installing DROs and I also found a few YouTube videos too. Ever mindful of plagiarism I have to say not all the ideas are my own, and I would like to sincerely thank those who gave me advice along the way. From these sources, I have selected the ideas I liked and added a few of my own.

When installing the DRO I was lucky in that I had my old mill so, could make parts, although there is nothing that could not be made with hand tools. Or even with a little care could be made before dismantling the mill.

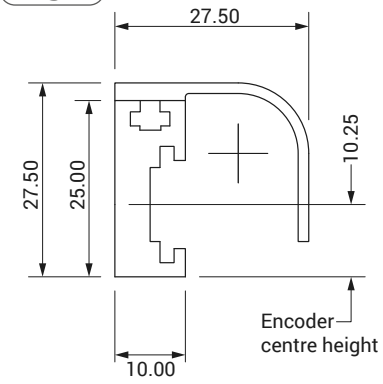
I bought the three-axis Universal DRO package with the M-DRO milling display and 5 µM magnetic encoders. I found the installation brackets to be too big to use and ended up only using three of the spacer blocks to save buying the aluminium bar. I did speak with Machine DRO, and they said that they are considering making a dedicated SX3 kit, but for me it was unavailable.

I have not looked deeply at other makes of DRO, but from what I have seen they are all fairly similar. **Figure 1** shows the basic dimensions of the EH-05 encoders and rails that I used. These should allow you to adjust the mounting bracket dimensions if yours are different.

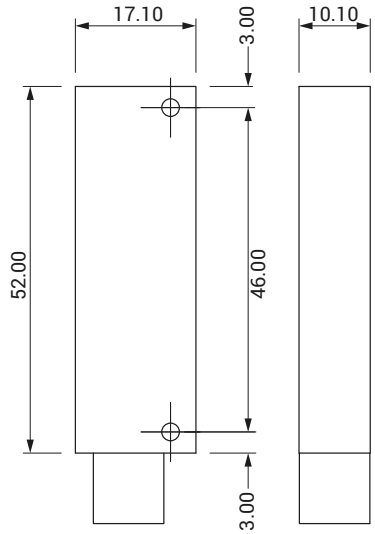
The main challenge for the install is the alignment between the magnetic tape and read head. The encoder specifications state they have to be within a couple of degrees pitch, roll and yaw also about a millimetre away from the tape. Also, with an encoder sensitive to 5 uM movement the mounting bracket needs to be rigid. Especially where the encoder is moving and getting tugged by the cable.

Z-axis, complete encoder mounting.

Fig.1



Rail And Cover

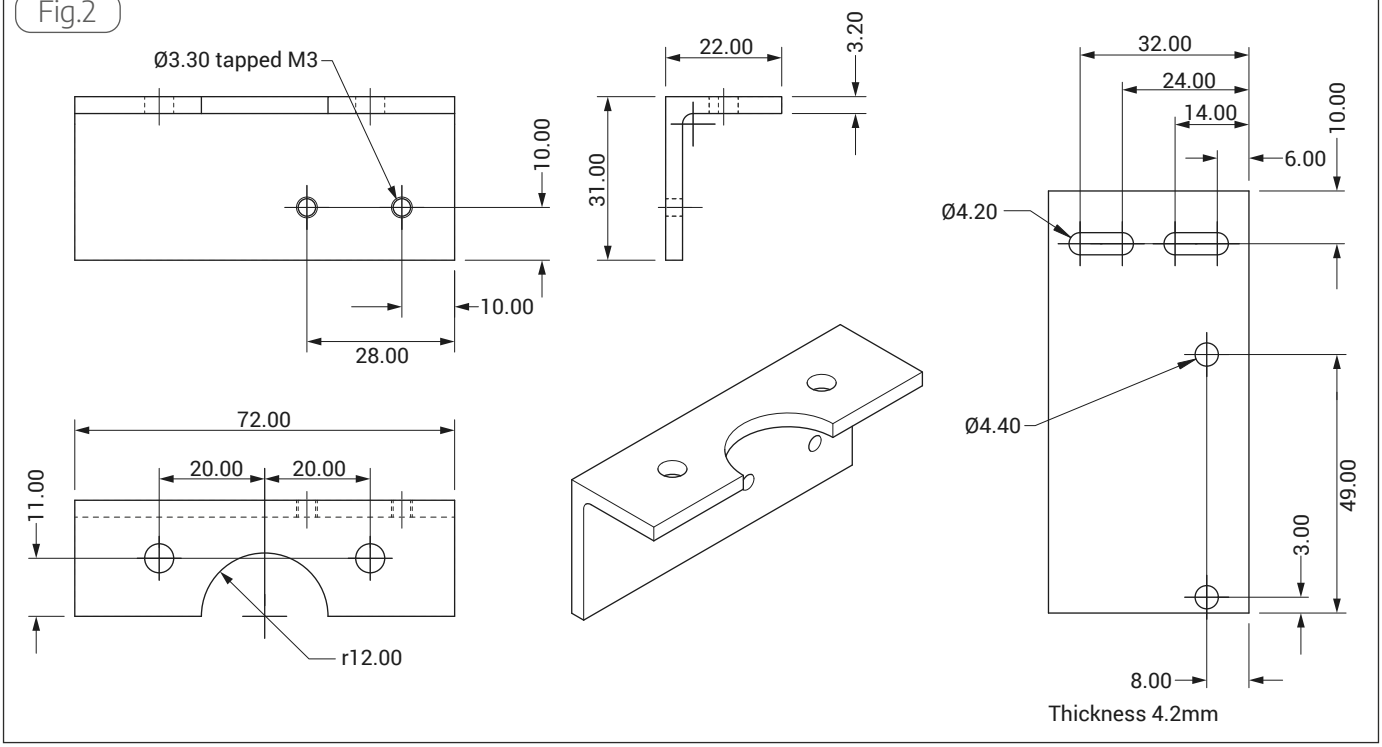


Encoder Head

Z-Axis

On the MEW forum, I saw the idea of mounting the encoder inside the column and thought it a neat and tidy idea. When I first removed the back of the mill, I was stumped how to fix the encoder to the lead screw nut bracket. After magnifying forum images, I decided to look from below the nut and to my relief there are four cap head screws fixing the nut.

Fig.2



Z-axis, casting mounting pads.

Z-axis, completed mounting pad.

Following what I could see in the forum images, I decided to make a right-angle bracket fixed to the nut, **photo 1**. The nut is drilled quite deep but was only partially tapped, and the original cap head screws are short and only have a few threads engaged. I re-tapped the holes and used longer screws to get more threads engaged. Then attached the encoder via a slotted bracket, **photo 2**. **Figure 2** shows the dimensions of the brackets. This gave me the ability to adjust the yaw of the encoder by bending the right-angle bracket, and the pitch, roll and flight height using the slots.

I cut 500 mm from the supplied 800 mm rail, it could have been shorter, but this length was convenient for the mounting holes.

Mounting the rail was another challenge, the inside of the column is a rough casting with a casting draw. However, the outside of the column is machined, and I found it was square with the axis of the lead screw.

To find the horizontal position of the rail, I moved the encoder fully towards the rail. The rail has a grove for the magnetic strip which is close to the same width as the encoder, this locates the rail ›

Z-axis, sanding mounting pad thickness.

Z-axis, improvised drilling jig.

Z-axis, fitting cover strip.

Z-axis, upper cable management.

Z-axis, lower cable management.

Z-axis, DRO bracket position.

in the correct position. I then measured the distance from the back of the casting to the rail. The vertical position was simply found from the lowest and highest positions of the encoder. I now marked the location of the top, middle and bottom mounting holes.

To make level mounting pads for the rail I used epoxy putty to 'cast' the pads. The type of putty that comes as a small roll that you cut and kneed. **Photograph 3** shows the casting of the pads. To ensure the surface of the pads were level with the outside of the casting. I clamped a small ball of putty to the casting using two pieces of wood separated by a third 15 mm thick piece. To stop the epoxy sticking to the wood I used polythene sheet which I also found needed a very thin smear of oil to stop it sticking. Before the epoxy fully hardened, I trimmed it using a sharp knife, **photo 4** shows a completed pad.

When I tried the rail against the pads, I found one was a little proud, so I used the same pieces of wood to help me sand it while keeping it flat, **photo 5**.

The rail came with M4 mounting screws, so I drilled and tapped all the way through from the outside of the casting. To ensure I drilled the holes for the screws straight, I drilled a hole in some scrap and used it as a drilling guide. **Photograph 6** shows how I aligned the drill with a centre pop.

When mounting the rail, I used the encoder to again locate the rail as I tightened each screw. To fit the magnetic strip, I found I needed to move the head to the highest point and unmount the encoder bracket. **Photograph 7** shows fitting the stainless-steel cover strip. I found the strip very easy to kink, but it was possible to feed it in from the bottom without kinking.

To adjust the height and to ensure the encoder was square (pitch) I used a 0.4mm, 0.5 mm and 0.6 mm feeler gauges to adjust the gap to 0.5mm.

Photographs 8 and **9** show how the cable is arranged and fixed to allow full movement without snagging. When the head is at its lowest point, the bottom loop in the cable from the encoder should just clear the bottom bearing mounting. The clips are fixed using the P-clips and M3 screws provided.

DRO arm bracket

While I had the mill the wrong way round, I mounted the DRO arm bracket. The hardest part is deciding what height I wanted the controller. I looked at all the examples of installs I could find. Most mount it about halfway up the column, after a little experimenting I decided on the bottom of the bracket being 400 mm above the bench, **photo 10**. For my height, this is a comfortable height while keeping it away from flying swarf.

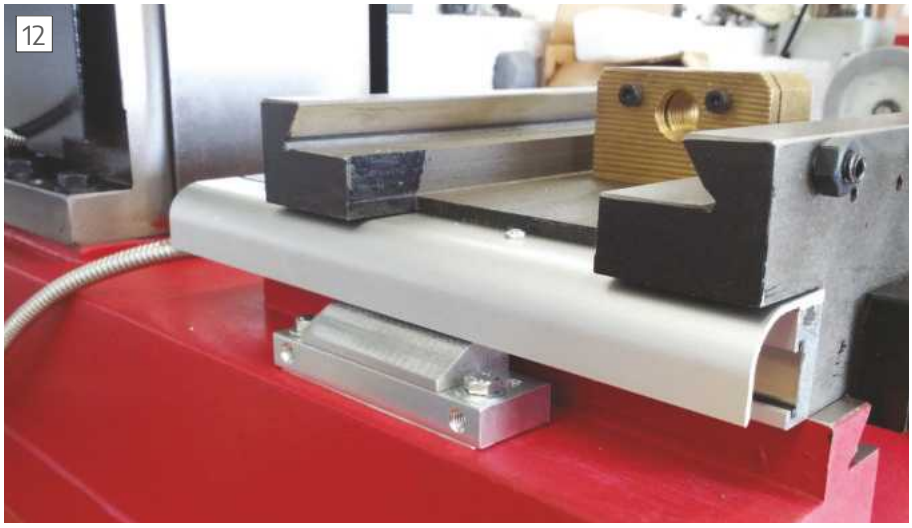
Photograph 11 shows how I used two pieces of wood to aid in the drilling. The inner piece protects the PCB from the drill and minimises the swarf dropping into the case. The outer piece is clamped

Z-axis, protecting PCB during drilling

horizontally at 400mm. I then used that to support the bracket while I marked the hole positions. The bracket seemed to be tapped for M5 in two of the holes, the other two I could not see a thread. It looked like the paint had filled the threads, and I ran a tap through to clear them. Then bolted from the inside of the column into the bracket, fiddly but neat.

Y-Axis

The examples I found of mounting the Y encoder online, have the encoder moving with the Y-axis. This involves making quite a large bracket to carry the encoder out and down to the rail. This is further complicated as I wished to use the dirt cover too. I decided to try a different way. **Photograph 12** shows the completed Y-axis. I found the rail and cover would just fit on the side of the carriage, which allowed me to mount the encoder on the mill base below the rail. Also, the length of the carriage is long enough to allow for full travel.

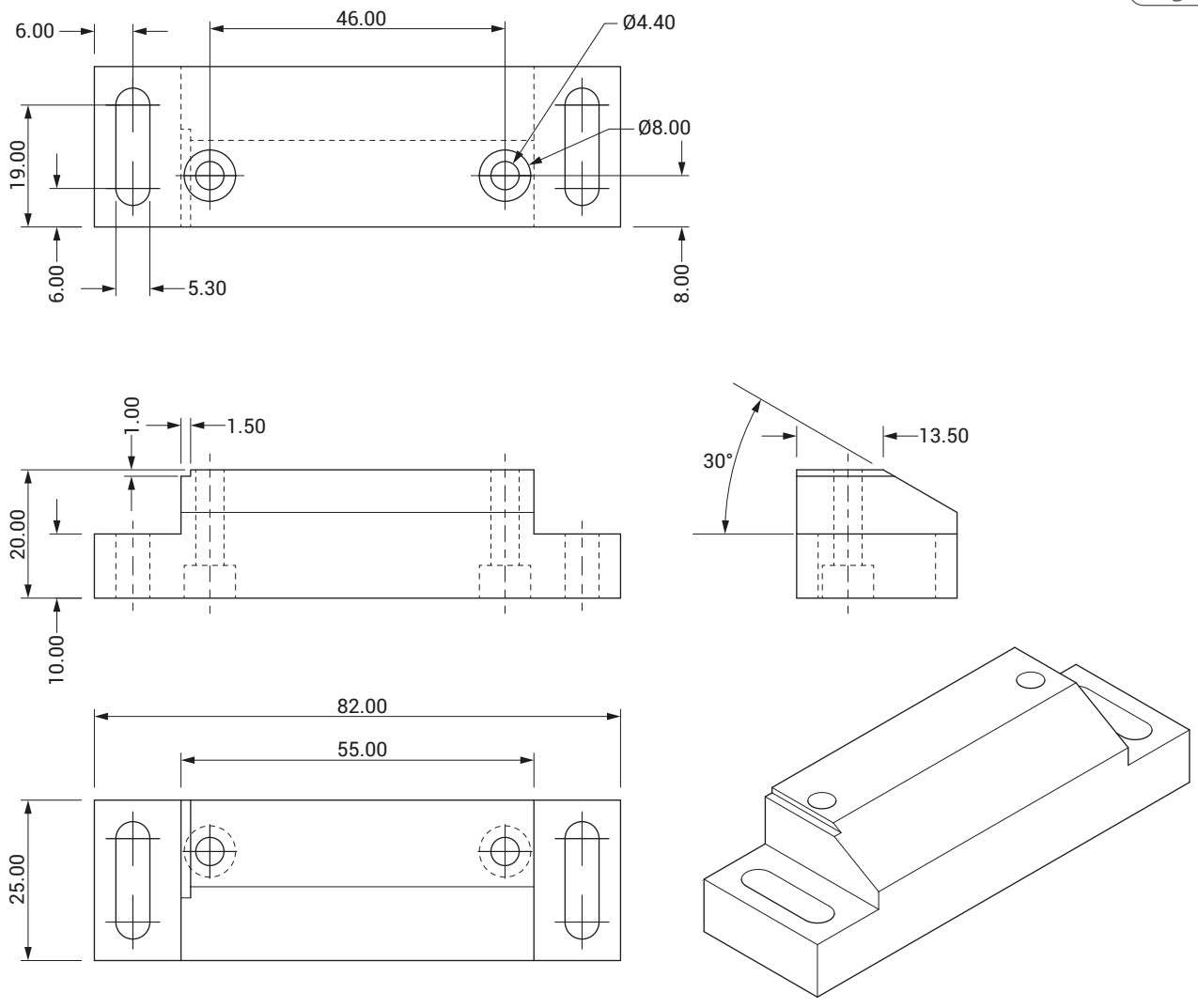


Y-axis, completed encoder install.

The advantages of this method are the encoder mounting is much simpler, and the encoder cable does not have to move. This also gave me the opportunity to slope the top of the mounting block to reduce swarf build-up.

The side of the carriage had some quite lumpy paint, and I needed to sand the lumps off before fitting the rail. The rail was cut to the same length as the carriage

Fig.3



and so it had mounting holes close to each end. The rail was aligned flush with the bottom of the carriage, then I drilled and tapped the two M4 holes.

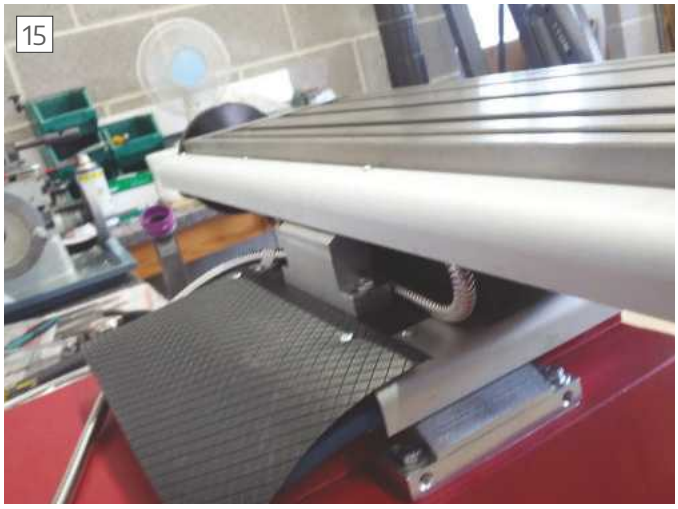
The encoder needed to be just over 20 mm above the base. As the mounting blocks supplied with the package were 10 mm thick, I decided to fabricate the mounting using two blocks. Then to use a shim to raise the encoder to correct height.

Figure 3 shows the mounting I fabricated from two of the mounting blocks, it could easily be made as a single piece.

I found the mill base was not perpendicular to the rail, it had a small slope down from the edge towards the

Y-axis, shim to level mounting.

X-axis, trying the MDRO mounting kit.



X-axis, completed encoder install.

slideway. I did try using the epoxy putty method to level it but found it difficult to clamp it down hard enough. I decided as there is no strain on the mounting block, that it was simpler to attach a shim with double-sided tape to one side of the mounting block, **photo 13**.

After which I added a full-width shim to raise the encoder to the correct height and using feeler gauges adjusted the gap to 0.5 mm clearance using the slots.

X-Axis

The X-Axis is the most straight forward of the three, **photo 14**, I looked at using the supplied mounting kit, but I did not like how it would catch the swarf. I decided to make a new bracket similar to the Y-axis. As you can see in **photo 15** it is neatly tucked away under the dirt cover.

I did not have any aluminium of the right dimensions to make it as a single piece, so I fabricated it in two parts.

Figure 4 shows the dimensions of the mounting block. As I had tried the supplied mounting kit, I could measure the exact height and make the mounting block accordingly. Like the Y-axis, I needed to smooth the rough paint but found the casting was square enough to not need shimming. As before the gap was adjusted to 0.5mm. **Photograph 16** shows how I arranged the cable. To allow free movement of the Y-axis, I fed the X-axis cable behind the mounting and out of the right side of the carriage to form an 'S' curve. The cable is fixed each end of the 'S' using the provided P clips.

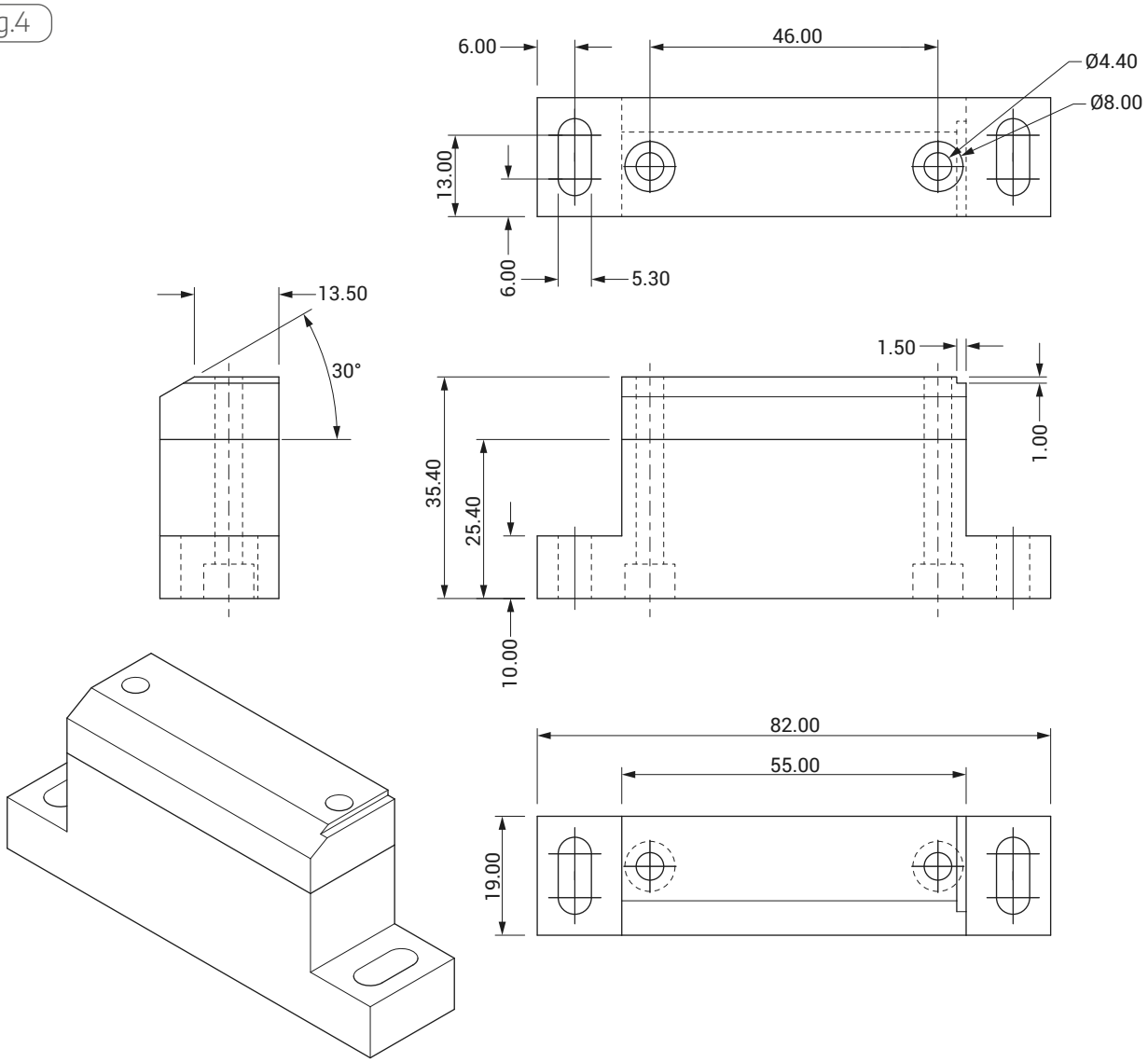
DRO Controller

The encoders come with quite long cables, **photo 17** shows how I formed

X-axis, cable management.

DRO, excess cable looping.

Fig.4



loops on the back of the column to take up the slack. I did this to keep the cable loops off the bench to aid in cleaning. The kit came with the DRO arm and clips to mount the cables to the arm which makes a neat job, **photo 18**.

I found that the Z-axis as installed counted backwards and I needed to reverse this in the DRO setup. All the rest of the factory settings were fine for the 5 µm encoders, although if you go for the 1 µm option you will need to change the resolution too.

Conclusion

When I bought the mill, I was advised to use a surge arrestor to protect the controller board. As they are only a few pounds each It made sense to also fit a surge arrestor to the DRO too. I bought plug tops with built-in surge arrestors for both the mill and DRO.

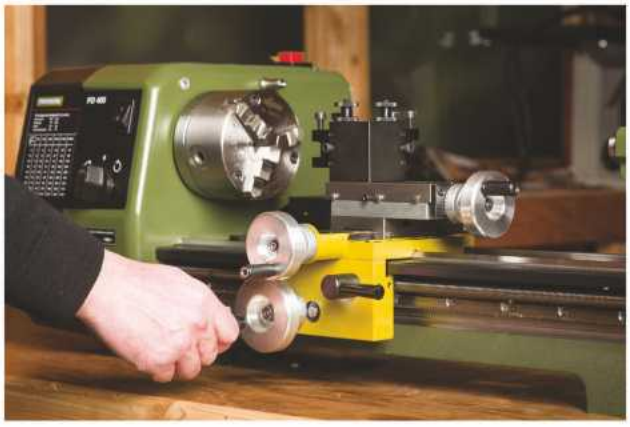
If I were to do this again, I would see if it was possible to get a deal on the parts without the mounting brackets. It seems such a waste and yet more things in the "useful one-day" box.

I have not had the problem yet, but on the Y-axis it looks possible for swarf to be carried under the cover by the cable. I would cut the rail slightly longer than the carriage to cover the cable at the back where it is close to the rail. Happily, I do have a piece of rail and tape left over so I can replace it later if needed. ∎

18

DRO, cable management.

PROXXON



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On the Wire

NEWS from the World of Hobby Engineering

SMEE Model Engineering Courses to Resume in 2022

Following a year of restrictions. the Society of Model and Experimental Engineers (SMEE) plans to run its popular training courses for newcomers to model engineering, in 2022, starting in February. Part 1 is a three-day course running on Saturdays, February to April, and designed to introduce newcomers to the hobby, and to help with decisions on the setting up of a workshop, and the purchase of machines and tools as well as introducing their use. The course also deals with silver brazing, tool sharpening, measurement and marking out.

Part 2 is the "Polly" course which covers the building of a simple model boiler and engine. This is spread over six, monthly, Saturdays. In each session we demonstrate making a different part of the project which students complete in their home workshops between sessions, ending up with a working steam model. The project involves sheet metal work, soft soldering, silver brazing, turning, milling, and painting and will equip students with all they need to undertake further engineering projects and develop their skills. Although aimed at model engineering, previous students have also been involved in restoration of classic cars and motorcycles. The Society also runs one-day courses in milling and in tool grinding.

SMEE is based in Lambeth, South London. Access is easy via Thameslink trains calling at Loughborough Junction station from where the building is just a few minutes' walk.

Full details of the courses are available on the SMEE website at **https://www.sm-ee.co.uk**

Date set for Lowmex 2022

The Lowestoft Model Engineering and Model Making Exhibition (Lowmex 2022) will now take place on the 29th & 30th October 2022 in the Energy Skills Centre, at East Coast College, St. Peters Street, Lowestoft, NR32 2NB.

Following the forced cancellation of the last two planned exhibitions due to Covid. We look forward again to running this annual event in an exciting new venue. The Energy Skills Centre is the latest new building on the Lowestoft College Campus. This building is very light and airy as you would expect from a modern building. The exhibition will be held over two floors, there is a disabled access lift to reach the second floor. There will be canteen facilities in the adjacent building and ample free parking on site.

Entry forms for previous exhibitors will be sent out in February. If you have not exhibited with us before and would like an entry form, please get in touch.

Further information is available **www.lowmex.co.uk** or contact **Kevin Rackham** on **01502 583317**.

Machine Mart New Product

The Clarke CCO14D Abrasive Cut-Off Saw includes a 14"/355mm cutting disc and a powerful 2200W 230V motor. A quick clamp helps to securely hold the material that is being cut whilst the unit has a spindle lock for fast and easy replacement of the cutting disc. It is able to slice quickly and cleanly through ferrous metal bar and tube only while also featuring a quick release vice assembly. It is adjustable from 0-45° for angled cutting with a carry handle for on-site handling.

Products can be purchased with confidence and ease in-store, online at **www.machinemart.co.uk** or via telesales on **0115 956 5555**.

A Simple Band Saw Fixture

Malcolm Leafe gets a grip on some lathe tooling.

Fixture holding a one-inch tool being cut to half an inch.

There are seemingly a multitude of add-ons designed to help when faced with cutting sections from short lengths of material using one of the Chinese bandsaws. Most solutions are versions of a vice which can be clamped to the machine. I too came up with my own solution to the problem – but I needed to cut thin slices from what were effectively very short sections of steel (maximum an inch long) which were mostly five to six inches wide.

Many years ago, I bought a largeish quantity of brazed carbide tooling which was originally intended for use on capstan lathes. The tools were brand new and mostly products of Coventry Tool and Gauge Co. Being intended for industrial use most were chunky, having ¾ in or 1in square shanks. My lathe toolposts mostly used shanks with a maximum thickness of ⅝ in. This didn't concern me at the time of purchase, I perceived that a quick run over with a suitable cutter in the milling machine would solve the problem – not for the first time I was wrong. The scheme worked OK for the first half-dozen or so and then became tedious; the shanks were not, as I imagined plain mild steel but were some similar but rather tougher material, (a few were gloriously solid HSS and one large tool was solid carbide -these I left alone).

Some months later, after I had tried the few tools that I had thinned down by milling – and the few which had usable size shanks, I tried various ways of holding the cutters so that they could be attacked by my bandsaw. Lengths of plate were fastened in the machine's vice and the lathe tools were attached with small G-clamps, toolmaker's clamps and facsimile milling table clamps. The clamps usually interfered with the blade and on odd occasions were themselves sawn through.

After a long spell of procrastination, always a useful approach in my workshop, I noticed a short length of cast iron angle plate lying under a bench, just waiting to be used– it had been cut from a longer original for some obscure reason. The spark of inspiration illuminated the workshop (dimly). The

Getting there.

Completed cut.

›

angle plate was clamped in the bandsaw vice like an upside-down capital L. Now, how to clamp a lathe tool vaguely in line with the saw blade so that a slice the length of the shank but only 1/8 in wide and ¾ in deep could be chopped off from what was the bottom of the tool?

I returned to the box which housed the previously abused selection of clamps with little hope, until I lighted on four home-made toggle clamps. These had been made many years earlier simply from interest and had been inspired by an article in MEW by Harold Hall – he was probably Editor at that time. Two of these unused, but, by now, slightly rusty trophies were eagerly grasped and bolted to what was now the top of the angle plate. A few minutes fiddling with spanners etc and they were positioned near to the short edge of the angle plate in such a way that they easily clamped a three-quarter inch tool shank on its side, overhanging and parallel to the saw blade. Switch on the saw, lower the blade on to the sharp corner of the tool shank, take the weight until cutting was underway and joy was unconfined. I sliced an eight or quarter inch from an endless number of lathe tools, well, actually about a dozen, keeping some for another day.

Fixture as cobbled up.

To complete the transformation all that was needed was to pop a sawn tool in the milling vice, couple of cuts with a suitable cutter (i.e. whatever was in the chuck at the time) and I was in business. At this stage one may easily change the angle of the brazed tip tool to either positive or negative rake – it is interesting to try both.

As I had a more than adequate supply of lathe tools, should I badly chip a tip, well, the shanks became either useful stock or became vice parallels, the widths are notably parallel and well finished.

If you lack a suitable piece of old rusty angle plate it may well be more convenient to clamp a piece of six inch wide plate in the saw's vice and attach suitable clamps using countersunk screws/ nuts.

The general arrangements are shown in the photographs.

By the way, I later found the useful article by Harold Hall on making toggle clamps on page 33 MEW issue 9– this is labelled as the Feb/March 1992 issue – was it really so long ago? ∎

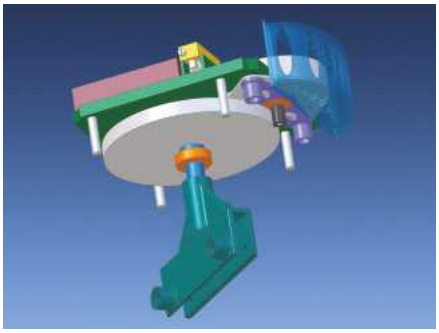
In our Next Issue

Coming up in issue 313
On Sale 18th February 2022

Content may be subject to change

Look out for your copy of MEW 313, the March 2022 issue:

Laurie Leonard shows how to improve the cross-slide leadscrew on Myford Lathes.



Mark Noel explains the ingenious engineering behind kite-borne aerial photography.

John Purdy describes a neatly made milling machine depth stop.

Making external turning TC tip holders

Jacques Maurel explains his technique for making tungsten carbide lathe tools using commercial tips.

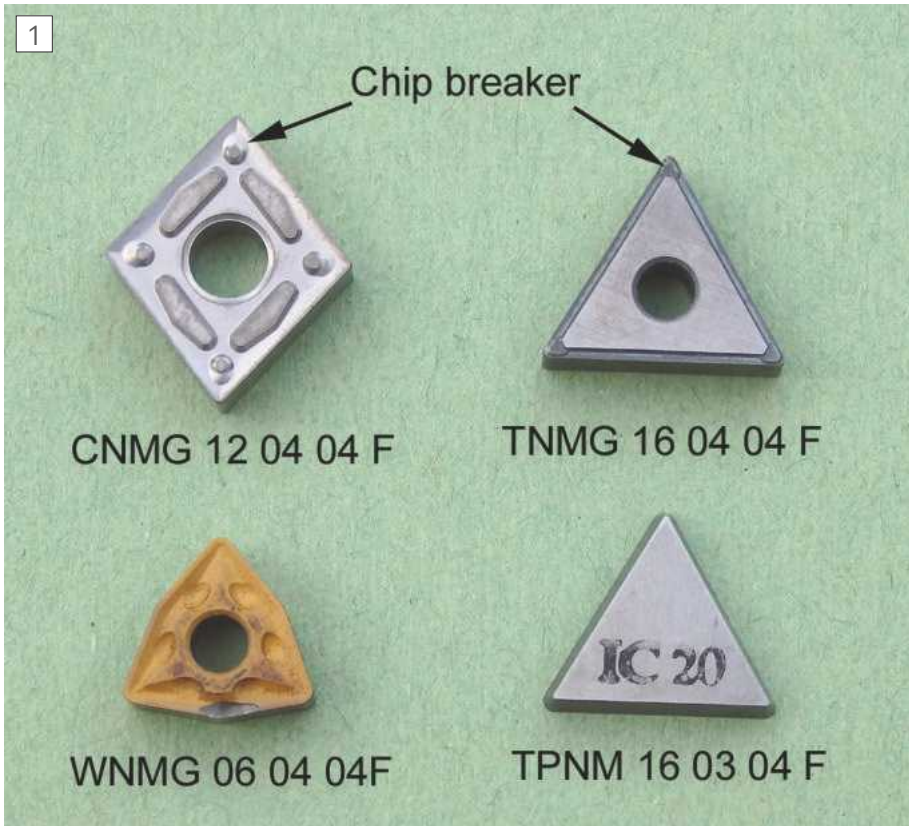
For the usual jobs such as turning and dressing (cleaning up rough material or castings) there are so many different types that I'll only speak about the ones I use and why. We want to minimize the number of different tips, so I use mainly two different types for external jobs, so it's worth buying a 10 tip box for each type. The ones I use are:

Lozenge: ISO name **CNMG 12 04 04 F** (**photo 1 top left**)

The meaning of the code is:

C = lozenge (80° and 100°angles)
N = 0° clearance (reversible)
M = dimensions tolerance
G = not flat (with some rake angle built in)
12 = dimension of the lozenge tip (½" between parallel sides)
04 = thickness 4.8mm (3⁄16")
04 = tip edge radius 0.4mm / F = sharp edge. I use the semi finishing type.

For external jobs, I use only reversible tips as this doubles the cutting edge number for each tip.



Types of carbide tip.

Triangle 1: ISO name **TNMG 16 04 04 F** (**photo 1 top right**)

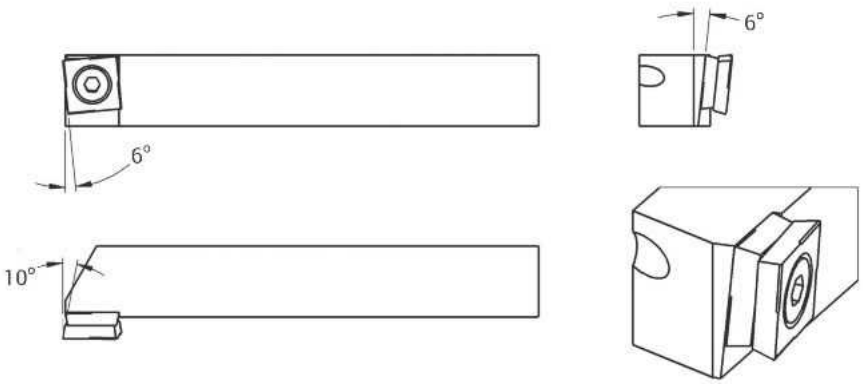
This has a reversible tip, 16mm edge length, 4.8mm thick, 0.4 tip radius. I use the finishing type. The triangle edge length will vary with the tip radius, but the 3 edges are tangential to a ⅜" diameter circle.

For external jobs, I use only reversible tips as this doubles the cutting edge number for each tip.

For rough turning and dressing to a shoulder (edge angle less than 90°):

I use the 80° angle edges of "C" type tips (lozenge) giving four 80° and four 100° edges for each tip. Why only for roughing? Because on our light machines it's not possible to break the chip (due to small feed) nor is it possible to clear the chips with a strong flow of lubricant, so from time to time, a chip will be caught in the 5° clearance between tip and machined part and spoils the machined surface.

Fig.1



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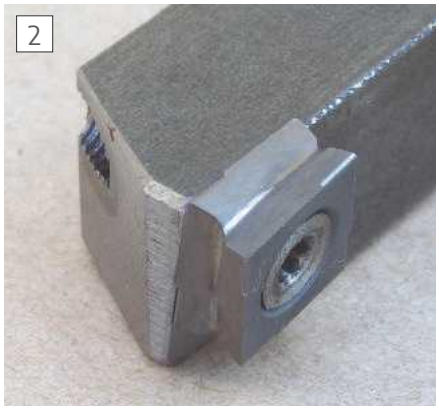


'Knife' tool used to provide eight cutting tips.

It's not wise to more than 1mm depth of cut or the chips will crowd against the chip breaker and give a bad surface or even break the tip.

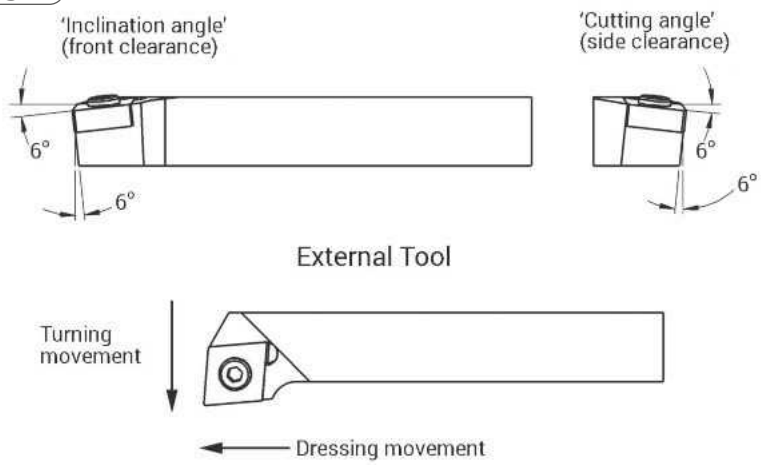
For finishing: I use "T" type tips (triangle) of finishing quality, so the chip is broken properly and moreover can't be trapped in the nearly 30° clearance.

The difference between semi finishing and finishing quality is mainly in the chip breaker (a sort of small slope just behind the cutting edge to curl and so break the chip) for the finishing type allowing 0.05mm/turn feed. It's not wise to take more than 1mm depth of cut or the chips will crowd against the chip breaker and give a bad surface or even break the tip.

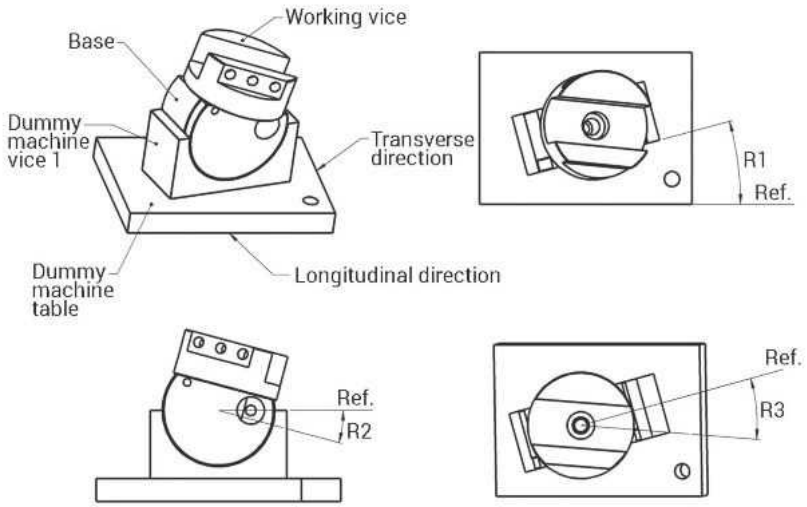
For dressing only (no shoulder):

I use "C" type tips (lozenge) but only the 100° edges which are sturdy due to obtuse angle. You can use all the edges of your lozenge tips, moreover these tips can be obtained free or for low price from professional machinists when the 80° edges are blunt as they usually don't use the 100° edges. Some price is justified as these tips ("heavy" as the density is 14!) can be sold for the tungsten and cobalt content. The "light" (density less than 5) type, whether they are made of cermet, titanium carbide, alumina (Al2O3 white) or silicon nitride (Si3N4 black) are of no value. With the sturdy edges and low price, you can dress the cheap first slice of steel bars which is usually wasted by ironmongers, as being flame cut they are filled with chilled and other hard points.

Fig.2



Drawing A



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Various tips on holders.

Note about other tips:

Triangle 2: ISO name **TPMN 16 03 03 F** (photo 1 bottom right) I used these tips as I was given a hand full, they are not reversible with 11° clearance.

Trigon ISO symbol "**W**" (**photo 1 bottom left**): Can be used in place of lozenge, they offer six 80° edges, the tip holders are slightly more difficult

3D CAD is of great help for the tip holder visualisation and machining with the universal vice.

to make, they don't give sturdy obtuse angles.

Special type, this is a knife tool type tip made by "Hertel", giving eight edges for one tip! See **photo 2** and **fig. 1**, I found some on the secondhand market and made a tip holder to use them but I don't have further information about them.

Types of tip holders and machining method for external jobs

The following notes should be helpful:

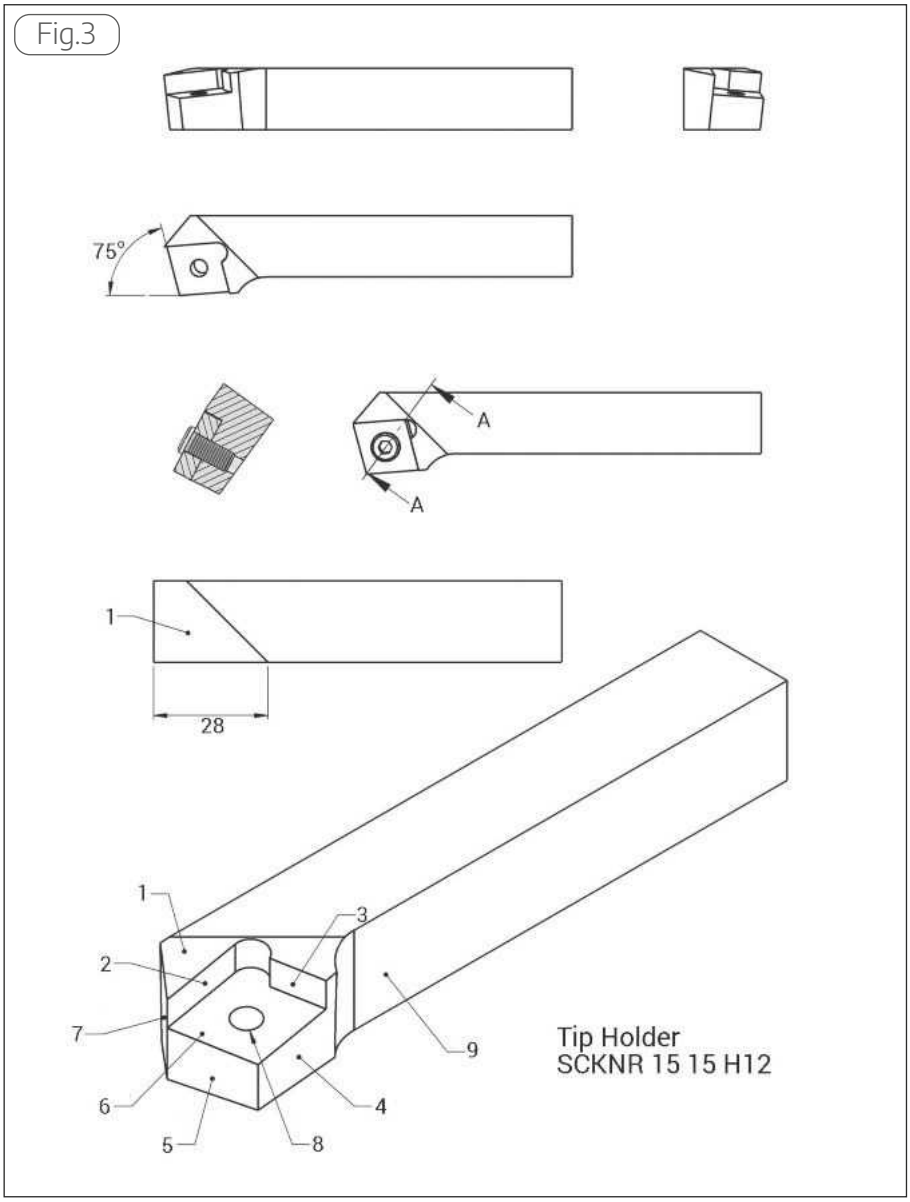
- All the necessary angles are given in the toolmaker's catalogs see **fig. 2** showing an external tool, the "cutting angle", which we call usually the side clearance, being most often 6° and the "inclination angle", which we call usually the front clearance, also most often 6°.
- 3D CAD is of great help for the tip holder visualisation and machining with the universal vice (described in MEW issue 306).
- Keep in mind that these home-made tip holders are only for occasional use, the industrial ones are made of hardened steel, with a carbide plate under the tip (to protect the tip holder when tip breaking) and usually a more complex tip clamping system.

Method for getting the good machining angles

Using 3D CAD and the sketch shown on

The tool holder is linked to the working vice, the plane to be machined is first set near the position you want (with the mouse) and then asked to be parallel with the plane you have chosen.

Fig.3



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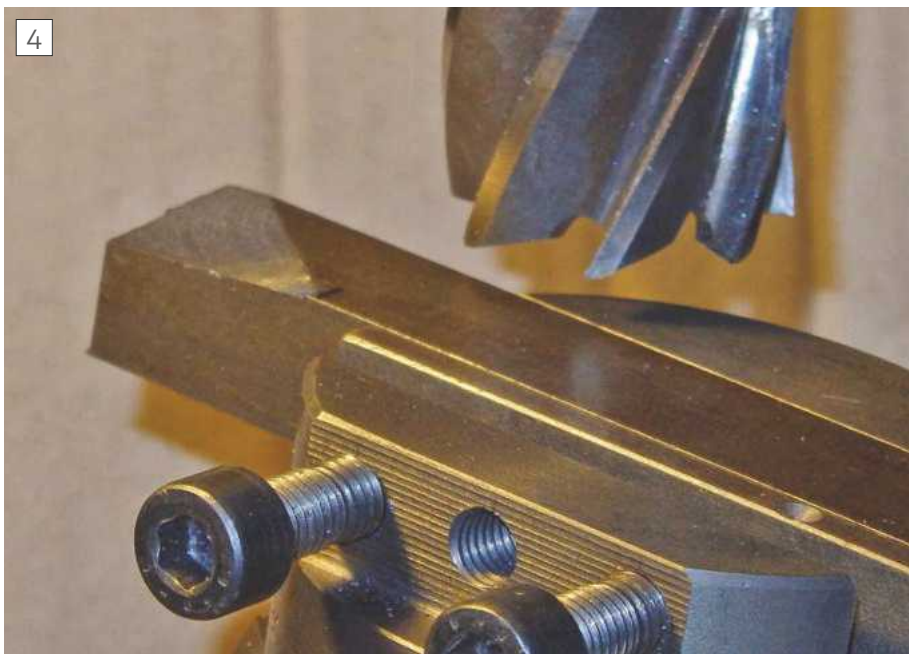


Machine surface 1.

drawing A (from the "universal vice" article, remember that on this drawing R1 is positive while R2 and R3 are negative).

The tool holder is linked to the working vice, the plane to be machined is first set near the position you want (with the mouse) and then asked to be parallel with the plane you have chosen. After that you just have to measure the angles (R1, R2, R3) between the vice parts.

Tip holders for external jobs:

I'll describe first the making of the three most useful holders shown in **photo 3** . The ISO designation is written on the shank. Starting with a detailed example:

Making the standard tip holder for dressing with the obtuse tip angle (see **fig. 3**)

The tip is ISO designation: **SCKNR 15 15 H 12**, the meaning of which is as follows:

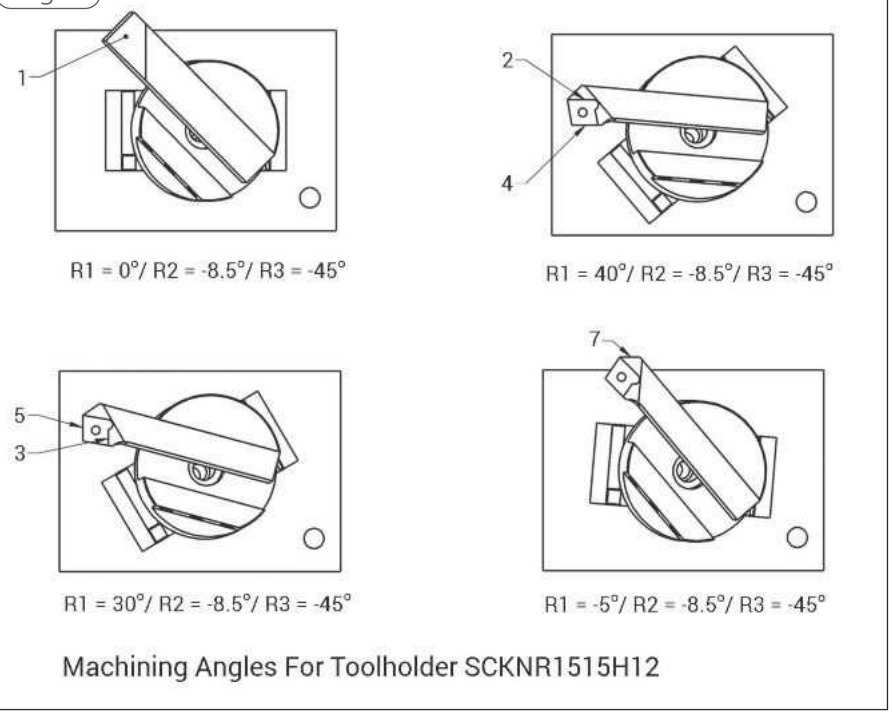
S = screw fixing
C = lozenge tip
K = 75° between cutting edge and dressed surface
N = 0° clearance tip (reversible tip)
R = right hand cutting edge
15 15 = 15mm square section for the tang
H = 100 mm long
12 = dimension of the lozenge tip (1/2" between parallel sides).

Machining method (**fig. 4** and **photos 4** to **11**)

Blank: 15x20mm CRS 100mm long medium grade steel (the same is used for all the tip holders).

First step: machining surface 1: set R3 = -45° and R2 = -8.5°. Surface 1 is now parallel with the machine table, whatever R1 is. All the machined surfaces (aside from 9) will need only R1 modifications. A plain flat is machined with a 35mm diameter end mill to get

Fig.4



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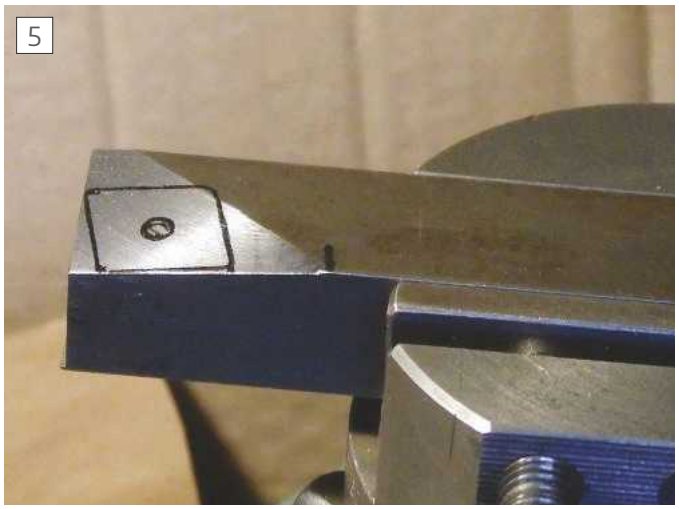
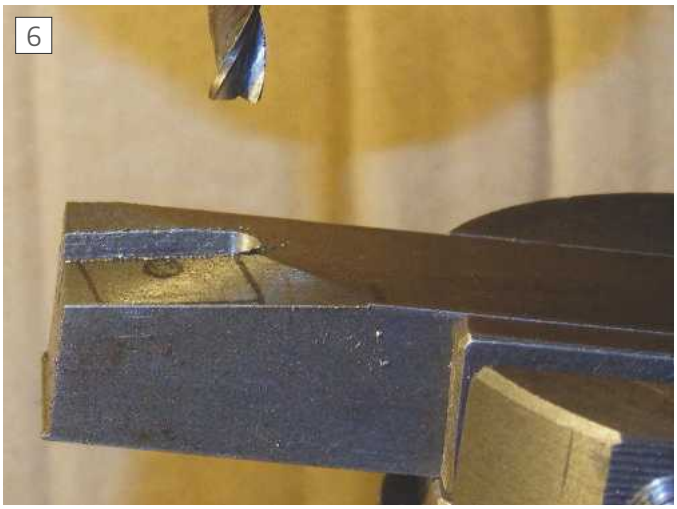


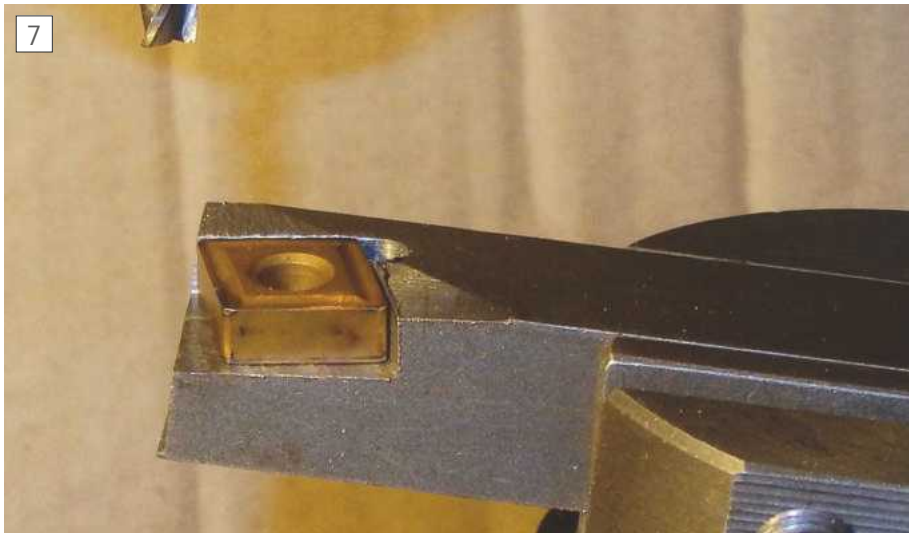
Marking contour of tip.

6



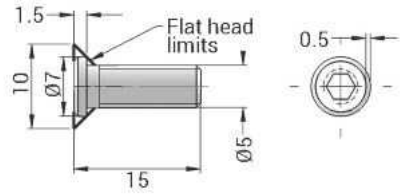
Machine surface 2.

7



Mark the limits of the tip's edges.

Fig.5



With the sturdy edges and low price, you can dress the cheap first slice of steel bars which is usually wasted by ironmongers, as being flame cut they are filled with chilled and other hard points.

the 28mm dimension see **photo 4**.

Second step: set a tip on surface 1 (15° front angle line drawn with a protractor) and mark the contour with a felt pen see **photo 5**.

Third step: machining surface 2 (and part of surface 6): set R1 = +40° a plain groove is machined (use longitudinal feed) width 5mm, depth 4.8mm (4x1.2mm steps) along and clearing the felt marks see **photo 6**.

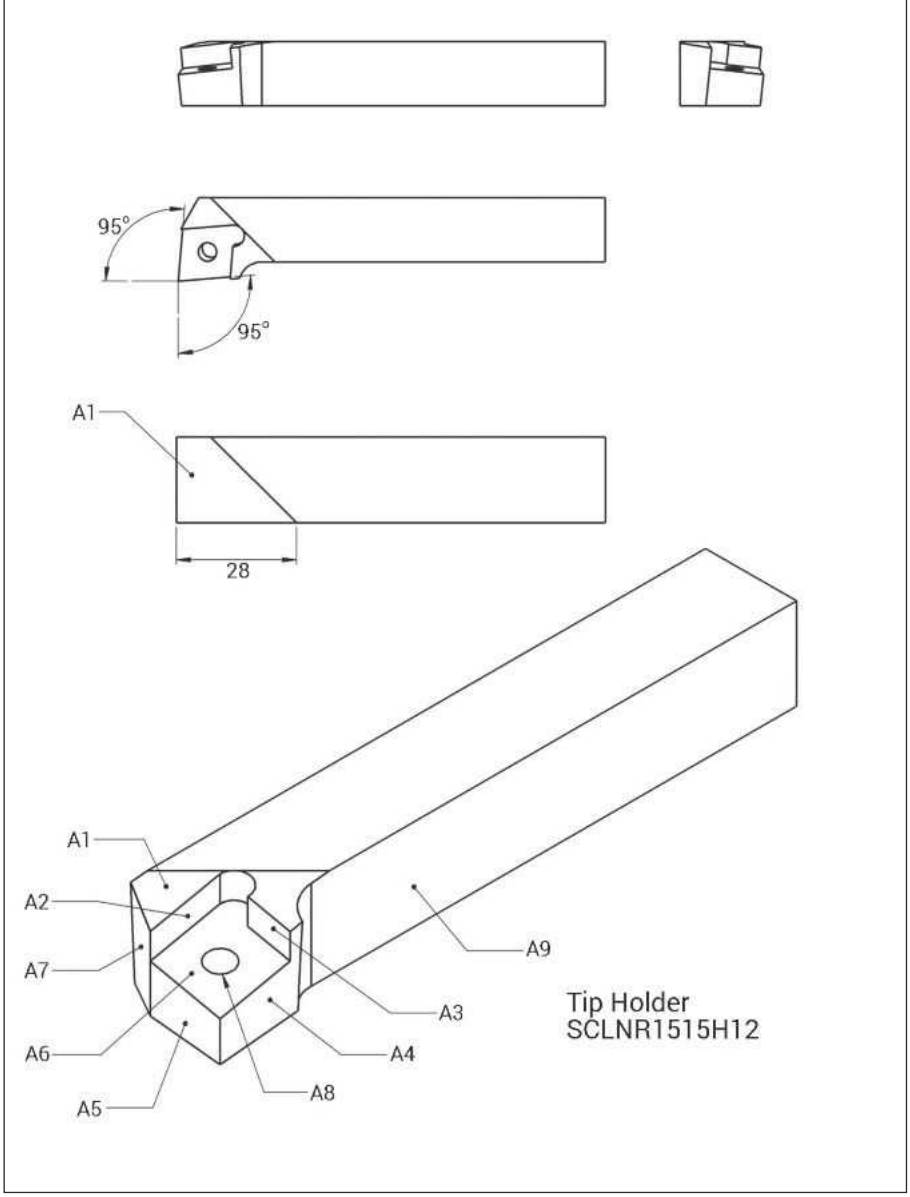
Fourth step: machining surface 3 (and the remaining of 6): set R1 = +30° transversal feeding with the same 5mm diameter end mill.

Fifth step: set a tip in place and mark the tip's limits on surface 6 with a sharp scriber see **photo 7**.

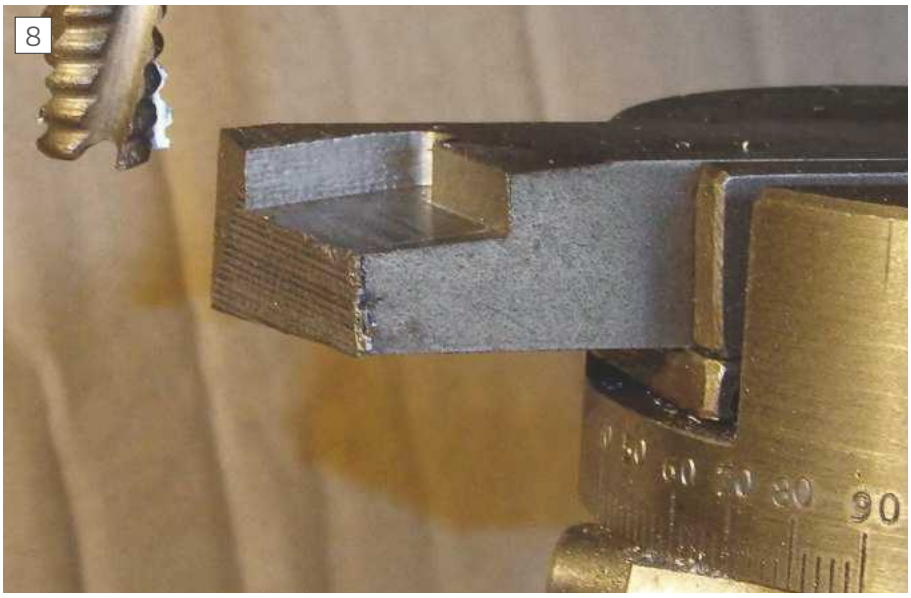
Sixth step: machine surface 5. The position is the same as for step four, but use a ripping mill (a heavy-duty milling cutter with chip breakers) if possible (diameter 11mm, transverse feeding) to the scribed line see **photo 8**.

●To be continued

Fig.6



8



Trim end of holder, surface 3.

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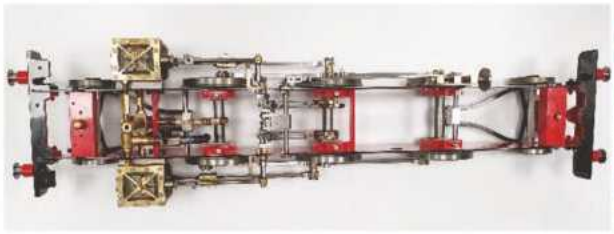

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