No.281

THE MAG FOR MAKERS, MODEL AND HOBBY ENGINEERS

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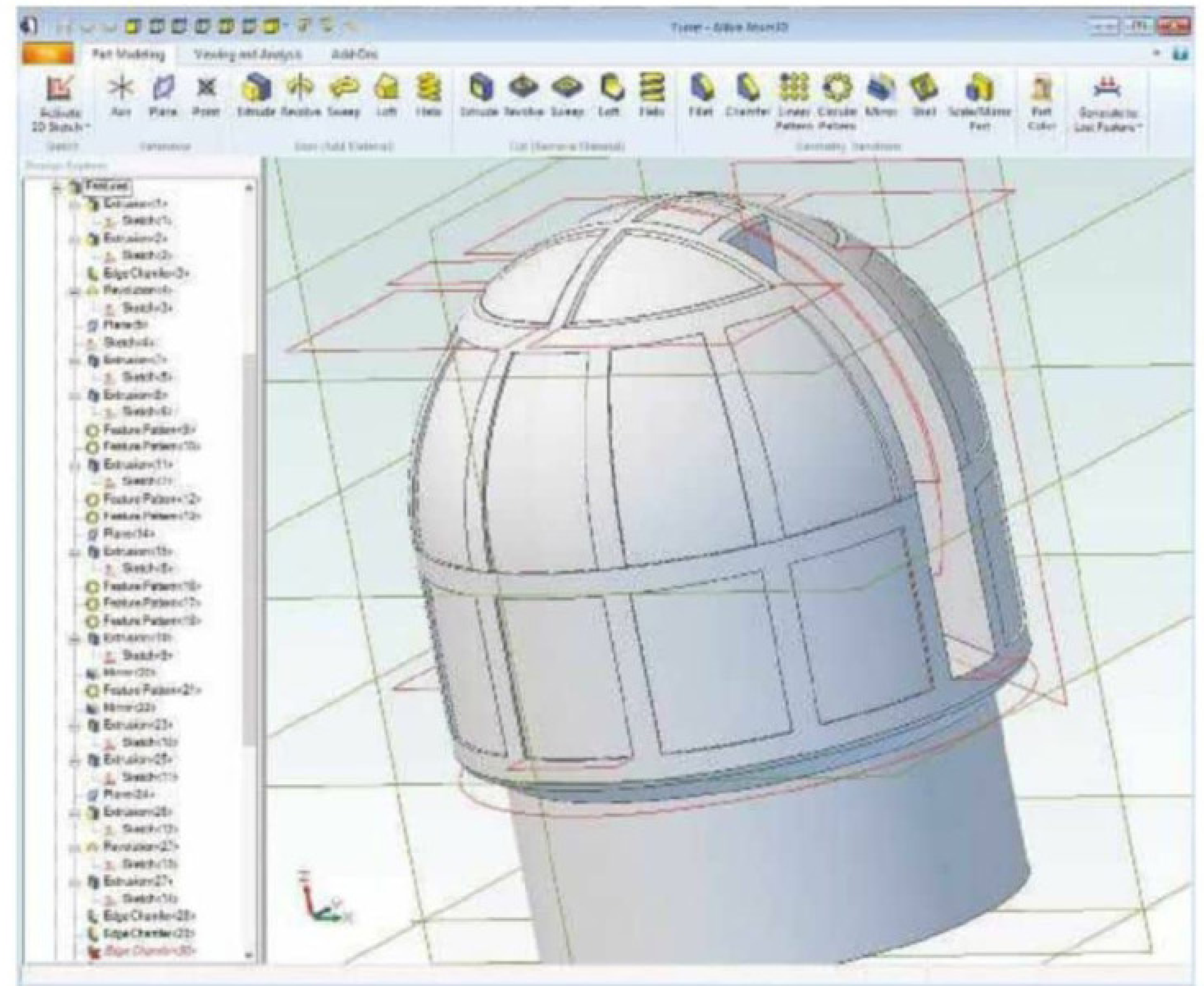
print & digital media publishers

Model Engineers' Workshop, ISSN 0959-6909, is published monthly with an additional issue in August by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 52.95GBP (equivalent to approximately 88USD). Airfreight and mailing in the USA by agent named WN Shipping USA, 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineers' Workshop, WN Shipping USA, 156-15, 146th Avenus, 2nd Floor, Jamaica, NY11434, USA. Subscription records are maintained at DSB.net Ltd, 3 Queensbridge, The Lakes, Northampton, NN4 5DT. Air Business Ltd is acting as our mailing agent.

On the Editor's Bench



Alibre Atom3D

Are you one of the many readers who have followed our 3D Cad for beginners series? If so, hopefully you now have some designs of your own. I am using Alibre Atom3D regularly, the picture shows a design for a turret for my 1:16 Air-Sea Rescue Launch, now printed in transparent PLA. To encourage readers to share their designs, I have come up with a little competition. Email me the CAD files for your favourite design (put them in a zip folder), each month we will choose a design to be photo-rendered and featured in MEW and on Mintronic's website. At the end of the year all the submitted designs (even ones we are unable to fit in) will be put into a draw by to win £100 of shopping vouchers, courtesy of Mintronics.

Readers who were 'early adopters' of the free six-month licence to Atom3D are starting to reach the end of their free period. Registered readers should receive an email from Mintronics with an offer to purchase Alibre Atom3D at a special reduced price. If you don't get the offer, please email Mintronics **business@mintronics.co.uk**.

If you don't want to purchase Alibre Atom3D but still want to be able to view Alibre files, your installation will work as a viewer, but it may need to be activated as one. Please visit this link and scroll to the bottom of the article for details:

www.model-engineer.co.uk/alibreatom3d

Voting for the Stevenson Trophy Competition

Entries have been received by the judges, and after some consideration we have identified a shortlist of eight items. My thanks to everyone who made an entry.

Criteria for inclusion on the shortlist are that the tooling is practical and capable of being used for accurate work in a home workshop setting. It should demonstrate ingenuity, good design, economical use of materials and be appropriately finished for its function.

Voting will close on the 10 May so you will probably see this too late but if you do see this in time, the voting page is **www.model-engineer.co.uk/stevenson**. The winner will be announced at the Doncaster Show on 11-13 May and our next issue will include a report.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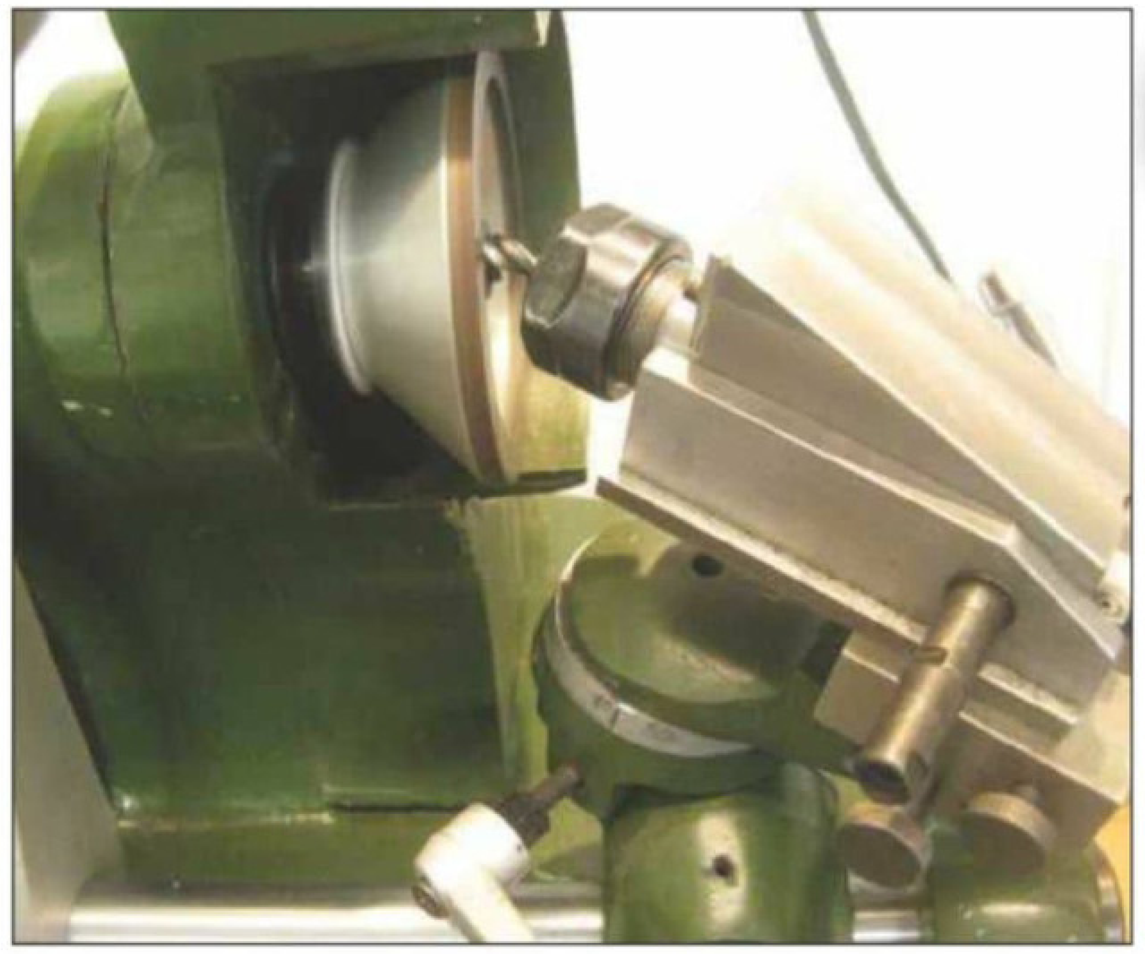
Coming up...

in our next issue

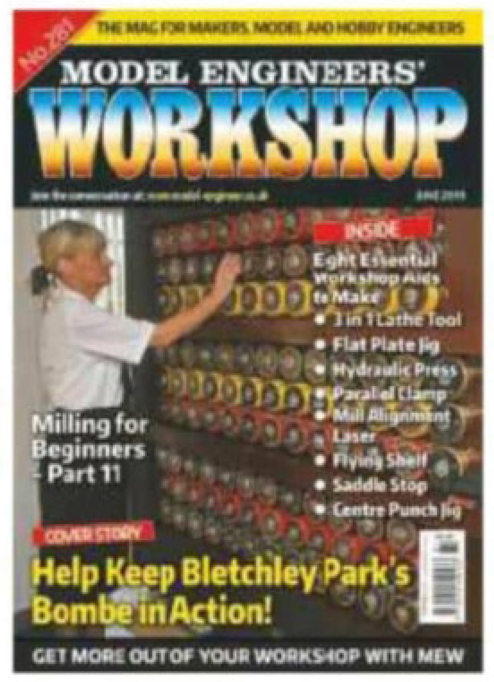
Coming up in our June issue, number 282, another great read



Regulars

ON THE COVER

This month's cover shows Bletchley Park's rebuilt Bombe codebreaking calculator designed by Alan Turing. See page 56 for more details.



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THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

Visit our website to access extra downloads, tutorials, examples and links. This month see the workshop tooling entered for the 2019 Stevenson Trophy competition: **www.model-engineer.co.uk/stevenson**

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

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

Vickers Bl 8 inch Howitzer cannon of 1917
- It's worth a visit to the forum just to see the lovely work Mal Webber is putting into this rapidly progressing model

Precision Levels
- An old chestnut! Your lathe doesn't need to be perfectly level - just without twist to cut accurately. But what's the best way to achieve that?

Building a Belt Grinder – Advice Please!
- An interesting discussion with some intriguing examples of belt grinder design.

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

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Centre Punch Tool

Will Dogget makes a jig for centre punching holes on round work

Over the years I have had problems with centre punching round stock that has a shoulder on it, even with the aide of a vee block you need three hands to hold the job, a centre punch and a hammer.

The other method is to use a tool makers vice or machinists vice, neither of these are very satisfactory so I muddled on for years until...

The concept

When working on another project I had a vee block and a micrometer on the bench, it was then an idea was born, see **photo 2**. It was the mic and the vee block that gave me the idea; this I put on a piece of paper in the workshop at the time as a quick sketch or scribble as you can see in **photo 3**.

The idea was to use a frame and a spindle in a similar shape to the micrometer. The barrel/spindle of the micrometer will become a spindle with a centre punch at the bottom and pass through the frame made in a similar way to the micrometer frame. The frame will be attached to a base to which the vee block will also be fixed to.

Constructing the punch tool frame

The frame for the centre punch tool was found in the workshop, standing by the mill. This was a leftover from another job, **photo 4**. This with modification this will make the frame along with the other parts that I have cut ready to make the centre punch tool shown in **photo 5**.

2

The idea

1

Finished punch tool

The first part to be made was the base, this is was already cut to length and the front part of the angle up stand was also removed, so I removed the rear corners at 45 degrees from the other up stand.

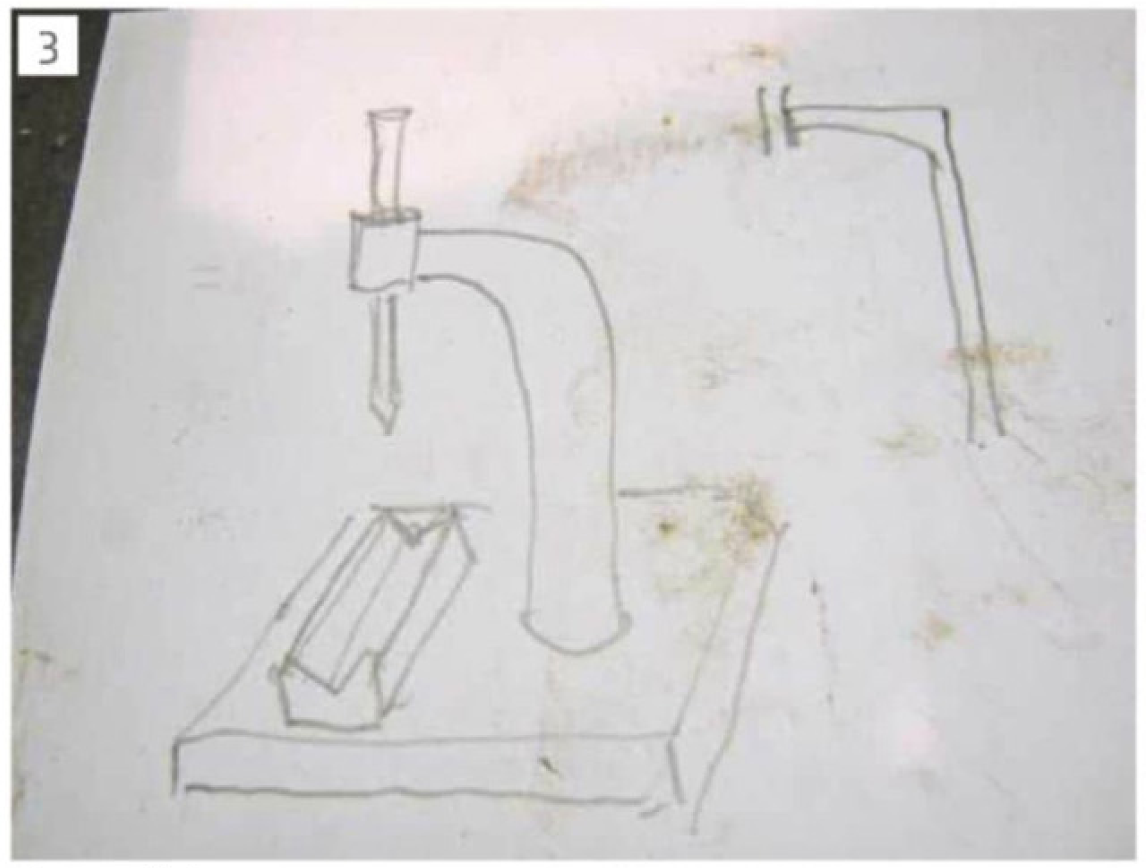
The frame was made from the large piece of channel this was marked out and cut to length ready to be welded to the base.

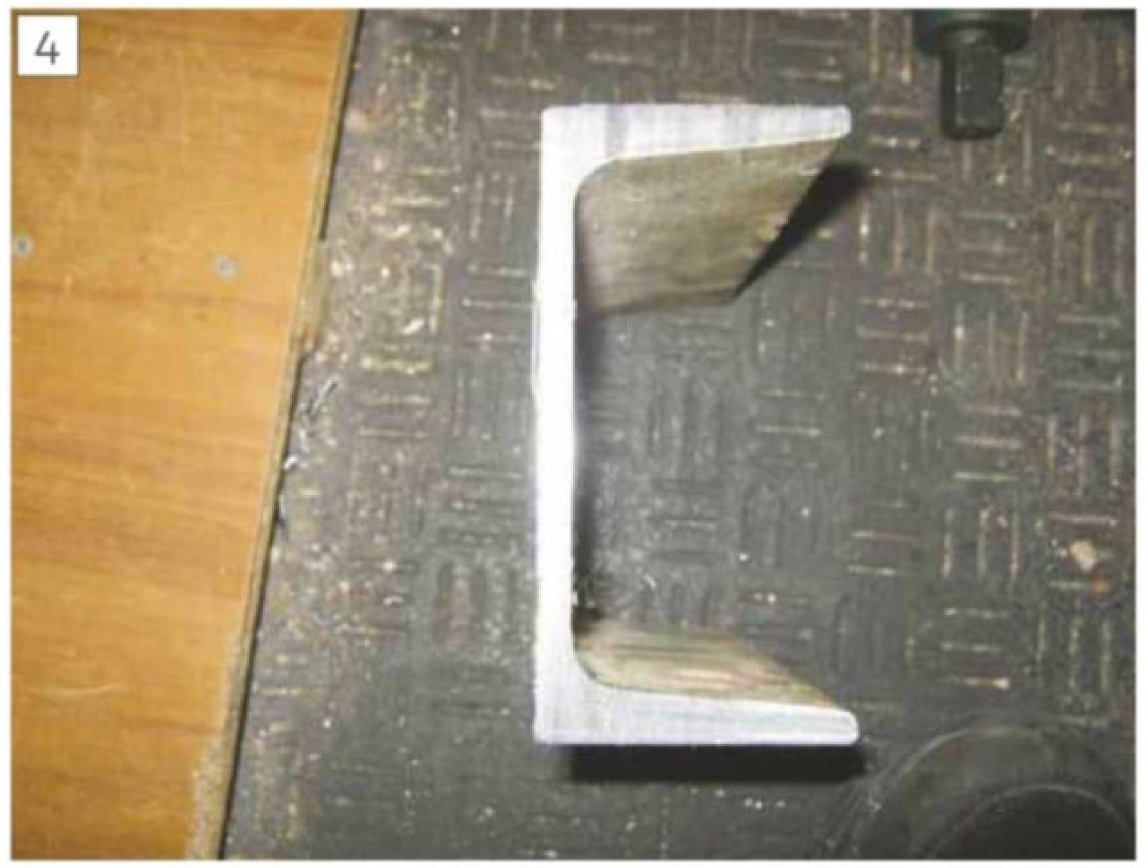
The guide part is the small stubby round piece top right in **photo 5** and was the next part to be machined. This was put in the lathe and faced both ends. One end I centre drilled, ready for opening up after it was welded to the top of the frame.

All the paint was removed with a wire brush on an angle grinder, before I started the welding. The base was clamped to the top section with a piece of steel for support with a clamp holding the guide bush on the top.

The three parts were then welded together; the welding is shown in **photo 6** - this photo is before it was cleaned up.

After cleaning up the welds on the


The scribble


Left over from another job

frame, it was put on my steel marking out plate. I then used a square to check whether the welding had distorted the frame. It had, so I used a lead hammer to straighten it and on rechecking it was now square with the base.

The next task was to clamp the base to the dill table and then drill the centre punch guide hole this was done in stages, **photo 7**. Before drilling started, I put a piece of timber under the guide overhang to stop deflection. After the last drill was used the guide was then reamed ½" as this is the size of the spindle, **photo 8**.

After drilling and reaming was complete, the frame was cleaned up with a file and emery paper. **Photo 9** shows the 'slight similarities' to photo 2.

Fitting the vee block

Now to position the vee block. I put marking out blue on the base plate, after it had dried, I put the block on the base then the punch was put through the guide and onto the vee block, **photo 10**. At this stage the punch was still square on the end, this was to help with positioning. The base was then marked around the block with a scriber.

The block is second hand, to say the least, as you can see from photo 2. I used it for this project because it has two M8 screw holes in the bottom and these would be used to attach the vee block to the base. I think it was originally an apprentice piece as it has a name stamped on the bottom and seems soft (as in not hardened).

The hole positions were then measured and marked out on the top of the base plate within the marked out area. It was not possible to drill the holes from the top, as the top frame is in the way, so the position for the holes was transferred to the underside of the base and remarked.

The piece of timber was put in place again and the frame was held upside down in the machine vice and the two 8 mm clearance holes were then drilled. The holes were then deburred the vee block can now be fitted.


The guide parts


The welded tool


Drilling the guide


Reaming the guide

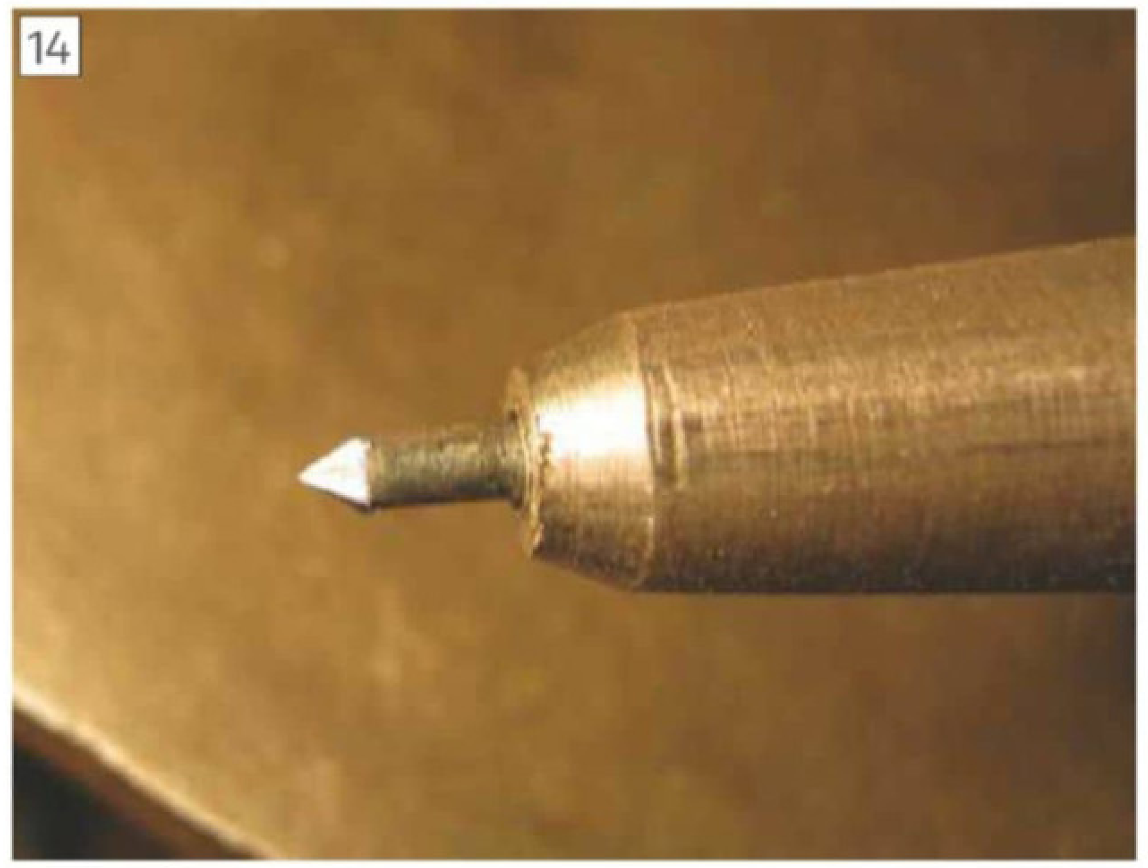

The similarities


Fitting the vee block


The raising blocks


Drilling the punch


The masonry nail


Reground tip

Base raising blocks

After the M8 bolts were used the underside required lifting because the heads of the bolts interfered with the base sitting flat, to remedy this problem I cut two pieces of 40 X 12mm and 60mm long and fixed them to the bottom of the base, **photo 11**, I used a glue that is supposed to stick most things including steel we will see.

The centre punch

The centre punch is made from ½" mild steel this was cut to 175mm in length and then put in the lathe chuck and a 5 deg taper was turned on the one end then it was drilled 2mm about 25mm deep, **photo 12**. It then was removed from the chuck and put back in the chuck the other way around and this end was machined on the face and a chamfer put on the edge.

The business end of the punch is a masonry nail which was shortened then driven home and held in place with screw retainer fluid. The end is about 35mm long this is so I can see the lines when punching. It was then ground to a 60 degree angle as this is the first punch to use when marking out. The second punch is a 30 degree angle - this was according to the toolroom foreman when I was working in there as an apprentice. I then realised after testing the tool the angle should be 30 degrees as this tool removes the need to start with a 60 degree punch, so the tip was reground to 30 degrees. This made the tool much better **photo 13** shows the punch with the 60 degree tip before modification and **photo 14** shows the reground tip, so now the punch is ready to be used.

The idea for the masonry nail came from an article on the mikesworkshop.weebly.com website (that of our regular contributor, Mike Cox), his article was about transfer punches.

Finishing

To finish the tool the frame was ready to be painted, but then I thought about the raising blocks that were glued on and decided that they would be better if they were held on with screws.


The cap head screws

The position of the fixing holes was marked out on the base bottom and drilled M5 tapping all the way through, then I opened the top part of the hole that is in the base to M5 clearance. I then tapped the four holes into the raising blocks, the screws don't interfere with the vee block in this position.

After tapping the holes, I put four hexagon cap head screws in them and tightened them up. **Photograph 15** shows them fitted I am now happier about the fixing of the raising blocks.

Now back to painting the bottom of the base was painted first, I then let the paint dry and painted the top to finish.

The tool in use

To use the tool, I marked the parts out as normal this usual means holding the part with a vice or vee block the advantage of the vee block it can have a clamp but this in itself can get in the way when centre punching.

Now that it is marked out with one hand holding the part level in the vee block of the tool I brought the punch down and placed its point on the intersection lines. It is then a simple matter of hitting the punch with a hammer to get a stress free centre punch mark on round material.

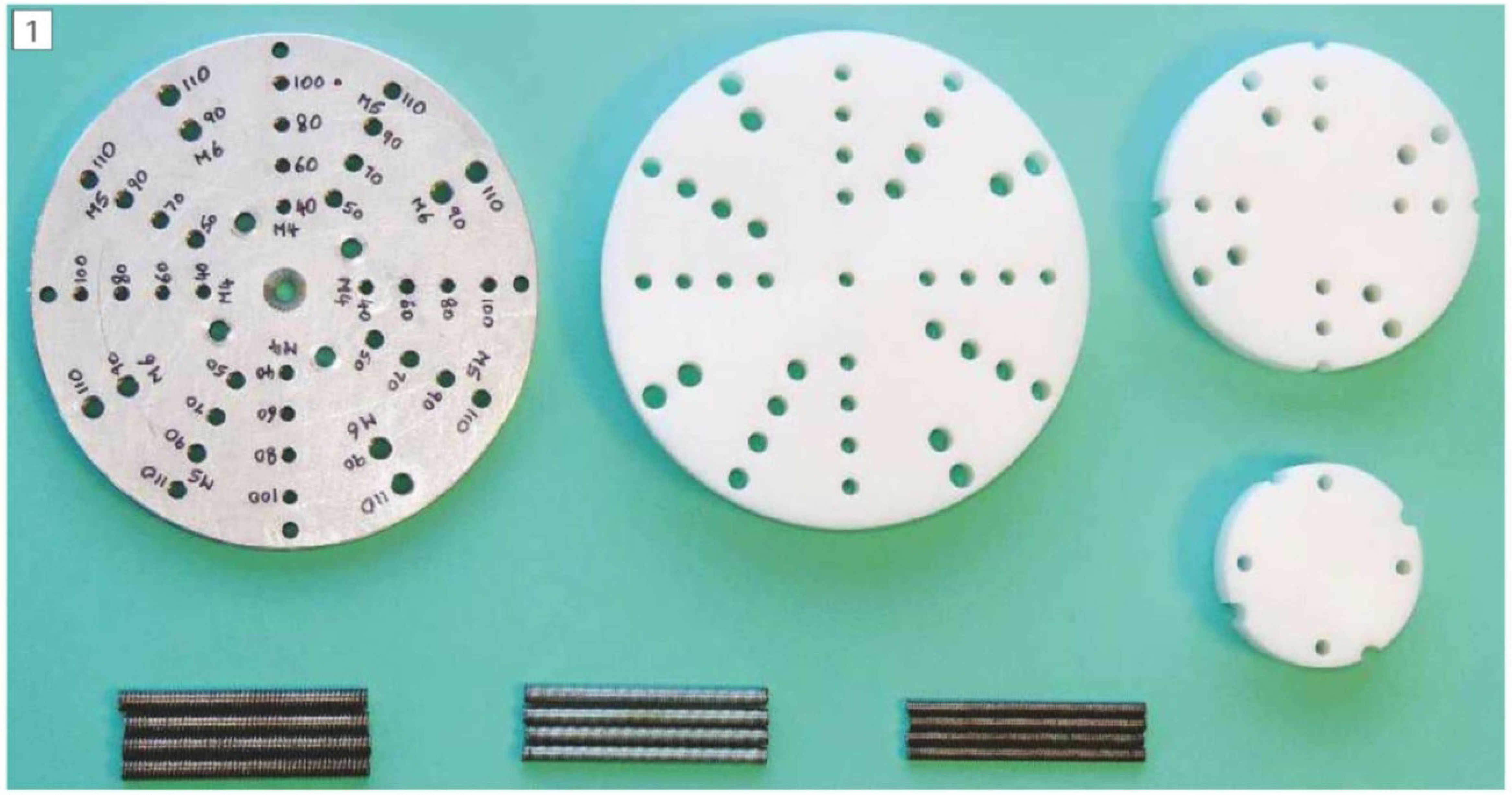
Conclusion

The construction didn't take that long I would say about a day to make before painting, in fact the painting was the longest part to do. But whether to make one and was it worth it? I think it is a yes as there are no more three handed jobs to do when marking out round material.

I am just wondering now why it took me so long to get around to making one of these tools. ■

Sub-Plates for Lathe Workholding

Dr Keith Keen describes a simple holder arrangement for machining circular plates that fits within the outside jaws of a self-centring lathe chuck.


A selection of plates in aluminium and plastic

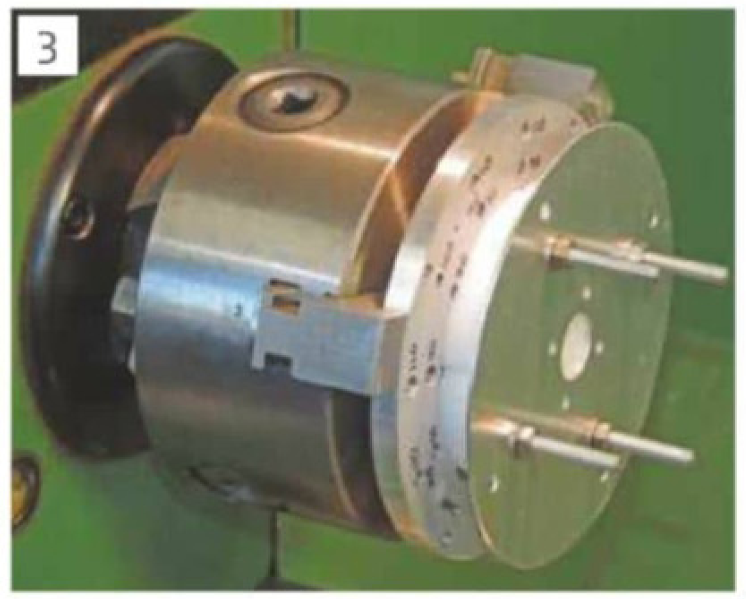
Quite often, I find that I have to machine the outside of a roughed out circular metal or plastic plate to a required outer diameter (OD), but I have trouble in finding a way to hold the workpiece. The plate usually has (or can have) a group of four equally spaced holes in it on a particular pitch circle diameter (PCD), which can be used for holding. I have devised a simple work holding arrangement to facilitate circumferential machining using any conveniently available holes, the parts of which are shown in **photo 1**.

In this short article I just wanted to show the scheme which others might also find useful. I don't intend to give a description of how my parts were made, or detailed drawings, because construction is fairly straightforward and obvious, and the parts shown in photo 1 were made specifically for use with the three jaw self centring chuck on my lathe, a Myford 254plus. Other parts' dimensions might be more suitable for other lathes, and different metal and plastic materials might be preferred. However, I would mention that a DRO equipped mill/drill is required for making the parts, in order to get all the holes in the correct positions.

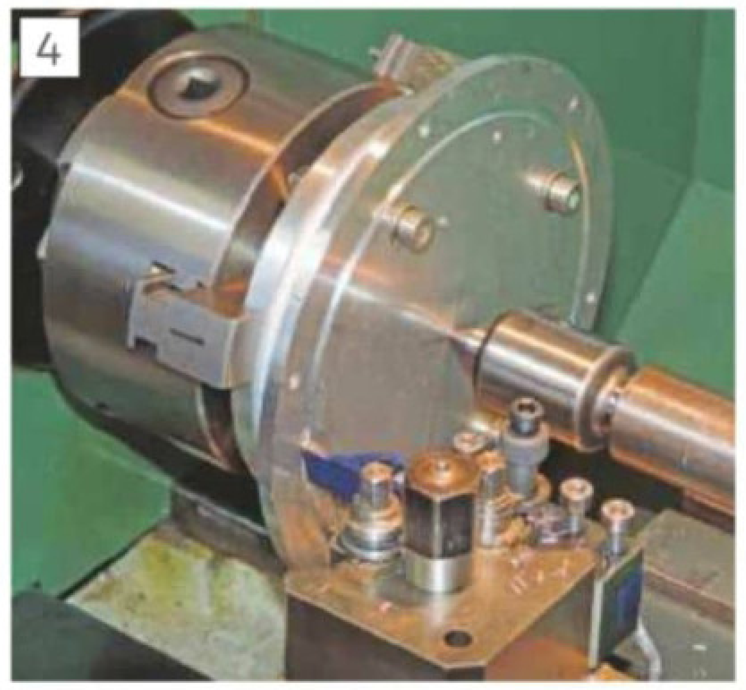
Description and Use

Photograph 1 shows the holder parts which consist of a metal disc with sets of tapped holes (left), three acetal plastic spacers, and three sets of threaded rod pieces. For my work holder parts, the disc has an OD of 125 mm and a thickness of 8mm, and was made of aluminium alloy, because this was what I had available - but steel would probably have been better, being more durable. The acetal plastic spacers are 18 mm thick and have ODs of 120, 80, and 50 mm. The threaded rods are M4, M5, and M6, 60 mm long, in sets of 4 for


Sub-plate held in lathe



Workpiece attached to plate



Parting rim extension for traction engine flywheel

each thread size.

The aluminium alloy disc has sets of four equally spaced M4, M5, and M6 tapped holes at PCDs which are likely to be useful for work-holding. The hole groups are spaced on axes 30° apart, to fit them all in. The plastic spacers have clearance holes to match.

Photographs 2 and **3** illustrate how the work-holder parts are used. The aluminium alloy disc is held in the outside jaws of the three jaw self centring lathe chuck. For machining the circumference of a roughed out circular workpiece (which has been pre-drilled with appropriate hole sets in the DRO equipped mill/drill), an appropriate plastic spacer is chosen, and the work piece is mounted in place using either the required set of threaded rods or four capscrews. In most cases, the threaded rods or capscrews can also have lock nuts behind the aluminium alloy disc for additional security.

In addition to machining the outside of circular workpieces, the lathe work-holder is also useful for other machining tasks. Photo 4 shows a rim side extension for a one fifth scale model steam engine flywheel being parted off, having already been turned to the required OD. A rotating centre in the tailstock gives additional support. **Photo 5** shows the completed flywheel. ■

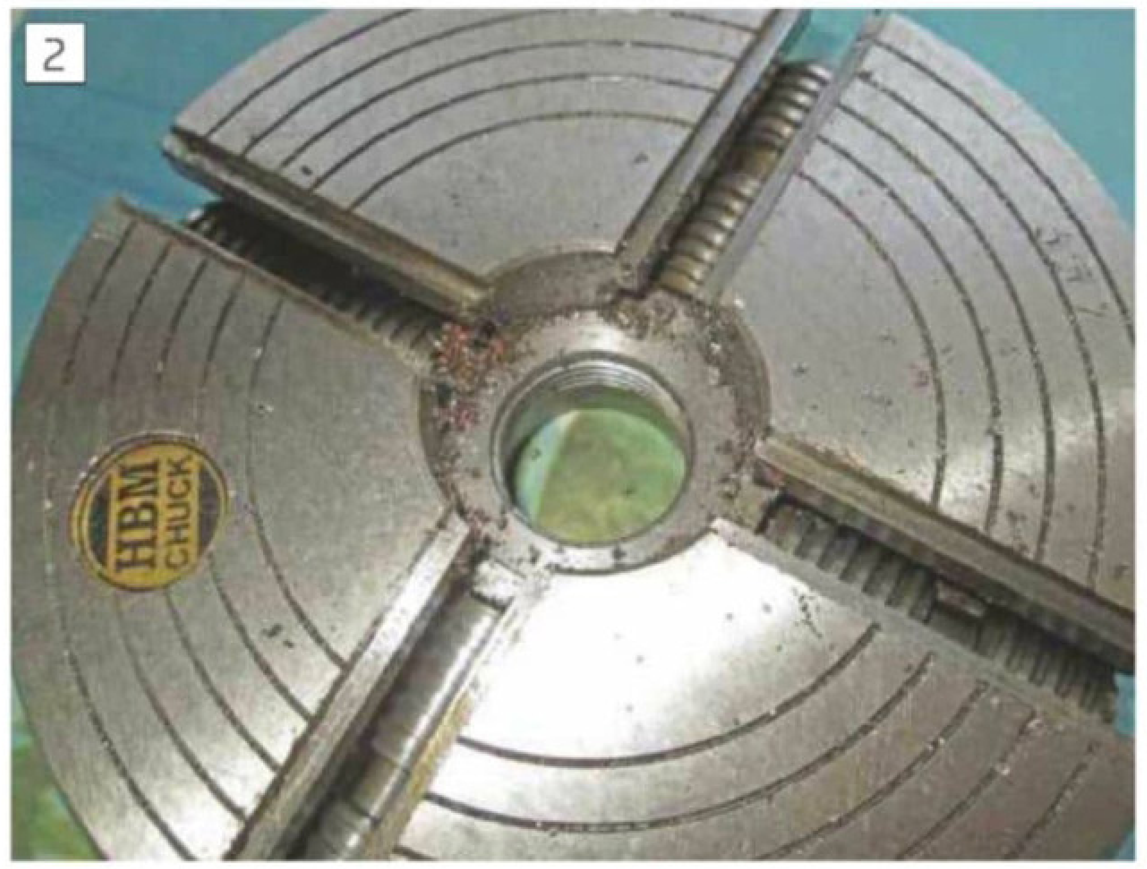
Finished flywheel

The "Soft" Side of the Workshop

Laurie Leonard takes a thoughtful perspective on our workshops

Soft Issues

Swarf in 4 jaw chuck



Swarf after removal of the jaws

Introduction

A title like this may conjure up all sorts of thoughts including the sentiment implied by **fig. 1**! The impetus for writing this article came when I was thinking of an editorial penned by a previous editor, MEW 166, in which he had the foresight to recount an incident in his workshop that resulted in a personal injury. David, I have often thought of this editorial and it is possible that it has saved me from a similar fate!

It got me thinking of other areas of workshop practice/behaviour that have a bearing on the execution of work but perhaps do not directly produce "something" at the time. The common thread running through these can be described as "soft" as it involves "thinking" and attitude of mind. General safety issues can be linked in here, but I will give a few other examples that have made me "think" and take a "side" action instead of ploughing on with the job and other related topics. These may jog other readers' memories.

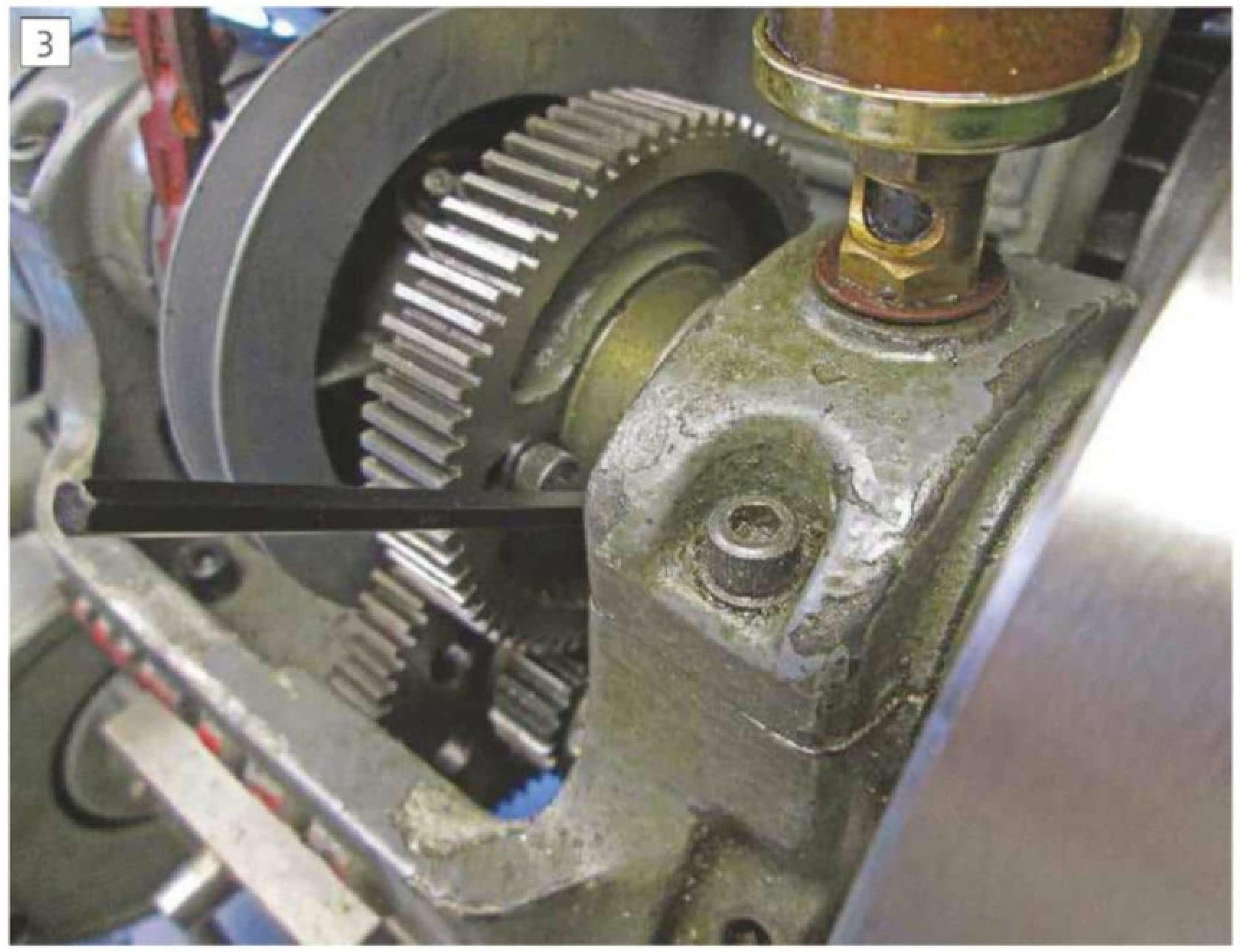
Time

Most of our activity in the workshop can be attributed to pursuing a hobby and as such time is not, or perhaps should not be, an overriding factor but there is often the urge to get the current element of a job completed so as to move on to the next. When I retired I told myself that I now had the time and that it was no longer necessary to "cut corners" because dinner would be ready soon and it was back to work tomorrow. Do I follow this practice to the letter?

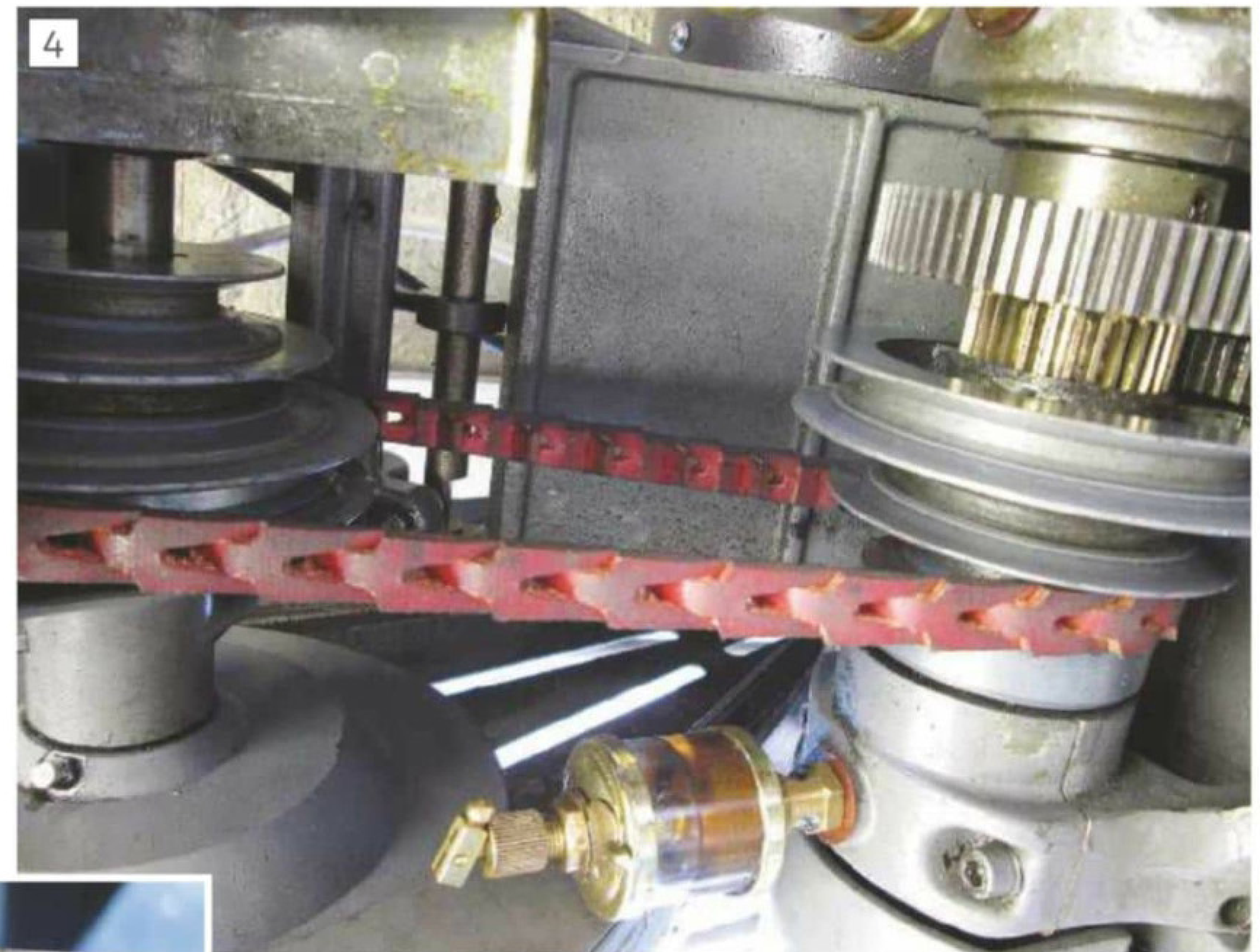
General Workshop Conduct

Under this heading I will give a few examples of issues that can arise when it is only too easy to plough on assuming you will "get away with" an observed potential problem or an area where corrective action should really be taken.

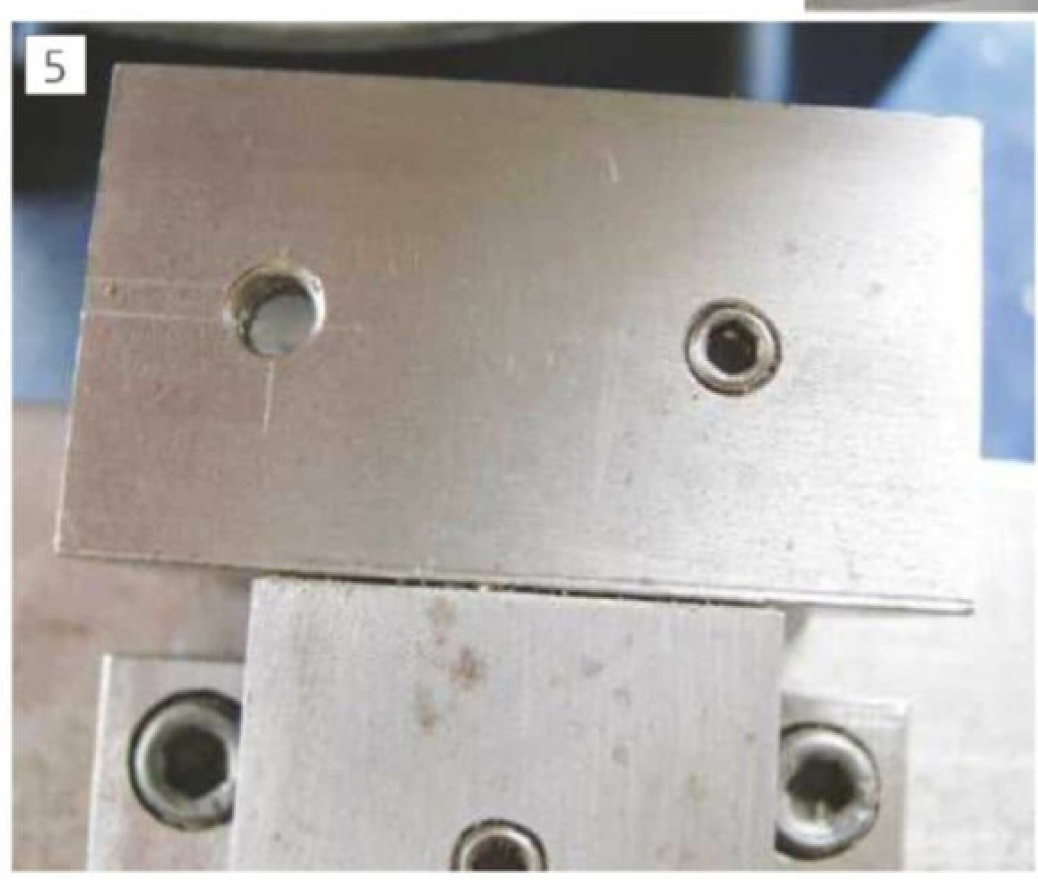
Photograph 1 shows my four jaw independent chuck after completing a boring (no pun intended but apt) job.



Tightening the drive dog on the ML7 lathe



Segmented drive belt - source of noise



Missing screw on Woden tool carrier

The work now needed to be remounted for another operation, but I noticed the swarf build up. Jaws still relatively clean: remount the work or clean the chuck? I removed the jaws and cleaned the chuck. **Photograph 2** shows the amount of swarf waiting to get into the threads and other places where it could cause problems.

I recently installed a variable frequency drive on my lathe and one of the side benefits to me was the quietness of the lathe when in motion. On one occasion when screw cutting, I noticed a "clunk" when changing direction to return the tool to the start of the thread. Not loud but there. Finish the job and look into it later? I switched off the drive, opened the belt cover and rocking the chuck by hand deduced that the dog on the drive gear had moved out and needed resetting, **photo 3**. As access is tight, I had already made a short arm Allen key for the purpose so there was no real fight this time to do it. Possible effect on the quality of the thread? Probably but I have a thing about noises that need to be explained.

As my hearing is bad, I have a thing about noise in general. I fitted a replacement drive belt on my lathe a while ago and not wanting to disturb the headstock bearings I used one of the segmented variety, **photo 4**. A short while after this the lathe developed an annoying squeak from the headstock area. I traced the noise to this belt: at least it was not the main bearings! A squirt of belt dressing cured the problem and removed the potential for it to mask something more important/sinister.

A project I was working on a while ago involved grinding (or more truthfully trying to grind) a piece of HSS steel to make an ACME internal thread cutting tool. I was about to set it up on my Worden tool and cutter grinder and noticed that one of the screws was missing from the tool carrier, **photo 5**. As the current job did not extend under the missing screw it did not matter on this occasion but as I have tried to adopt a policy of "Sort It" so a replacement screw was found and fitted.

I use a centre drill to start any drilling operation in the lathe but found that a lot of holes were off centre. I have play in my tailstock barrel, still to be attended to, but I found the chief cause was the tailstock chuck not seating correctly. I purchased a Morse 2 taper reamer and cleaned out the tailstock barrel but found that the chuck was still not seating consistently. Tapping the chuck into place was considered but rejected as not good for the chuck. I drilled and tapped the chuck arbour, fortunately it was soft, and made a draw bar out of stud bar, complete with turned thrust collar for the tailstock barrel, **photo 6**. The parts are shown in **photo 7** along with a brass dolly/drift used to tap the chuck out of the tailstock. The dolly does become burred over time and has to be cleaned up periodically, as done for the photo! Burrs are obviously dangerous and can fly off particularly on hard materials. When I was an apprentice one of the fitters had lost an eye as the result of a burr flying off a cold chisel when struck with a hammer.

Drawbar for tailstock chuck

Drawbar components for tailstock chuck and dolly/drift for chuck removal

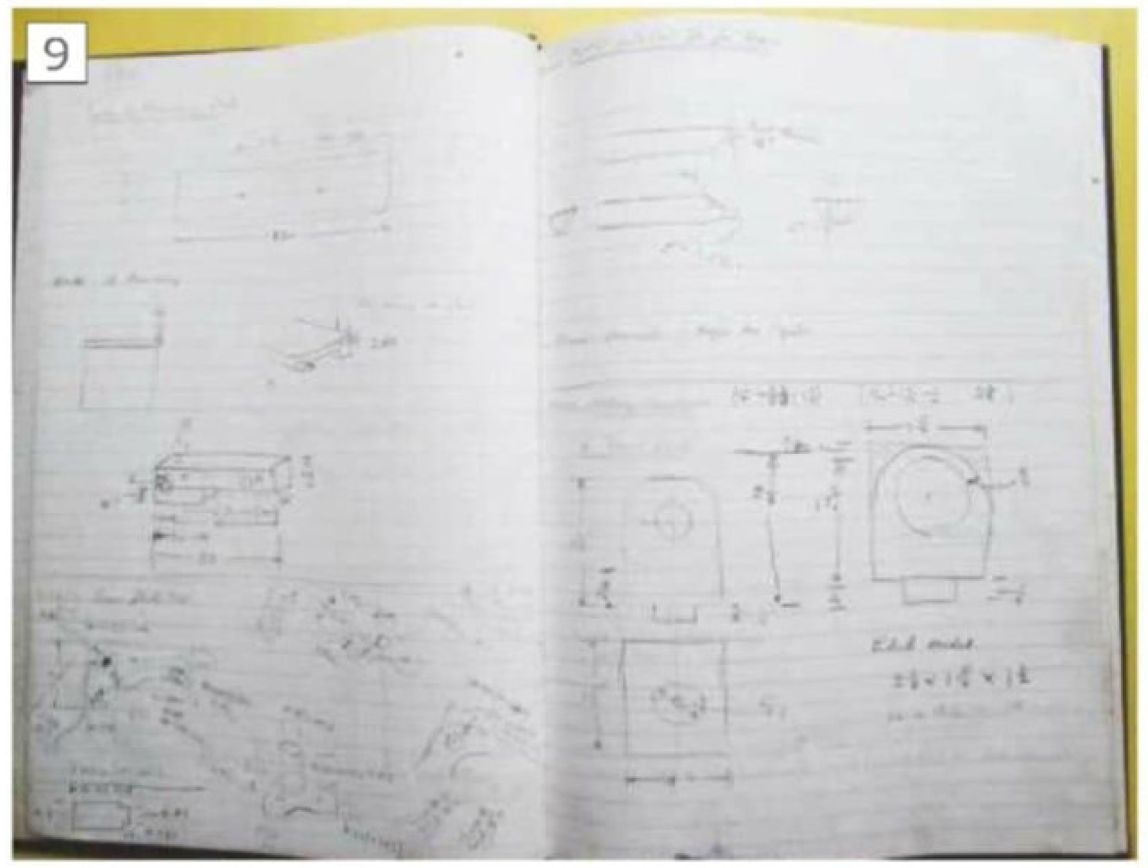
As the stud bar is much smaller than the inner bore of the tailstock the end of the stud bar was turned so that it would easily find the tapped hole in the chuck arbour, photo 8. The state of mind to always use the drawbar and not "risk" drilling without having done so is another soft issue. From experience the "feel" on the draw bar nut tightening spanner will indicate if all is not well particularly when there is some swarf between the barrel and the chuck arbour.

Paperwork

Recording

It is often necessary to record dimensions as work progresses or as part of the preparation for a job and indeed there is also a need for the proverbial "fag packet" to sketch out thoughts of the next master piece. Early in my career I discovered that the scrap of paper/drawing material had a habit of going walk about so I try to record all such information in a hard backed notebook. I filled many of these in my time at work (and even inadvertently took the boss's home once) and utilise the same system for the workshop, **photo 9**. The book does sometimes get lost, see comment above, but it usually turns up (I owned up). It also provides a useful record for future jobs.

Machined drawbar end to assist location in chuck arbour



Hard backed book used to record/make sketches

Stock Control

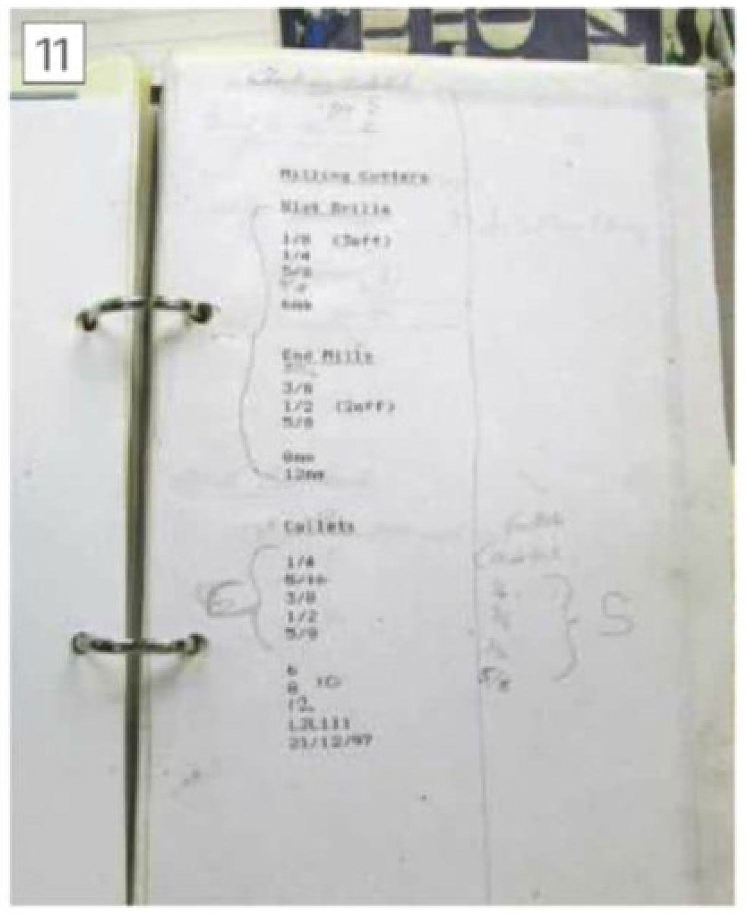
Well, not exactly but often one needs to know if one has any of a certain commodity or tool.

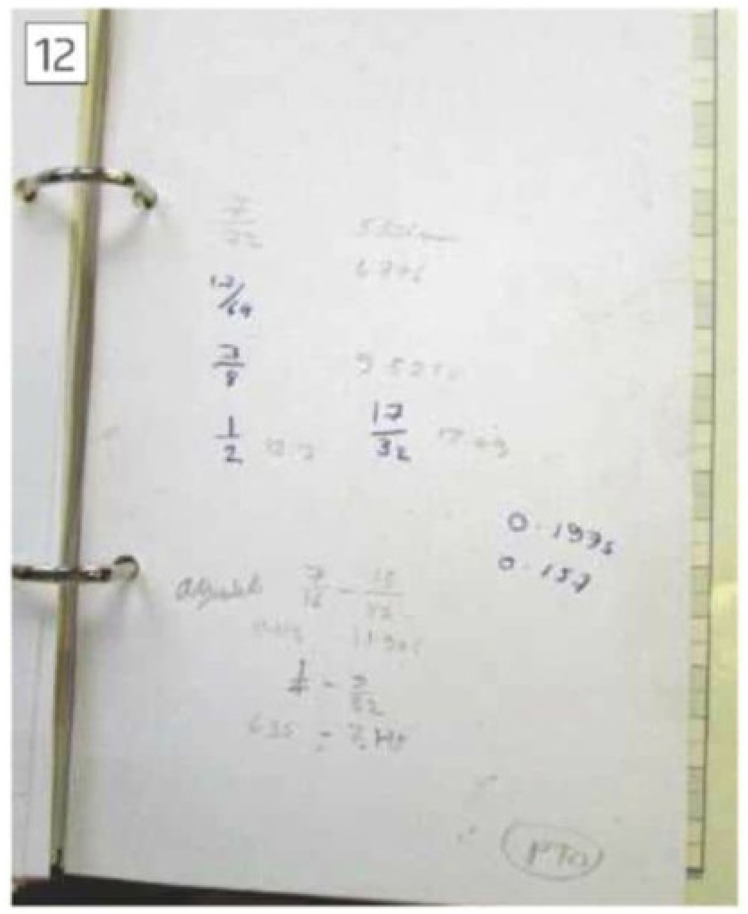
I keep a lot of bits in old margarine and sweet tubs. Shame they do not do them anymore as mine are coming to the end of their lives, **photo 10**. I keep paper lists of things like milling cutters, reamers and lathe gears, **photo 11-13**. I also use the same ring binder, which lives in the shed, as my personal reference book for things like the thickness of the kerf on my circular saw.

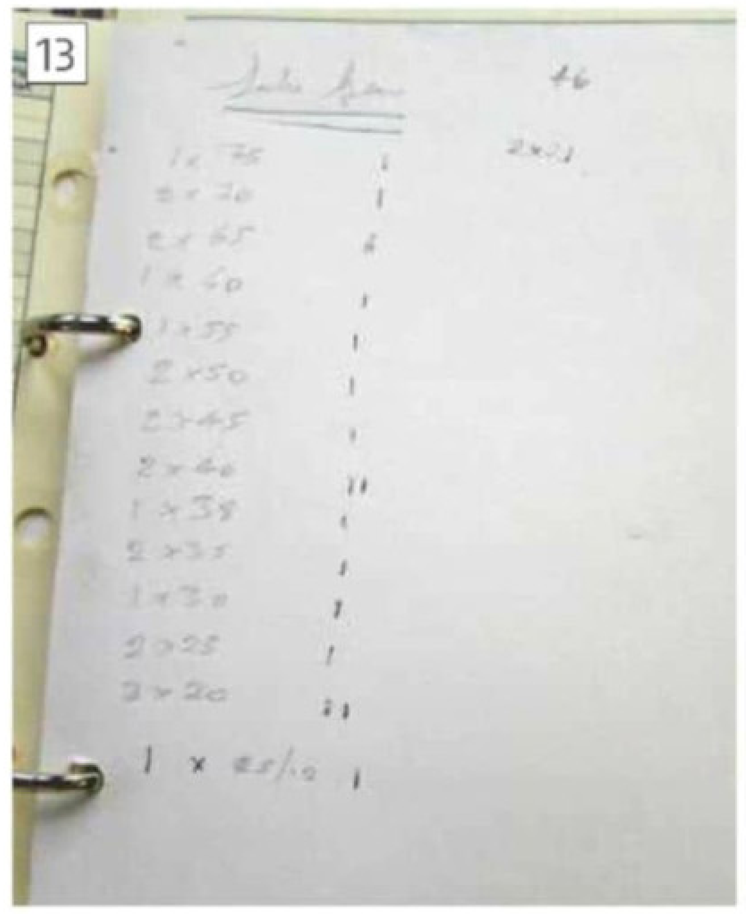
Margarine and sweet containers used for storage in the shed

Drawings

This is a tricky one made harder with the introduction of Computer Drawing Packages and subsequent use of Computer Aided Manufacturing (CAM). It is true that a lot of things can be made using sketches and "on the hoof" but where the cost of material is significant or the project is complex then time spent drawing, with pencil or computer, is well spent. I tend to use my A3 drawing board although I have used Turbocad but am still very much in the learning phase with this package. I am not suggesting that the drawing should be precious and indeed I "use" mine as the job progresses as can be seen in **photo 14**. The distortion is due to the folds needed to file it in an A4 ringbinder.



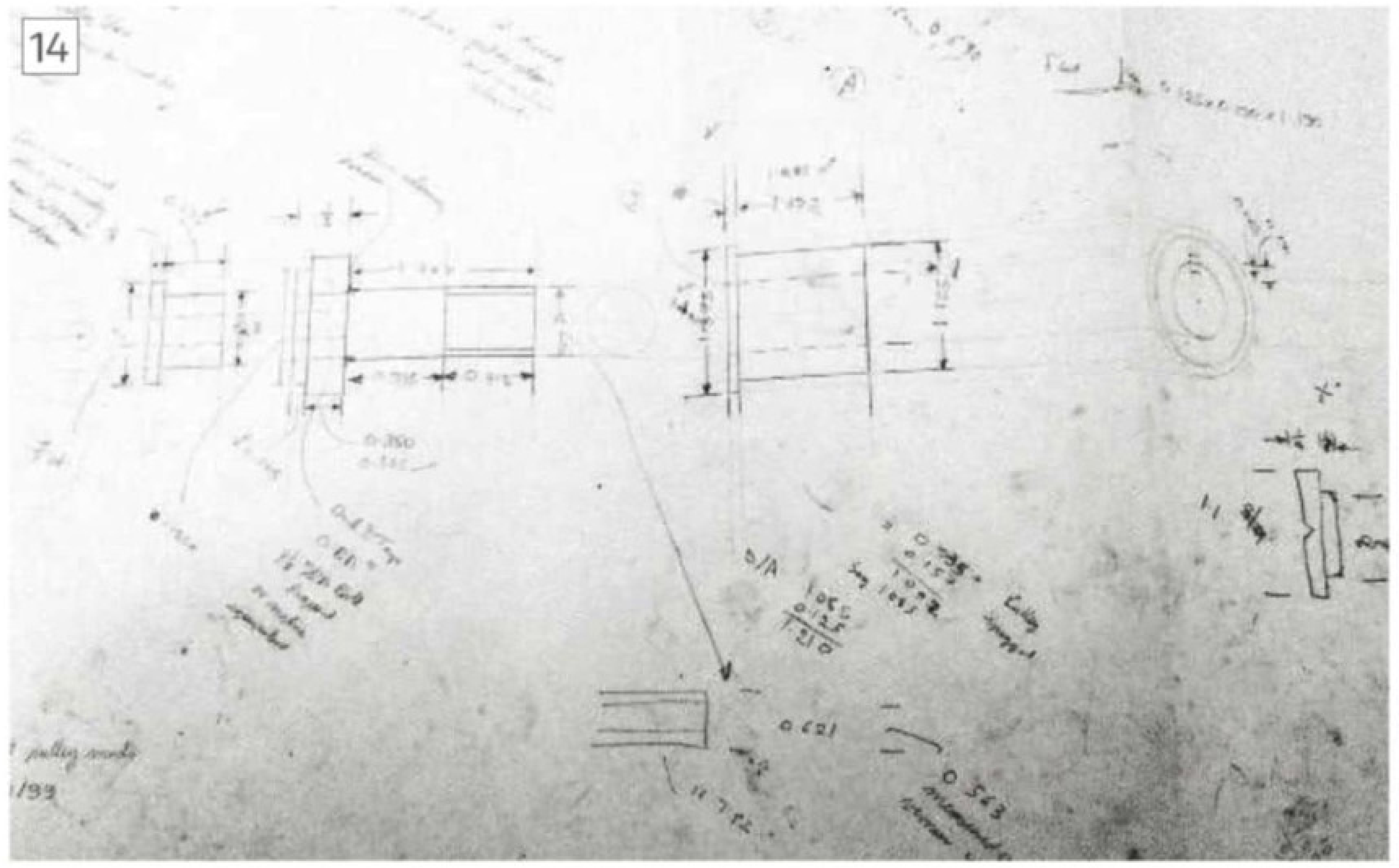




Examples of paper lists kept in the shed for reference

Conclusion

The purpose of this article was not to teach grandmothers to suck eggs but rather to promote an element of thought into areas that are off at a tangent to the mainstream of workshop work. ■

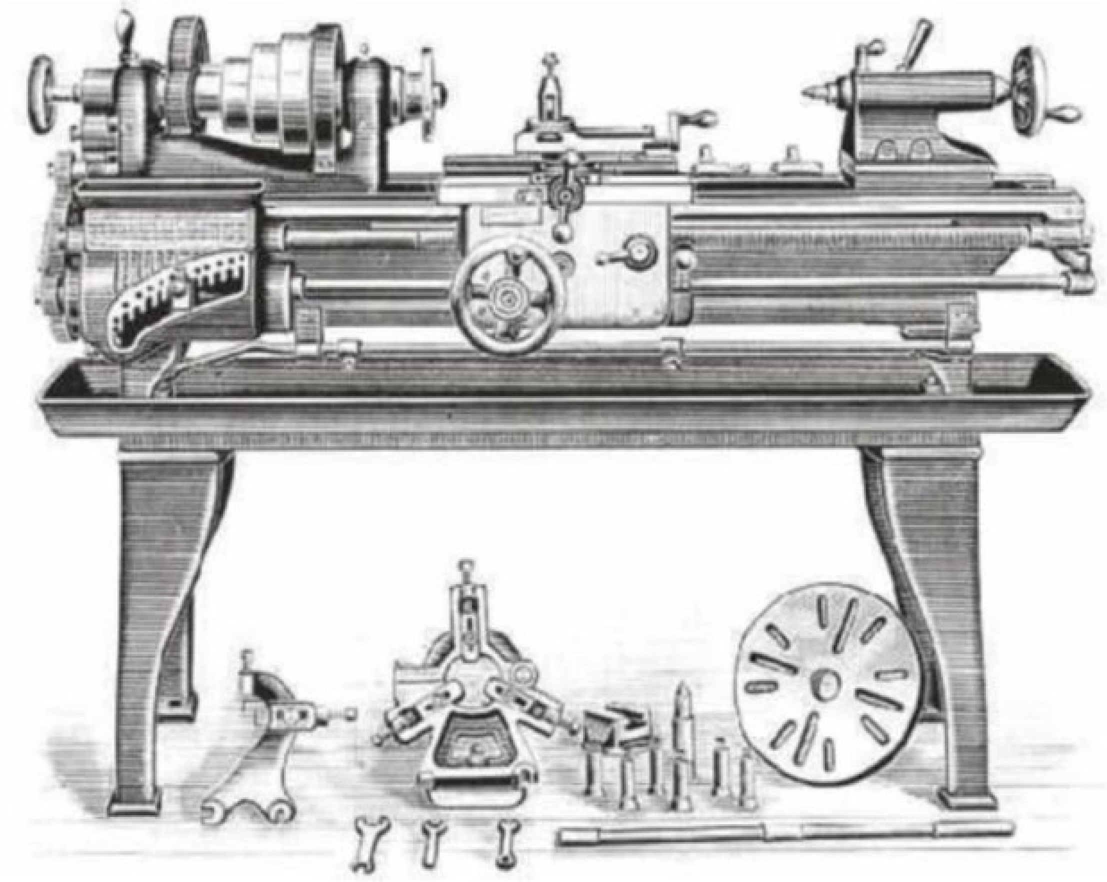


A drawing - in use!

Scribe a line

YOUR CHANCE TO TALK TO US!

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



Hendy Lathe

Dear Neil, I was fascinated by the Hendey gearbox rebuild, as a slightly younger 12inch Hendey has been living in my garage for the last 30 years. It was very interesting to see what changed (and what didn't) in the 15 years or so between the manufacture of the two lathes.

One thing that didn't was the use of cast gears in the gearbox. It's far too long since I had the gearbox apart for me to remember, as it only needed cleaning and reassembly. Fortunately, a chap in Rochester NY has various parts for a lathe like mine listed on eBay with good clear photos.

Hendey don't seem to have built their products to withstand abuse. From the tone of the operator manual and the various attachments available, they were clearly aiming at toolroom use. My lathe appears to have spent its working life in that sort of environment, from manufacture in about 1917 to retirement in maybe the 1950s. In that time various parts were replaced/repaired, apparently with locally made parts. All were well made in an establishment with good facilities, though not always with full understanding of the machine's unusual features! This treatment extended to a bed regrind towards the end of its working life. Very welcome from a practical point of view, but unfortunately the serial number was lost in the process, making precise dating difficult.

Garth Howarth, by email

Cutting Oil

Over the many years of satisfying use of my Myford Super 7 it has never become necessary to install a coolant system, I've always got by with neat cutting-oil brush applied only as required.

Recently I had to do some 8mm deep drilling of stainless steel using a fair amount of cutting-oil lubricant only to find that when the workpiece got hot enough acrid smoke billowed forth staining the bright steel components of the lathe, filling the workroom with choking fumes and requiring the windows to be opened to ventilate on a freezing cold day.

On the internet was a deal of information on the use of neat cutting oils but not much appropriate to my operations save for a terse comment that olive oil can be used for machining and that it did not smoke below 195 degrees Celsius.

Now it is a rule in my kitchen that shallow frying is permitted with small amounts of extra virgin olive oil never allowed to smoke and used only once so to avoid the possibility of generating carcinogenic substances. Using a contact pyrometer I checked that olive oil only smoked above 195 degrees C incurring disapproving glances from you know who. After cooking any residual oil is thefore discarded to an old tin can at the back of the hob to accumulate.

Back to the workroom deep drilling at the maximum cutting-speed of which my lathe was capable, application of the residual oil maintained cutting speed and swarf clearance but did not smoke. Cracked It I thought and resolved to communicate to fellow readers of my favourite journal.

Peter Peters, Sherborne

An interesting idea, I suspect one of my local take aways uses recycled cutting oil to fry its chips – Neil

Problem Nut in Issue 278

With a small chisel held at right angles, vertical and in the middle of a flat, hit it with a hammer to make a small indent.

Move the chisel at approximately 30 degrees to the flat, insert it in the indent and hammer the chisel in an anticlockwise direction.

If you start to remove metal, either increase the angle, blunt the chisel or use a punch.

This shock treatment will loosen the nut.

Or:

With a hacksaw, cut through the depth of the nut just proud of the bolt thread.

With a chisel or punch, placed on the sawn right hand side of the nut (when facing it), strike it with a hammer in an anticlockwise direction until it loosen the nut.

I hope this is of assistance to Jeremy Moore.

I enjoy the magazine. Keep up the good work.

Bill Ardus, by email

We have already had many suggestions and printed a few, but Bill's explanation is so succinct I thought it worth sharing – Neil.

Harrison and Harrison Organ Mandrels – 1

If you have not had any joy finding capacity yet, may I suggest Turn Wright Machine Works, machinist Keith Fenner has an engine lathe which can tackle job. E-mail. **turnwrightmachine@comcast.net**

Okay he is on the other side of the pond. Lathes with that capability are few and far.

Hope this info helps

Steve Deakin, by email

Harrison and Harrison Organ Mandrels – 2

Dear Neil, I was interested in the letter from Harrison & Harrison in Issue No. 279 of MEW, wanting a tapered mandrel 2.2 mtrs long, tapered from 70 mm down to 8 mm. I have been interested in pipe organs for over 70 years, and of course, know that H & H are one of the premium organ building firms in the UK. I'm intrigued to know what this mandrel is to be used for and know that pipe makers wrap sheet pipe metal round a mandrel and then solder the seam. The immediately obvious use of tapered pipes is for pipe feet – the bit below the pipe mouth which admits air into the base of the pipe – but for a 70 mm pipe body, the hole in the bottom of a tapered foot of reasonable length would be far too large. If it is to make tapered pipe bodies – and some pipes do have tapered bodies – the mandrel is only 7'-2" long – not long enough for the longest pipe of an 8 foot stop, and unnecessarily long for a 4 foot stop. Perhaps you can persuade H & H to supply a bit more information, purely out of interest.

Unfortunately I cannot offer to make such a mandrel, as my lathe is only about 18" between centres and has no taper turning attachment. To attempt to do this by 'twiddling the topslide' would be stupid for a job of this size, even if made in sections. I hope my curiosity will eventually be satisfied. You're never too old to learn!

Roy Smalley, by email

Corrosion Cleaning Solutions

Dear Neil, I have been taking MEW from the outset – but not really had any need to write in before.

Anyway, I was suitably impressed with the de-rusting powers of Distilled Vinegar (scribe a line – a while back now) and now use this cheap process all of the time.

This got me wondering – hence the need to write in – if there are any other similar liquids that the readers could recommend – in particular for cleaning off the white powdery corrosion that occurs on aluminium – particularly castings?

Any suggestions would be gratefully received – and given a suitable testing – on which I would be more than pleased to report back on.

I enjoy reading MEW although I don't actually do any modelling myself.

Chris Sayers-Leavy, Retired Railway Plant Engineer. Broadstairs, Kent.

Strength of 3D Sintered Parts?

Dear Neil, compliments for your latest MEW front cover featuring John Eva's diorama.

It oozes that atmosphere of a garage or (classic) car restoration workshop we are all familiar with, but rarely seen in this splendid detailed setting. With the right amount of grease, tools and dust!

I have another question, about 3-D printing or to be more specific SLS, selective laser sintering.

Does a 3-D printed metal part, made by SLS, have the same strength as a metal part cut or turned on a lathe from a solid block of e.g. iron.?

Because 3-D printing is done layer by layer, (therefore predictive) whereas the iron molecules/ particles within a solid cast block of iron are formed in a random natural manner? (Albeit some scientists believe that nature is formed in a mathematical way)

Also in case of predicting cracks and other anomalies, would it crack under pressure at the same time?

Henk de Ruiter, Holland

An Adjustable Saddle Stop

Lyndon Baugh has come up with this interesting approach to making an adjustable saddle stop.

My first lathe being used primarily for clock making was fitted with a simple yet effective saddle stop. If you have no saddle stop then you are missing out on quick accurate and repeatable machining, **photo 1**.

While I would have wished to copy the first stop made, this design would not have worked on the C8 lathe. In fact, the C8 lathe does come with a saddle stop as standard however there is quite a bit of movement in setting it up, it bears against the saddle wiper housing and it does not allow for fine adjustment. Not brilliant for all occasions.

My Alternative.

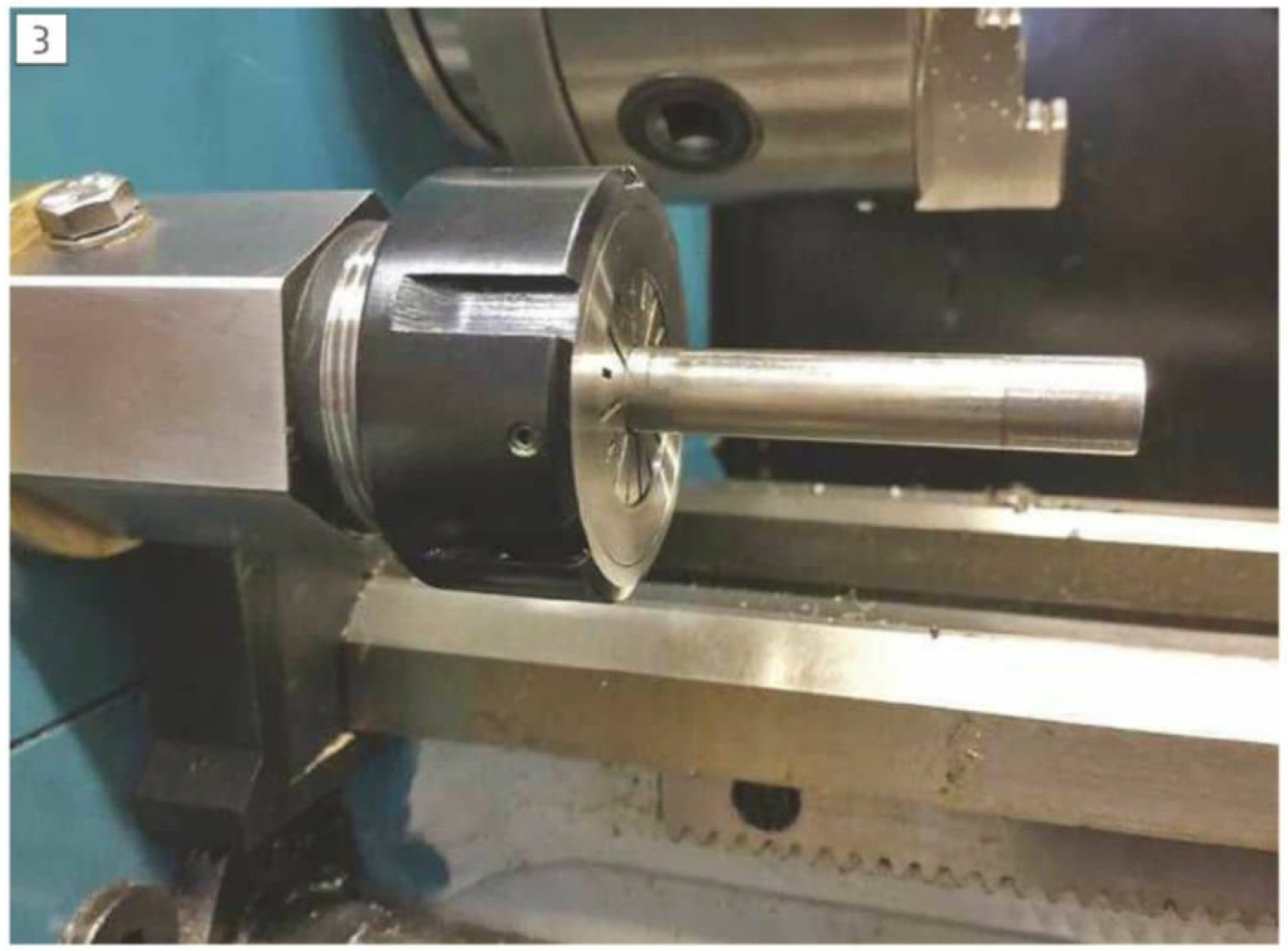
My design utilises an Er 32 collet block. What is required, is a method of mounting this on the lathe. I chose a brass bulkhead mounted spigot. The larger diameter is through fixed from the headstock using m 6 bolts into threaded holes in brass. A centre hole was drilled first (which is the hole the stop bar passes through). The brass was then bolted up and the three holes for fixing spotted and drilled. Two important things here; one, check stop bar

1

The conventional saddle stop on my first lathe

2

Mounting spigot



3

10mm bar fitted in ER32 collet

passes well clear of internal switching and wiring loom and two, that the fixing bolts do not foul fascia mounting cast in lugs!

The smaller diameter is a snug fit in the internal bore on the rear of the collet block. The collet block was drilled for M6 tapping but before tapping was placed fully on spigot, then the hole was spotted and continued right through. The collet block is then tapped M6, replaced on the spigot and then tapped right through.

I wanted rapid gripping of the stop bar, that is a small rotation of the nut to lock bar, this was achieved by selecting a stop bar of 10 mm in a 10 mm collet, **photo 3**. This gives minimum movements before collet tightens. I fitted quite a strong spring sandwiched between spigot end and collet end, this serves the purpose of pushing the collet off its taper when nut is loosened, **photo 4**. The result being fully clamped to fully released in half a turn of the nut.

Using the Stop.

Now I know there are many out in model engineering circles who will know that as a collet is tightened the work or in this case stop bar is pulled back into the collet block. Now for most things this does not matter. You make your initial cuts, slide the stop bar up to touch the saddle lock the collet and then you get another finishing cut.

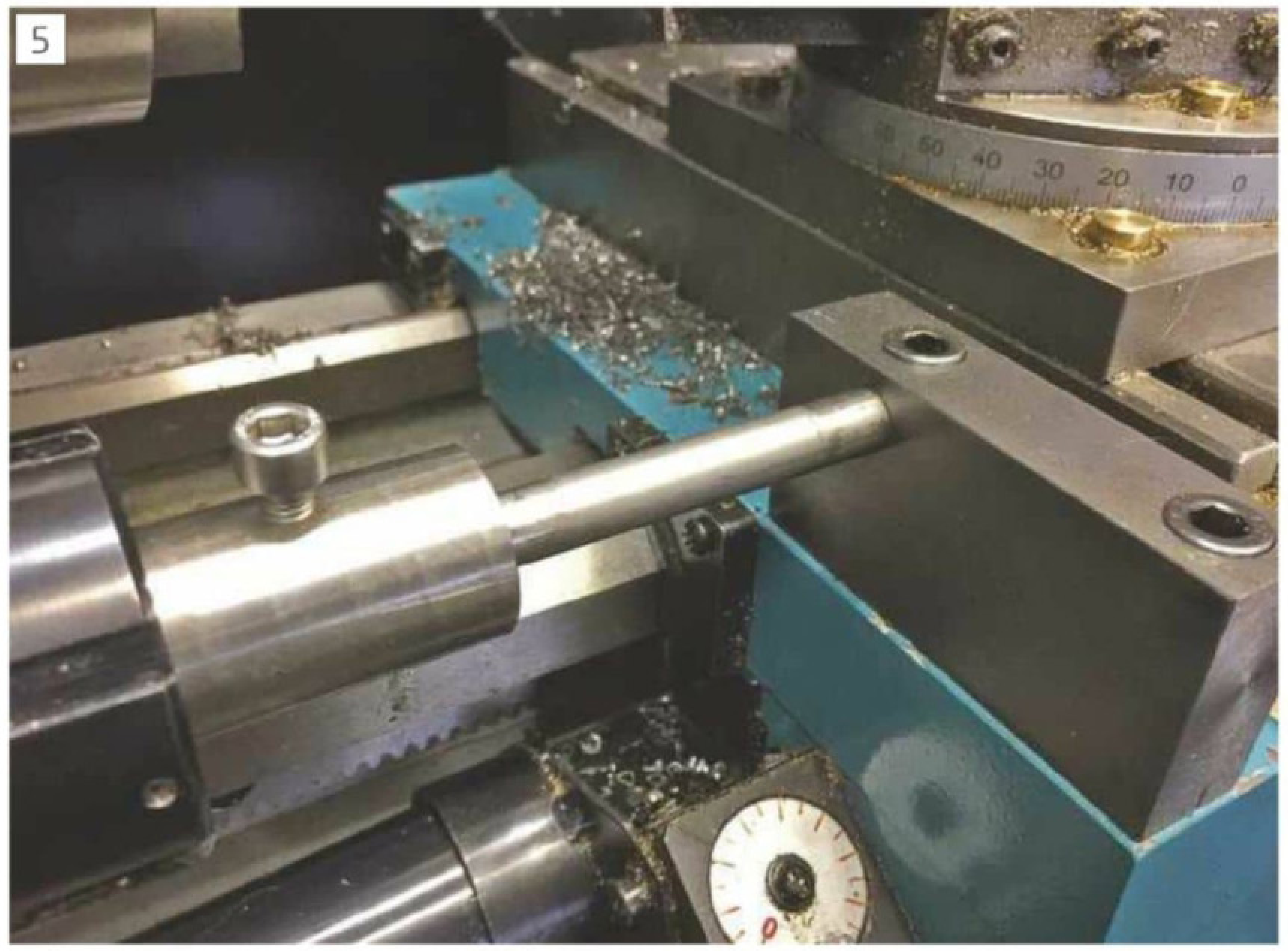
There are times when an accurate dead stop is required. So, a sliding, locking sleeve was made up. This is used thus: you have made a cut, but it must go no further, so slide stop bar up to touch saddle, lock the collet nut, this pulls stop bar off the saddle block slightly. Release the stop bars sliding sleeve and slide along stop bar to touch saddle block, then lock sleeve. Saddle is now 'stopped' where last cut was made. A dead stop, **photo 5**.

There are times where, after measurements are taken, a specific amount has to be removed. The tool is placed against the work, the dti is mounted on the stop bar and the stop bar slid forward until dti needle is reading approximately 2mm the stop bar is then locked and the dti zeroed, **photo 6**. The tool is withdrawn to clear work and the saddle is then advanced until dti reads amount to be removed. At this point stop bar is released withdrawn from saddle and dti removed. Stop bar is slid to touch saddle and locked, stop bar sleeve is slid to touch saddle block and locked. Now the work is machined until saddle stop is reached thus taking required amount off. Though this may sound a bit of a performance, in actuality it is performed quickly and after a few times automatically. ■

4

Spring inside collet holder

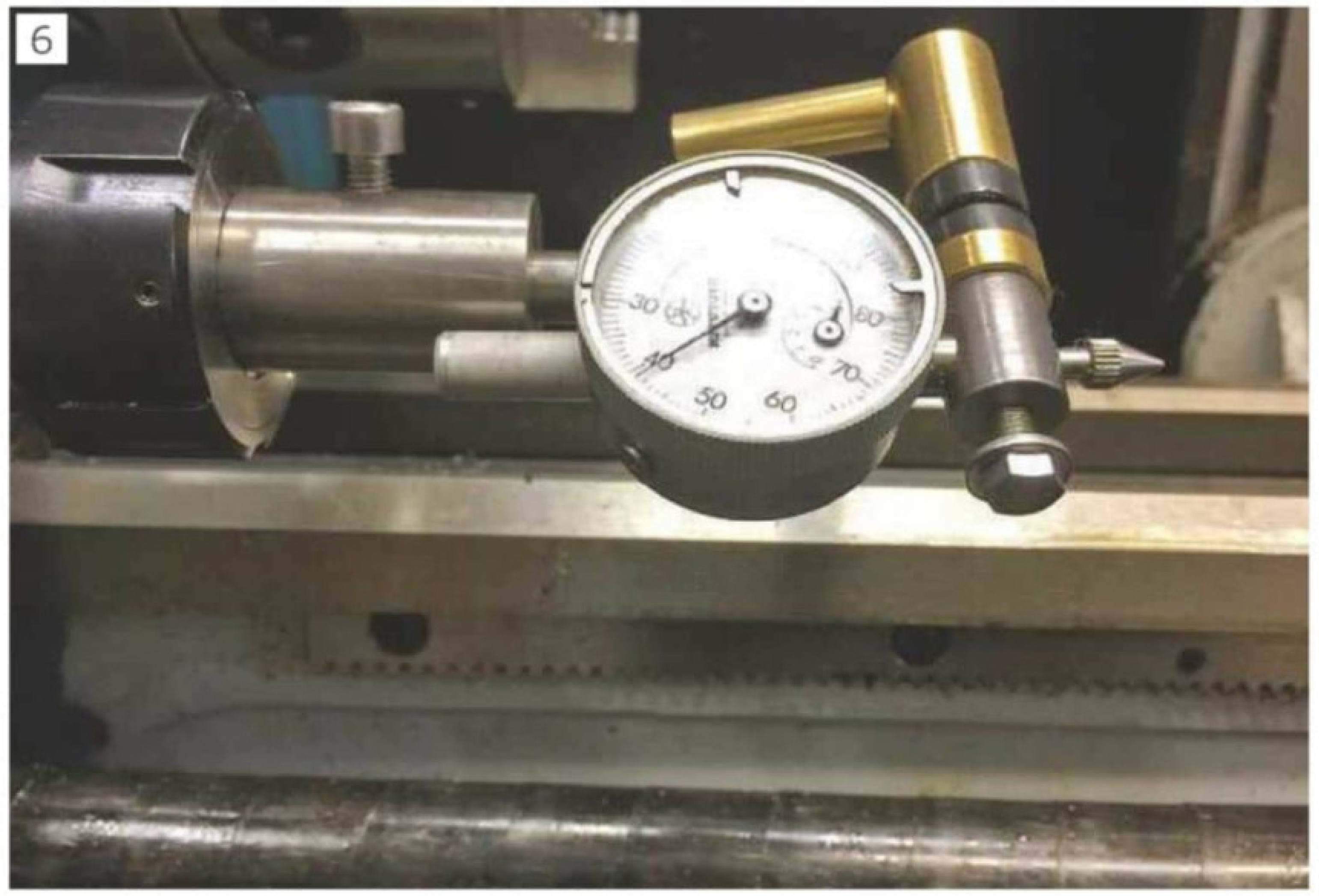
5



Locking sleeve

Though this may sound a bit of a performance, in actuality it is performed quickly and after a few times automatically.

6



Using a DTI to set the stop.

A Hydraulic Press

James Perry describes how to make a workshop press around a hydraulic jack.

Overview

Over quite a few years, I've struggled with many jobs the hard way, mainly with simple hand tools. The result has usually been satisfactory, but I always felt that some kind of press would have made many jobs so much easier.

Amongst my "Stuff" were two short lengths of 5x 3" Joist (RSJ) and a longish piece of 40mm x 80mm Rectangular Hollow Section (RHS). This was destined at some time in the future to form just such a tool, however, it always seemed to be one of those jobs "I'll get around to", but it always tended to recede into the distance.

I'm pleased to say MEW issue 183 suddenly got me going. Alan Hearsum's useful article on the construction of such a press intrigued me. My version is somewhat smaller than his and changes his design slightly. It has also awakened ideas on the variety of jobs to which it could be put. I've followed on with some of them here.

In order to optimise the operating height available, I opted to do away with the deep beam, beneath the jack, replacing it with a simple pressure plate. The guides aligning the assembly within the frame are alongside the jack instead of beneath it. **Photograph 1** shows the finished article with some of the tooling.

1

Introduction

I've avoided giving dimensions unless it is important to the principle. Apart from the Jack and the Springs, almost everything else, I already had. The size I've ended up with really was dependent upon what was available. Anyone wanting to make one would similarly size it to suit themselves (see later comments regarding sizing). I've used a mix of Metric and Whitworth simply because that was what I had, a situation familiar to many of us I imagine. Only when I got to the tooling did I have to start buying more metal.

Figure 1 provides names for the various parts. Whilst writing this I found myself giving different names to the same part, confusing me, let alone anyone else who might want to read it! The result is a little pedantic but hopefully the standardisation will help it to be clear.

Construction

Two brief comments by Alan Hearsum really are worth expanding upon. These are "do some practise welds before you start" and "leave plenty of clearance".

With regard to the first, it is so easy to get out of practise. Like most of us I suppose, welding gets done infrequently, so expertise suffers. I didn't put in the practise I should have and my earlier welds whilst adequate are not always pretty! I took care to cut sufficient chamfers at weld sites to aim for full penetration.

The second is very important. In any all-welded construction. It is possible to weld up in one go, turning over perhaps only once and achieve a perfect frame. However, unless you have the availability of a welder's surface plate and all the associated heavy clamping tooling usually found only in a fabricators workshop, pigs might fly!

Without such facilities, weld shrinkage tends to distort joints a surprising amount. Hence, I believe, Alan's comment on plenty of clearance.

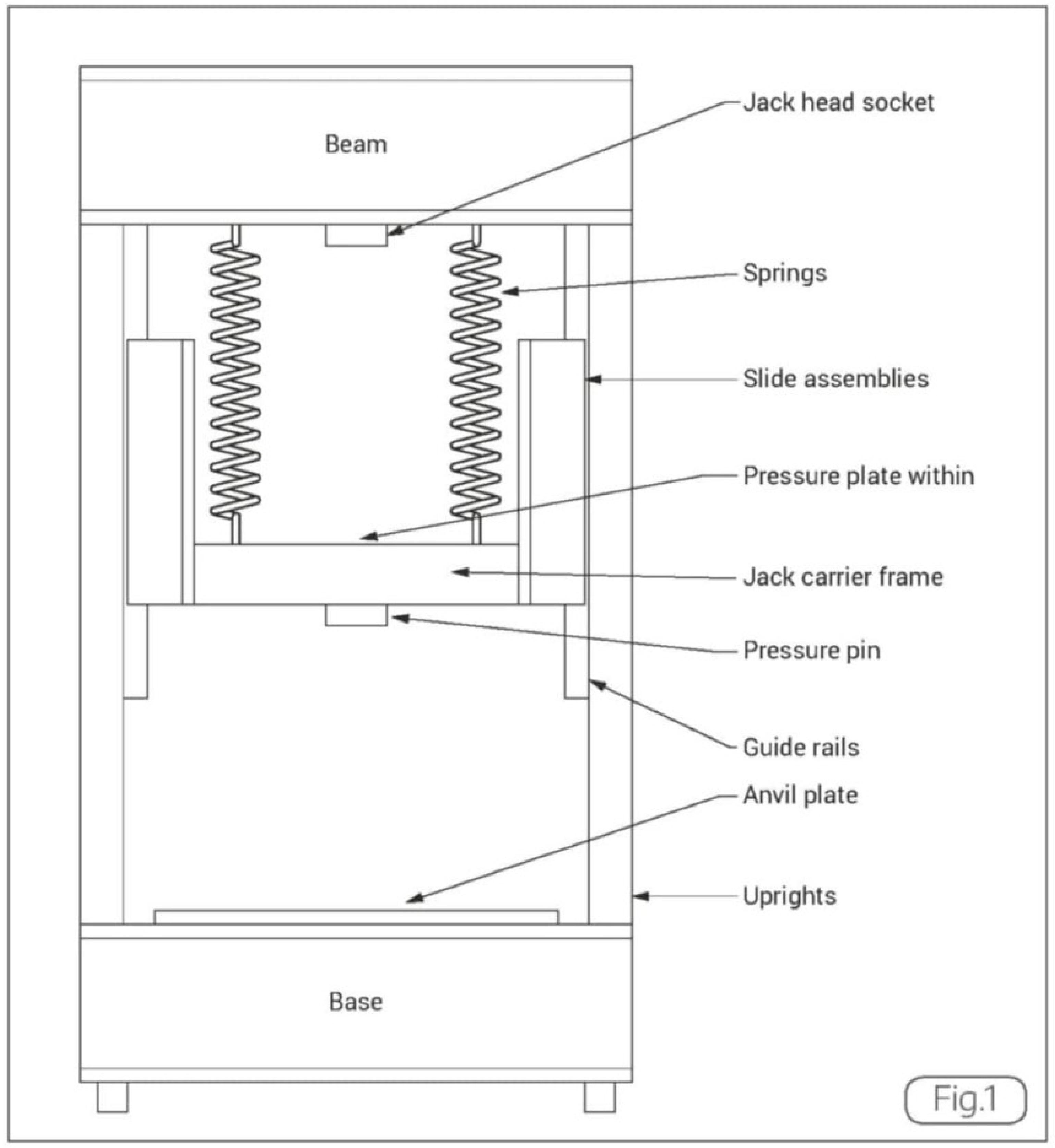
The Frame

With care and attention though, it is possible to achieve a good result. My aim was a maximum error in any dimension of 1mm. It was tedious but my procedure was to clamp up solidly, checking all dimensions and angles before starting to weld. I used a section of thick kitchen worktop to clamp down to.

I then tacked it together, but after each tack, rechecked for angles and dimension. The continual rechecking was necessary, bearing in mind my tacks are more like stitches (in manhandling heavy steelwork, tacks tend to fall apart too easily). Since distortion is always caused by weld shrinkage, it is usually possible to anticipate which direction the distortion will go. Professional welders will often take advantage of this to deliberately make a joint move. Where my joints did move adversely, I cut out the offending stitch and did it again. I was pleased to find that wasn't necessary too many times.

I started with the joint of one of the uprights to the base. The next was the opposite side, paying particular attention to getting the uprights parallel. Given good lighting levels and a white backdrop it was possible to stand back and sight along the tops of the uprights. It is always obvious when something is not parallel (certainly to less than the 1mm tolerance aimed for). This worked out very well but with the benefit of hindsight, the crossed thread method described later would have been better.

After that the Beam was fitted. This was simpler because by that time the alignment from the uprights was (hopefully) assured. I considered having the uprights welded alongside the ends of the Beam and Base rather than end on to them. This would have had the benefit of the welds being in shear rather than straight tension. Unfortunately, the length of RHS I had available would have reduced headroom far too much. It did mean of course that I had to make sure I had robust welds in tension.



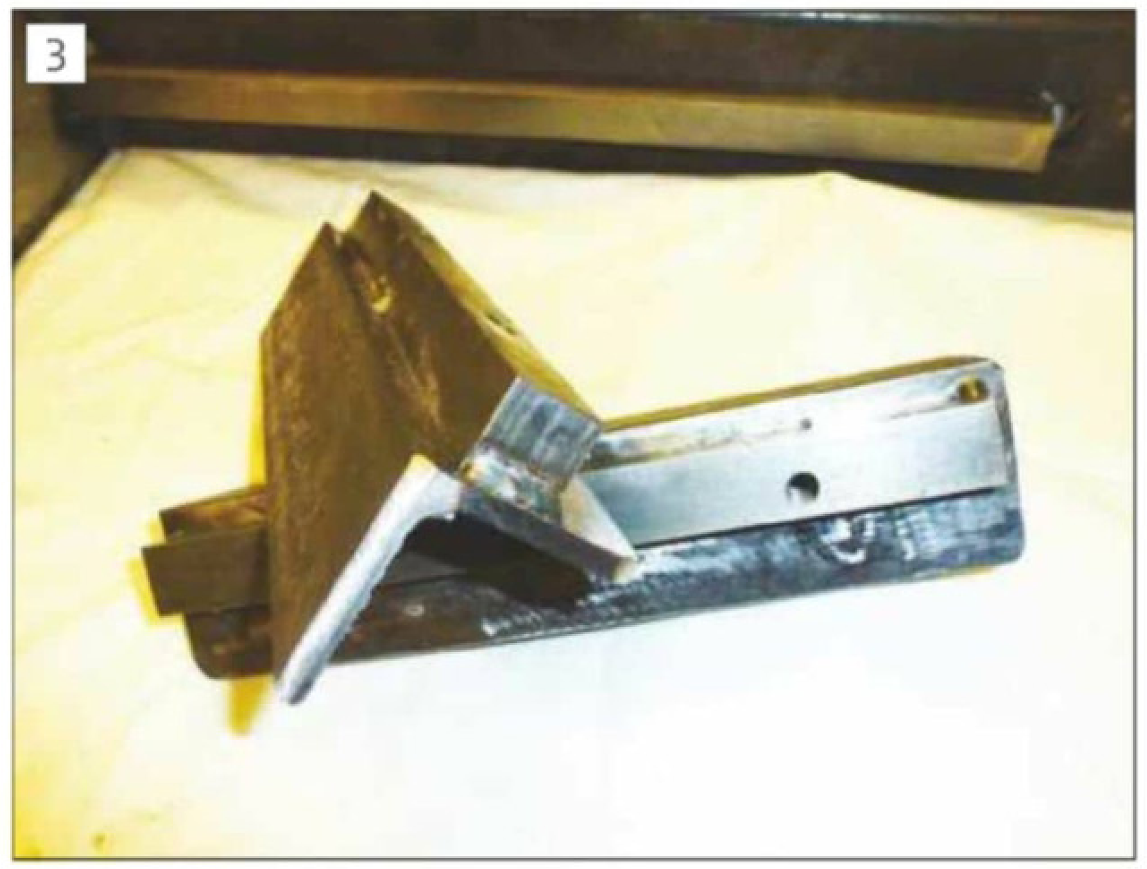
Now I had a frame ready for full welding. One run at a time on each joint was done rather than fully welding each joint all around. The latter way would certainly have caused the frame to distort. Progressing around the frame in this manner allowed each weld to cool off and limit its shrinkage effect on the frame alignment. Being the pessimist I am, I continually rechecked the frame alignment at regular intervals. Again, relief. Nothing shifted.

The next stage was to fit the Guide Rails on the inside of the Uprights. These are 20 x 20 mm bright drawn steel. The first was clamped along the centre line of one of the Uprights. A weld at top and bottom is all that was necessary. The second was then similarly clamped inside the other Upright. Before welding this one however it was necessary to check that it was parallel to the first. **Photograph 2** shows the method used to check. The cross threads are clamped to each end of the rails as shown and then tried with one of the threads tried both over and under the other. The position of the clamped, but still unwelded, rail is then adjusted sufficiently until the thread crossover appeared the same for both the "under" and "over" condition. This was then clamped tightly and welded. Photograph 2 was staged using coloured cord to show up adequately. I actually used the finest sewing thread I could find.

The Slide Assemblies

Completing the slide assemblies which support the jack and provides smooth vertical movement, were the next. For both sides, these are essentially twin 50 x 50mm angles back to back separated by another length of 20 x 20mm bright drawn steel.

2



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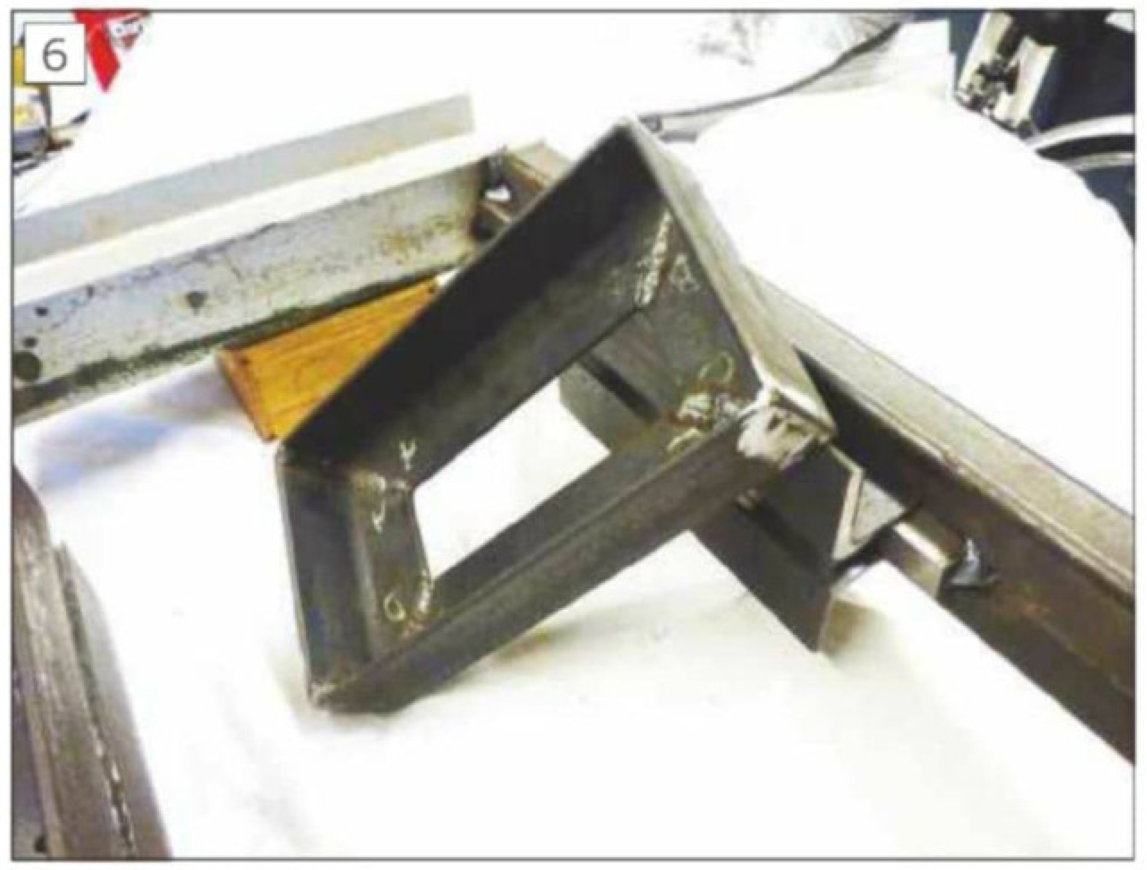

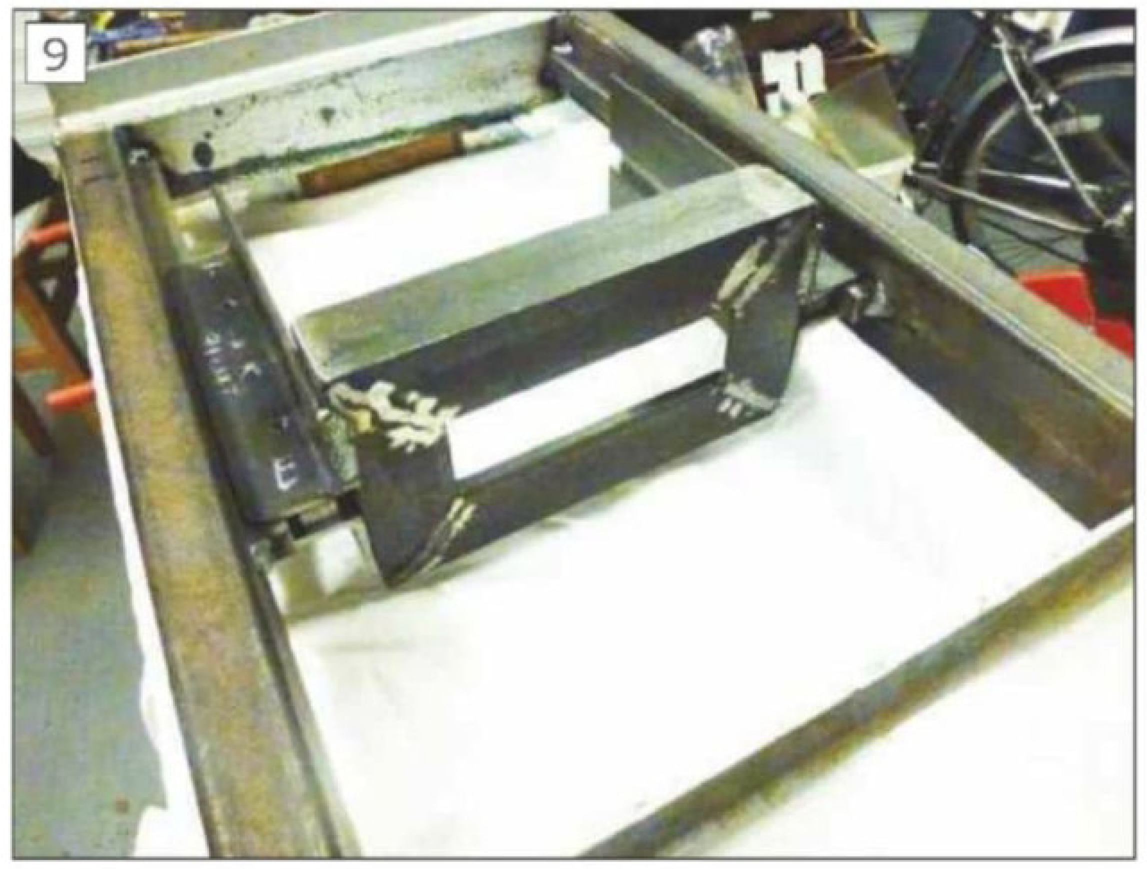

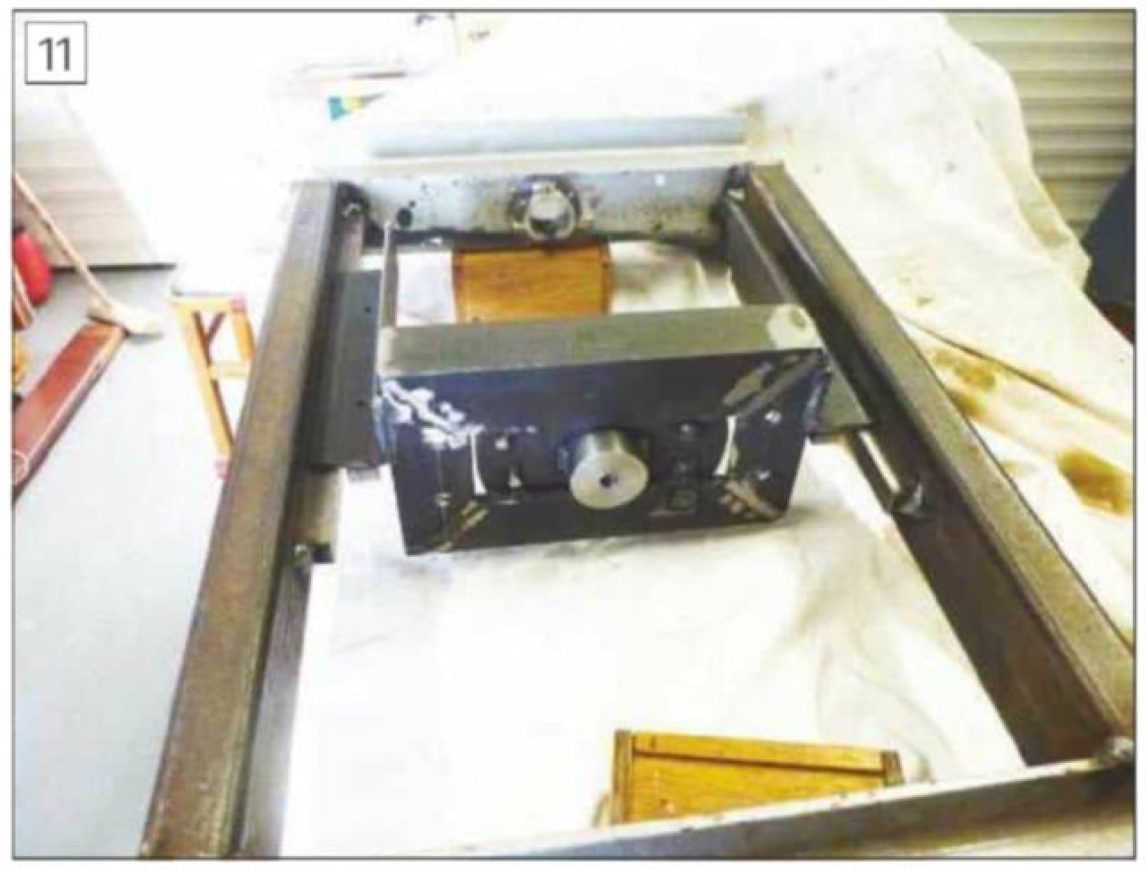

These spacers are not intended to provide a sliding surface, being set back from the toe of the angle by 25mm. At this stage they provide a nominal 20mm gap to allow the angles to fit closely over the Gide Rails. Sliding clearance is not yet required. The 20mm x 20mm spacers are only welded to the rearward angles. The front angles are bolted on by M8 screws. The inner surfaces of the angles, which bear on the Guide Rails, and which would eventually become sliding surfaces were then cleaned up. This was done by first lightly taking the millscale off with an angle grinder and then polishing each on a home made disk linisher. **Photograph 3** shows the rearward pair and **photo 4** the matching front pair which bolt on.

2.3) The Jack Carrier Frame

Photo 5 shows the Slide Assemblies clamped onto their Guide Rails, pushed hard against the respective Upright. Whilst I use the term "clamped", with both pieces made from 20mm x 20mm bar, it really is just a dead fit. It was sufficiently stiff to suit my immediate purpose, however.

With the Slide Assemblies in position, it was then possible to measure between them and make the Jack Carrier to fit. This is the rectangular frame made out of 50mm x 50mm angle shown in **photo 6**. In **photo 7**, the Carrier Frame is shown loosely mounted between the two Slide Assemblies. You will see the welds on the underside have been ground flat. This allowed it to sit flat on the surface block during later alignment. I was pleasantly surprised how flat and free from distortion it proved to be (my halo was shining brightly here).

Next it was necessary to correctly align, then weld one of the rearward sliding pieces to the jack support frame. The alignment and clamping procedure is shown in **photo 8**. For the welding, it was of course taken away from the surface block. This was the last measured aspect of the assembly. All matings from thereon depended on the alignment of the basic frame, Guide Rails and Slide Assemblies.

The Jack Carrier frame and it's now welded on Slide Assembly was then clamped into the main frame, hard against the Upright, onto the appropriate Guide Rail. The opposite, so far unattached, Slide Assembly was fitted onto its own Guide Rail (again hard against the Upright), moved to align it with the Jack Carrier, and then welded, to match the other side. **Photograph 9** shows the now largely completed Jack Carrier frame, complete with the two Slide Assemblies. At this time the slides are effectively tight to the Guide Rails allowing no vertical sliding clearances. With regard to side to side clearance however, I had expected the assembly to be tight between the Uprights and have to be knocked free. In fact, welding the jack carrier frame in had pulled the two Slide Assemblies in a little and given about 2mm clearance. I would have preferred it to have been tight allowing me to restore it to a closer sliding fit by filing the toes of the Slide Assembly angles.

All this time you may ask why I didn't show the whole thing on its feet in the various photos (which probably would have made them clearer). It was getting very heavy and I tried to shift it as little as possible.

Fortunately, at this stage, further work could be done by unbolting and removing the integral Jack Carrier and Slide Assemblies from the main frame. I considered the necessity for a stiffening brace across, joining the tops of the Slides (with clearance around the jack of course). The whole sliding construction proved to be very rigid, however, so I limited further strengthening to a further bolt in the front of each of the front angles into the Jack Carrier Frame.

The Jack sits on a Pressure Plate. I happened to have a mild steel disk 6.5" diameter x 0.5" thick. Using a slitting disk I cut flats on opposite sides to reduce its width sufficiently to allow it to fit down in the bottom of the Carrier frame, beneath where the Jack would sit. This included bevelling the lower sides of the flats to match the curve in the root of each angle. **Photograph 10** has the pressure plate welded in. this also shows the locating pegs which surround the base of the Jack. These were simply positioned by placing the Jack centrally on the pressure plate and choosing four places where the pegs would conveniently abut the edges of the Jack base. Next the Jack Head Socket and the Pressure pin were welded in as shown in **photo 11**. The pegs and the Head Socket merely constrain the Jack to its central position in the frame.

The Pressure Pin is drilled and tapped half inch Whit to accept extension/adaptor pieces for whatever job requires them. At no time would this thread be allowed to take the compressive load. The load would always be passed through the flat shoulders of the tooling fully screwed on.

It now became possible to establish suitable sliding clearances. As already explained, I had expected to have to file the outermost toes of the slide assemblies to give suitable clearance. This proved to be unnecessary. Side to side movement was already approx. 2 mm (so much for my planned tolerance of 1mm).

Sliding clearance on the Guide Rails was achieved by milling back a small clearance on the inside faces of the bolted on front angles. This was done using a fly cutter, the result being shown in **photo 12**. Fifteen thou. (0.38mm) was found by trial and error to be sufficient. A smear of grease on the Guide Rails gave a very smooth operation.

I was tempted to put a bead of weld on one of the angle toes and file it back to give a tighter side to side clearance. Common sense prevailed however. It would have been guilding the lilly somewhat.

The Anvil Plate across the base is merely a means of providing adequate "bench space" for the jobs being done.. The bare flange of the base RSJ would often be much too narrow. The Anvil Plate is drilled and slotted to facilitate job clamping. See **photo 13**. This is quite suitable for jobs such as Bearing Replacement. However, some jobs deserve something slightly more sophisticated. Where specific tooling is required, each is mounted on 100mm wide bright bar and constrained by cheek plates bolted to the anvil plate and set just 100mm apart. This enables the tool to move laterally where required along the centre line of the press.

Springs

Following Alan Hearsum's suggestion the springs used were intended for a trampoline. They proved to be ideal. I fitted all four initially because the Jack seemed very stiff to return. In practise only two proved necessary. **Photograph 14** shows the method of hanging the springs. This was the same for both ends, although taper washers were needed to match the taper flange on the upper beam, **photo 15**.

The Jack

The Jack was a Clark unit bought from Machine Mart, perfectly serviceable except for the less than perfect operating lever linkage. It was an accumulation of clearance holes which together gave a very sloppy action. It was in fact just a matter of cleaning the holes out with the right size drill and making dead size replacement pins. It was a nuisance, but

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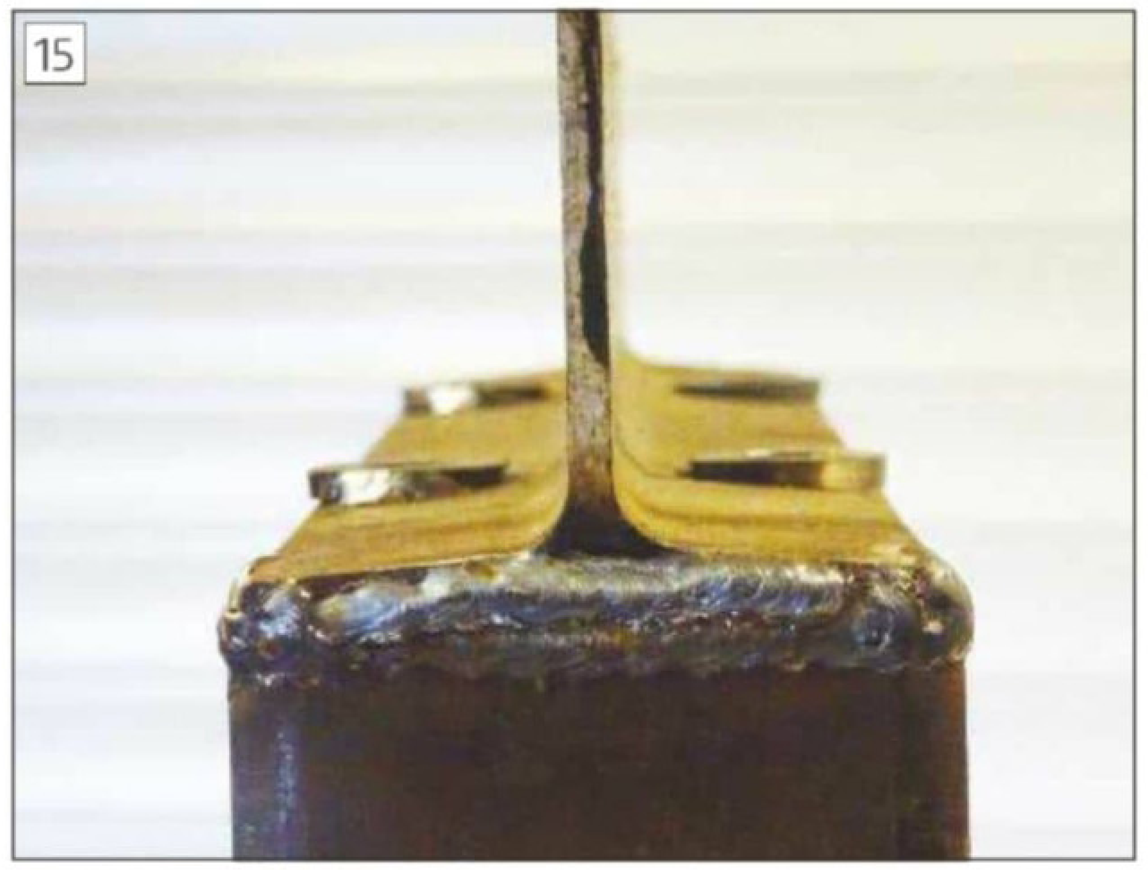
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the result gives a smooth backlash free operation and justified the effort. The operating lever supplied was also crude and slack. Sometime in the future I'll produce something better to replace it.

The relief valve on the jack is a small Tee Bar handled screw, difficult to operate as well as being obscured by the Carrier frame. A notch in the angle was made for better access. The best way to improve the valve operation would have been to replace the existing screwed plug with a longer one giving easier action. I wasn't keen on disturbing the oil fill so I opted for a separate key working the existing Tee Bar screw. **Photograph 16** shows this.

At the first complete assembly, I discovered the top weight of the now heavy frame caused the whole thing to oscillate unnervingly (given the slightest push) like a giant metronome. It was flexing about the unstiffened web of the base RSJ. Hence the boxing in of the Base ends as seen in photo 13. No more oscillation, thank goodness.

Uses

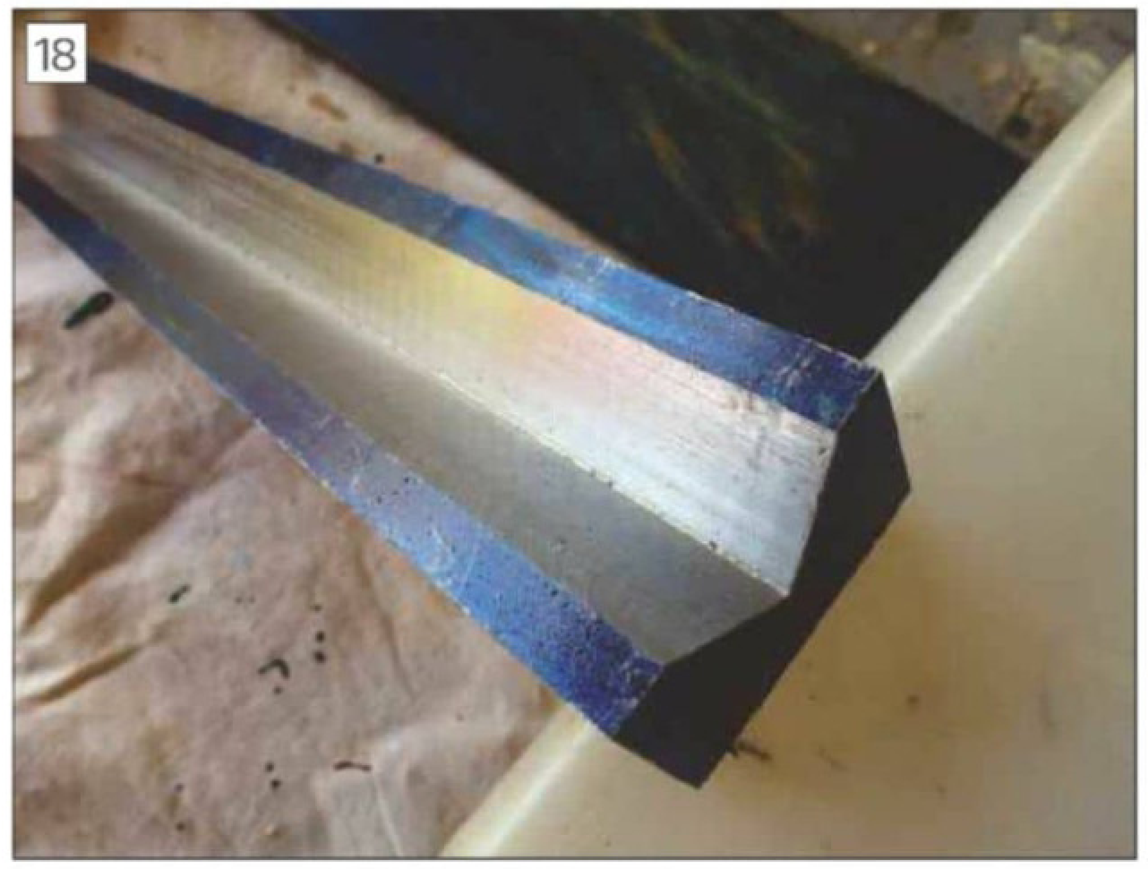
I've a feeling that I'm not the only person that this sort of thing happens to, but each time I use the press it usually dawns on me there is yet another use around the corner. The following represent some of the more positive uses to which I've put the press so far.

Bearing replacement

In my case this has been typically replacement of car wheel bearings. In the past I have used threaded rods and backing plates. Suitable for pulling in but not much good for extraction. In almost all cases the press solves all problems. If the old race is still complete, pressure can be transmitted

16


17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directly on the inner race. The important point here is that these actions all transmit the extraction forces via the balls to the outer race. It potentially damages the balls but since the bearing is scrap, it doesn't matter. Even if only the outer race is still in place it is usually possible to file up a small bridging piece to insert into the ball groove and press on that.

It does mean of course that pressing in any new bearing must always be done against the outer race only. Usually the race has to sink well below the surface of the housing to accommodate a retaining circlip. A way of overcoming this is obviously to machine a suitable dolly for that particular size. Tedious if you need a different size every time a bearing job comes up. A better way is to use the old bearing (ideally the outer race only – bearings can be dismantled). First, lightly grind the outer surface of the scrap race. It will then almost fall in what originally would have been a press fit. The press can then be used straight onto the suitably bridged scrap race resting on the new race outer.

These days when buying car spares you often find that only a complete hub and bearing assembly is available. I've found that bearings by themselves can still be purchased, however not from a car supplier. Go straight to bearing factors.

Whilst the width of my frame is reduced from Alan Hearsum's it has still proved wide enough for most jobs so far. I notice however that the discs on modern cars are getting bigger all the time. With the benefit of hindsight, I perhaps should have bought beam and base material to give an aperture of say 450mm wide.

Folding sheet metal

The folding tool is basically just as Alan Hearsum Described. Why spoil a good design?

Dimensions were changed slightly to suit the materials I had to hand. The frame meant the maximum width to be bent would be 305mm. The metal for the Die was bright drawn bar 30mm x 50mm


19

sawn to length. The saw produced nicely square cuts, so my home made linisher merely had to polish the ends.

When machining, the die was held down on the milling table upon a pair of angle blocks, the clamps above holding it down upon its top corner. I would have liked the angle blocks to have been a little larger but the clamping point was within the footprint of the blocks so there was no overturning moment. The very small clamping pressure points worried me a little, so I doubled up the clamps over each angle block and added a pair of substantial end stops. Between the clamps and the workpiece, I added small lengths of aluminium angle. This prevented the clamps from bruising the corner of the metal and helped spread the clamping load. My pessimistic nature had me checking clamping security during the machining. Nothing shifted. I've been accused of applying "Queen Mary" engineering techniques in the past so perhaps I shouldn't have worried anyway! **Photograph 17** shows the die being machined. I used a new Glanze fly cutter which was true on both face and side. This meant that although the machining was done by progressive bites down into the V, the result needed no more cleaning up and was accomplished with just the one setting on the milling table. **Photograph 18** gives the finished state.

The Die is fixed to the base plate via four 5/16 whit c/sunk alan screws. Usually I would have welded it to the base plate. I thought however there was a chance that later I might want to either deepen or change the tooling profile. The base plate is 100mm wide by 12mm deep by 360 mm long. This means of course that the cheek plates, set apart by 100mm on the anvil again keep the tool on the press centre line. Lateral movement isn't too fussy although in this case it is limited by the size allowed by the frame.

The Die position was marked out on the base plate and the various hole positions centre popped for drilling. As usual I started with a small drill to ensure it stayed accurately on the popped positions. They were then opened up to the 5/16 whit tapping size. **Photograph 19** shows this stage.

●To be continued

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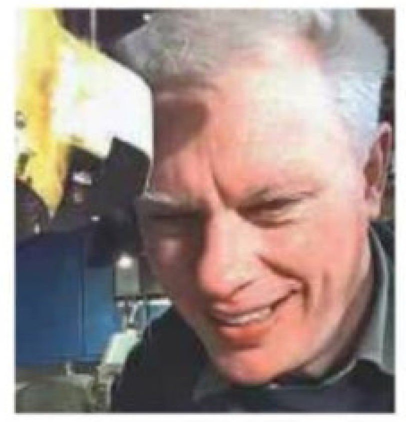
A Flying Shelf



Howard Jennings comes up with a solution for keeping things handy while you work.

This is less of a 'plan and make' article than an overview of how a project went from first idea to final fruition. However, I have included photos and a few measurements here and there to aid replication of most aspects. I wasn't sure during the build whether the project would be of interest so only took photos in a half-hearted fashion along the way. Then our editor put out a request for articles and I put this on the reply as an afterthought. He showed considerable interest and so the write- up started in earnest. Hence, as you will probably notice, some photos were taken after completion. Happy inspiration.

1

Articulated television bracket

The problem

A few years ago, a house move resulted in a serious downsizing of my workshop space. With a bit of planning, ingenuity and chucking out I managed to shoehorn all of my machines into the garage in such a way that they are useable as I await the day a new workshop arrives. However, at present the working space on my bench is shared with half-finished projects, bits of metal, boxes of fasteners etc. The worst issue though is that the most frequently used equipment (digital calliper, safety glasses, height gauge, calculator, Zeus book) was floating around the bench, getting involved with things they shouldn't and generally being difficult to locate when needed. I explored fitting an extra shelf at the back of the bench but where ever the shelf would squeeze in it would get in the way. I started to muse on a potential solution: a positionable mezzanine shelf that could follow me to wherever I'm working and could be moved out of the way, but less obvious was how to make this happen.

The spark

The starting point for inspiration was of course the articulated TV shelf as seen in bars and bedrooms throughout the '90s. A few years ago I picked up one of these, **photo 1** thinking it would make a good moving shelf for one of my machines, for storing tooling etc on a job. Unfortunately, after some thought and simple trials of the 'hold it in place on the wall' variety, I was just not happy with how the shelf would work in practice. Worse, it had the potential to be a liability, getting in the way at crucial moments. Another worry was that the shelf would start to vibrate badly if it was attached to or touching a machine. So that idea went out of the window, and the shelf ended up languishing in the shed waiting for the day it might re-emerge to glory in some way.

The lightbulb moment

At this point I remembered an article I produced last year 'A swing out magnifier' (MEW 244 August 2016). Really a review of some useful light brackets which are articulated to swing out from the wall and tuck away easily, this set me thinking could I do the same with a shelf? Would it work and overcome the problem of being in the way when you least need it? I began to wonder if the articulated television bracket could be fitted to a bracket itself! Further inspiration was kicking around in my workshop: in another, earlier article 'Tools from the bin' (MEW 228 May 2015) I mentioned the use of the shaft from a scrapped car strut to extend a slot drill. The remnants of the strut were hanging about in my useful scrap area under the bench. One of the bits, **photo 2** bottom right, is the bracket that attaches the strut to the front wheel bearing unit on the car. I wondered if one these with the base machined out would slide over one of the pieces of scaffold tube I use as rollers for moving large machines (all credit to the Ancient Egyptian pyramid engineers good enough for them good enough for me). Some measurements showed that the bracket would indeed likely slide together. with the scaffold tube. After a bit of persuasion using flap wheel in a power drill doing a little internal relieving inside the bracket they slid together. A plan was forming!

Safety first: be aware that many car front struts and suspension units are gas

2

Some of the parts inside a car strut

pressurised. If you cut into one oil will spray out under pressure. Also, parts could shoot out at high speed. If in doubt, don't breach them.

By the way if you are not a car maintenance enthusiast then your local garage, fast fit centre or motor factors will likely have one or two lounging in their scrap bin. You might find yourself crossing a palm with silver; nothing is free these days.

Pre fitting of components

So now I had a bracket from the car strut that would slide up and down a piece of old scaffold tube. 'Aha' thought I, if that tube was held vertically then the articulated television bracket could swing out from it. The next question was how to suspend the vertical tube?

My workshop/garage's flat roof is supported by a series of wooden beams roughly 6 x 2 inches each. This design is more than strong enough for the purpose so adding some extra load wasn't going to be a problem. How about a horizontal arm pivoting around a point somewhere near the middle of the workshop, above head height? Then the shelf could be positioned almost anywhere in the workshop, be moved in seconds if it ended up in the way and tuck away above my bench when not needed. For this to be practical, moving it away had to be smooth, easy and unfussy, requiring the bearing to be smooth and solidly mounted. Joining the two pieces of scaffolding tube perpendicularly was, as it turned out, easy: I had a right angle scaffolding clamp kept for years as part of a job lot of old scaffold tube I picked up.

By the way, these scaffolding clamps are worth asking around/looking out for: they turn up in the most unexpected places. Through just asking around I came up with two other scaffolding clamps, **photo 3** - the one used in this project is at the top.

The final ding on the old bell of inspiration in my head came when I realised that I didn't need to make a bearing to swing this scaffolding tube construction around. I could just use the bearing from the strut itself. It may

Scaffolding brackets

Flanged nut

be past its best but there was a lovely chromed strut shaft with a silky smooth fit in the bearing and (I postulated) well capable of taking the weight of the whole arrangement. The bearing is in the top left of photo 2. Also, by using the threaded end of the strut shaft I could utilise the lovely flanged nut, **photo 4**, from the strut; waste not want not!

Construction

To fit the strut bracket to the television bracket I decided to make maximum use of the original strut clamp fittings. This allowed me to use the strut bracket 'ears' which are really convenient to weld onto. The alternative would be some sort of plate adaptor welded to the tube section of the strut bracket, a right faff! To achieve the clamping, I broke out the slitting saw and cut a short slot between the clamp bolts, about 20mm short of the ends, **photo 5**. This approach maintained the integrity of the strut clamp tube but allowed it to close onto the scaffold tube. When tested it would not quite close using the original clamp bolt holes and new bolts: the solution was to add a new clamp bolt in between. Then I slit the television bracket, **photo 6**, so it would fit across the strut clamp 'ears'. Note the setup: I had to use a wooden backing attached through the original wall screw holes to keep everything together and stop the wobbles for this operation. Before welding the two together I also slit through the middle of the television bracket mounting. This operation allowed the strut bracket to close when the two brackets were welded together. The result you can see in **photo 7**: the television bracket has been welded to the strut bracket and the two slits align such that the strut bracket will close. The combined bracket unit is shown in **photo 8**: the two large bolts top and bottom of the bracket do very little and are really just for show. The clamping (it only needs a nip) is done by a bolt fitted into a newly drilled hole in the middle - it turned out to look quite neat.

Slitting between the strut mounting bolts

Slitting the television bracket

Opposing slits

Combined television and strut bracket

Horizontal arm

The next challenge was to fit the piece of scaffold tube for the horizontal arm on to the strut bearing shaft I had decided to utilise. This piece turned out to be about 600mm long, the vertical tube being 800mm long.

The chromed shaft from the strut is 22mm diameter and the scaffold tube 47mm diameter. I contemplated turning a bar to fit the inside of the scaffold tube, with a hole drilled through to take the strut shaft. Then I wondered whether I could save time and effort by just squashing the end of the scaffold tube and welding on the strut shaft: the answer was yes. A 6-inch vice easily squashed the end of the tube to suit the strut shaft diameter. To make a neater job of it I cut down the now squashed end of the scaffold tube with a 22mm diameter end mill. Two welds and the job was a good un'.

Bearing

To mount the bearing, I decided to take a bit of risk. The inside of the assembly has polymer bearings which are permanently set in hydraulically formed housings, not for disturbing. But would welding on some mounting lugs wreck them? Well I did it, figuring there was nothing to much to lose but a bit of time forming the lugs and on the lathe to clean up the sawn end. The lugs I cut with an end mill to match the bearing flange diameter. It worked! See **photos 9** and **10**. This saved a lot of time that would have been spent making a special bearing. The only thing left to do to adapt this bearing was to turn a 'top hat' washer, **photo 11**, to act as a bearing flange and stop the chromed shaft from sliding down, **photo 12**.

Assembly

The final assembly is shown in **photo 13**. You can see the original metal plate from the television bracket has been replaced with a larger piece of plywood. Photograph 10 also shows the two coach bolts driven into the wooden roof beam to mount the bearing overhead.

The Shelf in Action

When I started this project it had a large element of 'suck it and see' about it. I had some reservations about how useful it would be in practice. My biggest concern was how stable the whole thing would be. Would it wobble all over the place and cascade my instruments back onto the bench or, worse still, the floor? Well, you can see the height measure on the pictures. The shelf moves with silky smoothness, no dramas or holding things on. It is a dream to use; I can place it almost wherever I need it in seconds.

I have tried to put together some pictures of how well the shelf works. **Photograph 14** shows the shelf positioned conveniently for use beside my milling machine. The

Strut top bearing lugs

Bearing fitted

shelf is in position in seconds and takes the multitude of small tools (clamps etc) that collect on some jobs. **Photograph 15** shows the shelf at the other end of the workshop at the headstock of my Denford lathe. You can see the safety glasses, calculator, Zeus book and digital callipers all easily to hand. This avoids me having to constantly return to the bench while working. I have a larger Harrison lathe directly opposite and the shelf reaches over to that easily too. **Photograph 16** shows how the shelf 'tucks away' in the corner of my bench: you can probably see that it blocks some small drawers; this doesn't matter since moving it away to access them is so easy. For a 'tight' workshop situation the shelf has been a success and well worth the effort in making it.

Top hat washer

Top hat washer fitted

Oh dear...

When the shelf was complete I discovered a rather glaring error. Here I have described how I solved the problem so that newcomers can see that mistakes do happen. It is how you sort out mistakes and learn from them that really matters. When I first started reading magazines like MEW it seemed that things always went swimmingly well in articles and people never made mistakes. I thought at the time that this just could not be true and wondered what was left out, but this is my article, warts and all.

You will see in **photo 17** that the scaffolding clamp just misses the fluorescent tubes above where I stand in front of the bench. It won't surprise you to learn that the 'just miss' was originally a direct hit. "Oh deary, deary me" (or something like that) I exclaimed, I had not made allowance for the clamp to clear the workshop lighting. After getting over the initial d'oh moment, I considered my options:

1) Do nothing and hope I don't need the shelf to pass the lighting. Not good, too much chance of forgetting and finding myself in the dark, covered in fine shards of fluorescent tube glass with a live fitting over my head.

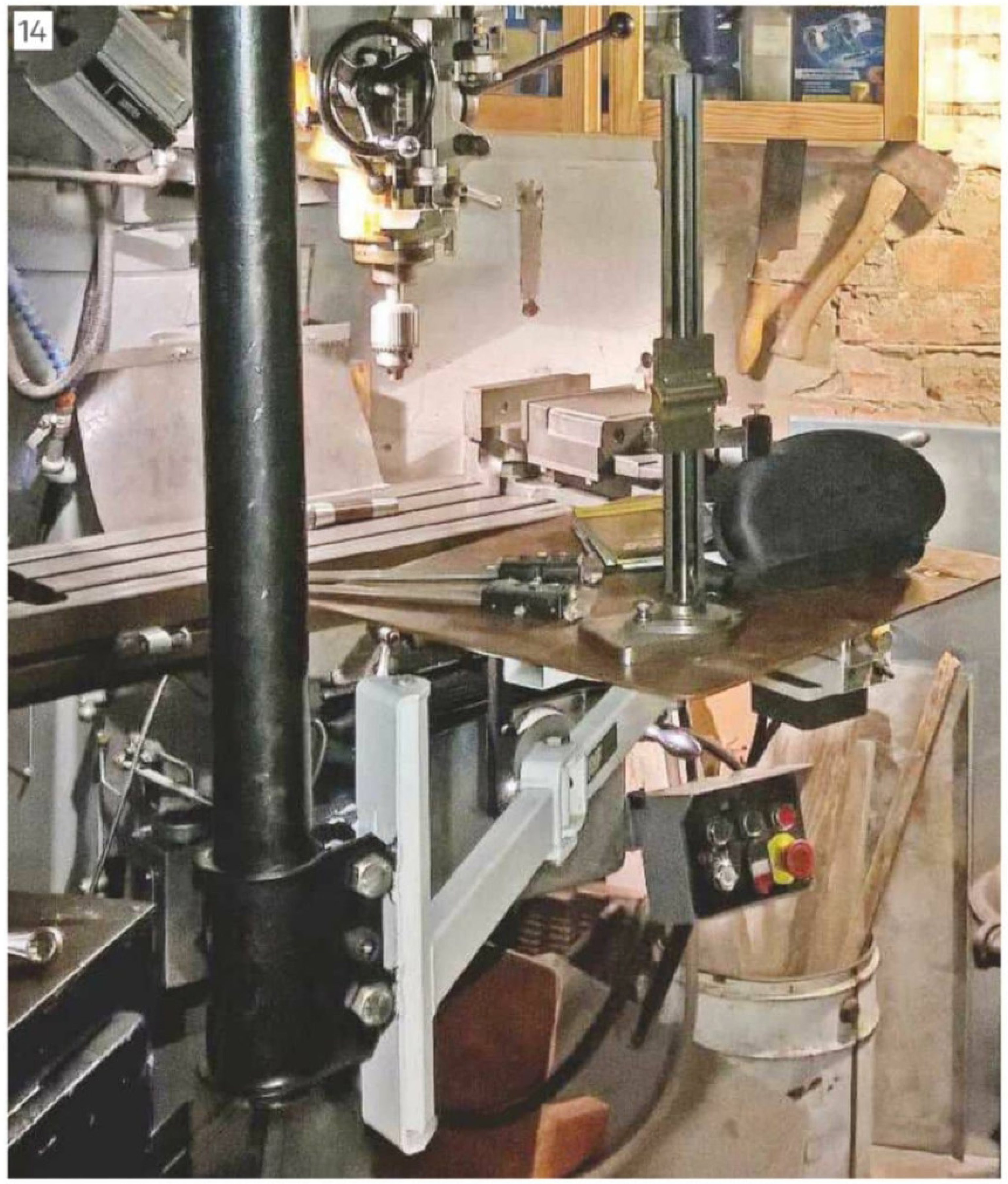
2) Add block packings under the bearing (see photo 10). I pondered this approach for some time but decided against it, mainly due to the risk of reducing the rigidity: it would need very long coach bolts which are a larger diameter and fitting problems start to emerge. Also it would look a bit of an afterthought, which would annoy me forever.

3) Extend the bearing shaft. I eventually decided to go ahead with this. Using the longer shaft from the other strut would have been easier, but it was already used (see above, 'The lightbulb moment').

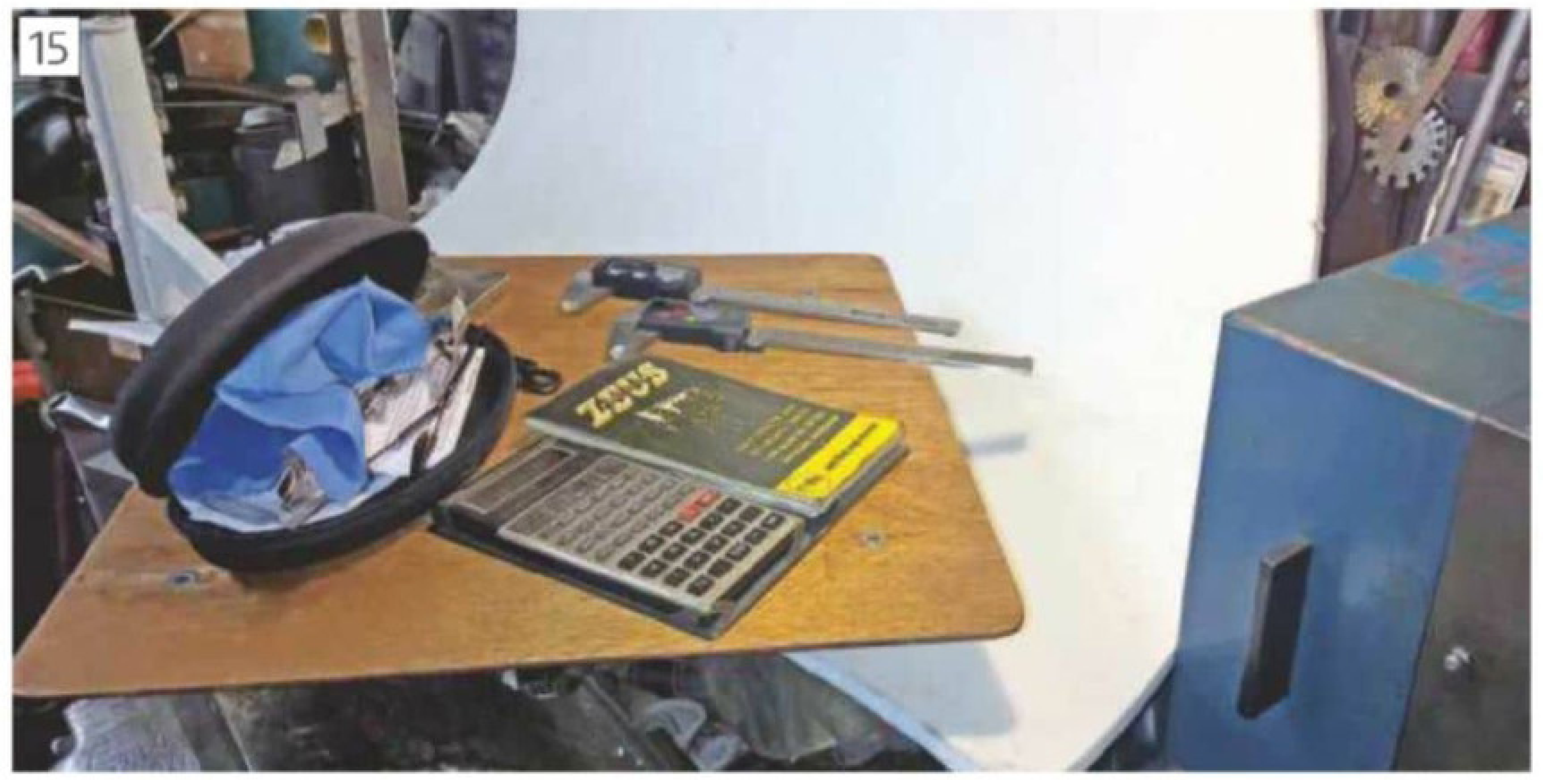
The shelf assembled

This rework involved carefully cutting the welds that held the chromed bearing shaft on the scaffold tube. This was not too arduous a job with careful use of an angle grinder and a cold chisel. Then I bored a length of 11/8inch (28.5mm) diameter bar to take the original chromed bearing shaft (just under 22mm diameter) having cleaned off the weld. The challenge was joining the chromed bearing shaft into the extension tube. I considered machining slots along the length of the extension tube wall on both sides then running a weld down the slot with plenty of amps. I have taken this approach on past jobs, it works well but is a lot of work on a project like this. Also, as the chromed tube had been exposed to welding heat already, I didn't want to raise the risk of the plating detaching after I had got away with it thus far.

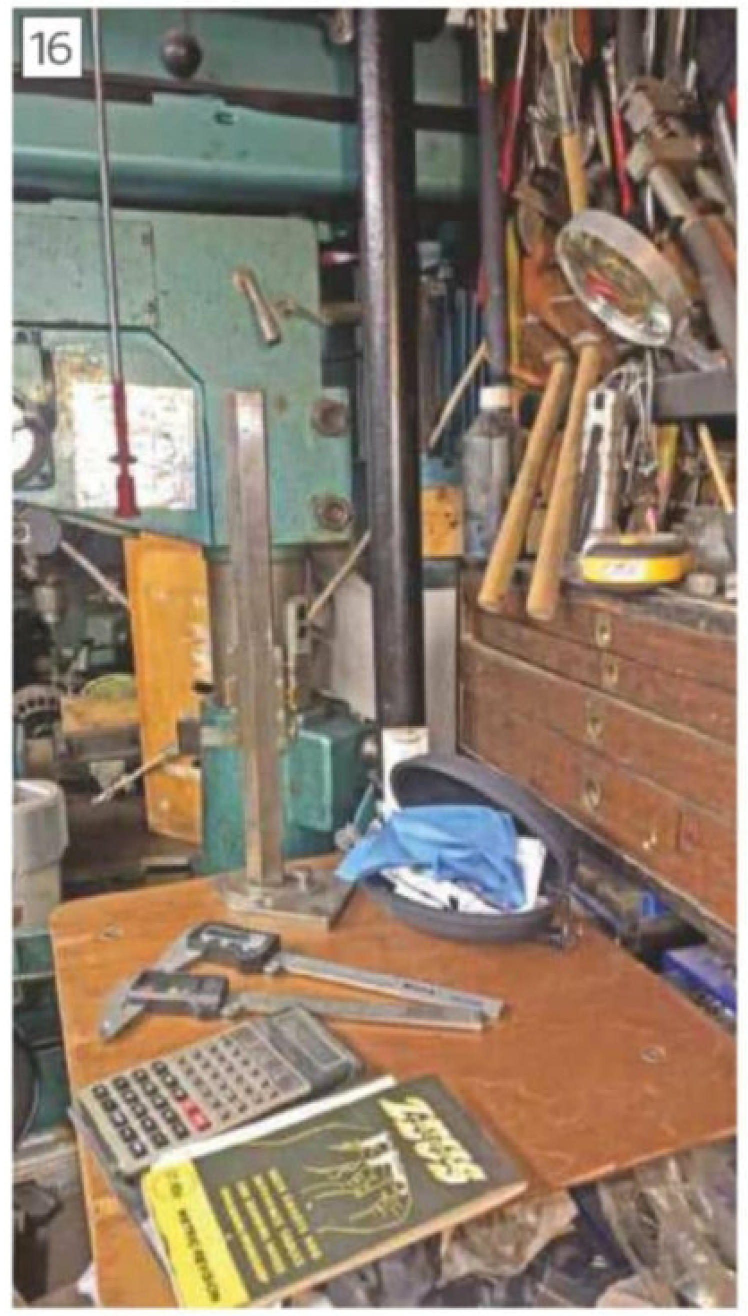
I chose to glue the tubes together. The chroming had been removed from the 'male' section when cleaning off the weld anyway, so all was ready to make a good adhesive joint, that is clean machined surfaces. The extension tube was welded to the scaffold tube after machining a new seating to suit the extension shaft. The tube bore and chrome shaft were cleaned with acetone, then both shaft and bore were coated with UHU Endfest epoxy resin. This is only widely available in Germany but can be purchased through specialist suppliers in the UK. The two were pushed together and the assembly left on my (switched off) workshop stove to set overnight as the stove cooled. A quick calculation told me that the joint



Convenient for the mill



Handy for the lathe



Shelf in stored position

Just missing the flouresent tube

would be capable of taking about 42 kg at the lowest strength cure, at 20°C. The temperature on top of the stove I would estimate to be 50-70°C, suggesting that the joint could stand a load of up to 70 kgs – more than enough for this application. See **photo 18** for the end result.

Next Steps

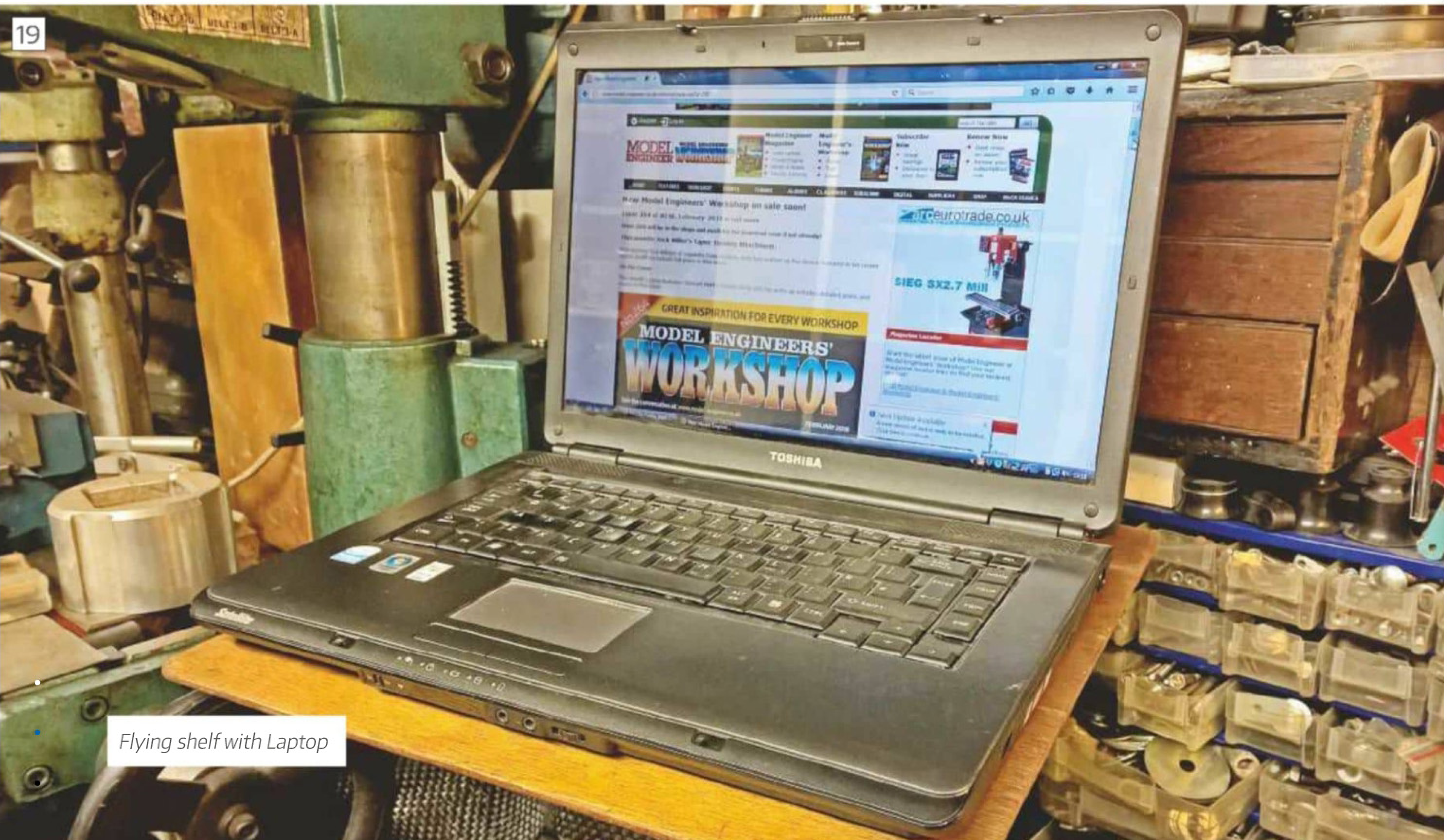
The shelf has been working well for the last few months and I have some ideas for small additions and modifications. For example, I sometimes need to use my laptop in the workshop to be able to respond quickly to emails etc. I am sure many of us use computers in the workshop for all sorts of reasons. Well, **photo 19** shows my laptop on the shelf – very accessible but easily moved away from potential hazards. The only downside is that I have to remove all the tools and accessories the shelf was built for in the first place! A rapidly attachable second shelf is needed here: I am thinking about adding this as I write.

It won't surprise you to learn that this shelf tends to collect bits and pieces awaiting the next stage of a job. It would be nice to slide away my digital callipers and Zeus book, note pads etc. I am therefore contemplating a mezzanine shelf for the er… mezzanine shelf! It would just involve some turned wooden dowels to separate the two shelves or something along those lines. I need a 'round tuit' on these projects, I have done

Reworked bearing arm

enough to be going on with.

There it is, a project that has come out well from pondering ideas around fitting together bits and pieces just lying around dodging the scrap bin. I have stuck in the 'warts and all bit' just to show I am human and make mistakes as we all do! ■



Flying shelf with Laptop

Keeping a Round Column Mill in Line

Howard Lewis describes his approach to keeping a round column mill in alignment

Every owner and user of a mill/drill machine with a round column will know the problem of keeping the head correctly aligned whilst moving the head up or down the column. How many times have we tried to hold down the quill with the drill in the hole, with one hand, while trying to wind the head up or down with the other, only to find that something moved during clamping?

After having spoken at one of the meetings of the Peterborough Society of Model Engineers, Stan Bray gave the tip of using a low-priced DIY store laser device as a means of dealing with this problem.

I took this advice, and bought one for £7.99, but found that the base supplied was too moveable to permit real repeatability and accuracy. The "to do" list acquired a new entry, "Make a firm base for the laser and fix to the machine". Eventually this task reached the head of the list, and what follows is my solution to the problem.

For safety reasons, the unit needs to be fitted above head, and eye line. To avoid eye damage, never look into a laser, either directly, or via a reflector such as a mirror.

Because there are a number of different versions of these Mill/Drills from various suppliers, no specific dimensions are given. By mounting the laser on a bracket, rigidly fixed to the machine, repeatability and accuracy would be achievable.

The intent was that the laser unit, using its integral magnet, would sit in a close-fitting groove on a piece of steel. This piece of steel was secured to a fabricated mounting bracket.

1

Bracket parts ready for welding.

The first problem to be solved was to find a suitable location for the bracket. The belt cover was unsuitable, because slack within the hinge precludes repeatability. The lower part of the belt housing was unsuitable because, a) access for fixings would be difficult behind the spindle driving pulley, and b) it was of a thin composite (plastic) material and, hence flexible. The head casting is already congested with fittings, and I did not want to drill any holes into it for fear of, hitting something vital or introducing swarf into moving parts.

Consequently, the decision was made to make a bracket which covered the upper of the two blanking plates on the front of the head. This would set the unit just above my eye level.

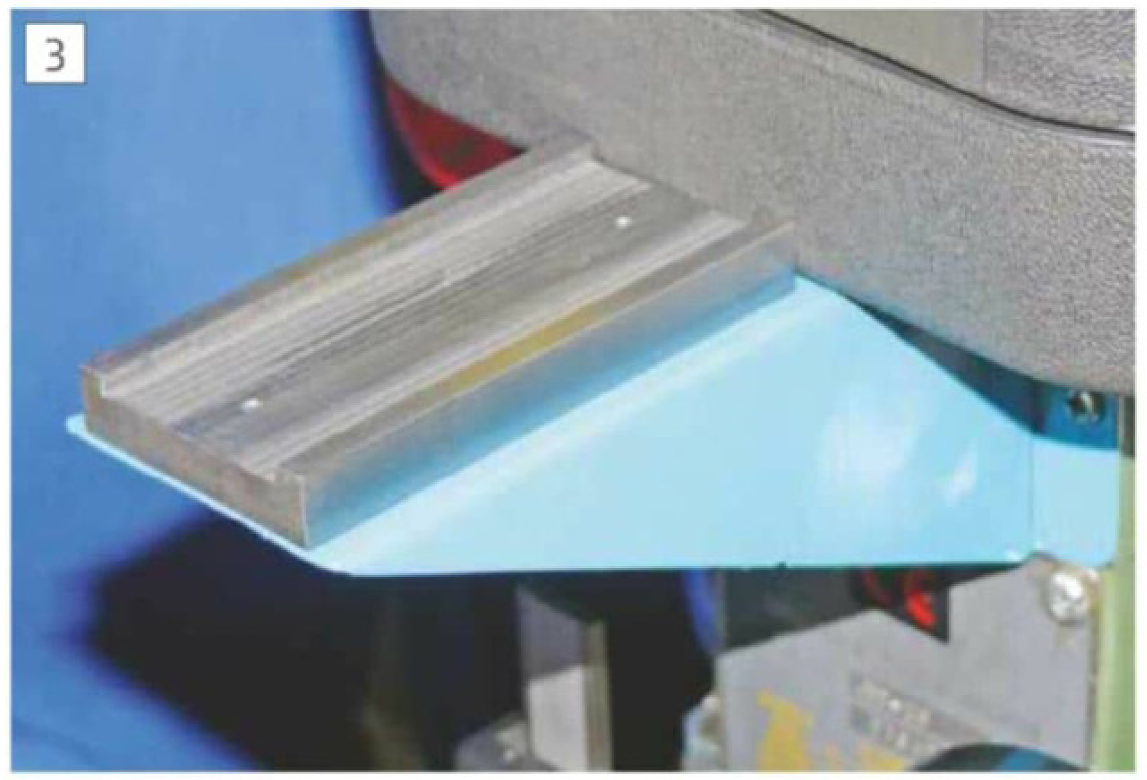
The bracket was to be made from sheet steel, because it was available, and I was overconfident enough to think that it could be made in one piece, and then welded together neatly.

In fact, the bracket was made in one piece, but my sheet metal working skills were insufficient to produce a good enough end product. So, the piece of steel originally destined to be the backplate was cut off, scrapped, and a new one made as a flat sheet.

The bracket and the new backplate were then ready to be welded together. It was noted that the holes in the cover plate over which it would be placed, were not centrally placed, so the plate had to be correctly oriented before being welded on. **Photograph 1** shows the pieces prepared for welding.

2

Milling a slot for the laser.



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The bracket in place.

Although this bracket was produced by fabricating and welding, there is no reason why the bracket could not be made from pieces of 6mm plate and held together by drilling and tapping for countersunk screws. Indeed, the thicker material will increase the rigidity.

The top plate, which was made from 50 x 12mm steel, could then be used as the top of the bracket, although the length would need to increase from 4 inches (100mm) to 5 15/16 (151mm) to suit a machine like mine.

Once sure that the backplate was facing the right way, the front part of the bracket was clamped to it.

During clamping it was ensured that the top of the bracket was flush with the top of the backplate, and that the sides were square to the top of the backplate, and centrally positioned on it.

The inside flange of one side was tacked at each end, before removing the clamp and running the weld along the full length. The other side was then aligned and welded in like manner.

Finally, the backplate was welded to the top edge of the bracket, to make a rigid assembly. The welding served to remind me that my MIG welding ability had not improved over the three or four years since this skill(?) was last used.

While the fabrication was cooling, the carrier for the laser unit was prepared. As has already been mentioned, this was a piece of steel, which was cut and machined to 4 inches (100mm) long. On the longitudinal centerline, ½ inch from each end, were drilled and tapped holes for 4BA screws. (M3 or M4 would do equally well). The screws are there to secure the plate to the bracket, and since no appreciable forces are involved, do not need to be large.

The width of the base of the laser unit had been measured, and the next task was to mill a slot into the plate to take the laser. In my case, the slot was made 1/8inch (3mm) deep, (actually deeper than the base of the unit) and a couple of thou wider.

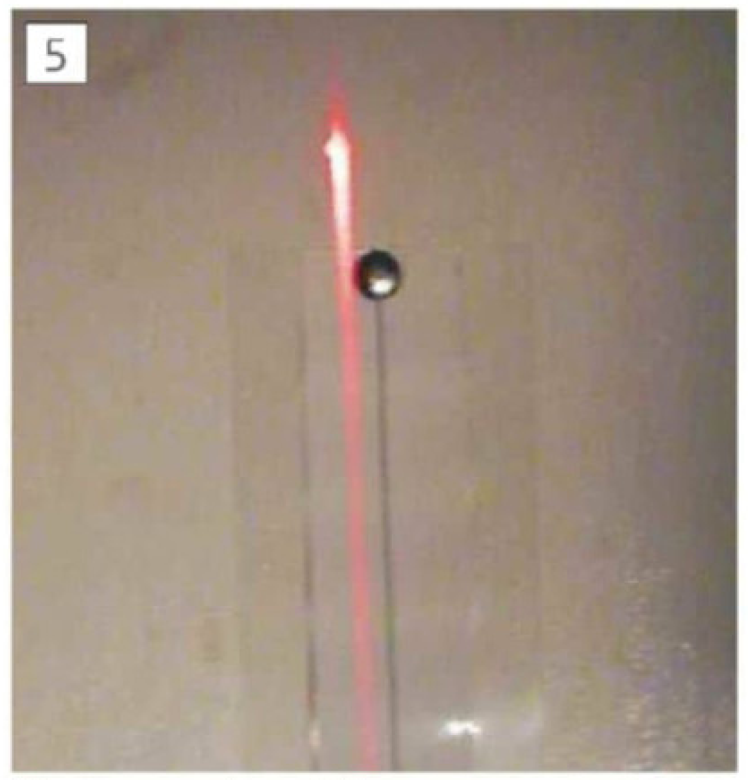
Photograph 2 shows this job nearing completion. Acting out of character, and being cautious, 25 thou deep cuts with a ½ inch slot drill were taken, before offsetting the cutter to produce the required width of slot, equally placed about the centreline. All that was then left to do on this item was to dress off burrs and break any sharp edges.

Meanwhile, the fabricated bracket had cooled and with excess weld dressed off, and sharp edges broken, a coat of paint was applied. Whilst the paint was drying, the 4 BA screws were filed to shorten them to the thickness of the machined carrier for the laser unit.

In due course, the carrier was fixed to the bracket, with the steel base for the laser unit was level with the front edge of the bracket, and the assembly fixed to the machine. Because fairly thin sheet steel had been used, it was possible to reuse the existing screws that retained the blanking plate on the machine head. Obviously, if the bracket is constructed from thicker material it will be necessary to use longer screws. (On my machine the screws appeared to be 3/16 BSW). **Photograph 3** shows the assembled bracket, fitted to the machine.

4

Laser on bracket.



5

The laser and pencil lines.

Photograph 4 shows the Laser unit in position on the bracket, ready for use. The particular unit obtained had spirit levels for lateral and fore and aft planes of the projected line.

Short of a lot of work, (The blanking plate seated onto two faces which seemed to have been fettled with an angle grinder, so that one was curved rather than flat) it would not be possible to centre the bubble in the fore and aft level, so the vertical alignment was accepted as it was.

By slackening the securing screws, and moving the bracket slightly, the bubble could be centred in the lateral level, although it probably would not matter too much if the projected beam were not truly vertical.

When switched on, the laser projected a, nominally vertical, red line onto the white painted far wall of the workshop.

Avoiding looking at the laser, pencil marks were made at the upper and lower portions of the line, before switching off the laser and using a long straight edge, (a 1metre long aluminium ruler) the two pencil marks were joined to form a continuous line.

If you have not already deduced it, the method of operation is that the machine, with the Laser switched on, is aligned so that the projected laser line coincides with the pencil line on the far wall. If the machine head is moved up or down the column, the head is moved around the column so that, when reclamped, the laser line again coincides with the pencil line.

The positional accuracy depends upon the distance of the laser from the surface. In my workshop, the laser is 93 1/4 inches (2369 mm) from the pencil line, so an error of 0.015 inch (0.381 mm) between laser beam and pencil line would represent an angular displacement of the machine head by 0.553 minutes of arc.

The laser is 8 ¾ inches (222 mm) from the spindle centreline, so by my calculation, such an error would result in the spindle being 0.0013 inch (0.033 mm) out of position, which agrees closely with Stan Bray's mentioned accuracy of "about a thou".

Over the years, the white paint has deteriorated, making the pencil line less easy to see against the projected Laser line. A slightly more durable pencil line was required.

To this end, a pencil line was drawn on a sheet of A4 paper, which was then guillotined to leave the line central on a 30mm wide strip. This piece of paper was then laminated, to become a "wipe clean" surface.

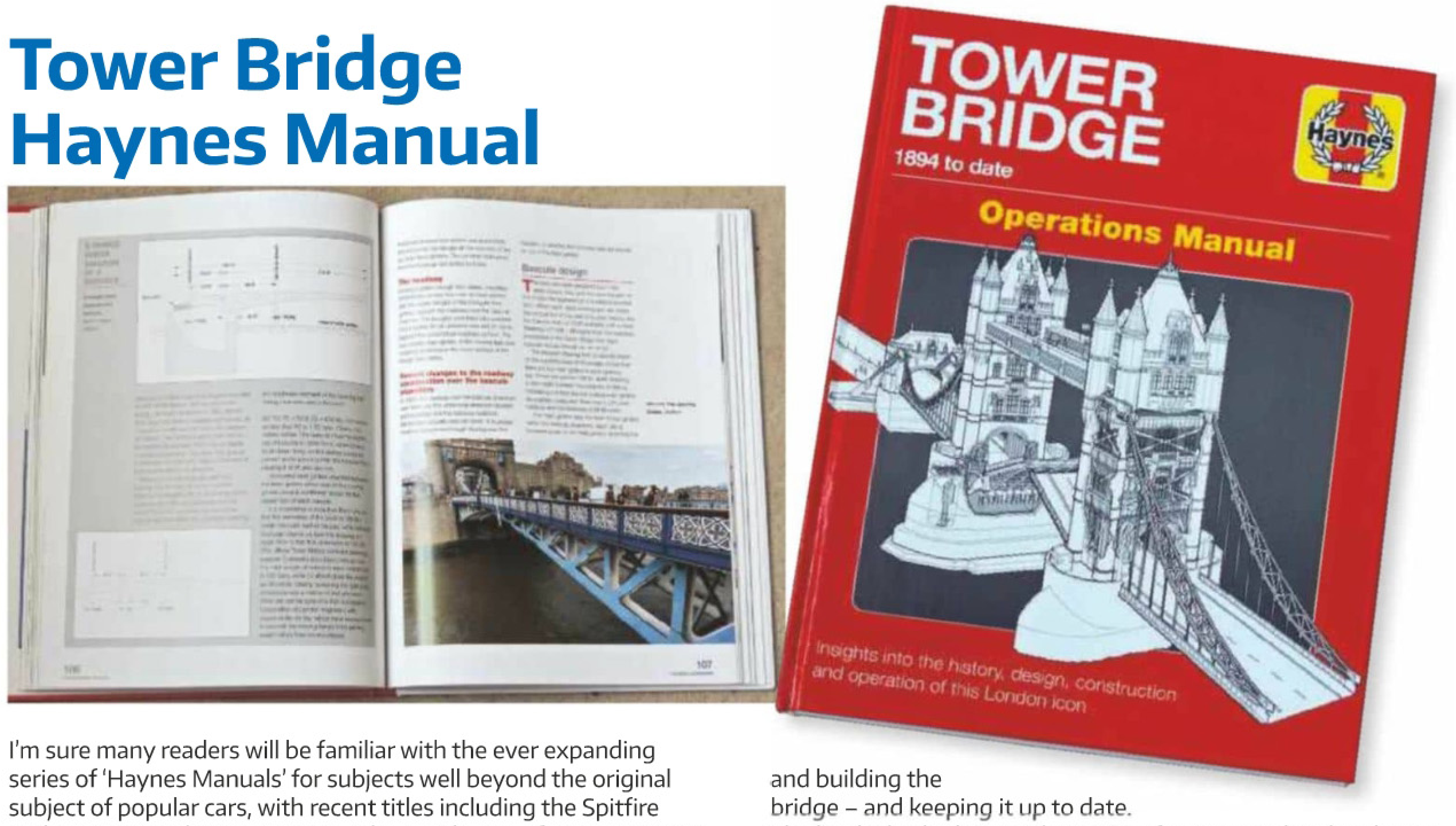
With the head of the machine aligned to where it seemed to be parallel to the Y axis, it was clamped, and the Laser set to project a line on the wall. The laminated paper strip having been punctured, at both ends of the line with a drawing pin, was aligned on the projected line of the Laser, and the drawing pins driven home.

Because of the low lighting levels needed to make the pencil line, and the laser line visible, **photo 5** is, not of the quality that would have been wished.

This should make it easier to keep things in line when moving the head up or down the column! ■

On the **Wire** NEWS from the World of Hobby Engineering

Tower Bridge Haynes Manual



I'm sure many readers will be familiar with the ever expanding series of 'Haynes Manuals' for subjects well beyond the original subject of popular cars, with recent titles including the Spitfire and International Space Station. John Smith, one of our past MEW contributors has recently seen the publication of his 'Tower Bridge Operations Manual'.

I'm sure readers won't be surprised to learn that assembly of Tower Bridge was a lot more complex than the reverse of dis-assembly! Actually, in common with most of these new titles the book is not a clone of the automotive manuals. It is a detailed review of the engineering and architectural challenges of designing and building the bridge – and keeping it up to date.

The book also looks at its history on fascinating detail and even offers biographies of the lead engineers and contractors involved in the project. A far cry from my old Morris Marina manual. Perhaps in 120 years' time someone will be preparing a comparable book on Crossrail?

The hardback book has 188 pages, many colour illustrations as well as historic images and even original contract and design drawings. It has an RRP. Of £25.

Help Clear a Workshop and REMAP at the same time

Recently I was contacted by a reader who was involved in sound engineering at a professional level, delivering sound studios for broadcasters. He had gone on to collect a vast amount of potentially useful machines and tooling to enjoy in his retirement. Sadly much of it has remained little used or unused, but he wished to see it go to a good home, and was also keen that a large part of the proceeds go to support a good cause. I put William in contact with REMAP and their Peterborough branch have been helping him catalogue the contents of his workshop. They found a 'huge' amount of specialist equipment and a vast amount of stuff, metal, woodworking and electronics, arising from an initial interest in building bespoke speaker systems.

Some of the equipment includes a 6 inch gear head lathe, a Metalworker mini lathe, Cowells lathe, 45 PF Mill (quite a heavy duty job with auto down feed), Sieg micro milling machine and a Startrite drill but the list goes on and on.

I will put a longer list on the forum at www.model-engineer.co.uk, if you are interested in any of the items, please send an email containing your contact details with REMAP in the subject line to **neil.wyatt@mytimemedia.com**. I will forward these to Peterborough REMAP. Please note that William is keen for as much of the equipment as possible to go to practising hobbyists for their own workshops.

Machine-DRO Moore and Wright Hotlist Sale

Machine-DRO are offering 'the hottest deals on selected Moore and Wright products' until the 30 September. The M&W Hotlist offer they are running is up to 50% off on selected Moore & Wright products which can be found at **https://www.machine-dro.co.uk/hotlist-sale.html**

Unimat 3 Accessories

Geoff Harding describes some of the devices he has made to get more out of his Unimat.

I have had a Unimat 3 for many years and have found it a very fine machine. I gradually accumulated many accessories. I found the screw cutting device particularly easy to use as the pitch bobbins could be used for the much larger thread diameters for camera fittings.

One of the first additions was the vertical drill /mill unit fitted on the back of the lathe bed using a vertical shaft. Other early additions were the auto feed unit and the screw cutting attachment. The indexing block with its dividing plates have also come in very handy.

Now as we all know it was not very long when an out of the ordinary operation was required. A friend was building a model wooden farm cart and asked me if I could true up the wheel rims. The wheels were in excess of four-inch diameter. I found that by mounting the vertical drill assembly with the head turned through ninety degrees and mounting a faceplate instead of the chuck the wheels could be turned in the gap between the bed ways and by raising the toolpost. Another restriction was when drilling the throat depth between the spindle and the

One of the first additions was the vertical drill / mill unit fitted on the back of the lathe bed using a vertical shaft.

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Versatile drill stand using the Unimat attachment support pillar was sometimes too small. To overcome this, I machined a mild steel block 38mm square and 92mm long with two 28mm diameter holes at right angles. The blocks have 2mm slots and 2 M6 Allen screws at each end to clamp the blocks to the support bars. Further bars were turned at various lengths to fit the blocks.

By assembling the drill head on the now horizontal support and moving the saddle to the end of the bed the throat depth was much increased.

It was soon apparent that by mounting the vertical support on a separate base plate a radial drill could easily be constructed. At the time I had access to the college foundry so I made a pattern and cast a base to which the support bars could be attached to the base plate. A short 28mm bar was turned to fit into a base casting this has a male thread in the top end so that the Unimate face plate or chucks could be mounted. The faceplate is also used to fix the small Unimat vice.

The power feed unit was not used very often so I converted it to a dividing head and made a dividing plate with several rows of holes at different radial pitches which could either fit on the lathe saddle or the new base plate. A larger faceplate was turned to fit the dividing head and more support bars turned.

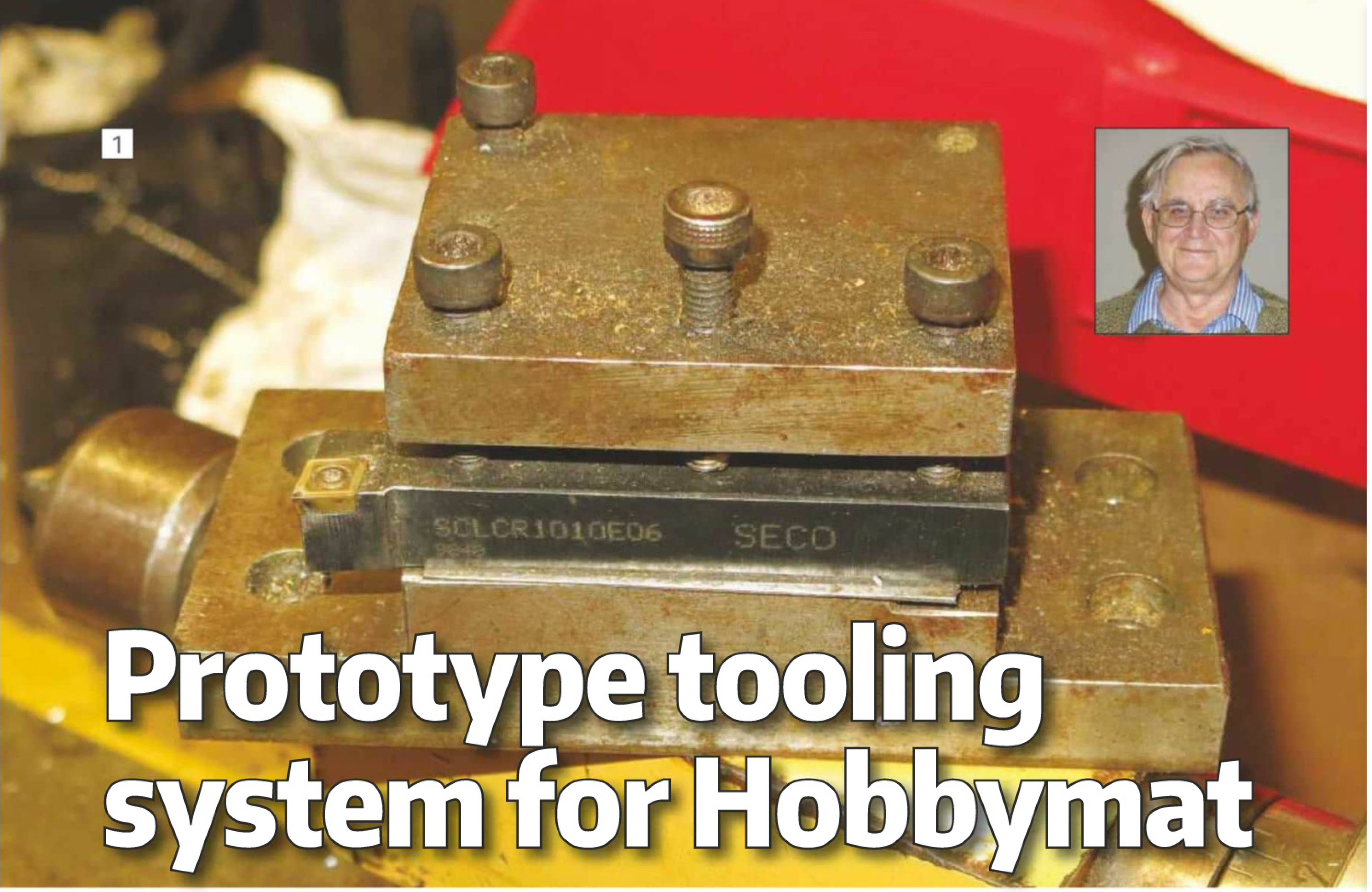
As can be seen in **photo 1** the drill head may be adjusted so that holes may be drilled at any angle and with a much-increased throat depth than is possible on the lathe.

The 125 mm diameter large faceplate, **photos 2** & **3**, is used only on the dividing head and has many countersunk 6mm holes spaced on two circles for attaching workpieces.

Now I have a very useful machine which has performed many unusual tasks and is capable doing most of it that is asked. ■

125mm faceplate

The hollow back of the faceplate



Prototype tooling system for Hobbymat

Solid block tool holder

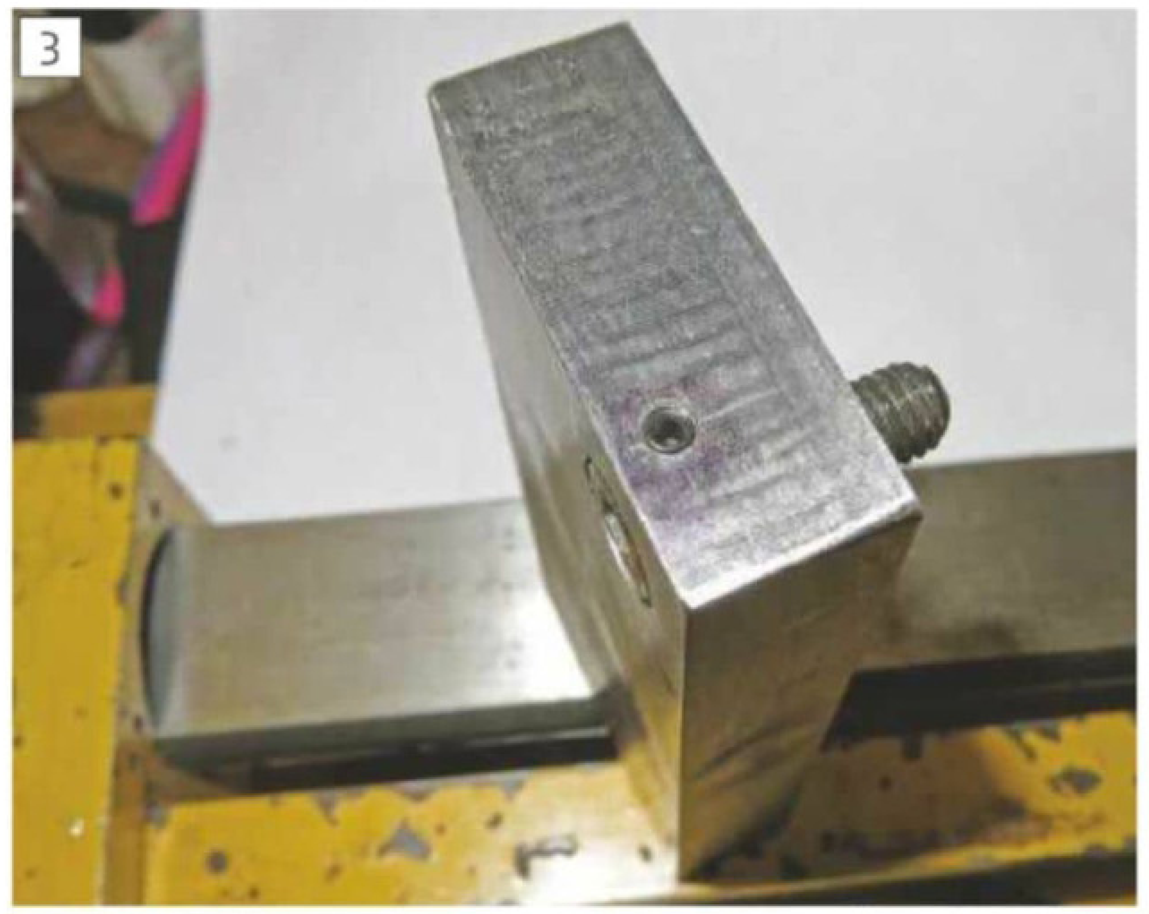
Richard T. Smith makes a basic insert holder for a Hobbymat lathe

Regular readers will know my Warco lathe came with a standard 4 way toolpost. There are a number of problems with them. First, you can't mount more than two tools without them fouling each other and probably stabbing you so forget about four-way. Second, each tool needs individual packing to put the tip on centre height. My turning tools need shim steel and my others need a couple of millimetres. I never had the exactly the right packing. Third, the toolpost completely blocks your view of the actual turning so that you have to lean over the lathe which is both undesirable and uncomfortable.

Along with the lathe I bought a set of indexable tools, these all use the same triangular inserts held at different angles to the tool shank. I wondered if I could use just one insert in a single mounting to duplicate the five positions the inserts are actually used in on the lathe. I came up with a tooling system with an insert mounted symmetrically on a holder rotating about a central hole. This arrangement gives all the five tool insert positions, and more. Tools are normally mounted so that the tips are close to the top left topslide corner, minimising the overhang and maximising the access to the work. The basic operations are all just a rotation away from each other, no tool changing.

> ...the toolpost completely blocks your view of the actual turning so that you have to lean over the lathe which is both undesirable and uncomfortable.

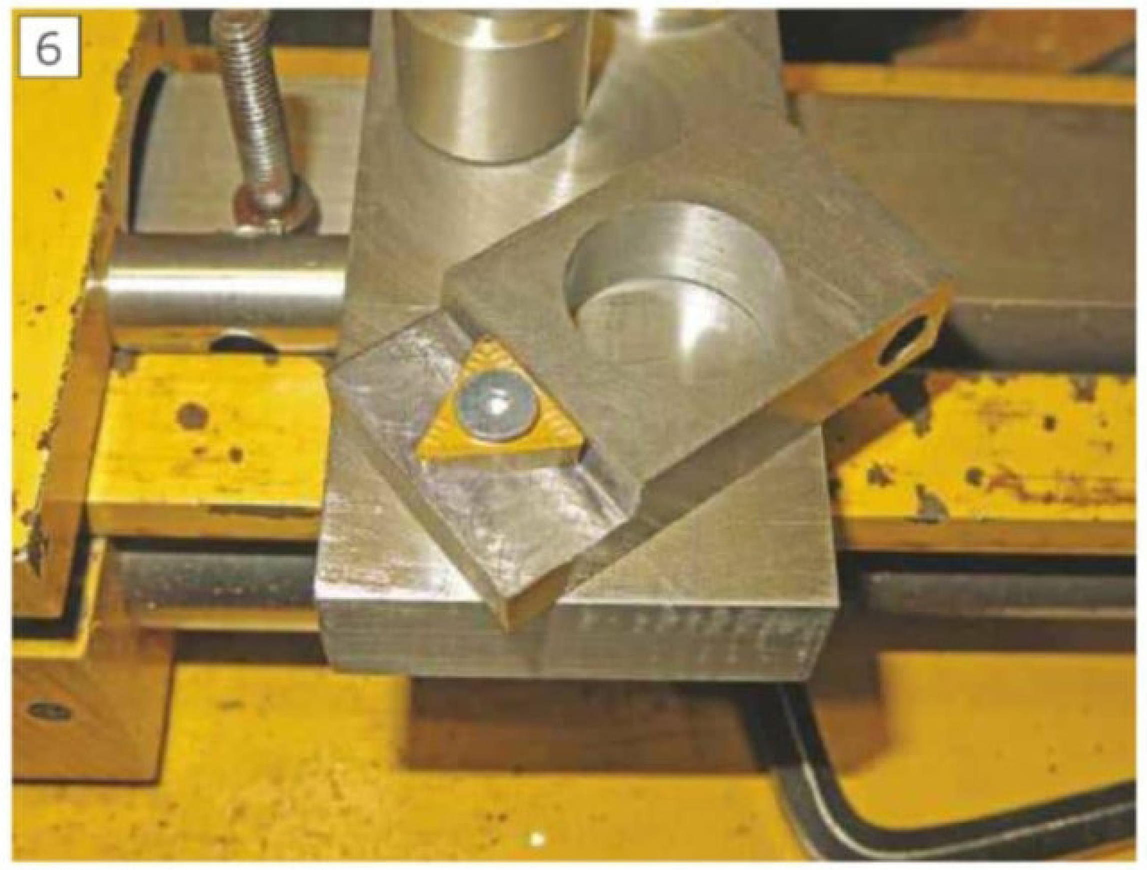
Counterbore for caphead screw



Lock screw

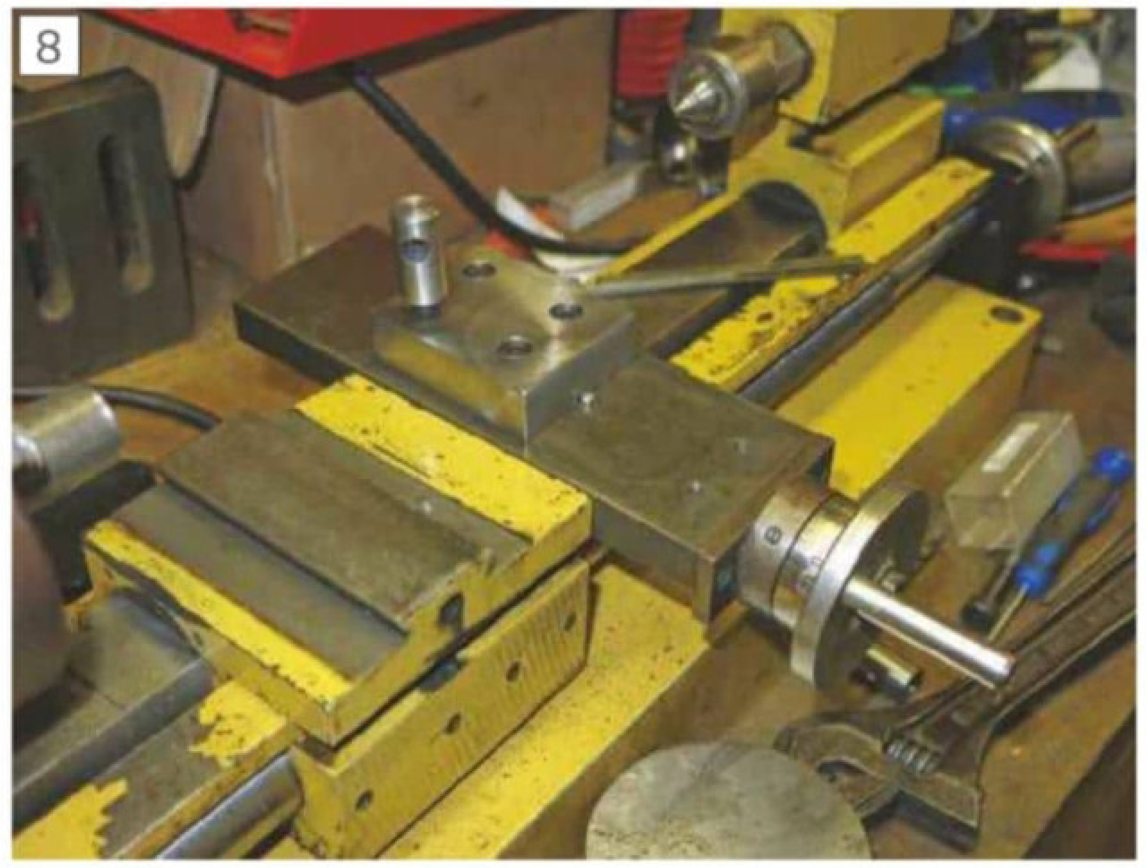
Pillar assembled to block

Embryo insert holder



With step for insert

Completed and fitted to block



Adaptor plate fitted to cross slide

Facing

The system has been described in detail in four earlier MEW articles. I have had a Hobbymat lathe for many years which has been unused for the last ten years since I acquired my larger Warco lathe. After I had cracked two cast iron topslides when tightening tools onto them, I had replaced the topslide with a solid block tool holder, **photo 1**, which bolted direct onto the cross-slide. The adaptor plate for the new insert holder would similarly bolt direct onto the cross-slide.

I had a piece of steel suitable for the adaptor plate and drilled an 8.5 mm diameter hole 12 mm in from the corner and milled a 12 mm diameter counterbore to accept an M8 turned down caphead screw – **photo 2**. I added a tapped hole for an M5 grubscrew to be able to lock

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the caphead in position – **photo 3**. Next I made a 22 mm diameter by 18 mm high pillar and a 3 mm thick washer together with a 14 mm diameter by 28 mm long blind M8 cylindrical nut. The nut was cross drilled 8 mm diameter 10 mm from the top for a handle as described previously. **Photograph 4** shows these assembled on the adaptor block.

The insert holder was also made as described previously but from some 30 x 12 mm BMS that I happened to have and had an M5 clamp screw. **Photographs 5** and **6** show stages and **photo 7** shows the holder clamped to the pillar and mounted on the adaptor plate. I shortened the adaptor plate and bolted

I wondered if I could use just one insert in a single mounting to duplicate the five positions the inserts are actually used in on the lathe.

Turning

it to the cross-slide using two of the existing tapped holes plus a third one that I made, **photo 8**.

Photographs 9 and **10** show the tool in use on some aluminium. I am don't normally use this lathe and made this just to show that the system can be easily adapted to a small lathe. ■

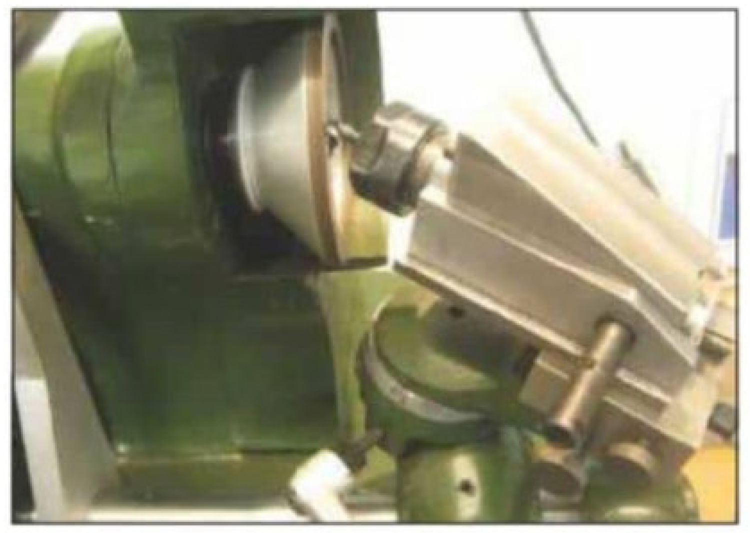
In our Next Issue

Coming up in issue 282
On Sale 14th June 2019
Content may be subject to change

July's issue, number 282, will once more be packed to the gills with more great workshop articles:


Glyn Davies refurbishes a Dewhurst Switch


Stephen Bondfield makes a nylon handwheel


Graham Sadler tames a 'Universal' Cutter Grinder

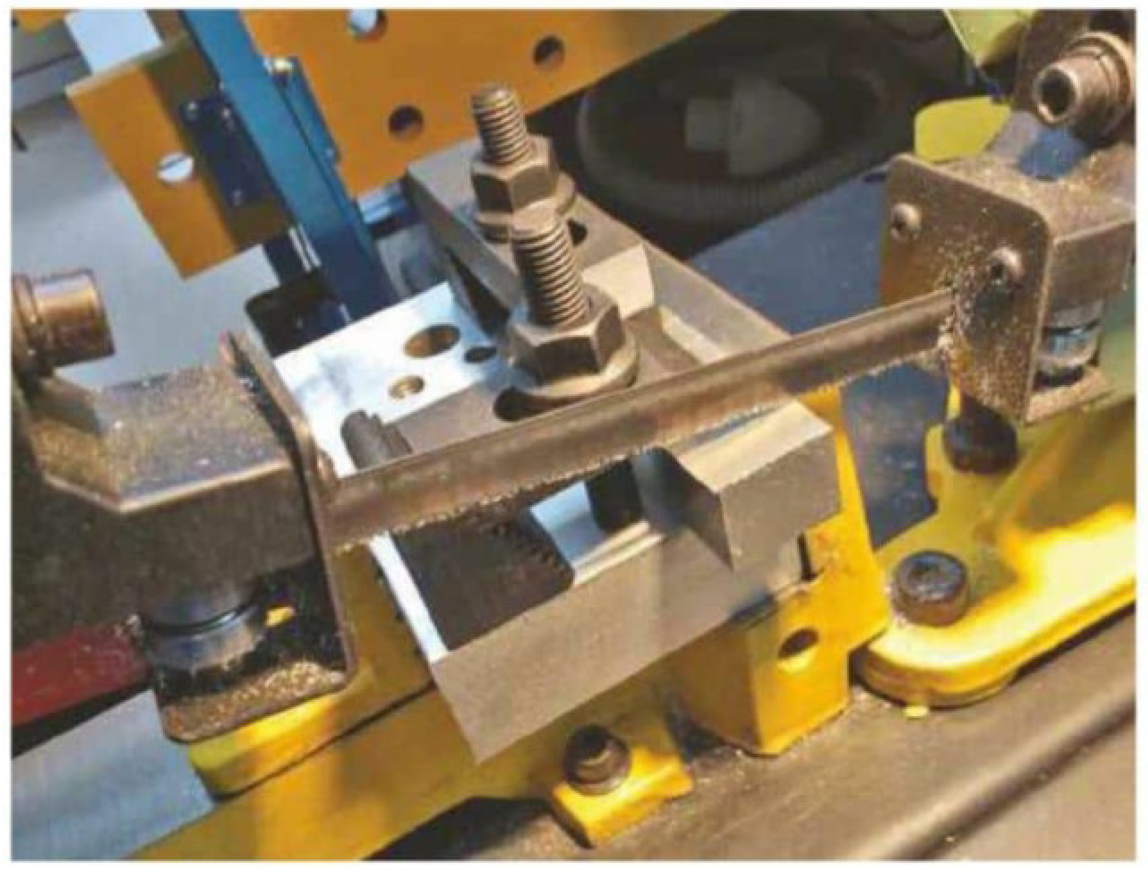
DON'T MISS THIS GREAT ISSUE - SEE PAGE 50 FOR OUR LATEST SUBSCRIPTION OFFER

Readers' Tips

CHESTER MACHINE TOOLS

A Clamping Block for the 3.5 inch bandsaw

TIP OF THE MONTH WINNER!

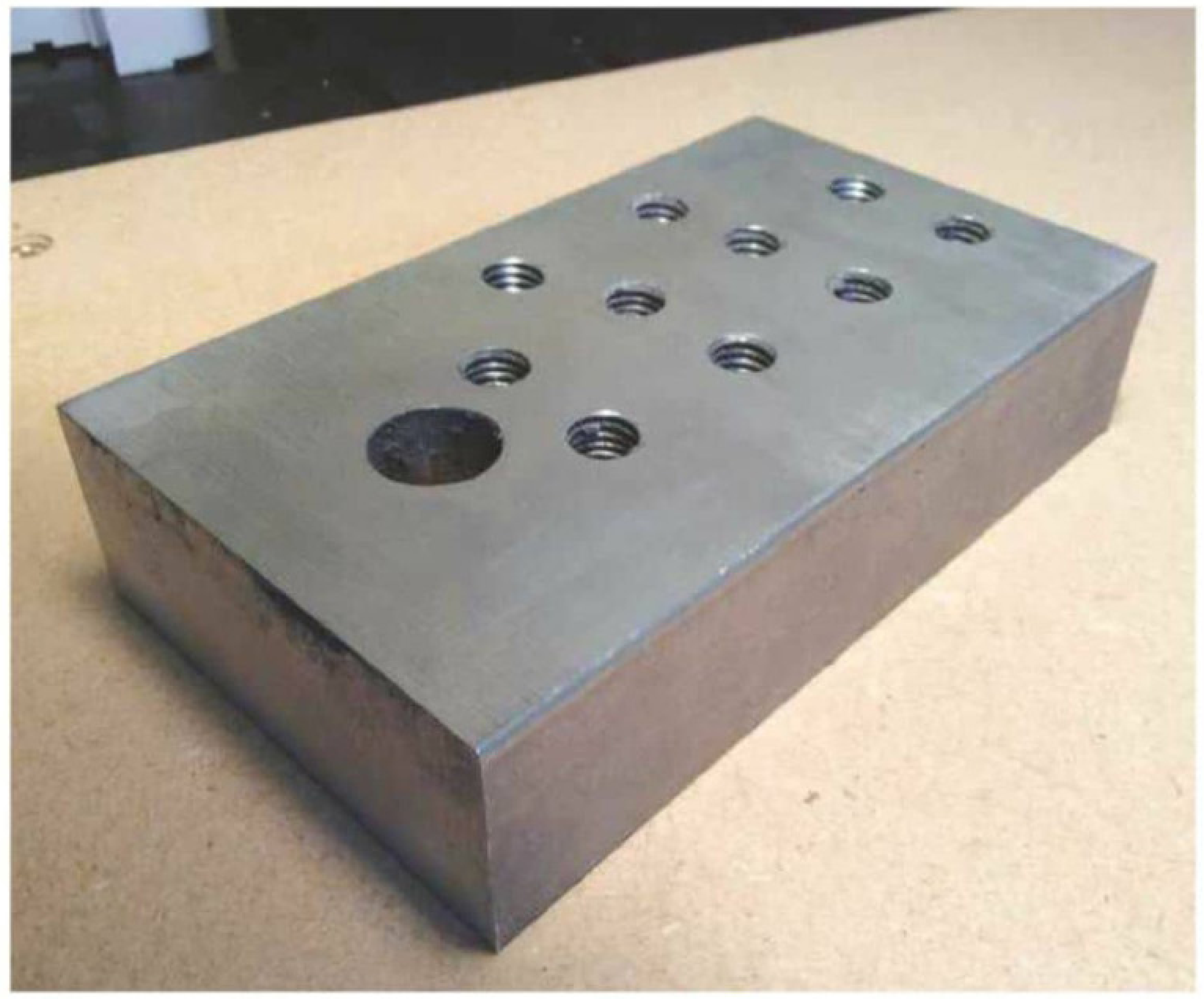


This month our lucky winner of £30 in Chester gift vouchers is Shaun O'Sullivan who has a new take on improving the clamping for small bandsaws.

A variety of ideas have been published to circumvent the shortcomings of the vice on the popular 3.5inch horizontal bandsaw. These have included replacing the jaws or adapting a smaller vice to enable small workpieces to be held.

My take on this problem is to use the clamping set that I have for my mill. I obtained a scrap block of aluminium size approx. 130x75x30mm. It had a few holes in it, but these do not get in the way. This is big enough to be held firmly in the vice, but shorter than the rear jaw which can thus act as a fence for the workpiece.

I used the milling machine to tidy up each face and make them square to each other. I then drilled an array of 8.5mm diameter blind holes, 15mm deep and tapped them M10. This enabled me to insert the threaded bars of the clamping set and use the step blocks and clamping bars to securely hold small workpieces. If you have a suitable clamping set, this solution costs almost nothing and works really well for holding small items that the main vice jaws cannot.

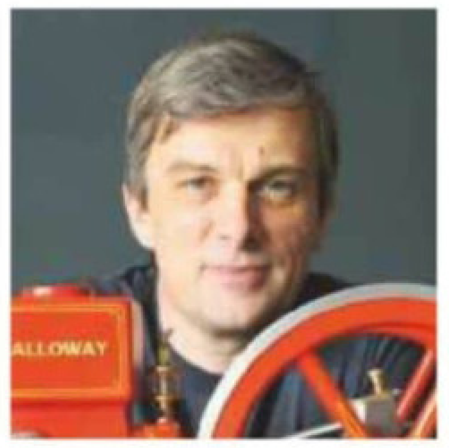


Shaun O'Sullivan

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to **neil.wyatt@mytimemedia.com** marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Don't forget to include your address! Every month I'll chose a selection for publication and the one chosen as Tip of the Month will win £30 in gift vouchers from Chester Machine Tools. Visit www.chesterhobbystore.com to plan how to spend yours!

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

Milling for Beginners



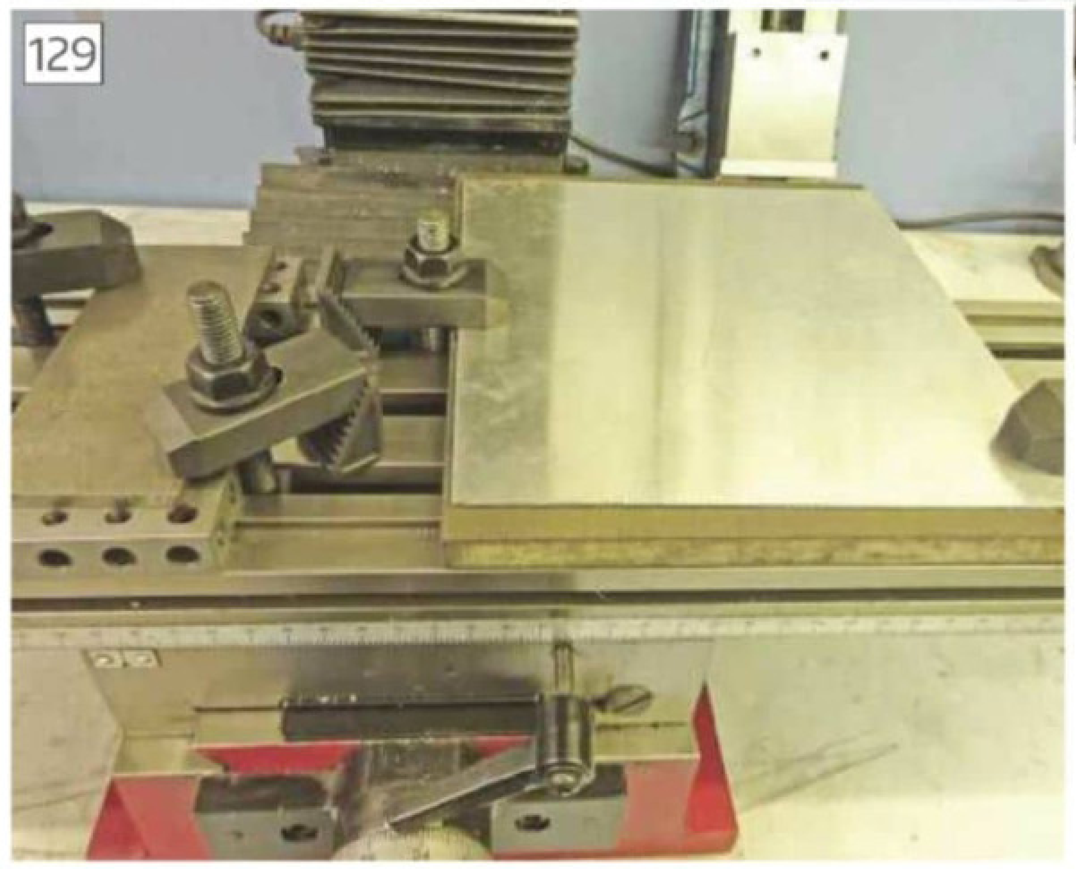
PART 11 - WORK HOLDING

This month Jason Ballamy discusses the various ways to hold work for milling operations

Nuts, Studs and Clamps

One of the most basic ways to hold work for machining is to clamp it directly to the mill's table and the usual way to do this is with the use of tee nuts located in one of the mill table's slots into which a stud can be screwed and then a clamping bar is tightened down with a nut. The other end of the clamping bar should be held level or very slightly higher than the work with packing, which often takes the form of toothed wedges, but can also simply be a piece of material the same thickness as the work or a jacking screw through a threaded hole in the end of the clamp. These items can be made but I expect many will take the quicker route of purchasing a clamping set. If you do decide to make your own then don't tap the tee nut thread all the way through, if the stud can pass through there is a risk of it tightening against the bottom of the tee slot and jacking the nut up against the underside of the tee which if tightened too much can damage the slot.

Correct placement of clamps.

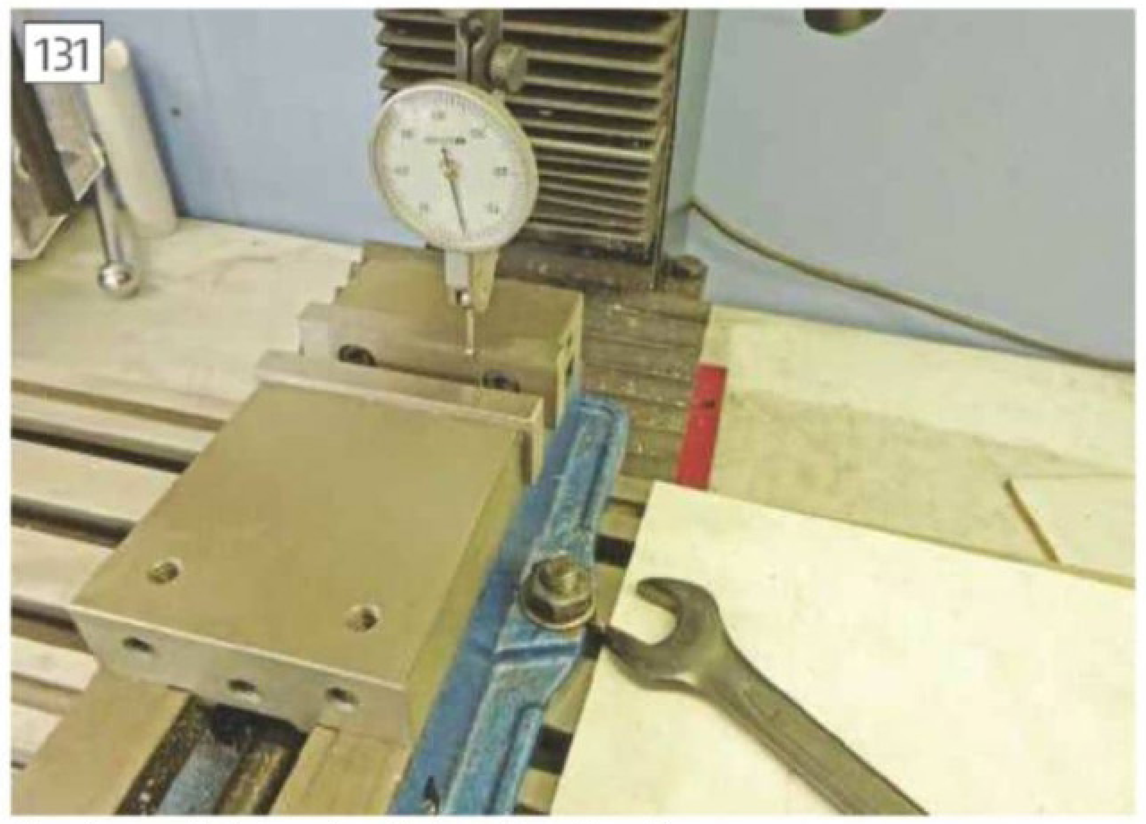


Clamping of plate and sheet materials to protect table

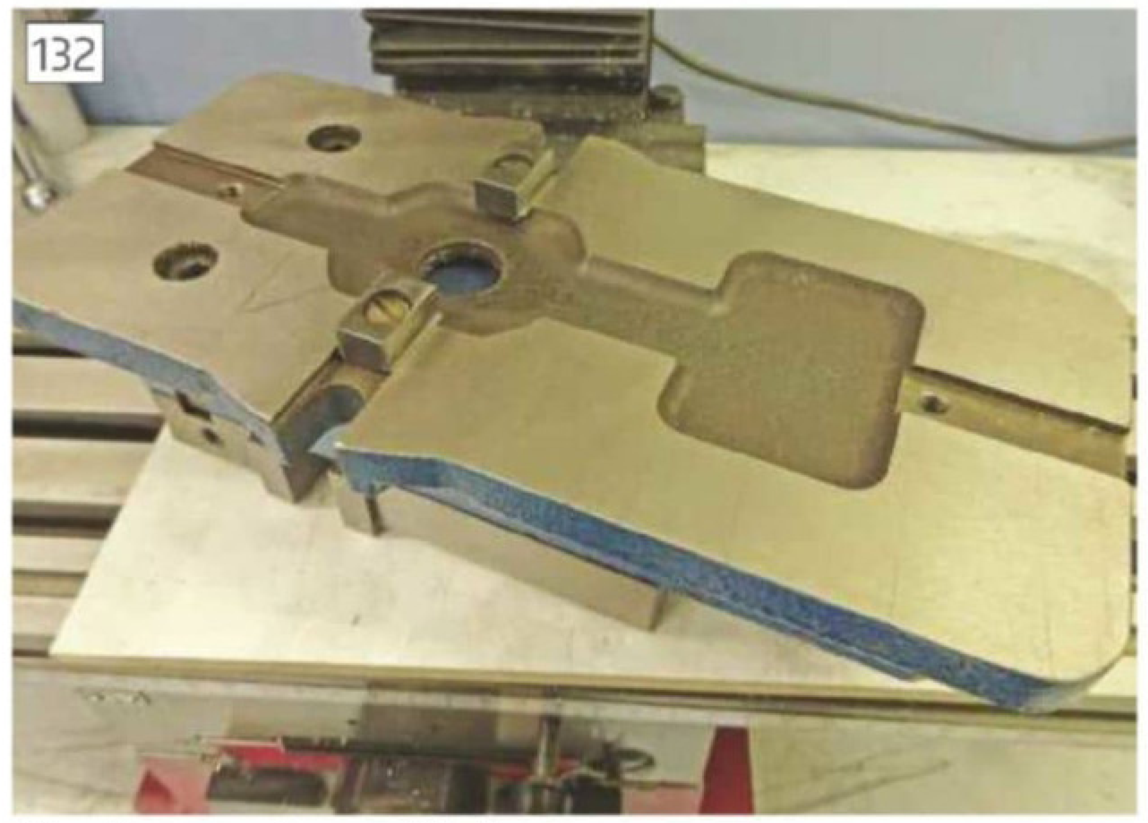
Where ever possible try to use two or more fixing points as this reduces the risk of the work rotating under cutting loads, if only one clamp is possible then a stop can be added to prevent the work pivoting around that single clamping point, a sheet of paper placed under the work can also help it to "grip" the table. Always have the stud and nut as close to the work as possible with the majority of the clamp's length on the packing side as this will allow the nut to apply the maximum clamping force to the work, **photo 128**. If working on plate, then raise this off the table with packing under each clamping point so that the table is not damaged if the cutter needs to go to the full depth of the work. If thin sheet then that is better supported over its whole area so that it does not deflect by clamping to some expendable material such as plywood, MDF or rigid plastic sheet, **photo 129**. You should also avoid clamping rough cast surfaces to the table, some packing will prevent damaging the table in this case and also allow adjustment of height as most cast surfaces vary to some degree. If you do purchase one of the clamping sets, a few more short studs will probably have to be made so that thin work can be clamped securely as the shortest of the supplied studs are generally too long to allow clamping of thin items, as the nut runs into the unthreaded section of the stud, the alternative is to put spacers under the nuts but the excessively long studs can then get in the way of chucks and the like.

Stud and nuts used as a simple jack

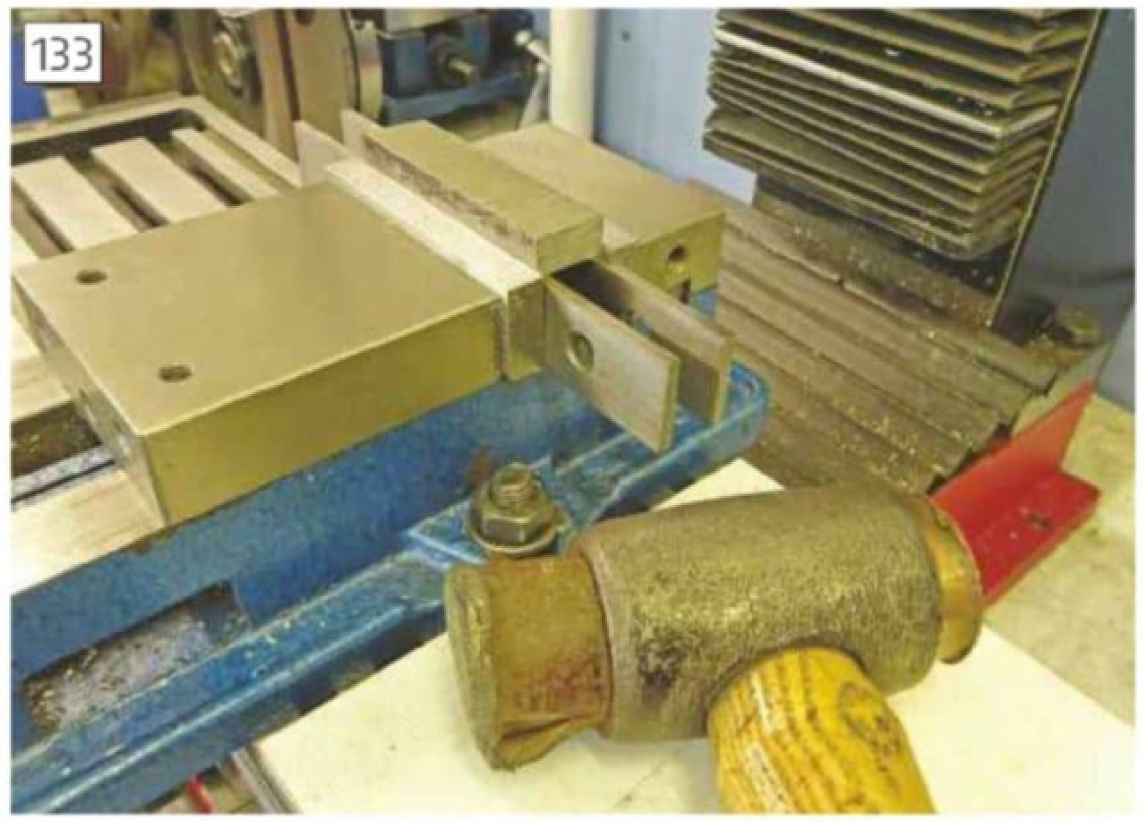
A simple machinist's jack can be knocked up from a stud and pair of nuts which will support overhanging work and stop it sagging under pressure from drilling or plunge milling. Just fit a nut to each end of a suitable length stud and with it held under the work gently unwind a nut to expand the jack until it is firm under the work but not too tight that it lifts the work, **photo 130**.



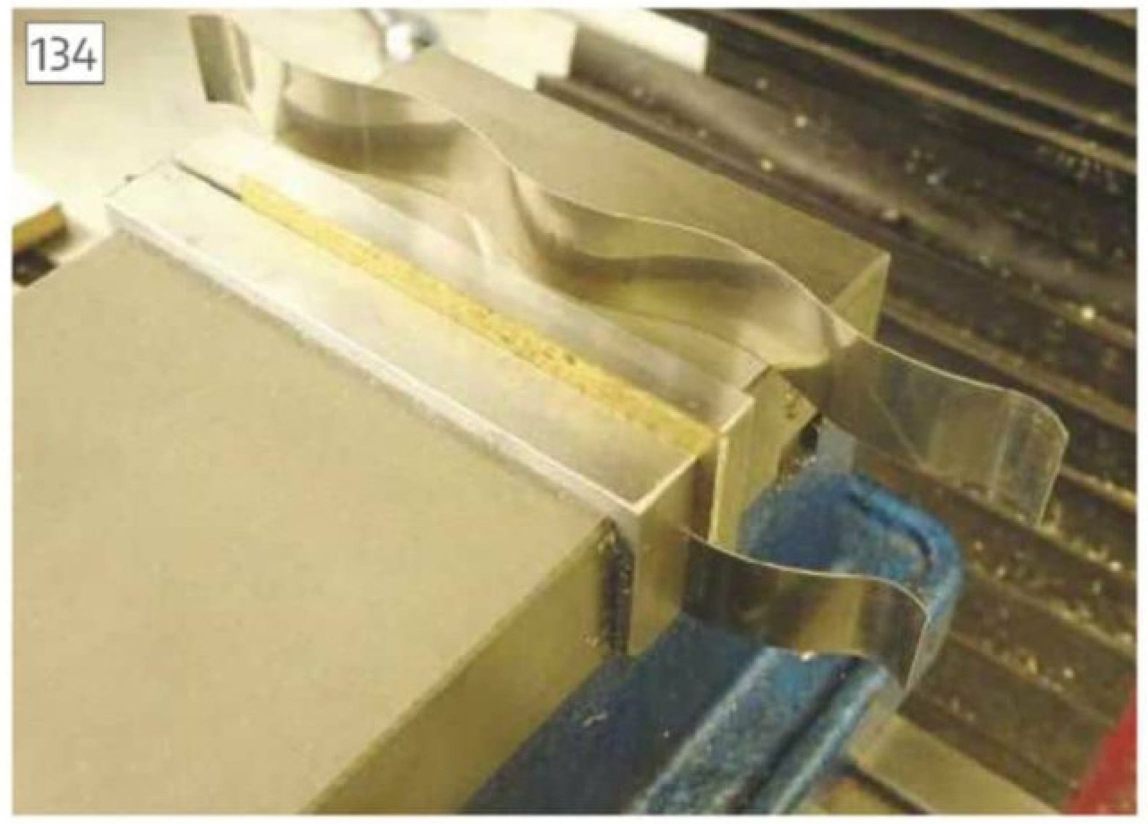
Setting to X-Axis using Dti against fixed jaw



Vice alignment slots and blocks



Shallow work supported on parallels

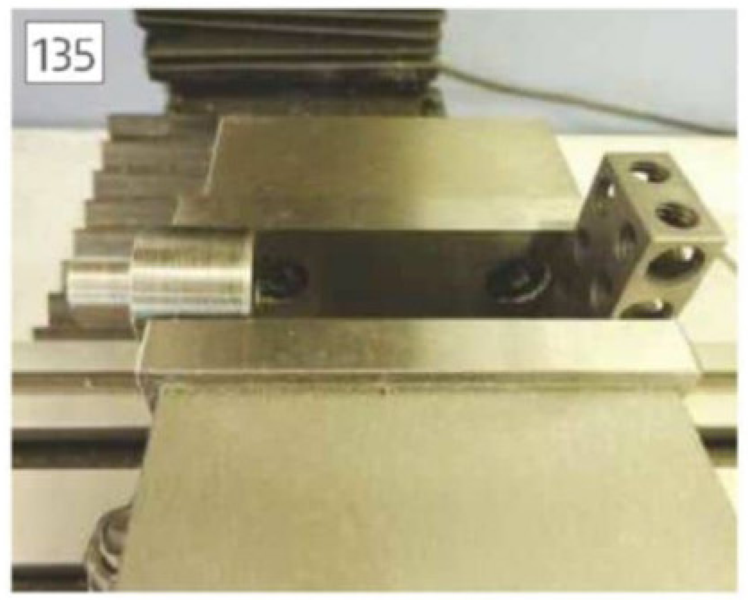


Wavy parallel supporting thin work piece

Machine Vices

For the majority of hobbyists, the vice will be the most often used method of holding work as once set up it is quicker to locate work true to the lathe axis and allows smaller items to be held without clamps getting in the way. If your chosen vice did not come with any means to hold it to the table then it is worth making up a dedicated pair of tee bolts if the vice has lugs for these or if it used a slot or horizontal holes at the side some dedicated one piece clamp blocks that don't need separate packing will make it easier and quicker to fit, these are also available to purchase.

It is important that the fixed jaw of the vice is parallel to one of the table axis and the X-axis is the one usually chosen which places the tightening screw towards the operator, there are odd occasions where it may suit the job to have the jaw lined up with the Y-axis but this can hamper opening and closing the vice. To line up the fixed jaw just nip up the two hold downs finger tight, then a lever type DTI on a magnetic mount can be attached to the underside of the mill's head and the stylus brought to contact the jaw. Now move the table sideways and gently tap the vice until there is no movement of the dti needle along the length of the jaw at which point the hold downs can be fully tightened, **photo 131**.

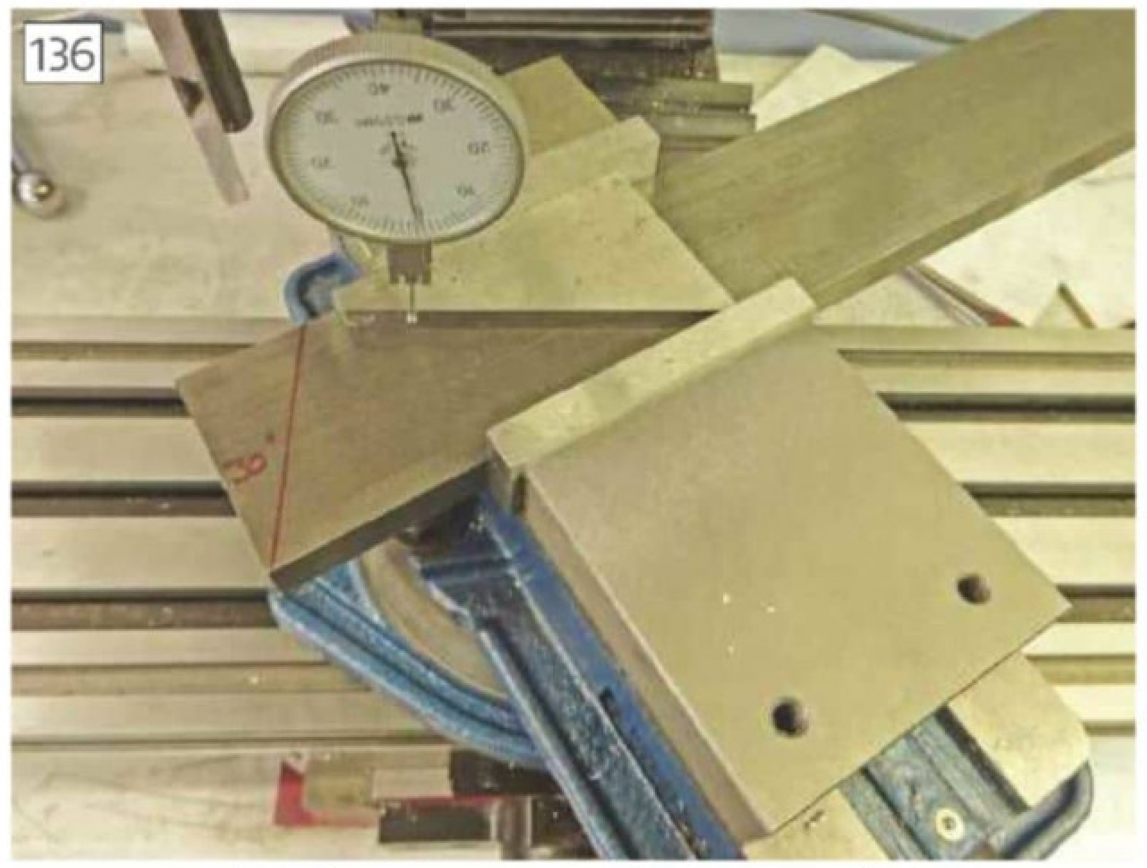


10-20-40 block used to pack opposite side of vice to work

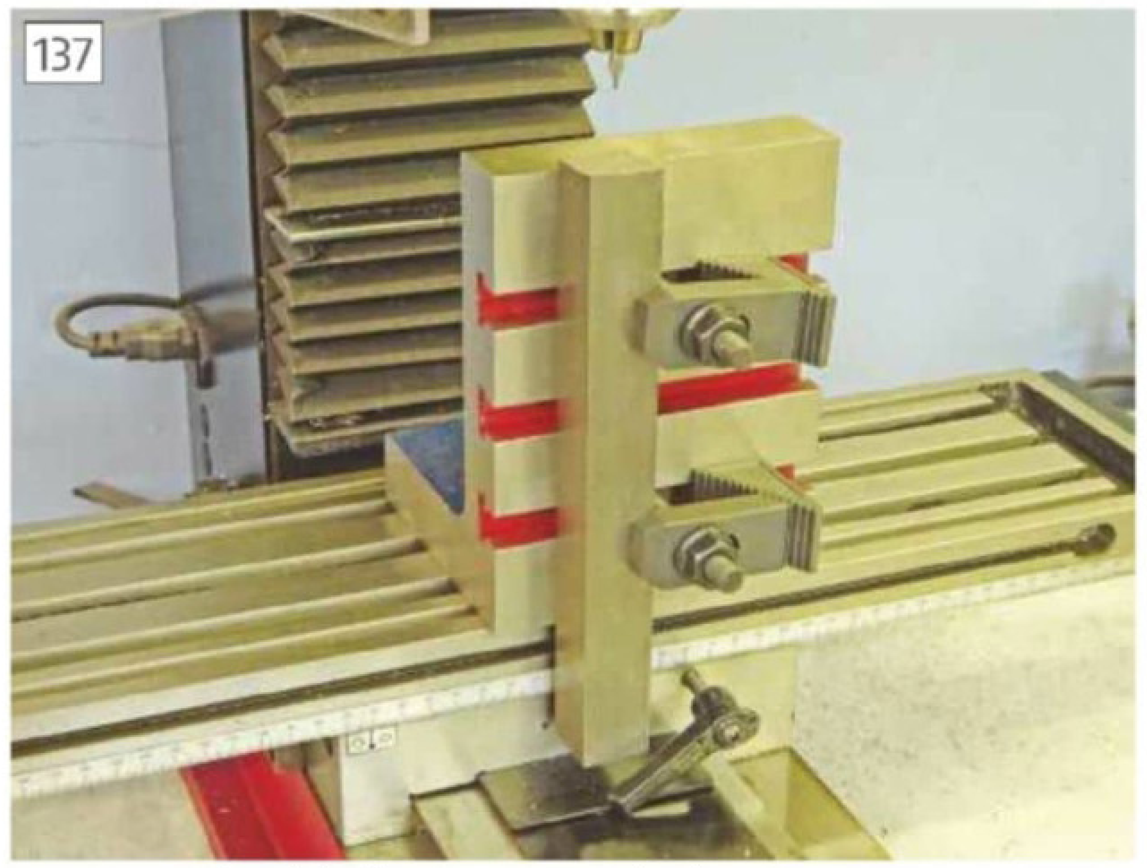
Some machine vices come with slots cut in the bottom which take two metal blocks that can be used to register the vice true by locating them in one of the tables tee slots this makes setting up the vice far quicker. If your vice does not have these slots there have been articles in both ME and MEW over the years showing the procedure for cutting these and ensuring that they are true to the fixed jaw. This same method can also be used on other items of tooling such as rotary tables, indexers and their tailstocks, **photo 132**.

When gripping work in the vice care should be taken that it is sitting down flat against the base of the vice as there is a tendency for the moving jaw to lift when tightened. This is more evident on some designs than others, so best to get into the habit of tapping the work down as the jaw is tightened using some form of soft but heavy hammer - lead, copper, nylon or hide would all work.

If the work is not deep enough for the surface being machined to project above the top of the vice then suitable packing should be used, raising it to a suitable height, this usually take the form of a pair of parallels of which several types are available. For hobby work on a bench top mill you don't really need parallels over 3mm (1/8") thick as they start to take up too



Setting swivel vice for mitre cut using Dti against angle gauge

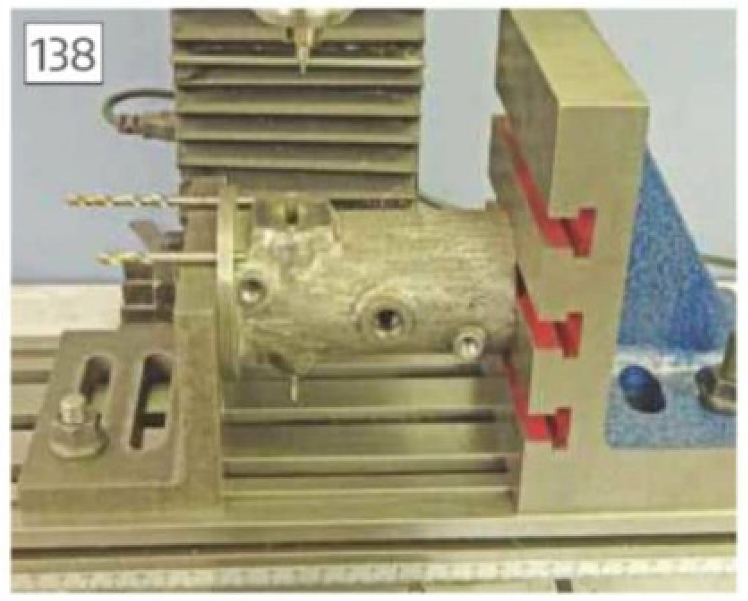


Long vertical work held against an angle plate

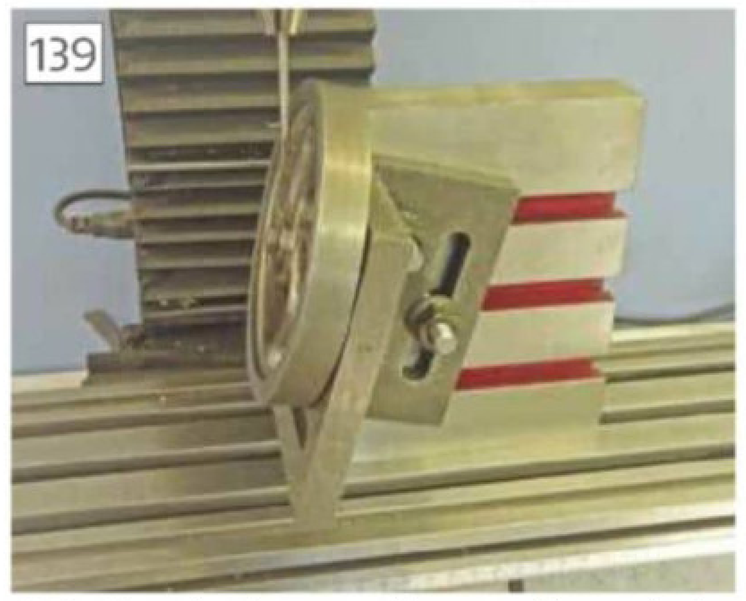
much room when working on small parts and prevent the vice from closing, **photo 133**. Even with a single 3mm thick parallel there will come a time when you want to pack up work that is less than 3mm and in these cases a set of "wavy" parallels can be useful as they will squash down to their material thickness of about 0.5mm. Their main downside for general packing is that it can be hard to tell where they are under the work so the risk of drilling or milling into them is slightly higher, if in doubt remove them before starting any through cuts, **photo 134**.

Where possible try to position the work in the middle of the vice as that is where it will give its strongest grip, if you have to hold things towards one side then a good vice should still hold tight enough for all but excessive cuts. If you find your vice does not grip so well like this, a packer of the same thickness as the work can be places at the opposite end which will keep the jaws parallel as they are tightened which should reduce the problem, **photo 135**.

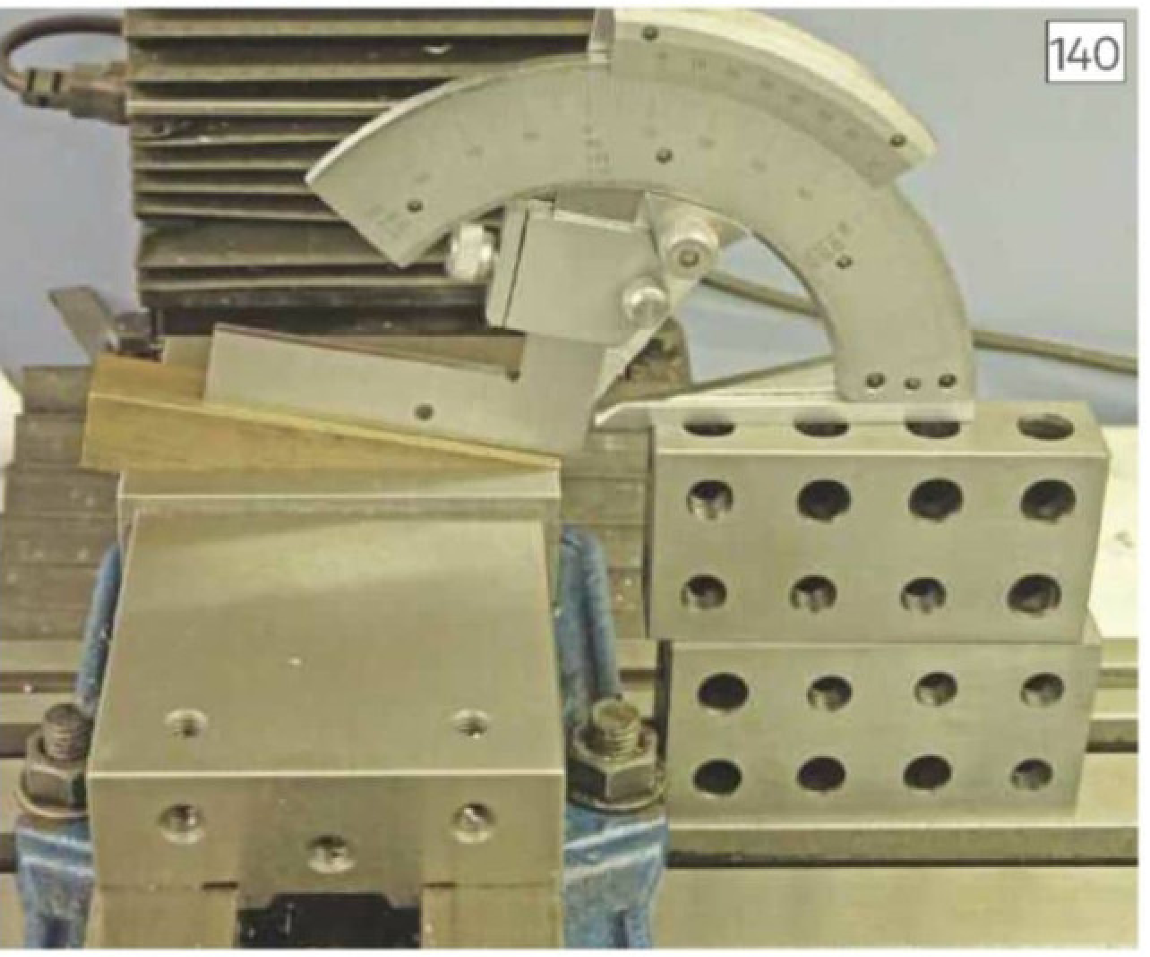
A lot of machine vices come with a base plate that allows the vice to be swiveled to an angle. You will find that this facility is not needed very often so the swivel base is best removed and stored away which will allow the vice to sit lower giving additional head room which can be in short supply on smaller bench top machines. The swivel facility can be useful for things like mitering the end of long items where they cannot be held sloping upwards, **photo 136**. If high accuracy is needed then the scale may be a bit lacking in that department so the vice jaw should be clocked to the correct angle using tri, angle gauges or if fitted a DRO can be set to an angle function.



Cylinder held between two angle plates



Pair of angle plates used to provide angled clamping surface



Setting work at an angle in vice with the aid of a protractor

Angle Plates

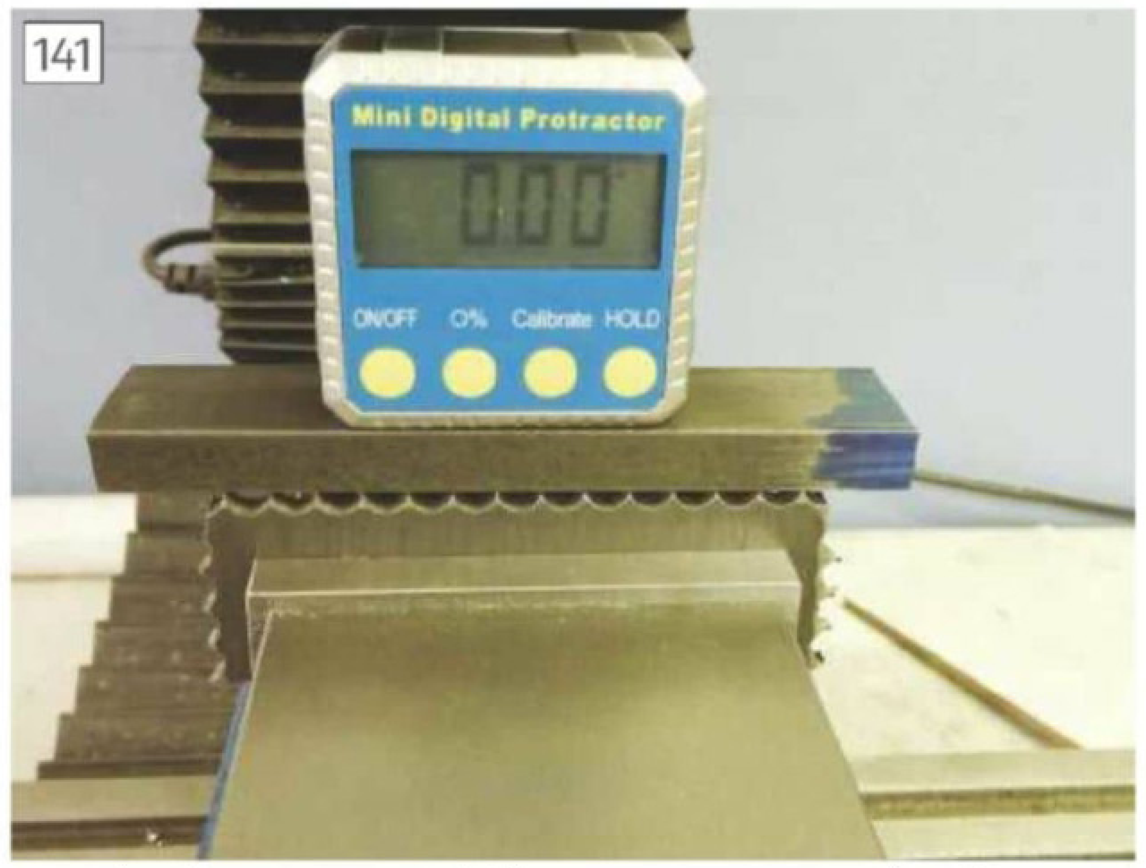
An angle plate or preferably two are useful items to have as they can be used to hold many odd or irregular items that may not easily fit into a vice or directly to the mill's table. One such use is drilling or boring into the end of long work pieces where the work can simply be clamped to the face of an angle plate that has been bolted either directly onto the table or for very long work the angle plate can be placed on packing such as 20-40-80 blocks, if the travel of the table allows then the work can also extend down below that, **photo 137**.

Another use is when working on the side of say a cylindrical item which can be rigidly held between two angle plates by passing a clamping stud through all three as can be seen in **photo 138**. Note the use of two drill bits in the flange which are being used to index the cylinder 90 degrees so that features can be machined on three sides and all be at right angles to each other.

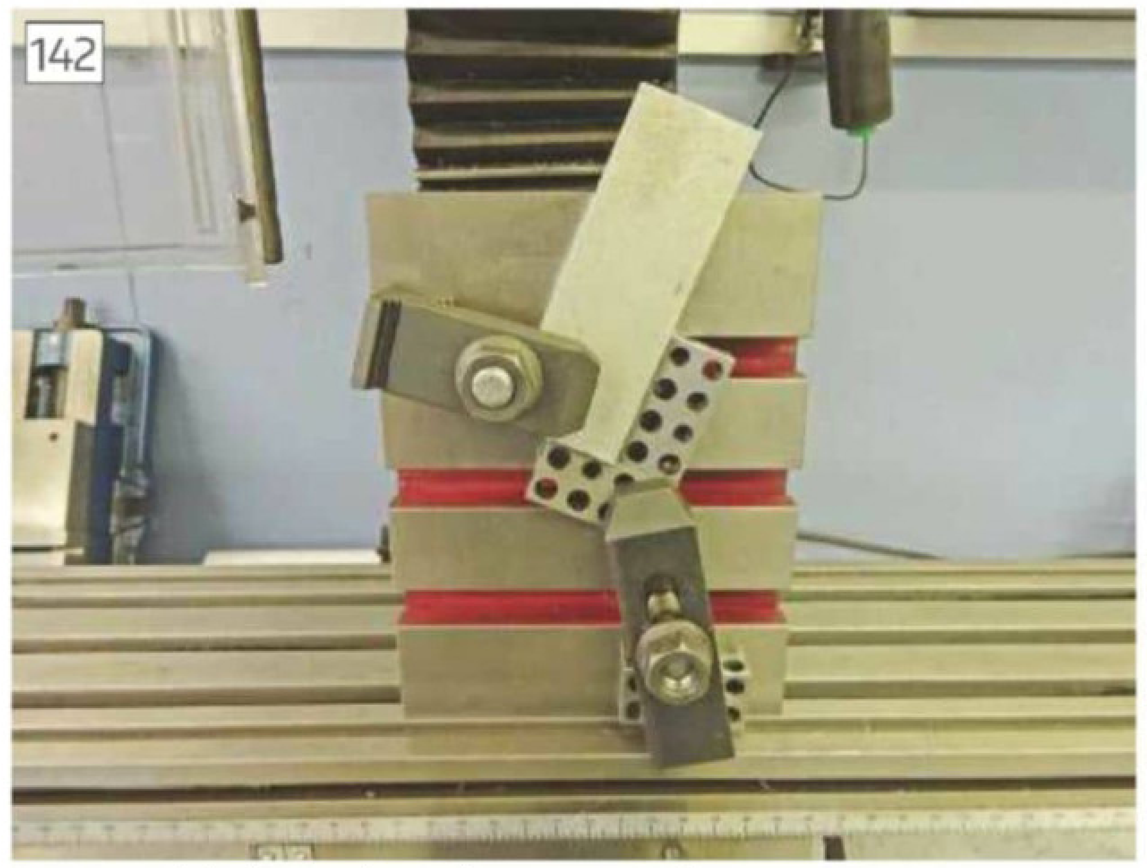
If you don't have a tilting table and need to machine something at an angle then a pair of angle plates can be configured in such a way to provide an angled face that the work can be held against which is usually sufficient for light work such as drilling and tapping for a grub screw as shown in **photo 139**.

Holding Work at an Angle

This brings us to the need to hold work at an angle, smaller items can easily be tilted in the vice and their angle checked using a dti against a suitable angle gauge, protractor, or sine bar, **photo 140**, but I think that most beginners are more likely to invest in one of the small digital angle boxes. These can be stood on the work which is then adjusted until the display shows the desired angle before finally tightening up the jaws, **photo141**. For some items it can be easier to get a measurement if the angle box is stood on a flat length of steel which effectively extends the length of it's base. It is also worth bearing in mind that the "off" button on these angle boxes just turns the display off, but it is still running and remembering the last zero position so if you are not using them regularly it is worth removing the battery.



Digital Angle Box on extended base to set uneven work surface

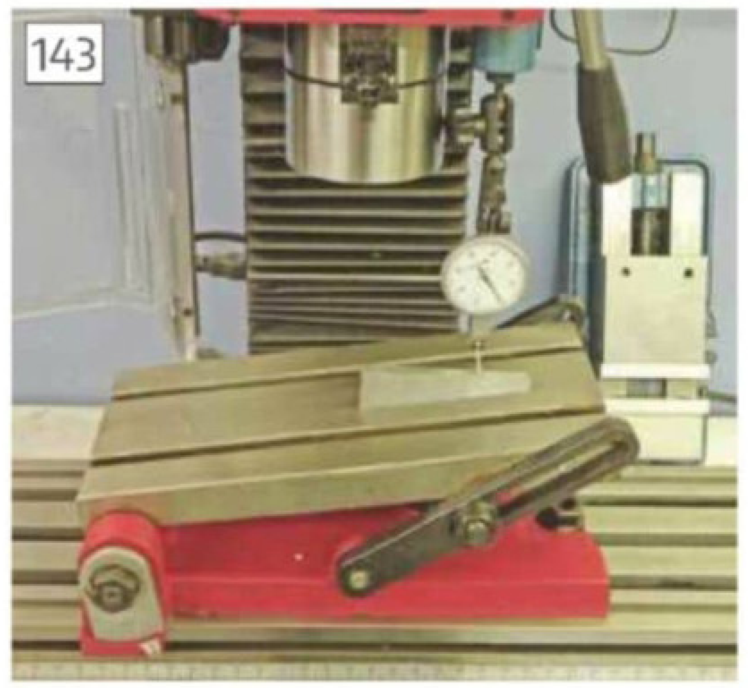


10-20-40 blocks used as reference stops for repeats setting

If the edge or end of work needs to be machined that will stick a long way out of the vice causing chatter it is often better to clamp it to an angle plate in much the same way as shown previously in photo 137.

If you have several parts that need to be machined to the same angle, time can be saved if a reference block is clamped to the angle plate at the required angle and then it is a simple job to butt the work pieces against this block rather than have to set their angle each time. Two blocks or even a pair of 10-20-30 blocks bolted together will also provide an end stop if you need to finish the parts to the same length, **photo 142**.

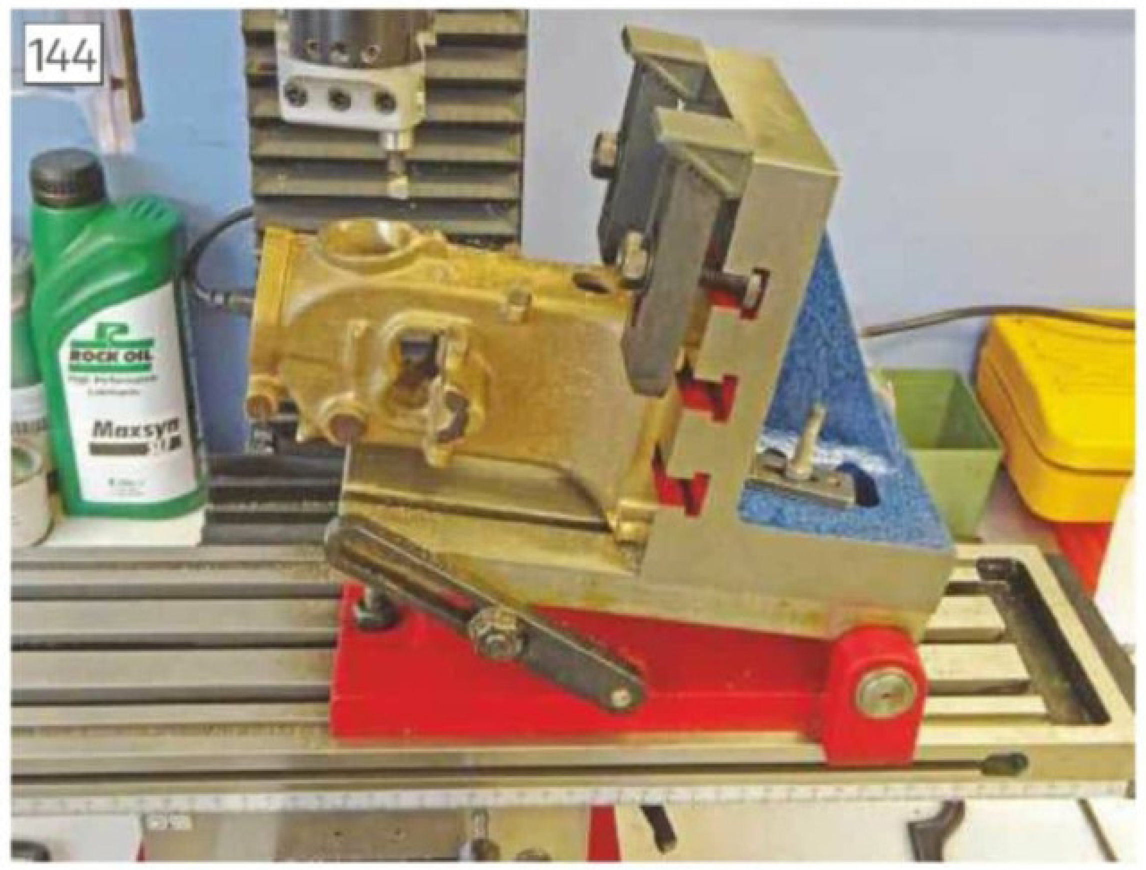
Larger work can be mounted on an adjustable table, these tend to come in two different forms. The "swivel table" has a base and upper tee slotted table that pivot centrally and can be tilted to 45 degrees in either direction. The other "tilting table" type have the pivot at one end and again can be tilted to 45 degrees, entry level ones have a basic scale and are best checked using one of the methods mentioned earlier, **photo 143b**. The more expensive "sine tables" use a stack of gauge blocks to raise the table a set amount which is calculated from the sine of the required angle. If you require an angle steeper than 45 degrees, then an angle plate can be bolted to the table which will give a wider angle range. **Photograph 144** shows a work piece that needed the base held to a surface that was 78 degrees from horizontal, by using the 90 degree angle plate and tilting the table to 12 degrees the face of the angle plate was at 78 degrees (90-12).



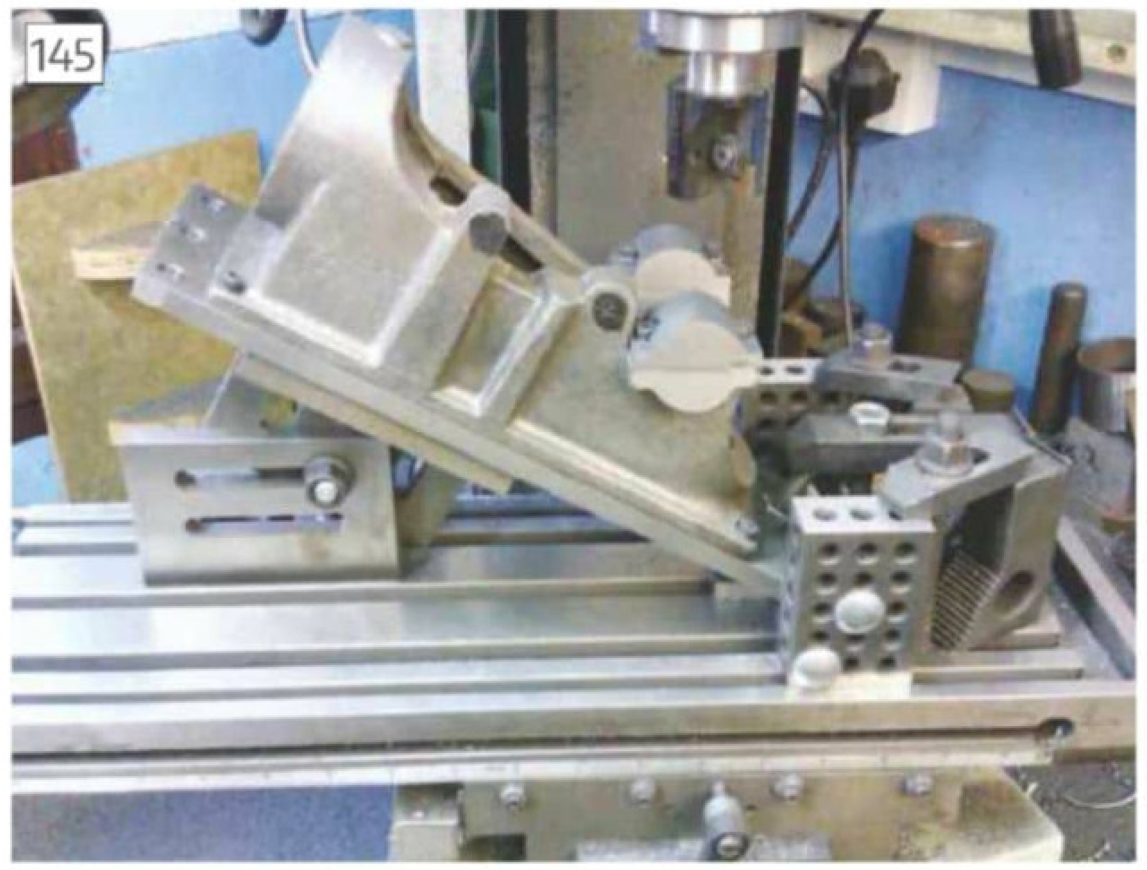
Clocking a tilting table with Dti and angle gauge

There does come a time when a large part needs to be worked on and the only way to hold it is to use various packing underneath and arrange clamps to not only hold the work down but also stop any risk of it sliding out of position. In **photo 145** the casting has been fixed to a machining plate which provides a good reference surface to clock true and set the angle from. Main support is from a pair of angle plates set at the desired angle which the machining plate is bolted to, stops at the lower end prevent the work sliding and various other clamps hold it down. ■

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



Combining tilting table and angle plate to achieve desired angle



You can never have enough clamps!

Can You Help Bletchley Park?

Most readers of MEW will be familiar with Bletchley Park where, during the darkest days of the second World War, a huge team of codebreakers, mostly women, worked to decode secret messages. It's thought that their work may have shortened the conflict by two years and saved millions of lives. At the heart of the code-breaking were electromechanical machines called 'Bombes' developed by Alan Turin with Gordon Welchman and the world's first programable digital computer - 'Colossus', designed and built by Tommy Flowers.

For many years a closely guarded secret, in the 1990s the work at Bletchley was made public and the recognition of its historic importance led to its establishment as a museum, one of its star attractions being a working rebuild of a Bombe. The site also hosts the National Museum of Computing which has a reconstruction of Colossus.

Bletchley Park Mansion (DeFacto, CC-by-SA)

John Harper has been in touch on behalf of Bletchley Park asking for help to make sure the Bombe continues to be able to be demonstrated to visitors.

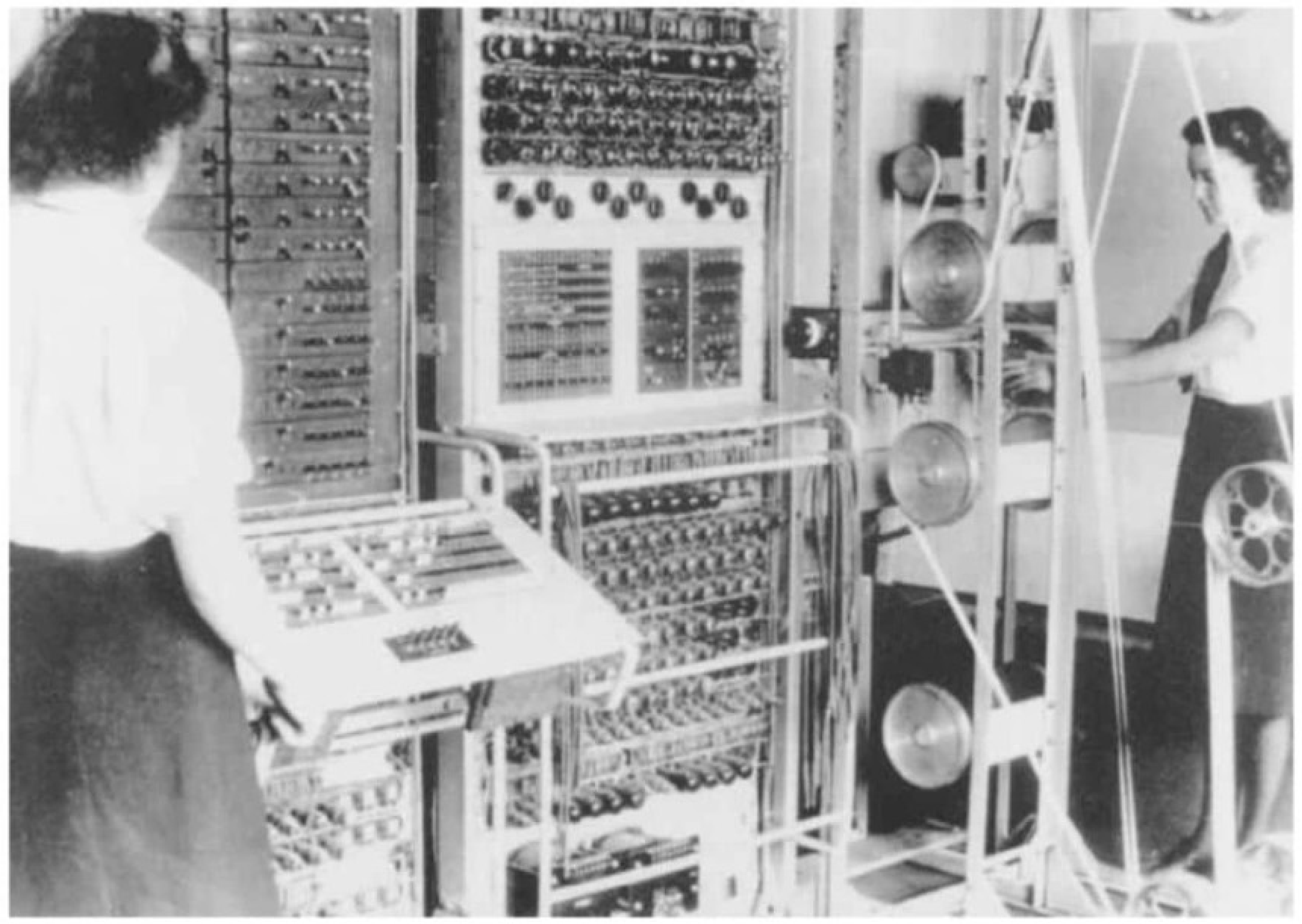
"Something like fifteen years ago model engineers were extremely helpful in making parts for the Bombe Rebuild at Bletchley Park. The machine was successfully completed and has now run on a regular basis for about twelve years and has been demonstrated to the public almost every day over this period. With only a few minor problems recently there has been little needed in the way of repair, but what it has done is to remind us that we don't have spares for all critical items."

Many additional parts were made at the same time as the machine itself but now in checking we find that there are a few spares that we should have but are not in stock. The main items are steel bevel gears."

In particular, there are two pairs that would put the machine out of action if they failed and another pair not so important but might be worth considering when appropriate machinery and cutter are available. Drawings for the parts needed are in AutoCAD"

If you are able to offer assistance with the making of gears and other precision spare parts for the Bombe, please email me: **neil.wyatt@mytimemedia.com** and I will forward your details to John. ■

The rebuilt Bombe, for which spare parts are needed.



Operating the Mark 2 Colossus Computer

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Machines and Tools Offered

■ Pratt No. 5 8" 4-Jaw Chuck no key, good condition. Buyer collects, £150, ONO. **T. 01924 902599. Dewsbury**.

■ Senior M1 Horizontal Mill with vertical Head. Some horizontal cutters, vice, good condition. £500, buyer collects. **T. 01335 324455. Ashbourne**.

■ Lathe, B.G.S.C. with tools and accessories, £120. Micrometer, Imperial, 4. £8. **T. 01952 242867. Wellington, Shropshire**.

■ Taper gauges. 50 INT, Brown and Sharp No.7 and No.9 also 4 and 5MT. Taps - 1/2 in to 7/8 in BSW taps, long shanks, old and store soiled but Ok. **T. 01205 290312. Near. Boston**.

■ Myford Dewhurst drum type switch and Myford mounting bracket - ex Myford S7. Leads to motor and connector still attached - good condition, £50. **T. 01609 881 584, Appleton Wiske, North Yorkshire**.

■ A0 drawing board with stand, parallel motion, ADMEL drafting machine and new rulers. Free to careful new owner. Buyer collects. **T. 01628 627641. Maidenhead, Berkshire**.

■ Proxxon MBS220E band saw, I've fitted a new drive belt to make sure it works, I suspect it could do with a new blade but it cuts. £72, collected. **T. 01925262525. Warrington**.

AD OF THE MONTH

■ Little John Lathe made by Raglan in good condition. 5" centres, 24" between centres, many spare parts and lots of gears. Installation manual, operator's handbook and parts list, £600. **T. 01592 873723. Burntisland, Fife**.

Parts and Materials

■ Don Young 31/2 gauge 43xx loco full set of castings and frame steel and full set of drawings. Buyer collects £500.00. **T. 01293 519087. Crawley**.

Models

■ 5" gauge 0-6-0 tender engine based on Ajax, £1,800. Sweet Pea rolling chassis, cylinder castings, drawings, £350. Boxhill chassis, professional boiler £1,200. 3 ½" gauge Sweet Violet professional boiler, has run, needs TLC, £550. Buyer collects, photos available. **T. 01622 761778. Maidstone**.

Magazines, Books and Plans

■ Collection of old Model Engineer magazines ranging from 1948 -1950 , 130 issues in total. Jan - Dec 1948 Vol 98, consecutive Nos. 2432 - 2484 (52 issues), Jan - Dec 1949 Vol 100 consecutive Nos 2485 - 2536 (52 issues), Jan - June 1950 Vol 102 consecutive Nos 2537 - 2562 (26 issues). All issues are in good condition for age, dog - eared from use perhaps, but each magazine is complete. **T. 01305 833605. Weymouth**.

Wanted

■ Cowells ME Lathe must be reasonably new with adjustable dials and accessories. **T. 01986 835776, Norwich**.

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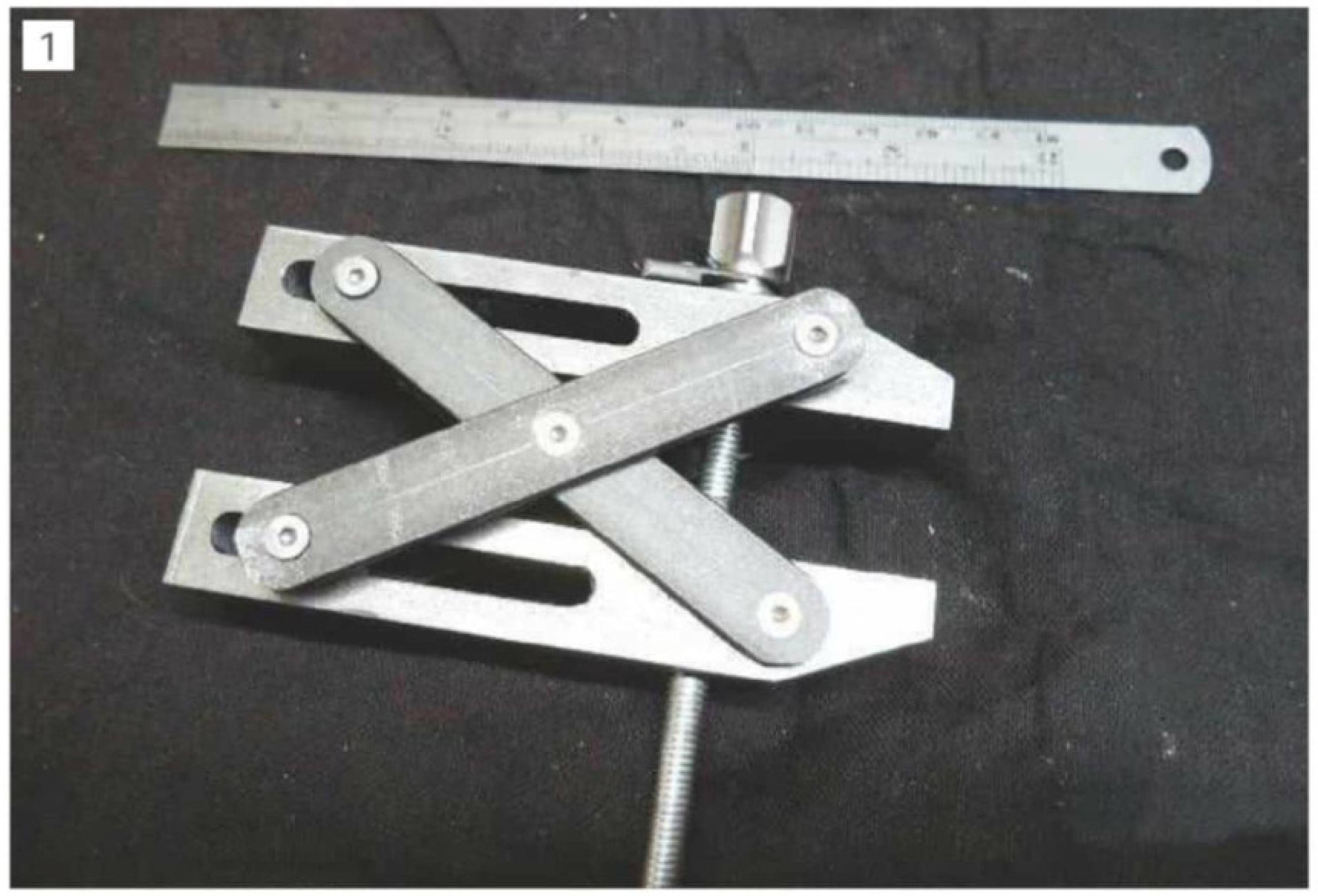
A One-Screw Parallel Clamp

Stewart Hart reproduces this useful clamp design seen in an old magazine

"Tool makers clamps" are a must in any workshop being put to use in many different ways, there are also lots a different variations on this theme with each type having their specific uses. This particular clamp I came across in an old magazine, though to be honest I have seen this type of clamp before. Its advantage is that it does away with the rear screw that tends to get in the way, it can be used with one hand, and the jaws move in unison parallel to each other, **photo 1**. A general arrangement is shown in **fig. 1**, which shows the numbered parts along with **fig. 2**.

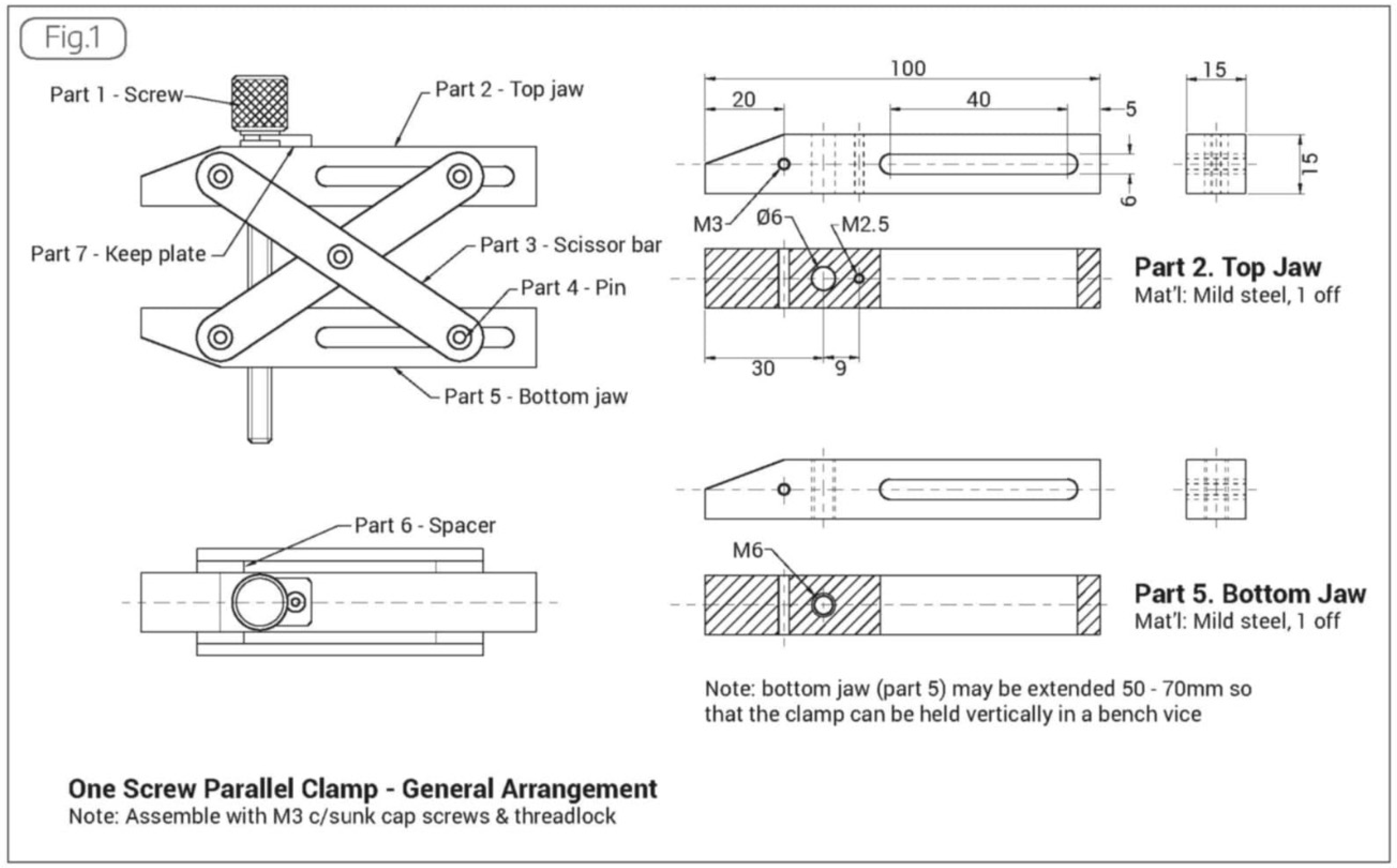
It can be made from stock size material scaled up or down, and anyone with a little experience and a modestly equipped work shop should be able to make it, **photo 2**.

Starting with Parts 2 and 5 Top and Bottom Jaws, these are identical mirror image of each other apart for a few holes that ae different. The first job is to face them off to the same length in the lathe



1

Completed Clamps



using a four jaw chuck. Black the parts up with a felt tip pen this is less messy than marking blue and just as effective and to get the marking as accurate as possible I would recommend making a cheap digital Vernier into a set of odd-legs, the best way to do this is with a Dremel cut off wheel as the legs are made from very hard steel. Mark the centre line and the hole positions and put in a good deep centre pop, **photo 3**.

If you are going to do the drilling on a pillar drill you can make things easier for yourself in getting the two jaws perfectly matching, if you use a vice fitted with a stop and use parallels to get the parts level in the vice. Centre the vice using a pointer on the marking, firmly clamp the vice down and leave it clamped in this position for drilling all the holes, set the stop for the M6 hole and drill and tap: - to ensure you tap square lightly chuck the tap and firmly clamp onto the plain body with the wrench once you've got the tap started square you can transfer over to the bench vice to finish tapping, **photos 4**, **5**, **6**, & **7**.

Put the other Jaw in the vice up against the stop which will accurately position it for drilling the 6mm clearance hole. By leaving the vice clamped on the table, all you have to do is slide the part along 9mm to the position of the M2.5 hole, drill and tap, flip the part on its side, position the stop for the M3 hole drill and tap, and then drill and tap the M3 in the other jaw, all the holes should end up in matching positions, **photo 8**.

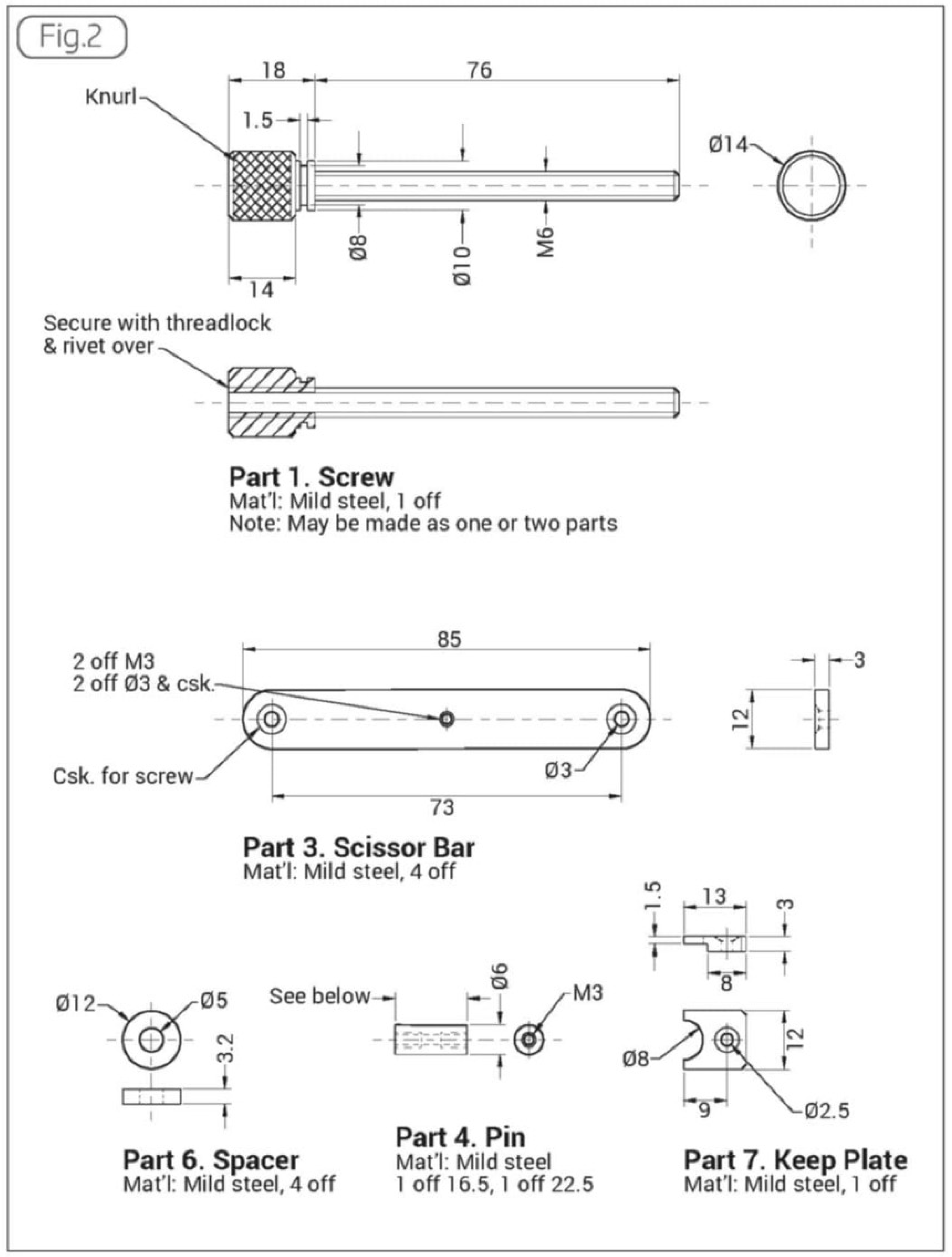
The easiest way to machine the 6mm wide slot would be on a milling machine with a end mill, but if you don't have a milling machine available the next best way is to drill a chain of 6mm holes in the centred vice, using a steel rule taped to the jaw to space the holes evenly, and using a hack saw blade cut through the web and file away the dragons teeth to create a clean slot, **photos 9** & **10**.

All that remains now to complete the Jaws is to chamfer the ends, if you are feeling energetic, hacksaw the surplus metal off and then level up using a file, I bolted the two jaws together then set them up in the mill vice and milled the chamfer off, **photo 11**.

Scissor Bars, Part 3 - Four bars are required, 2 with the centre hole tapped M3 and two with the centre hole drilled and CSK 3mm diameter. I did wonder if this centre hole was necessary and tried the clamp without the screw, and yes it did work, but the action was a lot smoother with it. First thing to do is to cut the bars off to all the same length mark the centre line and the middle of the bar and using the digital Vernier as a compass mark outlying hole position and centre pop. Then drill and tap the centre of 2 bars M3 and drill the centre of the remaining two 3mm diameter. Screw a one of each type of bar together and drill one of the 3mm end holes through both bars, rotate the bars 180 degrees and use the drilled holes to position the hole in the other end of the bar, this way the holes will be perfectly symmetrical around the centre, repeat for the remaining two bars, countersink the holes as required. To complete radius the end of the bar with a file, but I must confess that I cheated here and used a linisher, **photos 12**, **13**, **14** & **15**.

Screw Part 1 - Cutting this length of thread with a die wouldn't be very advisable as the die will tend to run off, and you'll end up with a wavy thread. So you have a choice: - the easy way or the hard way, the hard way is to screw cut the thread, if your machine is anything like mine you'll have to assemble a gear train then go through the nerve racking job of cutting the thread up to the shoulder, my machine has a horrible over run making this near impossible, I have screw cut threads working from the head stock to the tail stock to overcome this. I took the easy way, of using a length of 6mm studding with the knurled nob thread locked and riveted on, I used this method many years ago on a small set of clamps and they are still going strong, **photo 16**.

Instead of knurling the nob I milled a series of flutes down the bar with a bull nosed end mill using the spin indexer, I thought this would give a better grip, but




2
Material for use


3
Marking out using odd leg digital calipers


4
Vice stop


5
Vice firmly clamped to drill table


6
Drill M5 tapping

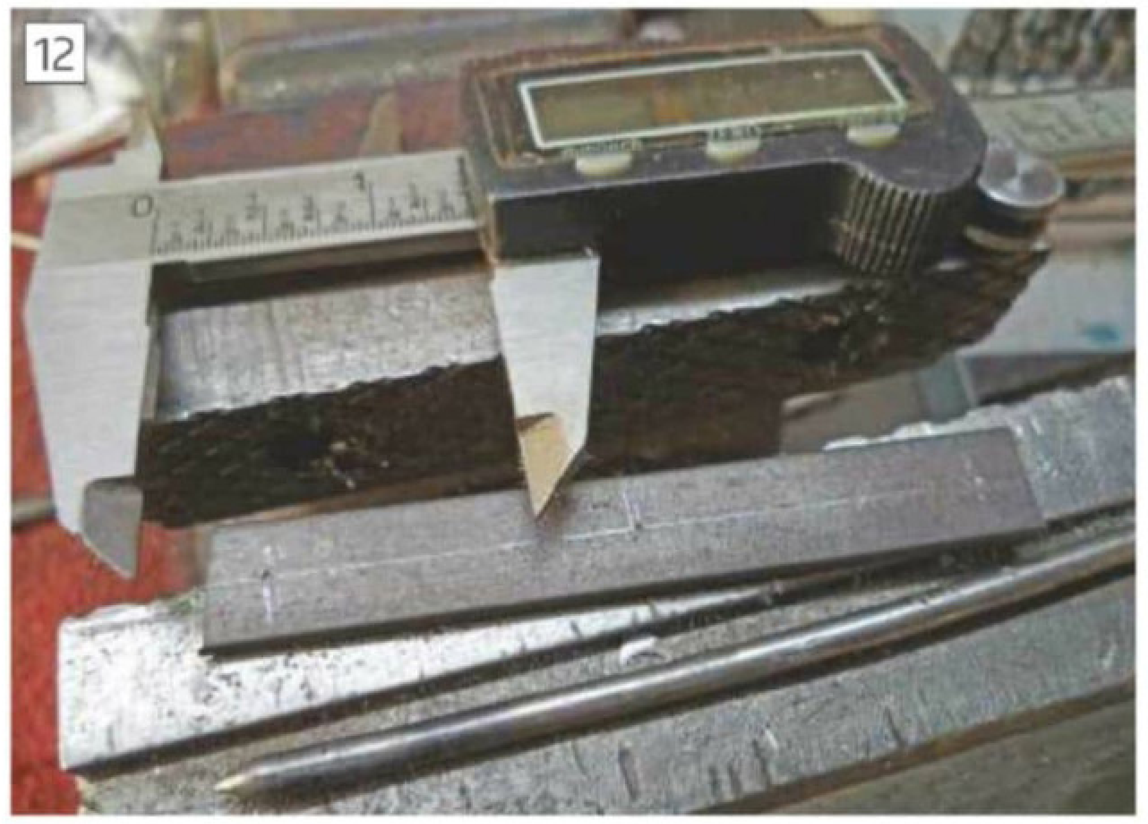

7
Starting the tap square


8
Drilling M2.5 tapping

Chain drilling 6mm holes for slot

Filling out slot

Milling the chamfer on the jaws



Scissor bars marked out

Drilling out middle holes

Pivot around the middle hole to drill the rest.

Countersinking

Parts for the screw assembly:- studding and knob

Fluting the bar

Turning the knob

Knob secured to studding

Drilling the keep

Fitting the keep note extra length for holding

if you don't have this facility a knurl will be fine. After knurling just drill and tap through M6 and machine the groove for the Keep Plate using a 1/16" wide parting tool, and part off. To assemble the nob to the studding apply a drop of high strength thread lock screw the studding in so that about 1mm stand proud of the nob and rivet it over, face off and tidy up with a chamfer - job done, **photos 17**, **18** & **19**.

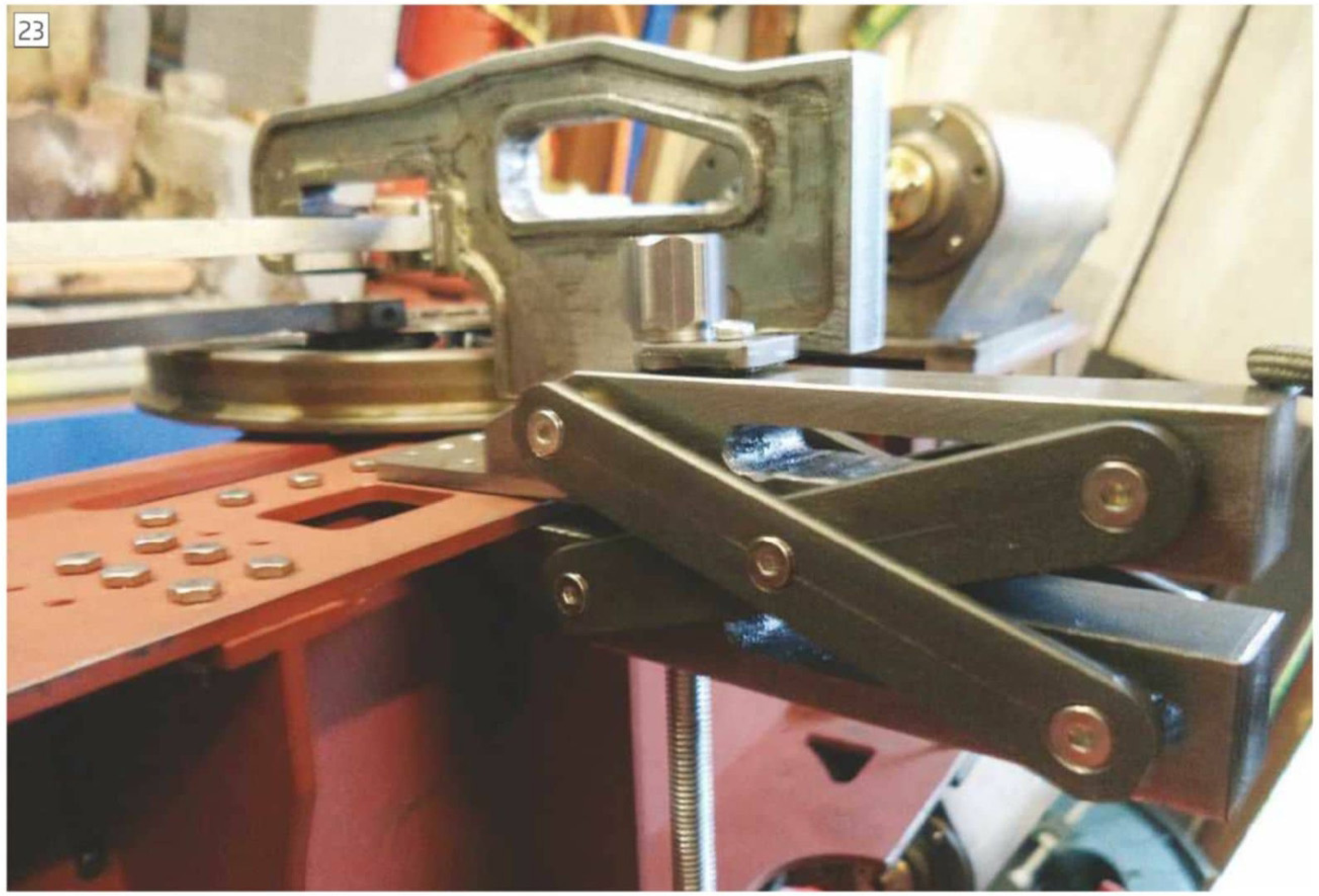
Keep Plate Part 7 - Made from a same material as used for the Scissor Bars, on the centre line just drill through an 8mm hole and 9mm from the centre of this hole drill through 2.5mm. Don't cut it off the bar until you've got it fitted to the jaw, as it will be easier to handle: - with an hack saw cut through the 8mm hole and with a file reduce the thickness so that it fits into the slot in the screw, try the fit of the M2.5 screw and adjust with a file until the screw turns nice and smooth, now cut it off the bar, **photos 20** & **21**.

Pin Part 4 and Spacer Part 6 - These are simple turning jobs not much to say about these except that there are two different lengths of pin.

Assembly - The vice was assembled with M3 countersunk cap screws using medium strength thread lock, for the pivot point of the scissor bars cut the screw off so just a small amount was standing proud and riveted the end of the threads over so that they moved freely, **photo 22**.

That's is job done: - I wanted the clamps for holding parts together for trial assembly or whilst I spotted through position with a drill, however a club member pointed out that if I'd left the bottom jaw 50 or 70mm longer you could grip on the extra length in the bench vice making the clamp an ideal vice for working on small parts **photo 23**. ■

Pivot screw riveted

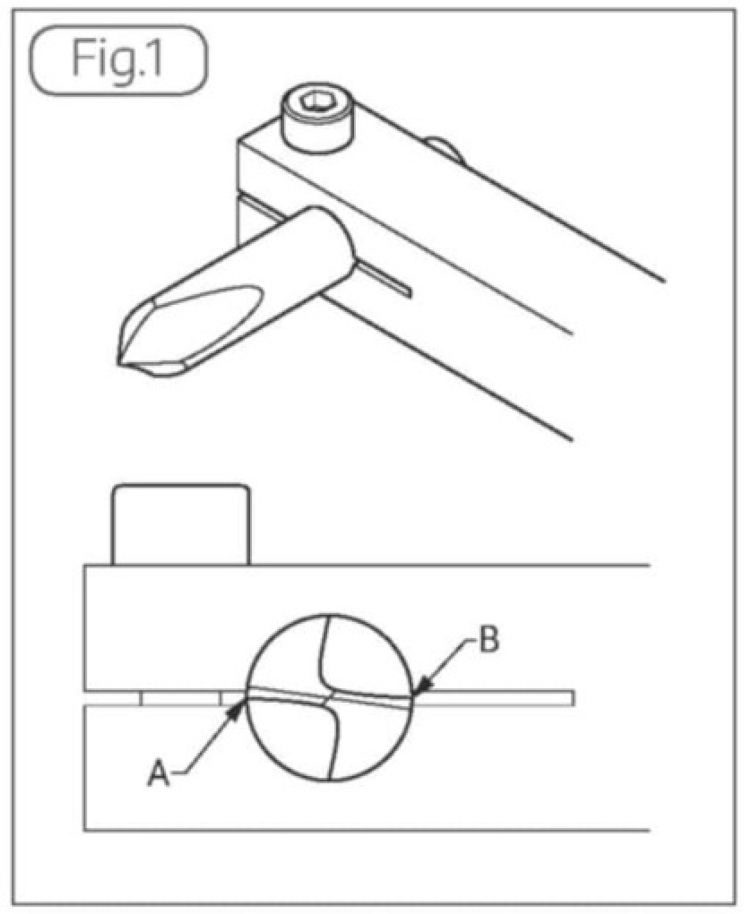


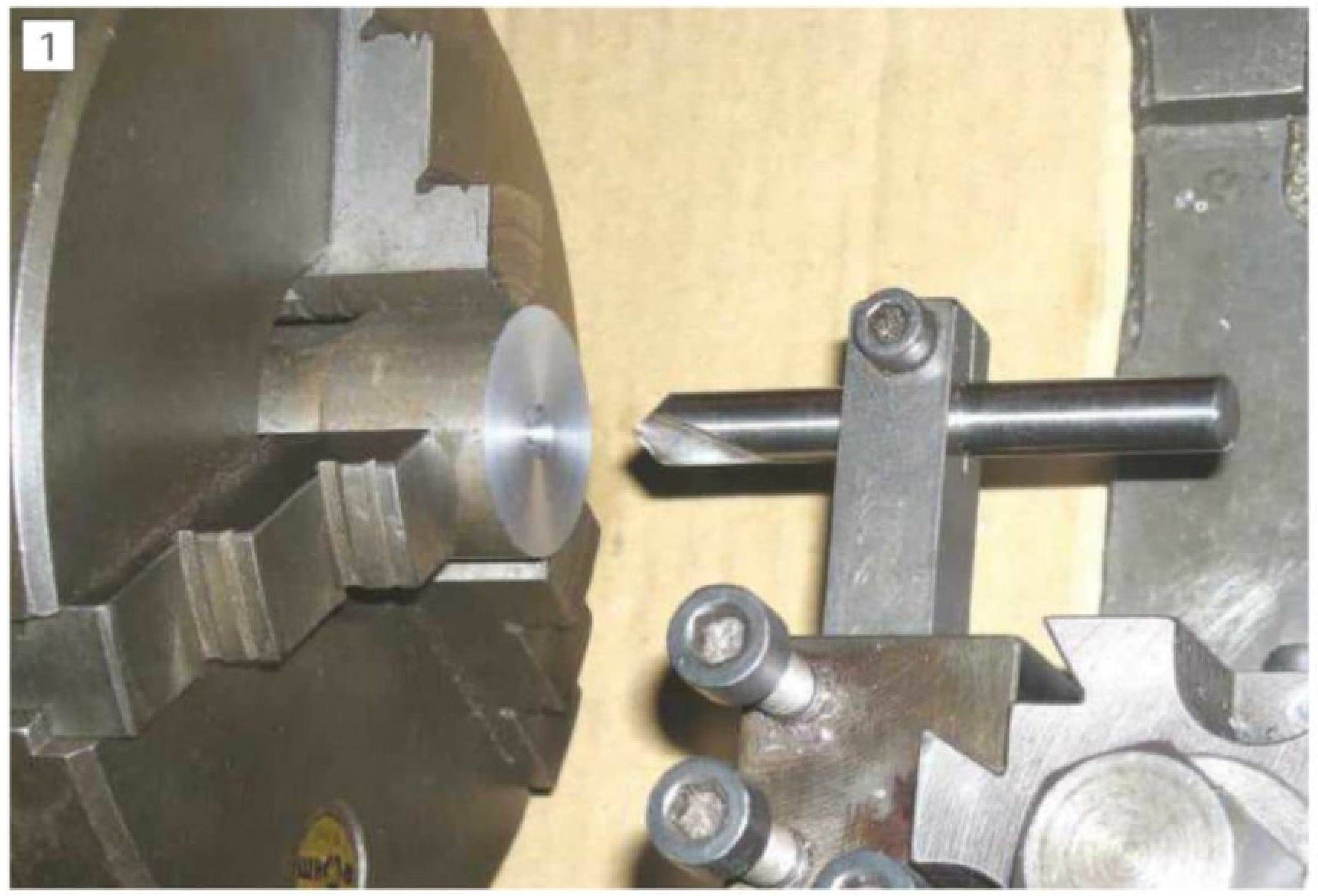
Clamps in use

The «Three in One Lathe Tool»

Jacques Maurel returns with another ingenious and practical piece of multi-purpose tooling.

Fig.1





Use as a centring tool

This very useful lathe tool is simply a spotting drill with 90° point angle set in a square shank being held in the toolpost, see **fig. 1**. The drill must be turned so that its center and outer edges (A & B) are in the same horizontal plane (this is not critical, a "by eye" adjustment is sufficient) and set at centre height.

First use: Centring Tool.

It's easy to "catch" the centre of a running workpiece (the cross slide being adjusted by eye) with this sturdy tool, **photo 1**, avoiding (or before) the use of the usual centre drill (held in the tailstock chuck) the small centre tip of which is very breakable.

The centre drill is only necessary if you want to use a centre and the centre hole is worth being made after spotting, as the small tip is often broken at the beginning of the drilling process due to an eccentric motion which won't occur in this case.

The spotting alone is sufficient if you only want to drill a hole in the workpiece.

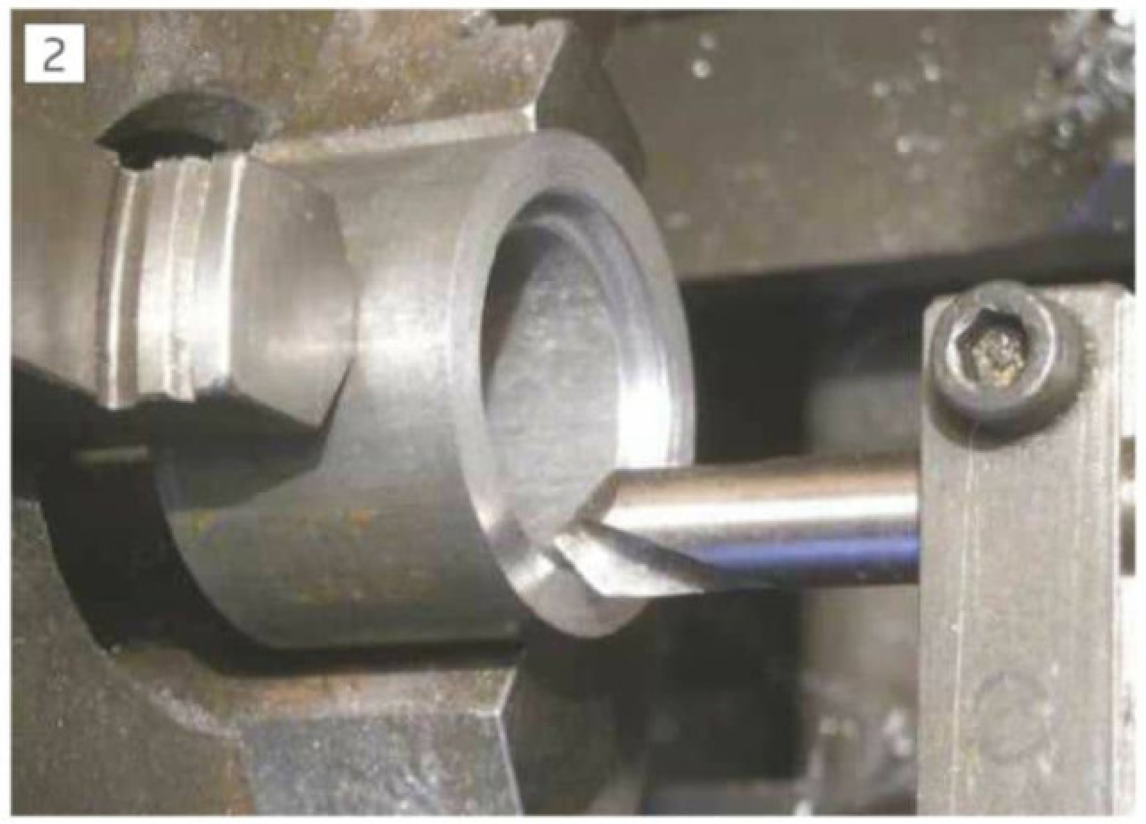
When doing batch work it's worth adjusting the shank protruding so that the centring tool is near it's working position at the end of the dressing operation, to minimize the cross slide movements.

Second use: Inside chamfering.

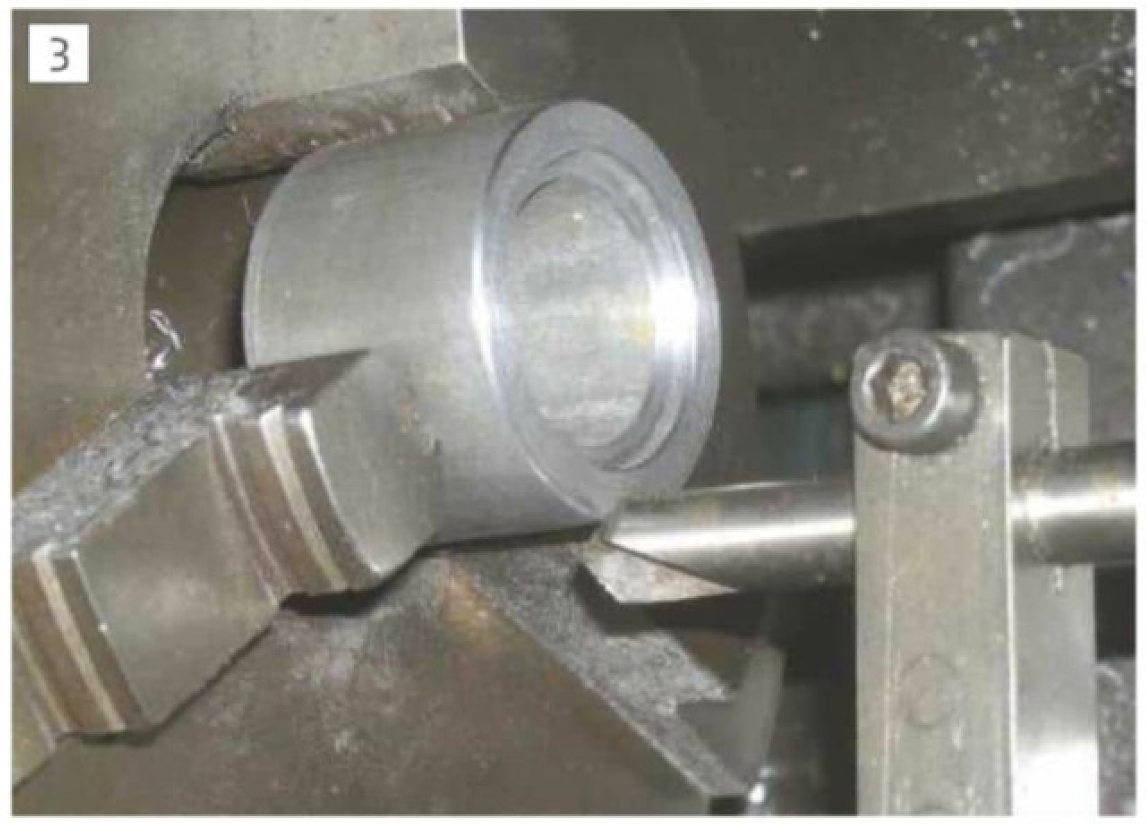
Photograph 2 is self explanatory, the chamfering is also possible in a stepped bore if not too deep.

Third use: Outside chamfering.

In this case the lathe must be run



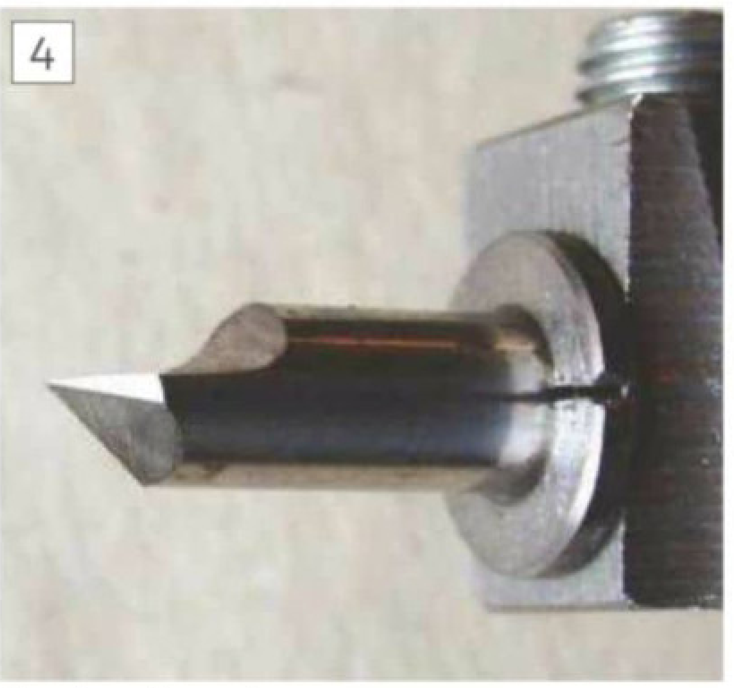
Internal chamfering



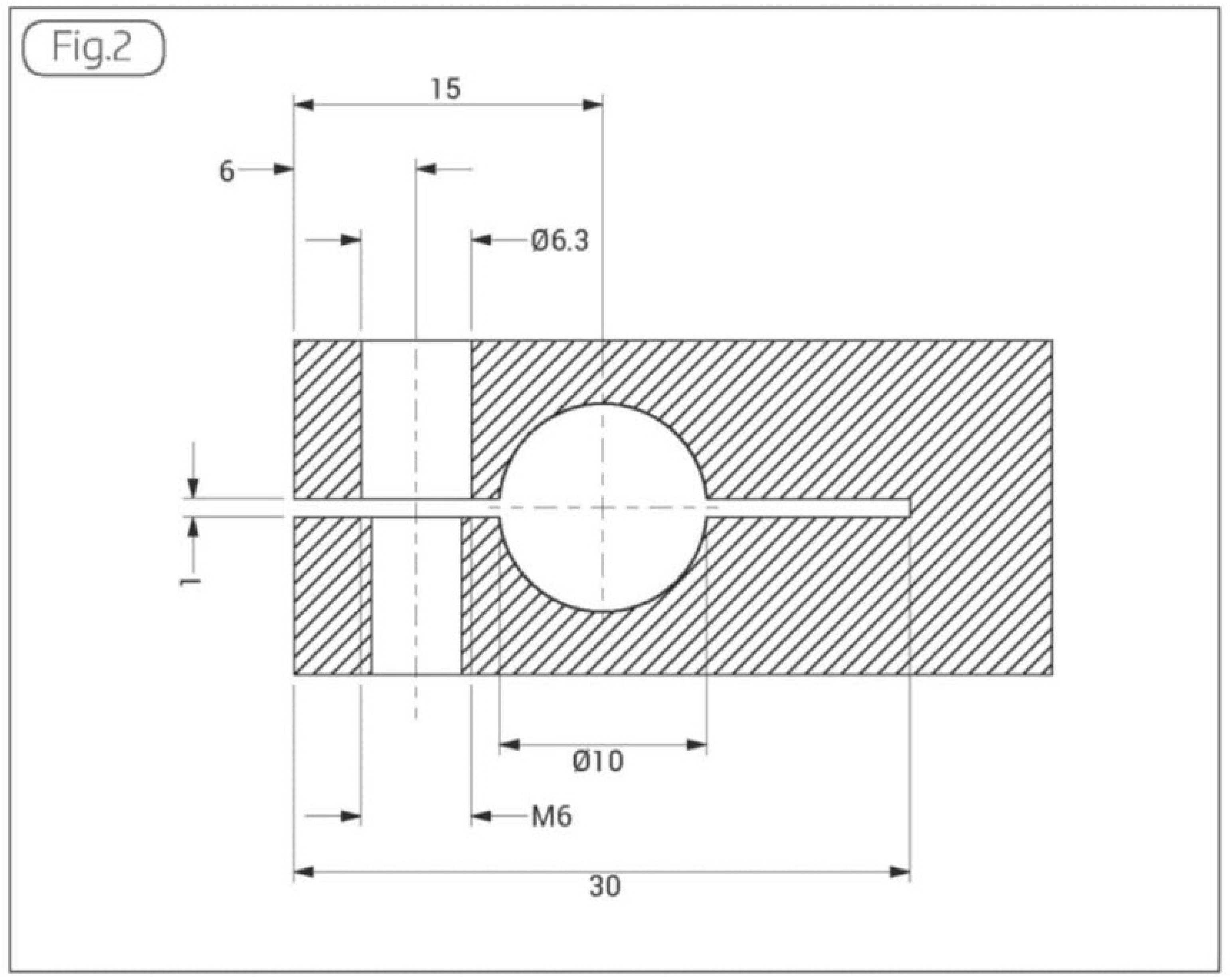
External chamfering with lathe running in reverse backwards, it's often convenient to be able to chamfer inside and outside with the same tool, **photo 3**.

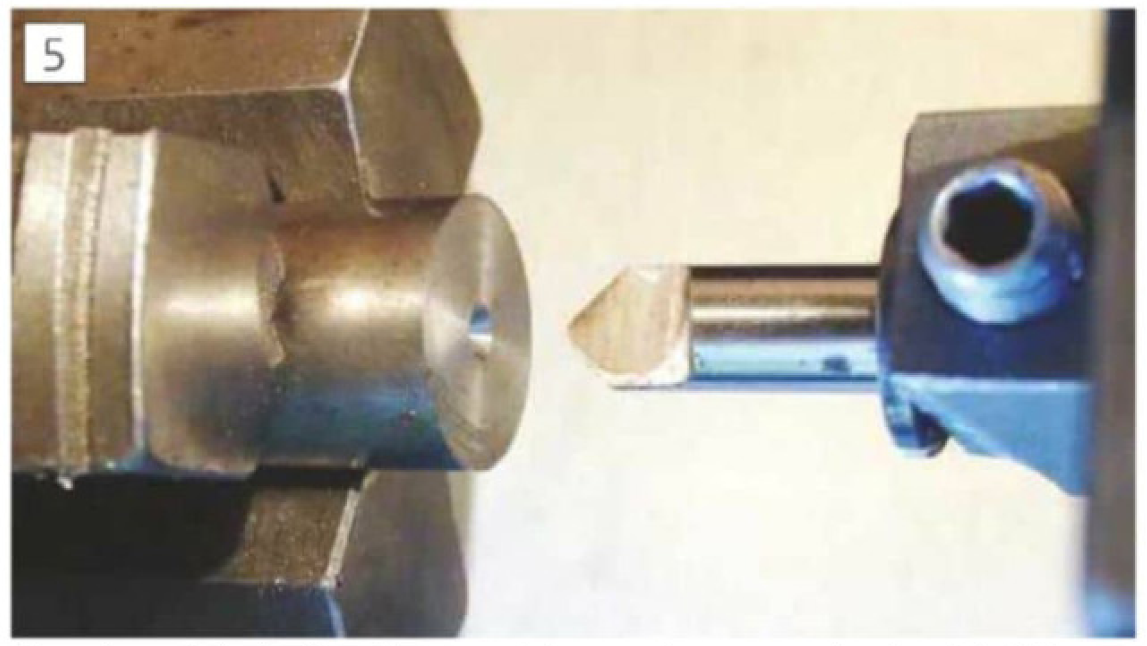
Making the Tool

I used a 10mm spotting drill protruding 30mm out from a 120mm long square shank made of 16mm cold rolled steel (CRS). **Figure 2** shows the details of the shank end.

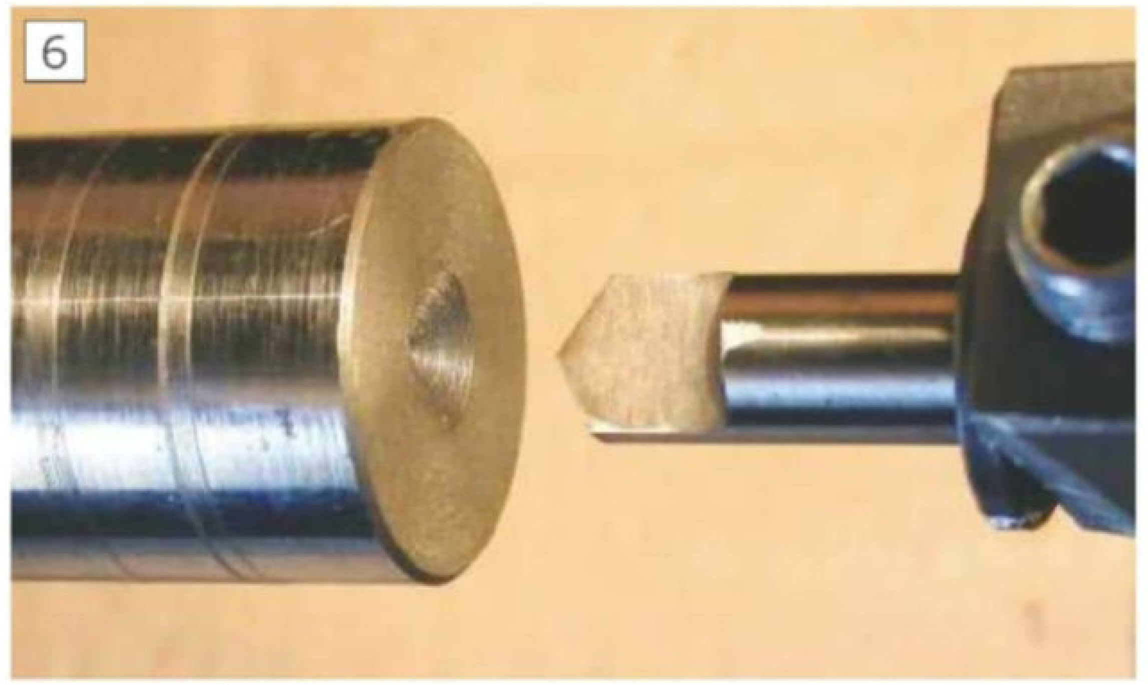


The four facet tip

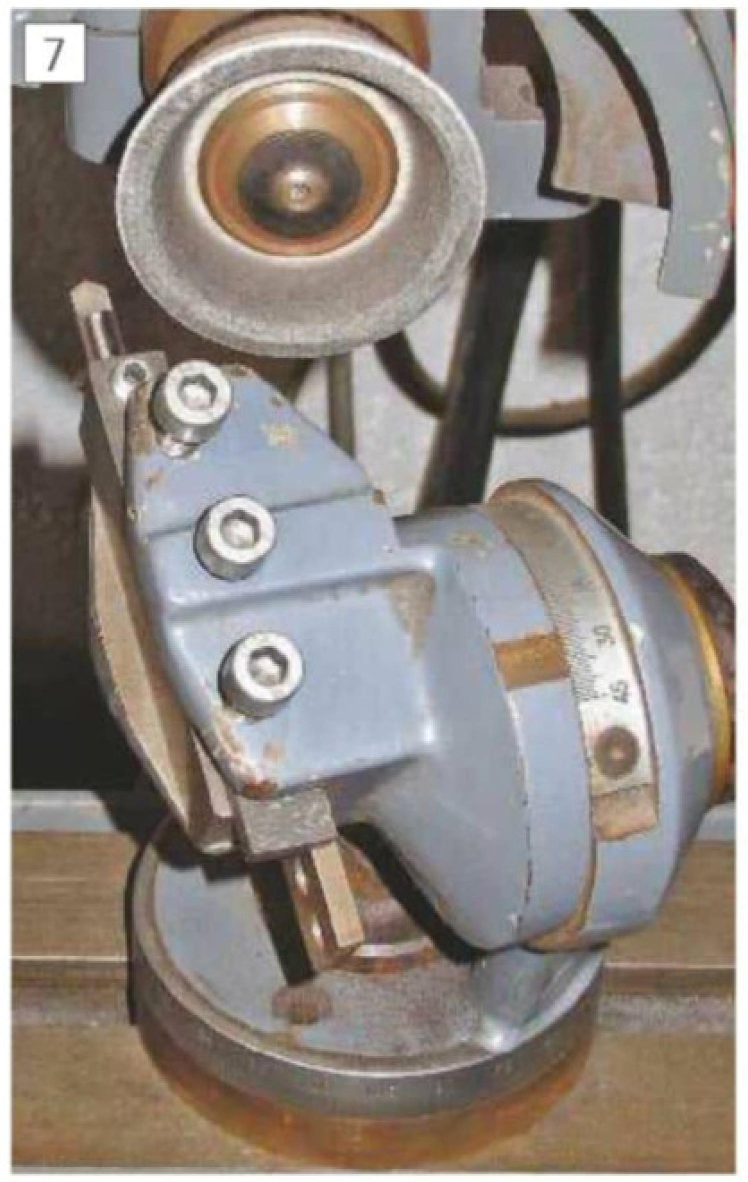




Centring with the four facet tool, it can also cut on the far side if the lathe can be reversed



Spotting with 120°



Grinding the 120° tool

Sharpening

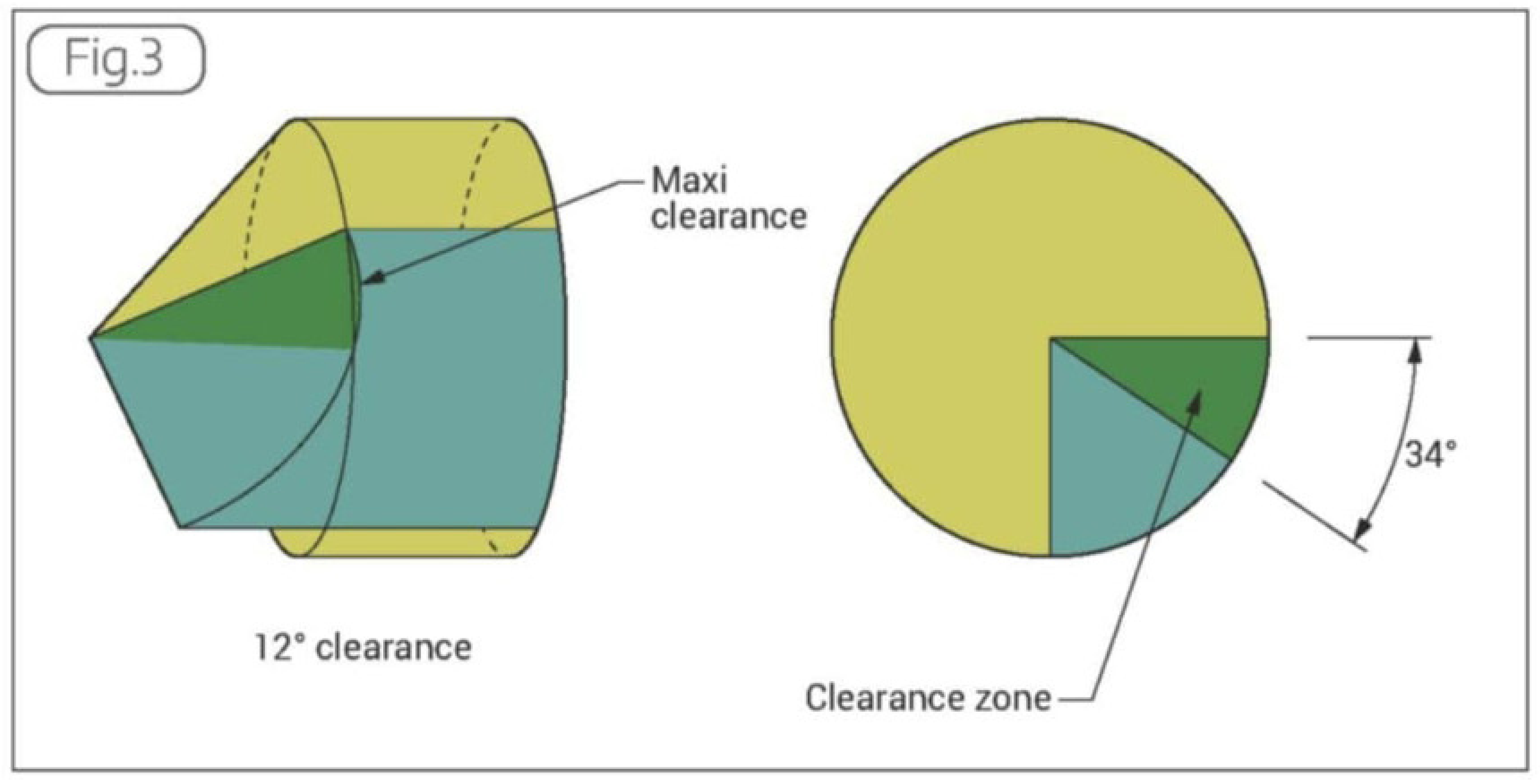
I use a 4 facet method, 12° for the first clearance, and 35° for the second.

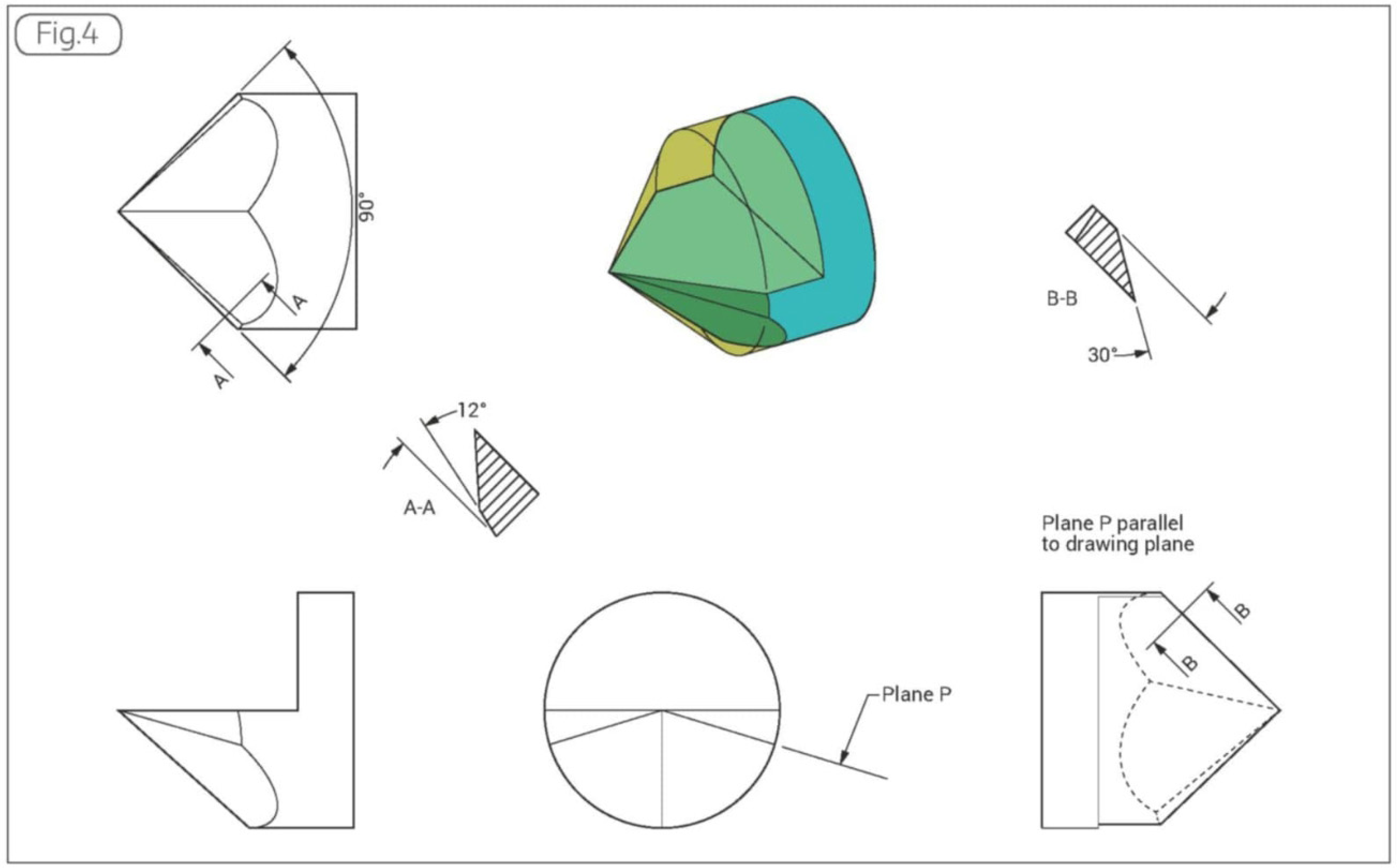
Improvements

The chisel edge makes the spotting force quite high, I wondered if it would be possible to make a tool with no chisel edge.

Figure 3 (from my article in MEW issue 246, about drill sharpening) shows a model of the drilled hole, but in negative (as if some molten material had been cast inside) coloured translucent yellow, assembled in the working situation with a model of the corresponding tool point, coloured blue. This is one quarter cylinder so 0° rake, with a 12° relief angle and 90° point angle. This figure shows that it's possible to have a clearance zone in this condition. The idea of a 4 facet tool is shown on **fig. 4** and photo 4 where a 12° first clearance is followed by a 30° one, all the clearance planes meeting at the centre of the tool. This tool was made and experimented with giving excellent results:

- Low feeding force.
- Internal and external chamfering without reversing the spindle rotation.





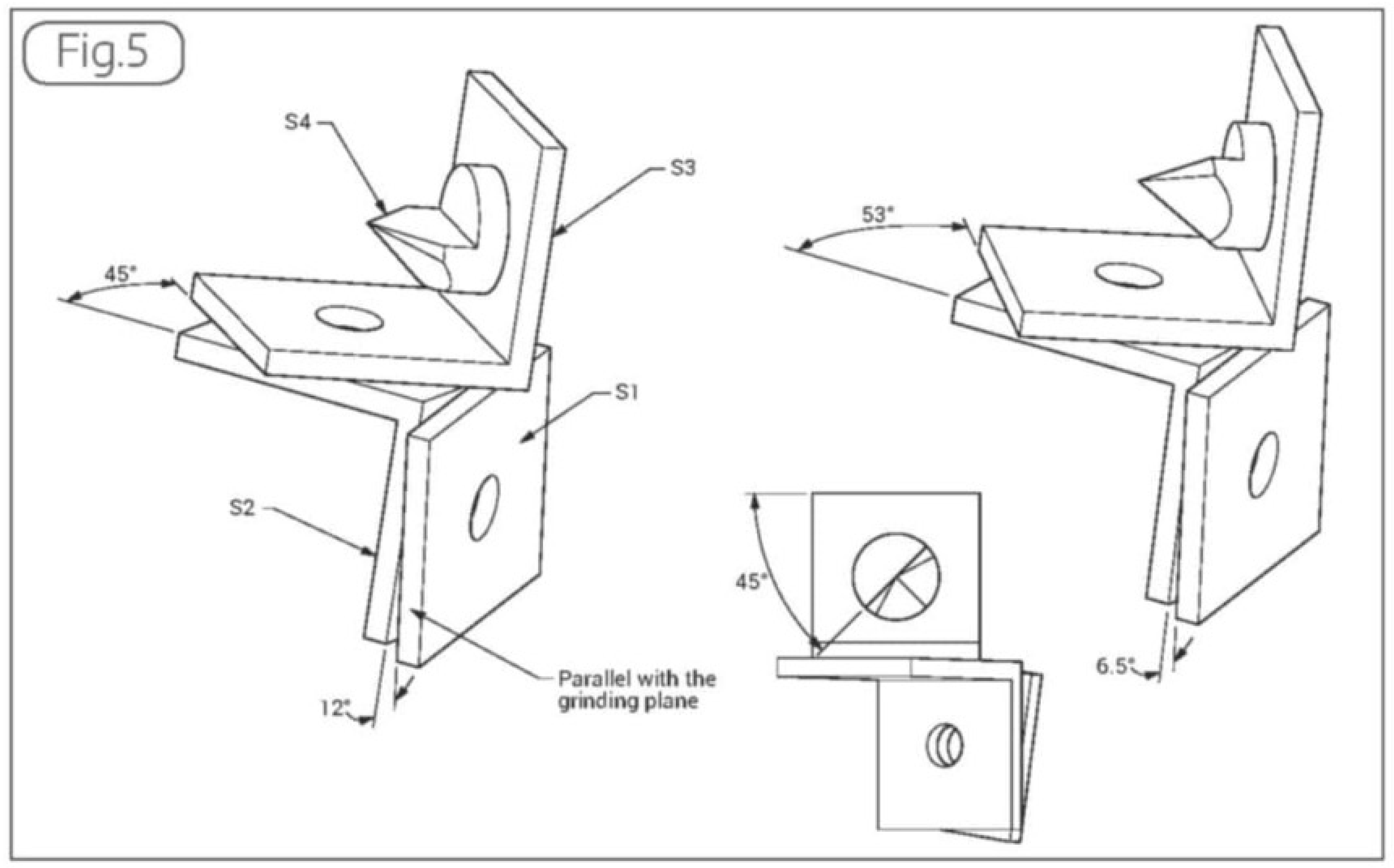
Use of the tool.

Set the tool at centre height, spindle in forward rotation, find the centre "by eye" the tool slightly toward you for the 2 tool lips to cut, **photo 5**. It's possible to turn backwards and work on the other side of the work-piece's centre.

Making the 90° tool.

The tool is made from a round HSS bit. A flat is ground to about half the diameter (this is not critical as we are not making a rotating tool). First a conical surface is made off hand for roughing the point. The 2 first clearances are ground until meeting in the centre of the flat (not critical for the reason already explained) and the 2 second clearances then ground, also meeting in the centre.

The problem when grinding is to get the right angles for the tool bracket. 3D CAD is a great help for this, **fig. 5**. The machine (Worden type here) is modelled using plain parts: S1 for the fixed body (one flat parallel with the grinding plane), first rotation between S1 and S2 (horizontal axis also parallel with the grinding plane); second rotation between S2 and S3; third rotation between S3 and S4 (tool). The assembly being made, I set the cutting



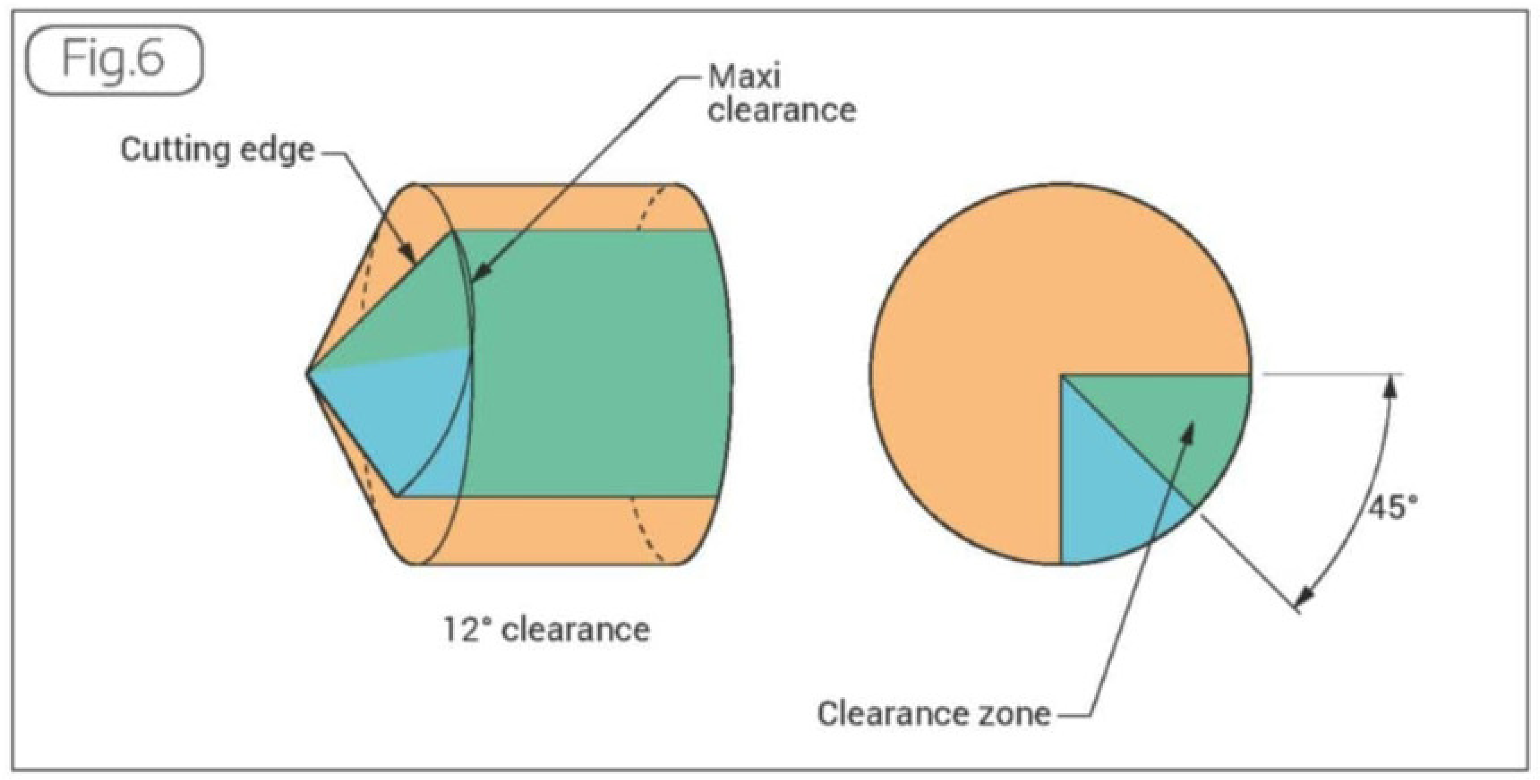


Fig.7

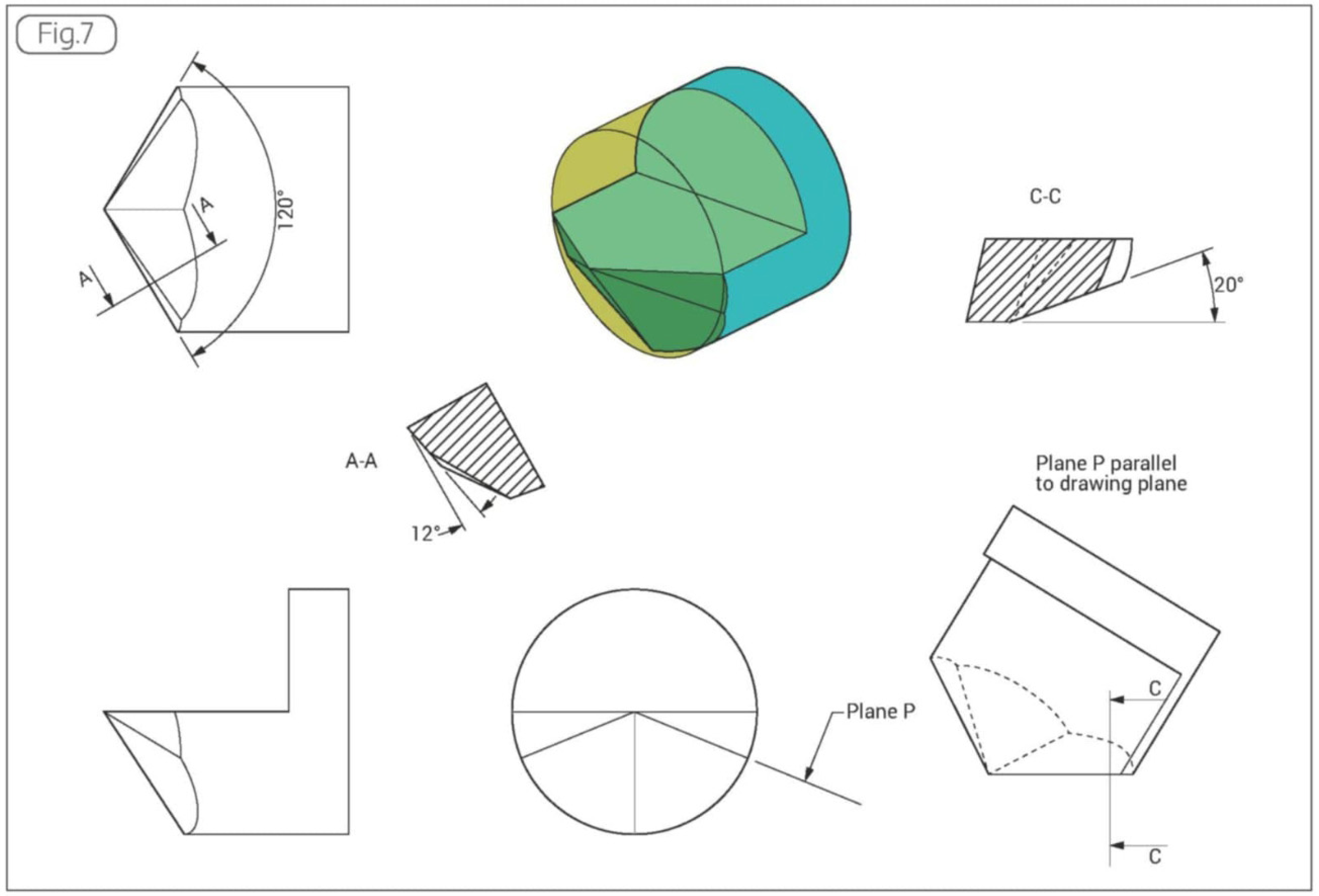
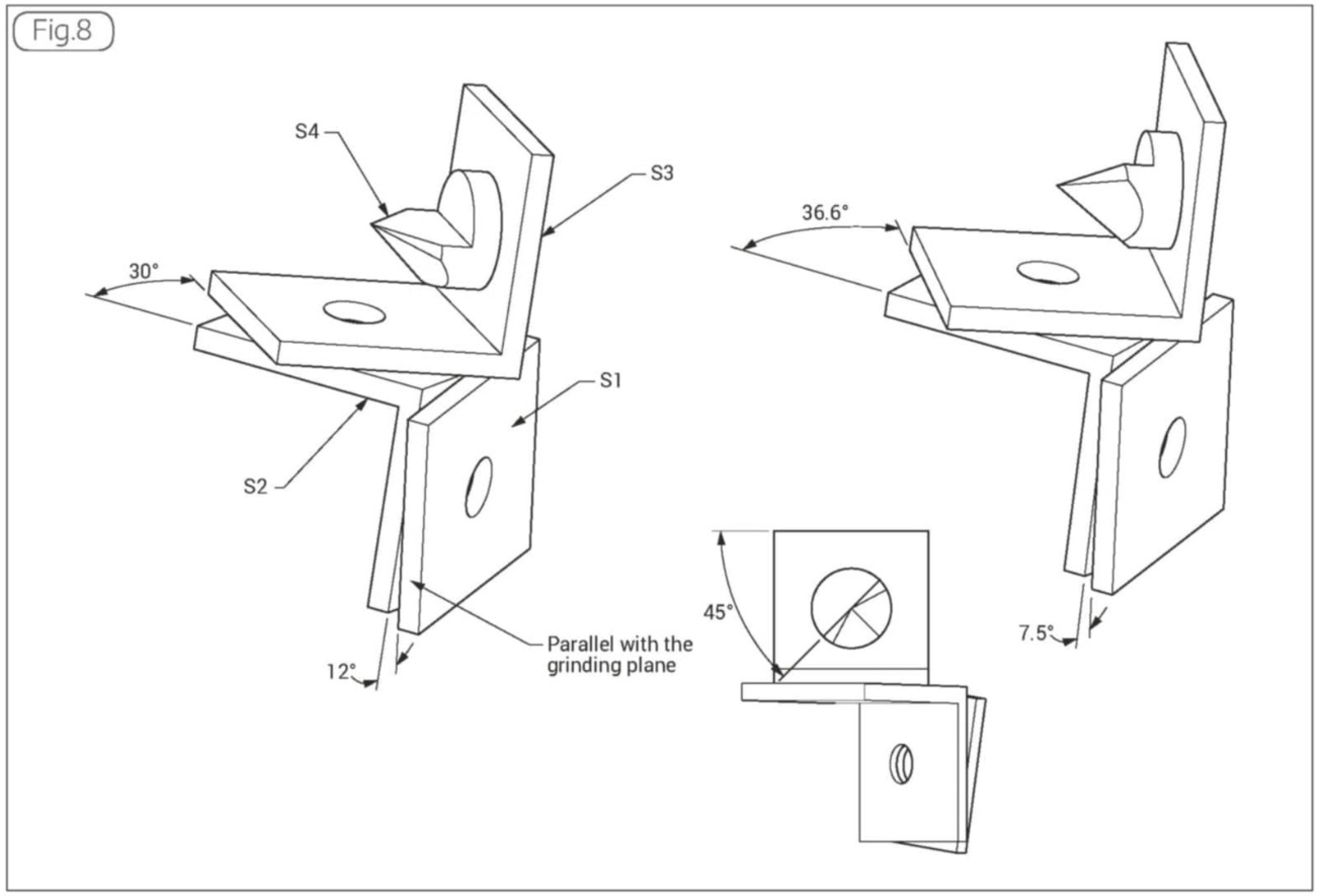
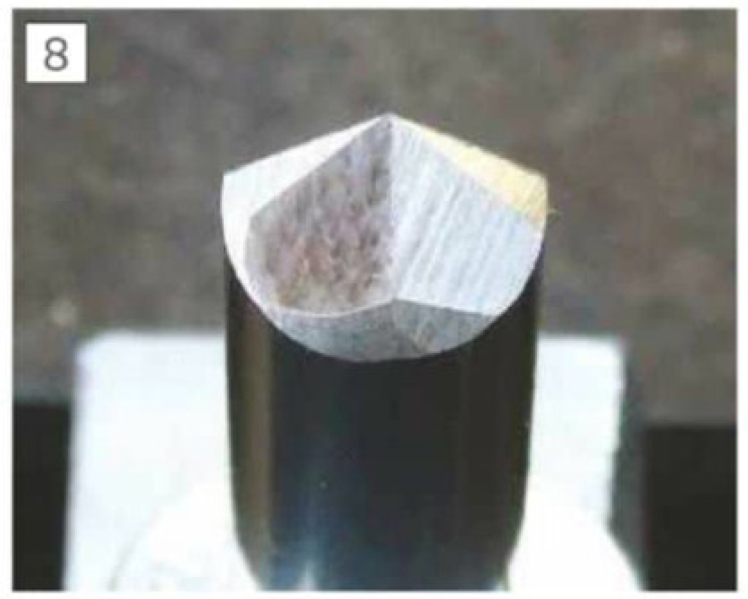


Fig.8





Four facets of the 120° tool

plane of the tool perpendicular with the second axis, then I moved the parts (using the computer's mouse) for the first clearance angle to be roughly parallel with the grinding plane and asked the software to put them exactly parallel. It was now possible to simply measure the two setting angles. The same routine was used for the second clearance, the cutting plane was set at 45° to the second axis to avoid a too great first angle that would be impossible to set on the grinding machine.

Making a 120° tool.

Used only for hole spotting, **fig. 6** shows the clearance zone, **fig. 7** shows the complete tool, **fig. 8** shows the grinding angles. **Photograph 6** shows the tool at work. **Photograph 7** shows grinding the tool, the bracket is different to the first, rotation being around a vertical axis, and the second around a horizontal one, off course it was also modelled with the CAD system. **Photograph 8** shows the 4 facets under the tool and some remains of the off-hand roughing.

Single edge milling cutter.

A near relative of this tool is the single lip milling cutter usually used for engraving, **fig. 10**. The cutting plane must contain the axis of rotation, if too high a part of the cone apex will remain, if too low a hyperbolic curve will be made, **fig. 9**. The first clearance must be 25°, a conical surface is tangent with this relief plane, the cone apex being the tool point, hence the relieving cone axis is the cutter axis.

Making the single edge milling cutter.

First grind a flat just half the diameter, rough the cone off hand, set for the first clearance and put the tool tangential to the grinding wheel (lapidary type), feed 0.04mm and turn the tool for about 180°around its axis, return to the starting point, take 0.04mm more and go on until the whole relieving surfaces are completely ground. ■

Fig.9

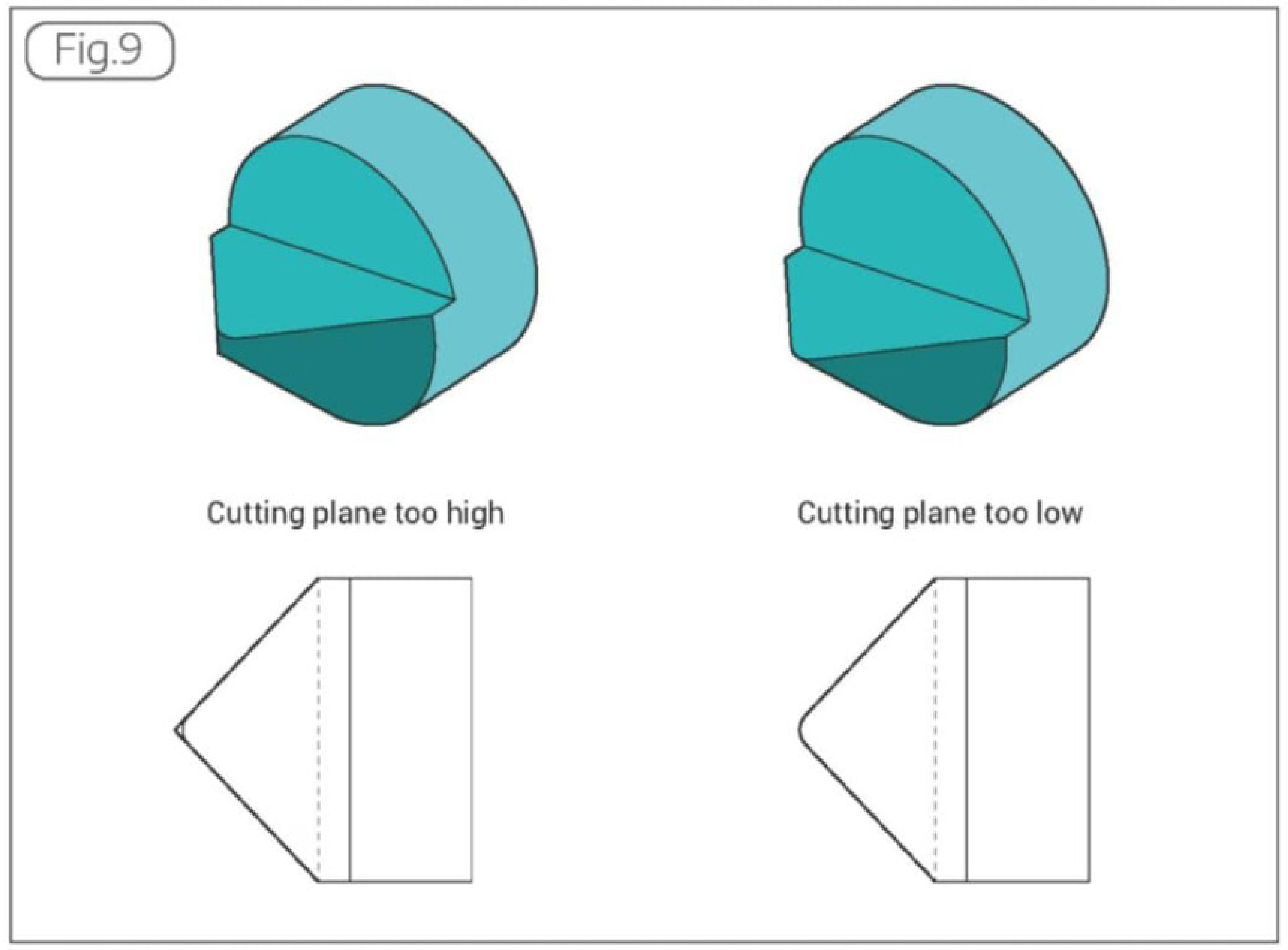
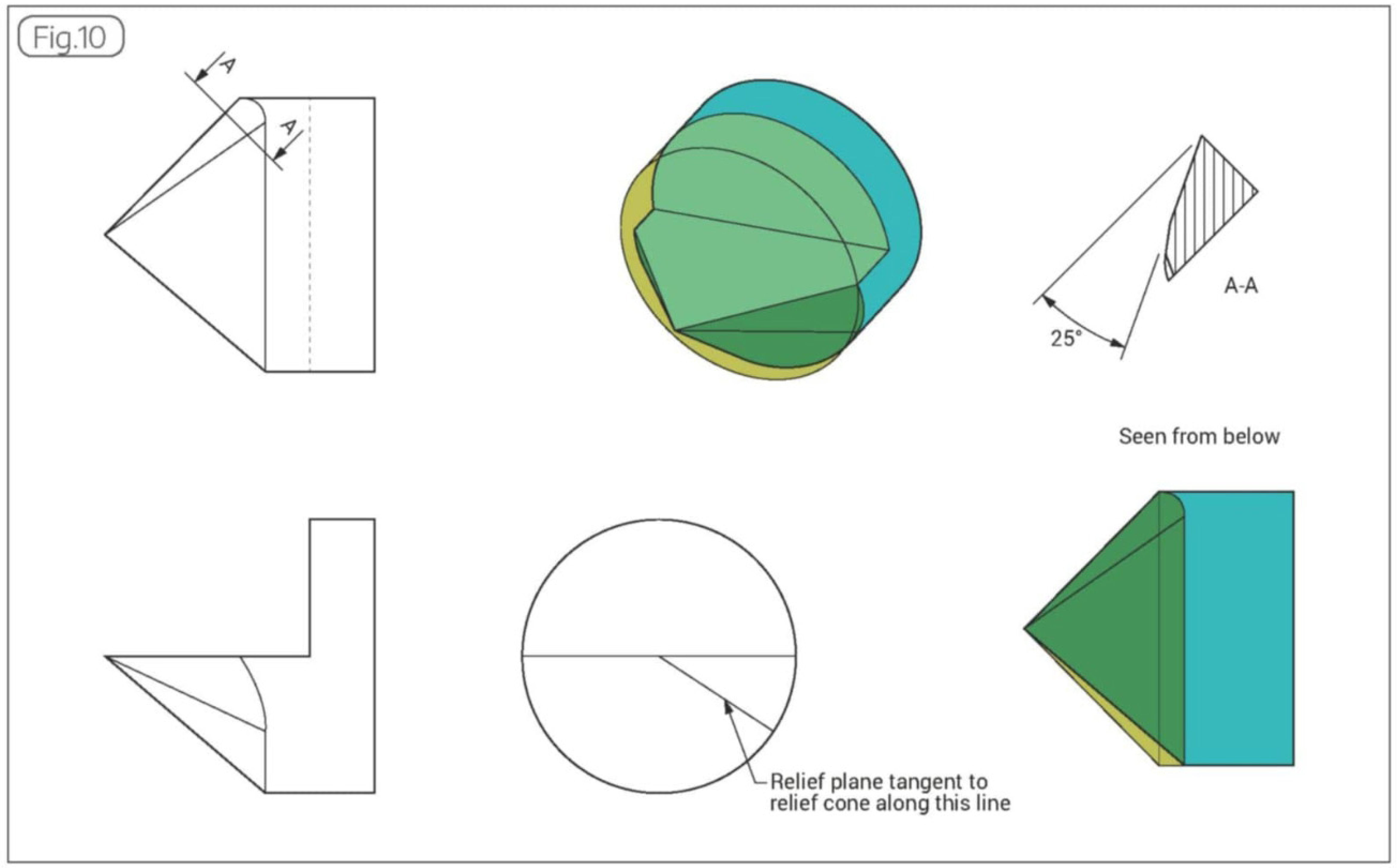


Fig.10



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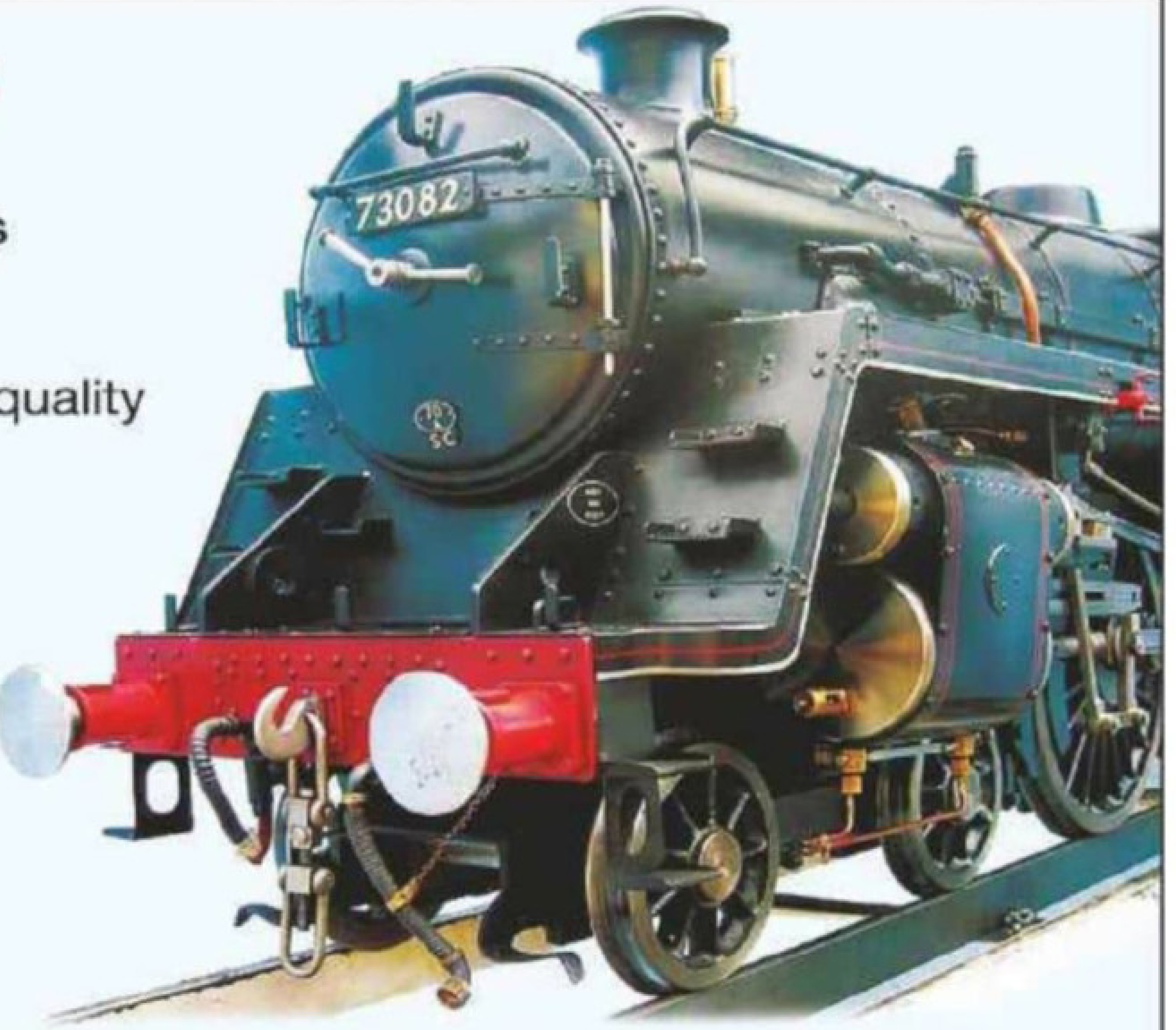

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